NOACA TRANSPORTATION ASSET MANAGEMENT PROGRAM

TRANSPORTATION ASSET MANAGEMENT PLAN

Prepared for

Northeast Ohio Areawide Coordinating Agency
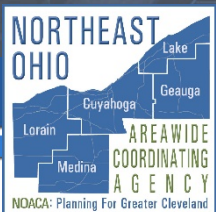
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NORTHEAST OHIO
Lake
Geauga
Cuyahoga
Lorain
Medina
AREAWIDE
COORDINATING
AGENCY
NOACA: Planning For Greater Cleveland

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Overview of Transportation Asset Management

This *Northeast Ohio Areawide Coordinating Agency (NOACA) Transportation Asset Management Plan* outlines the existing and planned state of transportation asset management (TAM) in the NOACA area. It begins with an overview of TAM and why it is important for the region. The Plan then discusses existing asset conditions and TAM processes. It presents objectives and measures for TAM in the region, discusses performance gaps, and summarizes risks. The Plan includes an assessment of NOACA's financial picture for the next 10 years, potential investment strategies, and future TAM process enhancements.

Introduction

Roadway infrastructure provides the backbone of America's transportation system. Maintaining it in a state of good repair is essential for all modes of transportation. Over the years, the United States built one of the world's most extensive transportation systems, representing trillions of dollars of public investment. This transportation network supports the economy and directly impacts the competiveness of the nation and the NOACA region. Recognizing the immense need for preserving transportation investments, transportation agencies turn to transportation asset management strategies to maintain, improve, and ensure future generations the ability to travel safely and efficiently.

Transportation asset management is a broad concept with many different definitions. At its core, asset management allows transportation agencies to operate rationally and comprehensively, by "starting with clear strategies for what infrastructure conditions they want to provide to the public."[1] Although TAM can include a variety of functions, activities, and decisions at the state, regional, and local levels, it is most commonly composed of:

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[1] Federal Highway Administration (FHWA). "Executive Brief: Advancing a Transportation Asset Management Approach," 2012, 4.

- Transportation investment policies;

- Institutional relationships between transportation agencies and public/private groups;

- Multimodal transportation planning;

- Program development for capital projects, operations, and maintenance;

- Real-time and periodic system monitoring; and

- Information technology (IT) support activities.

Asset Management is…

… a strategic and systematic process of operating, maintaining, upgrading and expanding physical assets effectively throughout their lifecycle. It focuses on business and engineering practices for resource allocation and utilization, with the objective of better decision making based upon quality information and well-defined objectives.

- (23 U.S.C. 101(a)(2), MAP-21 § 1103).

Agencies that implement TAM principles can reap many benefits, including lower long-term costs for infrastructure preservation, improved performance and service to customers, and better cost-effectiveness and use of available resources. TAM's focus on performance and outcomes can ultimately result in improved credibility and accountability for decisions and expenditures.

TAM approaches have gained favor over the past decade. The establishment of a new requirement for developing risk-based transportation asset management plans, as part of Moving Ahead for Progress in the 21st Century (MAP-21) Act, served as a major milestone. This approach was carried forward as part of the Fixing America's Surface Transportation, or FAST, Act. While state departments of transportation are the primary focus of the requirement, metropolitan planning organizations (MPOs) are also finding significant benefit from well-structured asset management plans. MPOs such as NOACA will gain from a forward-thinking preservation approach given the tremendous investment that infrastructure assets represent, and the demand for economic vitality in an era of limited funding.

Other factors driving transportation asset management include an increased emphasis on transparent performance measures in transportation, particularly on roadway and bridge system-wide asset conditions, and pending requirements for target setting at the state and metropolitan area levels.

Origin of the Plan

TAM has long been a focus of NOACA. In 2007, NOACA updated its Regional Transportation Investment Policy to include pavement targets and a pavement management program. In 2014, NOACA launched an effort to develop a transportation asset management plan (TAMP) with the support of a Federal Highway Administration (FHWA) Accelerated Innovation Deployment (AID) Grant. This Plan represents a step forward in creating a uniform vision and strategy for TAM in the region, which is consistent with the preservation component of the agency's vision.

NOACA serves Cuyahoga, Geauga, Lake, Lorain, and Medina counties. The total population of the region was estimated at 2,060,810 in 2015. In general, population has shifted over the last several decades, with some areas gaining population and others losing. Overall, the NOACA region's population has trended slightly downward.

The region's transportation needs are served by a number of assets, including several interstate highways, a major airport, passenger and freight rail, ports, transit, and bikeways. This transportation system also includes 3,069 bridges along 8,494 total lane-miles of federal-aid eligible roadways.[2]

NOACA faces the challenges that are common to many other local governments and transportation agencies: aging infrastructure, rising costs, and stable or declining funding. NOACA is being pressed to do more with less, and resources often fall short of the need to maintain a state of good repair across many transportation assets.

There is an opportunity to use TAM to foster coordination across regional stakeholders, ranging from the smallest communities up to federal decision makers. The Ohio Department of Transportation (ODOT) is also undertaking new TAM activities, and FHWA is supporting NOACA's TAMP development. NOACA has assembled a steering committee made up of a variety of local and regional stakeholders, such as municipalities and counties, in addition to ODOT Central Office, ODOT District 3 and 12 staff, and FHWA.

Definitions

State of Good Repair (SOGR), as defined in the MAP-21 Notice of Proposed Rulemaking is the condition in which an asset is able to operate at a full level of performance.[3] "Full level of performance" is defined by three standards below.

1. The asset is able to perform its manufactured design function;

2. The use of the asset in its current condition does not pose a known unacceptable safety risk; and

3. The asset's life-cycle investment needs have been met or recovered, including all scheduled maintenance, rehabilitation and replacements.[4]

Good/Fair/Poor refers to whether a bridge or pavement asset is in good, fair, or poor condition based on asset inspection. Under the requirements of MAP-21 (and continued under the FAST Act), agencies will be required to identify and report how many of their assets are in "good" and "poor" condition and set targets for future condition. The precise definition of "good" vs. "poor" is currently being determined through rulemaking.[5]

Preservation includes actions or strategies that prevent, delay or reduce deterioration of assets (such as bridges) or asset elements; restore the function of existing assets; keep assets in good condition; and extend their useful life. Preservation actions may be preventive or condition-driven.[6]

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[2] http://gis.dot.state.oh.us/tims

[3] Federal Transit Administration (FTA), "Notice of Proposed Rulemaking: Transit Asset Management/National Transit Database" (Docket No. FTA-2014-0020).

[4] Ibid.

[5] https://www.fhwa.dot.gov/tpm/rule.cfm.

[6] Spell out AASTO (ASHTO) Policy Resolution PR-3-11, http://highways.transportation.org/Documents/PR-3-

Maintenance is work done to keep facilities and equipment in a state of repair or working efficiently.[7]

Life-Cycle of an asset refers to an asset's life from start to finish, beginning with design and construction, continuing through operation and maintenance, and ending with replacement or decommissioning.

Life-Cycle Management is characterized as "maintaining existing system performance at a constant desired level while minimizing resource consumption and externalities over the long term."[8]

Least Life-Cycle Cost is the design, construction, maintenance, and preservation decisions that cumulatively add up to the lowest cost during an asset's useful life.

Performance-Based Planning and Programming is applying performance management principles to transportation system policy and investment decisions, and providing a link between management and long-range decisions about policies and investments that an agency makes in its transportation system. Performance-based planning and programming is a system-level, data-driven process to identify the strategies and investments.[9]

Risk is a broad term and could be related to any number of events, such as performance failure, weather events, cost controls, the selection of suboptimal preservation projects, regulatory delays, construction delays, etc. Risk management involves systematically identifying, analyzing, assessing, and managing the risks that threaten the ability to achieve organizational objectives.[10]

The **Federal-Aid Eligible System** includes all public highways eligible for assistance under Chapter 23 U.S. Code § 101 other than highways functionally classified as a local road or rural minor collector.[11] According to FHWA, "The Federal-Aid Highway Program supports State highway systems by providing financial assistance for the construction, maintenance and operations of the Nation's 3.9 million-mile highway network, including the Interstate Highway System, primary highways and secondary local roads. FHWA is charged with implementing the Federal-aid Highway Program in cooperation with the States and local government."[12]

11%C2%A0Adoption%C2%A0of%C2%A0an%C2%A0AASHTO%C2%A0Bridge%C2%A0Preservation%C2%A0Definition.pdf.

[7] Spell out NCHRP (NCHRP) Synthesis 330, http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_syn_330.pdf.

[8] Supplement to the AASHTO Transportation Asset Management Guide: Volume 2-A Focus on Implementation.

[9] FHWA Performance-Based Planning and Programming White Paper, https://www.fhwa.dot.gov/planning/performance_based_planning/resources/white_paper/perfplan.pdf.

[10] FHWA Transportation Asset Management Plan Literature Review.

[11] U.S. Code Chapter 23 § 101, https://www.law.cornell.edu/uscode/text/23/101.

[12] https://www.fhwa.dot.gov/federal-aidessentials/federalaid.cfm.

The **National Highway System (NHS)** consists of roadways important to the nation's economy, defense, and mobility. The NHS includes Interstates, Other Principal Arterials, the Strategic Highway Network (STRAHNET), Major STRAHNET Connectors, and Intermodal Connectors.[13]

Existing Conditions and Capabilities

This section describes the existing transportation asset conditions and transportation asset management capabilities within the NOACA planning region.

Transportation Assets

The NOACA region has significant assets. The non-infrastructure assets include people, the regional economy, NOACA's planning and research capabilities, foundation in strategic planning, partnerships, and data. These assets are presented below. Following this is an analysis of infrastructure assets, including pavements, bridges, transit, sidewalks, bikeways, and freight-related assets.

Non-Infrastructure Assets

People

Population is shifting in Greater Cleveland. Population in the region has generally trended downward over the last several decades. The total population of the five-county region has declined 11% from its 1970 peak of 2,321,037 to 2,065,723. Between 2010 and 2015, the region saw a further decline of 0.8%. Within the region, however, population shifts have been more nuanced. Cuyahoga County—by far the most densely populated NOACA constituent county—has seen its population decline from 1,721,300 in 1970 to 1,255,921 in 2015 (-27%). The population of more rural Medina County, however, has more than doubled from 82,717 in 1970 to 176,395 in 2015. Geauga, Lake, and Lorain counties have also seen their populations grow by 49%, 16%, and 19%, respectively, during the same period, indicating a shifting population.[14] In general, these data indicate a shrinking urban core and expanding suburban and exurban periphery, with some notable exceptions, such as Downtown Cleveland and the University Circle area. In fact, the population of Downtown Cleveland nearly tripled between 1990 and 2015, following national trends of population movement of Millennials and "empty nesters" to urban and downtown neighborhoods.[15]

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[13] FHWA Office of Planning, Environment, & Realty, http://www.fhwa.dot.gov/planning/national_highway_system/.

[14] http://www.census.gov/prod/www/decennial.html and http://quickfacts.census.gov/.

[15] U.S. Census, 1940, 1950, 1960, 1973, 1980, 1990, 2000, 2010, 2015.

The Regional Economy

The five-county NOACA area serves as an economic hub for the State of Ohio. According to the U.S. Census Bureau, the Cleveland metropolitan area has the greatest gross domestic product (GDP) among Ohio metro areas at approximately $123 billion as of 2013.[16] This regional GDP represents approximately 21% of the state's total GDP.

The City of Cleveland is home to the headquarters of eight Fortune 1000 companies, while 17 additional firms are headquartered in the remainder of the NOACA region.[17] Key sectors include healthcare, manufacturing, utilities, and education.[18] The region also possesses several nationally-renowned medical and academic institutions, such as the Cleveland Clinic, University Hospitals, and Case Western Reserve University that serve to further strengthen the regional economy. The healthcare sector in particular has recently been the focus of local investment, according to the Cleveland Department of Economic Development—the Greater Cleveland area is now home to more than 700 biotechnology and biomedical companies with 230,000 employees.

> ### NOACA's Strategic Location
>
> *The NOACA region is also well-situated to take advantage of the economic geography of the U.S. The region is located within 500 miles of:*
>
> - *44% of U.S. households and 43% of the U.S. population;*
> - *45% of U.S. effective buying income;*
> - *46% of U.S. earnings;*
> - *49% of U.S. manufacturing employment; and*
> - *56% of Fortune 500 U.S. headquarters.*
>
> Source: City of Cleveland Department of Economic Development. http://www.rethinkcleveland.org/Strategic-Advantages.aspx

Planning and Research Capabilities

NOACA has excellent planning and analysis resources, including:

- **Pavement management analysis tools.** NOACA implemented a pavement management system (PMS), RoadMatrix that was used to develop several pavement needs analyses. As part of its analysis, NOACA develops pavement condition reports for each member municipality.

- **Bridge and pavement needs assessment.** NOACA estimated annual expenditures needed to keep bridges and pavements in a state of good repair as recently as 2013.[19]

- **A strong research and analysis program.** NOACA produced valuable studies, such as a study of state gas tax donor/donee status by county, and a study of Transportation Improvement Program (TIP) match trends.

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[16] U.S. Bureau of Economic Analysis, http://www.bea.gov/regional/.

[17] http://fortune.com/fortune500/.

[18] Bureau of Labor Statistics Location Quotient (http://data.bls.gov/location_quotient/ControllerServlet).

[19] http://www.noaca.org/modules/showdocument.aspx?documentid=385.

Foundation of Strategic Planning

NOACA has a tradition of promoting TAM principles in its work. Several areawide plans help identify NOACA's priorities and serve as a foundation for future planning.

NOACA's Regional Strategic Plan

The Board of Directors adopted the Regional Strategic Plan, *Going Forward, Together*, on January 23, 2015. The Regional Strategic Plan is a progressive approach for propelling the region forward in an era of changing demographics, job climate, and funding constraints. An overarching goal of the plan is to keep Northeast Ohio sustainable, competitive in a global economy, and effective at moving people and freight.

The plan embraces a vision statement, five goals and strategies for meeting the goals and effectively allocating the region's resources. Future NOACA planning efforts will focus on activities that support the plan.

Vision Statement

NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure, and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE quality of life in Northeast Ohio.

NOACA's Provisional Asset Management Policy Adopted in 2014

The Board of Directors established the first Ohio-based MPO provisional transportation asset management policy to address the region's most critical pavement needs. This policy establishes the standard procedures that link the agency's strategic objectives with its investment decisions.

NOACA's *Connections⁺2035*

In *Connections⁺ 2035*, NOACA's long-range transportation plan, the NOACA Board of Directors identified guiding principles, several of which closely relate to asset management. The Plan calls for adequate transportation funding, efficiency, and enhancing economic viability through transportation. NOACA has listed 150 major projects and their estimated cost in *Connections⁺ 2035*. Many of these projects relate to asset management and include actions such as major rehabilitation, resurfacing, repair, bridge repair, and bridge painting.

Access Ohio 2040

Access Ohio 2040, the statewide long-range transportation plan, includes a comprehensive inventory of transportation services and infrastructure, forecasts of transportation demand, asset condition and performance, and an analysis of the trends that affect transportation in Ohio. As part of this Plan, ODOT established a Transportation Asset Management Committee to develop a framework for a centralized

inventory database and propose a series of recommendations focused on transportation improvement through asset management.

Partnerships

NOACA has a Board of Directors that includes members of county government, regional authorities, local elected and appointed officials, and state representatives. NOACA works with ODOT, project sponsors and other organizations to help address northeast Ohio's transportation, air quality, and water quality needs.

ODOT is a strong partner of NOACA with a history of using performance measures (referred to as critical success factors) in programming and project selection for more than 10 years. During the development of its TAMP, ODOT recently adopted several new business processes that increase the consideration of life-cycle costs, promote the use of pavement and bridge preservation treatments, and establish more consistent and collaborative work plans across the state. To support these business process improvements, ODOT is making ongoing investments in:

- Personnel development and capacity building

- Data integration and governance

- Technology and management systems

NOACA is making similar investments to support its asset management initiatives. For example, NOACA invested in a pavement management system that is being used to evaluate investment options and set realistic performance targets based on available funding levels. The pavement condition data for the federal aid eligible road system that has been input into the pavement management system was provided by ODOT, and the expectation is that ODOT will continue to provide pavement and bridge condition data for the federal-aid eligible system in the future. ODOT also provides funds to municipalities for eligible surface treatment and resurfacing projects on state and U.S. routes within municipal corporations through its Urban Paving Program. NOACA expects to be able to use the results of its pavement management analysis to support the region's request for funding through the Urban Paving Program.

FHWA is a strong supporter of transportation asset management and has supported funding for and participation in NOACA's program development process through an Accelerated Innovation Deployment (AID) Grant.

Data

Strong data resources for the region include the regional asset data contained in NOACA's GIS portal and the pavement and bridge data collected and maintained by ODOT. An assessment of NOACA's regional data is summarized below. The area has excellent data on pavements and bridges on the federal aid eligible roadway system from ODOT. At an areawide level, local roadway data on pavements are limited.

Data Resources

Asset	Areawide Data	Primary Dataset	Notes
Pavements			

Federal-Aid Eligible Roadways	Excellent	ODOT	PCR coverage is excellent, may be limitations with new FHWA requirements for pavement measures
Local Roads	Poor	Municipalities	Difficult to collect/maintain on a regional scale
Bridges	Excellent	ODOT, NBI	NBI is limited to bridges of >20 feet. ODOT inventory includes bridges >10 feet. Both datasets include condition data and condition ratings
Transit			
Fixed guideway	Excellent	GCRTA	Limited condition data
Vehicle fleet	Excellent	NTD	
Facilities	Good	NOACA (from TAs)	
Stops	Good	NOACA (from TAs)	Needs to be updated frequently
Routes	Good	NOACA (from TAs)	Needs to be updated frequently
Pedestrian	Acceptable	NOACA-compiled	Includes some ODOT curb coverage ratings
Bikeway	Acceptable	NOACA-compiled	Assembled from inventory and plans, no condition, needs regular update

Abbreviations: PCR – Pavement Condition Rating, NBI – National Bridge Inventory, NTD – National Transit Database, TA – Transit Agencies

Pavements

Roadway pavement condition in the NOACA area was determined using Pavement Condition Rating (PCR) data collected by ODOT and provided to NOACA for federal-aid-eligible roadways. Federal-aid-eligible roadways include all roadways except local streets and minor collector roadways located outside the urbanized area. In total, there are approximately 3,293 miles of federal-aid-eligible roadways in the NOACA region.

The majority of Interstate highway pavements in the NOACA region are in good or very good condition. On other non-Interstate federal-aid highways, more pavements are considered in fair or poor condition.

Other Roadway Assets

In addition to pavements and bridges, there are other roadway assets that support regional transportation. Several asset groups are not included in this inventory because:

- *NOACA is not a key decision maker on their maintenance and operation; and/or*

- *Areawide inventory and condition data are not available.*

Assets that fall into this category include culverts, ITS equipment (including traffic signals), retaining walls, noise walls, and streetlights.

