



REPORT CARD FOR
MISSOURI'S
INFRASTRUCTURE

2018

G.P.A.



“Don't wait.
The time will never be just right.”
-Mark Twain

ASCE AMERICAN SOCIETY
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EXECUTIVE SUMMARY

Infrastructure supports our way of life. Our roads enable us to get to work, our aviation infrastructure allows us to get to take vacations, our freight infrastructure brings us our goods, and our drinking water infrastructure lets us lead healthy lives. For many years, we made investments to support these systems. Unfortunately in recent years, there has been a trend of underinvestment in infrastructure that threatens our competitive edge and the health, safety, and welfare of our citizens. The time to prioritize our transportation and water infrastructure has come.

As civil engineers, our job is to plan, design, construct, and maintain our infrastructure networks.

The Report Card provides a snapshot for residents and policymakers to engage in conversation about where we are and where we need to be for continued economic success of the state.

In 2013, a panel of professional civil engineers and American Society of Civil Engineers (ASCE) members throughout the state graded our infrastructure as a C-. This past year, an expert team of more than 30 civil engineers was assembled to evaluate and study the major

components of our infrastructure. In 2018, the grade has remained as a C-.

Missouri's infrastructure continues to muddle along at the status quo, but if we don't increase investment soon we will start feeling the ramifications. Missouri stands to lose out on matching federal funds for transportation projects if state funding is not increased. Better coordination and increased funding through the National Levee Safety Initiative would more comprehensively mitigate flood risk. Regulation exemptions for high-hazard and significant-hazard dams potentially put our residents and their property at risk. While Missouri's ports and railroads are well-positioned to move an increased volume of goods, inland waterways and roads are not. Our freight network is only as strong as its weakest link. We need all partners – the state, localities, and the federal government – to invest in the freight system to ensure we're prepared for future growth.

We hope that this information provides the insight needed to start that conversation and ignite action.

GRADING CRITERIA

Infrastructure is graded based on eight criteria: capacity, condition, funding, future need, operation and maintenance, public safety, resilience, and innovation. ASCE grades on the following scale and defines these grades as:



EXCEPTIONAL, Fit for the Future

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



GOOD, Adequate for Now

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



MEDIOCRE, Requires Attention

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



POOR, At Risk

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

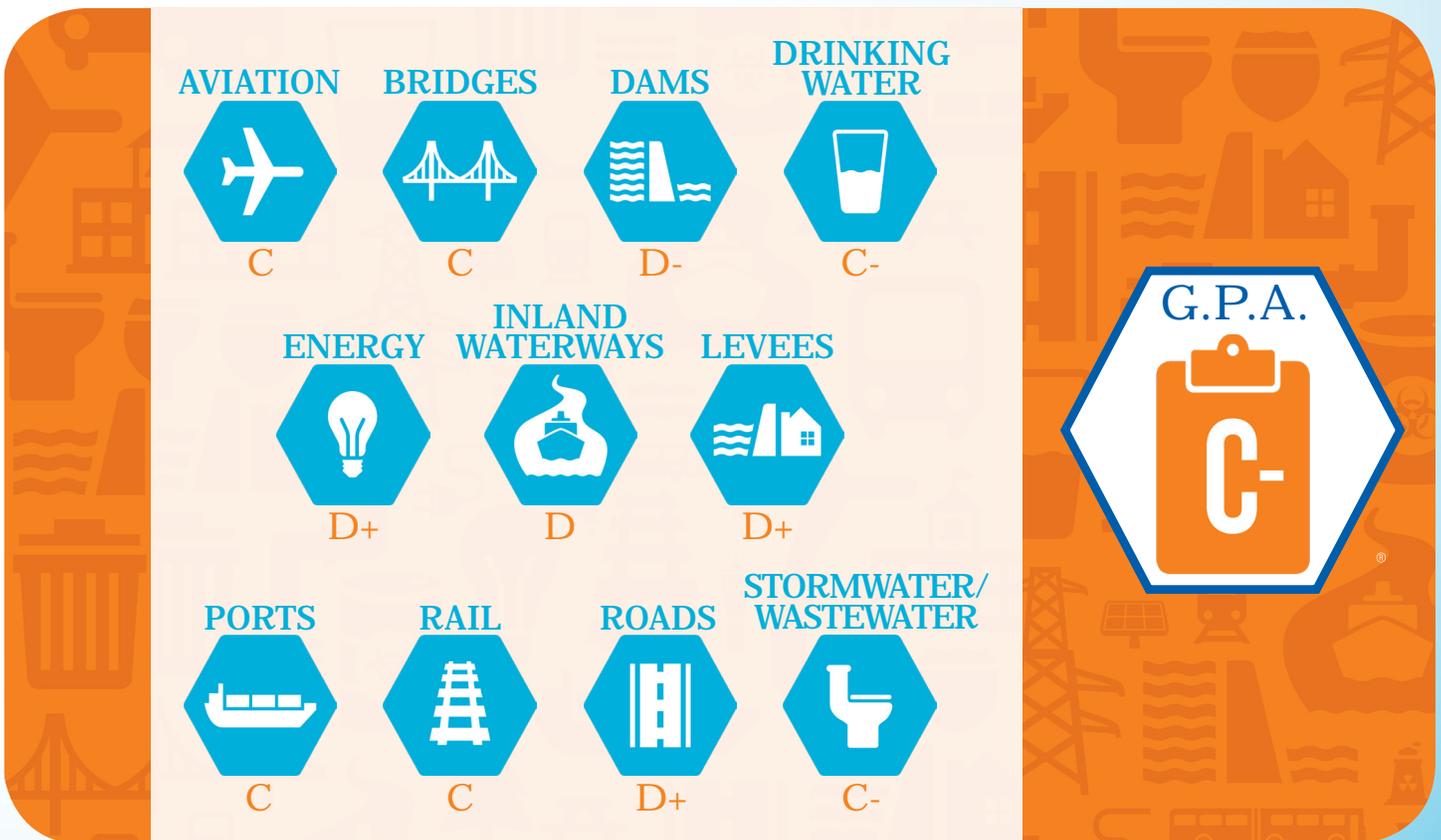


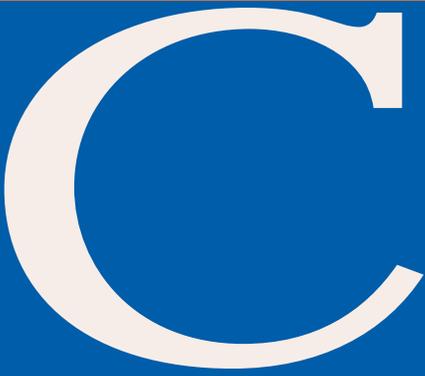
FAILING / CRITICAL, Unfit for Purpose

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

RESULTS

Eleven different categories of infrastructure for the State of Missouri were evaluated and graded. They are summarized in the following graphic:





RECOMMENDATIONS

- Federal and state aviation agencies should continue to provide guidance and financial support to improve the state's runway and taxiway facilities.
- The Missouri State Airport System Plan (MOSASP) is currently being updated. The report will present recommendations that should be implemented.
- Increase the cap on FAA Passenger Facility Charges (PFC) to fund improvements at Missouri's Primary Commercial Airports.
- Encourage the U.S. Congress to support multi-year reauthorizations of the FAA's Airport Improvement Program to maximize funding availability for Missouri's NPIAS airports.
- Prevent State Aviation Trust Funds from being diverted to other state funds to make up for statewide budget shortfalls.

EXECUTIVE SUMMARY

Missouri is home to nearly 500 aviation facilities, including Kansas City International Airport (MCI) and St. Louis Lambert International Airport (STL). In 2017, MCI reported over 11.5 million passengers and was ranked the 39th busiest airport by enplanements and STL reported over 14.7 million passengers and was ranked 32nd busiest airports by enplanements. MCI's 2009-2025 Airport Master Plan estimated an annual growth rate of 2.8% and shows the existing runway system should be fully capable of meeting demand during this period. STL's airport passenger rate grew 5.5%, airplane operations grew 3.1% and air cargo grew 2.4% in 2017. Both airports have identified needed projects and are working to secure funds to make them a reality. For example, in 2017 the city of Kansas City, MO voted to approve private financing for the construction of a modern, single terminal to replace the existing three terminals.

BACKGROUND

Missouri has nearly 500 aviation facilities, including both public and privately-owned airports, heliports, seaplane bases, and grass landing strips. Of those, 123 are publicly owned. There are 10 commercial service in Missouri including Kansas City International Airport (MCI) and St. Louis Lambert International Airport (STL). In 2017, MCI reported over 11.5 million passengers and STL reported over 14.7 million. The Missouri airports serve a wide array of activity including scheduled passenger air service, business-related and recreational flying.

MOSASP identifies four different roles served by airports in the state. The roles for the airports and corresponding service objectives are shown as follows:

Commercial Airports

Regional Airports serve primarily general aviation activity with a focus on serving business activity including small business jets and single- and multi-engine turbo-props. These airports support the system of commercial airports and provide significant access to the state's population. There are currently 31 facilities within the MOSASP which are designated Regional Airports.

Regional Airports

Regional Airports serve primarily general aviation activity with a focus on serving business activity including small business jets and single- and multiengine turbo-props.

AVIATION

Business Airport

Business Airports focus on providing aviation access for small local businesses as well as recreational flying activities throughout the state.

Community Airport

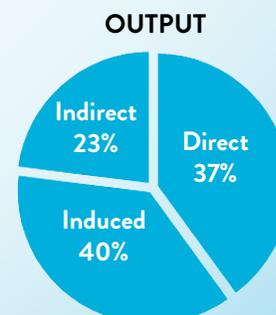
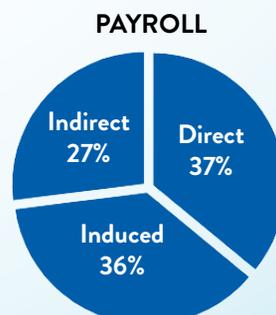
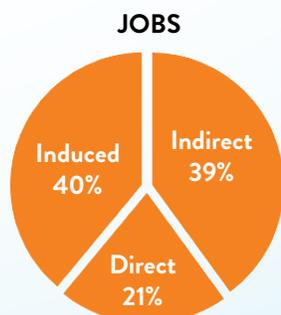
Community Airports are considered to have local community importance serving primarily recreational and personal flying activities in which they are located.

In 2012, Missouri Department of Transportation (MoDOT) completed a Missouri Statewide Airport Economic Impact Study. From 2003 through 2012, despite the economic recession, the economic contribution of Missouri airports grew 17.1%. The state is updating the 2012 study and intends to publish new results in 2019.

Missouri airports create direct economic impacts based on the sales, wages, and employment generated by on-airport business activity. There are currently 100,621 jobs in Missouri that are in some way connected to the airport system and its activities. These jobs have an annual estimated payroll of \$3.1 billion. When all economic activities are considered, total annual economic output associated with the system of airports in Missouri is estimated at \$11.1 billion. This represents 4.3% of the gross state product.

Additional indirect impacts from airports are experienced by the state. In 2012, an estimated 6.2 million visitors arrived in Missouri via commercial service airports, and an additional 264,000 visitors arrived on general aviation aircraft. These visitors spend on food, hotels, entertainment, recreational activities, transportation, shopping and other items. These expenditures support additional aviation-related jobs, payroll, and output.

Statewide Total Airport Economic Impacts	Direct (On Airport Businesses)	Indirect (Visitor)	Induced (Multiplier)	Total
Jobs	21,400	39,213	40,008	100,621
Payroll	\$1,169,385,000	\$842,835,000	\$1,116,426,000	\$3,128,646,000
Output	\$4,138,213,000	\$2,551,803,000	\$4,411,683,000	\$11,101,699,000





OPERATION AND MAINTENANCE

Each airport is responsible for the maintenance of airfield pavement. For any project to receive federal funds, the airport must provide assurance to the FAA that they have implemented an effective pavement maintenance management program. An effective maintenance program will provide a safe and operable airfield at the lowest cost. It will allow the airport to assess and prioritize projects and develop maintenance solutions to obtain the greatest return on investment. Due to the financial gap for aviation projects in Missouri, additional funding sources will be required to maintain safe and operable airport pavements.

CONDITION AND CAPACITY

According to the FAA Aerospace Forecast 2018-38, U.S. carrier passenger growth is expected to average 1.9% over the next 20 years. The long-term outlook for general aviation is stable to optimistic. The general aviation fleet is forecasted to remain relatively stable between 2018 and 2038, but the number of general aviation hours flown is projected to increase an average of 0.8% per year through 2038.

MCI

MCI's 2009 Airport Master Plan stated the projected demand and expected capacity at MCI over the forecast period, ending in 2025. The 2009 plan estimated an annual growth rate of 2.8% and shows the existing runway system should be fully capable of meeting demand during this period. In 2016, MCI was ranked the 39th busiest airport in the country based on enplanements. To address capacity and operational concerns with the existing terminals, the city developed a terminal area master plan. The program objective was to establish an affordable Terminal Modernization Program that meets the future needs of the Kansas City community, achieving customer convenience and operational efficiency objectives. In 2017, the city of Kansas City, MO voted to approve the construction of a new single terminal to replace the existing

three terminals with plans to start construction in 2018.

STL

For 2018, STL ranked as the 32nd busiest airport in the U.S. for passengers. The airport passenger rate grew 5.5%, airplane operations grew 3.1% to 196,405, and air cargo grew 2.4% to 72,104 tons. The FAA identified STL as the seventh fastest growing airport in the U.S. based on enplanements, and 2017 was the busiest year in a decade for the airport. In 2015, STL developed a five-year Strategic Plan, setting performance goals for itself in terms of air service, financial sustainability, economic development, and community engagement. Three years into the five-year plan, STL has already achieved some of its goals, specifically in the sectors of financial sustainability and air service.

All Other MO Airports

MOSASP, MoDOT Aviation Section evaluated the current infrastructure of 114 of the airports in Missouri. The data below is extrapolated from the plan.

Considering the system as a whole:

- 41% of the airports meet the minimum runway length objectives;
- 60% of the system's airports meet the minimum runway width objectives; and
- 50% of the airports meet their taxiway needs for their respective role.

Roughly half of the airports in the state fall short of providing adequate runway dimensions and taxiway facilities to serve users. Airport owners are encouraged to track user activity to determine the need to expand airfield facilities to serve demand.

Annual service volume (ASV) is a measure of an airport's annual operational capacity. The FAA recommends airports operate at less than 60% of its ASV in order to reduce delay and increase capacity. Three airports of 114 are

AVIATION

expected to exceed their target ASV in the future. Nearly all of the airports in Missouri experience minimal delays and are capable of maximizing the usage of existing facilities to accommodate a wide range of users which include a diverse fleet of small and large aircraft.

Published instrument approach procedures increase an airport's utility, safety and efficiency during low visibility and/or inclement weather conditions. Instrument approaches allow aircraft to approach to and land on a specific runway. 91% of Missouri airports have the ability to meet all-weather capabilities with published instrument approach procedures.

The grading summary of Missouri's airfield facilities' capability to achieve service objectives is presented in Table 1.

Table 1:
Airfield Facility Grading Summary

Objective	Percent (%)	Grade
Runway Length	41	F
Runway Width	60	D
Taxiway Type	50	F
FAA Design Standards	76	C
System Demand/Capacity	99	A
All-Weather Capabilities	91	A
Composite Score	70	C

Source: MOSASP

Pavement

The Pavement Condition Index (PCI) procedure is the standard used by the aviation industry to visually assess pavement condition, providing engineers with a consistent, objective, and repeatable tool to represent the overall pavement condition. During a PCI survey, visible signs of deterioration within a selected sample unit are recorded and analyzed, as are distress type, severity, and quantity. The PCI value ranges from 100 (new pavement) to 0 (the lowest value).

The Missouri statewide PCI condition summary, which excludes the large commercial airports such as Lambert-St. Louis International, Kansas City International, has a PCI weighted average of 75. The average includes runway, taxiway, apron/helipad and T-hangar pavement.

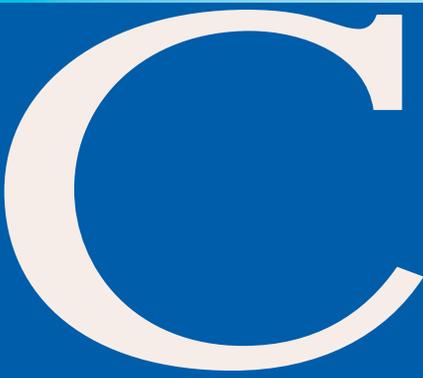
Branch use	Area-Weighted PCI
● Runway	76
● Taxiway	76
● Apron/ Helipad	72
● T-hangar	73
● All Pavement	75

The overall area-weighted PCI of Kansas City International Airport is 77. Of the 290 airfield sections inspected, 70 sections have PCIs below their established critical value, indicating a need for rehabilitation. The 2015 study at Lambert has an overall PCI of 76: runway average = 76, taxiway average = 85, and apron average = 60.

Due to operational and facility constraints discussed in this section in addition to funding shortfalls, the current infrastructure's performance is fair to marginal.

FUNDING

Airport improvement projects in Missouri are funded with federal, state and local sources. Because Missouri participates in the FAA's State Block Grant Program, MoDOT assumes the responsibility of administering federal Airport Improvement Program



(AIP) grants, or Non-Primary Entitlement (NPE) funds, for the state’s NPIAS airports. AIP grants provide 90% of improvement costs with the airport owners contributing the remaining 10%, with the exception of MCI and STL, which are a 75%/25% split. The FAA program administers federal funding to the airports with commercial passenger service over 10,000 annual passenger enplanements including Lambert-St. Louis International, Kansas City International, Springfield-Branson National, Columbia Regional, and Joplin Regional. The FAA also issues grants to Charles B. Wheeler Downtown Airport.

MoDOT also administers the Aviation Trust Fund (ATF) to fund improvements at non-NPIAS airports that are included in the State Transportation Improvement Program (STIP). The Trust Fund derives its revenue from a portion of the state sales tax on jet fuel and a \$0.09 per gallon tax on aviation gasoline. The Trust Fund covers 90% of project costs with the remaining 10% being contributed by the airport owner.

