Maryland's 2020 INFRASTRUCTURE REPORT CARD

Infrastructure matters to each of us every day.

Infrastructure is the roads and bridges we travel, water we drink, bays we crab, and reliable energy that powers our electronics. Infrastructure also moves our economy, taking goods from ports to roads to store shelves and transporting workers between their homes and workplaces. While most people might not think about infrastructure every day, Maryland's civil engineers do – we've pledged to build and maintain infrastructure for the public's health, safety, and welfare.

Our state excels at moving cargo and people efficiently via ports, airports, rails and roads. However, we face challenges when it comes to congestion and population growth.

Maryland's stormwater and wastewater policies set national precedents for the sectors. However, sanitary sewer overflows still occur. Wastewater and drinking water pipes are aging and some suffer from significant leakage.

To continue progress as an economic engine for the country, Maryland must bolster its strategic infrastructure planning.

Maryland's public and private infrastructure owners have been judicious stewards of limited existing resources. Many of Maryland's asset management policies lead the nation, but closer attention is needed for efforts that integrate sectors and streamline sustainable and resilient engineering solutions.

The Report Card for Maryland's Infrastructure is a simple tool to help residents, businesses, and policymakers understand and improve Maryland's infrastructure.

The 2020 Report Card for Maryland's Infrastructure covers 12 categories - aviation, bridges, dams, drinking water, energy, ports, rail, roads, solid waste, stormwater, transit, and wastewater.

Maryland's 2020 INFRASTRUCTURE REPORT CARD

ASCE AMERICAN SOCIETY OF CIVIL ENGINEERS

Aviation	B-
Bridges	B
Dams	C-
Drinking Water	C
Energy	C-
Ports	B-
Rail	C+
Roads	C
Solid Waste	B-
Stormwater	C
Transit	D+
Wastewater	C+
Overall G.P.A.	C

Report Contents:

About the Grades

The 2020 Report Card for Maryland's Infrastructure was written by a committee of 25 civil engineers across Maryland who volunteered their time to collect and analyze publicly available data, prepare and review their findings, and present their conclusions. The committee worked with the national staff of the American Society of Civil Engineers (ASCE) and ASCE's Committee on America's Infrastructure to provide a snapshot of the state of Maryland's infrastructure. With a commitment to serve and protect the public, the committee compiled the Report Card as a public, voluntary service to citizens and policymakers to inform them about Maryland's infrastructure needs.

Each category of infrastructure is graded based on the following eight criteria: capacity, condition, operation and maintenance, funding, future need, public safety, resilience, and innovation. ASCE defines the grades as follow:

- **A** — Exceptional, Fit for the Future
- **B** — Good, Adequate for Now
- **C** — Mediocre, Requires Attention
- **D** — Poor, At Risk
- **F** — Failing/ Critical, Unfit for Purpose

Maryland's 2020 INFRASTRUCTURE REPORT CARD

ASCE
AMERICAN SOCIETY OF CIVIL ENGINEERS

The 2020 Report Card for Maryland's Infrastructure covers 12 categories - aviation, bridges, dams, drinking water, energy, ports, rail, roads, solid waste, stormwater, transit, and wastewater.

Solutions to Raise Grades

- Strategic infrastructure planning will help accommodate future population growth and increasing freight volumes. A holistic approach to the movement of people and goods – one that capitalizes on multiple modes to create route redundancy – will help ensure Maryland remains economically competitive and an attractive place to live well into the future.
- Maryland is a national leader in sustainable watershed practices and resilient planning. However, retaining this edge will require extensive cross-collaboration among water and wastewater utilities, state and private infrastructure owners, local decision-makers and more. Cross-collaboration can be incentivized with state grant funding. Streamlined project permitting can accelerate innovation.
- Incorporating the impacts of climate variations and storm events into the design, operation, maintenance, and expansion of all types of infrastructure in Maryland can improve community resilience – reducing the time and extent that households, businesses, and critical services are affected during and after natural and man-made disruptions.

Get involved

The 2020 Report Card for Maryland's Infrastructure covers 12 categories and gives the state an overall GPA of C. There are solutions to the challenges Maryland's infrastructure faces; they will help us raise Maryland's infrastructure grades. By learning more about the conditions of the infrastructure you use every day, you can help raise the grade.

How you can get involved:

1. Get the full story behind this Report Card at www.infrastructurereportcard.org/maryland
2. Ask your elected leaders what they are doing to make sure your infrastructure is reliable for the future. Use your zip code to find your list of elected officials at www.infrastructurereportcard.org/take-action.
3. Find out the condition of infrastructure near you on the Save America's Infrastructure app available on the Apple App store and GooglePlay.

About ASCE MARYLAND

The Maryland Section of the ASCE was founded in 1914 and currently has more than 2,200 members. ASCE is the nation's oldest and largest engineering society. Its membership comprises civil engineers at all career stages and in all sectors and disciplines. Civil engineers plan, design, construct, and operate society's economic and social engine – the built environment – while protecting and restoring the natural environment. ASCE, by advancing technical excellence, advocating lifelong learning, and developing leadership, enables its members, partners, and the public to improve our infrastructure and build a better quality of life.

AVIATION

REPORT CARD FOR MARYLAND'S INFRASTRUCTURE 2020

2020 Grade: B-

Previous Grade (2011): NA

Executive Summary

Aviation is critical to the Maryland economy because well maintained public use facilities are important for attracting and supporting businesses. Maryland's aviation infrastructure includes 35 public use airports serving both commercial and general aviation needs. BWI Marshall airport is responsible for 99% of enplanements in the state. The airport has invested in capacity in recent years; subsequently, cargo by volume grew 43% in 2017. However, there is still a funding gap of $2.4 billion over the next six years at BWI. Additional funding could be found by increasing the fuel tax as a percentage per gallon to offset reduced gas prices and increasing the Passenger Facility Charge to provide airport modernization and additional capacity.

Introduction

Aviation in Maryland contributes significantly to the state's economy. Airport infrastructure, such as cargo facilities, passenger terminals, runways, parking garages, and more, supports tourism and business. In 2018, the total economic impact to the state from Baltimore-Washington International Thurgood Marshall Airport (BWI) was $9.3 billion. Additionally, there were 106,488 jobs generated due to aviation activity in the state resulting in $4.1 billion in personal income and consumption expenditures. State and local governments received $591.9 million in tax revenues. Continuing to invest in airport infrastructure and support sound aviation policy is an important step in building a competitive economic future for Maryland.

Capacity

There are 222 airports in Maryland. Of those, 35 are open to the public and three offer commercial air service – BWI, Hagerstown (HGR), and Salisbury (SBY). The 35 public use airports include the Pier 7 Heliport (4MD) and the Havre de Grace Seaplane Base (M06). There are 18 National Plan of Integrated Airport Systems (NPIAS) airports.

According to the most recent data available from the Maryland Department of Transportation (MDOT), BWI served over 27.1 million passengers in 2018. This was an overall increase of 2.9% from the previous year. Ninety-nine percent of the enplanements in the state of Maryland occurred at BWI. According to Airports Council International – North America (ACI-NA), in 2018, BWI was ranked the 22nd largest airport in the United States based on passenger traffic, 34th busiest airport based on airplane movements, and 31st for cargo tonnage landed at U.S. airports. With the addition of a new cargo carrier at BWI, the airport can better accommodate the more than 43% growth in cargo by volume (128,633 to 185,049 tons) from 2015 to 2017. Capacity at BWI is sufficient for now, however continued growth will necessitate planning and growth management to ensure continued effective operations. Asserted in the 2017-2021 NPIAS report to Congress, **BWI will not suffer from a lack of operational capacity if planned improvements are implemented.**

Aviation in Maryland contributes significantly to the state's economy. In 2018, the total economic impact from BWI was $9.3 billion. Additionally, there were 106,488 jobs generated due to aviation activity in the state resulting in $4.1 billion in personal income and consumption expenditures. State and local governments received $591.9 million in tax revenues.

Condition

Given the essential nature of airport pavement surfaces, assessing their condition provides one prominent indicator of airport infrastructure's condition. The Airport Safety Data Program is based on FAA Order 5010, which outlines the methods for collecting and disseminating operation and safety information about airports. On behalf of the Federal Aviation Administration (FAA), state transportation agencies conduct inspections of public airports annually and private airports every 3-5 years. The inspections produce a pavement condition index (PCI) which is a rating system that indicates the surface condition of airport runway pavement. PCI values range from 0 to 100 with associated ratings of pavement conditions from failed to excellent, respectively. According to the FAA 5010 inspection records, of the 39 paved public runways in Maryland, six runways are in excellent condition, 22 are in good condition and 11 runways are in fair condition. No public runways are considered in poor or failed condition. Note that pavement deteriorates with time and use. Airfield pavement surfaces require regular maintenance and repair to maintain their operability. Without ongoing attention, pavement conditions could deteriorate quickly to fair, poor, and failed categories.

All five terminals (A through E) at BWI have undergone some level of renovations in the last 15 years. Further expansions and renovations are expected to be completed over the next five years including a $100 million expansion to the international terminal, reconfiguration of passenger flow in the customs and border protection area, a $46.4 million concourse A improvement, concourse B expansion, concourse D HVAC renovation, and $51 million in restroom improvements.

Operation and Maintenance

BWI and Martin State Airport (MTN) are owned by MDOT, while the remaining Maryland public use airports are owned and operated by local governments such as cities or counties. These entities oversee the daily operation and management of their respective facilities and provide planning and management of facility construction projects.

MDOT Maryland Aviation Administration's (MAA's) Office of Regional Aviation Assistance (ORAA) inspects all public-use airports annually. It issues licenses to all eligible public-use, private-use, and commercial-use airports. The private-use, non-commercial use airports are only registered. Concurrent with the inspections, ORAA conducts Airport Safety Data inspections on behalf of the federal government to collect data published in federal documents and other public periodicals. ORAA provides land surveys for all proposed new facilities, takes traffic counts, and evaluates obstructions to public-use airports. It assists local governments with preserving and improving existing airports and helps plan new facilities to meet needs for future capacity.

Funding

Commercial airports in Maryland utilize the FAA's Passenger Facility Charge (PFC) Program. The PFC program allows commercial airports to fund FAA-approved projects that enhance safety, security, or capacity, reduce noise, or increase air carrier competition. These funds are vital to helping commercial airports meet future needs. The current PFC cap was instituted in 2000 and was not indexed for inflation or growth. PFCs are capped at $4.50 per flight segment with a maximum of two PFCs charged on a one-way trip or four PFCs on a round trip, for a maximum of $18 total. The cap limits an airport's ability to fund projects that are needed for future expansion, safety, capacity, and innovation. As a result, funding shortfalls result in deferred maintenance; ultimately, rehabilitation projects will be more expensive at a later date.

A Sample of Maryland Aviation Administration's $8 Billion Worth of Capital Improvement Projects

- BWI Residential Sound Insulation Program ($33M)
- BWI Shuttle Bus Replacement ($24M)
- BWI Midfield Cargo Area Improvements ($21M)
- BWI Concourse A Improvements ($43M)
- BWI Concourse D HVAC Replacement ($19M)
- BWI Restroom Improvements ($51M)
- BWI Aircraft Maintenance Facility Infrastructure ($52M)
- BWI Connector & Baggage Handling ($24 million)

2020 Grade: B-

AVIATION

Other sources of airport revenue include leasing of commercial retail space inside and outside of terminals, parking fees, and renting space to airlines. This funding supplements PFC dollars, as PFC dollars cannot be used for revenue-producing projects such as parking garages or terminal areas leased by specific air carriers.

In addition to PFC funding and airport revenue, the state of Maryland provides some funding for airport projects. According to the FY2020 MDOT MAA's capital budget is approximately $212 million with a 5-year total of nearly $480 million.

Maryland's ORAA manages the grants-in-aid program for all public-use airports in the state. For the public-use airports eligible for federal grants, these are awarded by the FAA under the Airport Improvement Program (AIP). Traditionally, FAA provides 90% of the total cost of the project and the local government/owner contributes 10% to cover the remaining cost. The program typically provides half of the airport owner's share of the project. For the public-use airports not eligible for federal grants, MDOT MAA assists in capital development through the Maryland Aid to Private Airports program with 90% funding of the local government/owner's expected contribution. From 2014 through 2019, the FAA awarded $184 million to Maryland airports through the AIP.

Future Needs and Innovation

There is a need for a variety of projects at Maryland airports including customer experience, operational reliability and capacity enhancements. Customer experience projects are terminal amenities, concession enhancement, hospitality improvements, security checkpoint improvements, and residential soundproofing. Operational reliability improvements include new Air Traffic Control Towers, security fence improvements, critical system maintenance and pavement maintenance. Capacity enhancement projects include terminal and baggage enhancements, new air carrier gates, airfield upgrades, runway extensions, and new aircraft hangars. These projects have an estimated price tag of $8 billion over the next 20 years.

According to the 2017-2021 NPIAS Report, Maryland has $583 million worth of development projects over the next five years at NPIAS airports. More than 60% of these projects are located at BWI. Projects are expected to include safety, capacity, environmental, and pavement improvements. Additionally, regional aviation in Maryland has a need of approximately $4 million per year. With only $2.4 million available, regional aviation has a funding gap of almost $2 million. Growing passenger forecasts combined with the need to implement a modernized system will continue to increase pressure and test the limits of Maryland's aviation network and funding streams. Several projects related to runway improvements, facility access, and Air Traffic Control technology will need to be implemented in the near future in order to avoid falling behind system needs.

Public Safety & Resilience

Many of Maryland's airport facilities have been in existence for over 50 years; most of their roots trace back to simple grass landing strips, which evolved into public use facilities. As demand increases, these facilities face numerous challenges to meet user needs. These facilities must contend with larger and faster aircraft, the need for longer runways, local noise restrictions, community resistance, and environmental requirements. In most cases, relocating and establishing a brand-new airport facility to replace an aging facility simply isn't feasible.

Maryland's ORAA fosters and promotes aviation through a series of activities designed to reduce accidents, provide information, and encourage growth in the industry. It publishes an aeronautical chart, an airport directory, and a series of smaller publications designed to keep the flying public informed of activities going on in the state.

2020 Grade: B-

AVIATION

The FAA's implementation of NEXTGEN Performance Based Navigation (PBN) has resulted in new challenges for BWI and the communities surrounding the airport. There has been a drastic increase in the frequency and concentration of aircraft and noise over limited geography. Prior to NextGen, the ATC model utilized "vectoring" to allow for proper spacing and safety buffers between aircraft. Locally, this resulted in dispersed airplane operations at BWI. With the introduction of PBN, although vectoring is still available, it is no longer used in routine practice. Instea, GPS aligned waypoints are used to create replicable procedures and standardized flight paths. This approach increases the predictability of operations and reduces pilot/air traffic control interaction, thereby potentially increasing safety. It also increases the number of planes traversing the same geography day in and day out; this creates a nuisance for some and a painful burden for others. There have been numerous complaints from residents with the implementation of the PBN Air Traffic Control system at BWI. The FAA, MDOT MAA, state officials, and the community have set up a roundtable to help understand these issues and look for mutually beneficial solutions.

After considering the available information, aviation infrastructure in Maryland is assigned a grade of B-

Recommendations to Raise the Grade

The capacity of Maryland's aviation sector has been steadily growing to meet the state's passenger and cargo requirements. However, Maryland officials face an $8 billion price tag and a $2.4 billion gap over the next several years for capital improvements that ensure continued service and safety. Thus far, resources have been well prioritized to maintain and improve runway conditions such that none are in poor condition and to renovate all five terminals at BWI. To continue this progress, Maryland should:

- Increase the Passenger Facility Charge with a mechanism for future automatic increases.
- Identify additional funding to meet the funding gap for regional airports.
- Accelerate and increase investment in airport improvement programs such as the pavement management program and projects that increase capacity.
- Implement and enhance technology related to FAA's NextGen initiative, including safety improvements.

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2020 Grade: B-

AVIATION

BRIDGES

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: B

Previous Grade (2011): B-

Executive Summary

The state of Maryland's bridges is improving as the number of poor bridges in the state continues to decline. Approximately 5% of Maryland's bridges are listed as poor condition, compared to the national average of 8.4%. The former has decreased for more than 20 years because of a concentrated effort by the Maryland Department of Transportation and the local jurisdictions. However, Maryland bridge owners face growing challenges associated with an aging bridge stock. On average, Maryland bridges are 48 years old, which means they are approaching the end of their 50-year lifespan. Approximately 25% of bridges in Maryland are over 60 years old. Performing routine maintenance and repairs can extend the service life of a bridge, but such maintenance requires funding. With Maryland facing an expected decrease in state and federal funding in the near future, the condition of its bridges is threatened, possibly leading to consequences to the state's economic competitiveness.

Introduction

Maryland relies heavily on public bridges for transportation and commerce in support of inter and intrastate travel. Bridge owners – both the Maryland Department of Transportation (MDOT) and local jurisdictions – strive to accommodate what amounts to almost 20 times more bridge crossings per day than there are people who reside in the state.

Condition and Capacity

Maryland's bridge system supports 116,131,464 daily crossings due to a dense, gradually increasing population of over six million residents and its location in the Mid-Atlantic corridor. Note that Maryland has the 19th largest population in the country despite being only the 42nd largest state by land area.

According to 2018 statistics from the Federal Highway Administration's (FHWA's) National Bridge Inventory (NBI), of Maryland's 5,357 bridges, 1,757 (32.8%) are in good, 3,326 (62.1%) are in fair, and 274 (5.1%) are in poor condition.

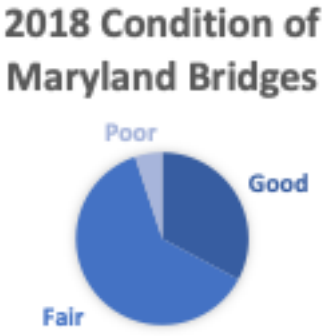

Chart 1 – Distribution of Maryland bridges by condition

The number of bridges that are in poor condition has decreased from 349 (7% of total bridges) to 274 (5.1% of total bridges) since 2012.

Furthermore, the percentage of Maryland's bridges rated poor is significantly lower than the national average of 8.4%. These improvements have been steady for more than 20 years because of a concentrated effort by MDOT and the local jurisdictions to reduce the number of poor condition bridges. At present, Maryland has the 17th-lowest percentage of bridges in poor condition in the country. According to FHWA, it would cost $623 million to replace Maryland bridges listed in poor condition.

About 54% of the total number of bridges are owned or maintained by MDOT and the remaining 46% are owned by local and other jurisdictions. That said, more than 80% of the total bridge deck area in Maryland is state-owned and only 1.4% of this deck area is in poor condition, according to 2018 data from FHWA. The state highway system carries the vast majority of traffic in Maryland, especially its heavy truck traffic, and it is important that bridges are kept in good working condition in order to facilitate the movement of goods and the population.

A bridge rated poor does not mean it is unsafe, but it can cause limitations on vehicle speeds and weights to ensure the structure remains open. The number of weight-posted bridges, or bridges that don't have the structural capacity to withstand heavier vehicles in Maryland has declined steadily over the last two decades. There are now 454 weight-posted bridges in 2018, compared to 737 in 2011. None of the weight-posted bridges are on national highways, so the majority of those that are most frequently utilized do not affect normal traffic flow. However, weight-posted bridges in rural areas or on less trafficked routes can still cause costly and lengthy delays for freight traffic and local residents.