Regional Pavement Conditions Summary

Pavement Condition Rating (PCR)		Element	2006	2008	2010	2012	2014
Very Good	90 - 100	Miles	1,132.5	1,044.3	864.5	989.9	644.6
		Percentage	34.7%	31.9%	26.3%	30.1%	19.6%
Good	75 - 89	Miles	1,203.8	1,239.6	1,318.4	1,226.8	1,517.0
		Percentage	36.9%	37.8%	40.2%	37.4%	46.1%
Fair	65 - 74	Miles	595.6	656.9	596.6	573.9	667.8
		Percentage	18.3%	20.0%	18.2%	17.5%	20.3%
Fair to Poor	55 - 64	Miles	247.2	244.7	350.9	357.8	348.8
		Percentage	7.6%	7.5%	10.7%	10.9%	10.6%
Poor	40 - 54	Miles	81.8	91.4	133.1	122.8	101.6
		Percentage	2.5%	2.8%	4.1%	3.7%	3.1%
Very Poor	0 - 39	Miles	0.0	0.3	18.9	12.6	12.7
		Percentage	0.0%	0.0%	0.6%	0.4%	0.4%
		Total Miles	3,260.9	3,277.1	3,282.3	3,283.7	3,292.5

Source: The Ohio Department of Transportation.

Bridges/Culverts

The NOACA area has 3,069 bridges. Based on ODOT condition ratings, 89% of all area bridges are in fair or better condition. The number of bridges by county is shown below. Around 40 percent of the bridges are located in Cuyahoga County.

Regional Bridge Conditions Summary

Condition Appraisal	Cuyahoga County	Geauga County	Lake County	Lorain County	Medina County	NOACA Region	% of Total
9 - As Built	29	36	8	56	38	167	5.4%
8 - Very Good	126	92	47	96	79	440	14.3%
7 - Good	391	51	70	139	165	816	26.6%
6 - Satisfactory	460	74	108	177	132	951	31.0%
5 - Fair	152	14	41	87	64	358	11.7%
4 - Poor	105	13	12	39	44	213	6.9%
3 - Serious	46	1	7	13	28	95	3.1%
2 - Critical	12	0	2	4	1	19	0.6%
1 - "Imminent" Failure	3	0	0	0	0	3	0.1%
0 - Failed	4	1	0	2	0	7	0.2%
Total	**1,328**	**282**	**295**	**613**	**551**	**3,069**	100.0%
% Good and Above	41.1%	63.5%	42.4%	47.5%	51.2%	46.4%	46.4%

Source: The Ohio Department of Transportation
Note: A failed bridge is out of service and considered beyond corrective action. Criteria for each appraisal level are defined by ODOT, which states, "General appraisal will be based on the existing condition of the bridge compared to its as-built condition."

The amount of bridge deck area in the region is approximately 20.6 million square feet. The following table summarizes the deck area by functional classification.

Deck Area by Functional Classification

FUNCTIONAL CLASS	TOTAL DECK AREA (ft²)	FUNCTIONAL CLASS	TOTAL DECK AREA (ft²)
Rural		**Urban**	
Rural, Interstate	278,699	Urban, Interstate	8,253,713
Rural, Principal Arterial	142,363	Urban, Other Freeways and Expressways	2,236,321
Rural, Minor Arterial	49,643	Urban, Other Arterial	2,371,688
Rural, Collector	259,281	Urban, Minor Arterial	3,640,075
Rural, Minor Collector	171,792	Urban, Collector	1,502,190
Rural, Local	394,734	Urban, Local	1,339,666
Total Rural	1,296,513	Total Urban	19,343,651
		Total	20,640,175
		Total Interstate	8,532,412
		Total NHS	13,282,784
		Total Non NHS	7,357,380

Transit

The NOACA area is home to a number of transit assets that help residents travel within the region. The Greater Cleveland Regional Transit Authority (GCRTA) provides Bus Rapid Transit, heavy rail and light rail, E-Line trolley and bus service throughout Cuyahoga County.

In total, GCRTA and the five other transit agencies in the region—Brunswick Transit Alternative, Laketran, Lorain County Transit, Geauga County Transit and Medina County Public Transit—carry 50 million riders each year.[20] In addition to serving intraregional travel, several transit agencies—including PARTA, SARTA, and METRO—connect to destinations beyond the NOACA region, including Akron, Canton, and Kent.

Regional Transit Assets Map
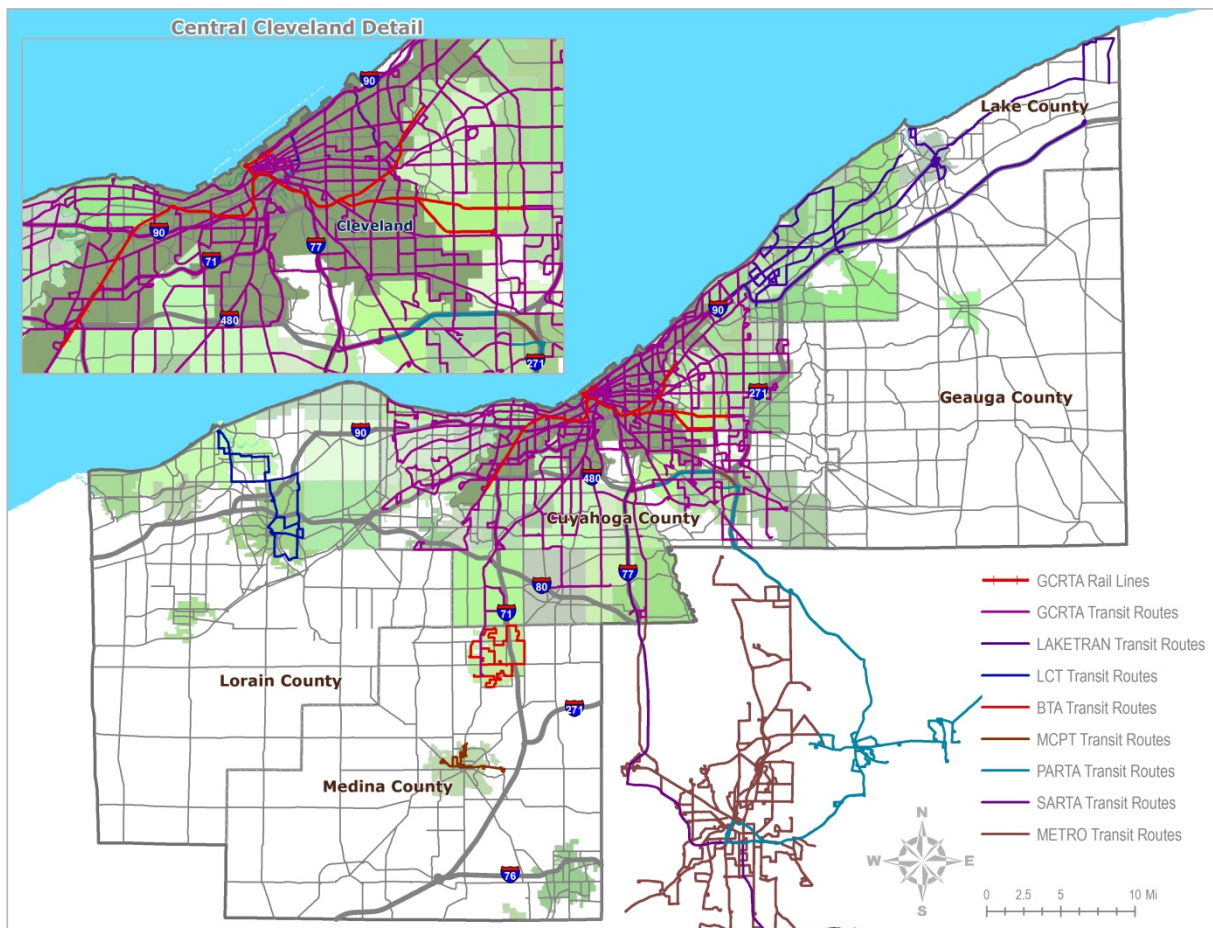
Transit assets include fixed rail guideway, vehicle fleets, facilities, signs, shelters/stops, and maintenance locations.

Sidewalks

The bulk of major streets in the five-county area have full or partial sidewalks (meaning sidewalks on only one side of the roadway). Most roadways outside municipal boundaries lack sidewalks. Generally at the

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[20] http://www.rethinkcleveland.org.

regional level—for federal-aid roadways where data are available—28% have full sidewalks, 20% have partial sidewalks, and 52% have no sidewalks, based on a 2010 sidewalk inventory.

Sidewalks Map
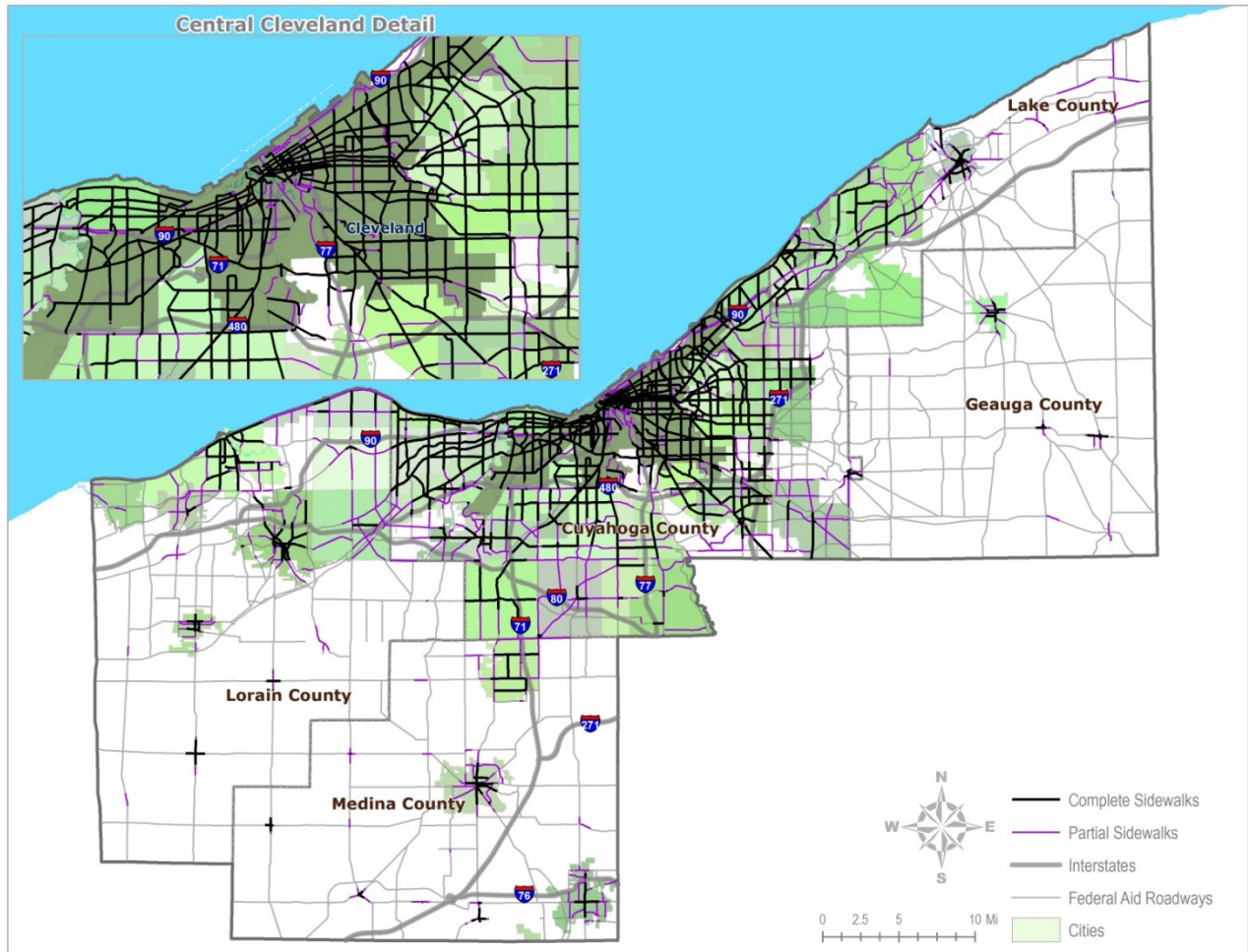
Bike infrastructure

The five-county area possesses a significant bikeway network. In addition to the 604 miles of bicycle facilities that currently exist, another 655 miles are either planned or proposed, based on data collected in 2013 and 2015. Existing facilities can be classified in the following categories:

- Bike Lane: 69 miles

- Bike Route: 274 miles

- Shared Use Path: 261 miles

Regional Bikeway Assets Map
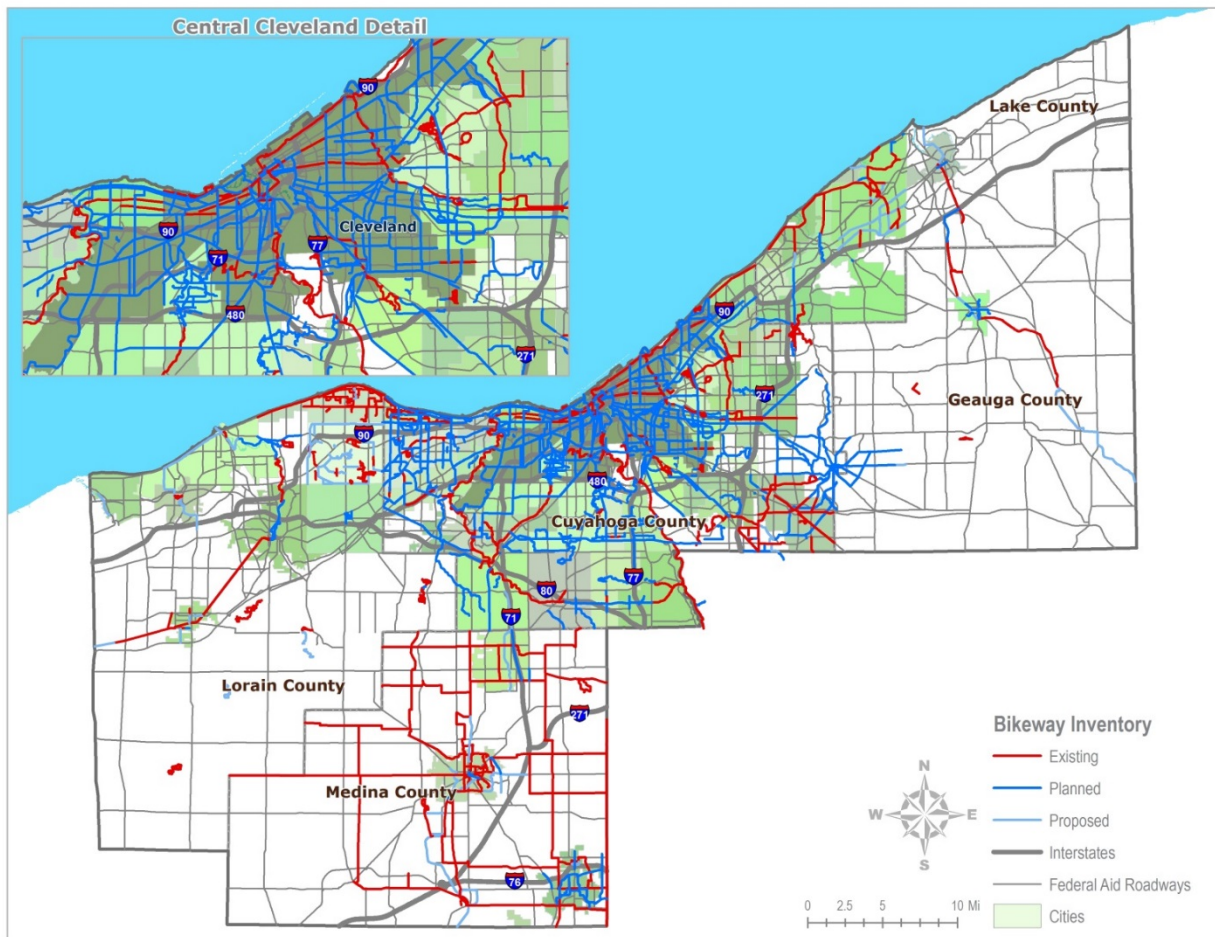
Freight infrastructure

The regional economy relies on freight transportation. The NOACA area has valuable freight assets, including approximately 54 miles of NHS Intermodal Connectors.[21] Other key freight assets include:

Airports

Cleveland Hopkins (CLE) and Burke Lakefront are the largest public airports in the region. In 2014, CLE handled 370 million pounds of cargo, up from 276 million pounds in 2008.[22] Burke Lakefront Airport primarily serves as a general aviation and reliever airport for Hopkins, as well as handling air cargo.

Ports

The five-county NOACA region also possesses three cargo ports. The Port of Cleveland is the region's largest port—it moved 11.5 million tons of freight in 2013, mainly iron ore, limestone, and imported steel products. The other two ports in the region—Fairport Harbor and Lorain Harbor—moved 1.5 million tons and 761,000 tons of freight, respectively, in 2013.[23]

Rail

The freight rail system in Northeast Ohio includes two Class I railroads, one Class II, and 5 short line railroads. CSX and Norfolk Southern (NS) operate the main lines running east-west through Ohio, providing long-haul service, while regional and short lines provide access to the regions ports, airport, and intermodal terminals. The NOACA region currently has more than 750 miles of freight railroad tracks, 69% of which are in Cuyahoga and Lorain Counties.[24]

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[21] See NOACA Intermodal Connector Technical Memorandum at http://www.noaca.org/modules/showdocument.aspx?documentid=10953.

[22] Federal Aviation Administration, All-Cargo Airports by Landed Weight, 2014 (http://www.faa.gov/airports/planning_capacity/passenger_allcargo_stats/passenger/media/cy14-cargo-airports.pdf).

[23] U.S. Army Corps of Engineers, Waterborne Commerce of the United States, Calendar Year 2013 (http://www.navigationdatacenter.us/wcsc/pdf/wcusnatl13.pdf).

[24] U.S. Department of Transportation Bureau of Transportation Research, National Transportation Atlas Database, 2012.

Goals, Objectives, and Measures

The broad goals for inclusion in the TAMP are drawn from NOACA's mission statement. All actions of the TAMP should support NOACA's mission and tie back to their broader organizational goals. For the purposes of the TAMP, these are broken into three key areas (**Strengthen**-**Preserve**-**Build**).

TAM Strategies and Objectives

NOACA will STRENGTHEN regional cohesion, PRESERVE existing infrastructure, and BUILD a sustainable multimodal transportation system to SUPPORT economic development and ENHANCE quality of life in Northeast Ohio.

The objectives are goals at a more specific and actionable level. The objectives provide a description of what NOACA intends to achieve through its transportation asset management program. The TAMP will provide a strong framework and supporting research and documentation to position NOACA for success with these objectives.

The strategies help create a roadmap to achieving objectives. The TAMP will provide greater detail on the purpose and implementation options for strategies. For example, adopting state of good repair (SOGR) targets for roadway assets is a strategy. The TAMP will include specific recommended targets. Both objectives and strategies are likely to evolve during the TAMP development process.

The objectives and strategies are drawn from several sources.