Commercial Service airports also create funding for airfield projects through Passenger Facility Charges (PFCs). The PFC Program allows the collection of fees up to \$4.50 for every enplaned passenger at commercial airports controlled by public agencies. 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. Airports use these fees to fund FAA-approved projects that enhance safety, security, or capacity; reduce noise; or increase air carrier competition.

According to the Missouri Statewide Aviation Transportation Program (FY2018-FY2022), which does not include MCI and STL, airport capital improvements projects over the next five years, including environmental, planning, engineering design, construction and land acquisition, are expected to cost nearly \$180,931,642. On average, this program receives \$20-25 million per year in funding. The table below summarizes the state aviation system’s short-term funding needs. Funding for these projects will be paid for by federal, state and local funding sources including city, county and third-party investments.

MCI’s 5-year total funding request is over \$260 million. Of that amount, 75% or \$195 million, is a federal funding request. On average, MCI has been receiving approximately \$15 million per year from the FAA so there will be a large funding gap for the upcoming projects. A majority of the funding request is for the apron improvements associated with the new terminal that is to be constructed in this time frame. As mentioned earlier

MISSOURI STATEWIDE TRANSPORTATION PROGRAM FY 2018-2022 AVIATION PROGRAM

		7/2017-6/2018	7/2018-6/2019	7/2019-6/2020	7/2020-6/2021	7/2021-6/2022
TOTALS	Federal Cost	\$35,018,000	\$34,814,000	\$25,703,000	\$22,683,000	\$17,955,000
	State Cost	\$10,108,000	\$5,460,000	\$4,220,500	\$3,155,000	\$5,367,000
	Local Cost	\$4,140,666	\$4,053,780	\$3,321,501	\$2,347,556	\$2,584,639
	Total	\$49,266,666	\$44,327,780	\$33,245,001	\$28,185,556	\$25,906,639
TOTAL	\$180,931,642					

AVIATION

in this chapter, in 2017 the city of Kansas City, MO voted to approve the construction of a new single terminal to replace the existing three terminals. Construction on the \$1 billion, privately-financed terminal is expected to begin in 2018. Details regarding the project continue to be negotiated.

The 5-year total for projects at STL is over \$57 million of which \$43 million is the federal share. STL has been receiving approximately \$8 million from the FAA annually. STL recently completed a project to increase the utilization of Terminal 2, including renovation of gates, which improved capacity for Southwest.

PUBLIC SAFETY

The FAA, in formulating the NPIAS, established a guideline in which access to the national air transportation system would be provided within 30-minutes of populated areas. MOSASP established this guideline as a service objective for the airport system. It is estimated that 99% of Missouri's population is within a 30-minute drive from any public airport in the state. Maintaining the infrastructure for the state of Missouri airports is imperative to achieving this objective.



RESOURCES

1. American Society for Testing and Materials (ASTM) D5340-11: Standard Test Method for Airport Pavement Condition Index Surveys.
2. CDM Smith, Inc., Missouri State Airport System Plan, 2005.
3. CDM Smith, Inc., The Economic Benefit of Missouri's Airport System, 2005.
4. Federal Aviation Administration.
5. Kansas City Aviation Department Traffic Statistics (2017)
6. Lambert-St. Louis International Airport Passenger Statistics (2017)
7. Missouri Airport Managers Association.
8. Missouri Department of Transportation, Aviation Section.
9. Missouri Department of Transportation, Multimodal Operations Division.
10. AOPA FAA general aviation statistics
11. Missouri Department of Transportation 2017 PCI Pavement Inspection
12. Missouri Department of Transportation 2018-2022 STIP Plans and Projects Program
13. Kansas City International Airport Master Plan Update Technical Report, December 2009
14. Kansas City International Airport 2017 Pavement Management Program Update
15. Airports Council International
16. FAA Aerospace Forecast 2018-38



RECOMMENDATIONS

- Identify additional sources of funding that are equitable to all users and acceptable to Missouri residents. This may require significant community outreach and dialogue. Increasing the fuel tax would put Missouri on more equal footing with neighboring states.
- Begin to explore alternative sources of funding (eg. mileage-based fees) as fuel economy of vehicles increases and eventually moves to an all-electric inventory.
- Aim to reduce the percentage of structurally deficient bridges by 1% per year over the next 10 years.
- Identify system expansion projects that increase the overall economic competitiveness of Missouri businesses.
- Continue to explore alternative delivery methods such as design-build and design-build-finance to accelerate delivery of critical projects.

EXECUTIVE SUMMARY

Missouri has the seventh largest number of bridges nationwide, yet must maintain its inventory with funding from just the fourth lowest gasoline tax in the country. Not surprisingly, the condition of the statewide inventory lags somewhat behind the national average. 12.5% of bridges in Missouri are structurally deficient, compared with 8.9% of bridges nationwide. Fortunately, the situation is improving. Over the last 10 years, the Missouri Department of Transportation (MoDOT) has directed available funding to its “Safe and Sound” bridge program, which replaced over 800 bridges from 2009 to 2013. While recent focused efforts by MoDOT and other agencies are helping to maintain the status quo, significant challenges remain ahead due to the inability to identify a funding source that is amenable to Missouri citizens. The state has identified 4,800 bridges that need repairs, totaling an estimated \$4.2 billion.

CAPACITY AND CONDITION

Missouri is home to 24,467 bridges, the seventh largest bridge inventory in the nation. To put a finer point on it, one out of every 25 bridges in the country are in Missouri. MoDOT owns and maintains 10,364 bridges, slightly less than half of the overall total, including 53 major river bridges. Almost all of the remainder of the bridges are owned by counties and cities.

A good indicator of the condition of bridges is the rate of structural deficiency. While not unsafe, structurally deficient bridges are those that require significant maintenance, rehabilitation, or replacement of load carrying elements. To remain in service, structurally deficient bridges are often posted with weight limits. More than mere inconvenience, posting can significantly increase commute times for school buses and has the potential to lengthen response times for emergency vehicles. On the MoDOT state system, 1081 or 10.4% of bridges are structurally deficient, while 15% of county/city-owned bridges are deficient. In total, nearly 3200 bridges in the state of Missouri (13.1%) can no longer carry the loads for which they were designed and/or require significant funding outlays just to prevent their further deterioration. For comparison, of the more than 600,000 bridges in America, 54,259, or 8.9% are structurally deficient. Thus, MoDOT’s state-owned inventory is performing somewhat worse than the national average, while locally owned bridges lag even further behind.

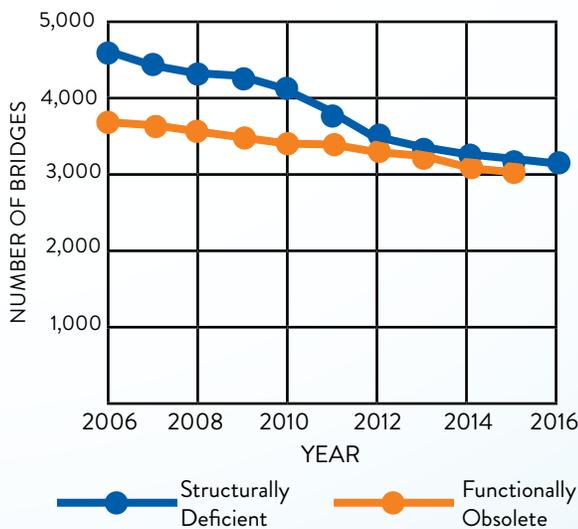
Additionally, 13% are functionally obsolete. This bridge classification indicates the design does not meet current safety standards for lane or

BRIDGES

shoulder widths, clearances, or does not meet the needs of increasing traffic. The percentage of functionally obsolete bridges in Missouri is similar to the national average.

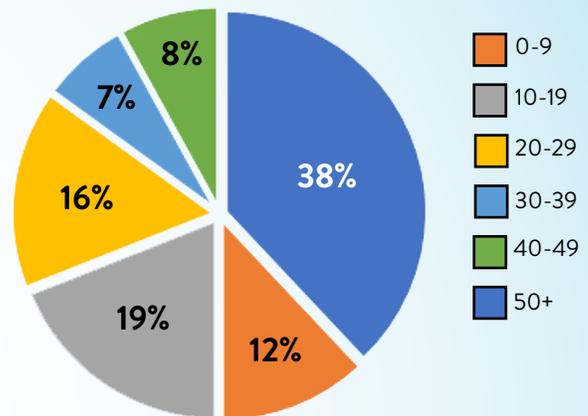
Fortunately, the situation has been improving. Figure 1 shows the drop in structurally deficient and functionally obsolete bridges over the last 10 years. 1,253 bridges are no longer weight restricted, representing a 6.6% decrease over the past four years. A significant portion of this decrease can be attributed to MoDOT's "Safe and Sound" bridge program, which replaced over 800 bridges from 2009 to 2013. However, the future is not as encouraging. 100 bridges fall into poor condition every year. The program is almost "holding its own" but it would cost \$1.1 billion to replace all structurally deficient bridges in the state, while \$740 million would be required just to rehabilitate them.

Figure 1:
Deficient Bridges Across the State of Missouri



Although today's bridges are designed to last 75-100 years, historically they were designed and built for a 50-year life span. Figure 2 shows that more than one-third of Missouri's bridge inventory has outlasted its useful life.

Figure 2:
Missouri Bridges by Age



FUNDING AND FUTURE NEED

In 2016, state transportation funding was nearly \$2.5 billion, with \$1.5 billion coming from state levies and \$900 million coming from the federal government. Of this, approximately \$400 million was directed to cities and counties for projects of their choosing (the majority of these entities also receive additional local tax revenues which are not included in this total). MoDOT also participates in cost sharing agreements to fund projects beneficial to both the local entity and the overall state network. MoDOT's other obligations include bond debt service, highway patrol, multimodal transportation, leaving \$1.4 billion for state road and bridge maintenance, with \$225 million dedicated to bridges. Going forward, overall revenues are forecast to increase by \$300 million by 2020 and then level off. It should also be noted that unlike neighboring states of Oklahoma, Kansas and Illinois, Missouri does not have toll facilities that fund transportation facilities.



Where does the money come from? Nearly half (45.3%) of the state funds are provided by Missouri's gas tax of \$0.17/gallon, fourth lowest in the nation (while maintaining the seventh highest number of bridges). It is also important to note that this rate has not been raised since 1996 and now has a purchasing power of less than half of what it originally did. In January 2018, the "21st Century Missouri Transportation System Task Force" issued recommendations to the state legislature, advising an increase to the gas tax to support the state's economy and boost its economic competitiveness. In recent years however, initiatives to raise the gas tax have been overwhelmingly defeated. Hence the near-term outlook for significant improvement in the funding situation is not favorable.

Cities and counties received \$270 million state transportation funds and \$138 million in federal funds for projects of their choosing. The majority of federal funding is for reimbursing a share of eligible costs, typically 80% of total project costs.

MoDOT was the second state agency in the nation to successfully work with the FHWA to obtain federal matching funds (80:20) for both contracted and in-house work, which is considered preventive maintenance or has other specific approval by FHWA. Missouri typically spends between \$100 to \$150 million per year on preventive maintenance activities.

INNOVATION

Missouri was an early adopter among state departments of transportation of the design/build approach to completing large-scale projects and has since implemented it on medium sized projects as well. MoDOT believes significant cost savings, schedule acceleration, and innovative solutions to their needs have been realized. To date, nine projects have been completed with three others under construction utilizing design-build methodology, totaling \$1.5 billion, while saving taxpayers an estimated \$275 million.

MoDOT also developed the "Practical Design" concept whereby rigid rules for design features may be waived by the project team when warranted the needs of specific projects and sites in order to avoid spending money unnecessarily. For this, MoDOT earned the AASHTO President's Transportation Award and became an FHWA standard.

High performance materials with higher strength and more durability are gradually being incorporated in Missouri bridges to extend the lifespans of bridges currently being built.

Finally, the Road to Tomorrow initiative charged with uncovering innovative methods and partners for funding maintenance and construction was launched in 2015. The program is discussed in greater detail in the Roads report.

RESILIENCY

Due in part to the vast number of roads and bridges in Missouri, there is a certain amount of redundancy built into the network, although this may involve significant detours. In fact, MoDOT has begun to adopt the approach of relying on detour routes to facilitate faster replacement of bridges. New bridges, particularly those part of critical lifelines and without viable alternates are being designed to withstand maximum credible earthquake events as well as with features to deter man-made attacks.

OPERATION AND MAINTENANCE

Given the limited funding environment, MoDOT has elected to prioritize maintenance of their current bridge inventory rather than undertaking significant expansions of the statewide system. In many cases this involves overlays, re-decking and repainting bridges. In other cases, where rehabilitation is impractical, or the cost of the repairs would not substantially extend the life of the bridge, complete replacement becomes the fiscally reasonable solution.

BRIDGES

PUBLIC SAFETY

While uncommon, failures of bridges grab headlines and often result in loss of life. Bridges are subject to regular inspections in accordance with federal requirements. Most bridges are inherently redundant, that is, damage to or failure of one component will not result in collapse of the bridge. Those types that have a greater susceptibility for collapse are inspected more closely and more frequently. MoDOT has routinely and promptly closed its bridges that have become unsafe.

Parts of Missouri are prone to major earthquakes. MoDOT has retrofitted some major bridges that could be susceptible to seismic damage, utilizing the latest research and methodology.

REFERENCES

1. <https://www.fhwa.dot.gov/bridge/nbi/no10/defbr16.cfm>
2. <https://www.fhwa.dot.gov/bridge/nbi/no10/owner16.cfm>
3. <https://www.fhwa.dot.gov/policy/2010cpr/execsum.cfm#c3h>
4. <http://www.modot.org/guidetotransportation/>
5. <http://www.modot.org/innovationschallenge/BridgeMaintenanceBestPractices.htm>
6. http://www.modot.org/plansandprojects/construction_program/STIP2016-2020/documents/Sec06SpecialProgrms.pdf
7. <http://www.modot.org/road2tomorrow/>
8. <https://taxfoundation.org/state-gasoline-tax-rates-2017/>
9. <http://www.modot.org/plansandprojects/documents/MissouriDOT-INFRA-Grant-2017-10-30-v3.pdf>
10. Citizen's Guide to Transportation Funding in Missouri, November 2016



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RECOMMENDATIONS

- Modify state legislation to require permitting and regulatory authority of all High Hazard Potential (HHP) and Significant Hazard Potential (SHP) dams.
- Emergency Action Plans (EAPs) should be prepared for all HHP and SHP dams.
- Secure appropriate funding for inspections of all HHP and SHP dams.

EXECUTIVE SUMMARY

Missouri's approximately 5,529 dams help the state meet its agricultural, recreational, storm water management, water supply, and commercial needs. As of July 2017, an estimated 4,624 of dams in the state, or 84% of total structures, were unregulated and their condition not reported to the state. Many of these unregulated structures are small agricultural dams and their failure would be of little consequence. However, due to legislative exemptions, an estimated 1,123 dams in Missouri earning a High Hazard Potential (HHP) or Significant Hazard Potential (SHP) rating are unregulated and their physical condition unknown to the state. A HHP rating indicates that should the dam fail, there is the potential for significant loss of life and property; a SHP rating indicates a potential for significant loss of property. These 1,123 unregulated HHP/SHP dams account for 68% of the total HHP/SHP dams in the state. Because they are unregulated, the condition of these dams is unknown, raising serious safety concerns.

INTRODUCTION

Missouri's estimated 5,529 dams meet a variety of needs including agricultural, recreational, storm water management, water supply, and commercial. The majority of dams in the state are relatively small, of earth construction, and privately owned. Dams that are not privately owned may be owned by a local municipality, the state, a public utility, or the federal government. The Missouri Department of Natural Resources Dam and Reservoir Safety Program (DRSP) has the primary responsibility of permitting and inspecting the state's dams that are not exempt by legislation.

Dams are categorized nationally to indicate the consequences that could be posed if the dam were to fail and release large amounts of water downstream. In Missouri there are an estimated 1,457 dams classified as HHP, which means there is the potential for significant loss of life and property if one of these dams were to fail. An additional estimated 190 dams are SHP meaning there is a potential for significant loss of property and an estimated 3,882 are considered as Low Hazard Potential (LHP).

CONDITION AND CAPACITY

As of July 2017, approximately 4624 of an estimated 5529 dams in the state (84%) were unregulated and their condition not reported to the state. Many of these unregulated structures are small agricultural dams and their failure would be of little consequence. However, an estimated 1,123 of the

DAMS

unregulated dam total are HHP/SHP dams. The conditions of these 1,123 HHP/SHP dams are unknown to the state, and their failure could pose danger to people and serious consequences to property.

Regular maintenance and repair of all dams in Missouri is the responsibility of the individual dam owners. The six full-time DRSP staff provides regular inspection of only the estimated 697 regulated dams under their jurisdiction. If requested, DRSP staff is available to offer assistance to owners of non-regulatory dams in the form of on-site evaluations and general engineering recommendations, but the engineering and construction for any needed improvements are the responsibility of the dam owner.

Of the estimated 1647 HHP/SHP dams in the state, the 466 DRSP regulated HHP/SHP dams were rated as follows in 2017: 92% Satisfactory (acceptable for all anticipated loading conditions); 2% Fair (acceptable for normal loading conditions); 1% Poor (remedial action required); and 2% Unsatisfactory (emergency action required). 3% of the DRSP regulated dams were unrated. The conditions of the 40 Federal dams in the state were rated as: 32.5% Satisfactory; 30% Fair; 20% Poor; and 5% Unsatisfactory (12.5% were unrated). The condition of an estimated 18 dams owned/regulated by state agencies (not DRSP) is not included in this report. As discussed above, the conditions of the estimated 1,123 unregulated HHP/SHP dams are unknown to the state.

An Emergency Action Plan (EAP) is often required to establish emergency contact information and operations to maximize safety of downstream residents in the event of dam failure or dam emergency. As of July 2017, it was reported that 401(85%) of the DRSP regulated 466 HHP/SHP dams had an EAP. The 2016 National Inventory of Dams indicated that there were an additional estimated 135 HHP/SHP dams that should have an EAP, many of which are likely not under DRSP or other regulation. We recommend the development of EAPs for all HHP and SHP dams in the state.