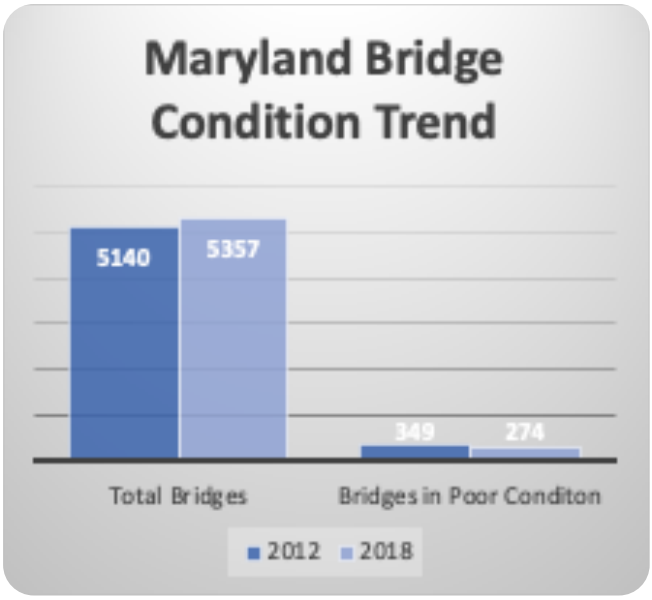

Chart 2 – Quantities of total and poor condition bridges in Maryland by year

Operation and Maintenance

Maryland bridges are inspected in compliance with National Bridge Inspection Standards (NBIS), which call for inspections to be performed at a maximum of 24 months apart (some newer projects can be inspected as far as 48 months apart). Bridges rated as poor are typically required to be inspected at least every 12 months.

MDOT is responsible for managing as well as maintaining and repairing state-owned bridges and culverts. It oversees 2,868 bridges. Within MDOT, the State Highway Administration (SHA) is the agency responsible for most of the state highways in Maryland. MDOT SHA's Office of Structures, consisting of the Bridge Design Division, Structure Inspection and Remedial Engineering Division, and Bridge Hydraulics Division, assist in operational oversight. The Maryland Transportation Authority (MDTA) is responsible for the state's nine toll facilities. MDTA has an Office of Engineering and Construction as well as individual facility managers who oversee bridge operation and maintenance. Each MDOT agency has a bridge inventory manual, specific inspection policies, and inspection procedures manuals based on their specific environmental and budget needs. Local jurisdictions across the state also have departments to oversee the inspection, operation and maintenance of the bridge inventory that is on local roads.

Funding and Future Need

The MDOT budget accumulates the majority of its funding from federal aid and state sources, which are composed of taxes, fees, and bonds. In fiscal year 2020, state sources account for $1.6 billion of the capital budget – nearly half. One of the primary state-based sources for the capital budget is Maryland's gas tax at 35.3 cents per gallon. Legislators raised the gas tax in 2013 and gradually phased in the increases to improve the availability of funding for surface transportation infrastructure. Maryland also generates revenue from motor vehicle registration fees, a motor vehicle title tax, and a portion of corporate income taxes.

However, over the next five years, Governor Larry Hogan's budget calls for a redirection of some MDOT SHA funding to transit investments. Additionally, a decrease (down to $2.2 million) in expected bond earnings will further restrict the money available for bridges. Consequently, to continue the progress Maryland has seen, state leadership will need new approaches to address the total estimated investment needed for repairing the state's bridge network, $3.5 billion according to the American Road and Transportation Builders Association.

2020 Grade: B

BRIDGES

Many bridges in Maryland are older and, within the next decade, will be reaching the end of their original design service life. The typical design life for an in-service bridge is between 50 and 75 years. More than 50% of Maryland bridges are over 40 years old and more than 30% are over 50 years old. Performing routine maintenance and repairs can extend the service life of bridges, but strategic investments are necessary to ensure that all critical projects are improved despite limited resources.

Resilience

Maryland continues to make strong efforts to ensure the resiliency of its bridges. Resilient bridges have the capacity to withstand all forces without collapse. They are able to recover from distress or major damage with minimal disruption to traffic or services. Maryland's engineers incorporate ductility, redundancy, and operational importance into their bridge designs to ensure resiliency. Bridge managers make sure that bridges are devoid of defects, weaknesses, and trouble spots that could lead to bridge closing or failure. Consequently, a robust bridge inspection program is essential. Maryland's inspection program has been cited as one of the best in the country. Maryland is also adopting innovative methods, technologies, and materials and using systematic preventive maintenance, bridge management systems, and asset management principles to balance needs and resources to maintain a high level of safety in highway bridges.

Innovation

Despite decreased funding, Maryland is focusing on major bridge construction projects over the next several years, including a $463 million project to construct a new Governor Harry W. Nice Memorial/Senator Thomas "Mac" Middleton Bridge over the Potomac River that will connect Charles County, Maryland to King George County, Virginia, and the American Legion Memorial Bridge on I-495 between Montgomery County, Maryland and Fairfax County, Virginia. The Chesapeake Bay Bridge has also received a $27 million investment for repairs, which is vital for a structure that sees 40,000 crossings each day. In 2016, the Bay Bridge received national recognition for its $51 million cable dehumidification project to preserve main cable systems by eliminating moisture.

MDOT is embracing Accelerated Bridge Construction as a means of quickly replacing bridges like the West Nursery Road Bridges over the Baltimore-Washington Parkway (MD 295) and the MD 213 bridge over Old Mill Stream Branch with greater speed and efficiency while reducing user impacts.

After considering the available information, bridges infrastructure in Maryland is assigned a grade of 

Recommendations to Raise the Grade

The condition of Maryland bridges has been steadily improving over the past twenty years or more. Officials in Maryland responsible for managing the condition of the bridge inventory have been excellent stewards of the public funds provided, using resources to maintain and improve bridge conditions throughout the state. To continue this progress, Maryland should

- Maintain the current robust bridge inspection program and management programs to identify and prioritize bridge maintenance and construction.
- Continue promoting innovative methods in construction and maintenance of existing bridges to stretch infrastructure funding.
- Advocate to elected officials to identify additional investment options to fill the gap between current and needed funding.

2020 Grade: B

BRIDGES

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2020 Grade: B

BRIDGES

DAMS

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: C-

Previous Grade (2011): C

Executive Summary

Dams are an essential part of Maryland's infrastructure that provide critical services such as flood control, water supply, and recreation. There are currently 539 dams in Maryland, approximately 45% of which are high hazard and significant hazard dams. While not indicative of condition, a high or significant hazard classification signals that, in the event of dam failure, there is potential for loss of life, property, and significant impacts on other critical infrastructure. The Maryland Department of the Environment Dam Safety Division (MDE-DSD) is charged with regulating the safety of dams in Maryland. While MDE-DSD is performing better than many other states' dam safety agencies relative to dam inspections, repairs of deficient dams, and requiring Emergency Action Plans, there is more to be done because Maryland has no dedicated funding source for repairing dams or ponds. Of equal concern is MDE-DSD's lack of sufficient resources – personnel and funding – to fully perform all its dam safety duties.

Introduction

Maryland has 539 dams serving as water resource management systems that provide essential benefits such as drinking water, flood management and mitigation, renewable energy through hydropower, areas for recreation, irrigation for agriculture, resources for firefighting, and natural habitats.

Maryland's dams vary greatly by age, with some built over 300 years ago. The peak dam construction period occurred during the 1960s and 1970s when over 130 of the state's dams were built.

Maryland defines a dam as any obstruction, wall, or embankment constructed for the purpose of impounding, storing, or diverting water. Maryland dams range in height from 6 to 296 feet. Small impoundments that are less than 20 feet in height, have less than a square mile drainage area, and whose failure will not cause loss of life or property damage are typically classified as small ponds, and as such, are not a specific consideration of this analysis.

Maryland dams are owned by both public entities such as local governments, state departments, and federal agencies and private owners. Private owners include individuals, homeowner associations, and corporations. Fifty percent of the high and significant hazard dams are publicly owned, while 50% are privately owned. Figure 1 shows the distribution of dams across Maryland.

Condition and Capacity

Inadequate inspection, funding, and maintenance of dams can cause catastrophic consequences such as loss of life and property, infrastructure and environmental damage, and hindered economic activity. Maryland classifies its dams as high hazard (HH), significant hazard (SH), or low hazard (LH). A dam's hazard potential is classified based on the anticipated impacts and consequences of failure that will occur downstream of the dam, and not solely upon the dam's condition. The dam hazard classifications are explained as follow:

- *High hazard potential (HH):* High Hazard dams are referred to as "Category I" dams in the Code of Maryland Regulations (COMAR) and "Class C" ponds by the U.S. Natural Resources Conservation Service (NRCS). The HH classification is denoted when dam failure would likely result in loss of human life, extensive property damage to homes and other structures, or flooding of major highways such as state roads or interstates.

- *Significant hazard potential (SH):* These are referred to as "Category II" dams in COMAR and "Class B" ponds by NRCS. A significant hazard dam is classified as such when dam failure could possibly result in loss of life or increase of flood risks to roads and buildings, with no more than two houses impacted and fewer than six lives in jeopardy.

- *Low hazard potential (LH):* Failure of these dams could result in loss of the dam or damage to the floodplains, but not of life.

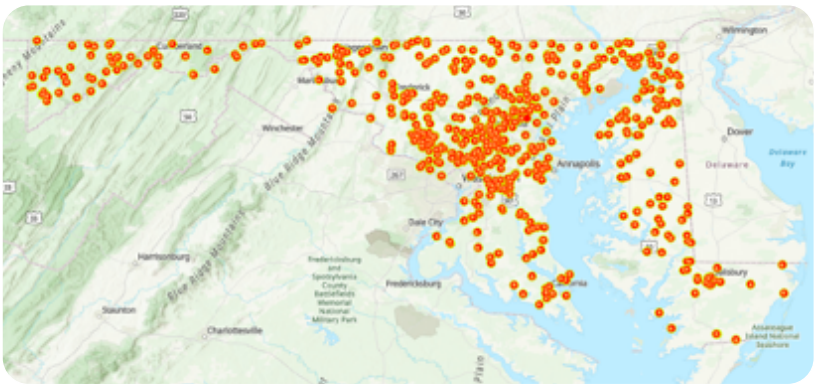


Figure 1 - Maryland Dam Locations

Maryland currently has 92 HH, 148 SH, and 299 LH dams across the state. Since 2010, because of developments downstream, the number of HH and SH dams in Maryland has increased by 13 and 34, respectively.

The number of Maryland's deficient dams quantified by the U.S. Army Corps of Engineers' 2018 National Inventory of Dams (NID) includes 17 HH dams (12 rated as Poor, and 5 rated as Unsatisfactory) and 32 SH dams (23 Poor and 9 Unsatisfactory). Many of these dams are determined to be deficient because of age, deterioration, and a lack of maintenance. The average age of MDE-DSD- regulated dams is over 60 years. Most dams built last century have the expected lifespan of 50 years, although that can be extended with regular maintenance.

Maryland is doing better than the national average in repairing deficient dams. Nationally, the number of HH dams and deficient dams is increasing faster than the latter are being repaired. Although, Maryland is ahead of the national average, any deficient dams within the state pose a potential danger for downstream residents and infrastructure.

Public Safety

Maryland has been assuring the safety of dams since 1934 through a permit and inspection program administered by the MDE-DSD; however, the responsibility and liability rests firmly on the shoulders of the dam owners. MDE's Dam Safety Program has many components including the following: annual and/or periodic safety inspections; dam monitoring; enforcement, permitting and design review; construction quality assurance/quality control oversight and reconstruction/rehabilitation; dam removals; emergency action planning (EAP); and dam owner education to regulate the safety and security of dams in Maryland. As of December 2019 only 81 of the HH and SH dam owners, approximately 34%, had participated in an EAP tabletop exercise, which is required every five years.

Figure 2 – Barren Creek Pond dam failure (July 14, 2016)

2020 Grade: C-

DAMS

Operation and Maintenance

Dam Inspections

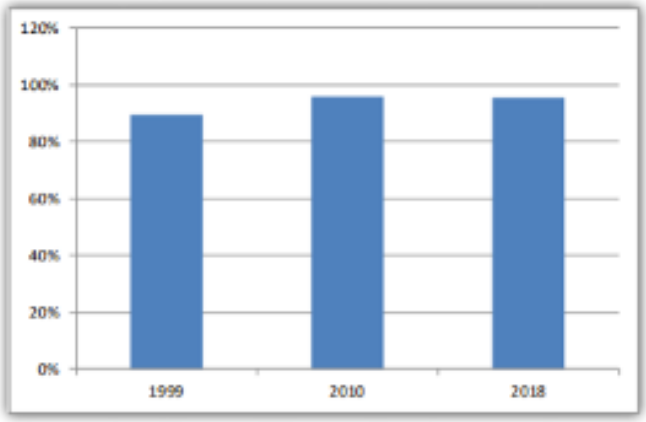
Dam inspections are an important way to assess the structural and operational conditions of the dams, identify any new conditions below the dam, and determine the need for repairs, modifications and/or rehabilitation. MDE-DSD is required to inspect HH dams annually and SH dams every three years. MDE-DSD's full-time staff who provide dam inspections have increased from five (5) in 2010 to nine (9) in 2019. This has greatly improved the ability to conduct the required inspections. Recently, MDE-DSD was able to conduct 95% of required inspections as compared to the national average of 79%.

MDE-DSD does not currently have sufficient resources, funding, or staff to conduct all the required dam safety inspections or to take appropriate enforcement actions. MDE-DSD has nine (9) full time employees to regulate 539 dams. MDE's DSD budget has increased from $444,138 in FY14 to $1,041,900 for FY19. While the number of dams per engineer is below the national average, MDE-DSD estimates that a staff of 11 is needed to perform the work required for all the existing dams and those added annually. As such, MDE-DSD has recently gained funding for adding two (2) positions in the FY19 budget.

Emergency Action Planning

EAP documents are essential in the event of a dam failure or potential failure in order to identify and notify people residing below the dam and to coordinate their evacuation. More than 90% of dams requiring an EAP have one, including 95% of HH dams. Nine percent are more than three years old. While MDE-DSD is to be commended for the high percentage of EAPs relative to the national average, 81% in 2018, any hazard dam without an EAP or with an outdated EAP may be insufficiently protecting downstream property owners and infrastructure. Recently enacted Maryland state law gives MDE-DSD the authority to require older dam owners to have EAPs. As such, MDE-DSD is working with the owners of these older dams to create or update their EAPs.

Percentage of State-Regulated High Hazard Potential Dam Inspections Completed



* Inspection percentages may vary above and below 100% for any given year based on a state's inspection frequency and scheduling.

On May 4, 2017, Governor Hogan signed into law House Bill 125, "Emergency Action Plans for Dams," which requires all dam owners to update their facility's dam safety emergency action plans by August 1, 2017. At the time of the bill signing there were 81 HH dams and 114 SH dams in Maryland, which have since increased to 92 HH and 148 SH, respectively. According to the law, dams designated as HH or SH dams are mandated to prepare and submit an EAP. This new state law addresses the previous ASCE Infrastructure Report Card recommendation to "provide statutory authority for MDE-DSD to be able to require all HH and SH dam owners to have and exercise EAPs." However, these EAPs are not linked to a regional or federal regulatory authority. The Maryland COMAR regulations have not been sufficiently strengthened to give MDE-DSD the authority with civil penalties to require dam owners to address dam safety requirements for their HH and SH dams to protect human life as well as downstream infrastructure.

2020 Grade: C-

DAMS

Funding

In 2019, the Task Committee of the Association of State Dam Safety Officials estimated approximately $218 million is needed to repair HH and SH dams located and regulated in Maryland, a value that has not changed since 2016.

In Maryland, MDE-DSD is monitoring the repair program for four dams which currently have design plans but lack the funds to go into construction. The estimated repair cost for each of these dams could range from $2 to $4 million.

" ... approximately $218 million is needed to repair HH and SH dams located and regulated in Maryland"

As reported on September 27, 2017 in The Sentinel Newspaper, the City of Greenbelt needs to borrow $2.5 million to make major repairs on the 81-year old HH Greenbelt Lake dam. The state issued the City a consent order in 2010 requiring its repair. This is a financial burden for a city whose entire capital projects program for 2017 was $1.97 million.

Many of the remaining deficient dams are privately owned which means they likely have significantly less resources for doing the repairs than the public owners. While not included in the estimates for repairing all HH and SH dams, LH dam repairs generally are less expensive than HH and SH repairs; cumulative cost of these repairs is still likely significant.

Lack of funding is a major challenge in addressing the needed repairs to deficient HH and SH dams. State and federal programs lack adequate funding to help dam owners fund repairs. Some local municipalities have dedicated funds toward dam repairs. However, most municipal dam owners must find emergency funds or compete with other types of infrastructure projects for limited resources. While some private dam owners (for water supply and hydroelectric power generation) have dedicated funds for repairs and maintenance, many smaller private owners such as homeowner associations do not have the same financial resources available. Smaller private owners oftentimes have to look towards a local government for assistance, thus putting added strain on the local government's budget.

Future Need

As Maryland's dams age and downstream development continues, many dams will require repairs and significant investment to maintain their proper function as they are reclassified HH. Most of the dam owners do not have adequate or specific funds set aside for dam maintenance and/or replacement. It is imperative that dam owners have access to funding and/or low interest loans to fund major dam repairs, especially for HH and SH dams, to protect the health, welfare, and safety of the public. The High Hazard Potential Dam Rehabilitation Program was authorized in the 2016 Water Infrastructure Improvements for the Nation (WIIN) Act, and was funded at $10 million FY19. However, future funding will continue to be an issue given the burdensome price tag of dam maintenance on local government budgets.

Resilience

Exelon Corporation owns and operates the 572-MW Conowingo Dam on the Susquehanna River for hydropower generation. Exelon cannot operate the dam without licensing by the Federal Energy Regulatory Commission (FERC). In May 2018, MDE required Exelon to reduce water pollution flowing from the Conowingo Dam into the Chesapeake Bay.

For decades, the Conowingo Dam trapped significant portions of the sediments and nutrient pollution carried by the Susquehanna River, and prevented it from reaching the main stem of the Chesapeake Bay. However, pollution and silting have built up behind the dam which is now at capacity, holding more than 31 million cubic yards of sediment. As the intensity and severity of major storms is projected to rise, scouring of sediments will pose potential long-term pollutant challenges.

2020 Grade: C-

DAMS

In October 2019, MDE and Exelon reached an agreement demonstrating a comprehensive, enforceable commitment by Exelon that progresses the state's agenda to holistically improve water quality and address climate resilience. The settlement identifies metrics for success and outlines Maryland's oversight commitments for monitoring and tracking progress to ensure the infrastructure is both safe and minimizes adverse environmental impacts to the Chesapeake Bay.

While environmental groups have expressed concerns that the agreement does not provide enough oversight or funds to address the environmental risks posed by the operation of the Conowingo Dam, it reflects an effort to manage infrastructure, control pollution, provide critical resources (e.g. flood protection, energy), and improve resilience at a watershed-level, an inter-agency, cross-sector approach that will become increasingly important as the cross-cutting impacts of climate change affect various types of infrastructure.

Innovation

Removing old mill dams and/or structurally deficient dams is expensive and could be challenging; however, if left in place, then these obsolete structures pose long term maintenance challenges and are obstructions to fish migration. The Bloede Dam removal project in Patapsco Valley State Park is one such example of successfully identifying and funding projects to remove these old mill dams. According to the Maryland Department of Natural Resources (MDNR), "the complex project involved relocating a 42-inch diameter Baltimore County sewer line and a 12-inch diameter Howard County sewer line, the demolition of the fish ladder and dam structure, and the repaving of a section of the Grist Mill Trail." These efforts not only removed an antiquated river obstruction which drained scarce operation and maintenance resources, but also alleviated a man-made fragmentation of the river's original aquatic habitat, improving fish populations, water quality, and public safety in the park. MDNR will perform physical and biological monitoring of the site for several years to collect data on the breadth of improvements in migratory fish upstream. Overall, the project demonstrates an innovative science, engineering, and public safety collaboration.

After considering the available information, dam infrastructure in Maryland is assigned a grade of C-

Recommendations to Raise the Grade

To address the current needs of MDE's Dam Safety Program and the safety and security of Maryland's dams, Maryland should:

- Dedicate and fully fund state and/or federal programs/grants, and/or low-interest loans for the rehabilitation and repair of HH and SH dams.
- Provide greater resources in the form of additional manpower and budget for MDE-DSD to educate and communicate with dam owners about the importance of performing the necessary operation and maintenance activities in a timely manner.
- Increase the amount of public education and outreach to dam owners to increase the number of updated and exercised EAPs and promote more frequent inspections and maintenance of HH and SH dams.
- Provide statutory enforcement authority for MDE-DSD to be able to impose civil penalties upon dam owners who do not address dam safety requirements.
- Provide sufficient oversight responsibility and annual reporting to track the progress for implementation of the Conowingo Dam Settlement action plan, project completions and funds commitment.