- NOACA's existing plans and policies—including 2014 & 2015 legislative agendas, the Asset Management Provisional Policy, and *Connections+ 2035* ●

- NOACA staff input—gathered in interviews with key NOACA staff ●

- Stakeholder priorities—including stakeholder responses to the TAM gap assessment survey and other comments drawn from meetings with the Project Steering Committee ●

- TAM best practices—good TAM policies with a focus on regional TAM ●

Key Sources: ● NOACA Plans ● NOACA Staff ● Stakeholders ● Best Practices

Strengthen Regional Cohesion

- **Objective 1**. Establish Transportation Asset Management as a regional priority ●●●●

  – Strategy 1A. Support consistent use of TAM to support decision making ●●●●

  – Strategy 1B. Partner with public and business community leaders to demonstrate links to economic development and quality of life ●

  – Strategy 1C. Conduct extensive outreach to both inform and obtain input from regional partners and the public on key asset management decision points ●●●●

- **Objective 2**. Serve as a liaison for NOACA members and partners like ODOT and FHWA ●

  – Strategy 2A. Foster agreement on common TAM goals and language ●●

  – Strategy 2B. Ensure consistency and transparency in project selection and funding priorities ●

  – Strategy 2C. Develop and maintain policies which reflect the priorities of local and regional partners ●●

Preserve Existing Infrastructure

- **Objective 3**. Apply a "fix-it first" mentality for projects relying on NOACA funds ●●●●

  – Strategy 3A. Communicate areawide preservation needs/costs ●●●●

  – Strategy 3B. Pursue new funding mechanisms to support system preservation investment ●●

  – Strategy 3C. Develop a TAM policy that supports preservation projects before allocating resources for expansion ●●

  – Strategy 3D. Incorporate TAM into the long-range planning process and strengthen the link between the region's long-range transportation plan and investment decisions ●●●●

- **Objective 4**. Achieve a state-of-good-repair for roadway assets ●●●

  – Strategy 4A. Formally adopt SOGR targets for NOACA planning and programming ●

  – Strategy 4B. Prioritize funding of projects that help achieve condition targets ●●

  – Strategy 4C. Regularly monitor and share progress toward condition targets ●

Key Sources: ● NOACA Plans ● NOACA Staff ● Stakeholders ● Best Practices

- **Objective 5**. Promote a least-life-cycle cost approach to transportation infrastructure investment ●●●●

- Strategy 5A. Strengthen data as a regional asset by developing and sharing data resources ●

- Strategy 5B. Provide tools to support transparent data-driven decision making for transportation investment ●●●

- Strategy 5C. Develop business processes that clearly connect the agency's strategic objectives with its investment decisions ●●

- Strategy 5D. Communicate impacts of "worst first" and "do nothing" scenarios ●●●●

- Strategy 5E. Provide guidance on considering life-cycle costs for new assets ●

Build a Sustainable and Multimodal Transportation System to Support Economic Development and Enhance Quality of Life

- **Objective 6**. Expand Transportation Asset Management program to other modes ●●

  - Strategy 6A. Support data development for other modes such as transit, pedestrian and bike, and other asset types such as safety infrastructure and signals ●●

  - Strategy 6B. Support condition targets for other modal assets such as transit, pedestrian and bike amenities, freight assets ●●

  - Strategy 6C. Support investment decisions that improve transportation conditions and performance for nonmotorized users ●●

TAM Performance Measures and Targets

NOACA is focused on measuring and improving the state of good repair for pavements and bridges in the region. A discussion of the measures follows.

Pavement Infrastructure Condition Measures

PCR is a scoring method developed by ODOT to monitor pavement conditions with time. Each pavement segment is given a numeric rating between 0 and 100. The score is determined by deducting points from 100 for each observable distress according to guidance issued by ODOT.[25] The PCR score is used by ODOT to determine condition categories for each highway segment, as shown to the right.

In January 2015, as required by MAP-21, FHWA issued a draft Notice of Proposed Rule Making (NPRM) on assessing pavement and bridge conditions for the National Highway Performance Program (NHPP).[26] This NPRM proposes a minimum pavement condition for interstate pavements, proposes the establishment of minimum pavement condition levels for NHS by state DOTs, and describes the process to be used by state DOTs to establish and report their targets.

The NPRM proposes that state DOTs report four condition metrics in uniform segments of 0.1 mile, including rutting, international roughness index (IRI), cracking, and faulting. A method is proposed for combining these metrics into an assessment of *Good*, *Fair*, or *Poor* condition for each 0.1 mile segment, as shown below. A standard maximum threshold of 5% of interstate pavement in *Poor* condition, calculated by state, is proposed. State DOTs will be required to establish their own targets for statewide condition of NHS pavements. MPOs will have the choice of establishing their own targets for NHS pavements within their jurisdictions, or supporting the target established by the state. There is no requirement for assessing the condition, reporting or setting targets for non-NHS federal-aid-eligible pavements.

PCR Classifications

Pavement Condition Rating (PCR)	
Very Good	90 - 100
Good	75 - 89
Fair	65 - 74
Fair to Poor	55 - 64
Poor	40 - 54
Very Poor	0 - 39

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[25] Ohio DOT 2006 PCR Manual.

[26] See https://www.federalregister.gov/articles/2015/01/05/2014-30085/national-performance-management-measures-assessing-pavement-condition-for-the-national-highway.

Proposed Pavement Condition Thresholds under MAP-21 Legislation

Metric	Rating		
	Good	**Fair**	**Poor**
IRI (inches per mile)	<95	95-170	>170
Cracking (percent of area)	<5%	5%-10%	>10%
Rutting (inches)	<0.20	0.20-0.40	>0.40

NOACA's pavement condition data is provided by ODOT and currently consists of PCR measurements with good time series and geographic coverage, and IRI values that cover a limited period of time and only state roads. While detailed distress data does exist for a few roads, it is very limited at this time. There is no rutting data available. Consequently, NOACA is not able to determine condition threshold attainment in accordance with MAP-21 legislation. Until such time as rutting, IRI, and cracking data is available for NOACA roads, it is recommended that NOACA use the **percentage of the lane-miles that are in *Good* or better condition based on PCR ratings (PCR ≥ 75)** to determine the state of good repair for pavements. This measure should be applied to all NHS pavements, all federal-aid-eligible pavements, and can also be applied to each set of pavements based on their classification of urban or nonurban. Additional targets, such as the **percentage of lane-miles meeting a minimum condition threshold (such as PCR > 55)** and the **system average PCR** can support the primary measure.

Pavement Infrastructure Condition Target

Establishment of pavement infrastructure condition targets is challenging for any agency and must balance budget implications and sustainability with expectations of decision makers and constituents. For NOACA this discussion is further complicated when considering that roads within NOACA's area of concern are actually maintained by others, and NOACA has limited opportunity to exert pressure on work performance. At this point NOACA seeks to establish condition target values that will help the agency coordinate among member communities to attain the best network conditions region-wide and support continued improvement over time. NOACA seeks to be recognized as a highly performing regional coordinating agency, and achievement of that requires establishment and progress toward regional condition goals.

In contrast, ODOT's current draft TAMP establishes critical success factor (CSF) PCR values of 85 for priority system roads, and 80 for general system roads. Please note that these draft values were under review at the time of the development of this report. Budget scenarios completed using current data have shown that attainment of the NOACA goal of a minimum of 75 PCR will require the same level of funding as an unconstrained analysis, something that will be extremely difficult to do with any constraints on funding.

Reviewing current conditions, roads on the urban and local federal-aid systems, those toward which NOACA primarily targets its funding, are currently at an average PCR of about 75. The table below shows the approximate percentages of roads below 75 for a number of different jurisdictions. As may be seen, roads within NOACA's area of concern show 34 to 56 percent of lane-mile lengths below the target value of 75.

Current Pavement Weighted Average PCR Values

Road Group	Average PCR	% Below 75
All Federal-Aid-Eligible Roads	78.1	35
All Urban and Local System Roads	76.2	43
- Cuyahoga Co.	77.3	43
- Geauga Co.	76.8	40
- Lake Co.	74.2	56
- Lorain Co.	81.6	34
- Medina Co.	77.5	46

Additional budget scenarios run for the urban and local systems indicate that, at the projected funding levels for urban and local federal-aid system pavements averaging approximately $50 million per year, the system shows a decline in condition over the 10-year analysis period. All of this shows that NOACA will need to increase roadway funding about $80 million a year to maintain an average condition of 75, and substantially more funding will be required to support a goal of 75 PCR or greater for all NOACA roads. The state of good repair gaps are discussed in greater detail in a later section.

Considering agency practice across the U.S. and current NOACA network conditions, it is recommended that NOACA consider infrastructure condition targets that define both an average network value and a bottom limit to prevent very poor pavements from being masked by larger roads in better condition. Given the recommended move away from a minimum value of 75 to an area-weighted average value, the agency might also consider increasing the stated average goal and seek greater consistency with proposed ODOT targets for greater interagency coordination. With that in mind it is recommended that NOACA consider infrastructure condition targets that focus on an **average network condition level for the urban and local federal-aid systems of greater than or equal to 80 PCR**, and **establishment of a target value for percent above a minimum level such as 85 percent of the network at or above 55 PCR**. Further financial analysis will need to be conducted to confirm that this is a sustainable expectation, but in this manner NOACA may help maintain the regional urban and local systems in an average Good condition, controlling the percentage that falls into the below-55 PCR condition categories (defined as either Poor or Very Poor by ODOT). Such a goal will be attainable and sustainable at reasonable funding levels.

Bridge Infrastructure Condition Measures and Targets

Per federal inspection standards, bridges are assigned a rating that represents the general condition of the structure. Structural assessments, together with ratings of the physical condition of key bridge components, determine whether a bridge is classified as "structurally deficient" or "functionally obsolete." The three components of a bridge that are individually inspected and rated are the deck surface; the superstructure that support the deck; and the substructure, which supports the superstructure and distributes all bridge loads to below-ground bridge footings. Structural assessments determine whether a bridge is classified as structurally deficient or not structurally deficient. A bridge is considered structurally deficient if significant load-carrying elements are found to be in poor condition due to deterioration and/or damage.[27] A structurally deficient bridge requires significant maintenance and repairs to remain in service. The classification of a bridge as "structurally deficient" does not imply that it is unsafe for travel.

FHWA guidelines assign a condition rating of Good, Fair, or Poor based on the minimum National Bridge Inventory (NBI) condition rating of the deck, superstructure, or substructure. If the NBI rating is 4 or below for any of the three bridge components, the bridge is classified as structurally deficient.

Bridge Condition Ratings

NBI Rating	Bridge Condition	Structural Classification
≥7	Good	Not Deficient
5 or 6	Fair	Not Deficient
≤4	Poor	Deficient

It is recommended that NOACA use **percentage of the deck area of bridges that is good or fair based on NBI ratings** to determine the state of good repair for bridges. This measure should be applied to all NHS bridges, all federal aid-eligible bridges, and can also be applied to the smaller subset of 10-20-foot bridges on which ODOT collects data.

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[27]FHWA, Bridge Preservation Guide, August 2011.

Bridge Infrastructure Condition Target

For bridges on the NHS, MAP-21 establishes the minimum condition level "no more than 10 percent of the total NHS bridge deck area may be on structurally deficient bridges." This metric measures the condition of the whole bridge, not just decks. Currently, the NHS bridges in the MPO region meet the MAP-21 standard, with 90 percent of total deck area on *not* structurally deficient bridges. MAP-21 does not require minimum performance targets for bridges outside the NHS system; however, the same rule of no more than 10 percent of deck area may be on structurally deficient bridges should be set as the target for the all bridges in the network.

As part of NOACA's commitment to maintaining regional bridges in SOGR over the life of this TAMP, it is recommended that NOACA consider a target that meets the MAP-21 requirement and dictates that **no more than 10 percent of the total NHS bridge deck area may be on structurally deficient bridges**.

Any additional targets for regional SOGR should follow the guidance of ODOT. A large portion of the funding for bridges in the region is at ODOT's discretion. Several ODOT programs to support bridges are based on joint projects between ODOT and municipalities or counties. Given this, NOACA cannot and should not play a major role in dictating bridge targets for the region. NOACA can still support ODOT in their target setting and advocate for adequate preservation funding for the region's bridges. In ODOT's latest version of its TAMP (in draft form at the time of writing), ODOT sets a performance target of 98 percent of state-owned bridges in fair or better condition based on their General Appraisal (GA) rating. The GA rates bridges from zero to nine. Fair or better indicates a bridge has a GA of five to nine.

Performance Gaps

This section identifies places where NOACA has an opportunity to improve its asset management processes and performance to meet the state-of-the-practice and fulfill regional stakeholder needs.

Gaps in TAM Process and Capabilities

To identify performance gaps and support the prioritization of NOACA TAM activities, a self-assessment survey was completed by stakeholders on the TAMP Steering Committee. The purpose of the self-assessment was to benchmark critical issues, identify appropriate initiatives, establish institutional direction, set priorities, develop consensus, and promote efficient resource allocation.

In some cases, there is a gap between what stakeholders think NOACA *should* be doing and what NOACA *is currently* doing. These gaps can help identify priority action items for implementation.

A few of the items that were identified as having the smallest gaps are listed below. Close scoring between the desired state and the current state typically demonstrate areas of strength for current practices. Smaller gaps don't always indicate a "solved" issue, but do show areas where the need for substantial business practice modifications might be lower.

- NOACA policies should consider customer perceptions and expectations.

- NOACA should periodically distribute reports of performance measures relevant to customer/stakeholder satisfaction with transportation system and services.

- NOACA has a complete and up-to-date inventory of pavement and bridge assets.

- NOACA policy should encourage resource allocation decisions based on cost-effectiveness or benefit/cost analysis.

- NOACA should regularly collect or consistently receive information on the condition of pavement and bridge assets.

- NOACA should be able to easily produce maps that display needs/deficiencies for different asset classes and planned/programmed projects.

Based on the largest gaps between current and desired states, NOACA has the opportunity to improve in the areas of risk assessment, data standards, use of performance measures, and customer outreach. The four largest gaps identified in the self-assessment follow:

- NOACA should use risk assessments in its project selection processes.

- NOACA should establish data standards to promote consistent treatment of existing asset-related data and guide development of future applications.

- NOACA's goals and objectives should be linked to specific performance measures and evaluation criteria for project selection.

- NOACA should regularly collect customer perceptions of asset condition and performance.

As part of the performance gap assessment process, NOACA stakeholders prioritized the TAM activities within several key subareas. Looking broadly at major potential directions, stakeholders found that:

- NOACA should also serve as a representative to state and federal agencies, communicating and coordinating on behalf of local agencies.

- Supporting condition-based decision making, especially for cities and counties without the staff to do much of it themselves, is a key role.

- NOACA's TAMP should clearly demonstrate the value of TAM. One way to do so is to clearly show the "no action" scenario.

- NOACA's TAM actions should provide value to local agencies. Good questions for local agencies are, would you use the tools developed to support TAM? Are they effective for your decision making off of the federal-aid -eligible system?

- Coordination with ODOT's TAMP is essential.

- The TAMP should provide the ability to add/integrate other assets over time.

Policy Guidance

There is opportunity for NOACA to continue as a policy leader for the region. Stakeholders will benefit from TAM development and decision making that is clearly documented, providing local agencies with a "roadmap" for TAM. NOACA's TAMP can't identify every project but can lay the foundation for a replicable process. It should be clear how this process saves money.

Planning and Programming

The biggest opportunity in planning and programming is to improve the information available and link costs to performance benefits and savings over time. Programming should communicate the value of planning for least-life-cycle cost to member communities/project sponsors.

Data Collection and Information Management

As part of the discussion on data collection and information management gaps, regional stakeholders concluded that it was important that NOACA have good data. It was less important whether that data is collected directly or compiled from other sources such as ODOT or local municipalities. Data needs to be regularly and consistently updated to be of value. Comprehensive pavement condition surveys are expensive but lose value after only a few years.

Consistent terminology is needed. Even the definitions of good/fair/poor are often a source of disagreement. NOACA should promote a clear understanding of these terms along with important terms like asset management, risk, and preservation.

Decision Support Tools

There were relatively few gaps in the decision support tools area. NOACA is addressing some of the current gaps by implementing a new pavement management system. There are several resources available through ODOT, such as the new Transportation Information Management System (TIMS) II. There are also training opportunities available for local agencies.

State of Good Repair Gaps

A previous section discussed measures and targets for pavements and bridges in the region. This section looks at the level of investment these assets need to maintain a SOGR and reach the targets in this TAMP.

Pavement State of Good Repair Gaps

For this analysis Stantec's RoadMatrix Pavement Management System (PMS) software was used, configured with condition data provided by ODOT. NOACA has PCR data collected by ODOT going back a number of years, with the most recent data from 2015. ODOT collects PCR data annually for the Interstate, U.S., and State routes, and every two years for locally maintained federal-aid routes. In very recent years ODOT has begun to provide IRI data for roadways, but the coverage and extent of this data was insufficient to include within the analyses conducted.

Analyses were conducted for all federal-aid-eligible roads, including ODOT general and priority systems, and separately for those roads within NOACA's primary area of concern (urban and local federal-aid systems). It is important to note that the analyses below do not include local roads that are not part of the federal-aid eligible system.

One of the first items to consider is the value of the roads within NOACA's primary area of concern (urban and local federal-aid systems). Using the RoadMatrix PMS, the replacement value of NOACA roads was determined using the road square footage values and unit cost per square foot for reconstruction. Although this is a simplistic estimate of the replacement value, it does provide an estimated value of the network. The total replacement value of urban and local system roads was determined to be approximately $5 billion, consisting of approximately $3.8 billion for local system roads and $1.2 billion for urban system roads.

For the purposes of the discussion of state of good repair gaps, several scenarios were conducted. Scenarios included:

- Unconstrained: Unlimited Budget.

- Do Nothing: Projected condition if nothing is spent on roadway improvement.

- Minimum PCR 75: Budget required to attain and maintain a minimum PCR value of 75 for all NOACA roads.

- Projected Budget Level (budget constrained).

Projected Pavement Condition Scenarios: All Roads
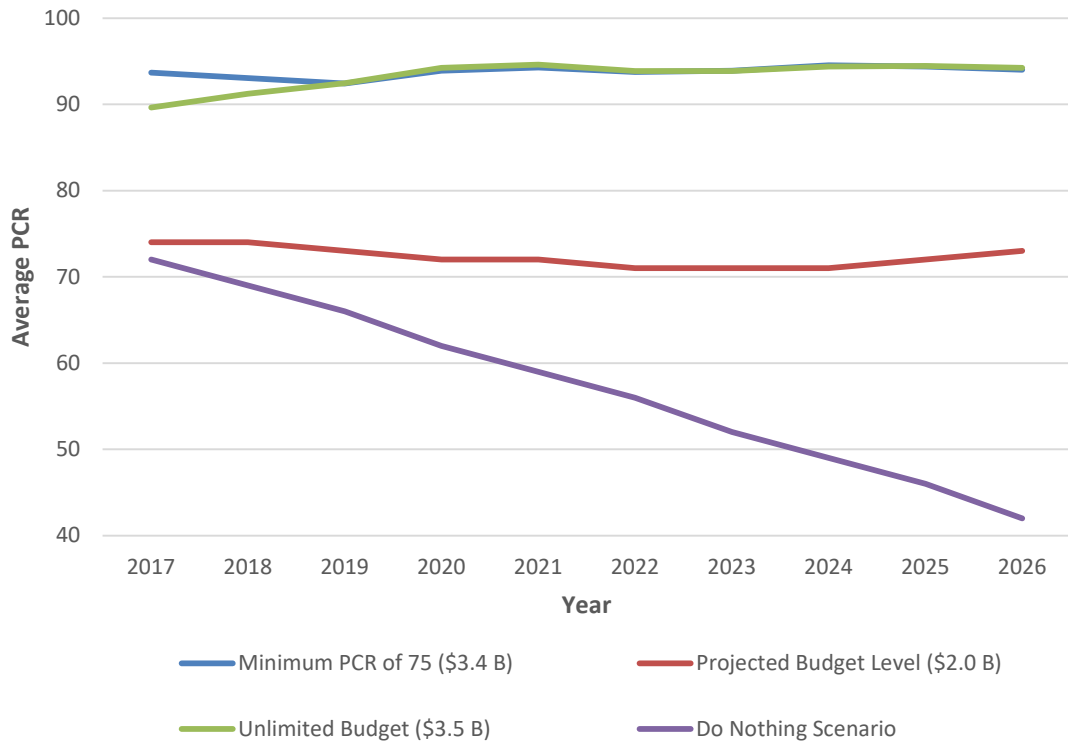
If completely unconstrained by budget, the PMS-recommended work program would put the average PCR for all federal-aid-eligible pavements at about 95 and eliminate all backlog at a cost of approximately $3.5 billion over the 10-year analysis period. This budget level is approximately the same as that required to achieve a condition where all roads have a PCR greater than 75. The cost required to maintain the current average condition of about 75 was found to be approximately $200 million per year, which is close to the projected available annual budget of $207 million for all roads. This analysis shows that the current spending level is approximately sufficient to maintain the current *average* condition of about 75, but significant additional funding, on the order of about $150 million more per year, would be required to achieve a condition where the minimum PCR is 75, or where the average PCR condition is about 95 and there is no backlog of needs.