OPERATION AND MAINTENANCE

Many dams were built with corrugated metal pipe or concrete principal spillways to handle the majority of flows through the dam. The anticipated life of corrugated metal is approximately 25 to 30 years, after which the pipes begin to corrode and develop holes. Water can escape through the holes and erode the dam from the inside, potentially causing a sudden failure. The anticipated life of concrete is often 50 to 75 years. The state of Missouri has an estimated 1,800 dams that are over 45 to 50 years old and are therefore expected to be a maintenance concern.

FUNDING AND FUTURE NEEDS

Funding for dams in Missouri is needed to mitigate the impacts of deterioration, meet changing technical standards, and better protect increasingly large downstream populations. Unfortunately, many dam owners, particularly private dam owners, struggle to identify funds to complete necessary rehabilitation and mitigation projects. At one time there was a cost sharing program available through the US Department of Agriculture to assist private dam owners with repairs to HHP/SHP dams but this program is no longer available in Missouri.

An estimated 22 of Missouri's major watershed project dams are more than 40 years old and quickly approaching the end of their 50-year service life. To ward of costly emergency repairs and protect the investments already needed, the Missouri section of the National Dam Safety Review Board estimated in 2015 the state's watershed dams need at least \$2 million annually to keep pace with existing needs.

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DAMS

PUBLIC SAFETY AND RESILIENCE

As of July 27, 2017, a staff of six in the DRSP regulates 466 dams. Funding for the state dam safety program has increased over the past few years, allowing the agency to add inspectors and decrease the number of dams each inspector is responsible for. Federal and other agencies regulate an estimated 58 HHP/SHP dams. While this is good news, it masks a major problem – an estimated 1,123 or 68% of HHP/SHP dams are totally unregulated. This serious situation has occurred because Missouri, by legislation, exempts dams in the state from regulation by the DRSP, regardless of hazard potential, if they are less than 35 feet in height OR are used for agricultural purposes. As a result, little to nothing is known about these structures because dam safety program inspections do not occur.

In August 2016, following a rain storm, an earthen dam on a recreational lake failed in Central Missouri causing downstream flooding and serious roadway damage. This is an example of a dam that was exempted from DRSP review because of its size and subsequently failed. Fortunately, in this case, there was no loss of life.

Increased regulatory oversight of the safety of Missouri dams is critical. Dam failures risk public safety and have the potential to inflict major harm on our economy. As storm severity increases, dams continue to play a critical role in protecting property and life.

RESOURCES

1. ASCE – 2013 Report Card for America’s Infrastructure (2013)
2. Association of State Dam Safety Officials – Performance Report for the State of Missouri (2015)
3. National Inventory of Dams Website, 2016 Inventory
4. Personal Communication – Ryan Stack, PE, Chief Engineer, Missouri Department of Natural Resources, Water Resources Center, Dam and Reservoir Safety Program, July 2017 & April 2018
5. Personal Communication – Mark P Ogden, PE, Association of State Dam Safety Officials, July 2017





RECOMMENDATIONS

- Expand and strengthen the DWSRF program, while also encouraging Congress to fully fund WIFIA.
- Streamline permit processes that delay projects and provide funding necessary to comply with federal public health mandates.
- Increase funding assistance for projects that employ regional solutions, water conservation and/or sustainable infrastructure.
- To facilitate improvement projects, remove onerous requirement of voter approval on revenue bonds.
- Include both water and wastewater service in the affordability analysis for loan and grant programs.
- Appropriate funds to reenergize the MDNR construction grants programs.
- Encourage utilities to perform periodic rate studies necessary to properly capitalize water systems, including maintenance and asset replacement.
- Increase funding for management and operational assistance to small utilities.

EXECUTIVE SUMMARY

Missourians benefit from well-managed and operated private and public water utilities. Unfortunately, these utilities have difficulty securing additional sources of funding and financing due to onerous state requirements that require voter approval to raise new revenue and issue general obligation bonds. As a result, investment in drinking water infrastructure continues to be insufficient, resulting in systems that are plagued with service interruption from main breaks, microbial contamination and inadequate capacity. The City of Kansas City (KC) experienced a record 1,844 main breaks in 2012 and St. Louis is facing similar issues with an average water main age of 55 to 65 years. The Environmental Protection Agency (EPA) estimated in 2011 the 20-year Missouri water infrastructure needs were \$8.5 billion. Improved planning, reduced regulatory impediments, and increased funding are vital if Missouri is to maintain present facilities and ensure safe and reliable water supplies for future generations.

BACKGROUND

Over five million Missourians receive drinking water from 2,735 public systems. The highest utilized source is the Missouri River, which serves 47.3% of the population. The Mississippi River forms the state's eastern border, yet only 1.3% of the population is served by this source.

Missouri's high number of small systems with aging infrastructure and inability to afford improvements negatively impact the state's overall assessment. Among the resources used in this review are the 2016 Missouri Department of Natural Resources (MDNR) State Revolving Fund Annual Report and the 2015 MDNR Annual Compliance Report.

In the most recent EPA Drinking Water Infrastructure Needs Survey and Assessment in 2011, Missouri's needs were estimated at \$8.5 billion through 2030. This is a 5.5% increase from the 2007 Survey. Systems that serve 10,000 or less population comprise 50.2% of the total.

CAPACITY

Missouri consumes an estimated 450 billion gallons (BG) of water annually, with 52%, or 233 BG, attributed to municipal use. The breakdown of public water supply use is estimated at 51.4% domestic, 8.7% commercial, 19.7% industrial, and 20.2% other public uses and

DRINKING WATER

water losses. Kansas City and St. Louis metropolitan areas account for over two-thirds of the total municipal use.

Missouri water systems are losing ground in their effort to maintain and upgrade water infrastructure and add needed capacity. From 1995 to 2011 the 20-year Missouri water infrastructure needs estimated by the EPA increased from \$3.1B to \$8.5B. The 16-year average annual increase is over 6.5%. Very few municipalities or private water companies have adequate funding for asset management and modernization.

CONDITION

Missouri's drinking water systems will require significant investment to maintain current service levels to customers in the future. Missouri's water infrastructure needs were estimated by EPA at \$8.5B through 2030. Approximately 72% (\$6.1B) of the total is for transmission and distribution, with treatment needs at 15% (\$1.3B) and supply and other needs the remaining 13% (\$1.1B).

Evidence of infrastructure age is demonstrated by excessive water main breaks in our largest utilities. KC experienced a record 1,844 main breaks in 2012. By 2013, KC began a program to replace 1%, or 28 miles, of mains annually. This rate requires 100 years for full replacement, but is double the national replacement rate cited in the 2017 ASCE Infrastructure Report Card. The KC program is producing significant year-to-year reduction in the number of main breaks. St. Louis is experiencing similar issues with an average water main age of 55 to 65 years and a replacement rate of approximately 0.5%/yr. Missouri American Water, a private utility that serves approximately 25% of Missourians, is currently achieving a 0.7%/yr. replacement rate.

OPERATION AND MAINTENANCE

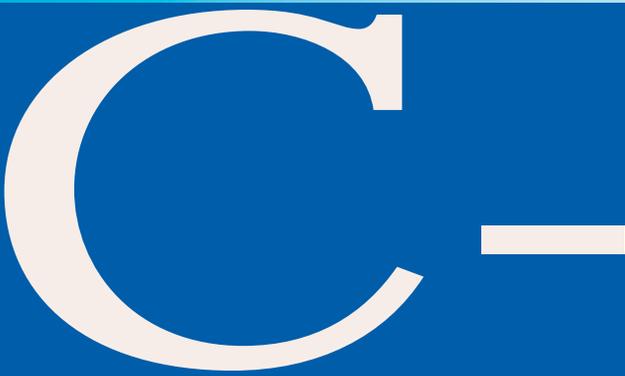
Asset management and reliability centered maintenance (RCM) programs are being employed by medium

and large utilities to identify critical components in their infrastructure and to guide maintenance and renewal decisions. While these programs provide information on the highest priority assets that need replaced or refurbished, the shortage of funding to make the needed improvements remains unaddressed. Most Missouri water systems continue to suffer failures that are the result of deferred maintenance and infrastructure elements that are beyond their useful service life. Consequences from these conditions are emergency repairs that consume valuable budget resources and service interruptions that negatively impact customer confidence. Compounding this situation are declining revenues due to a continued downward trend in per capita water use.

FUNDING

Much of the capital infrastructure funding for public drinking in Missouri is the responsibility of local municipalities and utility districts. Missouri is considered a restrictive funding state due to the requirement of voter approval on all revenue and general obligation bond issues. A further impediment to state and local government operation is the 1980 Hancock Amendment. This state constitutional amendment requires voter approval of any new or increased tax, license, or fee from the level that existed at the time of the amendment's inception.

A valuable resource for water utilities is Missouri's Drinking Water State Revolving Loan Fund (DWSRF). As of 2016, Missouri DWSRF had received a total of \$341 million in capitalization grants from the EPA. Combined with a minimum state match of 20%, Missouri's cumulative DWSRF binding agreements total \$436 million from 73 leveraged loans, 62 direct loans, and 45 grants. Transfers



between the Drinking Water SRF and Clean Water SRF are allowed with EPA's permission. From 2013-2016, a net \$18.5M has been transferred from the DWSRF to the CWSRF in Missouri. In the period 2014-2016, Missouri's allotment of federal DWSRF funds was 2.0% of the total. State allotments range from 1.0% to 9.4%.

The Governor's FY17 budget recommends a \$70M general obligation bond sale for Water Infrastructure Grants and Loans. This same recommendation was made in FY16, but the most recent bond sale under this type of authorization was \$50M in 2007. Missouri construction grants programs benefit small communities that may not qualify for SRF funding programs.

The 2017 Kansas City Mayor's Cost-of-Service Task Force on water and sewer service affordability recommendations included; attempting to negotiate modifications in the sewer Federal Consent Decree to make the customer rate impact sustainable, retaining the declining block rate structure with the life-line rate, setting system development fees such that "growth pays for growth", and assisting low-income customers by using non-rate revenue (late fees) on customer leak detection and water efficiency efforts.

FUTURE NEED

An evident gap exists between the needed \$8.5 billion in capital investment for improving Missouri's water systems through year 2030 and the funding available from federal and state programs. Simply put, capital infrastructure investment is inadequate to fund both current and future public drinking water system needs.

PUBLIC SAFETY

Although the overwhelming majority of the Missouri population receives safe drinking water, a significant number of citizens are negatively affected by water quality standard violations. In 2015, MDNR reported violations

for community water systems serving approximately 7.2% of the population, or about 368,300 people affected. The population percentage affected by these violations is as follows:

- » Bacteriologic – 3.64%
- » Stage 1 and 2 DBP – 2.8%
- » Radiological – 0.33%
- » Chemical – 0.21%
- » Surface Water Treatment – 0.16%
- » Groundwater Rule – 0.12%

The most prevalent type of violations were microbiological contaminants (Total Coliform Rule), with 319 systems reporting 462 non-acute violations. Only 21 public water systems (0.5%) had acute violations for coliform or E. coli and these occurred on very small systems. Boil orders for these acute MCL violations numbered 23 in 2015.

In a move that will enhance surface water sources, the Missouri Clean Water Commission received authority in 2011 to limit new pollutants flowing into its lakes and rivers categorized as distressed. This authority includes the ability to limit pollutant levels allowed in discharge permits and to bring enforcement action against a broader range of facilities.

RESILIENCE

Missouri being a riparian state, has limited authority to manage water quantity withdrawals in areas with limited resources. Source water protection districts are encouraged to protect watersheds used for public water supply. Likewise, system interconnects are encouraged to provide a back-up source during temporary emergencies. The Missouri Rural Water Association has circuit riders to assist water systems with operational challenges and has portable generators available for power outages. SCADA control system use continues to expand providing operators with on-line alarm notifications of equipment failure, power outage, or unauthorized entry.

DRINKING WATER

INNOVATION

The Water Infrastructure Finance and Innovation Act of 2014 (WIFIA) loan program's initial appropriation allowed EPA to offer funding to 12 projects from 43 letters of interest. Missouri's only project is within the Metropolitan Sewer District (St. Louis). This program, if properly funded in subsequent years by Congress, will become an important source of funding for Missouri water projects.

Innovation can also be in the form of improved project delivery methods. In 2016, Missouri legislation went into effect allowing municipalities and utility districts to procure projects through a design-build agreement. This provides Missouri water systems another tool to limit risk, shorten delivery time, and save infrastructure dollars.

Other innovations statewide include greater implementation of GIS systems, smart metering and UV disinfection.

- Raise the Grade Solutions: Expand and strengthen the DWSRF program, while also encouraging Congress to fully fund WIFIA.
- Streamline permit processes that delay projects and provide funding necessary to comply with federal public health mandates.
- Increase funding assistance for projects that employ regional solutions, water conservation and/or sustainable infrastructure.
- To facilitate improvement projects, remove onerous requirement of voter approval on revenue bonds.
- Include both water and wastewater service in the affordability analysis for loan and grant programs.
- Appropriate funds to reenergize the MDNR construction grants programs.
- Encourage utilities to perform periodic rate studies necessary to properly capitalize water systems, including maintenance and asset replacement.

- Increase funding for management and operational assistance to small utilities.

RESOURCES

1. Missouri Budget and Legislative Priorities, Fiscal Year 2017. (<https://archive.org/details/2017MOBudgetLegPriorities>)
2. MDNR 2015 - 20th Annual Compliance Report of Missouri Public Drinking Water (<http://dnr.mo.gov/pubs/docs/pub2662.pdf>)
3. MDNR Drinking Water SRF Intended Use Plan, Fiscal Year 2017 (<http://dnr.mo.gov/env/wpp/srf/docs/dwiup-fy17.pdf>)
4. MDNR Drinking Water SRF Annual Report 2016 (<http://dnr.mo.gov/env/wpp/srf/docs/2016-dw-annual-report.pdf>)
5. Annual Allotment of Federal Funds for States, Tribes, and Territories (<https://www.epa.gov/drinkingwatersrf/annual-allotment-federal-funds-states-tribes-and-territories>)
6. EPA News Release: EPA Selects 12 Projects to Apply for WIFIA Loans (7/19/2017)
7. EPA Drinking Water Infrastructure Needs Survey and Assessment – Fifth Report to Congress (<https://www.epa.gov/sites/production/files/2015-07/documents/epa816r13006.pdf>)
8. Construction Manager at Risk in Missouri - HB 2376 (<http://www.house.mo.gov/billtracking/bills161/billpdf/intro/HB2376l.PDF>)
9. Water Use of Missouri – Missouri State Water Plan Series Volume IV, Missouri Department of Natural Resources (<https://dnr.mo.gov/pubs/WR48.pdf>)

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RECOMMENDATIONS

- Provide a clear statewide energy policy including potential sources of energy generation, goals for make-up of the future generation sources and the transmission (delivery) systems required
- Provide for improvements in critical infrastructure protection cyber security reliability standards.
- Provide for maintenance and retrofit to existing facilities, specifically the aging generation and transmission infrastructure.
- Invest in the research of alternative energy and advanced nuclear energy sources to diversify the energy generation sources within the state.
- Streamline the permitting process to remove unnecessary permitting hurdles that delay critical projects.
- Create proper incentives to catalyze the generation and transmission investments.

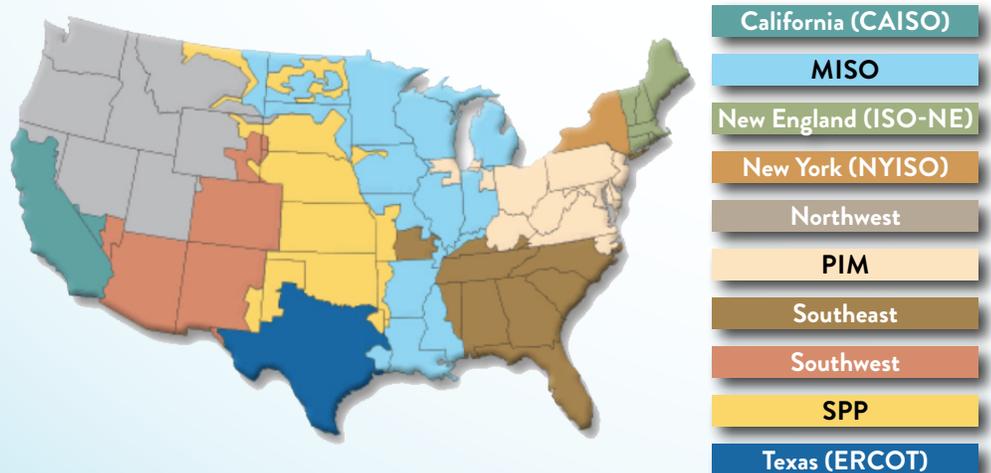
EXECUTIVE SUMMARY

Approximately 79% of the energy in Missouri is produced by coal power plants with another 12% being provided through nuclear energy. The remainder of Missouri's energy needs are met through natural gas, hydroelectric, solar, and wind generation. Aging infrastructure and government regulation continue to be major drivers of large expenditures for both the power plants and in the distribution system. While the retail price of electricity in Missouri is below the national average for all end-users, over the past 10 years state electric rates have risen faster than every other state but four. Additionally, permitting and siting issues continue to threaten planned high-voltage transmission lines as well as oil and gas pipelines.

BACKGROUND

Energy and transmission infrastructure in North America is divided into several networks. These networks separate the infrastructure into geographical regions which are then managed by Independent System Operators (ISO). The ISO's are responsible for supplying the country with efficient and reliable energy. Missouri is part of three ISO networks: Southwest Power Pool (SPP), Midwest Independent Transmission Systems Operator (MISO), and Southeastern Electric Reliability Council (SERC).

Electric Power Markets: National Overview



The nation's energy is primarily generated from four different types of fuel: coal, gas/oil, nuclear, and renewables. Missouri relies principally on generation from coal with eight of the 10 largest power plants in the state being coal-fired. In 2015, officials published the Comprehensive State

ENERGY

Energy Plan, which included recommendations to improve Missouri's access to diverse energy sources, encourage energy efficiency, create jobs and economic growth and facilitate stable energy prices. While this plan is forward progress, the state continues to fall behind its neighbors when it comes to producing renewable energy.