2020 Grade: C-

DAMS

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2020 Grade: C-

DAMS

DRINKING WATER

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: C

Previous Grade (2011): C-

Executive Summary

Maryland residents receive water services from a combination of large water utilities like Baltimore City or Washington Suburban Sanitary Commission, regional systems, and privately-owned wells. These many agencies and different water supply sources serving the state's residents provide water quality that is generally at or above average national levels. In many of Maryland's cities and towns, the leading issue related to drinking water is aging infrastructure, which negatively affects the reliability of the water system. Baltimore City has recently averaged nearly 1,000 breaks each year. With limited budgets, infrastructure owners prioritize repairs to maintain service and ensure public safety. For example, approximately 60% of Baltimore City's total water budget goes toward projects aimed at improving the aging water infrastructure.

Introduction

A drinking water system is a collection of water supply, treatment, storage, and distribution systems, including pipes and pump stations. The water provided can be used for drinking, fire protection, and general residential and commercial use.

The Maryland Department of the Environment (MDE) administers the Water Supply Program to ensure the safety and sustainability of the water supplies for the state's more than 5.7 million residents. MDE's mission comprises planning and protection tasks, including water supply withdrawal planning, water quality monitoring of public water systems and supplies, and onsite inspections and emergency response. However, individual public water systems, while subject to the MDE regulations, are generally owned and operated by public or private entities.

Maryland's two areas of greatest population density are the Baltimore region and around Washington, D.C., specifically, Prince George's and Montgomery Counties. Baltimore City Department of Public Works (DPW) is the main provider of drinking water in the Baltimore region, serving approximately 1.8 million residents. The Washington Suburban Sanitary Commission (WSSC) provides drinking water over nearly 1,000 square miles in Prince George's and Montgomery Counties and serves 1.8 million residents. Small community water suppliers in Maryland service other parts of the state.

Condition and Capacity

Just 10% of Maryland community water systems rely on surface water sources, but those community water systems provide water to 80% of the state's population. Furthermore, 16% of Maryland's population gets water from privately owned wells. There are no privately-owned wells in Baltimore City.

The current water supply in the states densest population areas is adequate for the population served. In these two regions, water supply is entirely surface water dependent and is protected by an extensive watershed management plan to guard against possible contamination. In addition to the supply available during normal conditions, there is also a backup water supply source from the Susquehanna River.

Figure 1 – City of Bowie cast iron water main

The Baltimore DPW owns and operates a distribution system of over 4,500 miles of water main pipes, as well as a series of pumping stations, storage tanks, and reservoirs. Three plants treat and produce up to 360 million gallons per day of water that meets or exceeds federal and state drinking water standards.

Baltimore City and County residents benefit from safe and reliable drinking water, but aging infrastructure causes issues related to loss of water in the pipes and reduced level of service. According to DPW, the system is plagued by close to 1,000 water main breaks each year, although that number has been declining in recent years due to additional investments in the aging infrastructure. Increasing rates has enabled DPW to increase the rate of water pipe replacement from five miles per year to over 20 miles per year. Today, approximately 60% of Baltimore City's total spending budget for water goes toward projects aimed at improving the aging water infrastructure.

In Baltimore City, a majority of the distribution system is cast iron pipe that is reaching the end of its useful service life. Most water mains are more than 65 years old.

The distribution system in the surrounding counties, though maintained by Baltimore City, is constructed primarily of relatively new ductile iron pipe and is less prone to catastrophic breaks than the old cast iron pipes.

WSSC in the Washington, D.C. metro area owns and operates nearly 5,800 miles of water main pipe and two water filtration plants. Water mains, which range from 1 to 96 inches in diameter, deliver safe and reliable water to customers. Like many northeastern cities, WSSC laid cast iron pipes from 1916 to 1976. Since these are more prone to breaks than the ductile iron pipes that are used today, they are responsible for a large portion of the watermain breaks in WSSC's approximately 2,900 miles of distribution network. The commission has initiated an aggressive water replacement program to improve service reliability and meet customer expectations. More than 60 miles of pipe are replaced each year. WSSC is faced with an additional challenge of providing new infrastructure to population growth and urban sprawl.

Funding

The public water systems in the state are operated by public water utilities that are funded primarily by customer water bills, which are then leveraged into debt financing. The average customer water bill in Baltimore City for a family of three is approximately $98 dollars a month, according to a July 2019 statement from DPW. WSSC employs a tiered rate structure for its water and sewer bills, with rates ranging between $11.89 per 1,000 gallons to $20.26 per 1,000 gallons; with the assumption that a typical 3-person household uses 165 gallons per day, or 4,950 gallons per 30 days, its bill is $58.86-$100.29.

Baltimore City DPW is fully funded with utility funds, which are the fees paid for water, sewer, and stormwater services. Each budget year, capital projects are financed by a combination of current revenue (utility funds), debt that will be repaid by future utility funds (revenue bonds and state or federal loans), and other sources such as county grants. For the 2020 budget, the recommended funding for the utility programs totals $347 million, and includes projects such as upgrades to pump stations, repairs, rehabilitation and replacement for water infrastructure, and upgrades and improvements at treatment facilities.

WSSC's proposed 2020 budget includes the issuance of almost $385 million in new water, sewer, and general construction debt. It also provides the payment of debt services of nearly $320 million of which over $306 million is in the water and sewer operating funds. Other priorities include continuing to implement the IT Strategic Plan, maintaining the agency's "AAA" credit rating, and maintaining operating reserves at 10% of water and sewer operating revenue.

2020 Grade: C

DRINKING WATER

Operations and Maintenance

WSSC, Baltimore City, and the surrounding counties all have programs in place to assess public water infrastructure and water quality and address deficiencies as needed. The assessment and monitoring are diverse and include visual inspections of facilities and pipes and chemical analysis of delivered water.

Another issue faced by the public water sector is not an issue unique to Maryland, but is the nationwide concern of an aging workforce. Drinking water facilities and water systems are operated by specially trained and certified/licensed personnel. As this workforce ages and retires, the need for a new generation of water operators who continue delivering safe drinking water to the public increases.

Maintenance of the state's drinking water quality requires attention and efforts throughout the watershed. Since watersheds do not usually follow county and state lines, coordination of watershed protection plans between counties within the state and bordering states will continue to be important matters for the drinking water sector. At least 70% of Marylanders utilize public water systems that have protection plans in place, including a cooperative plan developed by WSSC and Baltimore City. Challenges are presented for the remaining small and medium systems for whom the size of the source watershed to protect is vastly different than the size of the municipality the source serves. Consequently, it will be imperative for jurisdictions to cooperate and coordinate watershed protection plans and integrate land development plans with water supply planning.

Public Safety

Though there are many agencies and different water supply sources serving the state's residents, water quality is generally at or above average national levels. However, Baltimore City has consistently exceeded lead testing standards, so testing requirements changed from 100 homes every year to 500 homes every three years.

Furthermore, nine water systems were tested in Baltimore County with only one nitrate violation. Nitrate is among the most common contaminant found in Maryland public water systems due to fertilizer runoff, septic tank leaching, and natural deposit erosion.

Prince George's County tested five water systems with no violations. Frederick County tested 30 water systems with only two violations: haloacetic acids (natural byproduct of chlorination) and radioactive contaminants (decay and erosion of natural and man-made deposits). No violations were found in Garrett County's 17 water systems. Additionally, WSSC showed no violations.

Lastly, well systems have no routine comprehensive water monitoring requirements like public systems; sampling is only required at the time of construction. Proactive monitoring does not largely occur, but once local authorities are aware of contaminant issues, additional scheduled monitoring can take place. For example, Anne Arundel County monitors for radium, southern and eastern Maryland counties monitor for arsenic, and the Piedmont region monitors for radon. However, when considering the potential impacts to drinking water quality (via groundwater sources) from a growing industry like hydraulic fracturing, Maryland does not yet have a clear picture of the threats and policy implications. Future studies in this area should be conducted to produce the information that the state's regulatory agencies currently lack.

2020 Grade: C

DRINKING WATER

Future Need

Drinking water is one of the most critical of public resources. The availability of funds and resources for the monitoring and assessment, and proactive rehabilitation and replacement of drinking water infrastructure is a concern While WSSC, Baltimore City, and the surrounding counties all have programs in place to monitor and assess, public water infrastructure, more resources are needed to increase the speed with which the pipe replacement programs replace old, at-risk, or failing infrastructure. The funding for these programs is received through water bills. Debt financing is also utilized; funds are made immediately available for infrastructure spending and paid back over time through water rates.

In 2019, the federal government, through the Environmental Protection Agency (EPA), made available nearly $2.6 billion in new funds to improve drinking water and wastewater infrastructure throughout the nation. Maryland will receive $58,975,000 of this new funding to rehabilitate and rebuild aging water infrastructure and ensure Maryland residents have safe and clean water. EPA administers several programs to make these funds available including the State Revolving Funds (SRFs), the Drinking Water State Revolving Fund (DWSRF), and the Clean Water State Revolving Fund (CWSRF).

Even with these federal initiatives, funding is inadequate to improve Maryland's infrastructure and remain in compliance with ever-tightening state and federal regulations. According to the EPA's 2015 Drinking Water Needs Survey, Maryland has an estimated $9.3 billion drinking water infrastructure need over the next 20 years. To safeguard reliable supply of potable water to the Baltimore region and across the state, more funding will be needed in the near future.

Innovation

Until funding ran out, the Maryland Geological Survey (MGS) worked on developing a geographically based Aquifer Information System for both the Coastal Plain (CP-AIS) and Fractured Rock (FR-AIS) regions. Since 2008, MDE has been utilizing the data so that withdrawal strategies can better optimize aquifer use and better evaluate water quality and withdrawal requests. Permit reviewers, scientists, planners, and other stakeholders can evaluate the data to inform water supply decisions and to help protect these water sources. Both the CP-AIS and FR-AIS are still in use by MDE, but the latter in a more limited capacity since it was not fully developed when funding ran out.

After considering the available information, drinking water infrastructure in Maryland is assigned a grade of C

Recommendations to Raise the Grade

Maryland has good quality drinking water. It has implemented effective measures to monitor and proactively rehabilitate or replace drinking water infrastructure. For further improvement, Maryland should:

- Continue progress toward full compliance with state and federal regulations.
- Garner public support for projects through public awareness campaigns.
- Increase funding at all levels, specifically to address aging infrastructure and for smaller systems.

continued ...

2020 Grade: C

DRINKING WATER

- Provide additional training and educational opportunities for professions within the drinking water industry, focusing on compliance and contaminant challenges unique to Maryland, and to train the next generation of water operators.
- Include the integration of land development with water supply planning across multiple jurisdictions.
- Revise monitoring regulations for well contaminant testing. The impact of hydraulic fracturing on drinking water quality and supply is not yet fully understood. Future studies in this area will yield important information.

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2020 Grade: C

DRINKING WATER

ENERGY

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: C-

Previous Grade (2011): NA

Executive Summary

Maryland's electricity is supplied by three separate but integrated groups: generation, transmission, and distribution. Most of the associated infrastructure is operating well past its planned 50-year design life. During peak loads, transmission and distribution needs are at or beyond capacity due to bottlenecks in configuration. Natural gas pipelines that supply electricity-generating assets are also often near capacity limits. In 2015, Maryland imported 44% of its electricity as compared to 22% in 2000; this figure is likely to increase as in-state generation declines. According to PJM Interconnection, a regional transmission organization, while this decline in in-site generation has been considered in Maryland's overarching system planning, it is still likely to impact resilience due to risks to electricity supply, especially during severe regional weather events. Without greater attention to aging infrastructure, integration of resilience into infrastructure planning, and incorporation of renewable energy technologies, Maryland will likely experience longer and more frequent power interruptions.

Introduction

Energy is an extremely broad topic and generally defined as power derived from the utilization of physical or chemical resources, especially to provide electricity and heat or to work machines. Maryland is not an energy resource-rich state; it imports most of the resources needed to produce the energy that is consumed. This analysis of Maryland's energy infrastructure focuses solely on electricity.

The generation and supply of electricity is not regulated in Maryland, and prices are set by the competitive marketplace. Maryland depends on regional transmission and import by the PJM Interconnection, LLC (PJM) Reliability Pricing Model. The high-voltage, bulk electric transmission system is a regulated monopoly and subject to regulations by the Federal Energy Regulatory Commission. The distribution of electricity within the state is subject to price and quality-of-service regulations that are established by the Maryland Public Service Commission (PSC).

Most of the requisite electric infrastructure in use today for transmission and import is operating well beyond its planned 50-year design service life. This is due in large part to current regulatory and permitting processes which present substantial expenses and delays to construction. Currently, there is no new coal, oil, natural gas, or nuclear generation planned in Maryland through 2026.

For distribution, Maryland is geographically divided into thirteen electric utility service territories (see Figure 1) and each of these utilities is required to file a tariff with the Maryland PSC.

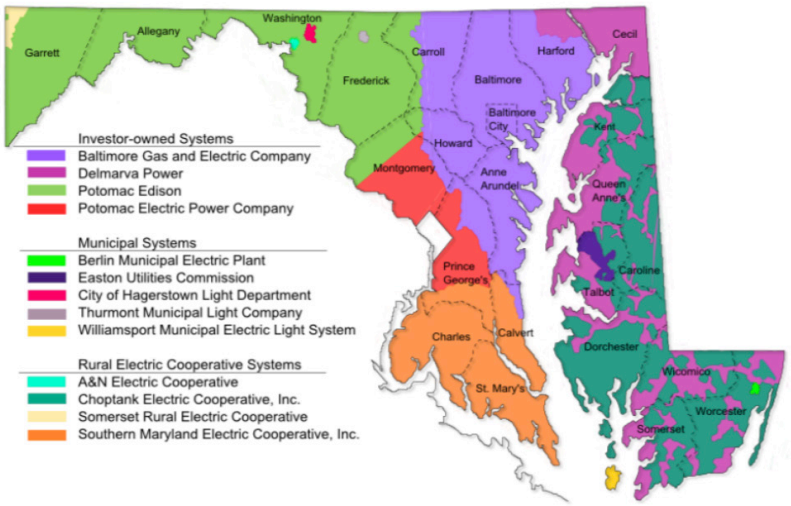


Figure 1 – Maryland's electric utility service territories

Condition and Capacity

The capacity and condition of any electric system depends on many things including ownership of the generating assets, the ability of the transmission system and interconnections to deliver power where it is needed, and the robustness of the local distribution system. Reduced electric demand during the Great Recession and new environmentally protective regulations have prompted significant and rapid transformations across the PJM grid. Within the PJM footprint, between 2015 and 2018, 8,081MW of predominately coal-generating assets were retired, while 22,818 MW of new, mostly natural gas generation has come online. This rapid transformation will continue to increase with the premature closing of nuclear plants across the region. In September 2019, 819 MW of generation from the Three Mile Island nuclear plant was decommissioned due to economic reasons. Neither Maryland nor Pennsylvania recognizes nuclear energy as a source of zero emissions energy, so additional nuclear plants are scheduled for premature closure. This pace of industry change and retirement of base load generation is pushing grid operators like PJM to prepare for future vulnerabilities for which no set of standards exist.

It is important to keep in mind when discussing generation assets and transmission interconnections the need to handle peak loads like that experienced during the 2014 and 2018 polar vortices. Electric companies like PJM face serious challenges during peak load periods due to complexities in accommodating various state's public policies – like Maryland's Renewable Portfolio or Pennsylvania's Zero Emission Credits – while maintaining the integrity of the system.

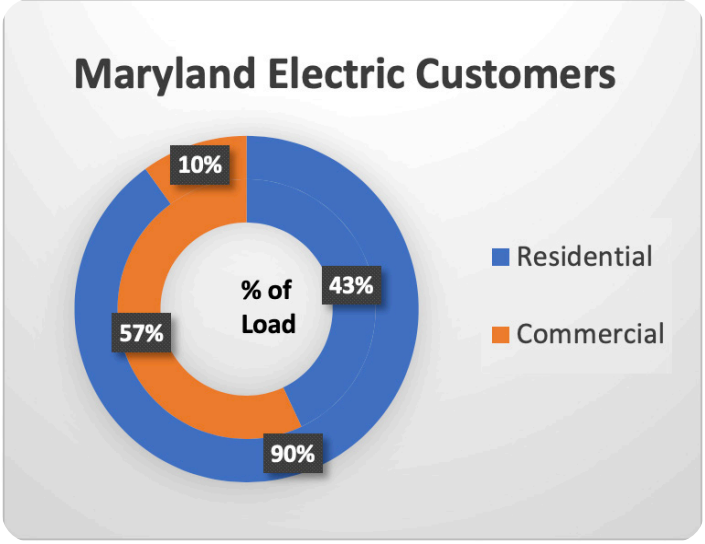


Chart 1 – Maryland customers and their percent of load

Maryland's local utilities and associated distribution systems use Gross Domestic Product (GDP) projections as one tool to perform load forecasting across the state. In general, electricity demand has diminished due, in part, to declines in residential demand, milder weather, reduced industrial production, and efficiency gains.

The Maryland utilities' load forecast for 2017-2026 indicates a modest amount of growth in the number of customers, energy sales, and peak demand throughout the state. Approximately 90% of utility customers in Maryland are categorized as residential, representing 43% of the load forecast. Conversely, just over 10% of customers are commercial and industrial, yet they correspond to more than 50% of the load. Projected utility growth is closely tied to residential household formation which is forecasted to increase on average by 7.8% thru 2026.

To accommodate the increase in residential users, the state will rely on energy conservation efforts and Maryland's Renewable Energy mandate, which requires electricity suppliers to obtain an increasing percentage of their power through renewable sources. In April 2019, the Maryland General Assembly passed a measure mandating that half the state's electricity supply come from renewable sources by 2030, with 14.5% of that coming from solar energy. That is a hefty increase from the state's current goal of 25% renewable energy by 2020, of which only 2.5% had to be solar. This bill is not without controversy as solid waste incineration is included as clean energy in Maryland and receives similar subsidies as solar. While these renewable resources address environmental concerns, they may not meet demands during peak load periods thus increasing the importance of conservation programs and load shedding technologies. When combined with the continued retirement of coal assets, Maryland's dependence on imported power and PJM's transmission interconnections will continue to increase.

2020 Grade: C-

ENERGY

Operation and Maintenance

Maryland's electricity supply is part of a highly interconnected electric system (PJM) that extends beyond state boundaries. The PJM system includes key U.S. Eastern Interconnection transmission arteries, providing members access to PJM's regional power markets and adjoining systems. Collaborating with more than 990 members, PJM dispatches more than 176,560 MW of generation capacity over 82,540 miles of transmission lines. The system is actively managed by regulatory agencies and commissions who enforce performance criteria, standards, and requirements to ensure the reliability of the electric power system.

From a distribution perspective, each utility service provider has a unique tariff that governs pricing and operation and is governed by the Maryland PSC whose primary role is to promote safe, reliable, and economical electricity to Maryland citizens.

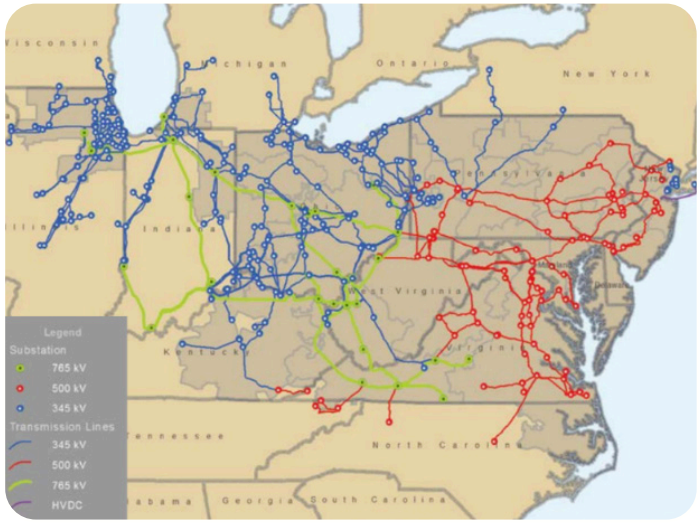


Figure 2 – PJM's electric system

Funding and Future Need

Through September 2019, Maryland's average electricity rate of $12.83/kWh is slightly below the national average of $13.17/kWh.