It is important here to clarify what is meant by average condition. The PMS software reports results as area-weighted average conditions, not a simple arithmetic average based on the number of roads. This is a more appropriate way to represent the network, but it should be understood that one road with a lot of area in good condition may mask (offset in the average calculation) a number of small area roads in poor condition. For this reason agencies will typically establish two performance targets to both set a reasonable average value and also to maintain control on the lower limits. This supports the earlier target recommendations to maintain 85 percent or more in fair or better condition, effectively limiting the area allowed to dip into the poor or very poor condition categories.

Note that these scenarios for all federal-aid-eligible roads do not differentiate on where the money is spent to keep the average PCR above 75. As demonstrated in the analysis below, the urban and local systems face a

much greater challenge than the network as a whole. ODOT's historical investment in the priority and general systems is greatly lifting regional PCR averages.

Projected Pavement Condition Scenarios: Urban and Local Systems
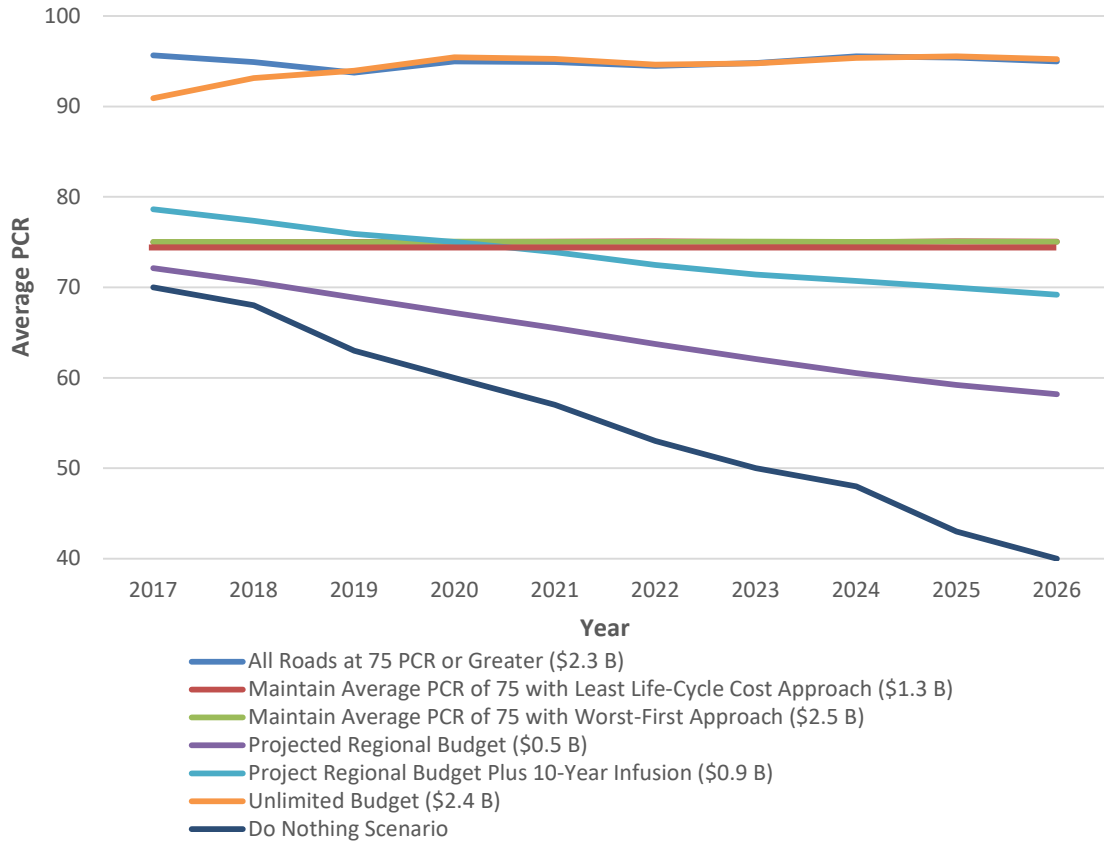
To maintain an average PCR of 75 for the urban and local systems, funding levels approaching $1.3 billion, or an average of $130 million annually, are required (see the red line above). If the region seeks to attain a condition where the minimum condition of all urban and local system roads is 75, a budget requirement of about $2.3 billion is projected (see the blue line above). This shows a gap of about $80 million annually to maintain an average condition of 75, and a gap of about $180 million annually to achieve a condition where the minimum roadway condition is PCR 75.

When looking at budget constraints, two different scenarios were reviewed. The first assumed the regional budget for pavement over the next ten years will include NOACA's entire Surface Transportation Program (STP), or the portion of the Surface Transportation Block Grant (STBG) program that used to be referred to as the STP, at an annual average of $35 million as well as local matches on NOACA funds, the ODOT Urban Paving Program with an annual average of about $8.4 million, and a local match on the Urban Paving Program. With this average level of funding of approximately $50 million annually, pavements would decline in condition about 15 PCR points over the 10-year analysis period (see the purple line above).

The second budget constraint scenario looked at the potential for an infusion of 10 years of STP funds at the front end of the analysis. With this infusion, pavement conditions rise initially but then show a similar rate of decline over the 10-year period (see the light blue line).

While performing analyses, the cost impact of treatment strategies was also investigated. Specifically, a comparison was performed to review the budget implications of worst-first treatment applications as compared to using a more preservation-oriented, optimized treatment strategy. For this analysis the program was asked to identify the annual budget required to maintain an average network lane-length weighted PCR of 75 using a worst-first treatment strategy (see the green line in the graph), then using an optimized strategy (the red line). The difference was striking. The worst-first strategy resulted in a budget requirement approximately equal to that in the unconstrained analysis ($2.5 billion over 10 years), while the optimized treatment strategy showed a budget requirement of about half that ($1.3 billion over 10 years) to meet the same goal state. NOACA and its member agencies should review their policies and consider treatment strategies in light of this, to ensure that available funds are being managed most efficiently.
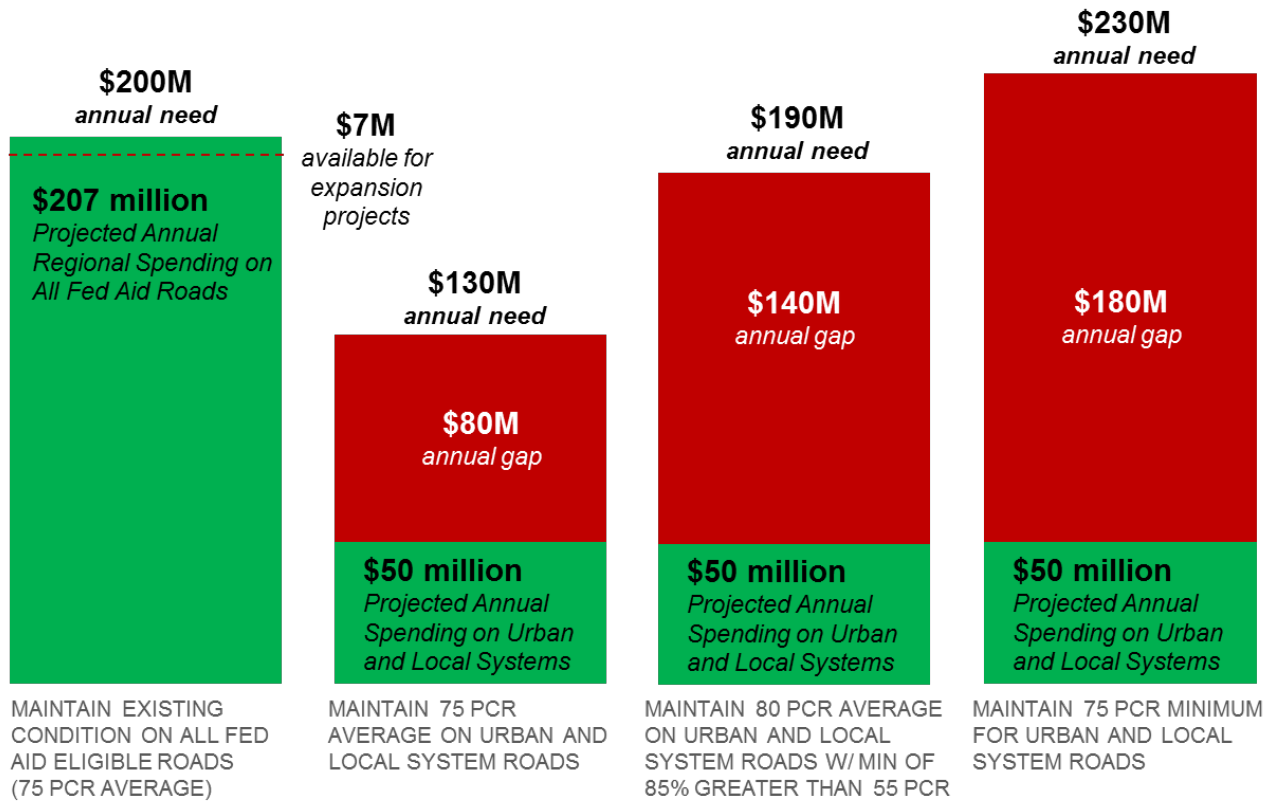
The review of current roadway conditions shows that the urban and local systems have the potential to face significant decline in the face of underfunding. Tabulated results presented earlier showed that 43% of the urban and local system roads are below the desired PCR value of 75. Urban and local system roads are poised on a precipice that should be recognized and avoided if possible. Typical roadway performance over time shows a drop-off in the performance curve usually taken in the range of PCR 60-70, after which the decline in condition accelerates. At this point the roadway condition may decline faster than an agency can budget repairs, and repair option unit costs get more expensive. Agencies are typically encouraged to maintain roads at an average above this level for efficient management of the roadway network. With all of this said, NOACA is encouraged to manage funding levels to the point where the current network condition may be maintained or improved gradually over time, rather than allowing it to decline to the point where deterioration accelerates and funding levels to maintain condition dramatically increase.

To estimate available annual pavement investment over the next 10 years, a project database from ODOT that includes highway projects within the region using federal and state transportation funding programs from 2004 to 2013 was reviewed. For this analysis future investments were assumed to be allocated similarly across modes and across the state. Based on the financial projections for the region (discussed in greater detail in the financial plan section), it was assumed that the region, through FHWA, ODOT, NOACA, and local match funds, will invest about $207 million per year in all federal-aid-eligible roads (not including bridges).

An investment level of $207 million per year may allow the region to maintain existing pavement conditions on the federal-aid-eligible system with an additional $7 million per year available for expansion projects. The SOGR gaps are clear, however, when the urban and local systems are reviewed separately. Anticipated available revenue for the urban and local systems is $50 million per year. There are significant gaps when looking at the urban and local system needs to reach sample targets, such as:

■ Maintaining a 75 average PCR (a cost of $130 million per year, which leaves a gap of $80 million per year);

■ Maintaining an 80 average PCR with 85 percent of the network at or above 55 PCR (a cost of $190 million per year, which leaves a gap of $140 million per year); or

■ Achieving and maintaining a minimum condition of 75 PCR (a cost of $230 million per year, which leaves a gap of $180 million per year).

Pavement Performance Gaps

$200M
annual need

$207 million
Projected Annual Regional Spending on All Fed Aid Roads

MAINTAIN EXISTING CONDITION ON ALL FED AID ELIGIBLE ROADS (75 PCR AVERAGE)

$7M
available for expansion projects

$130M
annual need

$80M
annual gap

$50 million
Projected Annual Spending on Urban and Local Systems

MAINTAIN 75 PCR AVERAGE ON URBAN AND LOCAL SYSTEM ROADS

$190M
annual need

$140M
annual gap

$50 million
Projected Annual Spending on Urban and Local Systems

MAINTAIN 80 PCR AVERAGE ON URBAN AND LOCAL SYSTEM ROADS W/ MIN OF 85% GREATER THAN 55 PCR

$230M
annual need

$180M
annual gap

$50 million
Projected Annual Spending on Urban and Local Systems

MAINTAIN 75 PCR MINIMUM FOR URBAN AND LOCAL SYSTEM ROADS

Note: PCR = Pavement Condition Rating

Bridge State of Good Repair Gaps

For this analysis, bridge inventory and condition data were collected from the 2014 NBI data submitted by ODOT to the FHWA as part of the national bridge inspection program. The NBI database is a collection of information covering all of the nation's bridges more than 20 feet in length that carry public roads, including Interstate Highways, U.S. highways, state, and county roads, as well as publicly accessible bridges on federal lands. NBI records of the bridges within the five-county region were extracted from the Ohio NBI file.

In Ohio any self-supported structure equal or greater than 10 feet in length is considered a bridge. Thus, inventory and condition data of highway bridges between 10 feet and 20 feet were collected from ODOT's Transportation Information Mapping System (TIMS). These "non-NBI-length" bridges are scrutinized at the same level as the NBI-length bridges.

Future system-wide bridge condition, using the measure of **percentage of the deck area of bridges that is not structurally deficient (good or fair) based on NBI ratings,** was projected using the FHWA's National Bridge Investment Allocation System (NBIAS). NBIAS is used by FHWA to produce a report to Congress on the condition, performance, and future capital investment needs of the nation's bridges. NBIAS is designed to minimize maintenance costs by generating an optimal set of preservation actions for bridge elements based on life-cycle user and agency costs, and engineering standards of bridge maintenance needs. Bridge replacement and improvement costs were adjusted to Ohio, based on state-specific adjustment factors developed by FHWA from cost data provided by the states. Part of the development of the TAMP included training for NOACA staff on the use of NBIAS to support future TAM activities.

System preservation needs were estimated over a 10-year period (i.e., 2017-2027) for three networks: (1) National Highway System (NHS), (2) Federal-aid network, and (3) Non-NBI bridges (10-20' long).

In the case of the NHS system, maintaining the existing conditions would meet the MAP-21 target for the NHS of 90 percent not structurally deficient. NBIAS determines the maximum performance level based on economic optimization analyses that consist of life-cycle user and agency costs. NBIAS estimates that an annual investment equivalent to $150 million in 2016 dollars is the optimal funding level needed on the NHS system to achieve the target performance level and ensure maintenance needs are cost-effectively addressed as intended in their life cycle. To maintain the current state of good repair of the whole federal-aid network through 2027, an annual investment equivalent to $190 million (2016 dollars) is required.

NBIAS estimates that an annual investment equivalent to $15 million in 2016 dollars is needed to achieve 100% of total deck area on 10'-20' bridges in good or fair condition (i.e., *not* structurally deficient bridges).

Available annual bridge investment over the next 10 years was analyzed using a process similar to that discussed for pavements. Based on the financial projections for the region (discussed in greater detail in the financial plan section), it was assumed that the region, through FHWA, ODOT, NOACA, and local match funds, will invest about $70 million per year in bridges. Even if all of this money is dedicated to preservation instead of capacity/expansion projects, there are significant gaps, as shown in the diagram below. Note that the projected annual spending is a conservative estimate which does not include routine maintenance on bridges and local spending with no federal or state component.

Bridge Performance Gaps

$150M
annual need

$80M
annual gap

$70 million
*Projected Annual
Regional Spending
on Bridges*

MAINTAIN EXISTING CONDITION ON
NHS/MEET MAP-21 TARGET (90% NOT SD)

$190M
annual need

$120M
annual gap

$70 million
*Projected Annual
Regional Spending
on Bridges*

MAINTAIN EXISTING CONDITIONS ON ALL
BRIDGES (89% NOT SD)
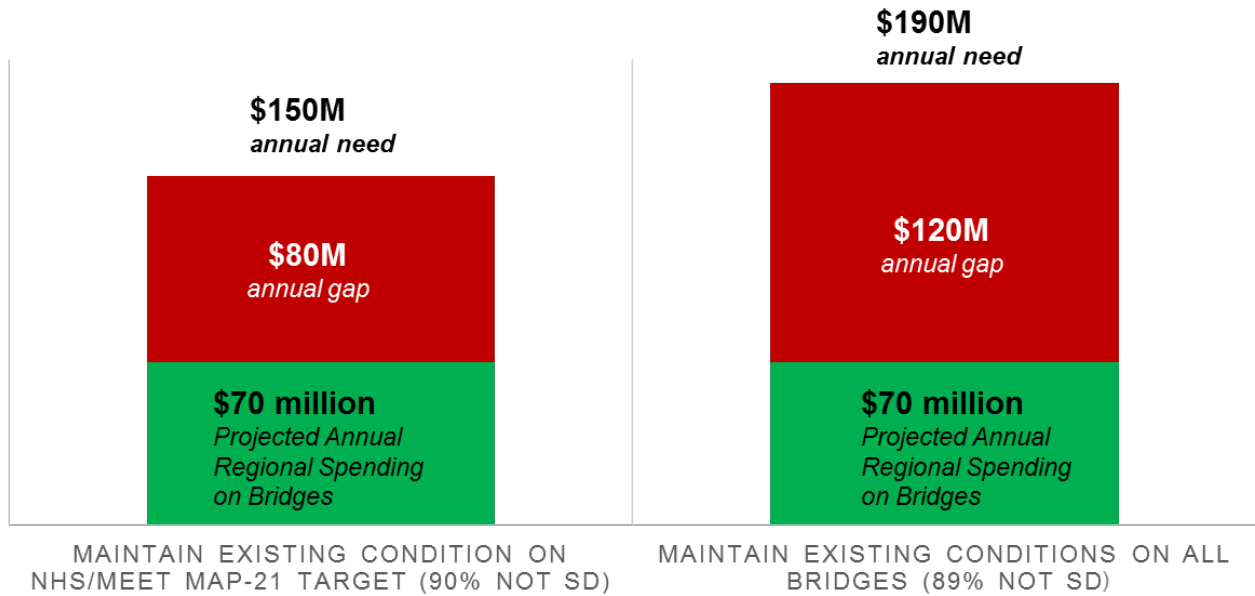
Note: SD = Structurally Deficient

Life-Cycle Management

When a new asset is built, the owner is committing not only to the initial construction costs, but also to the future costs of maintaining and operating that asset. Over a long time, future costs can be much greater than the initial cost. An important part of TAM is managing facilities as cost effectively as possible over the entire service life and to be mindful of whole-life costs when making decisions about an asset.

Life-cycle management is characterized as "maintaining existing system performance at a constant desired level while minimizing resource consumption and externalities over the long term."[28] Life-cycle management applies data and analytics to develop a long-term strategy for managing an asset or group of similar assets at the lowest possible whole-life costs. This is accomplished by addressing all phases of an asset's life cycle and applying the most effective treatment at each point in an asset's life. The emphasis is on long-term preservation and sustainability without sacrificing system performance or public safety.