CONDITION AND CAPACITY

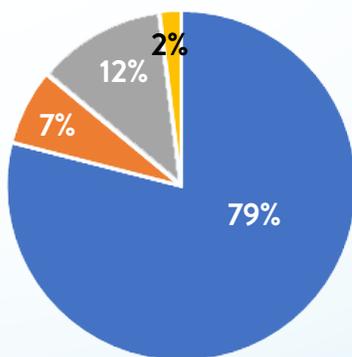
Missouri relies on many miles of transmission lines that are in aged condition and were originally arranged to support local needs instead of regional needs. Due to these dynamics, Missouri power producers are facing uncertainties related to fuel cost variability, environmental regulations, and land acquisition restrictions. Increased investment in generation facilities and transmission/distribution networks is needed to maintain a reliable power system. Including updating and increasing cyber security to ward off increasing cyber attack threats. In October 2017 federal agencies released a joint technical alert providing information on what they deem are "advanced, persistent threat actors." These threat actors employ a variety of methods such as open-source reconnaissance, spear-phishing emails, and watering-hole domains to target industrial control systems.

The electric utilities in Missouri are made up of privately- and publicly-owned electric utilities that generate, transmit, distribute, and/or sell electricity primarily for use by the public. These include investor-owned electric utilities, municipal and state utilities, federal electric utilities, and rural electric cooperatives. Investor-owned electric utilities include Ameren Missouri, Empire District Electric Company, Kansas City Power & Light, and KCP&L Greater Missouri Operations Company. There are 47 distribution electric cooperatives in Missouri and 67 municipally or publicly-owned electric systems. Missouri's several hundred power substations are 45 years old and the state's 500,000 distribution system poles are 40 years old, on average.

Missouri has a large coal fleet. These coal plants are aged and will continue to require maintenance and upgrades. Missouri does not have a viable coal, petroleum, or natural gas reserve in the state. Although a large amount of coal is located in the state, it is not considered viable due to its high sulfur content. Missouri receives a substantial portion of its coal from Wyoming via rail car. Most of the coal, gas, and petroleum consumed in the state are imported from other states. Coal accounts for 79% of Missouri's generation. The average age of Missouri's coal units is approaching 50 years.

Nuclear energy generation accounts for 12% of Missouri's power generation. This nuclear energy is provided by a lone source, Callaway nuclear plant. Renewable (hydroelectric, wind, solar, biogas, and landfill gas) generation account for approximately 2%. Nearly 80% of the renewable generation can be attributed to wind generation with approximately 11% and 8% of renewable generation attributed to solar and hydroelectric generation, respectively.

Utility Scale Net Electricity Generation



Coal Oil/Gas Nuclear Renewables

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Oil and gas make up 7% of Missouri's power generation. Missouri is crossed by many natural gas pipelines that typically enter the state from the west and the south. Major pipelines cross the state, providing the means of transport for these resources into and through the state, including the Rockies Express Pipeline. Missouri has only one natural gas storage field with a capacity of almost 14 billion cubic feet near St. Louis. Natural gas is abundant in neighboring Kansas, and it has established a marketplace that has proved reliable and cost efficient in the near term. This marketplace is tied to innovative methods of drilling, cheaper gas prices, and a strong demand. Infrastructure projects associated with gas delivery have proven to be difficult to permit due to environmental challenges, delaying the potential economic benefits of gas exports and the associated jobs.

Missouri has adopted a renewable portfolio standard that requires investor owned utilities to deliver renewable generation of 10% total output by 2018 and 15% total output by 2021. This renewable standard will require investment in renewable infrastructure or means to purchase reliable renewable energy from other states, including creating a need for upgraded and new transmission. Missouri does have considerable renewable energy potential, and the production of energy from renewable sources in Missouri has increased approximately 15% since 2012.

FUNDING AND OPERATIONS AND MAINTENANCE

The retail price of electricity in Missouri is below the national average for all end-users. Residential and commercial customers pay approximately 80% and industrial customers pay approximately 97% of the U.S. average. This is primarily linked to Missouri's use of coal generation. However, in recent years, electric rates have increased at a much faster pace than the national average. From 2007 to 2016, rates in the state increased 46.7%, while the average nationwide increase was just

11.2%. Missouri was ranked third among the states for increases during this time period. The state will lose its competitive edge and the cost of living will continue to increase if modernization of the state's electric grid is not undertaken in the coming years.

Because the majority of the U.S. transmission system is 50 to 60 years old, significant replacements and/or upgrades are required now and in coming years to maintain and improve system performance with much of the system approaching/exceeding its useful life. Extensive investments also are needed to integrate new renewable and distributed energy resources and to respond to a rapidly changing energy mix. It typically takes approximately three times longer to site, permit, design, and construct a transmission pipeline than a fossil energy pipeline.

Given current trends, a national energy infrastructure investment shortfall of \$107 billion is expected by 2020. This lack of investment is expected to reduce GDP by \$126 billion and cost 529,000 jobs by the year 2020.

FUTURE NEED

Missouri has a unique power network, containing three regional entities, the SPP, MISO and southeast pool. The SPP, MISO and southeast pool are responsible for maintaining their respective infrastructure and charting unique paths forward, dependent on their regional needs. In the SPP region, the anticipated average growth in the upcoming years is forecasted to be roughly 1.16 % annually. As of 2017, the SPP generation portfolio consisted of the following breakdown: gas/oil (15%), coal (31%), renewables (hydro, wind, solar) (47%), and nuclear (7%). The Midwest ISO (MISO) growth for baseline peak demand is forecasted to increase on average 1.3 % per year through 2025. As of July of 2016, the MISO generation portfolio had a market capacity of 180,711 MW. As of July 2016, the SERC capacity was 238,000 MW.

ENERGY

PUBLIC SAFETY

The Missouri Public Service Commission regulates investor-owned electric, natural gas, steam, water, and sewer utilities in Missouri. The commission also regulates the operational safety of the state's rural electric cooperatives and municipally owned natural gas utilities. Investment is needed to harden energy infrastructure against natural disasters and cyber threats. If this need is not met public safety could be in jeopardy due to prolonged power outages. Additionally, if investment is not made to maintain Missouri's oil and gas pipelines periodic leaks and failures present risks to the environment and the public.

RESILIENCE

Without the needed improvements, the probability of failure associated with weather related events increases for transmission infrastructure. The most common natural hazard in Missouri is thunderstorms and lightning. The second-most common, and with the highest loss of property, is flooding. The leading cause of electrical transmission outages is due to severe weather thunderstorms, but winter storm severe weather affected the largest number of electric customers as a result of the outages.

INNOVATION

Utilities can create a more reliable business model through more efficient transmission systems. Creating an efficient system appears to be an opportunity currently being vetted utilities. Transmission infrastructure is critical to creating a reliable energy distribution network for a day-ahead marketplace. With the establishment of a day-ahead marketplace, it appears that utilities and their clients could potentially benefit from these efficiencies as well as improve reliable energy delivery. Financial incentives and improvements to permitting speed and land access would help accelerate these projects.

RESOURCES

1. Missouri Department of Economic Development Division of Energy. https://energy.mo.gov/sites/energy/files/Executive_Summary_FINAL_10.05.2015.pdf
2. FERC Federal Energy Regulatory Commission. <https://www.ferc.gov>
3. U.S. Energy Information Administration. <https://www.eia.gov>
4. Energy Star. https://www.energystar.gov/ia/partners/.../state.../State_Profiles_Missouri_508.pdf
5. U.S. Department of Energy. State of Missouri Energy Sector Risk Profile.
6. Midwest Independent Transmission Systems Operator. <https://www.misoenergy.org>
7. Southwest Power Pool. <https://www.spp.org/>
8. North American Electric Reliability Corporation. 2016 Summer Reliability Assessment.
9. Missouri Public Service Commission. <https://psc.mo.gov/>
10. Consumer Energy Alliance. <https://consumerenergyalliance.org/cms/wp-content/uploads/2018/01/CEA-Missouri-Energy-Grid-Modernization-Report.pdf>
11. The Missouri Times. <https://themissouritimes.com/46496/rep-berry-files-bill-to-cap-electric-rates-and-modernize-missouris-energy-grid/>
12. United States Computer Emergency Readiness Team. <https://www.us-cert.gov/ncas/alerts/TA17-293A>

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RECOMMENDATIONS

- Increase the USACE budget for dredging of the navigation channel and maintenance of the locks and dams and control structures within the waterways.
- Develop innovated process to streamline the planning and permitting for projects within the waterways.
- Initiate a study to investigate options for providing a more consistent river flow (depth) on the Missouri River.
- User fees should be considered for the non-navigational beneficiaries of the inland river system such as water supply sources for municipal, industrial and farming purposes, as well as, the recreation industry in order to provide additional funding for the O&M needs of the system.
- Development of a strategy and method to prioritize projects on the basis of the service needs of the system would be a prudent approach towards allocating these limited funds available for investment.

EXECUTIVE SUMMARY

The State of Missouri has over 1,050 miles of navigable waterways positioned on the Missouri, and the Upper Mississippi rivers, ranking it 10th in the nation in terms of mileage. Funding shortfalls to repair and replace locks and dams on the Mississippi River are common, and Congressional appropriations are inconsistent. This causes delays in maintenance dredging, often leads to an increase in unscheduled delays at the locks, and frequently results in costly emergency funds serving as a major source of revenue for needed repairs. In fact, in fiscal year 2016 alone, the USACE allocated \$1.6 million in emergency lock repairs for the St. Louis District. On the Mississippi River, shippers also must contend with five locks with 600-foot chambers. Unlike 1,200-foot chambers, which allow for a 15-barge tow to navigate through efficiently, 600-foot chambers require a barge tow to break up to navigate through the lock, thereby increasing the time and cost to move goods.

CAPACITY

The State of Missouri has over 1,050 miles of navigable waterways positioned on the Missouri river, which runs from Kansas City east to St. Louis, and the Upper Mississippi river, which runs from the Des Moines River near Alexandria south to the bootheel near Caruthersville. The river system carries commodities such as sand and gravel, agricultural products, manufactured goods, chemicals, petroleum and coke, cement and metals

The Mississippi River has seven locks that reside in the upper portion of Missouri and is free-flowing south of St. Louis. Of these locks, only two of them have 1,200-foot chambers which allow for a 15-barge tow navigate through it efficiently. The others rely on 600-foot chambers that require a barge tow to break up in order to navigate through the lock, thereby increasing the time needed to move goods through the lock and the overall cost to the shipper. While the Water Resources Development Act of 2007 authorized locks 20, 21, 22, 24, and 25 to construct 1200-foot chambers, funds from Congress have not been appropriated. And even if those projects were to be undertaken and completed, the middle portion of the Upper Mississippi lock system would still be comprised of 600-foot chambers.

The Missouri River is free flowing throughout the state. Unfortunately, this provides for unreliable depths within the navigation channel that results in a limited “barge season” that runs from April to November on a given year. This limited access to the Missouri River for barge traffic results in reduced

INLAND WATERWAYS

shipping from the ports and terminals located on the river and pushes commodities that are a natural for the inland river system on to the rail and highway network. Without a lock and dam system on the Missouri River, operators will continue to struggle with the unreliability of the navigation channel. This leads to terminals and operators moving cargo off the river and onto other modes, thus reducing the tonnage using the system which leads to a reduction of available funds to maintain the system.

CONDITION

The vast majority of the locks and dams located on the Mississippi River were constructed in the 1930s and are considered beyond their 50-year design life. Age alone is not a useful indicator of condition given the fact the Corps of Engineers has completed various levels of repairs and rehabilitation on these structures over the years. However, as time goes on, infrastructure needs increased attention and resources applied to repairs and maintenance in order to extend its respective useful life. With the competing uses of the Missouri River for hydroelectric power, flood control, municipal water, irrigation, fish and wildlife habitat and recreation, it is challenging to balance the stewardship of the environment and the maintenance of its required 9-foot navigation channel. In fact, a landmark ruling was made in March 2018 in the case of *Idecker Farms, Inc., et al. v. United States* (Case No. 14-183L) which found the Corps of Engineers responsible for much of the increased flooding experienced downstream of these structures since the Missouri River Recovery Program (MRRP) began in 2004. While there is still potential for this case to be appealed and litigation to continue, the lasting effect of this ruling is expected to change the dynamic of how these competing interests are handled in the future.

OPERATIONS AND MAINTENANCE

All of the inland waterways for the State of Missouri are under the jurisdiction of the U.S. Army Corps of Engineers. The Corps of Engineers are responsible for

the maintenance and operation of the infrastructure within the navigable waterways. This includes the locks and dams and dredging within the authorized channel to the 9-foot authorized depth. However, funding shortfalls are common, and Congressional appropriations are inconsistent. This causes delays in maintenance dredging, often leads to an increase in unscheduled delays at the locks, and frequently results in costly emergency funds serving as a major source of revenue for needed repairs. In fact, in fiscal year 2016 alone, the USACE allocated \$1.6 million in emergency lock repairs for the St. Louis District.

The lock system is especially sensitive to the funding shortfalls due to the advanced deterioration of many of the locks. While the Corps of Engineers has made great efforts to utilize the limited funds they receive, there just is not enough funding to allow for appropriate modernization and/or replacement. While much of the focus of the inland waterways infrastructure needs is directed towards navigation, the structures in place to protect the navigation channel provide for the needs of other beneficiaries such as municipal, industrial and farming water supplies, as well as recreation. These beneficiaries do not provide a direct revenue stream towards the operations and maintenance needs of the system they depend on.

FUNDING

Funding for the inland waterway system is a federal responsibility. The lock and dam system that helps provide a consistent channel depth on the Upper Mississippi River and the dredging needs to maintain the authorized navigation channel continues to be underfunded. The Inland Waterways Trust fund is setup to help pay for capital projects on the system. These projects are paid for on a 50/50 cost-share between the federal government and

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tax revenue on fuel used by the barge industry. While the Inland Waterways Trust Fund does provide some investment funds on capital projects (especially after the users increased the 29 cents-per-gallon tax on barge fuel by nine cents in April of 2015), there are not enough funds to cover all the needs of the system. Operations and maintenance needs are not allowed to be funded by this trust fund account and are 100% the responsibility of the federal government.

FUTURE NEED

Projects on the inland waterways are funded through a two-step process. They must first be authorized by Congress in a water resource bill and then funded through annual appropriations. Congress passed the Water Resources Reform and Development Act in 2014 and the Water Infrastructure Improvements for the Nation Act in 2016, both of which included projects for the inland river system. Unfortunately, most these projects only included the necessary authorizations and not the corresponding appropriations stream to implement the projects.

The USACE Navigation and Ecosystem Sustainability Program has looked at long-term navigation improvements and ecological restoration along the Upper Mississippi River. Five of the locks located on the Upper Mississippi River are proposed to be reconstructed to 1,200-foot chambers (#20, 21, 22, 24, 25). While these projects were authorized by the USACE in 2004, they are far from becoming reality.

While past practices tend to focus on assessing the validity of a project using a benefit-cost analysis of a particular project to determine whether or not it meets a minimum threshold, they have not been used to rank projects for priority. This only tends to add projects to the backlog of authorizations, compounding the need for the limited funds made available for capital investment in the system. The Transportation Research Board made a recommendation in 2015 that the development of a strategy and method to prioritize projects on the basis of the service needs of the system would be a prudent approach towards allocating these limited funds available for investment.

PUBLIC SAFETY

One gallon of fuel can move one ton of cargo 647 miles on the waterways, compared to 477 miles on rail or 145 miles on the road. Because of this,

INLAND WATERWAYS

waterway transportation provides significant environmental benefits and a reduction in fatalities. The Texas Transportation Institute has shown that inland marine transportation provides many environmental advantages such as less emissions per ton-mile when compared to rail and road. The waterways account for 15.6 metric tons of greenhouse gases per million ton-miles compared to 21.2 on the railroads and 154.1 on the highways. Additionally, less spills occur each year on our rivers compared to the other modes; 2.12 gallons spilled per million hazmat ton-miles on the river, compared to 5.95 on the railroads and 6.04 on the highways. From 2001-2014, both fatalities and injuries are nearly non-existent on the inland rivers compared to those on the railroad and highways systems. The rate of fatalities per million ton-miles during this time is a total of six on the waterways compared to 807 on rail and 4,452 on the highways.



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RESILIENCE

The river system tends to have great swings in water levels throughout the year. It is not uncommon to see 30- to 40-foot swings within the summer months on the Mississippi in St. Louis. Over the past few years, the system has experienced some extreme flood events and droughts which have had an impact on the reliability for shippers.

INNOVATION

Planning, design and funding for projects on the inland river system tend to take decades from the time they are conceived to when they are placed in service. This long-lead process is not conducive for the ever-changing markets. Shippers require flexible and nimble freight options. The current process of federal authorization and appropriation just does not allow for creative investment. Alternative financing options need to be explored that allow for private investment and a faster permitting process in order to bring infrastructure projects to completion on a timeline that meets market demands for shippers.