PJM's Regional Transmission Expansion Plan (RTEP) identifies transmission system additions and improvements needed to serve more than 65 million people throughout 13 states and Washington, D.C. From 2017-2018, RTEP reported that upgrades across Maryland and Washington, D.C. cost more than $52 million while project costs for additions to the transmission system range from approximately $18-$130 million.

Within the entire PJM grid, the only new type of base load utility-scale power plant that is being brought online is natural gas. While this makes sense given the abundance of relatively inexpensive gas in the United States, it is important to keep in mind that winter electric peaks occur at the same time the demand increases for natural gas for heating. These dynamics lead to capacity constraints that drive increases in future need within the current natural gas pipeline system.

Maryland currently has no plans for development or expansion of base load generation, so the state's dependence on the PJM planning processes will increase, particularly with the pending retirements of significant coal generating assets.

Public Safety

With the exception of potentially energized downed wires from severe weather, the state's electricity infrastructure does not present a public safety threat from electrocution.

Some of the older pipe-type underground transmission systems within Baltimore and Washington, D.C. use mineral oil as an insulator; corrosion of these cable systems may result in leakage of dielectric oil, a hazardous waste. As just one example, Baltimore Gas & Electric Company (BGE) operates and maintains a 45-year old pipe-type cable transmission line that crosses underneath the Patapsco River (outer harbor of Baltimore). This cable has reached the end of its useful life; it is scheduled for replacement with an overhead transmission line beginning early 2020.

2020 Grade: C-

ENERGY

The larger investor owned utilities within Maryland have deployed smart electric meters using mesh communications. During larger storm events with system wide outages, this mesh-based communications system is rendered useless as the smart meters require electricity to communicate. It can take weeks for a mesh-based smart meter system to resume normal operations after power is restored.

Resilience

The North American Electric Reliability Corporation, Reliability First Corporation, and PJM are responsible for supply reliability, while PJM and the Maryland PSC are responsible for delivery reliability.

Cold weather alerts are issued when forecasts indicate temperatures below 10 degrees Fahrenheit. The alerts notify members of higher-than-normal demand and ask them to restore all available transmission and generation equipment and to defer any maintenance activities planned during the alert period. PJM's operators, having learned lessons from the extreme conditions in the 2014 Polar Vortex, had a significant reduction of forced/unplanned generator outages thus reducing demand for natural gas as a fuel type.

Metrics for the reliability of service delivery, both System Average Interruption Duration Index and System Average Interruption Frequency Index have been trending downward. Aggressive tree trimming programs have also played a huge role in ensuring services either do not go off or they are quickly restored after disruption.

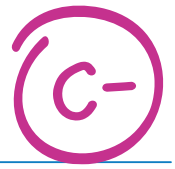
Innovation

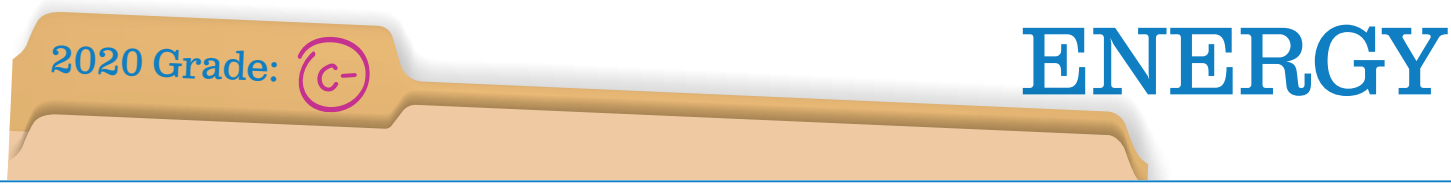
Per the Maryland PSC's 10-year plan (2017-2026), Maryland is planning to bring 1,730 MW of renewable generating capacity before 2026.

Smart meters have been deployed at BGE, Delmarva Power & Light, and Potomac Electric Power Company (Pepco). The technology has been deployed at these utilities utilizing a mesh network which broadcasts pulsed radio frequency signals using unlicensed frequencies from meter to meter to a utility antenna communications tower, requiring thousands of integrated endpoints and network management to handle communications. Due to communication delays and frequency congestions, mesh networks have not proven to be completely effective during major storm restoration efforts. Southern Maryland Electric Cooperative is also in the process of deploying a smart grid using a different methodology of point to point communications – a system which has demonstrated to be effective in recent hurricane restoration efforts associated with Hurricane Irma in the Southeast.

Cities and towns across the state are looking for ways to cut costs without shedding jobs or services. Energy bills are the top target, but some communities are having a hard time, given the tariff structures within the state. Take smart lighting as one example. Most towns or cities own some of their own streetlights (typically underground supplied decorative fixtures) while utilities own the overhead pole mounted streetlights. If tariffs promulgated by the PCS promoted innovation, city and towns across the state could reduce their energy load by more than 40% by converting the existing lights to network-controlled LED with dimming. Furthermore, the lighting can be managed via dispatchable load while obtaining analytics so that resources and energy are used only when necessary to reduce operation and maintenance costs.

After considering the available information, energy infrastructure in Maryland is assigned a grade of





Recommendations to Raise the Grade

With declining in-state generation and projected population growth, Maryland's dependence on imported energy will likely increase in coming years. This trend, coupled with a large stock of transmission and distribution infrastructure past its design life, may compromise the state's energy resilience during severe weather events. To address current needs and accommodate future demand, Maryland should:

- Streamline permitting processes to facilitate prompt construction of critical new transmission lines. Process streamlining must include steps to consider alternative approaches and ensure prudent and safe routing.
- Adopt an energy policy that carefully assesses alternative energy sources and rapidly changing base loads and considers their impacts on system reliability and resilience.
- Update user fee structures which are often old and outdated and do not keep up with today's innovation thereby inhibiting customer adoption of energy saving solutions like network-controlled LED streetlighting. Electricity user fees are necessary to defray the total cost of producing and supplying energy. The actual user fee that a customer pays depends on many factors including the type of load, the time at which the load is required, power factor, and amount of energy used.
- Develop a storm hardening plan that expands beyond the existing tree trimming and increases the ability of new and rebuilt distribution lines to handle the impacts (increased wind, ice, and temperature fluctuations) associated with a changing climate.

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2020 Grade: C-

ENERGY

PORTS

REPORT CARD FOR MARYLAND'S INFRASTRUCTURE 2020

2020 Grade: B-

Previous Grade (2011): NA

Executive Summary

Maryland ports are vital links for freight and raw materials, moving over 40 million tons of cargo annually. In 2018, the Port of Baltimore was ranked the 11th largest U.S. port by tons and 9th largest by dollar value of freight moved. The ports and rivers of Maryland's Eastern Shore collectively move 2.5 million tons of bulk commodities including petroleum, grain, and aggregates each year. Jobs associated with the Port of Baltimore represent 7% of the Maryland workforce and nearly 3% of the total wages earned in the state. The Port of Baltimore is linked to over 139,000 jobs in Maryland and responsible for $5.9 billion of economic activity. The Port's capital budget has more than doubled over the last seven years and it is making investments that will allow continual growth. However, the Port of Baltimore has limited rail access and no direct truck route access, both of which impede capacity and economic activity.

Introduction

Maryland ports include a combination of publicly operated, privately operated, and public-private partnership ports. The largest concentration of port facilities is near Baltimore City; at these, over 40 million tons of cargo are moved annually. The Port of Baltimore is one of the fastest growing ports in the nation. It is top ranked for several categories of cargo and has received ratings as the most efficient container port in the United State for several years. The ports and rivers of Maryland's Eastern Shore move an additional 2.5 million tons of bulk commodities each year. All of Maryland's ports are vital to the economy and a major source of employment in the state.

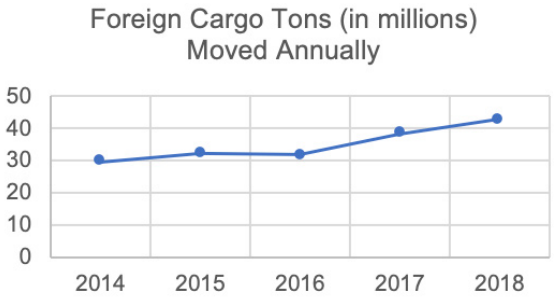
Capacity and Condition

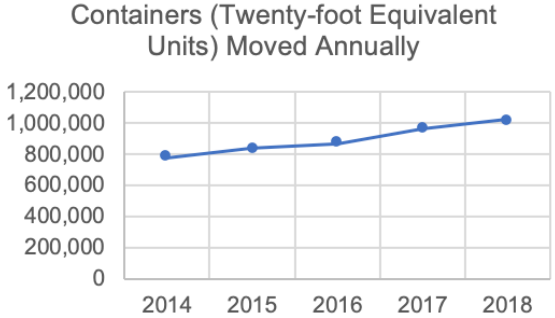
The Port of Baltimore

Baltimore started attracting attention as a port in 1670 as a transfer point for Maryland's tobacco exports to England. Today, The Port of Baltimore, Maryland's largest port, is the fourth fastest growing port in North America and is recognized as one of the most efficient U.S. container ports. The Port of Baltimore recently set records for general cargo and containerized cargo in addition to moving more automobiles and light trucks than any other port in the U.S. The Port of Baltimore is ranked first in autos/light trucks, roll on/roll off cargo, and sugar imports. It ranks second in exported coal.

The Port of Baltimore includes both privately and publicly owned terminals. Recently, the Maryland Port Administration (MPA), the public agency responsible for public terminal operations, established a 50-year agreement with a private company, Ports America Chesapeake, to operate one of the Port of Baltimore terminals – Seagirt Marine Terminal. Such a contract leverages beneficial private and public investment.

To keep up with growth and the trend towards larger ships requiring deeper navigation channels, the Port of Baltimore has prioritized infrastructure and





Charts 1 and 2 – Annual Cargo Movement at Port of Baltimore

operational improvements such as an asset management program which enhances its capacity and efficiency. The Journal of Commerce has ranked the Port of Baltimore as one of the most efficient for container berth productivity three years in a row. It is also prepared to take on larger, post-Panamax ships with new, larger cranes and dredging work that maintains the 50-foot depth for channels and berths. Future expansion may be limited by a lack of available land surrounding the Port of Baltimore and access options for multiple modes of transportation.

Figure 1 – Seagirt Marine Terminal

The marine terminal facilities are aging; some dating as early as the 1920s. They require costly maintenance to sustain and improve operations. With forethought, many of the terminals are designed to be adaptable, accommodating a variety of types of cargo. This flexibility may provide future economic opportunities as market conditions change in response to global trends.

The Port of Baltimore is primarily a truck-based port. However, truck access at the terminals is limited because there are not dedicated truck routes, drivers encounter mandatory tolls, and backups occur during peak hours that often incentivize truckers to utilize local streets. This has a negative impact on the surrounding community and reduces operational efficiency.

Rail access to the Port of Baltimore suffers from multiple limitations including nearby tunnels which were not designed for the heights of modern rail traffic and constrain the volume of containers that can be moved via rail.

Maryland's Eastern Shore

The rivers on Maryland's Eastern Shore create a shipping network, conveying approximately 2.5 million tons of petroleum, grain, and aggregates each year. Approximately 43% of this cargo is moved via the Wicomico River and Maryland's second largest port, Salisbury. The remaining water born freight is primarily moved using the Chester, Choptank, Nanticoke, Pocomoke, and Tred Avon rivers. Similar to the Port of Baltimore, the waterways of the Eastern Shore are challenged with frequent dredging to maintain channels, necessary truck/rail access improvements, and neighboring development impacting waterborne facilities.

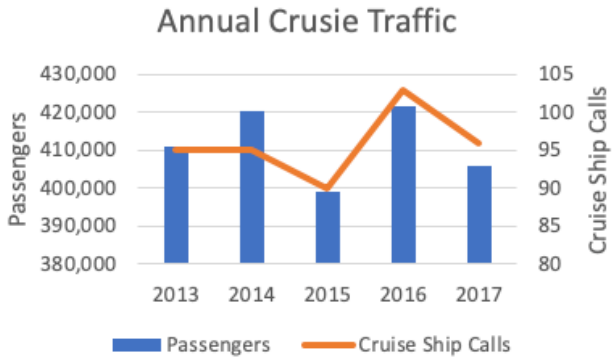


Chart 3 – Annual Cruise Traffic from Port of Baltimore

Cruise Terminal

Not only does the Port of Baltimore have one of the major cargo presences in the U.S., it also operates a cruise terminal with both Carnival Cruise Lines and Royal Caribbean. These offer year-round cruises. In fiscal year 2016, the cruise terminal had 440,000 passengers depart, ranking the cruise terminal second in the Mid-Atlantic and 11th in the U.S. for number of cruise passengers. Cruise terminal capacity will ultimately be constrained due to the inability to accommodate more than one vessel calling in the same day and to future air draft restrictions at the Francis Scott Key Bridge (I-695).

As both cargo and cruise ships increase in size, the air draft restrictions at the Chesapeake Bay and Francis Scott Key Bridges will become limiting factors to the

2020 Grade: B-

PORTS

ships the Port of Baltimore is able to accommodate. Both bridges are approximately 185 feet above the water; ships must have an air draft less than 185 feet to safely pass under the bridges to/from the Port of Baltimore. Container and cruise ships are trending towards larger ships with some of the largest ships having air draft approaching 230 feet.

Funding and Future Need

The Port of Baltimore's capital budget has more than doubled from $57 million to $153 million over the last ten years and the Port of Baltimore is making investments that will allow continual growth.

The MPA does not rely solely on appropriations to operate, but benefits from a revenue stream that offsets the annual expenditures. Annual Port of Baltimore revenue of nearly $55 million is generated through lease agreements and fees assessed on imported/exported cargo. The MPA further supports capital expenditures which not only benefit the public marine terminals, but also provide a benefit to the private marine terminals, such as channel dredging.

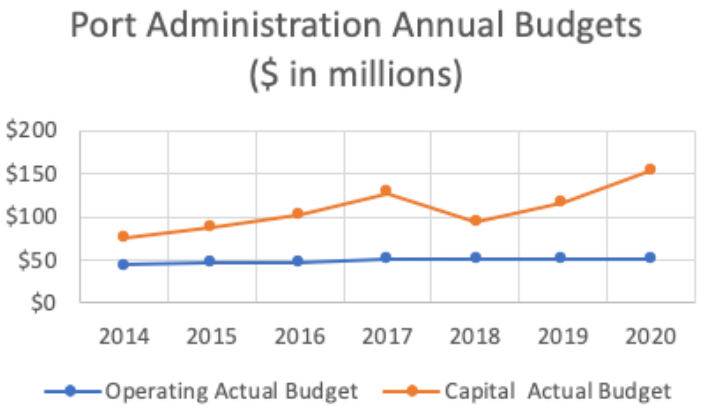


Chart 4 – Maryland Port Administration's Annual Budgets

Projects funded and provided by the U.S. Army Corps of Engineers (USACE) Civil Works Budget provide a significant benefit to Maryland ports. This includes funding from the USACE general fund, harbor maintenance trust fund, inland waterways trust fund, and special recreation user fees. Funding for projects benefiting Maryland ports has generally increased from $38.7 million to $65.6 million over the last ten years. This funding includes an average annual expenditure of $22 million for the Poplar Island project. The project provides a location for the dredged material which must be removed from navigable channels each year and rebuilds a historic island and habitat for wildlife. Additional significant projects include an average annual expenditure of $18 million for the operation and maintenance of the Chesapeake & Delaware Canal and $20 million for Baltimore Harbor dredging. Dredging for the Wicomico River on the eastern shore has increased from $1.5 million in 2011 to $4 million in 2020.

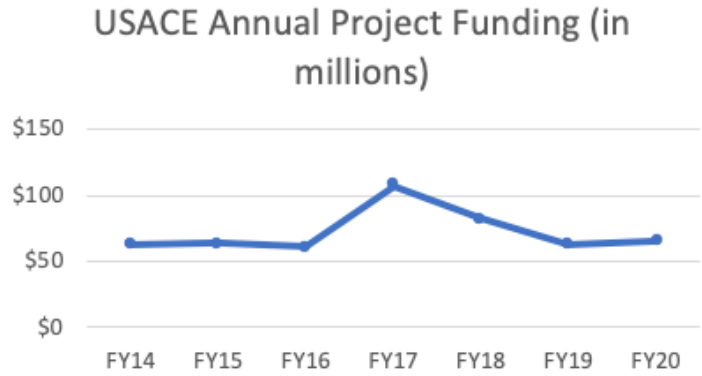


Chart 5 – ASACE Annual Project Funding

Figure 2 - Poplar Island

In 2017, the former Sparrow's Point steel mill, now called Tradepoint Atlantic, received a $20 million TIGER grant to transform the defunct site into a modern port facility, which will allow easier transfer of bulk cargo to truck and rail for shipping. The grant will also fund a berth which will permit larger ships to use the facility. This investment is expected to generate 17,000 jobs and $3 billion of economic impact when fully completed in 2025. Previously, the Port of Baltimore also benefited from a $10 million TIGER grant in 2015 for general port access improvements and a $10 million TIGER grant in 2013 to increase handling capacity for roll on/roll off cargo. In 2018, the MPA received a BUILD grant of $6.5 million to add a second berth capable of serving deep draft vessels with associated land side improvements.

2020 Grade: B-

PORTS

Public Safety, Resilience, and Innovation

The Port of Baltimore has received a rating of excellent for ten consecutive years from the U.S. Coast Guard who conducts an annual safety and security review of all U.S. ports. In 2018, the Port of Baltimore received a $1.2 million FEMA grant to further improve security and resilience and an additional $700,000 in FEMA funding in 2019. The funding will be used to improve cybersecurity and physical security features and update the MPA's security plan. Improvements such as these help prevent unauthorized physical and digital access to the terminals and important computer systems. It also reduces the likelihood that the Port will be affected by a targeted attack and will be able to recover quickly in the event of a disaster.

After considering the available information, ports infrastructure in Maryland is assigned a grade of B-

Recommendations to Raise the Grade

Maryland ports are experiencing consistent growth and making important investments in capital infrastructure projects to meet current and future infrastructure needs. However, the Port of Baltimore has space and infrastructure limitations at the port and access points beyond it which will impact its ability to meet increasing demand. To meet current and future demands, Maryland should:

- Look for land expansion opportunities or creative ways to improve internal port capacity without the need for physical expansion.
- Improve landside access to eliminate delays and barriers to both truck and rail access to improve capacity and minimize dwell time of cargo within the terminal.
- Continue efforts on Maryland's Eastern Shore to ensure moving bulk commodities through marine facilities continues to be an economically advantageous alternative to road and rail transport.
- Evaluate long term strategies to increase available air draft for ships transiting to the Port of Baltimore.
- Increase the utilization of the cruise terminal infrastructure within existing infrastructure constraints, such as attracting smaller boutique cruise ships.

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2020 Grade: B-

PORTS

RAIL

REPORT CARD FOR MARYLAND'S INFRASTRUCTURE 2020

2020 Grade: C+

Previous Grade (2011): NA

Executive Summary

One of the first railroads in the United States, the B&O Railroad was constructed in Maryland in 1827 to connect Baltimore seaports westward and towards the south. Today, the Maryland rail network consists of approximately 1,150 miles of track and carries over 80 million tons of freight worth $5.4 billion. Passenger rail in Maryland carries 9 million MARC passengers and over 2 million Amtrak passengers boarding or alighting at a Maryland station each year. Maryland rail infrastructure is primarily privately owned by freight operators who make significant investments in infrastructure upgrades, with $62.5 million invested by CSX and $4 million invested by Norfolk Southern in 2015 and 2016, respectively. However, according to the statewide rail plan, freight and passenger rail collectively face a funding need of more than $8.2 billion to fully modernize infrastructure and meet growing demand.

Introduction

Maryland rail has two categories – privately owned freight rail and passenger rail. There are overlaps with Maryland Area Regional Commuter Service (MARC) operating on some freight infrastructure and freight transporter Norfolk Southern operating on passenger infrastructure due to trackage rights. Four railroads (Amtrak, CSX, Norfolk Southern, and Maryland and Delaware Railroad) collectively own 76% of the tracks statewide. The remaining are short lines, rails within ports, and tracks reserved for future use. Collectively, more than 10 million passengers and 80 million tons of freight move over Maryland rail each year.