Asset Life Cycle Diagram
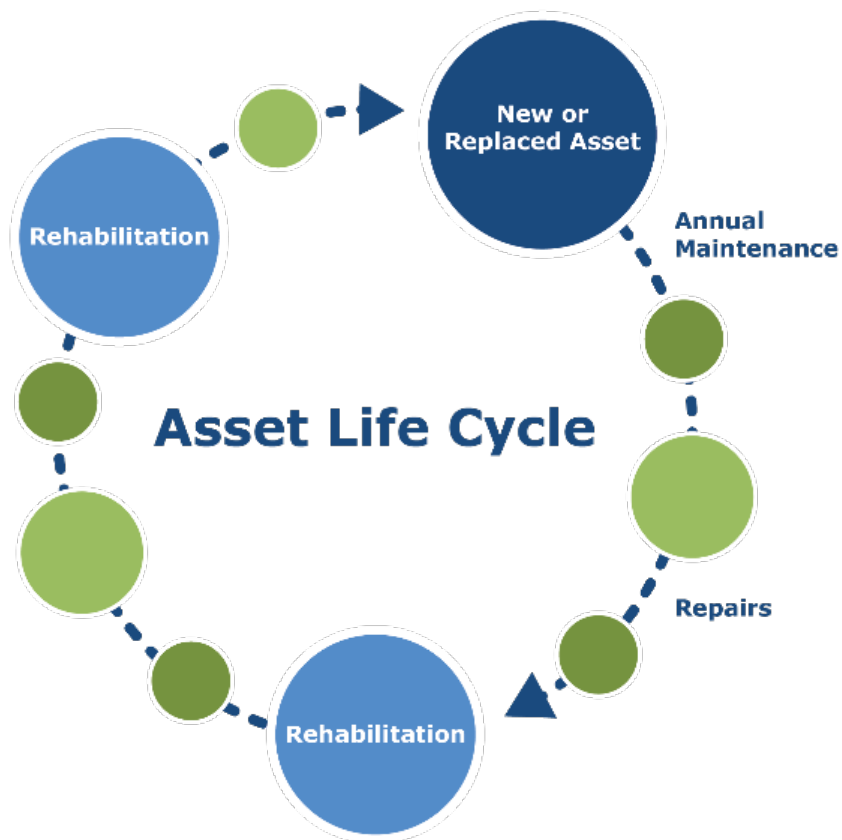
Generally, DOTs have accepted that a worst first approach to maintaining or replacing assets is not optimal. A worst first approach is one in which an agency ranks its assets from worst condition to best condition, and then works down the list until funds are expended. Most often, assets that are prioritized on a worst first

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[28] AASHTO, Supplement to the Transportation Asset Management Guide: Volume 2-A Focus on Implementation, 2013?

basis require reconstruction or replacement, which is very costly relative to other types of maintenance and preservation activities.

A more cost-effective approach is to consider preventive maintenance activities and rehabilitation activities that stop short of asset replacement. A common example of a preventive maintenance activity is changing the oil in a car. Car owners who change the oil in their car can significantly extend the life of their engine compared to owners who perform no work until the engine seizes up and requires replacement. Preventive maintenance and rehabilitation are designed to slow down the deterioration of an asset and to prolong its life. As an asset's life span is extended, expensive replacement can be pushed further into the future. As a result, preventive maintenance and rehabilitation strategies can drive down the overall cost of ownership.

Implementing life-cycle management requires information about the assets to be managed, such as the type of asset being managed, asset locations, attributes (owner or responsible agency, funding eligibility, age, etc.), and condition. Information is also needed on how the assets deteriorate, what types of treatments are available to prevent or correct that deterioration, and how much these treatments cost. Once the necessary data is collected, computer models are used to determine the most cost-effective treatment option for each asset. Treatment options generally range from "do nothing" to "complete replacement." These computer models can be used to help an agency determine the funding needed to achieve a desired condition state, the optimal use of available funds and many other calculations that previously would have been determined through expert judgment or consensus.

When managing a population of assets, such as a pavement network, using a life-cycle approach, agencies find that it is much more cost effective to apply preservation treatments earlier in the life cycle of an asset to prevent deterioration from progressing to a point where only expensive treatments are viable. This strategy is much more cost effective because lower-cost treatments can be used while the asset is still in good condition.

When considered over the serviceable life of an asset, the preservation strategy results in a lower annualized life-cycle cost because low-cost treatments are used to extend the life of the asset and postpone the need for more costly rehabilitation treatments. An illustration of this concept is shown below.

The Value of Preservation

This example explores two options for managing the lifecycle of a hypothetical one-mile segment of pavement. Since the initial construction cost is the same for both scenarios, it is excluded from the calculations.

Option 1. Allow the pavement to operate with no maintenance for 20 years, then apply a rehabilitation treatment. The rehabilitation costs $525,000 and lasts 15 years. This option would have an annualized preservation cost of $15,000 ($525,000/35).

Option 2. Apply a total of three preventive maintenance treatments at a cost of $20,000 each before applying the rehabilitation treatment. Assume the first preventive maintenance treatment is applied in year 10 and that each preventive maintenance treatment lasts 5 years. The rehabilitation treatment has the same cost and life from Option 1. Although the total cost is higher than Option 1 ($585,000), the additional life provided by the preventive maintenance treatments reduces the annualized cost to $14,625 (or $585,000/40).

While the savings on one mile of pavement is small, over a network of only 1000 miles, the savings would be $375,000 per year. That would be enough to preserve an additional 18 miles of pavement each year.

As part of the effort to develop this TAMP, NOACA has invested in developing a pavement management system to support implementation of life-cycle management. The system uses data already collected by ODOT and will provide NOACA staff and member agencies with analysis results and insights into the benefits and consequences of potential planning and programming strategies, allowing NOACA to make the best possible use of its available resources. In addition, NOACA is developing expertise with the NBIAS bridge needs assessment tool, which can strengthen understanding of the life-cycle management needs of bridges within the region.

The pavement management system supports life-cycle management by selecting the most appropriate treatment for each pavement section in each year of the analysis period according to decision trees which have been developed by NOACA staff. The decision trees use condition data to determine the most appropriate, lowest-cost treatment for each segment. An example decision tree from NOACA's pavement management system is shown below.

Using the treatment recommendations from the decision trees, analysts can determine the most appropriate time to apply maintenance treatments and at what point more costly repairs or rehabilitations will be needed if maintenance is not applied. Combining this information on optimal treatment timing with other inventory data such as functional class and traffic volume, NOACA analysts can develop a prioritized list of treatments that would deliver the greatest overall benefit for the given budget.

Pavement Management System Treatment Decision Tree

```
                    PCR
                    < 90
                   /      \
           Do Nothing      PCR
                          < 83
                         /      \
         Preventative           PCR
      Maintenance Minor        < 75
                              /      \
             Preventative            PCR
          Maintenance Major         < 65
                                   /      \
              Minor Rehab without        PCR
                 Repairs (AC)           < 50
                                       /      \
                        Minor Rehab with      Major Rehab/
                          Repairs (AC)        Reconstruction
```
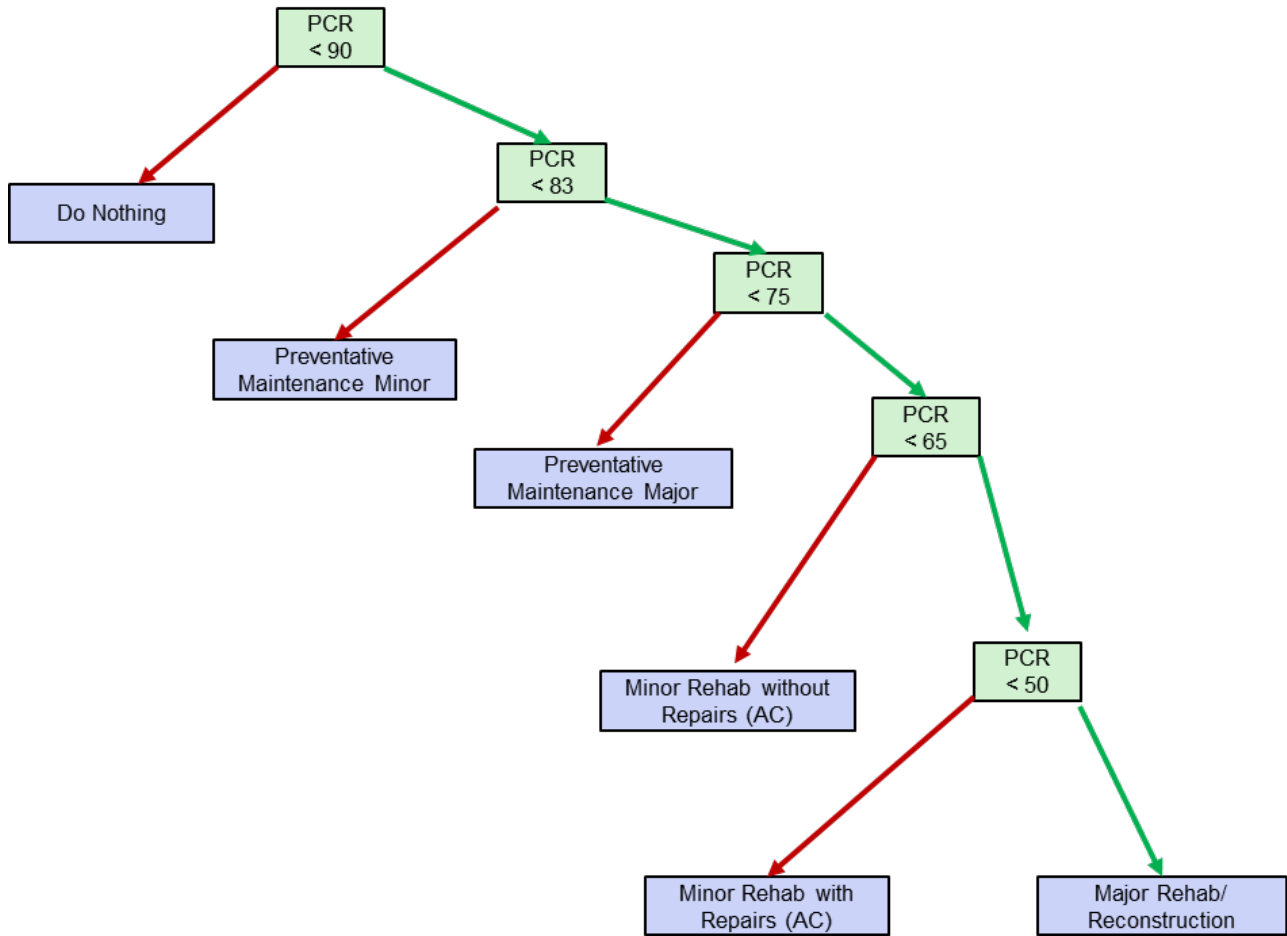
To facilitate life-cycle management, NOACA staff will update data in the pavement management system and review the decision trees annually. Pavement inventory and condition data will come from ODOT. Information on treatment types, costs, and decision trees will be updated by NOACA staff based on information gathered from member agencies. NOACA, and potentially member-agency staff, can use the pavement management system to analyze the projected benefits of various investment strategies and budget levels. This information can then be used by NOACA to inform the planning and project prioritization/selection decisions.

Risk Management

This section discusses risk and includes an assessment of the greatest risks to NOACA's assets and overall mission.

Risk refers to events, such as performance failure, weather events, cost controls, the selection of suboptimal preservation projects, regulatory delays, construction delays, etc., that interfere in NOACA's ability to perform its mission.

Risk management for NOACA involves systematically identifying, analyzing, assessing, and managing the risks that threaten the ability to achieve the agency's organizational objectives.

NOACA considered risk in five categories without preference for importance or likelihood. These categories include:

- Infrastructure damage

- Environmental and extreme weather

- Funding

- Internal (including training and staff characteristics)

- External (including political, stakeholder reputation, and regulatory)

A Risk Workshop was held at NOACA offices in July 2015. At the workshop, regional stakeholders identified the highest priority risks for inclusion in the TAMP:

- Bridges are structurally damaged by motor vehicle crashes, accelerating repair/rehab.

- Lack of regular maintenance leads to deteriorated infrastructure and more costly repairs.

- Bridges fail or are posted for weight restriction (NOT rendered inserviceable).

- Bridges or pavement are damaged due to overweight/overheight loadings.

- Extreme snowfall causes major disruptions in mobility.

- Federal officials reduce funds across the board for transportation.

- State officials increase maintenance obligations without identifying a funding stream.

- No new dedicated capital funding streams are instituted.

- Inability to provide local match prevents scheduled projects from coming to fruition.

- State officials earmark or mandate capital projects.

- Major events force change in priorities.

- Lack of coordination between other infrastructure projects, which deteriorates pavements more quickly or disrupts schedules.

NOACA does not currently have a specific process in place to address risk. Most MPOs do not. It may be valuable, however, for NOACA to maintain the risk register developed for this TAMP and consider integrating risk into regular decision points (see Appendix C for full risk register).

In discussions with regional stakeholders, managing several of the risks identified in the risk register should be a part of the general long-range planning, research, and policy development work NOACA currently does. Raising awareness of long-term risks and communicating potential consequences to regional decision makers is a valuable role for NOACA.

Most of NOACA's highest priority risks relate to unexpected costs that affect the region's ability to meet its transportation goals. To address these, NOACA's risk management strategies could include development or continuation of the following:

- Continuing regular communication with legislators about the impacts of policy changes, funding cuts, and unsustainable funding levels

- Regular monitoring of current and projected financial resources and how they compare to system needs

- Coordination with other agencies such as ODOT to identify and ensure emergency revenue streams are available to address sudden, unexpected needs

Financial Summary

This section covers major sources of revenue for the region and specific to NOACA, their historical values and trends, and revenue predictions for a 10-year planning horizon (2017-2026).

Transportation Funding in the NOACA Region

Transportation funding at NOACA comes from various federal, state, and local funding sources. The FHWA, the Federal Transit Administration (FTA), and ODOT provide roughly 80% of NOACA's annual budget, with FHWA supplying the bulk of the funding. Federal and state funds are made available to NOACA through various programs administered by ODOT for roadway construction and other multimodal projects. Funds controlled by ODOT and allocated through ODOT's project selection process include:

■ **National Highway Performance Program (NHPP).** This program provides support for the condition and performance of the National Highway System (NHS), for the construction of new facilities on the NHS, and to ensure that investments of federal-aid funds in highway construction are directed to support progress toward the achievement of performance targets established in a state's asset management plan for the NHS.

■ **Surface Transportation Block Grant Program (STBG).** The Surface Transportation Block Grant Program (STBG) provides flexible funding that may be used by states and localities for projects to preserve and improve the conditions and performance on any federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals. ODOT-controlled STBG funding is used primarily for state-maintained roadways. STBG funds are also allocated to the ODOT Urban Paving Program to support maintenance of state and U.S. routes within municipalities.

■ **Highway Safety Improvement Program (HSIP).** The HSIP is a core federal-aid program with the purpose of achieving a significant reduction in fatalities and serious injuries on all public roads, including non-state-owned public roads and roads on tribal lands. The HSIP requires a data-driven, strategic approach to improving highway safety on all public roads that focuses on performance.

■ **Grant Anticipation Revenue Vehicles (GARVEE Bonds).** GARVEE bonds are a financing mechanism used by states to finance highway projects. ODOT issue state bonds to advance construction projects that are later paid with future federal money.

ODOT Central office is responsible for the management and forecasting of the funds expected to be available from the above sources. NOACA, however, does have direct control over several funds. The NOACA-administered funding sources used for highway projects include:

■ **Congestion Mitigation Air Quality (CMAQ).** CMAQ provides flexible funding to state and local governments for transportation projects and programs to help meet the requirements of the Clean Air Act. In 2012, ODOT developed a statewide CMAQ program for Ohio's eight large MPOs (200,000 population). The statewide program replaced the individual programs previously administered by the largest MPOs (the small MPOs still receive individual allocations). With one statewide budget, the eight large MPOs collectively establish, prioritize, and manage annual programs of CMAQ projects. In the NOACA region, these funds are commonly used for traffic signal upgrade projects, bus replacement, bike facilities, intelligent transportation system improvement, transit center, and park and ride lot

construction. It is important to note that CMAQ funds cannot be used for general roadway or bridge maintenance projects.

- **Surface Transportation Block Grant Program (STBG-local).** STBGP provides flexible funding that may be used by states and localities for projects to preserve and improve the conditions and performance on any federal-aid highway, bridge and tunnel projects on any public road, pedestrian and bicycle infrastructure, and transit capital projects, including intercity bus terminals. FHWA directs funding to NOACA through ODOT by a distribution formula for MPOs of regions with a population greater than 200,000, and ODOT suballocates an additional amount of discretionary STBG.

- **Transportation Alternative Program (TAP).** The TAP provides funding for programs and projects defined as transportation alternatives, including on- and off-road pedestrian and bicycle facilities, infrastructure projects for improving nondriver access to public transportation and enhanced mobility, community improvement activities, and environmental mitigation; recreational trail program projects; safe routes to school projects; and projects for planning, designing, or constructing boulevards and other roadways largely in the right-of-way of former Interstate System routes or other divided highways.

Every year NOACA receives an allocation of STBG and TAP funds through ODOT for highway and transportation alternatives projects. These funds are controlled by NOACA and allocated through NOACA's project selection process. CMAQ funds for the eight large MPOs are administered by the Ohio Association of Regional Councils (OARC). The MPOs collectively establish, prioritize, and manage annual programs of CMAQ projects.

NOACA generally administers between $46 and $50 million of federal-aid funding each year. In addition to revenue sources from ODOT and FHWA, NOACA can influence local investments used to match federal funds and state funds through their project selections. In 2014, NOACA adopted a Provisional Transportation Asset Management Policy (PTAMP) to address the region's most critical pavement needs. This policy was funded by NOACA funding for fiscal years 2015 and 2016 by rightsizing the existing State Infrastructure Bank (SIB) debt service in the TIP to free up available capital funds.

Transit Funding

The six public transit systems that operate within the NOACA region each operates independently with individual service areas. The region receives transit funding from several FTA funding programs, state-administered funding programs, NOACA-administrated funding programs, and local funding sources. Federal sources include Urbanized Area Formula (5307), Enhanced Mobility of Seniors and Individuals with Disabilities (5310), State of Good Repair (5337), and Bus and Bus Facilities (5339). State transit sources include ODOT-administered STBG and CMAQ programs. NOACA has also administered funding to transit through the STBG, TAP, CMAQ, and FTA Section 5310 Funding. On the local scale, transit agencies receive transit funding from the general fund, farebox revenue, and dedicated local taxes. Debt financing has played a significant role in funding the local share of capital grants.

Data show that Ohio is among the states with the lowest state support for public transit. Based on 2014 funding data submitted by transit agencies to the Federal Transit Administration, Ohio ranked in the bottom 14. Among the neighboring states, Pennsylvania provides the highest support for transit operating expenses (i.e., 47% share). The State of Ohio provided less than 1% of operating expenses in 2014.