RESOURCES

1. Texas A&M Transportation Institute, Center for Ports and Waterways, “A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2014”, January 2017
2. Margaret Stafford, The Associated Press, republished by St. Louis Regional Freightway, “Barge Traffic Makes a Resurgence on the Missouri River”, Published online May 30, 2016 <https://www.thefreightway.com/barge-traffic-makes-a-resurgence-on-the-missouri-river/>
3. Suzanne Hogan, KCUR 89.3, “Making the Case for Barges on the Missouri River”, published online April 12, 2016 <http://kcur.org/post/making-case-barges-missouri-river#stream/0>
4. U.S. Chamber of Commerce, “Waterways Work for Missouri” State Fact Sheet, accessed online <https://www.uschamber.com/programs/lets-rebuild-america/waterways-work-america>
5. Missouri Department of Transportation, “Missouri State Freight Plan”, 2014
6. Missouri Department of Transportation, “Economic Impact Study for Public Ports”, 2018

INLAND WATERWAYS

7. U.S. Army Corps of Engineers – Kansas City District, “Missouri River Bed Degradation Feasibility Study Technical Report”, May 2017
8. Texas Transportation Institute, “Our Inland Waterways: A Maintenance and Funding Challenge”, published online, July 16, 2015, <https://tti.tamu.edu/2015/07/16/our-inland-waterways-a-maintenance-and-funding-challenge/>
9. Patrick O’Connell, Chicago Tribune, “Illinois Rivers Project Could Get New Life with Trump Infrastructure Push”, published online March 13, 2017, <http://www.chicagotribune.com/news/local/breaking/ct-river-locks-trump-infrastructure-met-20170213-story.html>
10. Missouri River Flood Case Website, www.missouririverflooding.com, accessed March 2018
11. American Society of Civil Engineers – St Louis & Kansas City Section, “Inland Waterways Infrastructure Report Card”, 2013
12. Transportation Research Board, “Special Report 315: Funding and Managing the U.S. Inland Waterways System – What Policy Makers Need to Know”, 2015
13. U.S. Army Corps of Engineers – Waterborne Commerce Statistics Center, “Preliminary Waterborne Commerce Statistics for Calendar Year 2016, Waterborne Commerce National Tools and Selected Inland Waterways for Multiple Years”, August 1, 2017
14. U.S. Army Corps of Engineers – Navigation and Civil Works Decision Support Center, “The U.S. Waterway System, Transportation Facts & Information”, November 2013
15. U.S. Army Corps of Engineers – Navigation and Civil Works Decision Support Center, “The U.S. Waterway System, Transportation Facts & Information”, June 2015
16. U.S. Army Corps of Engineers – Navigation and Civil Works Decision Support Center, “The U.S. Waterway System, 2014 Transportation Facts & Information”, December 2015
17. U.S. Army Corps of Engineers – Navigation and Civil Works Decision Support Center, “The U.S. Waterway System, 2015 Transportation Facts & Information”, November 2016
18. U.S. Army Corps of Engineers, “Final Integrated Feasibility Report and Programmatic Environmental Impact Statement for the UMR-IWW System Navigation Feasibility Study”, September 24, 2004
19. U.S. Army Corps of Engineers – Headquarters, “WRRDA 2014 Implementation Guidance”, published online and accessed September 25, 2016, http://www.uasce.army.mil/missions/civil-works/project-planning/legislative-links/wrrda2014_impguide/
20. 113th U.S. Congress – Second Session, “Water Resources Reform and Development Act of 2014”
21. 114th U.S. Congress – Second Session, “Water Infrastructure Improvements for the Nation Act”

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RECOMMENDATIONS

Leadership is required on state and federal levels to coordinate levee maintenance and repairs, and to identify needed improvement to hold back major floods. Innovative methods of communication and synchronization of activities between levee districts are needed.

Funding the National Levee Safety Initiative under the Water Resources Development Act (WRDA) would help fund the state program for levee inspections and increase funding for levee repair in Missouri. The Missouri state program would particularly benefit from the following actions:

- Complete the National Levee Inventory for both federal and nonfederal levees.
- Complete levee mapping as outlined in the National Flood Insurance Program reform bill and implement FEMA's new levee mapping and analysis program.
- Funding of the National Levee Safety Initiative (NLSI) could help close the gap on levee inspections.

EXECUTIVE SUMMARY

Over the past five years, levees in Missouri have undergone increased inspection, repair, and capital improvements. The structures that are being inspected are in fair condition. However, there has been a piecemeal approach to capital improvements, with some levees being raised while neighboring levees are unchanged, resulting in an increased risk of flooding in the neighboring areas. Additionally, coordination between levee districts is lacking, and people and property remain vulnerable to flooding. While the U.S. Army Corps of Engineers and the Missouri State Risk Management Team are raising awareness and developing flood hazard identification maps, funding is insufficient to comprehensively mitigate flood risks. Funding of the National Levee Safety Initiative could help close the gap on levee inspections.

BACKGROUND

The Missouri River flood of 2011 spurred the United States Army Corps of Engineers (USACE), levee districts, and cities to improve levees, sewers, and pump stations. Levees with observed problems during the flood are being re-designed to improve their stability. Cities are constructing permanent systems to remove runoff water behind levees during long-term floods (duration greater than one month). Some of this work is ongoing.

Lack of coordination among levee districts on the Mississippi and Meramec Rivers has been reported. A recent USACE study (Rock Island District) found that 80 out of 202 miles of levees from central Iowa to St. Louis are above their authorized heights, some by as much as two to four feet. Missouri, Iowa, and Illinois all have levees in violation of Corps requirements, with Illinois reportedly having the most. A proposed rule change by the State of Illinois could start a race of who can build their levees higher and faster. In a letter dated May 9, 2017, the Missouri Attorney General, Josh Hawley, urged the Illinois Department of Natural Resources (ILDNR) to back away from its plan to allow levee districts along the Mississippi to raise their levees at the expense of Missouri acreage. Several Illinois legislators have subsequently weighed in on both sides of the rule change, which is still under review.

LEVEES



CONDITION AND CAPACITY

The National Levee Database (NLD), a compilation of levees participating in USACE programs, lists Missouri as having a total of 335 levees with a total length of 2,729 miles. Levees in Missouri included in the database have increased 57% by number, or 32% by mileage, since 2010. These are positive developments, since an increased number of levees in the NLD should result in an increased number of levees being inspected and an increased number of levees being maintained and repaired.

The NLD indicates that 231 levees (69%) undergo routine inspections. The inspections cover 2,132 levee miles (78%). The inspections found 34 levees (10%) to be in an unacceptable condition, covering 502 levee miles (18%). Seventy-five levees (22%) covering 340 levee miles have not been inspected.

The USACE has developed a program called the Rehabilitation and Inspection Program (RIP) to ensure that flood control works continue to provide reliable protection to the public. In Missouri, 243 levees covering 1,850 levee miles (68% of total) are registered as active in RIP.

OPERATIONS AND MAINTENANCE

Long-term repairs include replacement of aging pipe penetrations, backfilling of settlement and erosion damage, repair or replacement of concrete structures, or other capital improvements. The NLD indicates that approximately 30% of Missouri's levees have adequate funding for long-term repairs, compared with 5 to 10% in the 2013 report card.

FUNDING

The 2014 Water Resources Reform and Development Act (WRRDA) created a new National Levee Safety Initiative (NLSI). The NLSI creates levee safety guidelines, a national levee inventory, a rehabilitation and repair program, and provides assistance to states for establishing related safety programs. WRRDA authorized \$395 million to support NLSI. However, funding has been not yet been appropriated and the program has not been identified in the Presidential Budget Request as a priority.

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RECOMMENDATIONS

continued

- Assess levees using updated hydrology and hydraulic analyses that incorporate the impact of urbanization and the effects of raising levees on adjacent properties.
- Provide leadership to coordinate communication and activities between levee districts along a river.

While the President's budget does not call for funding for NLSI, it does advise Congress to increase funding for other flood control-related components of infrastructure. The Trump administration budget calls for a 15% increase in funding for 2018 for operation and maintenance of inland waterways and coastal navigation projects. In general, a new emphasis of infrastructure investment is being touted by the Administration and Congress.

RESILIENCE AND INNOVATION

USACE. The Rock Island and St. Louis Districts are performing hydrologic modeling studies and flood plain mapping for the Upper Mississippi and Meramec River with planned completion in 2018.

SRMT. The State Risk Management Team (SRMT) in Missouri under the umbrella of the State Emergency Management Agency (SEMA) is working with the Kansas Hazard Mitigation Team to develop a prototype inundation map to convey flood risks to communities between Parkville, Missouri, and Leavenworth, Kansas. They intend to extend the map to all of the Missouri River floodplain within the state. The pilot program is funded by the USACE Silver Jackets program. The SRMT is also evaluating flood risks in Buchanan County, on the Little Blue River in Kansas City, and Roubidoux Creek in Waynesville.



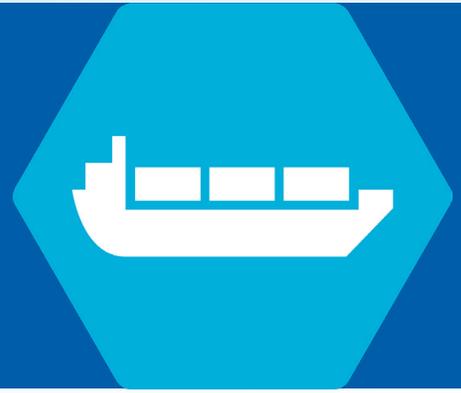
LEVEES



RESOURCES:

1. ASCE – 2017 Infrastructure Report Card.
2. USACE National Levee Database; <http://nld.usace.army.mil> (accessed August 2017).
3. Levee Owner’s Manual for Non-Federal Flood Control Works; USACE, March 2006.
4. 2013 Report Card for Missouri’s Infrastructure; ASCE.
5. “Proposed Amendments to Illinois Administrative Code Title 17, Part 3700,” letter to Mr. Loren Wobig, OWR Regulatory Projects Division Manager, Division of Resource Management, Illinois Department of Natural Resources from Joshua D. Hawley, Attorney General of Missouri, dated May 9, 2017.
6. Quotation from Scott Whitney, Chief of Project Management, U.S. Army Corps of Engineers Rock Island District, “Overbuilt levees upstream reignite skepticism about ones near St. Louis,” Bryce Gray, St. Louis Post-Dispatch, May 1, 2017.
7. “Illinois plan for higher levees concerns some in Missouri,” Jim Salter, Associated Press, reported in St. Louis Post-Dispatch, June 20, 2017.
8. Silver Jackets Program; <http://silverjackets.nfrmp.us>.

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RECOMMENDATIONS

- Identify additional funding opportunities for capital investment within Ports. Specifically, find ways to apply local matches for large federal grant programs.
- Initiate a study to investigate options for providing a more consistent river flow (depth) on the Missouri River.
- Provide training to port authorities on how to use the new legislation to attract customers and leverage revenue for future grants.

EXECUTIVE SUMMARY

The State of Missouri has a good port system with connections to much of the state's expansive freight network. The Missouri Department of Transportation (MoDOT) recently conducted an economic impact analysis which showed that nearly four million tons of freight was shipped through the state's public ports in 2016 alone, equating to a 78% increase since 2011. Ports in Missouri have sufficient capacity to accommodate this growth and adequate access to the Interstate Highway System, Class I railroads, and major utility services. However, funding for capital projects and regular operation and maintenance continue to be a challenge. Governors Nixon and Greitens reduced funding for ports starting in 2016 as an attempt to balance the state's budget. In FY2017, ports received just over \$4 million for their programs, down from \$6 million in 2016. Alternative revenue streams, grants from federal programs, and innovative financing should continue to be perused in order to prepare for the 26.9% increase in waterway freight that is anticipated by 2030.

BACKGROUND

The State of Missouri has 15 public port authorities and over 200 private terminals located along the Missouri and Mississippi Rivers. Missouri Statue allows for the formation of Port authorities at the city and county government level to foster local economic development. These ports serve as a vital link within Missouri's transportation chain, facilitating the movement of over 500 million tons of cargo each year. Ports provide businesses within Missouri a strategic logistical advantage over other states. The ability to access the inland waterways provide significantly lower transportation costs to shippers. The lower logistical costs, in concert with public investment, attracts private investments that create economic opportunities in both the short and long term for the communities and regions with ports.

Figure 1:
Map of Ports
(Missouri Business Magazine)

- public port
- rivers
- interstate
- county boundaries



PORTS

CAPACITY

One of the greatest assets the ports in Missouri have to offer is capacity. Nearly all Missouri ports have sites ranging from five to 250 acres available for industrial development. With access to the Interstate Highway System, Class I railroads and major utility services, Missouri ports are positioned well for economic prosperity. As it stands today, much of the commodities moving through Missouri ports are agricultural products, as the state is a major agricultural producer. 62% of soybeans and 46% of corn grown in Missouri is exported abroad, including to Asian nations via the Panama Canal. The Port at St. Louis is the second largest inland port in the U.S. by trip-ton-miles and third largest by tonnage. Ports help facilitate trade and contribute significantly to the state's economy and can continue to do so well into the future. The Missouri Department of Transportation expects that by 2030, waterway freight within the state will increase by 26.9%.

CONDITION

The conditions of the ports within Missouri are as diverse as the jurisdictions they serve. The ports located within larger metropolitan areas, such as the Port of St. Louis, the Port of Kansas City and Southeast Missouri Port, are thriving with development. More rural ports, such as Pike/Lincoln County, are struggling to develop. Some have been placed out of commission by flooding like the Port of New Bourbon.

OPERATIONS AND MAINTENANCE

With limited funding sources, maintenance of existing infrastructure tends to be a struggle for most ports. The ports that do not fund routine maintenance still fall short of their overall needs. Additionally, when unscheduled maintenance or repairs are needed, most ports struggle to find funds to adequately address.

In MoDOT's 2015 State Freight Plan, the agency provides a list of "top five" port and waterway system needs. The number one priority, according to MoDOT, is the maintenance of both land and water side operations.

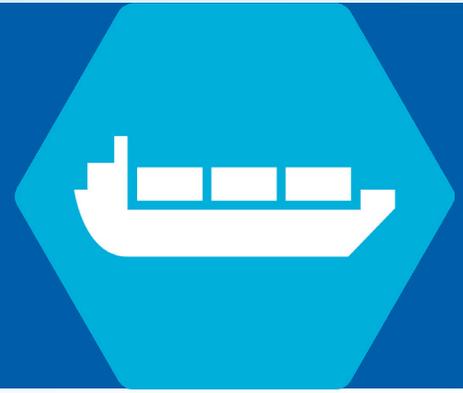
Additionally, the agency identifies support for the development of emerging ports as important.

FUNDING

The Ports within the State of Missouri are fortunate to have several funding sources available to them. Port capital needs are jointly prioritized annually each fall by the MoDOT and the Missouri Port Authority Association. MoDOT typically budgeted \$3 million per year for ports since 2012 and increased this funding to \$6 million in 2015. However, both Gov. Nixon and Gov. Greitens reduced funding for ports starting in 2016 as an attempt to balance the state's budget. In FY2017, ports received just over \$4 million for their programs. MoDOT did reinstate their cost share program in 2017 which allows entities, such as Missouri Public Ports, to use additional MoDOT funds for roadways and bridge improvements at a 50/50 cost share.

In addition to capital and administrative funds available through the state DOT, there are a variety of economic development programs to assist in providing competitive financing packages to prospective developers and investors. Ports have access to Community Development Block Grants, Enhanced Enterprise Zones and the newly implemented Port Authority Advanced Industrial Manufacturing Zone Fund. The Missouri Department of Transportation has indicated that for every \$1 of public funds invested into the Ports results in between \$7-10 in private investment.

However, one issue that the ports struggle with is finding matching funds for large grant opportunities. Existing federal grant opportunities, like the U.S. Department of Transportation's TIGER program or INFRA (formally known as FASTLANE), both support capital projects in the tens of millions of dollars range. Unfortunately, finding



matching funds to be qualify and be competitive in the grant application process is practically impossible for the smaller ports with limited or no revenue in their annual budget.

FUTURE NEED

In order to be ready for future freight needs, ports will have to invest in large-scale capital projects that leverage the unique transportation assets they have available. This means construction of new cargo facilities that will meet the rising consumer demand for raw commodity movements in agriculture and petroleum. Additionally, efforts are underway to utilize the inland waterways for container-on-barge traffic to provide optimizations and efficiencies on the movement of consumer goods due to the Post-Panamax traffic through the gulf. The Missouri Department of Transportation identified within their 2015 freight plan some key issues that will need to be considered to address the anticipated growth of freight to the states waterways. These issues are the under-utilization of the Missouri River, low water levels that occur throughout the year, outdated locks, continued funding opportunities for ports, and the need for consistent support for dredging.

PUBLIC SAFETY

Both the Corps of Engineers and U.S. Coast Guard have jurisdiction over the safety of the inland river systems. The ports typically have their operators and tenants apply any appropriate safety protocols and procedures that are necessary for their industry.

RESILIENCE

Transportation connections to the ports via rail and road are reliable. However, the river system has limited reliability as a result of many complex dynamics that come into play. While the Upper Mississippi River's lock and dam system provide for a consistent flow and channel depth, the Mississippi River south of St. Louis has seen periods of low water that has resulted in reduced cargo movements and even closures of the system. Additionally, the Missouri

River's barge season is primarily limited to April through November; outside of those months the river levels are too low to reliably move cargo.

INNOVATION

Much of the innovation attributed to the ports in Missouri are related to the legislative actions taken to open up opportunity for additional funding streams. Specifically, Missouri Senate Bill 861, which became effective at the end of August 2016, provides a new funding stream that helps funds capital projects within the ports. This act establishes Advanced Industrial Manufacturing Zones, areas that are being developed or redeveloped within a ports jurisdiction and establishes a special fund consisting of 50% of the state withholding tax from new jobs within the zone. Additionally, beginning in January of 2017, the Transportation Facilities Tax Incentive became effective. This allows manufacturers or distributors shipping cargo by waterborne vessel through a port facility located in Missouri to apply up to a \$50 deduction per shipping container moved once a prior year baseline is established and up to \$3,500 per new full-time employee or 2% of capital investment made in an international trade facility. These types of creative funding programs allow Ports to package attractive investment deals for new development.