Capacity and Condition

Freight Rail

Freight rail infrastructure is divided into three classes based on operating revenue. Maryland has two Class I (CSX and Norfolk Southern), one Class II, and four Class III railroads. According to the Association of American Railroads' freight snapshot **for 2017, Maryland rail moved 80.3 million tons of freight to/from, through, and within the state. With freight volumes expected to double over the next 30 years, increases to rail infrastructure capacity are needed to meet the demand.**

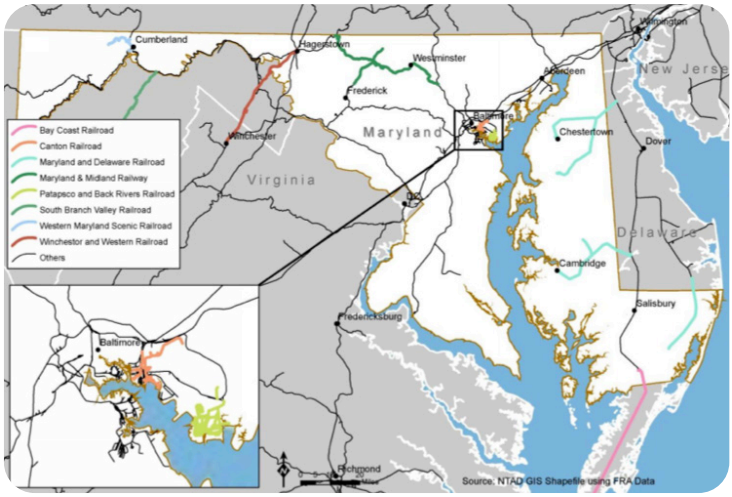

Figure 1 – Maryland Class III and Terminal Railroads (source: Maryland Statewide Rail Plan, 2015)

One of the most efficient ways to double capacity is to stack shipping containers two-high on rail cars. In order to accommodate double stack railcars, infrastructure improvements removing barriers to increased height and weight requirements are needed. The National Gateway and Crescent Corridor initiatives are making significant investments in Maryland to allow double stacked rail; however, the statewide and regional capacity is constrained by rail tunnels through Baltimore.

Much of the infrastructure in the city is over 100 years old and outdated for modern rail traffic. Steep grades and sharp curves through bottleneck areas contribute to the limitations on capacity due to the slower required speeds.

The Howard Street Tunnel is an example of how outdated infrastructure is limiting capacity. The 7,400-foot long tunnel was built in the 1890s and was once the longest in the B&O Railroad's network. Today, the tunnel does not have enough vertical clearance to accommodate double stacked containers, preventing containers from leaving the Port of Baltimore as rapidly as theoretically possible. Increasing the height of the tunnel has the potential to move an additional 178,000 containers each year which now leave the port via truck. A $466 million plan has been developed to increase the tunnel height. After months of uncertainty and negotiations, Maryland and CSX have identified a combination of state, private, and federal funding to close the funding gap. Funding includes a $125 million federal grant for the project.

Figure 2 – South approach to Howard Street Tunnel (courtesy of National Park Service)

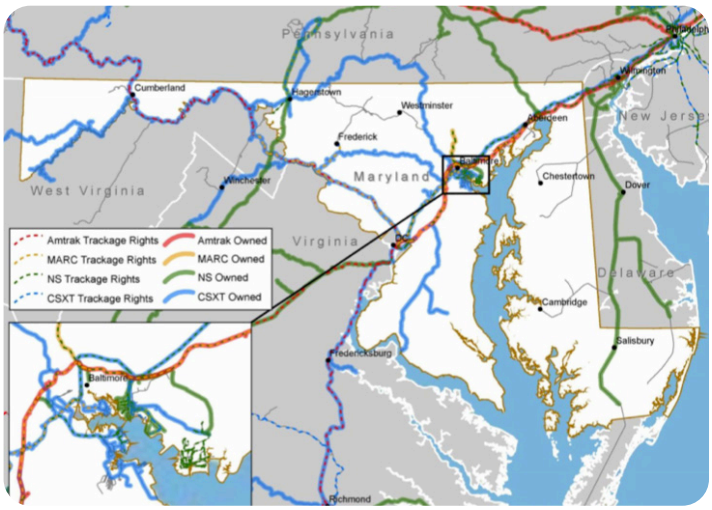

Figure 3 – Maryland Class I & Passenger Railroad (source: Maryland Statewide Rail Plan, 2015)

Passenger Rail

Maryland's intercity passenger rail is provided by Amtrak and MARC which both operate on heavy or commuter rail (as opposed to light rail). During fiscal year 2018 (FY18), Amtrak served 2 million Maryland passengers, nearly a 4% increase from FY16. In FY18, MARC served 9.4 million Maryland passengers.

In Maryland, Amtrak operates 90 trains daily across six stations; two are in the top 13 of Amtrak's busiest stations nationwide and ridership is growing at all Maryland stations. Heavy usage creates capacity and reliability challenges for the aging infrastructure along Amtrak's Northeast Corridor (NEC). To remedy this, Amtrak is partnering with a master developer to make rail infrastructure improvements at Baltimore's Penn Station, engage in station rehabilitation, and foster partner projects in the vicinity of the station to better serve over a million annual passengers.

Figure 4 – B&P Tunnel (courtesy of MDOT)

Amtrak and other passenger rail partners are making investments to improve the aging infrastructure, but costly upgrades are needed to meet current and future demand. For example, the Baltimore & Potomac Tunnel, which runs under Baltimore, is a bottleneck in the NEC. The 7,700-foot, 1870s era tunnel no longer meets the needs of today's rail network. While the tunnel is primarily used for passenger rail, it is also used by four freight carriers. Track geometry, including a steep grade and a sharp curve, prevent freight trains from traveling above 30 mph. The tunnel's dimensions prevent the movement of large loads including double stacked containers. The bottleneck created by this tunnel limits freight access to the Port of Baltimore. The planned project to provide significant rehabilitation of the tunnel, bringing it to modern standards, is finalizing funding for design and construction.

2020 Grade: C+

RAIL

Delmarva Peninsula

Freight rail access on Maryland's Eastern Shore is critical for industries who access the greater freight network through state and privately-owned short lines and Norfolk Southern rail. A cost/benefit analysis of preserving the Eastern Shore rail network found that benefits exceed costs at a ratio of 3 to 1 based on shipper savings and avoided road maintenance. Maryland Department of Transportation (MDOT) is investing in the state-owned short lines and working to improve rail access through capital improvements. Preservation of these rail lines will help ensure industry on the Eastern Shore continues to have cost effective options for import/export.

Funding and Future Need

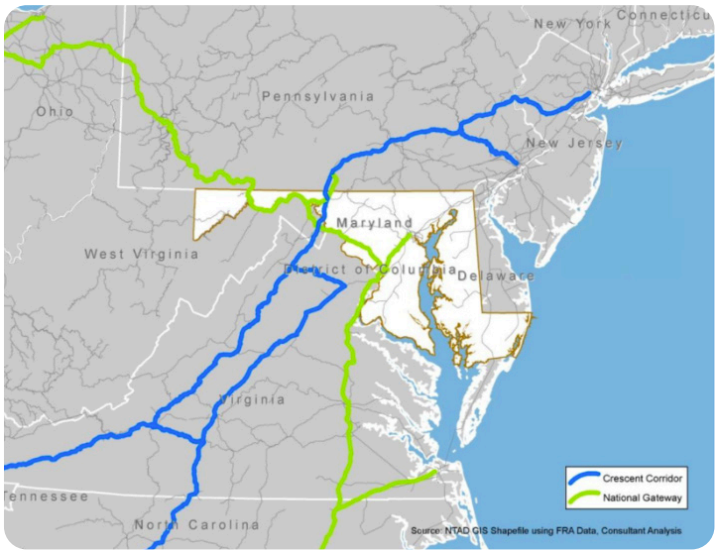

Figure 5 – Maryland freight corridors (source: Maryland Statewide Rail Plan, 2015)

Freight Rail

CSX and Norfolk Southern are making major infrastructure investments in Maryland. CSX's National Gateway project aims to better connect Mid-Atlantic ports with the Midwest and will open double stacked clearance between Chambersburg (on the Maryland-Pennsylvania state line) and ports in Virginia. Norfolk Southern's Crescent Corridor aims to connect New York and New Jersey with the southeast U.S. and will include a major terminal near Hagerstown, Maryland.

CSX operates 1,400 miles of track within the state and, in 2015, invested $62.5 million in infrastructure improvements. Norfolk Southern operates 269 miles of track within the state and, in 2015, invested $4 million in infrastructure improvements. Expansion of CSX's Howard Street Tunnel is expected to cost $466 million.

MDOT's 2015 State Rail Plan's prioritized project list identifies $3.1 billion of high priority projects which benefit Maryland freight rail through 2040. Freight rail funding is primarily provided by the private entities which own the infrastructure; however, state and federal funding and financing are occasionally available.

The National Gateway Coalition, a public private partnership (P3), obtained $98 million in TIGER grant funding to improve double stack container access on three major CSX routes from east coast ports to the Midwest. This is a $842 million project that includes ten projects in Maryland and numerous projects in nearby states. The Crescent Corridor Project is a similar $2.5 billion P3 project underway by Norfolk Southern. It received $105 million in TIGER grant funding to straighten curves, add tracks, and extend intermodal terminals. Although none of the major Crescent Corridor projects are located in Maryland a new intermodal facility is located near Hagerstown.

Passenger Rail

One-fifth of Amtrak's passenger trips and one-third of its revenue depend on travel through Baltimore, making Maryland a significant component of the NEC. Baltimore's Penn Station is the 8th busiest station in the Amtrak system and its station at BWI airport is the 13th busiest. **Amtrak is predicting a 21% increase in passenger trips by 2050 in Maryland.**

2020 Grade: C+

RAIL

Figure 6 – Maryland passenger rail boardings and alightings in 2011

MDOT's 2015 State Rail Plan's prioritized project list identifies $5.1 billion of high priority projects which benefit Maryland passenger rail through 2040. MARC and Amtrak funding is generally derived from public funds which is often less than the funds needed for improvements. This creates unpredictability in long term funding, complicating long term planning and large, capital-intensive projects.

MDOT received $91.4 million through the federally funded High-Speed Intercity Passenger Rail Program (HSIPR) to complete preliminary engineering and a National Environmental Policy Act (NEPA) review for the B&P Tunnel replacement, Susquehanna River Railroad Bridge replacement, and BWI Rail Station improvements. These projects alone are expected to cost over $3.2 billion. Additionally, the state received $9.4 million in federal funding towards installation of modern safety features, such as positive train control (discussed in Public Safety, Resilience & Innovation section), which will improve safety for millions of Maryland rail commuters.

Public Safety, Resilience, and Innovation

In the last two decades there have been several significant rail incidents in Maryland including the 2016 derailment of a CSX train at the Howard Street Tunnel, a 2014 adjacent retaining wall collapse, and the Howard Street Tunnel Fire in 2001. Over the last several years, rail accidents in Maryland have cost more than $9.9 million, excluding accidents due to human error and miscellaneous causes.

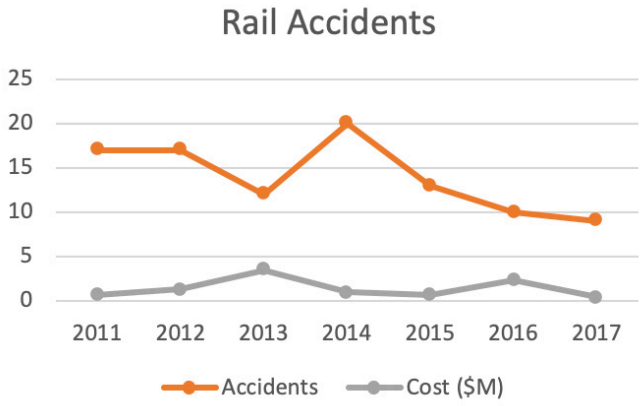

Chart 1 – Maryland rail accidents

Information regarding specific security efforts for safeguarding railroads is highly sensitive and not publicly available. However, the Department of Homeland Security emphasizes three areas aimed at preventing major incidents. These include the following:

- Standardizing security planning
- Improving worker security awareness since railroad employees are a first line of defense in preventing security related incidents
- Limiting dwell time of unattended, loaded toxic material rail cars in urban areas

Another recently implemented safety improvement is Positive Train Control (PTC) which is a signaling system designed to determine a train's location, direction and speed and use that data to prevent collisions, derailments, unauthorized movements and ensure safe operating speeds of passenger and freight rail. The federal government mandated installation of PTC by 2016 for all trains carrying passengers or poisonous or toxic by inhalation materials. However, technology challenges pushed the federal deadline to the end of 2018 with the expectation that

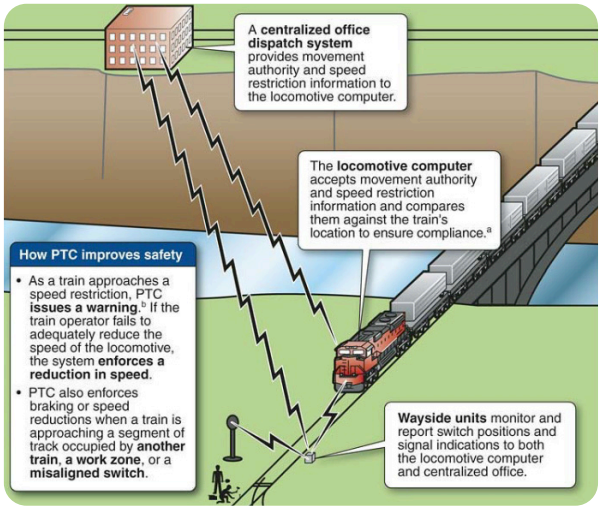

Figure 7 – Positive Train Control system

2020 Grade: C+

RAIL

all assets will be in fully-functioning order by the end of 2020. The MARC Penn line has lagged the other two lines (CSX and Norfolk Southern) due to falling under Amtrak's Approved Alternative Schedule as the host railroad.

MDOT listed "enhance the safety of transportation system users and provide a transportation system that is resilient to natural or manmade hazards" as a goal in its latest (2015) report.

After considering the available information, rail infrastructure in Maryland is assigned a grade of C+

Recommendations to Raise the Grade

Maryland is implementing measures to enhance the safety, capacity and resiliency of the freight and passenger rail systems; however, current and future capacity needs will require significant investment to ensure the infrastructure meets economic needs safely, securely, and efficiently. To meet these demands, Maryland should:

- Establish a state rail funding program that suits the needs of Maryland's rail stakeholders and identify funding to reduce the funding gap needed to improve rail infrastructure. Consider federal funding, increased state funding, and private partnerships/investments.
- Evaluate alternative methods to deliver projects that reduce cost and shorten implementation time.
- Replace infrastructure that is beyond its useful life to ensure long term resiliency and identify specific challenges and solutions towards building long term resiliency against manmade and natural disasters.
- Remove barriers to double stacked rail and high-speed rail access.

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2020 Grade: C+

RAIL

ROADS

REPORT CARD FOR MARYLAND'S INFRASTRUCTURE 2020

Executive Summary

The condition of Maryland's roadways has modestly improved since 2011; approximately 80% of pavement condition for county and city roads is assessed as Fair to Very Good. However, roadway capacity continues to lag in meeting travel demand during peak hours with heavy to severe congestion occurring on 254 miles (15%) of the freeway/expressway network. Maryland Department of Transportation projects and programs have been developed to provide benefits for motorists and multi-modal users to yield a safe and modern transportation system. As of 2019, their efforts in combination with other initiatives resulted in more than $1.6 billion of annual user savings due to lowered delays, fuel consumption, and emissions. Advancements in technology, better asset management, and efforts to preserve roadways have improved the state's infrastructure and provided a way to spend roadway funding more wisely. However, as Maryland's vehicle miles travelled continues to increase, every effort should be made to leverage revenue sources to fill the funding gap necessary to maintain a state of good repair and provide roadway enhancements.

Introduction

Maryland's roadway network is essential to the state's economy and influences the areas people want to work, live, and raise families. Reducing congestion and enhancing mobility provides roadway users with a safe, efficient, and high-quality travel experience.

Maryland roadways include state, county, municipal, and federal ownership with a total of 31,151 miles (68,649 lane-miles) as of December 2017. The Maryland Department of Transportation (MDOT) maintains 5,274 of these miles comprising all the state routes.

In 2017, cost of congestion to travelers on the Maryland freeway/expressway system amounted to more than $2.8 billion dollars annually. This is an increase of approximately 36% over 2016 levels according to MDOT State Highway Association's (SHA) 2018 Maryland State Highway Mobility Report. To abate this, MDOT is monitoring existing travel trends and establishing long-term strategies, policies, and programs to address congestion and safety. Transportation Performance Measurement (TMP) goals for infrastructure safety, condition, and reliability are now required by each state under guidelines established through the Federal Surface Transportation Reauthorization (FAST) Act.

Capacity

Insufficient roadway capacity contributes to congestion resulting in increases in travel time, loss of economic competitiveness, and impacts on the environment such as air quality. Congestion in the Baltimore and Washington, D.C. metropolitan regions is already among the most congested areas in the country and continues to increase. These increases are attributed to the strong job and population growth of the region. Traffic volumes on Maryland roadways have increased steadily since 2012, which follows the nationwide pattern.

Analysis of vehicle speed data in 2017 identified that heavy to severe congested conditions occurred on 254 miles (15%) of the freeway/expressway network in the evening peak hour. This percentage remained unchanged from the previous year.

For the third straight year, Maryland experienced a record number of vehicle miles traveled (VMT) on its roadway systems.

VMT was nearly 60 billion miles in 2017, a 1.6% increase over 2016. Travel along and through urban area roadways was the major reason for the increase in VMT. For the decade prior to 2016, statewide VMT growth was relatively flat.

Traffic signal systems are often in need of timing upgrades due to changes in traffic volumes. In 2017, signal retiming and optimization modifications provided an estimated reduction of one million hours of delay and saved 370,000 gallons of fuel. Retimed signals reduced delay by 9% compared to 2016 levels and resulted in $35 million annual user savings.

Condition

The health of the MDOT SHA network is monitored using pavement performance parameters including ride quality, friction, rutting, and cracking. SHA roadways are assessed annually with the use of an Automatic Roadway Analyzer (ARAN).

A large majority of roadways in the state network continue to push towards an age that will require major rehabilitation investments. However, the ride quality on MDOT roadways has been improving since 2011 due to a continued focus on funding preservation projects throughout the system.

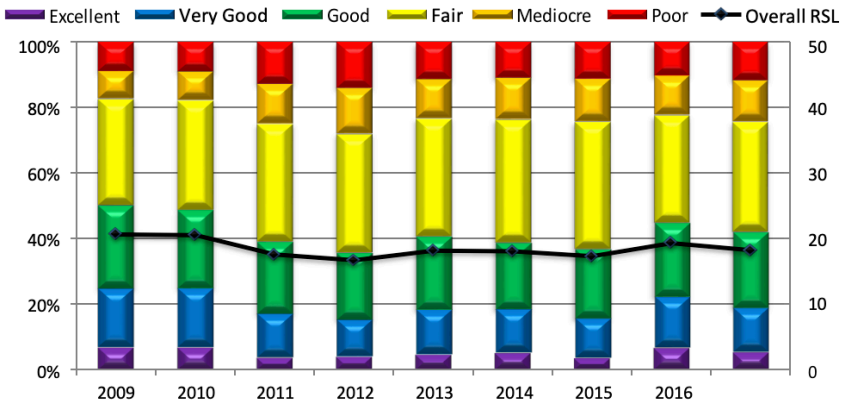

Figure 1 – Percent of lane miles by RSL (2009-2017) per MDOT SHA 2017 Pavement System Preservation Report

The Remaining Service Life (RSL) is an indicator MDOT SHA uses to assess the overall pavement network condition. In 2017, the MDOT SHA pavement network had an average of 18 years of RSL, which is consistent with several of the previous years. Figure 1 shows both the average overall RSL per year, and how that value correlates with the MDOT SHA roadway condition classification.