State Funding for Transit Operations (Funding Per Capita)
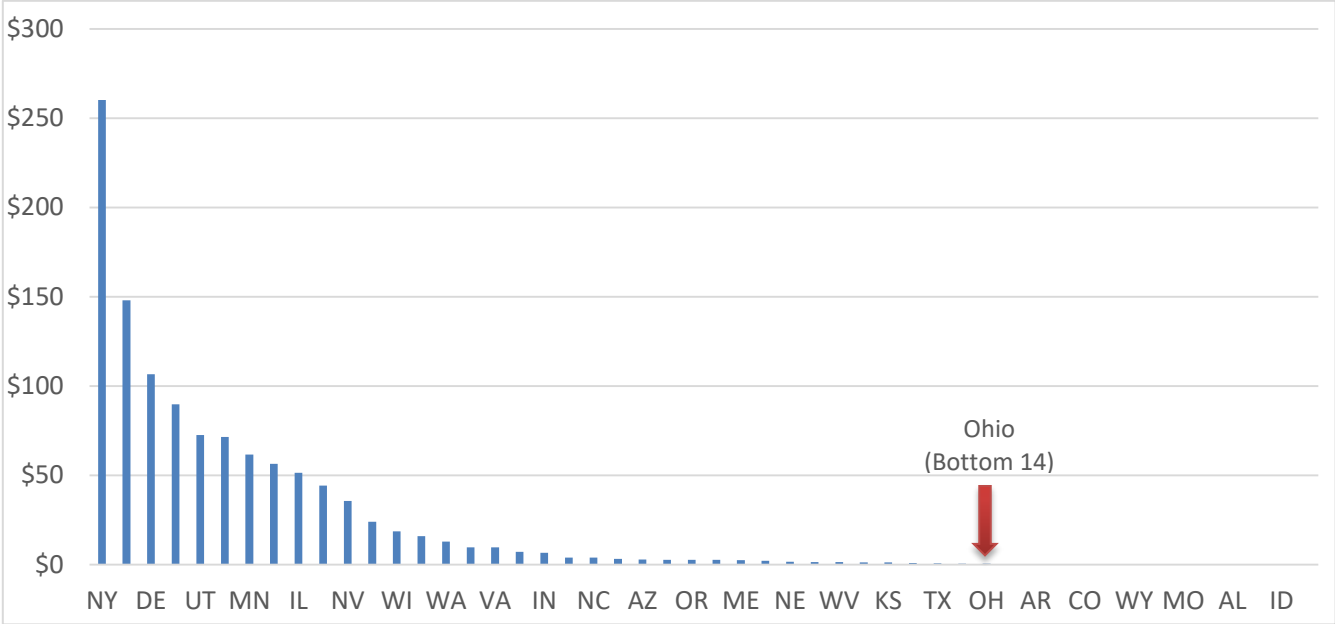
Source: National Transit Database, 2014

Operating Funding Shares
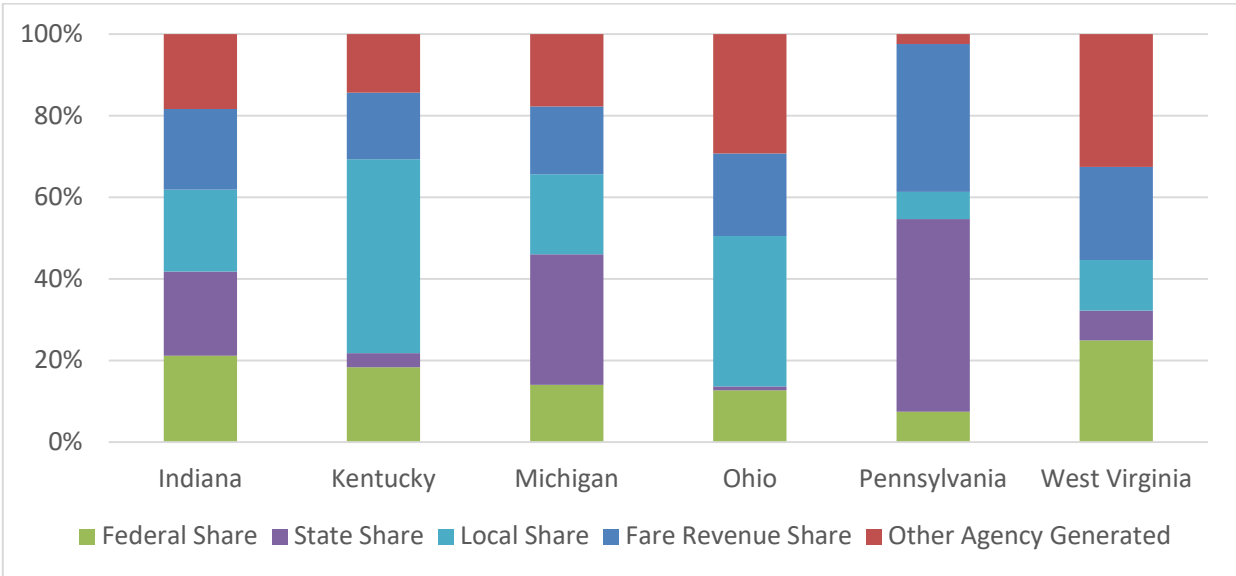
Source: National Transit Database, 2014

Historical Project Spending

Annual spending on bridges and pavement have varied significantly over the past 10 years mainly due to competing needs and available funding. An evaluation of an ODOT database that includes highway projects using federal and state transportation funding programs from 2004 to 2013 within the region revealed that on average, the region spends about $63 million per year on bridges and close to $183 million per year on pavements. The database excludes local projects with no state or federal funds.

Average Annual Spending in the NOACA Region by Work Category

Work Category	Average Spending in Millions (2004-2013)
Bridges	$63
Pavement*	$183
Bike and Pedestrian Infrastructure	$3
Railroad	$9
Environmental	$2
Capacity/Expansion	$64
Traffic Operations	$9
Others	$31

*Includes ODOT Urban Paving Program at $8.4 Million

Projected Funding Levels

Revenue projections were developed using the latest Transportation Improvement Program (SFY 2016-2019) as the baseline. The FAST Act provides modest growths for the federal funding programs over the next five years, ranging from 2.1% to 2.4% per year, to offset the effects of inflation. Based on this certainty for surface transportation funding, NOACA assumed that allocations from FHWA and FTA programs will grow at 2.3% per year from 2020 through 2026. Currently the TIP anticipates $25.5 million in revenue bonds. For this TAMP, no revenue bonds were assumed after 2019. Federal funds typically require a 20% nonfederal match. The match requirements vary depending on the federal program, priorities, and projects. It was assumed that project sponsors would provide the 20% nonfederal share for the locally administered funds used for construction projects.

All transportation revenues expected to be available from federal, state, and local matches is estimated at $6.0 billion over the plan horizon. Of this, $4.5 billion is projected for highway purposes and the remainder for transit purposes. Note that revenues in the table below include all projected available revenue for the NOACA region. The following section examines the federal funds administered by NOACA as a subset of all available revenues.

Federal, State, and Local Match Projections

HIGHWAYS		
Federal Funds	**Total**	**Annual Average**
Administered by NOACA		
STP (part of STBG)	$334,608,700	$33,460,900
TAP (part of STBG)	$33,460,900	$3,346,100
CMAQ	$175,491,500	$17,549,100
Administered by ODOT		
NHPP	$1,725,082,200	$172,508,200
STBG-State	$198,486,500	$19,848,600
CMAQ-State	$17,956,700	$1,795,700
HSIP	$89,342,700	$8,934,300
Other Federal	$139,082,800	$13,908,300
Urban Paving Program	$87,400,000	$8,740,000
State Funds		
Bonds	$10,000,000	---
ODOT (funds used for federal match and agency generated)	$1,127,252,300	$112,725,200
Local Funds		
Local Matching Funds	$215,211,600	$21,521,200
TOTAL HIGHWAY FUNDS	**$4,521,445,300**	**$452,144,500**
Transit		
Federal Funds		
5307, Urbanized Area Formula	$302,158,600	$30,215,900
5310, Enhanced Mobility for Seniors and Individuals with Disabilities	$19,395,000	$1,939,600
5337, Fixed Guideway	$17,749,600	$1,775,000
5337, State of Good Repair	$118,496,900	$11,849,700
5339, Bus and Bus Facilities	$23,345,800	$2,334,600
State Funds		
General Obligation (GO) Bonds*	$4,622,000	$1,540,700
Local Funds		
Dedicated Tax	$25,781,900	$2,578,200
Farebox	$2,504,228	$250,400
Other Local Contributions	$995,082,000	$331,694,000
TOTAL TRANSIT FUNDS	**$1,509,136,900**	**$150,913,700**
Total Revenues	**$6,030,582,200**	**$603,058,200**

* The annual average for GO Bonds corresponds to a 3-year average (FY17-FY19)

Funds Administered by NOACA

The federal transportation funds administered by NOACA is an important subset of all available regional funds. This value represents the revenue that NOACA will have at its disposal to meet regional transportation goals in coordination with the investments of its partner agencies (ODOT, counties, and cities among others). Based on the overall revenue projections, NOACA will administer an estimated $652 million of funds from 2017-2026, an average annual gross revenue of $65 million (see NOACA Administered Funds Table). This revenue includes the state and local matches required for federal funds. The NOACA Administered Funds table shows the breakdown of NOACA-administered funds.

It is important to note that in addition to STBG, TAP, and CMAQ funds, NOACA uses loan proceeds to finance local transportation projects. Local jurisdictions have taken out loans from the State Infrastructure Bank (SIB) to advance construction projects. Loans are repaid with federal MPO money, more specifically, NOACA-administered STBG funds. Current debt service payments extend through 2028. Outstanding NOACA debt service has been accounted for to refine future projected revenues available for new projects. Debt service obligations are subtracted from NOACA-administered gross revenue projections for the final (net) financially constrained forecast to reflect debt repayment needs as a priority, before additional transportation investments are considered. The outstanding debt service over the 2017-2026 period is $71 million.

The net funding (after debt obligations are considered) expected to be available for NOACA's control is estimated at $581 million, an annual average of about $58 million.

NOACA Administered Funds Table

Yr.	STP (portion of STBG)	TAP (portion of STBG)	CMAQ	Local Match (10%)	Debt Service	Net Revenue
17	$30,141,900	$3,014,200	$15,808,500	$9,792,900	($5,723,300)	$53,034,200
18	$30,835,200	$3,083,500	$16,172,100	$10,018,200	($7,482,800)	$52,626,100
19	$31,544,400	$3,154,400	$16,544,000	$10,248,600	($10,854,400)	$50,637,100
20	$32,269,900	$3,227,000	$16,924,500	$10,484,300	($10,892,000)	$52,013,700
21	$33,012,100	$3,301,200	$17,313,800	$10,725,400	($10,060,400)	$54,292,100
22	$33,771,400	$3,377,100	$17,712,000	$10,972,100	($5,244,800)	$60,587,800
23	$34,548,100	$3,454,800	$18,119,400	$11,224,500	($5,251,000)	$62,095,900
24	$35,342,800	$3,534,300	$18,536,100	$11,482,600	($5,257,400)	$63,638,400
25	$36,155,600	$3,615,600	$18,962,500	$11,746,700	($5,263,900)	$65,216,500
26	$36,987,200	$3,698,700	$19,398,600	$12,016,900	($4,923,500)	$67,178,000
Total	$334,608,600	$33,460,800	$175,491,500	$108,712,200	($70,953,500)	$581,319,800

NOACA Administered Funds Chart
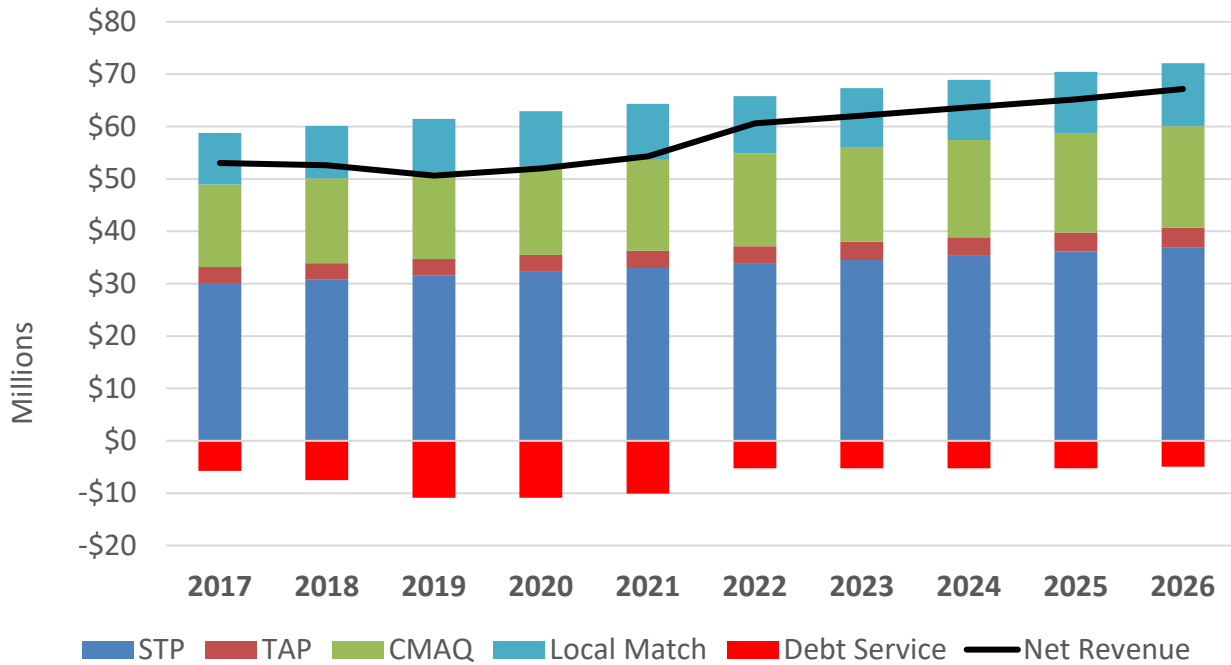
It is important to note where there are limitations to the NOACA financial estimates.

■ On the **revenue side**: Projections include federal and state money. For local revenues, only the match is calculated, and it is assumed that it will be available. The forecast doesn't include other local revenues that may be available due to the lack of data. The forecast could be strengthened if local revenue data from member jurisdictions can be obtained.

■ On the **cost side**: Aside from local debt service payments, no other costs were deducted from the revenues. If these revenues are used to pay other operating costs, these should be added and deducted from the revenues.

Investment Strategies

As an MPO, NOACA is responsible for leading the coordinated transportation planning efforts for its constituent area of northern Ohio. Fundamental to this effort is establishing policies and procedures that achieve the shared objectives of the Long-Range Transportation Plan (LRTP) and TIP as efficiently as possible. To this end, NOACA will pursue several efforts to ingrain life-cycle management as a core principle of long-term and short-term strategies. NOACA will also use all available tools, particularly the newly developed pavement management system to improve decisions in all aspects of planning and programming highway and bridge projects.

It is noted that NOACA is not an owner of the transportation system and cannot directly propose or select projects. Instead, NOACA's efforts will be directed toward gaining consensus on the need to adopt life-cycle management practices and a common set of asset management priorities, not just for federal-aid eligible

roads, but all public transportation funding. In doing so, NOACA will lead efforts to make planning and programming more data driven, goal–oriented, and objective.

NOACA is under no mandate, state or federal, to implement these changes. Instead, this effort is being undertaken for the purpose of improving practices and making better use of public funding. Through its role as the coordinating agency for transportation planning, NOACA will seek progress though consensus building, communication, and transparency. Absent the specifics of a mandate, NOACA will be able to work with members to set the scope and pace of implementation best to address member needs and concerns.

While member agencies are free to establish their own strategies for investing local funds, the adoption of life-cycle management principles at all member communities, along with the development of common asset management priorities, would be of great benefit for the region. NOACA will work to educate managers of external funding programs on asset management practices, and make the newly developed pavement management systems available to external managers for use in managing their assets on and off the federal-aid-eligible system.

NOACA has a few specific opportunities to leverage its role as a project sponsor within the region.

- **Dedicate the bulk of STP (now STBG) funds to pavement projects of regional benefit on the urban and local federal-aid-eligible systems.** Analysis of the 10-year pavement needs of the region has clearly demonstrated that funds are sorely needed on the urban and local federal-aid eligible systems. While there are also important bridge projects, the bridge needs of the region largely fall under ODOT's jurisdiction. NOACA should devote its attention to the parts of the system where it (OR the agency) can make a significant difference.

- **Require local projects seeking NOACA funds to demonstrate that they match PMS program recommendations.** NOACA can put its PMS to use, ensuring that funded projects make sense. One way to do this is to publish a PMS-recommended work program among regional stakeholders. This will give stakeholders the opportunity to identify and nominate highly ranked projects. Another mechanism is for NOACA to run nominated projects through the PMS to see if the data-driven system agrees with the projects' value in addressing the whole life-cycle system needs of the region. NOACA can also make the PMS available to project developers and champions to empower them to shape projects that address the region's greatest needs. NOACA should make efforts to prevent this from becoming a black-box scenario where project nominators are uncertain as to why their project was selected or not. NOACA should also ensure that it values local input and engineering judgment.

- **Develop a Transportation Asset Management Policy to formalize NOACA investment in regional preservation.** Both of the above recommendations should be formalized as part of a comprehensive TAM policy. The PTAMP provides an excellent model and foundation for effective regional TAM. Under the PTAMP, 25% of STP funds are dedicated to pavement projects that match NOACA's prior PMS's recommendations. With greater tools at its disposal and a deeper understanding of the pavement needs of the region, NOACA should consider developing a new program with a more aggressive funding allocation as the primary mechanism to address the previous two bullets and leverage its role as a project sponsor into a better state of good repair for the region.

Process Enhancements

NOACA has several opportunities to enhance its TAM processes to strengthen the region. Most significantly, the newly implemented pavement management system will provide NOACA and its member communities with a strong analytical tool to consider asset performance in its planning and programming decision making. A core functionality of asset management programs is the ability to determine what level of service can be expected from a given level of investment, or conversely, the level of investment needed to attain a desired level of service. Using the PMS, NOACA can evaluate investments in priority choices. This will not only improve planning practices, but will allow the setting of objective, attainable goals in the Long Range Transportation Plan (LRTP) and TIP. As programs are delivered, NOACA will be able to track progress and recommend strategic or programmatic adjustments as necessary.

By setting sustainable condition goals that progress to a preferred state of good repair, NOACA can determine the funding required to meet its asset needs for the entire jurisdiction or any subset of assets. This will allow the comparison of available budgets to the needs of subsets of the roadway network (such as the urban system). This comparison will allow NOACA to determine which portions of the system have been adequately funded by traditional allocation practices and which portions of the system have not. Armed with this information, NOACA can look to adjust suballocation or project prioritization criteria to drive funding to the areas of greatest need.

NOACA's increased TAM capabilities will give it and its members the ability to analyze how well any candidate project aligns with the life-cycle management goals. Member communities can use reports from the PMS to nominate projects that match treatment recommendations provided by the software. Additionally, the project nomination process can be enhanced to include measureable requirements related to how well projects align with the strategic objectives for the region. This will increase transparency and objectivity in the project nomination, prioritization and selection processes.

The discussion of strategies found in an earlier section is recapped here as a set of potential process enhancement opportunities. The symbol ☑ has been placed next to strategies that have been at least partially addressed by NOACA's development and adoption of this TAMP. These strategies should be strengthened over time. NOACA should look to integrate the remaining strategies over time in coordination with its regional partners.

Under each strategy there are one or more recommendations for specific actions NOACA should undertake over the next couple years. These should be revisited as part of TAMP updates and during undertakings such as the update of the LRTP and TIP development. Multiple recommendations refer to the development of a TAM policy and discuss the different elements that should be a part of that policy.

- **Objective 1. Establish Transportation Asset Management as a regional priority.** ☑

  - **Strategy 1A**. Support consistent use of TAM to support decision making. ☑

    Recommendations:

    Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development.

    Make NOACA's PMS available for use by local agencies for project development and prioritization.

    Incorporate NOACA's risk register into the LRTP update and consider risk during project prioritization and selection.

    Continue risk mitigation through communication with legislators and monitoring financial resources.