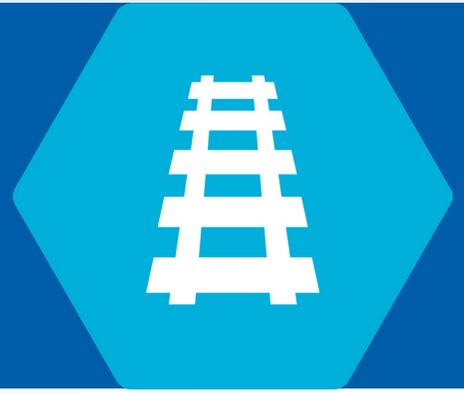
RESOURCES

1. Texas A&M Transportation Institute, Center for Ports and Waterways, "A Modal Comparison of Domestic Freight Transportation Effects on the General Public: 2001-2014", January 2017
2. Missouri Department of Economic Development, "Advanced Industrial Manufacturing Zones Act", August 2017
3. ASCE Infrastructure Report Card Survey for Missouri Ports, published online and last accessed on September 25, 2017, https://docs.google.com/forms/d/e/1FAIpQLScE6KyESdO939JDnGLmov-jujoSaDEcWjJUkwhEyUYeq0xxTg/viewform?usp=sf_link

PORTS

4. Margaret Stafford, The Associated Press, “Barge Traffic Makes a Resurgence on the Missouri River”, Published online May 30, 2016, <https://apnews.com/5536a51e82344a23b2b9b26bb95f4873/barge-traffic-makes-resurgence-missouri-river>
5. Rep. Shelley Keeney Capital Report, Daily Journal Online, “Importance of Missouri Ports”, published online September 30, 2015, http://dailyjournalonline.com/democrat-news/news/opinion/columnists/legislative/importance-of-missouri-ports/article_d3c4f006-d643-5740-b8cd-0f556b833bd1.html
6. Jim Cunningham, KMBZ 98.1fm, “KC Port Officials Have High Hopes for Increased Barge Traffic”, published online March 31, 2017, <http://www.kmbz.com/articles/kc-port-officials-have-high-hopes-increased-barge-traffic>
7. Missouri Ruralist, “Missouri Governor’s Port Proposal Will Help Move Farm Commodities”, published online January 21, 2016, <http://www.missouriruralist.com/story-missouri-governors-port-proposal-help-move-farm-commodities-9-136576>
8. Missouri Department of Transportation, “MoDOT Waterways Summary”
9. Travis Zimpfer, The Missouri Times, “Port Committee Holds First Interim Hearing”, published online August 12, 2015, <http://themissouritimes.com/20926/port-committee-holds-first-interim-hearing/>
10. Jacob Luecke, Missouri Business, “River Port Renaissance”, published online August 17, 2015, <https://mobizmagazine.com/2015/08/17/river-port-renaissance/>
11. Missouri State Senate, “Senate Bill 861 – Advanced Industrial Manufacturing Zones”, http://www.senate.mo.gov/16info/BTS_Web/Bill.aspx?SessionType=R&BillID=23922639
12. St. Louis Freightway, “St. Louis Regional Ports and Terminals Ranked Most Efficient”, published online September 21, 2017, [http://www.thefreightway.com/regional-ports-in-st-louis-ranked-most-efficient/?ct=t\(N\)](http://www.thefreightway.com/regional-ports-in-st-louis-ranked-most-efficient/?ct=t(N))
13. Missouri Department of Transportation, “Update of Missouri Port Authority Assessment”, November 2007
14. Missouri Department of Transportation, “Economic Impact Study for Public Ports,” February 2018
15. Missouri Department of Transportation, “Cost Share Program Guidelines,” April 2017
16. Missouri Department of Transportation, “Financial Snapshot – An appendix to the Citizen’s Guide to Transportation Funding in Missouri,” November 2017
17. Missouri Port Authority Association, “Missouri Ports Flyer” available online via MoDOT <http://www.modot.org/othertransportation/waterways/waterwaysgeneralinformation.htm>
18. U.S. Chamber of Commerce, “Waterways Work for Missouri” State Fact Sheet, accessed online <https://www.uschamber.com/programs/lets-rebuild-america/waterways-work-america>
19. Missouri Department of Transportation, “Missouri State Freight Plan”, 2014
20. •Bob Watson, Missouri News, “Mix of Cuts, Increases in State Budget”, published online February 5, 2017, <http://www.newstribune.com/news/missouri/story/2017/feb/05/mix-cuts-increases-state-budget/660319/>
21. David Lieb, The Associated Press, “Nixon’s \$59 million in Budget Cuts Include \$1.9 million for Missouri State”, published online September 15, 2016, <http://ky3.com/content/news/nixon-budget-cuts-59-million-393605361.html>

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RECOMMENDATIONS

- Promote development and implementation of improvements to passenger rail service in the intercity and long-range plans for high speed rail passenger service in the Midwest and among other regions of the United States.
- Work with the public and private sectors at the federal, state and local levels to ensure coordination among the various entities having an interest in passenger rail service and to promote Midwestern interests regarding passenger rail.
- Aggressively pursue all avenues available to implement proposed rail improvements for both immediate and long-term benefit and to bring high speed rail service between Kansas City and St. Louis.

continued

EXECUTIVE SUMMARY

Given Missouri's location at the center of the country, the state is an important crossroads for goods and people, and the railroad infrastructure that facilitates these movements is vital. Utilization of rail is forecasted to grow; the 2012 Missouri State Rail Plan estimates a more than 30% increase in freight traffic along a majority of the state's rail corridors through 2031. Class I railroads are planning accordingly. From 2016-2017, Union Pacific and Burlington Northern Santa Fe Railroad spent approximately \$49 million and \$140 million respectively on maintenance, increasing operating efficiencies, and safety enhancements. While much of the freight system is privately funded and maintained, the passenger system relies on public funds. Missouri should continue to aggressively pursue all avenues available to implement proposed rail improvements identified in the State Rail Plan.

CAPACITY AND CONDITION

Missouri's Comprehensive State Rail Plan (2012) found 4,822 total rail miles in Missouri. As indicated in Table 1 below, 87% of total rail miles were utilized by the large Class I freight rail operators. As per the Surface Transportation Board, railroads are classified based on their operating revenue. A freight railroad with an operating revenue exceeding \$457.9 million, such as Burlington Northern Santa Fe (BNSF) Railway, Kansas City Southern Railway, Union Pacific Railroad (UPRR) etc., is classified as Class I. Class II railroads, often called as "regional railroad" have an operating revenue between \$36.6 million to \$457.9 million. Class II railroads, often called as "short line railroad", have operating revenue of \$36.6 million or less. Missouri hosts six of the seven Class I freight railroads that, nationwide, operate over 160,000 miles of track.



RAIL

Table 1: Missouri Rail Capacity in 2012

Railroad	Acronym	Miles Owned	Operating Rights	Total Miles
Class I Railroads				
BNSF Railway Company	BNSF	1,593	166	1,759
CP/SOO Line Corp. (Formerly Iowa, Chicago & Eastern RR)	CP/SOO	139	5	144
CSX Transportation	CSX	0	13	13
Kansas City Southern Railway	KCS	396	0	396
Norfolk Southern Corp.	NS	344	65	409
Union Pacific Railroad	UP	986	511	1,497
Total Class I		3,458	760	4,218
Switching & Terminal Railroads				
Central Midland Railway	CMR	52	0	52
Columbia Terminal	COLT	22	0	22
Kansas City Terminal Railway Co.	KCT	32	0	32
Manufacturers Railway Co.	MRS	4	3	7
Missouri North Central Railroad	MVP	27	0	27
Missouri North Central Railroad	MNC	4	0	4
Semo Port Railroad, Inc.	SE	8	0	8
Terminal Railroad Assn. of St. Louis	TRRA	26	0	26
Total Switching & Terminal Railroads		175	3	178
Local Railroads				
Arkansas & Missouri Railroads	AM	33	0	33
Kaw River Railroad	KAW	21	0	21
Missouri & Northern Arkansas Railroad	MNA	331	0	331
Ozark Valley Railroad, Inc.	OVRR	25	8	33
South Kansas & Oklahoma RR	SKOL	8	0	8
Total Local Railroads		418	8	426
Total Rail Miles in Missouri		4,051	771	4,822

C



RECOMMENDATIONS

continued

- Pursue all avenues available to prosecute proposed fixed guideway improvements for commuter services in Kansas City, Jefferson City, Springfield and St. Louis to improve connectivity and reduce congestion for alternate transit services in those and other communities in Missouri including street car and light rail systems to connect to the high-speed rail network.



Amtrak provides passenger rail service in Missouri and operates on four different routes. Those four routes are Missouri River Runner, Lincoln Service, Southwest Chief and Texas Eagle. Table 2 below shows the total Missouri passenger rail ridership by those four rail lines.

Year	River Runner		Lincoln		Southwest Chief		Texas Eagle		Total Ridership	
	Riders	% Change	Riders	% Change	Riders	% Change	Riders	% Change	Riders	% Change
FY2007	110,312	--	110,111	--	68,267	--	46,649	--	335,339	--
FY2008	137,713	24.8%	145,576	32.2%	66,851	-2.1%	46,821	0.4%	399,509	19.1%
FY2009	153,482	11.5%	157,468	8.2%	66,496	-0.5%	51,953	11.0%	431,774	8.1%
FY2010	164,817	7.4%	173,448	10.1%	70,653	6.3%	52,593	1.2%	463,888	7.4%
FY2011	190,628	15.7%	160,619	-7.4%	74,042	4.8%	64,147	22.0%	492,793	6.2%
FY2007- FY2011		72.5%		45.9%		8.5%		37.5%		46.9%

Source: Amtrak Fiscal Year: July 1 - June 30

RAIL

FUNDING

The railroad industry has traditionally operated and financed under private ownership. UPRR and BNSF are investing to increase capacity in the state. By 2016, UPRR and BSNF saw increases of 56% and 15%, respectively, in total miles owned when compared to 2012. In addition, UP and BNSF have planned 2016 – 2017 investments of \$49 million and \$140 million, respectively, aimed at maintenance, increasing operating efficiencies, and safety enhancements.

Public funding assistance programs also exist to help meet needs to upgrade capacity, enhance intermodal transport, improve safety, preserve short lines, alleviate clearance restrictions, and expand passenger service. These arrangements typically include reduced interest rate loans or grants under matching funds between the government, local and private parties involved. For example, the US Department of Transportation's Federal Railroad Administration (FRA) and Federal Transit Administration (FTA) have announced federal grants for Positive Train Control implementation (PTC), discussed under public safety later in this chapter.

State funding and financing programs include the Highway-Rail Crossing Safety Program, Passenger Rail Service Support, State Transportation Assistance Revolving Fund (STAR), Missouri Transportation Finance Corporation (MTFC), and Missouri Port Capital Improvement Program. These programs are funded on the most part by a portion of 2% of the first one-half of the motor vehicle sales tax, annual assessments of railroad companies, a small portion of motor vehicle registration or renewal, and federal funding.

Many of these state programs are generally oversubscribed and unfunded. The Missouri State Rail Plan recommends expansion of the STAR and Port Capital Improvement Programs as well as a new assessment of MoDOT railroad section organization and staffing needs for a rapidly

changing transit landscape in Missouri. Also, a specific program not found in Missouri, but common in other states is a State Freight Rail Economic Development Grant Program. This grant program is typically administered as a part of the overall state economic development program and designed to provide support for industrial development activities.

Missouri does not have a dedicated state funding source to provide operating support to the Missouri River Runner Service, the Amtrak line that serves St. Louis and Kansas City. Multiple federal funding programs give priority to grant requests which identify specific and dedicated state funding sources, and the lack of a dedicated funding source for the Missouri River Runner Service puts it at a disadvantage when applying for other sources of support.

Public Private Partnerships (P3) provide another potential funding source for Missouri rail projects, which require some level of partnering between the state and private railroad companies. Public benefits from private sector involvement may include innovation, financing and project schedule acceleration. The use of innovative project delivery methods such as design-build can assist in controlling public sector costs where P3 can be used to transfer financial risk to the private sector. Missouri has two unique finance vehicles including Transportation Corporations (TC) and Transportation Development District (TDD) which can provide opportunities for P3 projects.

Federal programs include those under the Passenger Rail Improvement and Investment Act (PRIIA), USDOT Budget Appropriations, Transportation Investment Generating Economic Recovery (TIGER) Discretionary Grant Program, Safe, Accountable, Efficient



Transportation Equity Act – a Legacy for Users (SAFETEA-LU), FHWA Funding Programs, Transportation Infrastructure Finance and Innovation Act (TIFIA), Grant Anticipation Revenue Vehicle (GARVEE), IRS Tax Exempt Private Activity Bonds (PAB), and IRS Railroad Track Maintenance Credit Program that support railroad infrastructure investment. Many of these programs require annual appropriations and recurring reauthorization based on on-going legislative activity.

FUTURE NEED

The 2012 State Rail Plan forecasts a more than 30% increase in freight traffic along a majority of the state's rail corridors through 2031. Assuming no system improvements, notable capacity constraints are predicted along corridors between St. Louis and Kansas City, as well as southwest of Springfield.

In passenger rail, ongoing shifts in demographics and development patterns continue to create transportation challenges in the Kansas City Metro area. MARC forecasts that by 2040, regional jobs located within 1-1/2 mile of access to transit will be 50% (a 10% decrease from 2010). In addition, suburbanization of poverty and an aging population are increasing demand for public transit and enhanced mobility. Regional planning authorities are incorporating passenger rail as a piece of the solution, including a local streetcar starter line with planned expansions and a planned commuter rail utilizing diesel multiple units. Identifying and tapping stable sources of funding for expansion of public transit remains a challenge.

One example of an opportunity to improve the system includes the Merchant's Bridge project that is ready for construction and to be completed as early as 2021. These improvements could create more than \$456 million in economic activity over a 20-year period by doubling its existing capacity. This critical Mississippi River crossing for a consortium of five Class 1 railroads currently can function as a bottleneck to the National Highway Freight Network. This project is a model for the significant impact and successful organization of public-private-partnerships. The Terminal Railroad Association (TRRA) of St. Louis will fund nearly two-thirds of the \$220 million cost of the project. The project will also rely on a federal INFRA (previously FASTLANE) grant for the other one-third for economic feasibility. A large portion of the private funding is financed through the public Railroad Rehabilitation and Improvement Financing (RRIF) program. The federal grant program is very competitive and underfunded. Without

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these upgrades the bridge would need to go out of service in the next 10 years due to deterioration and high maintenance costs. The state should have a response on the grant later in 2018.

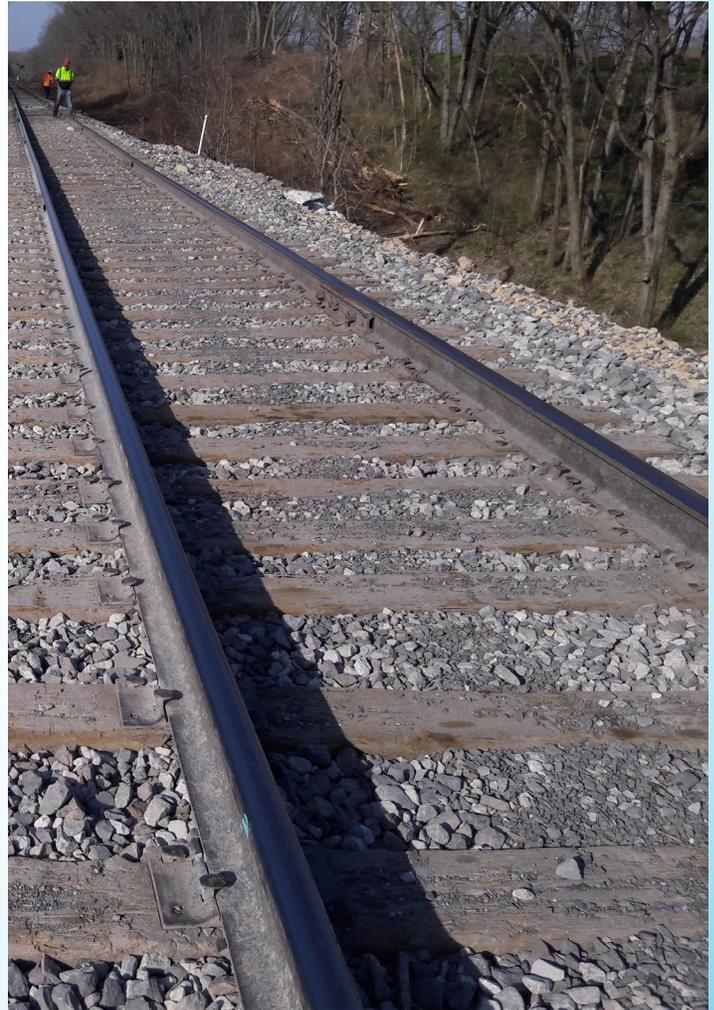
PUBLIC SAFETY

The FRA and FTA grants include \$12.02 million to design, install, and test the federally mandated rail operating safety system, Positive Train Control (PTC). PTC is being implemented as a fully integrated and functional Interoperable Electronic Train Management System (I-ETMS) over approximately 8.5 route miles of Kansas City Terminal (KCT) Railway right of way where Amtrak operates in the Kansas City metropolitan region of Missouri. PTC is one of the federally mandated safety measures that can prevent train to train collisions, derailments, accidental movement of a train through a switch left in the wrong position and other cause of accidents that may arise from human error.

The project will implement wayside and communications PTC equipment that provide fail-safe responses to the loss of communication data, along with an integrated back-office system capable of providing interoperability for all tenant railroads. Since the project's geographic reach covers one of the most congested rail hubs in the U.S., the safety improvements will significantly affect over 92,000 trains per year, including six daily passenger trains with approximately 552,000 riders per year.

RESOURCES

1. HNTB Corporation. (2012). Missouri state rail plan. Jefferson City: Missouri Department of Transportation.
2. Midwest High Speed Rail Association <http://www.midwesthsr.org/missouri>
3. Missouri Department of Transportation, Service Development Plan and other information: <http://www.modot.mo.gov/othertransportation/rail/index.htm>
4. <http://www.modot.mo.gov/othertransportation/rail/freight.htm>



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RECOMMENDATIONS

- Identify a sustainable state source of funding to meet transportation investment targets, as recommended by the 21st Century Transportation Task Force.
- Increase Federal funding to sustain and support the completion of important ongoing and planned maintenance, operations, equipment and 10-year plan expenditures, especially as it pertains to the interstate system.
- Continue to address critical roadway and bridge infrastructure safety and improvement needs while maintaining the existing system.
- Continue to promote programs that encourage higher occupancy rates, such as ride-share programs, in order to reduce roadway congestion and airway emissions.
- Invest in infrastructure that promotes economic development and traveler and goods movement efficiency within the state of Missouri.
- Invest in emerging technologies to improve traffic safety and operations for Missouri travelers.
- Continue to utilize and explore innovative delivery methods to accelerate roadway projects.

EXECUTIVE SUMMARY

Missouri's roughly 34,000-mile highway network, the 7th largest in the country, plays a critical role in the state's economic growth, traveler efficiency, and the quality of life of its citizens. In recent years, the Missouri Department of Transportation (MoDOT) has been able to fund and deliver roadway pavement maintenance improvements, significantly improving road surface conditions throughout the state's transportation system. However, the state motor fuel tax has not increased since 1996, and Missouri ranks 4th lowest in state gas tax and 47th overall in revenue per mile. Due to inflation and rising construction costs, the 17-cent tax now equates to eight cents in purchasing power. Missouri only spends 43% of the national average on operations and maintenance per state-controlled mile. Without action in the state legislature, funding constraints are anticipated to continue, leaving Missouri's ability to sustainably fund future roadway maintenance and improvement projects in jeopardy. Meanwhile, residents spend \$604 annually per motorist in extra vehicle repairs and operating costs, compared with \$533 per driver nationwide. A long-term revenue stream for transportation must be identified in order to improve Missouri's economic competitiveness and keep residents safe.