The metric for pavement quality used by Baltimore City and Maryland counties is the pavement condition index (PCI). PCI is a numerical index between 0 and 100, developed by the United States Army Corps of Engineers. In 2017, approximately 80% of the participating county and city roadways reported an average PCI of 70 or better, which equates to a condition rating from Fair to Very Good.

Operation and Maintenance

To ensure the state's road networks are operating efficiently, MDOT implements Incident Management and Intelligent Transportation Systems (ITS) programs, traffic signal system optimization, and multimodal strategies like HOV lanes and park-and-ride facilities. MDOT also utilizes operational strategies, including Transportation Systems Management and Operations (TSM&O) Strategic Plan, and provides Traffic Incident Management training to partner organizations. The agency also explores local, regional and state incident management coordination opportunities.

TRIP, a private, national transportation research nonprofit that researches, evaluates, and distributes economic and technical data on surface transportation, stated in a May 2019 report that **driving on roads in need of repair costs Maryland motorists $1.5 billion a year in extra vehicle repairs and operating costs, an annual average of $357 per motorist.**

2020 Grade: C

ROADS

Public Safety

Maryland leaders continue to build partnerships with government agencies, private citizens, safety advocates, and nontraditional partners to emphasize public awareness on traffic safety. The MDOT Highway Safety Office (MHSO) and SHA adopted the national Toward Zero Deaths (TZD) initiative in 2010, which places emphasis on lowering motorized and non-motorized fatalities and serious injuries.

Following annual increases in statewide traffic-related fatalities from 2015 through 2017, the number dropped sharply (12%) in 2018. This was similar to the annual trend for serious injury crashes. Table 1 compares safety performance criteria values between current data and projected goals. In support of the TZD initiative, MDOT published the 2016-2020 Strategic Highway Safety Plan (SHSP), which established safety targets using extrapolated trends from an analysis of the reported safety data.

Table 1 - Road-Related Incidents by Year

Safety Performance Criteria	2015 (Actual)	2016 (Actual)	2017 (Actual)	2018 (Actual)	2020 (Target)	2030 (Target)
Total Fatalities (traffic-related)	521	522	558	492	391	296
MD Fatality Rate *	0.91	0.89	0.93	N/A	0.64	0.53
National Fatality Rate *	1.12	1.18	1.16	N/A	N/A	N/A
Total Non-Motorized Fatalities	110	127	128	135	83	61
Total Non-Motorized Serious Injuries	378	489	587	464	345	265

* Rates are per 100 million vehicle miles traveled (VMT)

Maryland's fatality rate continues to be lower than the national rate.
However, a sobering trend statewide is the steady increase each year in pedestrian and bicyclist fatalities, which may be partially attributed to distracted driving. In late 2019, Governor Hogan made $3.8 million available for a "safe, inter-connected bicycle network for generations to come."

Funding

Maryland's transportation system receives funding from several different streams including dedicated taxes and fees, operating revenues, bond sales, and federal aid. MDOT customers pay user fees such as motor fuel taxes, vehicle titling taxes, registration fees, operating revenues, and corporate income taxes for transportation infrastructure. The Maryland Transportation Authority (MDTA) used tolls and bond sales to fund its $3.26 billion program. In 2013, the state raised the motor fuel tax rate from 23.5 cents to 30.3 cents per gallon. This income stream along with the state's vehicle titling tax are the two largest sources of revenue for the Transportation Trust Fund, which is now protected through a lockbox statute. Maryland also receives federal aid for its roadway program from the FAST Act.

The MDOT SHA program is fiscally constrained since the list of potentially funded projects is tied to estimates of future revenue; this complicates project planning. Funds are dispersed among not only Maryland's counties and Baltimore City for local transportation needs but also to the

General Fund. For MDOT SHA's six-year Consolidated Transportation Program (CTP), $1.3 billion is funded for major projects and $6.5 billion is for safety, system preservation, and community enhancements.

Future Needs

MDOT works together with residents, businesses, local jurisdictions, and local and state elected officials to prioritize projects for inclusion in the CTP. MDOT also establishes a 20-year vision for transportation through the Maryland Transportation Plan (MTP). This plan, updated every five years, outlines the state's overarching transportation priorities. Currently, these are to address roadway congestion through system preservation and capacity improvements, person throughput within the existing network, and the aging infrastructure.

Resilience

MDOT has several systems in place to prevent or protect against threats and incidents to the roadway network. For example, when roadways are washed out or destroyed and rockslides occur due to severe flooding, MDOT has emergency procurement funding with which to respond. Such funding enables work to start immediately without being hindered by the normal procurement process. It allows the districts to work in a much shorter timeframe to reduce delays for the traveling public.

- Impacts to facilities may occur during extreme events that could potentially displace personnel. SHA has a Continuity of Operation Plan (COOP) that assigns staff to locations at their home facility. It is designed to keep business operating as usual, even though an emergency has occurred.
- A Hazard Vulnerability Index shows where roads are most vulnerable to flooding in coastal areas. Baltimore City and 14 other counties were included in the index. Local roads were assessed by the depth of water accumulated.
- MDOT has tracked impacts due to extreme weather events since Fall 2018 in response to FAST Act reporting requirements.

Innovation

MDOT SHA is pursuing innovations in operations and maintenance, construction, and financing. Some initiatives, techniques and delivery methods include:

Transportation Systems Management and Operations (TSMO) – MDOT SHA published a TSMO Strategic Plan in 2018 in an effort to maximize the efficiency of the existing system and improve travel time reliability. TSMO outlines MDOT's investment with advanced modeling and analytical tools that use big data to inform transportation decision making. Projects are being implemented that advance mobility performance management, employ state-of-the-art modeling tools, and reflect innovations for transportation planning and operations. MDOT SHA has also completed a Connected & Automated Vehicle (CAV) Strategic Plan which established a vision to deliver collaborative and leading-edge CAV solutions. The integration of CAV technology can kickstart stronger planning, design, operation and maintenance of surface roadways, prevent traffic-related fatalities and serious injuries, and move people and goods efficiently. Accordingly, a CAV Working Group has been formed to oversee research and testing of various vehicle and systems deployment.

High Friction Surface Treatment (HFST) –The treatment increases roadway friction, which provides vehicle traction on pavement surfaces, especially important on wet pavement. HFST has been implemented on several high incident interchange ramps throughout Maryland to reduce the number of crashes. According to FHWA, Pennsylvania, Kentucky and South Carolina transportation departments have used HFST applications, reducing crashes by 100 percent, 90 percent and 57 percent respectively during trial projects. The technology is part of the Federal Highway Administration's (FHWA) 'Every Day Counts' initiative to speed up the delivery of highway projects and to address the challenges presented by limited budgets.

2020 Grade: C

ROADS

After considering the available information, roads infrastructure in Maryland is assigned a grade of C

Recommendations to Raise the Grade

With the implementation of various policies and programs, the condition of Maryland's roadways has improved for motorists and multi-modal users, but roadway capacity continues to lag in meeting travel demand. Advancements in technology, better asset management, and efforts to preserve roadways have improved the state's infrastructure and demonstrated wise stewardship of roadway funding. To continue this progress, Maryland should:

- Consider state policy changes which find innovative ways to increase Transportation Trust Fund revenues.
- Continue partnering with private entities to help fund and implement the state's major congestion relief projects through the use of price-managed lanes.
- Continue developing and implementing the Maryland Strategic Highway Safety Plan, focusing on user safety (i.e. Towards Zero Deaths initiative) by emphasizing efforts that increase pedestrian and bicycle safety and capacity to meet the growing demand of these alternative modes of transportation.
- Incorporate resilience into infrastructure planning and improvements such that increased frequency and severity of extreme weather events are considered.
- Continue to invest in research on cutting edge technology such as CAV solutions that are outlined in the MDOT SHA TSMO Strategic Plan.

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2020 Grade: C

ROADS

SOLID WASTE

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: B-

Previous Grade (2011): NA

Executive Summary

Maryland generates 4.6% of the total density of solid waste generated in the U.S., despite containing less than 2% of the population. While this has the potential to be concerning, Maryland's residents recycle at higher rates than the national average, 2.68 pounds per person per day, compared with the nation-wide value of 1.51 pounds per person per day. Currently, local funding is adequate to support solid waste programs and facilities while maintaining stable rates. However, solid waste management systems throughout the state may struggle in the future to meet changing community needs, regulatory requirements, and mandates. For example, the impact from climate change to the eastern part of the state are not fully known and could stand to jeopardize capacity. Availability of that capacity is a concern beyond 2050. With the state population increasing roughly 1% a year and constrained resources for funding waste disposal, improvements will be necessary for adequate state management of solid waste.

Introduction

Solid Waste was assessed based on analysis of the Solid Waste Management Plan developed by Maryland in 2017, as well as Solid Waste Management Plans from constituent counties and county-equivalents, 24 in all.

The Maryland Recycling Act (MRA) requires all Maryland counties and Baltimore City to recycle 20-35% (depending on population) of waste generated. Maryland has established a voluntary waste diversion goal of 60% and a voluntary recycling rate of 55% that was to be accomplished by 2020.In 2019, this goal was extended to 2035.

As of 2017, Maryland had achieved a 48.4% rate of recycling.

Although Maryland tracks multiple waste streams that are either recycled or destined for disposal (construction and demolition debris, land clearing debris, industrial waste, and others), management focus has been on the municipal solid waste (MSW) portion of disposed solid waste. The state estimated that there was a total of 6.5 million tons of MSW generated in Maryland in 2014 (the most recent date for which data is available), of which 2.7 million tons were recycled and the remaining 60% was destined for disposal. Despite the state's efforts to reduce and divert solid waste, 2.3 million tons were exported to out-of-state facilities and 1.4 million tons were incinerated.

Almost 80% of MSW destined for disposal originates in the state's mostly suburban counties. Rural areas, on the other hand, generate predominately residential wastes, while the urban regions tend to generate institutional/commercial/industrial (ICI) waste. In 2016, the most prevalent materials in the Maryland MSW stream were food waste at 18%. Different types of recyclable fiber also made the top 10 list; recyclable paper and cardboard each amassed approximately 8% of the waste stream. Maryland's emphasis moving forward will be on waste reduction, diversion, and identification of new opportunities for recycling.

Capacity

Maryland is a densely populated state facing a solid waste disposal challenge. **While less than 2% of the U.S. population resides in Maryland, residents and industry in the state generated 4.6% of the 258 million tons of solid waste in the United States.** This is almost twice the density of waste generated per square mile of the mostly densely populated state, New Jersey.

As of 2016, there were 81 permitted facilities operating in Maryland. One-half of them were privately owned. According to the Maryland Department of the Environment (MDE), the municipal solid waste landfills have a total capacity of 52.1 million tons; the remaining capacity of the landfills will last 31 years with the current disposal rate of 1.7 million tons per year. This estimate does not account for the estimated capacity of other types of facilities, including construction and demolition landfills (24 years), industrial landfills (65 years), and land-clearing debris landfills (102 years).

Although Maryland facilities manage some solid waste imported from other jurisdictions, the state is a net exporter of solid waste and sends a significant amount for recycling and disposal to other states. In 2014, a total of 2.3 million tons of solid waste, or 19% of the total generated in the state, was exported.

According to MDE, 41 of the 81 permitted solid waste acceptance facilities in the state exported solid waste to destinations in 16 states in 2014. Approximately 77% went to Virginia over a single rail route. The bulk nature of this material lends itself to shipment by railroad. Rail transport will play a key role should more out of-state disposal sites become necessary in the future. Furthermore, the Maryland Department of Transportation (MDOT) State Highway Administration (SHA) forecastes that waste-related traffic will grow 19% by 2040. This practice is already a necessity for several major urban areas on the eastern seaboard.

The reliance of the state's waste export operations (Waste Export by Rail (WEBR)) on a single line south into Virginia is cause for concern. As more mid-state and eastern shore counties commence WEBR operations to address capacity issues, more of the state's rail infrastructure will be used, raising concerns over its adequacy. MDOT SHA notes in its management plan that there are concerns over rail infrastructure investment. Yet, one mid-state county with large demand on the rail network, Montgomery (roughly 10% of the state's total), makes no mentions of rail network issues in its county level management plan. Several other counties such as Frederick and Baltimore mention waste export as safety measures in their capacity analysis, but their county-level plans do not mention infrastruture issues to improve capacity. There is also concern over the lack of coordination between MDE and MDOT SHA which is responsibile for rail infrastructure. Other states (e.g. Delaware, New York, and Washington) discuss solid waste exporting in their Freight Management Plans for both rail and road traffic.

Lastly, in-state solid waste management transfer facilities have the capacity to meet current demand. However, the lack of available municipal solid waste landfill capacity in the region beyond 2050 raises concerns. Some county facilities in the mid-state area are operating under the assumption that currently unplanned transer facilties relying on either rail or road infrastructure will eventually come online. Given the leadtimes to develop this infrastructure, reliance on these unplanned future measures raises concerns about the viability of future capacity estimates.

Condition, Operation and Maintenance

In Maryland, each facility subject to a refuse disposal permit must comply with specified location, design, construction, operation, and monitoring requirements. Among other things, any installation, alteration, or extension of a refuse disposal system must conform with the applicable county solid waste disposal plan. Each permitted facility also must file an annual report.

2020 Grade: B-

SOLID WASTE

In Maryland, each public and private reuse/transfer facility has individual requirements outlined in its operating permit which is overseen by the state, county, or regional solid waste authority. These permitted solid waste facilities in Maryland have physical infrastructures with service lives over 100 years in some cases and are expected to remain functional, durable, and safe during that time.

On Maryland's Eastern Shore, there are several facilities exposed to the effects of extreme climate and weather events such as sea-level rise and storms. Engineering practices and standards associated with these facilities are reviewed periodically and revised as appropriate to ensure they continue to provide acceptably low risks of failures in functionality, durability, and safety over their service lives. Unlike MDOT in its management planning , MDE does not utilize sea-level change and extreme weather event data to look at climate impacts on solid waste infrastructure, nor does it require its permitted facility operators to do so.

Funding and Future Need

Local governments use a dedicated enterprise fund, general tax revenue, or a combination of both to fund their solid waste management programs. The monies come from a variety of sources, including system benefits charges, tipping fees, impact fees, interest or investment income, bond revenues, and recycled commodity revenues. Local funding is adequate to support current solid waste programs and facilities while maintaining stable user rates. According to a 2017 survey conducted by the Maryland Association of Counties' Department of Legislative Services, Budget and Tax, the average rates for residential and commercial tipping fees are approximately $56/ton and $69/ton, respectively. These values are greater than the national average of $53.11 (2014 rates adjusted for inflation).

Solid waste management systems throughout the state may struggle in the future to meet changing community needs, regulatory requirements, and operational mandates. In the eastern part of the state, the environmental effects due to impacts of climate change are not fully known due in part to the lack of climate and sea-level change data. Additionally, as capacity in the nearby in-state landfills is used, transportation to landfills farther away will be an increasing problem and expense for certain counties. Currently, the state exports approximately 20% of its waste south into Virginia using only one rail route, posing a risk for future operational efficiencies for the state's waste program.

Maryland's solid waste infrastructure would benefit from the development of improved markets for recyclable materials, permitting of additional municipal solid waste (MSW) landfills, an increase in state-wide funding to support mandated solid waste programs, and evaluation of future rail capacity to transport solid waste via a second cross-state rail line.

Public Safety

Maryland's solid waste program assures that the state's disposal facilities are permitted to ensure "the proper disposal of solid waste in an environmentally acceptable manner while protecting the public health and the environment, including surface and groundwater." However, there are increasing concerns over a lack of state policy items covering issues such as the proliferation of electronic waste in the solid waste stream and solid waste facilities' adaptation to climate change.

Resilience

While MDOT uses data to forecast climate impacts on its infrastructure portfolio, MDE has not performed a sea-level rise risk assessment on the state's solid waste infrastructure future flooding hazards through 2050.

2020 Grade: B-

SOLID WASTE

Another threat to the resilience of the Maryland's solid waste programs is the single rail line used for exporting solid waste out of state. Should there be any negative impact to the rail line, limited redundancy to maintain normal waste disposal operations is provided by road infrastructure. Further adding to this challenge is a lack of integration between state agencies' management plans.

After considering the available information, solid waste infrastructure in Maryland is assigned a grade of B-

Recommendations to Raise the Grade

Presently, local capacity and funding are adequate to accommodate the state's solid waste needs and support ongoing programs and facilities while maintaining stable rates. However, solid waste management systems throughout the state may struggle in the future to meet changing community needs, regulatory requirements, and mandates. To meet state-wide solid waste needs and accommodate improvements, Maryland should:

- Explore new approaches for planning and funding sustainable waste programs.
- Increase Maryland Recycling Act Mandatory Recycling Rates.
- Expand recycling infrastructure.
- Increase diversion of organics such as food waste out of the waste stream.
- Develop state government policies that anticipate the impacts of solid waste on rail and road infrastructure, particularly to those areas with limited access. Incorporate solid waste exports into the Environmental Stewardship objective for the state's freight rail management plan and require coordination with permitted waste facility management plans.
- Identify critical solid waste infrastructure that is most threatened by sea-level rise and extreme weather and revise engineering design standards, codes, regulations, and associated laws that govern such solid waste infrastructure.
- Develop state government policies that anticipate the impacts of climate change on the built environment. Specifically, MDE should be encouraged to conduct risk assessments to determine the vulnerability of solid waste flows for a 25-year storm event in coastal areas.
- Promote initiatives that expand producer responsibility principles, including programs and initiatives to manage carpet, fluorescent lights, computers and televisions, paint, and mattresses

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2020 Grade: B-

SOLID WASTE

STORMWATER

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

Executive Summary

The Maryland Department of the Environment (MDE) administers stormwater permits in the state. The agency's stormwater management efforts are regarded as some of the most innovative nationwide. Since 2000, when MDE began upgrading its then-outdated stormwater management plan, its forward-thinking vision has been reflected in both Maryland stormwater policies and databases. However, the state faces significant challenges. The Chesapeake Bay water quality has been steadily declining over the last few decades. In 2010, new limits on the amount of pollutants that can enter the body of water were set, but statewide stormwater costs to comply with these regulations are projected to be more than $3 billion. The cost of building supporting infrastructure mostly falls to local municipalities and the state, taxing their already limited resources.

Introduction

Stormwater is precipitation (e.g. rainwater and melted snow) from natural storm events. Prior to the Clean Water Act's introduction in 1972, most states did not require stormwater treatment. All precipitation from natural storm events would flow from impervious surfaces into drains and eventually to important water bodies such as the Chesapeake Bay without treatment, picking up various amounts of pollutants along the way. Since the federal Clean Water Act, stormwater management has been required to prevent further deterioration of water bodies across the country. Local jurisdictions have set various regulations over the years to meet the minimum standards of the Clean Water Act but have also gone above and beyond to improve water bodies in individual counties. Starting in the 1980s, stormwater treatment was mandated for water quantity. From the 1990s onward, stormwater treatment has been mandated for both water quality and water quantity. Since 2010, treatment is expected to mimic pre-hydrologic conditions.

To restore clean water to the Chesapeake Bay and its streams and rivers, the Environmental Protection Agency (EPA) established the Chesapeake Bay Total Maximum Daily Load (TMDL) on December 29, 2010 and began requiring six states, including Maryland, to meet specific TMDLs. The Maryland Department of the Environment (MDE) is responsible for all programmatic and technical oversight of the stormwater management program. County jurisdictions are required to monitor and administer their own stormwater programs in accordance to state laws and regulations or defer to their counties program by mutual agreement.

Stormwater treatment facilities vary. There are several acceptable best management practices including but not limited to micro-bioretention facilities, planter box micro-bioretention facilities, underground structural practices such as sand filters, dry wells, and more.

Capacity

Federal storm water regulations establish minimum treatment requirements nationwide. The National Pollutant Discharge Elimination System (NPDES) Storm Water Program is administered by the EPA in states without approved programs and sets procedures that must be followed for stormwater. Most states, however, administer the program throughout most of their jurisdictions. NPDES Phase I regulates stormwater discharges from medium and large municipal separate storm sewer system (MS4) programs, while Phase II applies to smaller MS4 programs. As of 2015, EPA's most recent update, Maryland has ten Phase I permits, 55 Phase II MS4 permits, and 18 Federally-owned facilities.