  - **Strategy 1B**. Partner with public and business community leaders to demonstrate links to economic development and quality of life. ☑

    Recommendations:

    Make TAM a central component of the region's LRTP.

    Continue coordination with the Business Advisory Council and provide stakeholders with the tools to share the messages.

  - **Strategy 1C**. Conduct extensive outreach both to inform and obtain input from regional partners and the public on key asset management decision points. ☑

    Recommendations:

    Use the LRTP update process and plan document to publicize the findings of the TAMP.

    Regularly update the public and stakeholders on system performance and SOGR gaps.

- **Objective 2. Serve as a liaison for NOACA members and partners such as ODOT and FHWA.** ☑

  - **Strategy 2A**. Foster agreement on common TAM goals and language. ☑

    Recommendations:

Use the definitions within this TAMP to foster consistency and update the TAMP as needed.

– **Strategy 2B**. Ensure consistency and transparency in project selection and funding priorities.

Recommendations:

Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development.

Publicize project selection and prioritization criteria and processes as projects (?) mature.

– **Strategy 2C**. Develop and maintain policies that reflect the priorities of local and regional partners.

Recommendations:

Continue coordination with TAMP Steering Committee and other regional stakeholders on TAM topics, especially target setting and progress evaluation.

Ensure LRTP and TAMP updates include local and regional stakeholder input.

■ **Objective 3. Apply a "fix-it first" mentality for projects that rely on NOACA funds.** ☑

– **Strategy 3A**. Communicate areawide preservation needs/costs. ☑

Recommendations:

Use the LRTP update process and plan document to publicize the findings of the TAMP.

Update and publicize areawide preservation needs on a regular cycle.

– **Strategy 3B**. Pursue new funding mechanisms to support system preservation investment.

Recommendations:

Focus the discussion on regional funding on the SOGR gaps and look for funding mechanisms to address the gaps.

– **Strategy 3C**. Develop a TAM policy that supports preservation projects before allocating resources for expansion. ☑

Recommendations:

Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development. This policy should prioritize preservation over expansion.

– **Strategy 3D**. Incorporate TAM into the long-range planning process and strengthen the link between the region's long-range transportation plan and investment decisions. ☑

Recommendations:

Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development.

Make TAM a central component of the region's LRTP.

- **Objective 4. Achieve a state-of-good-repair for roadway assets.** ☑

  - **Strategy 4A**. Formally adopt SOGR targets for NOACA planning and programming. ☑

    Recommendations:

    Coordinate with TAMP Steering Committee and NOACA Board of Directors formally to adopt SOGR targets that rely on the analysis within this TAMP and coordination with ODOT.

    Coordinate with ODOT and FHWA to meet MAP-21/FAST Act performance management requirements.

  - **Strategy 4B**. Prioritize funding of projects that help achieve condition targets.

    Recommendations:

    Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development. This policy should prioritize funding of projects that help achieve condition targets.

    Dedicate the bulk of STBG funds to pavement projects of regional benefit on the urban and local federal-aid-eligible systems.

    Require local projects that seek NOACA funds to demonstrate that they match PMS program recommendations.

  - **Strategy 4C**. Regularly monitor and share progress toward condition targets.

    Recommendations:

    Develop a condition progress reporting template and share it via NOACA's website or regular newsletters/reports.

- **Objective 5. Promote a least-life-cycle cost approach to transportation infrastructure investment.** ☑

  - **Strategy 5A**. Strengthen data as a regional asset by developing and sharing data resources. ☑

    Recommendations:

Continue development and promotion of the NOACA GIS portal.

Discuss data as an asset in the LRTP.

Share roadway data compiled in PMS with interested agencies.

Coordinate with local agencies to address gaps in pavement condition data and work history on local roadways.

– **Strategy 5B**. Provide tools to support transparent data-driven decision making for transportation investment. ☑

Recommendations:

Use PMS recommendations to shape project development and prioritization. Keep the life-cycle management approach up-to-date and relevant by annually revisiting treatment decision trees.

Make NOACA's PMS available for use by local agencies for project development and prioritization.

Train NOACA staff on the NBIAS tool and encourage others to make use of the resource.

– **Strategy 5C**. Develop business processes that clearly connect the agency's strategic objectives with its investment decisions. ☑

Recommendations:

Develop a formal TAM policy that clearly outlines NOACA's use of TAM in project selection and LRTP and TIP development. This policy should identify strategic objectives.

– **Strategy 5D**. Communicate impacts of "worst first" and "do nothing" scenarios. ☑

Recommendations:

Use the LRTP update process and plan document to publicize the findings of the TAMP on the impacts of the "worst first" and "do nothing" options.

Coordinate with local agencies to educate elected officials and councils on the impacts of the "worst first" and "do nothing" options.

Update and publicize areawide the "worst first" and "do nothing" PMS scenario outputs on a regular cycle.

- **Strategy 5E**. Provide guidance on considering life-cycle costs for new assets. ☑

  Recommendations:

  Use the research in this TAMP as a foundation for including discussion of life-cycle costs in project selection processes and nominations for new projects.

■ **Objective 6. Expand the Transportation Asset Management program to other modes.**

- **Strategy 6A**. Support data development for other modes such as transit, pedestrian and bike and other asset types such as safety infrastructure and signals.

  Recommendations:

  Monitor data resources for other modes and identify weaknesses.

  Discuss data as an asset in LRTP.

- **Strategy 6B**. Support condition targets for other modal assets such as transit, pedestrian and bike amenities, and freight assets.

  Recommendations:

  Conduct a second phase of regional TAMP development focused on transit.

  Consider additional asset classes such as pedestrian and bike amenities, freight assets, and signal systems when updating the TAMP.

- **Strategy 6C**. Support investment decisions that improve transportation conditions and performance for nonmotorized users.

  Recommendations:

  Consider additional asset classes such as pedestrian and bike amenities when updating the TAMP.

  Apply TAM principles to CMAQ funding allocations.

TAMP Updates and Keys to Success

Development of this TAMP represents an improved process; however, this process needs to be standardized so the strategies and goals described here are implemented and updated as necessary. The TAMP should be updated approximately every 2 years under the direction of a Steering Committee. This will provide a plan that is between the LRTP and TIP in planning horizon (10 years). In addition it helps balance the plan focus between strategy and tactics. While the TAMP does not list specific projects to be delivered, it can link the long-term objectives of the LRTP to measureable goals that are achievable through a properly programmed TIP.

While the initial TAMP is intended to focus primarily on pavements and bridges, the program should ultimately expand to include other assets such as transit, bicycle and pedestrian amenities.

Implementation of this TAMP will require that member communities understand and embrace life-cycle management, preservation strategies, and goal-oriented programming. To facilitate adoption of these practices, NOACA staff will provide targeted and significant outreach and support.

It is important that the public understand why and how this evolution in thinking and process is being made. Preservation strategies implemented at budget levels below ideal can lead to programming decisions that seem counterintuitive. An example would be deciding to apply maintenance on a section of road in *good* condition to keep it from requiring much more expensive repairs, while a neighboring road that is already in *poor* condition receives no major work. The reason for these types of decisions is that the future cost incurred if the former pavement goes untreated is significant, while there is no increase in future cost for postponing the latter. These are hard decisions to make and explain. For the sake of future transportation users and taxpayers, however, it is essential that NOACA remain disciplined in the implementation of life-cycle management.

Public outreach will be needed at every opportunity and to every constituent group. Elected officials, interest groups and individual citizens all have specific concerns regarding the health and future of the transportation system. Each will need specific, targeted information to understand how life-cycle management is the best overall approach for preserving the system at the lowest possible cost.

Appendix A. Performance Gap Assessment: Full Results

To identify performance gaps and support the prioritization of NOACA TAM activities, a self-assessment survey was completed by several stakeholders on the TAMP Steering Committee. The purpose of the self-assessment was to benchmark critical issues, identify appropriate initiatives, establish institutional direction, set priorities, develop consensus, and promote efficient resource allocation. For all questions, respondents were asked to indicate whether they agreed with a statement. They were provided with the options of Fully Agree, Agree, Disagree, or Fully Disagree. For example, participants were asked what level they agree with the statement: *NOACA policy guidance should support preservation.* Then they were asked what level they agree with the statement: *NOACA policy guidance currently supports preservation.*

In some cases, there is a gap between what stakeholders think NOACA *should* be doing and what NOACA *is currently* doing. These gaps can help identify priority action items for implementation.

The self-assessment voting and subsequent discussion as part of the Gap Assessment Workshop had some clear conclusions about the need for and role of the TAMP.

- NOACA can and should play a coordination role between local agencies and ODOT and FHWA. The TAMP will only be of value if it has scalability and can provide value to local agencies and clarify relationships and opportunities linked to asset management with state and federal partners.

- The TAMP should clearly make the "no action" case to demonstrate its value in decision support.

- The TAMP should clearly define terminology and promote consistency in terminology and understanding of TAM benefits.

NOACA TAM Performance Gaps

To begin the gap assessment process, a few of the largest and smallest gaps were identified—the largest gaps don't always align with the areas of greatest need, but they generally show a priority action. Smaller gaps don't always indicate a "solved" issue, but do show areas where the need for substantial business practice modifications might be lower. The performance gaps help identify and prioritize the TAM process enhancements NOACA should undertake (discussed in a later section).

Areas with the Smallest Performance Gaps

Close scoring between the desired state and the current state typically demonstrate areas of strength for current practices; however, they can also show areas that are not high priority areas for the TAMP. The five smallest gaps identified in the self-assessment follow.

- NOACA policies should consider customer perceptions and expectations.

- NOACA should periodically distribute reports of performance measures relevant to customer/stakeholder satisfaction with transportation system and services.

- NOACA has a complete and up-to-date inventory of pavement and bridge assets.

- NOACA policy should encourage resource allocation decisions based on cost-effectiveness or benefit/cost analysis.

- NOACA should regularly collect or consistently receive information on the condition of pavement and bridge assets.

- NOACA should be able easily to produce maps displaying needs/deficiencies for different asset classes and planned/programmed project.

Areas with the Largest Performance Gaps

NOACA has the opportunity to improve in the areas of risk assessment, data standards, use of performance measures, and customer outreach. The four largest gaps identified in the self-assessment follow.

- NOACA should use risk assessments in its project selection processes.

- NOACA should have established data standards to promote consistent treatment of existing asset-related data and guide development of future applications.

- NOACA's goals and objectives should be linked to specific performance measures and evaluation criteria for project selection.

- NOACA should regularly collect customer perceptions of asset condition and performance.

Highest Priority Gaps

As part of a Gap Assessment Workshop, NOACA stakeholders prioritized the TAM activities within several key subareas. The first area was broad and included discussion of the major potential directions for NOACA TAM activities.

Stakeholders found that:

- NOACA should also serve as a representative to state and federal agencies, communicating and coordinating on behalf of local communities.

- Supporting condition-based decision making, especially for cities and counties without the staff to do much of it themselves, is a key role.

- NOACA's TAMP should clearly demonstrate the value of TAM. One way to do so is to clearly show the "no action" scenario.

- NOACA's TAM actions should provide value to local communities. Good questions for local agencies are, "Would you use the tools developed to support TAM?," and "Are they effective for your decision making off the federal aid eligible system?

- Coordination with ODOT's TAMP is essential.

- The TAMP should provide the ability to add/integrate other assets over time.

Priorities for Major Asset Management Activities
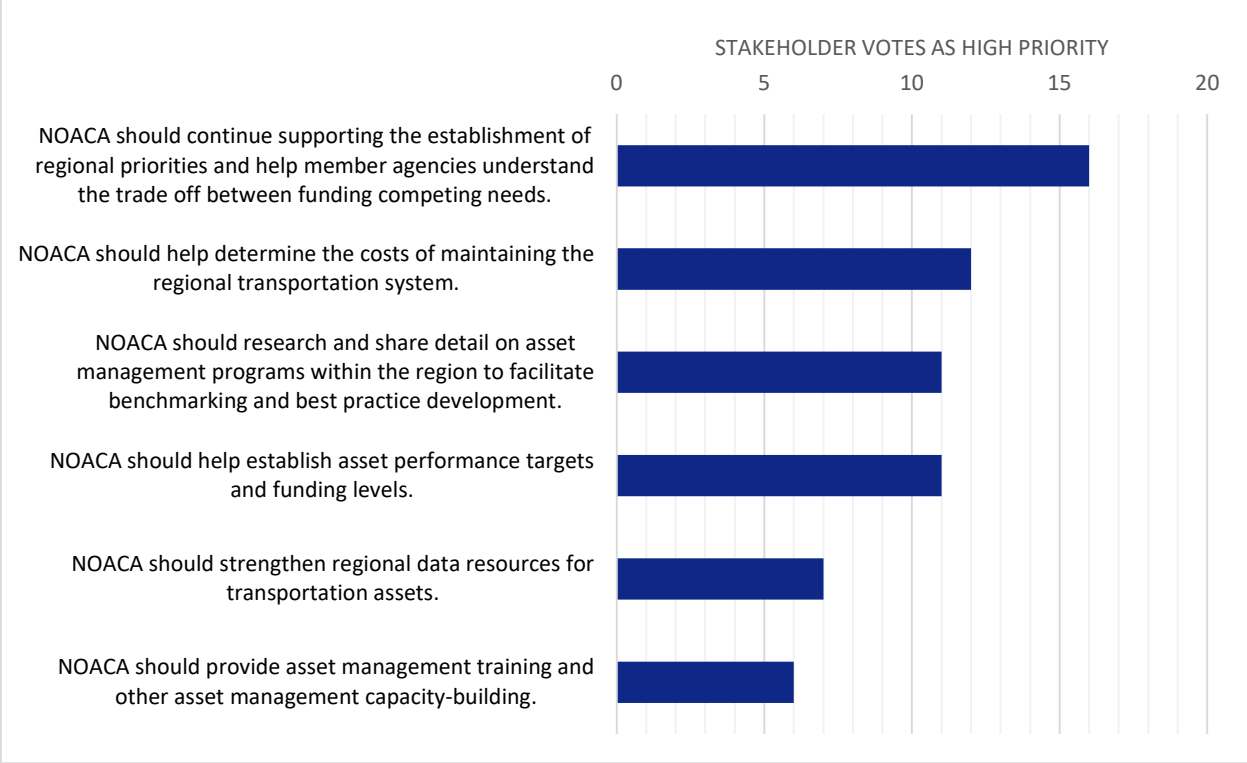
Policy Guidance

All of the areas discussed in policy guidance were identified as important. There is opportunity for NOACA to continue as a policy leader for the region. Stakeholders will benefit from TAM development and decision making that is clearly documented, providing local communities with a "roadmap" for TAM. NOACA's TAMP can't identify every project but can lay the foundation for a replicable process. It should be clear how this process saves money.

Priorities for Policy Guidance

STAKEHOLDER VOTES AS HIGH PRIORITY

0 5 10 15 20	

NOACA should have a business plan or strategic plan with comprehensive well-defined goals and objectives to guide project selection and resource allocation

NOACA policy should encourage resource allocation decisions based on cost-effectiveness or benefit/cost analysis

NOACA's goals and objectives should be linked to specific performance measures and evaluation criteria for project selection

NOACA should work with political leaders and other stakeholders to present funding options and consequences

NOACA policy guidance should support preservation

NOACA policy guidance on resource allocation should allow sufficient flexibility to pursue performance-based project selection

NOACA should communicate accomplishments in meeting policy objectives to customers and other stakeholders

Planning and Programming

The biggest opportunity in planning and programming is to improve the information available and link costs to performance benefits and savings over time. Programming should communicate the value of planning for least-life-cycle cost to member communities/project sponsors.

Priorities for Planning and Programming
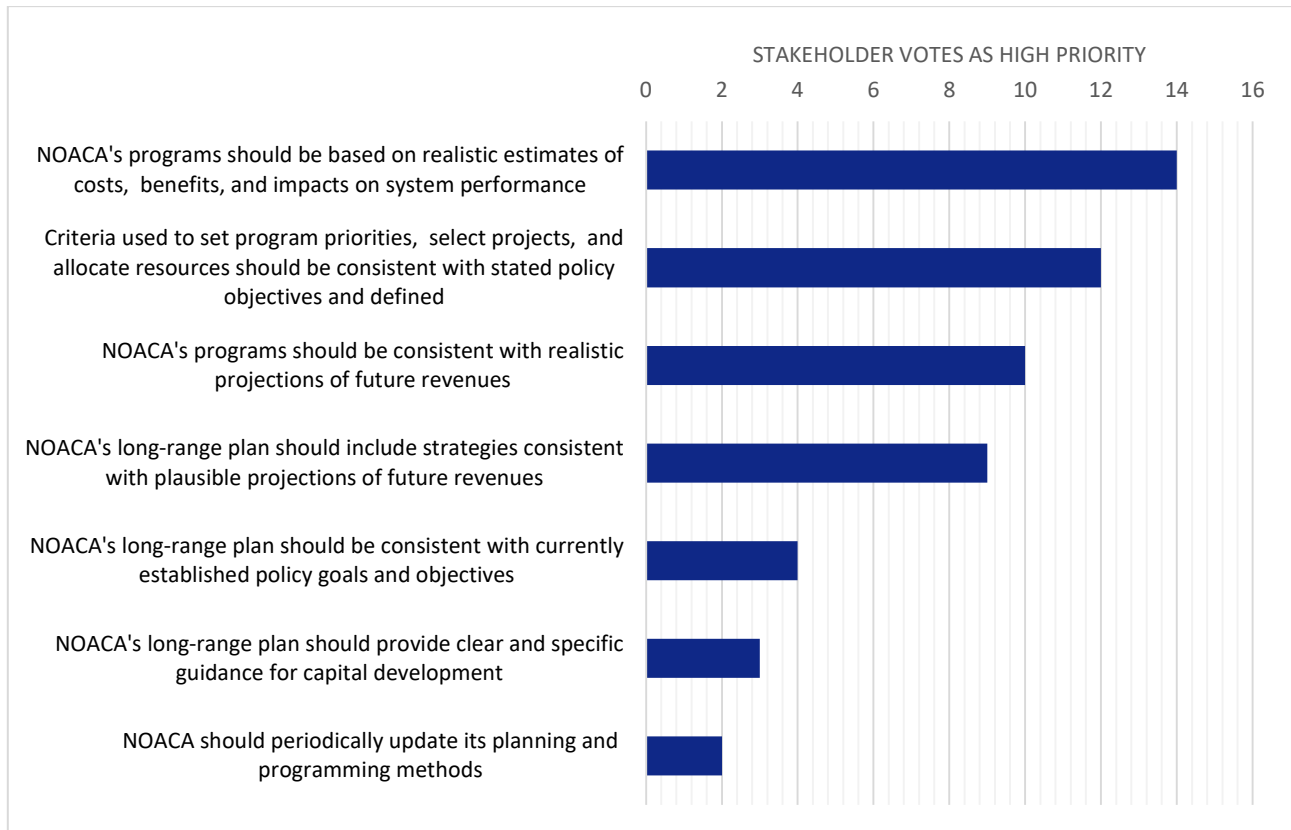
Decision Support Tools

There were relatively few gaps in the decision support tools area. NOACA is addressing some of the current gaps by implementing a new pavement management system. There are several resources available through ODOT, such as the new Transportation Information Management System (TIMS II system). There are also training opportunities for local communities.

Data Collection and Information Management

As part of the discussion on data collection and information management gaps, regional stakeholders concluded that it was important that NOACA have good data. It was less important whether that data is collected directly or compiled from other sources such as ODOT or local municipalities. Data needs to be regularly and consistently updated to be of value. Comprehensive pavement condition surveys are expensive but lose value after only a few years.