CAPACITY AND CONDITION

As Missouri's population and economy grow, increased demand on the state's major roadways has led to greater congestion as well as increased wear and tear on the transportation system. In 2016, Missouri's population reached approximately 6.1 million residents, a 9% increase since 2000. Over the same time frame, vehicle travel on Missouri's highways increased by 13%, and vehicle miles traveled (VMT) are projected to increase an additional 20% by the year 2030.

Due to this increase in traffic volume, 43% of Missouri's major urban highways currently experience congestion during peak hours. Traffic congestion not only causes significant delays for Missouri's auto commuters, but also costs Missourians money through excess fuel consumption and increased cost of consumer goods. According to the 2017 TRIP (The Roads Information Project) report, 75% of the \$495 billion worth of commodities shipped to and from sites in Missouri are transported by trucks on the state's highways. As traffic congestion becomes a more prominent problem in Missouri, the cost of transporting consumer goods will increase due to

ROADS

extended delivery times. As a result, the cost of consumer goods will increase to accommodate this cost imbalance, negatively affecting the state's economy. Table 1 illustrates the annual relative cost to Missouri motorists as a result of elevated levels of traffic congestion.

Table 1: Average Annual Congestion Cost in Missouri

Location	AUTO COMMUTERS		TRUCKS
	Annual Delay (Hrs. Per Motorist)	Congestion Cost (\$ Per Motorist)	Congestion Cost (\$ Million)
Jefferson City	8	\$172	-
St. Joseph	10	\$263	-
Columbia	14	\$304	-
Joplin	15	\$335	-
Springfield	25	\$556	-
Kansas City	39	\$933	\$1,085
St. Louis	43	\$1,020	\$1,637
Statewide		\$516	

Source: 2015 Urban Mobility Scorecard, Texas A&M Transportation Institute
Annual truck congestion cost could only be obtained for Missouri's major urban cities. Truck data pertaining to the remaining cities could not be determined.

Missourians have indicated that keeping the existing state roadway system in good condition should be one of the state's highest priorities, and over the years MoDOT has been able to fund pavement maintenance programs to significantly improve road surface conditions. Missouri measures the condition of its roadways using a combination of criteria such as pavement smoothness and physical distress cracking. As a result of Missouri's efforts to improve road surface conditions, 90% of Missouri's major highways, 81% of state minor routes, and 73% of state low volume routes are currently rated in good condition, ranking Missouri's roads 12th best in the nation in terms of overall smoothness. Despite the effectiveness of MoDOT,

the agency is working with limited funding, and Missourians pay the price. According to TRIP, residents spend \$604 per motorist annually in extra vehicle repairs and operating costs, \$2.5 billion statewide.

OPERATION AND MAINTENANCE

MoDOT employs more than 3,000 field employees throughout the state to operate and maintain the transportation system. Operations and maintenance of the transportation system includes litter and debris removal, incident response, pavement repairs and sealing, traffic signs and signals, mowing, winter operations, and roadway repairs. In fiscal year 2016, MoDOT invested \$509 million in operations and maintenance, approximately 36% of MoDOT's total budget. According to the 22nd Annual Highway Report, Missouri spends \$13,397 (12th least) in maintenance disbursements (costs to perform routine highway and state road upkeep) and \$2,024 (2nd least) in administrative disbursements (office related expenditures excluding project related cost) per state-controlled mile. Nationwide average expenditures are \$25,996 in maintenance disbursements, and \$10,051 in administrative disbursements per state-controlled mile. In comparison, Missouri spends 43% of the national average on operations and maintenance per state-controlled mile.

FUNDING AND FUTURE NEED

MoDOT receives funding from federal and state sources (Figure 1). Just over one-third of the state's transportation revenue comes from the federal government, which is generated through the federal fuel tax and government aid programs like the Fixing America's Surface Transportation (FAST) Act, which authorizes federal programs for the five-year period from 2016-2020 (Figure 3). The remainder of the transportation budget is funded through

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Missouri state user fees and state general revenue funds. These funding sources include vehicle registration and driver's licensing fees (20.7%), multimodal and highway safety fees (0.1%), motor vehicle sales and use taxes (25.9%), and interest and miscellaneous fees (7.7%). However, the primary source of user fee revenue comes from the state motor vehicle fuel tax (45.3%) (Figure 2).

Figure 1: Missouri Transportation Revenue

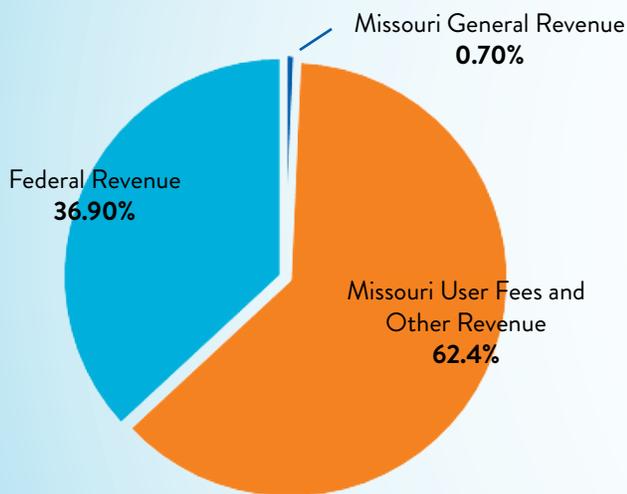


Figure 2: Missouri State User Fee Breakdown (Missouri User Fees and Other Revenue from Figure 1)

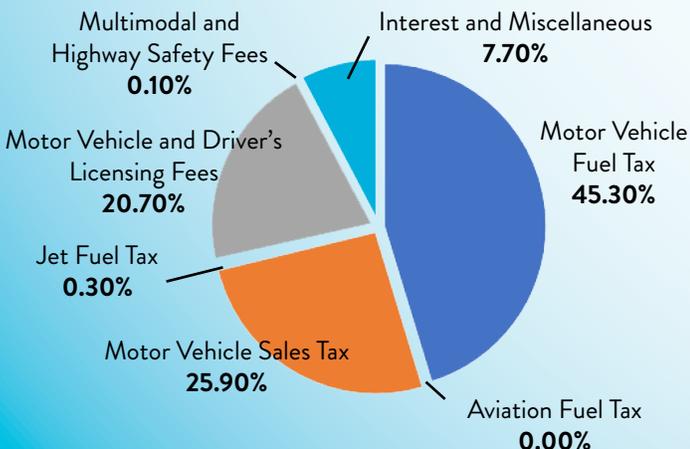
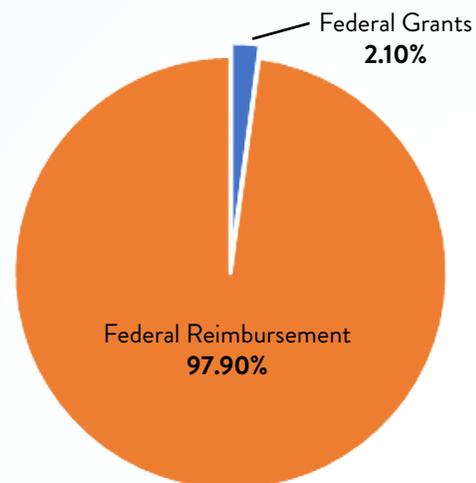


Figure 3: Federal Revenue Breakdown (Missouri share of Federal Revenue from Figure 1)

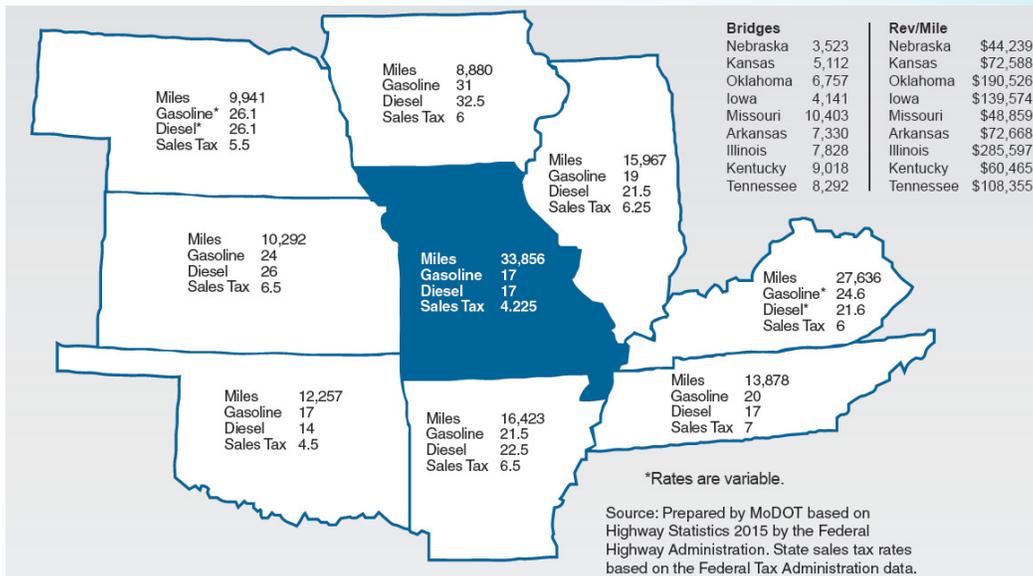


Source: MoDOT Financial Snapshot-November 2016

Since 1996, Missouri's state fuel tax has remained at 17 cents per gallon. Due to rising project construction costs, inflation and vehicle fuel efficiency improvements, the purchasing power of Missouri's state fuel tax has dropped from 17 cents to eight cents per gallon. With fuel tax being the major source of Missouri's transportation funding, Missouri's ability to fund future transportation maintenance and capital projects is in jeopardy. When compared to its eight surrounding states, Missouri has the largest state highway system, but the lowest fuel tax rate other than Oklahoma, which has a robust toll road network to help offset its fuel tax funding, as seen in Figure 4.

ROADS

Figure 4: Fuel Tax Rates and Highway Miles by State



Source: MoDOT Citizens Guide to Transportation: How Does Missouri Compare? (2016, Does not reflect recently enacted fuel tax increases in Iowa or Tennessee)

In an attempt to secure more funds for the state transportation system, Missouri added Amendment 7 to the 2014 August ballot that would have raised sales taxes in the state by three-quarters of a penny per dollar spent, and was projected to generate nearly \$5.4 billion for the state over a 10-year period. However, voters rejected the amendment, leaving Missouri to examine other avenues to fund the state’s transportation system.

In 2017, Missouri’s General Assembly passed a resolution establishing the 21st Century Missouri Transportation System Task Force, tasked with exploring ways to fund improvements to the state’s transportation system. The mission of the task force was to evaluate the condition and needs of the state transportation system, evaluate current and potential, future funding options, and make recommendations for funding the state’s transportation needs. The task force was comprised of five members of the House of Representative, five members of the Senate, the Governor or his designee, heads of the State Highway Patrol, Department of Economic Development and

Department of Transportation, and nine Missouri residents or representatives from non-governmental organizations within Missouri. MoDOT has identified \$825 million in unfunded transportation needs annually to address its transportation system. These funding needs include: \$170 million to maintain roads, \$275 million in economic development, \$300 million to reconstruct interstate highways, and \$80 million to improve mobility options.

In early 2018, the task force provided the Missouri legislature with a three-part roadmap outlining long-term and short-term strategies for how to fund and improve Missouri’s transportation system. The recommendations provided by the task force consist of the following:

- Increase gasoline tax by 10 cents and increase the tax on diesel by 12 cents.

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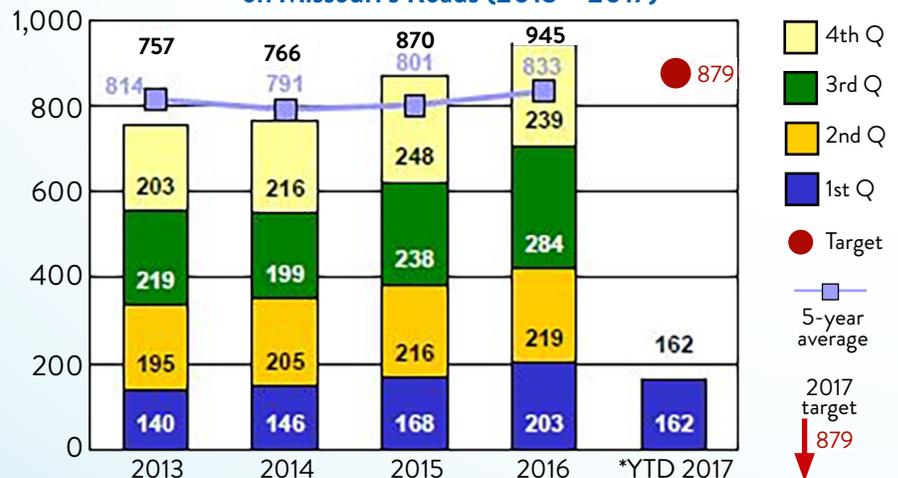


- Incorporate long-term funding options such as various road-user or vehicle-miles-traveled fees, tolling and congestion pricing, indexing fuel with inflation amongst a number of other revenue generating options.
- Explore methods for project delivery that involve innovative partnerships and solutions.

PUBLIC SAFETY

According to TRIP, the three major factors associated with fatal vehicle crashes are driver behavior, vehicle characteristics and roadway features. Crashes in Missouri are on the rise. Since 2013, Missouri has experienced a 25% increase in traffic crash fatalities, claiming the lives of 945 individuals in 2016 (Figure 5). Of those 945 traffic fatalities, 686 were vehicle drivers and passengers, with 63% being unbuckled. Table 2 provides more insight on the number of fatalities occurring on Missouri’s roads, by evaluating fatalities occurring in major cities throughout the state. Currently, Missouri’s overall traffic fatality rate is 1.21 (per 100 vehicle miles traveled), which is higher than the national average of 1.13.

Figure 5: Number of Annual Fatalities on Missouri’s Roads (2013 – 2017)



*YTD 2017 - First quarter fatalities were derived from MSHP radio reports.
Source: MoDOT Tracker Measures of Performance: Keep Customers and Ourselves Safe

ROADS

Table 2: Fatalities Occurring on Roads in Metropolitan Areas in Missouri – 2015

City	# of Fatalities	Percent of Total Fatalities Statewide
Kansas City	65	7.5%
Springfield	21	2.4%
St. Louis	50	5.8%

Source: MoDOT Blue Print Crash Statistics

Crashes cost Missourians. In 2015, 148,642 total traffic crashes were reported resulting in 870 fatalities and severely injuring 53,890 individuals. As a result, these traffic crashes cost the state of Missouri \$4.3 billion in medical costs, lost productivity and travel delays. To effectively reduce the number of fatalities and severe injury crashes experienced on Missouri's roads, MoDOT has embarked upon the following initiatives to improve roadway features:

- Adding shoulder and rumble strips to minor roads
- Installing high-friction surface treatments to roads
- Improving intersection safety

While it is difficult to correct driver behavior, MoDOT launched its Buckle Up-Phone Down campaign in 2017 to challenge Missourians to wear seat belts and limit cell phone use while driving. Statistics show that distracted driving is a leading cause of crashes, not only in Missouri, but throughout the United States. When a person decides to text and drive, they are 23% more likely to be involved in critical events. In 2015, the Missouri State Highway Patrol reported cellphone uses as the cause of 2,237 crashes. By advocating drivers to incorporate these two policies (wearing seat belts and putting phones down while driving) impacts on both incident and highway fatalities are expected.

RESILIENCE AND SUSTAINABILITY

A resilient transportation system is defined as one that has the capabilities to prevent or protect against significant multi-hazard threats and incidents, but can also withstand and recover critical services with minimal damage to public safety and health. At this time, MoDOT does not have any specific plans or policies for the sole purpose of resiliency, however there are programs in place that aid in resiliency efforts.

According to MoDOT Tracker, having the ability to respond and quickly address incidents on the road network improves overall system performance, and through Missouri's intelligent transportation systems, KC Scout, St. Louis Gateway Guide, and Springfield Ozarks Traffic Information, traffic incidents can quickly be mitigated and return traffic to normal conditions. With these intelligent transportation systems in place, the following services are offered:

- Real-time traffic monitoring
- Disabled motorist assistance
- Responder assistance for lane obstructions (stalled vehicles, car accidents, debris)
- Law enforcement support, emergency first responders and emergency agencies in the form of traffic control and back up for incidents on the area interstates.

When evaluating the sustainability of Missouri's roads, the impacts road deficiencies and traffic congestion have on the economy, environment, and on the Missourians utilizing the road network must be considered. Missouri's economy depends on the transportation system for freight and employee movement, attracting and retaining

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businesses, and tourism. However, traffic congestion, when considered from an economic perspective limits economic performance through the forms of lost productivity due to increased travel times (Table 1), and inflated transporting cost of consumer goods.

However, traffic congestion has the potential to affect more than a state's economy. Environmentally, traffic congestion increases CO₂ emissions and increases fuel consumption through stop-and-go driving patterns. But more importantly commuters exposed to this air pollution, such as motorcyclist, have increased health risk. These health risk include chronic lung diseases, increased blood pressure, and increased heart attack and stroke risk. According to a study by Washington University in St. Louis, longer commutes, as a result of congestion, consume exercise time thus causing weight gains, lower fitness levels, and can lead to higher chronic stress.

INNOVATION

MoDOT fosters an innovative culture and is always looking for new and improved ways to solve transportation problems. In 2007 MoDOT launched its innovation challenge that encourages its employees to submit their innovations to improve safety, efficiency, and productivity. Since the launch of the innovation challenge, 1,500 employee innovations have been submitted, with nearly 250 innovations chosen as MoDOT's best practices. In 2015, MoDOT kicked off its Road to Tomorrow initiative, with the goal to innovatively improve and fund the I-70 corridor between Kansas City and St. Louis, to create the next generation of highways providing new technologies and discover new means of funding maintenance and construction. Through this initiative, private industry, innovators, entrepreneurs, and the general public have combined their efforts to explore innovative techniques, products and funding systems. MoDOT has dedicated a 4-mile stretch of I-49 as a technology integration lab, where ideas are put to a road test.