Readily available to the public is StormwaterPrint – an interactive map published by MDE. This online catalog has a database of a comprehensive list of parameters related to Maryland's Phase I stormwater facilities. Specifically, the database contains informative parameters such as drainage area, impervious area, and rainfall treated. Currently, the standards to meet are for 1" to 2.7" of rainfall to be treated, as 2.7" of rainfall treated simulates runoff conditions similar to woods in good condition.

In addition to MDE, the Maryland Department of Transportation (MDOT) handles MS4 permitting to regulate stormwater drains connected to the state road network through their Drainage and Stormwater Asset Management Program. In 2015, MDOT State Highway Administration (SHA) received an NPDES MS4 permit (No. 11-DP-3313) from the Maryland Department of the Environment (MDE) to control storm-drain-system pollutant discharges in MS4-designated areas. As of June 30, 2018, MDOT SHA manages nearly 8,500 permanent stormwater management facilities and Environmental Site Design (ESD) practices, nearly 168,500 hydraulic structures, and over 141,000 conveyance features (over 9 million linear feet) statewide. According to MDOT's Annual Report (dated October 9, 2018), 68.7% of inspected stormwater assets are functional in an inventory of 2,604.

"68.7% of inspected stormwater assets are functional"

Condition

The Chesapeake Bay is a major waterbody to which several major Maryland watersheds drain. Its water quality has been steadily declining for the last few decades while water pollution treatment has been insufficiently funded. According to the EPA-approved Maryland Final 2018 Integrated Report of Surface Water Quality, 2,400 square miles of streams in the state are classified as impaired due to nutrient pollution such as nitrogen and phosphorous. An additional 1,200 square miles are contaminated by biological pollutants. The report also mentioned that increased salt concentrations within the freshwater bodies have been a growing trend attributed to road salt. Since the salinization is linked to aquatic degradation, MDE has been working with counties to incorporate road salt into MS4 permits.

While there's not a readily, publicly available data source which lists the age of current Maryland stormwater infrastructure, StormwaterPrint has dates of inspection and inspection results for different stormwater projects and a local stormwater watershed assessment, for which the quality of all urban watersheds is studied thoroughly in terms of water quality, goals, and action plans needing development. According to StormwaterPrint, 5.8% of BMPs failed their most recent inspection, most of which occurred between 2014 and 2017.

Operation and Maintenance

Assessing the operation and maintenance of stormwater facilities in Maryland proves to be a difficult task since the responsibilities belong to several agencies, jurisdictions, and private entities who take ownership and are in charge of carrying such duties. Experts in their fields share their knowledge with local government staff to promote best operation and maintenance practices.

In Maryland, stormwater infrastructure condition is maintained according to stormwater management plans which must be approved by MDE. Prior to approval, Stormwater Construction Plans must include a maintenance schedule for each type of BMP. Maryland's stormwater guidelines were most recently updated in 2010 in the Maryland Model Stormwater Management Ordinance. The Ordinance Appendix dictates stormwater condition checks and frequency of maintenance required for each BMP. For instance, it specifies that a bioretention basin must be maintained seasonally and after a major storm by inspecting dewatering rates and mulch layer composition. It suggests remedial actions if the BMP is found to be in improper condition upon inspection.

2020 Grade: C

STORMWATER

Funding and Future Need

Costs to meet the minimum TMDLs as defined by the Chesapeake Bay TMDL blueprint in 2010 were projected to be around $7.7 billion for Maryland. In response to the 2010 blueprint, the Maryland General Assembly passed SB 863, which required ten of 24 Maryland County jurisdictions to create a stormwater remediation fee. These fees were used to implement green infrastructure throughout the state.

However, in 2015, due to high rates of the stormwater remediation fee, a modified bill was passed with several amendments, allowing for more creativity within each jurisdiction to facilitate achievement of the minimum TMDL.

With no state-mandated stormwater remediation fee, financial assurance plans, indicating a detailed 5-year plan of how stormwater runoff will be treated and paid for in Maryland's ten largest urban jurisdictions is required. Each jurisdiction must provide annual reports to the Governor and Maryland General Assembly by September 1 every year and demonstrate financial ability to pay for restoration practices for a minimum of the next two years.

Per MDE requirement, between January 2014 and March 2017, 228 industrial sites were required to submit stormwater discharge sampling reports to show compliance with stormwater permits. Only 180 facilities provided the report and 65 facilities exceeded acceptable pollution levels for pollutants such as copper, aluminum, zinc, and lead. Additional work and funding are needed to enforce current policies and maintain existing infrastructure.

While more flexibility was provided to individual jurisdictions, the responsibility of funding to meet the Chesapeake Bay TMDL still falls on local jurisdictions. Some restoration funding was created by the Watershed Protection and Restoration Program (WPRP) fund for the jurisdictions required to meet NPDES MS4 Permit development requirements, but the remaining funding need falls on local jurisdictions.

Public Safety

Residents can be exposed to deadly threats when flooding occurs. Floods are the most common, and among the most deadly, natural disasters in the United States. The velocities associated with flash floods can reach up to 9 feet per second, and as little as 6 inches of water is enough to wash an average vehicle away with any flood.

The dangers to public safety can be very different from one county to another throughout Maryland. Through better management and clear allocation of operation and maintenance responsibilities, some risks can be mitigated.

MDE uses its flood hazard mitigation program to help communities identify and understand their flooding risks using maps that show flood risk areas that are posted to its website. In addition to the maps, MDE gives support to the communities through a variety of programs, like the Comprehensive Flood Management Grant Program, which helps provide funding to projects that will reduce risk and improve the safety for people and property.

Resilience

The average annual precipitation in Maryland has increased by about 5%. This is concerning because current infrastructure is not capable of containing water from increasingly frequent heavy storms. Severe storms are not the only threat adding to flood potential. Sea-level rise is a major concern for Marylanders living on the 3,100 miles of tidal shoreline. Shoreline flooding also exacerbates flooding in low-lying areas, causing shoreline erosion, deterioration of tidal wetlands, and saline contamination of low-lying farm fields.

2020 Grade: C

STORMWATER

In order to better understand the states flood risk and increase its resilience, the Maryland Resilience Retreat was held on November 30, 2018, where the Maryland Emergency Management Agency, the Federal Emergency Management Agency, the U.S. Department of Energy, and the National Governors Association met with the Maryland governor's executive council. These partners came together to build an interdisciplinary understanding of resilience and identify how Maryland's state agencies can leverage programs and relationships to reduce statewide risk and advance resilience. As the state continues to increase its resilience through updated infrastructure, officials urge their communities to make sure they are prepared for emergencies and know how to respond.

Innovation

Maryland's stormwater management efforts through MDE are regarded as some of the most innovative nationwide. Since 2000 when MDE began upgrading its outdated stormwater management plan, its forward-thinking vision has been reflected in both Maryland stormwater policies and databases. **MDE developed the 2000 Maryland Stormwater Design Manual, Volumes I and II**, to establish stormwater design criteria and provide specific procedures for local jurisdictional use in improving existing programs for nonpoint source pollution control within the Chesapeake Bay. **Many other states have designed their stormwater plans based on this design manual because of its innovative approach to stormwater management.**

Technological advances have also helped support strong stormwater management planning in Maryland. For instance, MDE's Green Infrastructure Assessment mapped an ecological network using satellite imagery which allowed experts to identify 33% of Maryland's total area as providing important green infrastructure benefits. Outside of MDE, the University of Maryland conducts groundbreaking research on stormwater management. In 2019, they received a patent for a new way to remove pollutants from stormwater using adsorbent media. The combination of innovative technological and management approaches shows promise for the future of stormwater treatment to improve water quality in Maryland.

After considering the available information, stormwater infrastructure in Maryland is assigned a grade of C

Recommendations to Raise the Grade

The Maryland Department of the Environment's stormwater management efforts are regarded as some of the most innovative in the nation. However, the water quality of some of Maryland's watersheds has been steadily declining over the last few decades, increasing the cost that local municipalities and the state will have to invest for improvements. In order to continue leading in the stormwater sector, Maryland should:

- Given the intricacies of operation and maintenance planning, the state would benefit from additional, explicit, and clear designation of which is the entity responsible for operation and maintenance as part of the permitting phase.
- State and local governments should provide dedicated funding for maintenance and replacement of stormwater infrastructure through user fees or other measures.
- Local governments should continue asset management efforts in order to effectively maintain their stormwater infrastructure.
- MDE is tracking the capacity to treat rainfall for each facility that has either a Phase I or II permit, as well as CSOs. The upgrade of any best management practice that does not treat a minimum of 1" of rainfall using ESD needs to be better incentivized.

continued ...

2020 Grade: C

STORMWATER

- MDE should continue to implement transfer of knowledge via workshops and presentations to spread useful information regarding simple mistakes in stormwater design that hinder operations and maintenance and could easily be avoided.
- In order to successfully mitigate the risks related to stormwater events, Maryland needs to work closely with local representatives to understand what the biggest threats on a local scale are and create mitigation activities and solutions that will work.
- Maryland should consider resources and additional funding opportunities for all Maryland counties to promote even stormwater management treatment throughout the state rather than in only ten county jurisdictions.

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TRANSIT

REPORT CARD FOR MARYLAND'S INFRASTRUCTURE 2020

2020 Grade: D+

Previous Grade (2011): NA

Executive Summary

Two major transit agencies operate in the state: the Maryland Department of Transportation Maryland Transit Administration (MDOT MTA) and the Washington Metropolitan Area Transit Authority (WMATA). MDOT MTA supports 103.6 million annual unlinked passenger trips, manages 487 miles of track, and operates 1,986 vehicles. Cross-jurisdictionally (Maryland, Washington, DC, and Virginia), WMATA supports 352.5 million annual unlinked passenger trips, manages 234 miles of track, and operates 3,633 vehicles. Although Maryland continues to embark on planning efforts for transit system improvements and expansion, the eight-year constant decline in ridership is indicative of systemic issues. Such challenges are further complicated by significant budget shortfalls (for MDOT MTA and WMATA) to achieve a state of good repair and improve on-time goals across all modes. Meanwhile, various initiatives in rural Maryland counties aim to improve the fluidity among systems and improve the transit access gap.

Introduction

Two major transit agencies provide service in Maryland – the Maryland Department of Transportation Maryland Transit Administration (MDOT MTA) and the Washington Metropolitan Area Transit Authority (WMATA). Out of the 2,422 U.S. agencies that report to the National Transit Database, both MDOT MTA and WMATA are among the top 50 transit agencies across the country by ridership.

MDOT Maryland Transit Administration

MDOT MTA operates seven modes of transportation.

1) local bus in mixed traffic and dedicated bus ways
2) commuter bus
3) light rail
4) metro subway
5) MARC train
6) mobility (paratransit service)
7) a taxi access system

Its service area covers 2,560 square miles encompassing a population of 7,811,145. The local bus, light rail, and metro subway system are jointly branded as BaltimoreLink.

Figure 1 – MDOT MTA local bus service traveling in dedicated bus lane in Baltimore City

As a transit service, MARC is discussed in this analysis; however, note that it operates on heavy rail which is infrastructure that is covered in the rail analysis.

Locally Operated Transit Systems (LOTS)

MDOT MTA manages funding for and provides technical assistance to locally operated transit systems, across Maryland's 23 counties. The larger LOT systems include the following:

- MDOT MTA Inter County Connector Commuter Routes
- Ride On – Montgomery County
- The Bus – Prince George's County
- RTA – Howard County
- Annapolis Transit – City of Annapolis
- Anne Arundel County Transit

Washington Metropolitan Area Transit Authority

WMATA divides its service into four modes of transportation.

1) bus
2) heavy rail (Metro)
3) demand response
4) demand response taxi

Its service area covers 950 square miles and a population of 3,719,567.

While WMATA serves an important transit function in Maryland, its service area also spans Washington, D.C. and Virginia. Because of the state-spanning jurisdiction, WMATA oftentimes reports system-wide data. As much as possible, this analysis will narrow the focus to the portion of the WMATA transit system within Maryland.

Capacity and Conditions

In 2018, ridership across all MDOT MTA transit modes was just over 95 million. For the past eighteen years, total ridership has fluctuated within a small range between 120.6 million and 95 million. However, the past five years saw a decrease in ridership at an average of five percent per year. For the first time in 18 years, the total annual ridership has dropped below 100 million. This reflects a larger national trend of decreasing transit ridership.

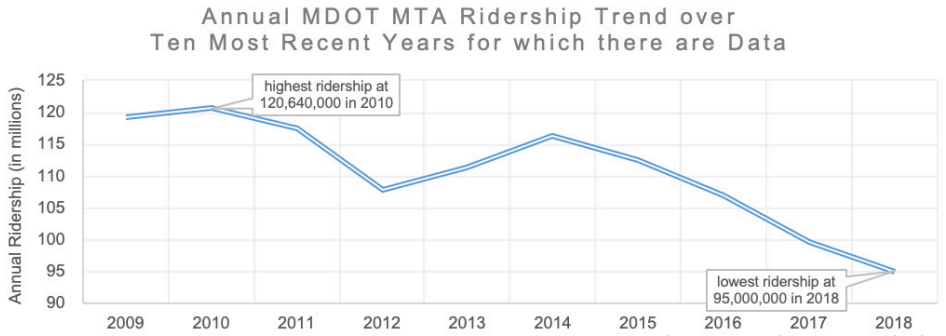

Chart 1 – Annual MDOT MTA ridership

Ridership on local bus service accounts for 65% of MDOT MTA's ridership. Metro subway accounts for 12% and the remaining modes each account for less than 10% of MDOT MTA's ridership.

2020 Grade: D+

TRANSIT

Local bus, commuter bus, metro subway, and light rail ridership have consistently decreased over the past five years. Metro subway has the largest five-year annual average decrease at 15%. MARC train ridership has increased at 2% over the recent two years. Mobility and taxi service have increased over the past five years.

WMATA ridership has decreased across all of the mobility options except MetroAccess, the region's paratransit service, which saw more than a 37% increase (6,274 users in 2016 to 8,610 users in 2018).

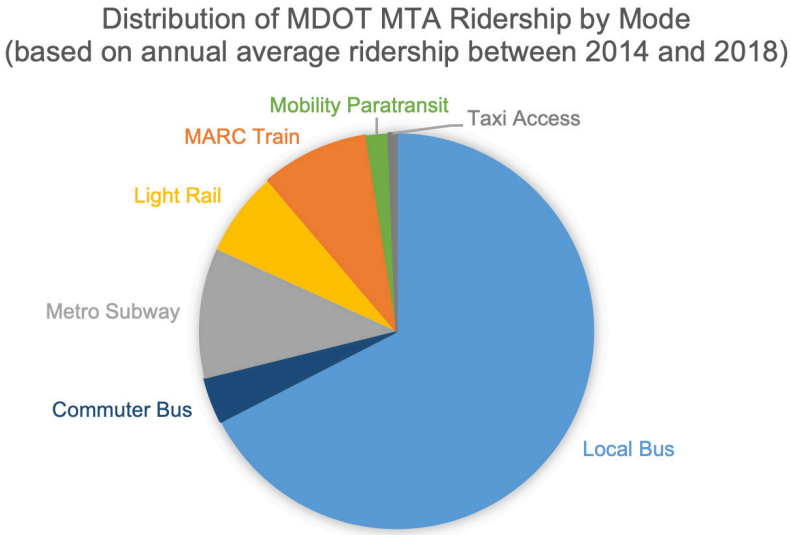

Chart 2 – Distribution of MDOT MTA Ridership by Mode

On-Time Performance

On-time performance measures the reliability of transit service. Specifically, it tracks when a transit vehicle arrives at its stop within a designated time frame of its scheduled arrival time. Since the measure is directly experienced by users, it is a metric that is most related to patron satisfaction.

MDOT MTA's on-time performance standard is when a transit vehicle arrives at the scheduled stop within two minutes early to seven minutes late of the scheduled time. This reflects a change in the standard that occurred in 2017; previously, the range allowed only one minute early to five minutes late. The current standard is consistent with WMATA's, but is looser than the top 20 transit agencies by ridership across the country.

MDOT MTA sets specific on-time performance goals for each mode. Bus service aims to arrive on time 80% of the time, light rail and metro subway 95% of the time, MARC 93% of the time, and mobility service 92% of the time. Between April 2016 and July 2019, all modes except for MARC met their goals approximately 65% of the time. MARC was on time 28% of the time.

State of Good Repair

Reliable transit service is dependent on reliable transit infrastructure including adequate track condition, safe and dependable service vehicles, and suitable facilities that house the day-to-day operation and administration of the transit system. The MDOT MTA system requires $1.5 billion of immediate funding to bring equipment and facilities to a state of good repair (SGR). Over the next ten years, an additional $4.2 billion is needed to continue to maintain a SGR as the system ages. Planned funding leaves the system $2 billion short.

Figure 2 – MDOT MTA light rail at the Convention Center stop in Baltimore City

WMATA developed a Transit Asset Management (TAM) process to comply with the Federal Transit Administration's requirements. The TAM procedure streamlined the reporting and forecasting on the next decade's (2019-2028) capital needs. According to the Capital Needs Forecast FY 2019-2028, more than $15.6 billion is needed to maintain SGR of WMATA's system over all three

2020 Grade: D+

TRANSIT

jurisdictions. Included in this value is $5.03 billion of SGR-related backlog issues. While this value seems daunting, the Capital Needs Forecast FY 2019-2028 shows a $2 billion reduction in 2016's estimations of the backlog expenses due to improvements in the safety and condition of the Metro track and railcars from successful jurisdictional support and federal grants. Overall, WMATA projects $1.1 billion per year on average is necessary reinvestment to keep up with the system's aging assets and increasingly deteriorating condition.

Public Safety

Within the MDOT MTA system, half of the safety events, including collision, derailment, fire, and security, occur on local buses, which carry 65% of MDOT MTA's annual ridership. The total number of events has decreased – by 56% from 2016 to 2017 and by 23% from 2017 to 2018. Over the past ten years (2009-2018), an average of three fatalities per year occurred within the MDOT MTA system. A single transit crash in 2016 resulted in six fatalities, higher than the annual total since 2004. Per the NTSB Report, an at-fault school bus collided with an MTA bus. Excluding the single incident in 2016, the average number of annual fatalities over the past ten years is reduced to 1.8. MDOT MTA fatalities account for 1.1% of all transit fatalities nationwide. Relative to passenger miles traveled, MDOT MTA's fatality rate is 1.8 times less than the national rate.

Figure 3 – MDOT MTA police

Considering WMATA's bus and rail services, several safety performance measures (bus-related collisions, injuries, fatalities as well as rail-related security events, injuries, and fatalities) are the same or better than the average values of eight peer transit agencies (2014-2015). However, bus security events and rail-related collisions, fires, and derailments perform 43% and 32% greater, respectively, than average.

To track and systematically set goals for improving safety, MDOT MTA established target rates for preventable accidents per 100,000 vehicle miles and has tracked achievement since 2011. A unique target rate was set for four primary modes – bus, light rail, metro subway, and paratransit/ taxi access. As of 2018, MDOT MTA meets or exceeds preventable accidents per 100,000 vehicle miles target rates for all modes. MDOT's 2019 attainment report cites the following influencers of the improved preventable accident rates: better training for operations staff, piloting mobile-eye camera system to help operators see in blind spots, and MDOT MTA Operations Control Center working with local jurisdictions to understand where preventable accidents are most likely to occur. Strategies cited to continue working on include the following: continue to improve staff training, install light rail and metro subway vehicle upgrades, and implement new FTA Safety Management Systems policies targeted towards reducing preventable accidents

Funding

Transit agency funding is divided into operating and capital expenditures. Operating expenditures are associated with the operation of the transit agency (such as driver salaries) while capital expenditures account for the purchase of capital equipment and financing capital projects (such as new rail cars).