ROADS

RESOURCES

1. 22nd Annual Highway Report: The performance of State Highway Systems - 2016 http://reason.org/files/22nd_annual_highway_report.pdf
2. A Citizen's Guide to Transportation in Missouri, <https://showme.org/wp-content/uploads/MoDOT.pdf>
3. Buckle Up-Phone Down Campaign, <http://www.modot.org/newsandinfo/District0News.shtml?action=displaySSI&newsId=209840>
4. Citizens Guide to Transportation, <http://www.modot.org/guidetotransportation/>
5. House Concurrent Resolution No.47, 21st Century Transportation Task Force, <http://www.house.mo.gov/billtracking/bills171/hlrbillspdf/2324H.02P.pdf>
6. If Missouri Has Transportation Needs, Where Did Amendment 7 Go Wrong?, Adie Tomer <https://www.brookings.edu/blog/the-avenue/2014/08/18/if-missouri-has-transportation-needs-where-did-amendment-7-go-wrong/>
7. Missouri Crash Statistics <http://modot.org/safety/blueprintcrashstatistics.htm>
8. Missouri Senate Gives Stamp of Approval to Create Transportation Task Force, Jason Taylor <http://www.missourinet.com/2017/05/11/missouri-senate-gives-stamp-of-approval-to-create-transportation-task-force/>
9. Missouri Transportation Tax Proposal Soundly Defeated, Virginia Young http://www.stltoday.com/news/local/govt-and-politics/missouri-transportation-tax-proposal-soundly-defeated/article_e3e0b7e6-4f55-5697-b759-d289d298d911.html
10. MoDOT Financial Snapshot-FY 16, <http://www.modot.org/about/documents/FinancialSnapshot.pdf>
11. MoDOT Innovations Challenge, <http://www.modot.org/InnovationsChallenge/>
12. MoDOT's Road to Tomorrow, <http://www.modot.org/road2tomorrow/>
13. MoDOT Tracker, <http://modot.mo.gov/about/Tracker.htm>
14. Real World CO2 Impacts of Traffic Congestion
15. <http://escholarship.org/uc/item/4fx9g4gn#page-3>
16. Report of the 21st Century Missouri Transportation System Task Force, <https://house.mo.gov/billtracking/bills181/commit/rpt1723/Transportation.pdf>
17. Stress, Pollution, Fatigue: How Traffic Jams Affect Your Health <http://www.gmanetwork.com/news/lifestyle/healthandwellness/536203/stress-pollution-fatigue-how-traffic-jams-affect-your-health/story/>
18. TRIP Report 2015, http://www.tripnet.org/docs/MO_Transportation_by_the_Numbers_TRIP_Report_April_2015.pdf
19. TRIP Report-2017, http://www.tripnet.org/docs/Fact_Sheet_MO.pdf
20. TTI for Urban Congestion, <https://static.tti.tamu.edu/tti.tamu.edu/documents/mobility-scorecard-2015.pdf>

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RECOMMENDATIONS

- Perform a condition assessment of existing stormwater and wastewater infrastructure and determine funding need.
- Implement small-scale and large-scale green stormwater infrastructure strategies to reduce and eliminate SSOs.
- Prioritize infrastructure improvements based on critical need and adjust local rates with a rate assessment to capitalize on ratepayer contribution.
- Overlay proposed stormwater and wastewater improvements with other proposed infrastructure improvements to create an integrated infrastructure improvement plan.
- Create a sustainable funding source for infrastructure improvements in Missouri.
- Create an integrated infrastructure improvement strategy with annual goals.

EXECUTIVE SUMMARY

Wastewater and stormwater systems are made up of four components: collection, conveyance, treatment, and discharge. Regular investment in, and maintenance of, these systems is critical to protecting public health through prevention of untreated sewer overflows into Missouri's surface waters. The average age of this infrastructure throughout large municipalities and small towns in Missouri is approaching the end of its expected life, resulting in increased frequency of leaks and failures within sewer systems. Fortunately, many municipalities are innovating and investing. The Metropolitan Sewer District of St. Louis is currently working to implement \$4.7 billion in improvements over 23 years. In Kansas City, improvements totaling \$2.5 billion will be completed over 25 years and the city is leading the nation in green infrastructure innovations. However, more is needed; a 2012 assessment by MDNR and the EPA estimated that \$9.6 billion would be needed to address Missouri's wastewater and stormwater infrastructure needs over the next 30 years.

BACKGROUND

Wastewater and stormwater systems in Missouri are regulated by the Environmental Protection Agency (EPA) and by the Missouri Department of Natural Resources (MDNR). In Missouri, wastewater and stormwater are collected and transported as a combined sewer system (CSS), or they are collected separately; Stormwater is directed to a stormwater system and sanitary flow directed to a sanitary sewer system (SSS). Combined sewer overflows (CSOs) and sanitary sewer overflows (SSOs) can occur when the capacity of these systems is exceeded. In St. Louis and Kansas City, extensive sewer separation projects are underway to separate stormwater from sanitary flow with the addition of a separate storm sewer system. These improvements will alleviate capacity issues at downstream treatment facilities and prevent public health risks associated with CSOs.

CAPACITY

Inflow and infiltration (I&I), added to the existing sanitary flow in SSSs, can create flow that exceeds pipe design capacity, leading to sewer backups in homes, overflows at manholes and untreated sanitary discharges in Missouri streams and rivers. Infiltration occurs when rainwater or groundwater enters the sewer system through cracks or defects in sewer pipe, while inflow occurs when water flows into sewer pipe from sources like yard and area drains and roof gutters.

STORMWATER/ WASTEWATER



Of the 452 Missouri communities surveyed for the Statewide Wastewater Assessment by the Missouri Association of Council of Governments, 43% have documented I&I issues and have instituted an I&I reduction program while 31% have documented I&I issues, but do not have an I&I reduction program. The other 26% did not report I&I issues. I&I programs in Missouri incorporate CCTV inspections through pipelines and manhole inspections to identify specific I&I locations. Then, spot repairs with cementitious material or large pipeline repairs can be performed based on inspection results.

One solution for reducing and eliminating CSOs is to integrate green stormwater infrastructure into community-wide infrastructure planning and stormwater management. Green stormwater infrastructure is effective in reducing stormwater runoff to sewer systems by capturing the runoff before it enters the enclosed system, resulting in more

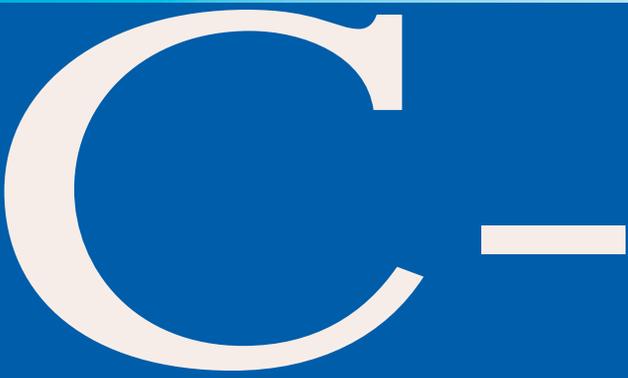
available capacity in downstream sewer pipe and reduced peak flow to wastewater treatment facilities. Lessening stormwater flow entering the sewer system reduces the amount of energy and resources used to treat wastewater, lowering costs paid by ratepayers.

CSSs, which are prone to CSOs, are common among large municipalities throughout the United States. Nationwide, 772 communities operate CSSs. Several municipalities in Missouri – including the Metropolitan St. Louis Sewer District (MSD), Cape Girardeau, Kansas City, Macon, Moberly, St. Joseph, and Sedalia have experienced recent CSOs. While these communities work to eliminate the immediate threat of CSOs, long-term control plans are being developed to mitigate future overflows to Missouri surface waters.

CONDITION

In some Missouri communities, combined sewer systems constructed with brick in the late 1800s are still in operation. In the bi-state St. Louis region, nearly half of the regional sewer system has exceeded its expected life. Concrete structures, associated mechanical and electrical equipment at wastewater treatment plants, as well as interceptors and force mains within the sewer system are examples of some of the infrastructure that requires replacement.

In Missouri, 150 Municipal Separate Storm Sewer Systems (MS4s) are regulated by MDNR and are required to develop and implement a stormwater management program to prevent and reduce contamination of surface waters, including the prevention of illegal discharges.



Wastewater treatment facilities in Missouri are subject to National Pollutant Discharge Elimination System (NPDES) permit requirements. Treatment system failures, bypasses, accidental spills, and illicit waste disposal are all types of violations that can occur.

In January 2018, the EPA finalized Numeric Nutrient Criteria for Missouri Lakes. Numeric nutrient criteria are an important tool for protecting and restoring a waterbody's designated uses and results are considered during the NPDES permit process. 34 lakes in Missouri were designated "impaired," impacting 30 wastewater treatment facilities that discharge to these lakes.

Kansas City

The Kansas City Water Services Department (WSD) provides wastewater collection and treatment for approximately 653,000 people through operation of their seven wastewater treatment plants and extensive CSS and SSS. To meet the requirements of the City's Consent Decree with the EPA, Kansas City administers improvements through its Overflow Control Program (OCP) to reduce CSOs from the City's sewer system, at a cost estimated at \$2.5 billion over 25 years.

St. Louis

The Metropolitan Sewer District of St. Louis (MSD) provides wastewater and stormwater service to approximately 1.4 million people via 9,600 miles of sewer pipe. MSD operates seven treatment facilities and 285 pump stations, processing over 330 million gallons of stormwater and wastewater every day. During heavy rains, the capacity of the combined sewer system is frequently exceeded and CSOs are discharged directly to the Mississippi River or to one of the River's tributary streams. MSD's Consent Decree with the EPA involves \$4.7 billion in improvements over 23 years to eliminate illegal overflows of untreated sewage and reduce pollution discharged to the Mississippi River.



FUNDING

At the state level, Missouri's Clean Water State Revolving Fund (CWSRF) provides low interest loans to eligible communities for stormwater infrastructure, non-point source elimination projects, and water conservation and reuse projects. Funding for CWSRF is provided by the EPA with matching funds from the state of Missouri. Since 1989, the CWSRF has committed \$2.8 billion in loans to Missouri communities and \$86 million in grants for wastewater infrastructure needs. During the 2015 reporting period, seventeen direct loans, and eleven grants were awarded for \$280 million in CWSRF commitments.

For St. Louis MSD, CWSRF has provided over \$200 million in low-interest loans to repair and improve wastewater and stormwater infrastructure. This financing method is estimated to save MSD over \$60 million compared to conventional loans and project financing.

For smaller Missouri communities that need to meet new ammonia treatment criteria, Special Needs Grants may be used to fund projects that aim to meet more stringent EPA and MDNR requirements for wastewater treatment. Costs to upgrade a lagoon system to meet ammonia limits could be funded up to 50% through Special Needs Grants.

STORMWATER/ WASTEWATER

Additional cost-share funding opportunities are available to address disaster relief, and small flood damage projects. The Federal Emergency Management Agency (FEMA) offers funding through the Hazard Mitigation Grant Program to areas of the State, as requested by the Governor, to reduce risk of loss of life and property from future disasters. Likewise, the U.S. Army Corps of Engineers (USACE) provides funding for Small Flood Damage Reduction Projects to provide local flood protection through construction of levees, channels, and dams, installation of flood warning systems, and relocation of flood prone facilities.

FUTURE NEED

An assessment by MDNR and the EPA in 2012 estimated that \$9.6 billion would be needed to address Missouri's wastewater and stormwater infrastructure needs over the next 30 years. CSO correction was the category that required the most funds - \$3.4 billion - in Missouri. In this area, Missouri ranks 4th worst after New Jersey, Ohio, and New York. For new conveyance systems, Missouri requires \$2.3 billion. For secondary wastewater treatment improvements and installation projects, Missouri requires \$2.1 billion. For I&I correction and conveyance system repair, Missouri ranks fifth worst in terms of need, requiring \$1.9 billion.

Missouri communities demonstrate resiliency via rate assessments. Kansas City WSD convened a Cost of Service Task Force in 2017 to create recommendations for city-wide sewer rates and long-term revenues. Among the task force's recommendations was an advance payment policy for new customers where one month's bill is paid in advance, as well as improved education and outreach to educate customers about rates, affordability, and how to read their bill. St. Louis MSD convened a similar group - the Rate Commission - to provide public input for MSD's rates. The Rate Commission consists of 15-member organizations that review all rate proposals before approval.

While strategic rate assessments and integrated planning can help to fund and prioritize critical projects, a sustainable wastewater and stormwater infrastructure funding program is needed in Missouri.

OPERATION AND MAINTENANCE

Wastewater and stormwater infrastructure is minimally maintained in Missouri. The maintenance culture is reactive, where municipalities often go without repairs and routine maintenance operations until a major failure occurs. A lack of funding and a lack of programmed maintenance activities can overwhelm small municipalities with many assets and few resources. For example, street inlets for stormwater drainage require routine maintenance to remove trash and yard waste that eventually travels downstream through the pipe network. If left alone, a blockage can form, rendering the pipe network useless and causing backups onto the street.

MDNR reported 960 wastewater treatment facilities in non-compliance with 67 permittees receiving formal enforcement action in 2016 and assessed a total of \$456,000 in penalties in 2016 for violations of compliance.

Political leadership and strong professional management is critical to the success of stormwater and wastewater programs in Missouri. Without a local champion, infrastructure improvements will continue to be overlooked.



PUBLIC SAFETY

Overflows from combined and sanitary sewer systems are environmental and public health hazards. Pathogens within the wastewater may be discharged to nearby surface waters, exceeding water quality limits and posing a threat to the aquatic environment. Bacteria, viruses, and protozoa pose the greatest risk to human health. Eliminating CSOs and SSOs would reduce the public safety risk by containing wastewater and treating pathogens before release.

RESILIENCE

New and repaired wastewater treatment infrastructure in Missouri prioritizes adequate redundancy and elimination of single points of failure. Engineering designs include standby pumping and parallel treatment trains so that the treatment process can continue regardless of sections being shut down due to planned or unplanned maintenance. Additionally, basins and other treatment structures are sized with future population and growth in mind so that the treatment can be expanded easily.

INNOVATION

In general, MDNR encourages Missouri communities to assess their long-term needs when considering wastewater and stormwater solutions. Green stormwater infrastructure is one method in which Missouri communities use vegetation and natural processes to manage stormwater and decrease the volume of flow entering CSSs. Kansas City WSD was the first utility in the United States to include green stormwater infrastructure as a requirement to meet a federal consent decree mandate for reduced CSOs and the Institute for Sustainable Infrastructure names Kansas City as a national leader for infrastructure sustainability.

Integrated planning is another way that Missouri communities implement creative solutions to stormwater and wastewater issues. Integrated planning encourages municipalities to prioritize their existing and future infrastructure projects and sequence those projects to holistically update infrastructure in a cost-effective manner. The City of Columbia began hosting public meetings in 2017 to advise the City's long-term planning effort as part of an Integrated Management Plan (IMP). The IMP aims to meet the community's critical needs through analysis of benefits and costs of Columbia's potential wastewater and stormwater infrastructure investments.

STORMWATER/ WASTEWATER

RESOURCES

1. Missouri Integrated Water Quality Report and Section 303(d) List, April 7, 2016 <https://dnr.mo.gov/env/wpp/waterquality/303d/docs/2016-ir-305b-report.pdf>
2. Missouri Department of Natural Resources Annual Noncompliance Report NPDES Non-Major Facilities, 2016 <https://dnr.mo.gov/env/wpp/enf/docs/2016ANCR.pdf>
3. Missouri Department of Natural Resources Water Protection Program Water Pollution Control Branch, 2016 Annual Compliance and Enforcement Report <https://dnr.mo.gov/env/wpp/enf/docs/2016-ann-enf-rpt.pdf>
4. Missouri Clean Water State Revolving Fund, Intended Use Plan and Priority List for Fiscal Year 2018, Nov 6, 2017 <https://dnr.mo.gov/env/wpp/srf/docs/cwsrf-fy18-iup.pdf>
5. Our Aging Infrastructure: The Attributes and Needs of Water and Wastewater Infrastructure in the Bi-State St. Louis Region, October 2011 http://mwipartnership.com/mm/files/MWIP-Our_Aging_Water_Infrastructure.pdf
6. Statewide Wastewater Assessment, State of Missouri, Missouri Association of Council of Governments, 2011 [https://midmorpc.org/plans/604\(b\)/604-b-Statewide-wastewater-assessment-report-draft-1%20web%20version.pdf](https://midmorpc.org/plans/604(b)/604-b-Statewide-wastewater-assessment-report-draft-1%20web%20version.pdf)
7. Clean Watersheds Needs Survey: EPA report to Congress, Jan 2016 https://www.epa.gov/sites/production/files/2015-12/documents/cwns_2012_report_to_congress-508-opt.pdf
8. Missouri Department of Natural Resources Rural Sewer Grant Program, March 2014 <https://dnr.mo.gov/pubs/pub2307.htm>
9. Missouri Department of Natural Resources Numeric Nutrient Criteria for Missouri Lakes, January 2018 <https://dnr.mo.gov/env/wpp/rules/docs/numeric-nutrient-criteria-factsheet.pdf>
10. Missouri Department of Natural Resources Ammonia Criteria: New EPA Recommended Criteria, February 2014 <https://dnr.mo.gov/pubs/pub2481.htm>
11. Missouri Department of Natural Resources Evaluating Wastewater Treatment Alternatives for Small Communities with Lagoons, October 2015 <https://dnr.mo.gov/pubs/pub2587.htm>
12. Kansas City, Missouri Water Services Department Overflow Control Program Overflow Control Plan, January 2009 https://www.kcwaterservices.org/wp-content/uploads/2013/04/Overflow_Control_Plan_Apri302012_FINAL.pdf
13. St. Louis Metropolitan Sewer District Combined Sewer Overflow Long-Term Control Plan Update Report, February 2011 <https://www.stlmsd.com/sites/default/files/education/448861.PDF>
14. City of Columbia MO Press Release <https://www.como.gov/CMS/pressreleases/view.php?id=4974>
15. Missouri Department of Natural Resources Guide to Green Infrastructure, May 2012 <https://dnr.mo.gov/pubs/pub2446.pdf>
16. Catalog of Federal Funding Sources for Watershed Protection, 2018. <https://ofmpub.epa.gov/apex/watershedfunding/>

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