MDOT MTA's annual operating expenditures have increased annually with inflation since 2013, with the most recently available figure at $754 million expended in 2017. Over the most recent five years, fares covered 20% of the operating expenses while the state covered a majority (75%) and the federal government supported the balance (5%). Total annual capital expenditures are approximately half of operating expenditures. In 2017, total capital expenditure was $368 million; the state government covered 59% and the federal government covered 41%. The last notable

increase in capital funding was in 2015 at $50 million. According to the 2017 National Transit Database National Trends Summary, nationwide, 32% of operating expenses were paid through fares and other directly generated funds, and the federal government typically funds 35% of capital expenditures. By comparison, MDOT MTA is supported by more federal funding and fares account for less of the budget compared to the average budget breakdown of transit systems across the country.

A 2013 law tied MDOT MTA fares to the consumer price index. When the consumer price index increases over the prior two years, MDOT MTA is required to increase transit fares by a minimum of ten cents for local bus, light rail, metro subway, and mobility service. Fare increases for commuter buses and MARC trains occur every five years with the next review scheduled in 2020.

The most recent six-year spending plan calls for $2.3 billion in capital spending, or $383 million per year equating to a 4% increase from the 2017 annual capital expenditure. Of the $2.3 billion, 98% is slated for good repair funding including replacing worn rail, new and overhauled railcars, MARC engine overhauls, and new buses. The remaining 2% will be for service enhancements.

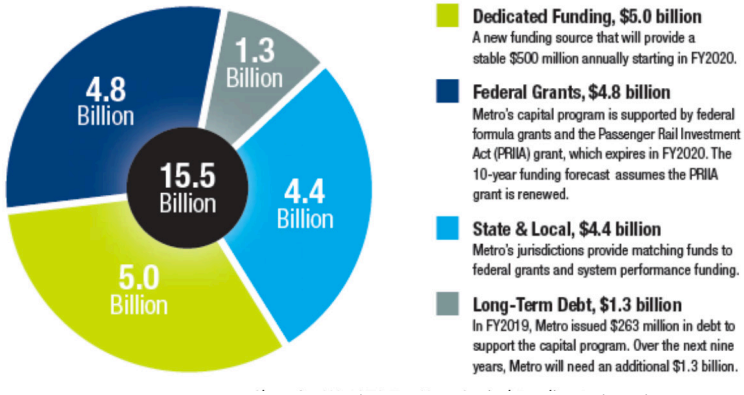

Chart 3 – WMATA Ten Year Capital Funding Program

The operational and capital expenses for WMATA have been met by the three groups referenced above – transit users, taxpayers within the service area (i.e., District of Columbia, Maryland, and Virginia), and the federal government. According to the Budget Highlights: Fiscal Year 2020, and consistent with the state's commitment to a joint investment in the WMATA transit system, Maryland's 2020 budget includes the state's taxpayers contributing $167 million for improvements in safety and reliability via capital investment. While this contribution does not meet WMATA's aforementioned $1.1 billion per year reinvestment need, it does comprise Maryland's portion of a $500 million cross-jurisdictional stable source of annual funds. Over the 10-year timeframe, this dedicated funding will total a $5 billion investment in WMATA's capital needs.

Local transit support is provided by MDOT MTA with technical assistance and funding programs. Transit funding from the state helps supplement local and farebox revenue to provide service to smaller communities and disadvantaged populations.

Future Need

Central Maryland comprises a significant majority of the state's transit operations with density and development patterns that have the potential to sufficiently support a successful transit system. As such, MDOT MTA is leading the development of a 25-year transit plan, due to be published by September 2020, that outlines a clear path forward.

More immediately, however, a new light-rail line project, the Purple Line, is progressing with a 2022 scheduled opening. The Purple Line is a 16-mile, east-west line with 21 stations providing connections to MARC trains, WMATA Metro/local bus, and Amtrak in Montgomery and Prince George's Counties. Its electric power design equates to zero-emission in the immediate environment while saving one-million gallons of gasoline over 20 years based on the estimated 17,000 cars it will take off the road daily.

After considering the available information, transit infrastructure in Maryland is assigned a grade of D+

2020 Grade: D+

TRANSIT

Recommendations to Raise the Grade

Maryland's transit system faces significant budget shortfalls (for both MDOT MTA and WMATA) to achieve a state of good repair across all modes, has seen decreasing ridership in recent years, and lacks progress in achieving on-time performance goals. In order to raise Maryland's transit infrastructure grades, Maryland should:

- Identify funding, including fare increases, to cover the projected $2 billion shortfall needed to achieve a state of good repair.
- Improve on-time performance to meet established goals and industry standards that will transform MTA into a leading transit agency. On-time performance is a key service metric that equates to rider satisfaction and leads to increased ridership.
- Identify innovative tools to maintain a relevant transit system that keeps pace with modern technological advancement as a tactic to maintain and increase ridership.
- Embark on a public education campaign to revise the public perception of safety on transit as an additional tactic to increase ridership.

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2020 Grade: D+

TRANSIT

WASTEWATER

REPORT CARD FOR MARYLAND's INFRASTRUCTURE 2020

2020 Grade: C+

Previous Grade (2011): C

Executive Summary

Maryland's wastewater infrastructure systems range in size from household septic systems to large-scale wastewater treatment plants. These systems are designed to effectively manage day-to-day operations and wet weather flows for households and communities across the state. There are several legacy systems over 150 years old that have been upgraded and expanded many times. Fortunately, many of these upgrades have reflected Maryland's national leadership in implementing both advanced wastewater treatment systems and innovative funding mechanisms. One such funding mechanism is the Bay Restoration Fund, a state grant funding program, paid for with a monthly $5/household "flush tax." Despite the gains in water quality, Maryland continues to face significant challenges, including reducing the sanitary sewer overflows, leakage from urban areas that have aging pipes, and quantity of inadequate or failing privately-owned septic systems.

Introduction

Maryland's wastewater infrastructure is essential to protecting environmental and public health, especially within the Chesapeake Bay Watershed (Figure 1). The state's wastewater infrastructure comprises centralized systems of sewage collection pipes (sewers), wastewater treatment plants (WWTPs), and decentralized treatment systems, such as septic tanks and leachfields. Sewer systems and treatment plants are managed by individual counties and municipalities and are regulated primarily by the Maryland Department of the Environment (MDE) though delegated authority from the United States Environmental Protection Agency (EPA) under the Clean Water Act. Privately-owned, decentralized wastewater systems are regulated by the Maryland Public Service Commission.

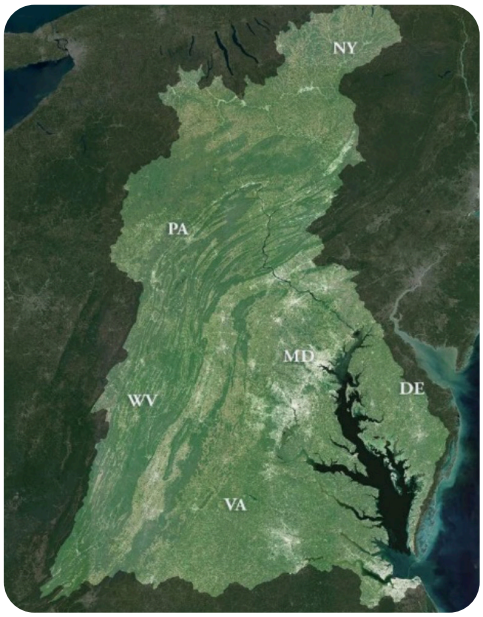

Figure 1 – Chesapeake Bay Watershed (Source: NOAA)(VMT)

Unlike many surrounding states and Washington, D.C., Maryland predominantly has separate sanitary and storm sewers that avoid Combined Sewer Overflows (CSOs). Maryland leads the nation in implementation of advanced wastewater treatment, including enhanced nutrient removal (ENR) that reduces nitrogen and phosphorus loading, known to cause eutrophication. Figure 2 depicts the primary nutrient sources and percentages they contribute to Maryland waterways. All of the 67 major (defined as >1 million gallons per day (mgd)) wastewater treatment plants in Maryland will soon be upgraded to ENR. Currently, only three major WWTP ENR upgrades remain to be completed.

Capacity

Much of the capacity of Maryland's wastewater infrastructure is driven by the Chesapeake Bay Total Maximum Daily Load (TMDL) which regulates effluent water quality from WWTPs according to a trend of strict nutrient reductions. However, improvements in both collection and treatment may reach a point of diminishing returns in the near future, underscoring the value of investment in pollution reduction from non-point sources, such as agricultural and urban runoff.

While Maryland's sewage systems are designed and have capacity to accommodate population growth, they must also handle the infiltration and inflow of groundwater and stormwater that robs the collection and treatment systems' existing capacity, impacting their performance and increasing costs.

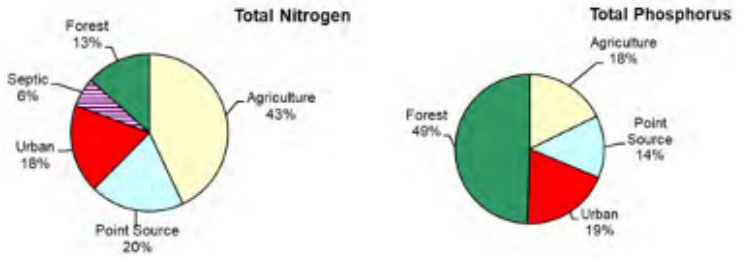

Figure 2 – Nutrient sources and percentages
(Source: Maryland 319 Nonpoint Source Program SFY2018)

The two largest metropolitan areas in the Chesapeake Bay Watershed – Baltimore and Washington, D.C. – have implemented costly long-range sewer rehabilitation programs to eliminate sanitary sewer overflows (SSOs) and, in Washington, D.C., CSOs. The cities' modified Consent Decrees (CDs) imposed by MDE and EPA establish a regulatory framework for the scope and schedule of needed upgrades.

Figure 3 – Wet weather sanitary sewer overflow
(Source: Blue Water Baltimore)

Condition

Collection system and WWTP condition varies widely across Maryland; sanitary sewer systems generally lag the condition of treatment facilities. Larger WWTPs tend to be in better condition than smaller systems, while privately-owned systems, serving small developments such as trailer parks, are often the most neglected.

The poor condition of aging sewer infrastructure leads to eventual failures. These result in higher treatment costs, non-compliance fees, and more frequent sewer overflow events which yield recreational water use and fishing restrictions. Infiltration, generally gets worse over time due to deterioration of the pipes and joints. This trend is manifest in chronic issues of sanitary sewer failures rather than the catastrophic, sudden failures associated with pressurized water main. Failures due to concrete deterioration of the crown of the sewer pipes have also resulted in collapse of the roadway(s) above the pipes, though this is relatively easy to detect via video inspection.

Failing individual septic systems and sewers that leak into the groundwater via exfiltration also contribute to non-point source pollution.

Condition assessment of larger systems is often implemented as part of an overall utility asset management program. Integrated asset management methods are increasingly used by mid-sized and larger utilities to track condition and proactively allocate resources for maintenance or replacement. An example of such proactive maintenance is the Utility Asset Management Division of Baltimore City, which has spent millions of dollars over the last 20 years implementing a program of continuous assessment and maintenance of utility infrastructure. Due to the relatively high cost to establish and maintain GIS-based asset management systems, smaller utilities have not yet widely implemented a modern asset management approach.

Operations and Maintenance

In some cases, Maryland utilities may be operated under a regionalized approach, such as the Washington Suburban Sanitary Commission, or through an inter-municipal agreement, such as the one existing between Baltimore City and the surrounding counties which may combine several utility types. A very small number of utilities (22), serving a population of around 11,000, are regulated and overseen by the Maryland Public Service Commission (PSC). Environmentally, all systems are regulated by MDE.

2020 Grade: C+

WASTEWATER

Most wastewater systems in Maryland have a good performance record of operations and maintenance (O&M).

Maryland long ago implemented a system of WWTP operator certifications that require continuing education. Additionally, the local industry associations of ASCE, Chesapeake Water Environment Association, and the Water and Wastewater Operators Association actively collaborate with the Maryland Center for Environmental Training to provide training support.

One unique O&M advantage enjoyed by Maryland is an independent quasi-state agency – the Maryland Environmental Service (MES). MES serves as a statewide resource for operations and maintenance on either a temporary or a long-term contractual basis. MDE has the statutory authority to order MES to take over any Maryland WWTP operations in an emergency or other condition as determined by the Secretary of MDE.

Funding

The quality of operations and maintenance, implementation of innovative watershed-based pollution controls, and update of wastewater technologies depends, in large part, on adequate funding. Local wastewater utilities bear the primary responsibility to fund both capital and operational expenses, generally through a tiered system of user fees. In many cases, wastewater infrastructure crosses jurisdictional boundaries and may require allocating the cost of building, operating, and maintaining these infrastructure assets fairly between jurisdictions. In addition to cross-jurisdictional cost sharing, MDE provides most of the external funding and financing for wastewater-related capital improvements.

Integrated utility asset management and capital depreciation principals are generally being applied to wastewater infrastructure to operate as self-sustaining enterprises, supported by user fees or dedicated local tax revenues. However, due to changes in regulatory requirements, population growth and development, and in some cases prior neglect, capital investment is required. Maryland provides targeted funding mechanisms as both grants and loans, each with specific objectives and program requirements.

The Bay Restoration Fund (BRF) or "Flush Tax" was implemented in 2004 as an inducement to larger facilities to upgrade to ENR treatment levels. Legislation in 2017 expanded the use of the BRF to cover the Biological Nutrient Removal and Enhanced Nutrient Removal Wastewater improvements (the BRF previously covered the ENR upgrade and the state's Biological Nutrient Removal Program covered the BNR upgrade). The BRF has approximately $75 million in funding annually for improvements to WWTPs, combined sewer overflows and sanitary sewer overflows, stormwater management, and for septic connections to WWTPs. The BRF also has approximately $15 million to fund septic system improvements. The BRF is not intended to provide funds for increased treatment capacity; so, any capacity expansion must be funded by the utility, generally through user fees. In 2004 the BRF Wastewater Treatment Plant Fund was established to prioritize funding for large publicly-owned treatment works (POTWs), although as the state finalizes the upgrade of the 67 largest POTWs, smaller systems (below 500,000 gpd) were also given priority for funding based on cost-effectiveness.

Maryland's Water Quality Revolving Loan Fund receives a capitalization grant from EPA of approximately $38 million annually, which is matched with approximately $8 million in state funding. This funding, along with "recycled funds" from prior loan repayments, is available to provide new funding for projects. In Federal Fiscal Year 2018/State Fiscal Year 2020 the Water Quality Loan Fund provided over $335 million for 56 projects in 14 jurisdictions, though some of the funded projects are not specifically wastewater-related.

Given that over 420,000 households in the state of Maryland are served by on-site wastewater treatment systems, a funding mechanism, known as the BRF On-site Disposal Systems Fund, was put in place to assist homeowners with the cost of upgrading or replacing failing systems. A $60 annual fee is collected from each user served by an onsite system. The total estimated program income is about $27 million per year, 60% of which is used to fund upgrades to these systems and 40% of which is used for agricultural vegetation (crop cover activities) to improve nutrient removal.

2020 Grade: C+

WASTEWATER

Costs for wastewater utility service are generally based on connection type (domestic or industrial), size, and the amount of metered drinking water consumed. In some cases, dedicated enterprise funds paid by users are intended to ensure that adequate money is available to properly operate and maintain the collection and treatment systems. In many cases, the connection fees are included in the annual property tax bill. User rate increases are generally required over time to maintain the expected level of service. Affordability is a major consideration in planning the schedule of implementation as well as application of enforcement provisions. For example, the Baltimore City Consent Decree was recently modified to relax the schedule of compliance to accommodate affordability considerations within low- and moderate-income communities within the city. However for smaller utilities, reliance on general funds to cover the cost of major maintenance is a common problem.

Future Needs

From rehabilitation of aging collection systems, to completion of treatment works, the projected wastewater infrastructure capital costs for the next 20 years will be on the order of $10 billion statewide. From a capacity standpoint, significant funding is needed for improvements to collection system infrastructure. It is anticipated that much of that funding will be to build new capacity for centralized collection and treatment and replace failing septic tanks, particularly along the coastal areas in rural parts of the state.

Future funding needs also include rehabilitation and expansion of centralized wastewater collection and treatment infrastructure, research into leak detection, treatment practices, and disposal of contaminants of emerging concern, systematic upgrades for all non-point source systems throughout the watershed, and biosolids reuse or disposal. Upgrades to wastewater treatment may be required in order to respond to the threat of contaminants of emerging concern such as Perfluorooctanoic acid, a forever chemical also known as PFAS.

Public Safety

Public notification of sewage overflow events occurs in Maryland with a warning to the public to avoid specific areas affected by the overflow. Water contact notifications are also given via social and public media to mitigate the threat of contact with raw sewage. Citizen science is widely used in Maryland to supplement the resources of professionals engaged in water quality monitoring and underscores both the importance of protecting public health as well as the strong interest of the citizens of Maryland in protecting environmental health.

Sewage backups into homes may occur as the result of wet weather hydraulic overload of the sewers, though such problems may also be caused by an accumulation of fats, oils, and grease (FOGs) or roots in the pipes. Often these problems occur on the property of the individual homeowner and private plumbing contractors must be called in to clear the line.

Resilience

Maryland requires on-site back-up power for wastewater pumping facilities and for aeration and other key processes at WWTPs. Climate change resiliency is now being discussed as sea level rise increases the risk of inundation of WWTPs and extreme storm events increase infiltration and inflow to sewers. It is widely agreed among wastewater utilities that climate change must be addressed with studies and vulnerability assessments and an additional source of funding is needed.

The threat of accidental or intentional spills of chemicals or industrial waste on land or directly into a sewer system throughout the state poses a risk to the infrastructure, disruption of the nutrient reduction processes at advanced WWTPs, and threatens the beneficial agricultural reuse of biosolids (WWTP sludge). Improving the resilience of wastewater systems to these threats has occurred though routine enforcement of regulations.

2020 Grade: C+

WASTEWATER

Innovation

Development of advanced nutrient removal technology stands out as one of the principal innovations of Maryland's wastewater utility industry. For example, many WWTPs in Maryland are required to reduce nitrogen to a degree that is lower than requirements for drinking water. Furthermore, several innovative and creative solutions, including phosphorus removal from wastewater through a process known as struvite harvesting, are helping redefine wastewater as a resource versus simply a pollutant.

Flow monitoring technology applied to sanitary sewers is another area in which Maryland has shown national leadership. Robust hydraulic models incorporated into geographic information system (GIS) based asset management systems will improve the cost-effectiveness and sustainability of wastewater infrastructure.

Net Zero Energy consumption is a goal of many facilities, through improvements in energy efficiency and water conservation, energy recovery from sludge digester gas, and the addition of other renewable sources such as solar power.

After considering the available information, wastewater infrastructure in Maryland is assigned a grade of C+

Recommendations to Raise the Grade

Maryland is home to legacy wastewater systems and treatment plants that have been effectively upgraded and expanded to meet increasingly stringent water quality standards and population demands. The projected capital costs for rehabilitating the remaining wastewater collection system statewide total nearly $10 billion over the next 20 years. To continue the commendable efforts of maintaining, rehabilitating, updating, and expanding the state's extensive wastewater systems, Maryland should:

- Prioritize investment in western Maryland and the Eastern Shore. Lagging behind the larger and better-financed systems in central Maryland are many smaller rural counties and towns, especially in western Maryland and the Eastern Shore where poor wastewater infrastructure performance is often seen. Future grant funding should target these rural jurisdictions, including incentivizing improvement of their asset management practices.
- Funding mechanisms should prioritize projects that maximize the net overall benefits of infrastructure to residents and users (e.g. industry, manufacturing) while mitigate unaffordable increases to monthly costs.
- New technologies should be developed, particularly those emphasizing water quality improvements to non-point sources such as agriculture and urban stormwater runoff.
- Contaminants of Emerging Concern, such as PFAS, pharmaceuticals and plastic microfibers may require advanced wastewater treatment and other measures as evidence of their presence and the environmental effects become better understood. Funding for scientific research, as well as anticipating and planning for solutions to such unforeseen contingencies should be considered, perhaps at a federal or state level.

References

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2020 Grade: C+

WASTEWATER