Consistent terminology is needed. Even the definitions of good/fair/poor are often a source of disagreement. NOACA should promote a clear understanding of these terms along with important terms such as asset management, risk, and preservation.

Priorities for Data Collection and Information Management
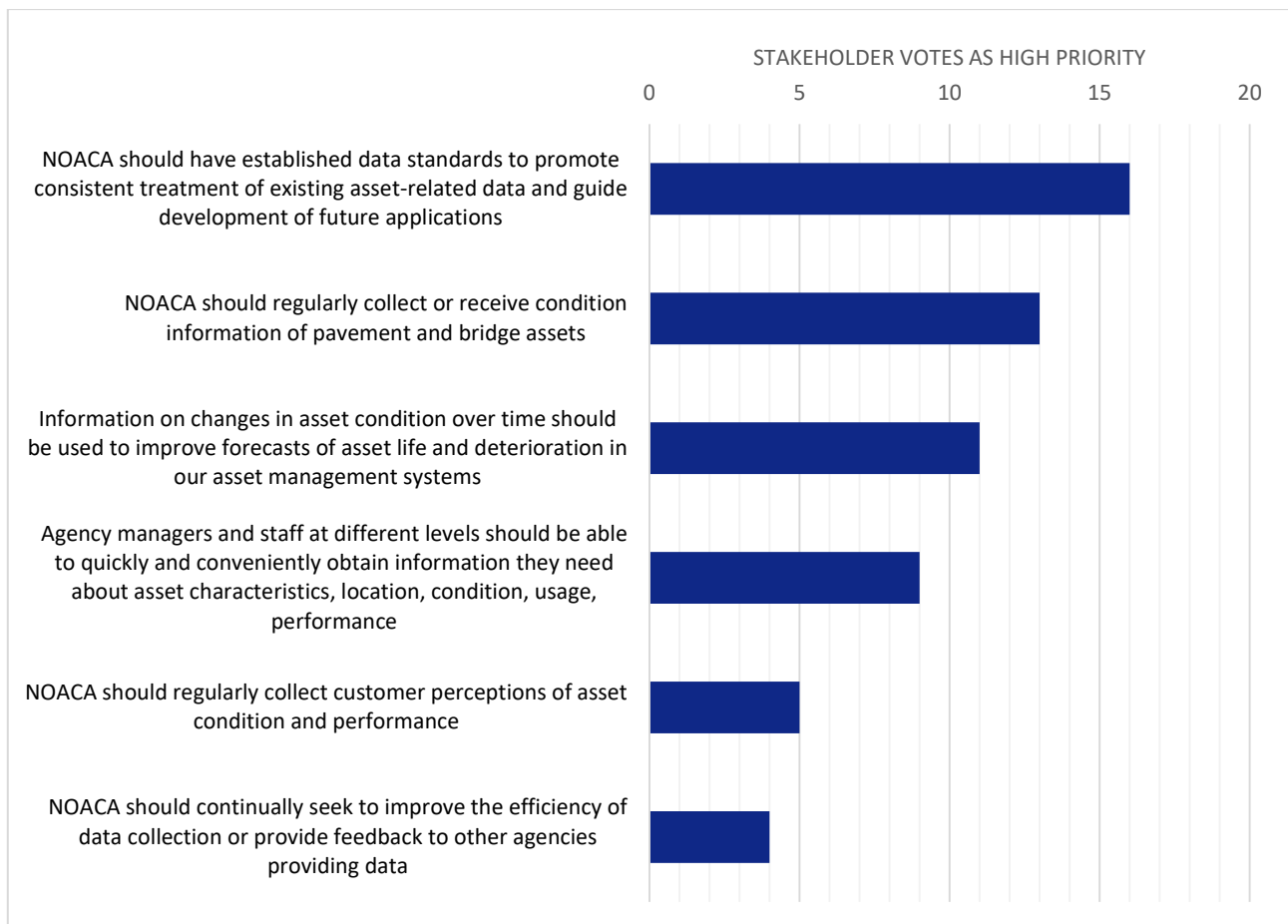
Appendix B. Bridge Performance Curves

This appendix provides deeper technical detail on the bridge analysis used to estimate SOGR gaps.

Future system-wide bridge conditions (using the measure of **percentage of the deck area of bridges that is good or fair based on NBI ratings**) was projected using the FHWA's National Bridge Investment Allocation System (NBIAS). NBIAS is used by FHWA to produce a report to Congress on the condition, performance, and future capital investment needs of the nation's bridges. NBIAS is designed to minimize maintenance costs by generating an optimal set of preservation actions for bridge elements based on life-cycle user and agency costs, and engineering standards of bridge maintenance needs. Bridge replacement and improvement costs were adjusted to Ohio based on state-specific adjustment factors developed by FHWA from cost data provided by the states.

System preservation needs were estimated over a 10-year period (i.e., 2017-2027) for three networks: (1) National Highway System (NHS), (2) federal-aid network, and (3) non-NBI bridges. The figures below show the performance curves for each of the networks. The curves tie performance (vertical, or Y-axis) to annual investment level (horizontal, or X-axis). The curves, represented by dotted lines, represent the percentage of the deck area of bridges that is good or fair based on NBI ratings at the end of year 2027. Each graph has a solid horizontal line, which represents the existing network condition (i.e., the percentage of deck area that is currently in good or fair condition). Where the horizontal line that represents "*Existing Network Condition*" intersects with the 2027 curve, that point indicates the annual budget level required to maintain the existing network condition.

In the case of the NHS system and the federal-aid network, maintaining the existing conditions is achieving the state of good repair. NBIAS determines the maximum performance level based on economic optimization analyses that consist of life-cycle user and agency costs. NBIAS estimates that an annual investment equivalent to $150 million in 2016 dollars is the optimal funding level needed on the NHS system to achieve the maximum performance level at which maintenance needs are cost-effectively addressed as intended in their life cycle. To maintain the state of good repair of the whole federal-aid-eligible system through 2027, an annual investment equivalent to $165 million (2016 dollars) is required. NBIAS estimates that an annual investment equivalent to $15 million in 2016 dollars is needed to achieve 100% of total deck area on *non*-structurally deficient bridges.

Annual Investment in NHS Bridges and Performance over a 10-Year Horizon

NHS System

Existing Network Condition

ANNUAL BUDGET (2016 DOLLARS)
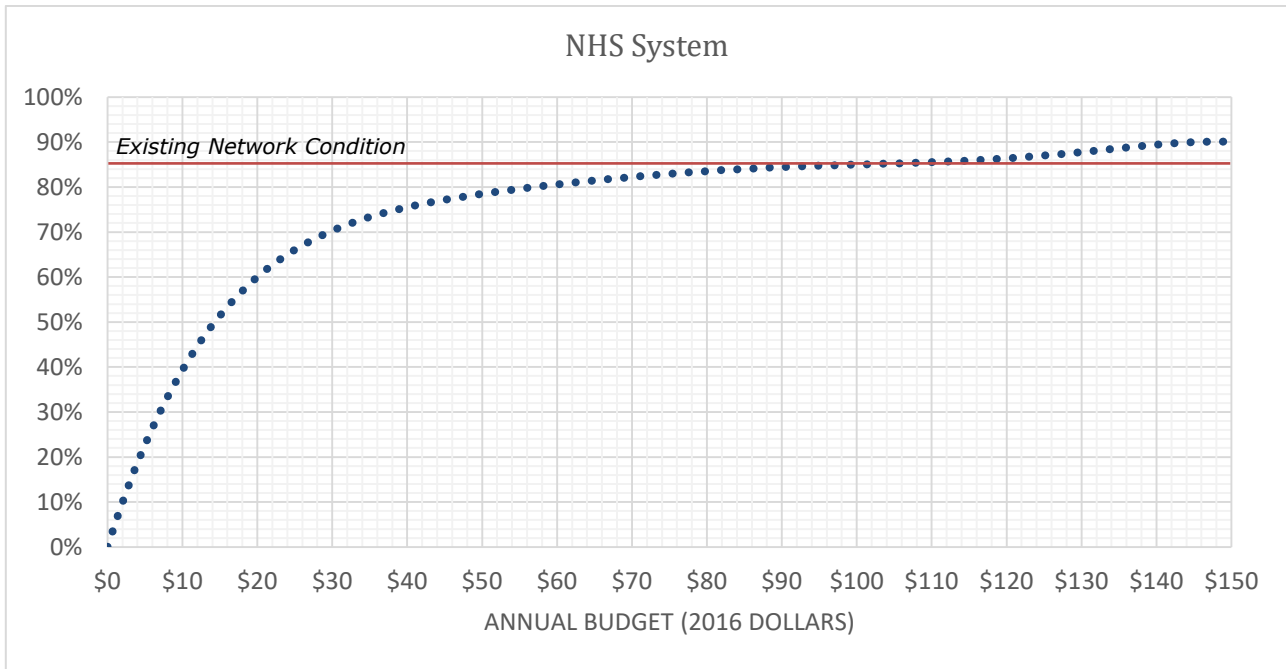
Annual Investment in All Federal Bridges and Performance over a 10-Year Horizon

All Federal-Aid System

Existing Network Condition

ANNUAL BUDGET (2016 DOLLARS)
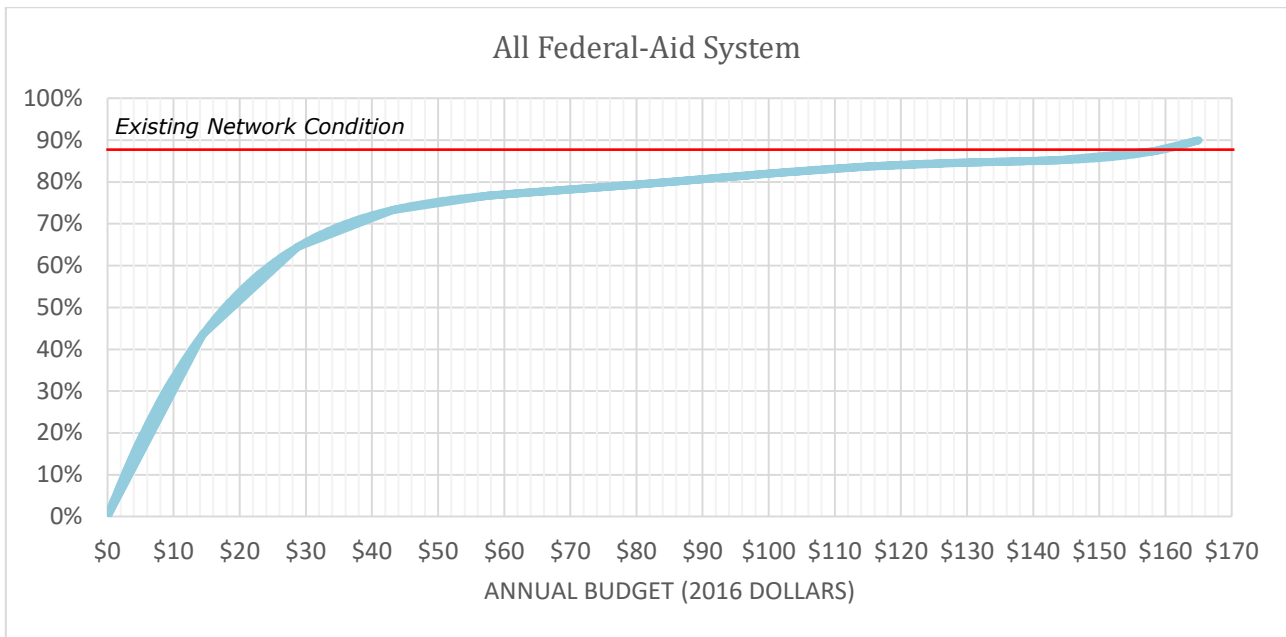
Annual Investment in 10-20' Bridges and Performance over a 10-Year Horizon

Non-NBI Bridges (<20')

Existing Network Condition
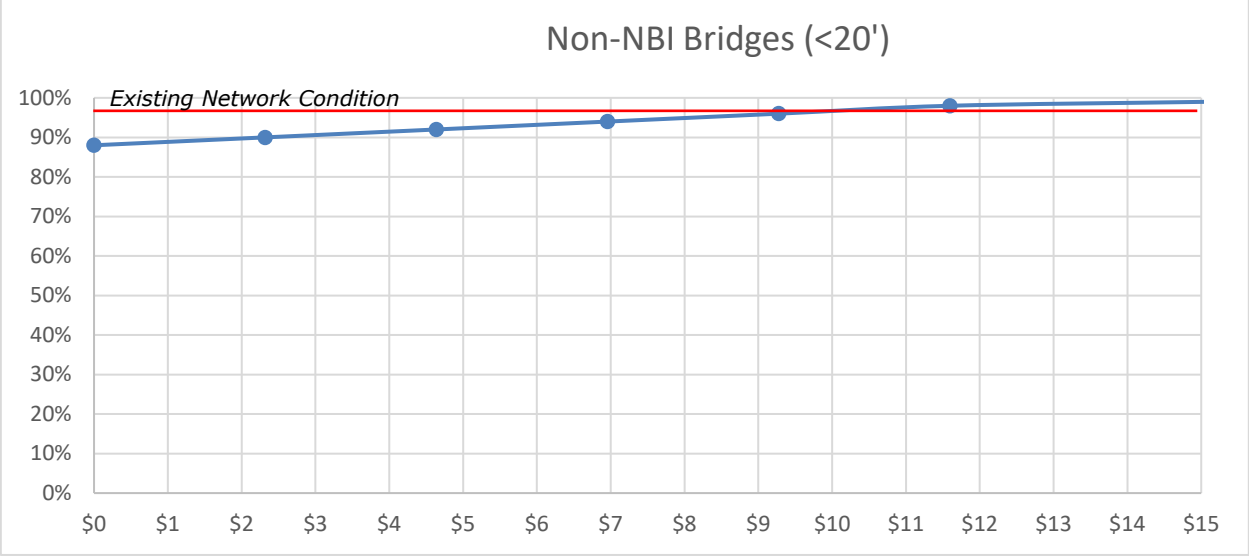
Appendix C. NOACA Risk Register

To identify the greatest risks to NOACA's mission, a risk register was developed with the support of the TAM Steering Committee and participants in a risk workshop. This appendix shows the detail behind the quantification process and contains the full risk register.

To provide consistent scoring within the risk register, scoring tables were used for several consequence categories. Consequences were rated on a scale from one to five, with five being the most severe. The consequence categories included public safety, asset condition impact, regional scope, mobility, and financial impact. So, for example, a regional scope score of one would indicate that the event would impact a single asset. A regional scope score of five would indicate that the event would impact many assets across the region. The other categories were given similar ranges from moderate to severe impact.

Likelihood of occurrence was also rated on a scale of one to five, which represented a range from one instance in 10 years (one) to more than one instance per year (five). To generate a single risk score, the likelihood rating was multiplied by the average of the different consequence categories. This produces a single risk score ranging from one (lowest likelihood and lowest consequences in all categories) up to a possible 25 (highest likelihood and highest consequences in all categories). A higher score indicates a greater risk and a stronger need to ensure that risk mitigation strategies are in place.

Risk Register

	Event #	Description	Likelihood	Consequence						Strengthen	Preserve	Build	Support	Enhance	Event Score
				Public Safety	Asset Cond. Impact	Regional Scope	Mobility	Finance						
Infrastructure Damage	A	Bridges are structurally damaged by minor floods and scour, requiring accelerated repair/rehab	2	2	3	3	2	2		X				4.8
	B	Pavement and bridge deck is damaged by minor floods, accelerating repair/rehab	2	1	2	2	2	1		X				3.2
	C	Bridges are structurally damaged by motor vehicle crashes, accelerating repair/rehab	4	2	3	3	3	2		X				10.4
	D	Lack of regular maintenance leads to deteriorated infrastructure and more costly repairs	4	2	2	1	2	1		X				6.4
	E	Assets are damaged due to civil unrest (including transit assets)	2	2	2	1	1	2			X			3.2
	F	Bridges fail or are posted for weight restriction (NOT rendered inserviceable)	3	2	5	3	3	3				X		9.6
	G	Ancillary structures fail, damaging bridges or pavement	3	1	2	1	1	1		X				3.6

Event #	Description	Likelihood	Consequence						Strengthen	Preserve	Build	Support	Enhance	Event Score
			Public Safety	Asset Cond. Impact	Regional Score	Mobility	Finance						
H	Retaining walls, slopes, or rock walls fail, damaging bridges or pavement	1	3	3	2	2	1		X				2.2
I	Culverts or other drainage facilities fail, damaging bridges or pavement	4	1	3	1	2	1		X				6.4
J	ITS or traffic safety systems fail, damaging bridges or pavement	2	1	2	1	1	2		X				2.8
K(1)	Vandalism causes damage to infrastructure	2	2	2	1	1	1						2.8
K(2)	Sinkholes damage pavement infrastructure	3	2	1	1	2	1						4.2
K(3)	Snow and Ice removal equipment damages infrastructure	4	1	2	1	1	2	X	X				5.6
K	Bridges or pavement are damaged due to overweight/overheight loadings	4	1	3	3	2	2		X		X		8.8
L	Pavement and bridge deck is damaged by major floods, caused by excessive rainfall	2	5	4	2	4	2		X				6.8

	Event #	Description	Likelihood	Consequence						Strengthen	Preserve	Build	Support	Enhance	Event Score
				Public Safety	Asset Cond. Impact	Regional Scope	Mobility	Finance						
Environmental / Weather	L(2)	Ice floes break up and damage bridge infrastructure	2	2	2	1	1	1		X				2.8
	M	Bridges and ancillary infrastructure are structurally damaged by extreme weather	1	4	4	2	4	2		X				3.2
	N	Pavement and bridge deck is damaged by extreme temperature	3	1	3	2	3	2	X	X			X	6.6
	O	Bridges are structurally damaged by major floods, caused by excess rainfall	2	1	3	3	3	1		X				4.4
	P1	Wind events damage infrastructure (including ancillary assets)	3	2	2	2	2	2						6.0
	P	Extreme snowfall causes major disruptions in mobility	5	3	1	5	5	2		X				16.0
Funding	Q	Federal officials reduce funds across the board for transportation	4	0	2	5	1	5	X	X	X	X	X	10.4
	R	Federal officials mandate capital improvements that produce unfunded maintenance obligations	2	0	4	3	1	4		X		X		4.8

Event #	Description	Likelihood	Consequence						Strengthen	Preserve	Build	Support	Enhance	Event Score
			Public Safety	Asset Cond. Impact	Regional Score	Mobility	Finance						
S	State officials increase maintenance obligations without identifying a funding stream	4	0	3	5	1	3		X		X		9.6
T	Inflation in project costs effectively reduces available funds agency-wide	3	0	4	5	1	3		X		X		7.8
U	No new dedicated capital funding streams are instituted	5	0	3	5	1	4	X		X	X	X	13.0
V	Under-prediction of costs reduces available funds agency-wide	4	0	2	5	1	3		X				8.8
W	Unexpected costs of new technology reduce NOACA's ability to deliver programs	3	0	2	3	0	2		X				4.2
X	Unexpected variation in project costs reduces funds available for the program	3	0	4	3	1	2		X				6.0
Y	Inability to provide local match prevents scheduled projects from coming to fruition	5	1	2	4	3	3	X					13.0
Z	Diversion of funds to high-profile projects reduces available funds for other programs	3	3	4	3	1	2		X	X			7.8

	Event #	Description	Likelihood	Consequence						Strengthen	Preserve	Build	Support	Enhance	Event Score
				Public Safety	Asset Cond. Impact	Regional Scope	Mobility	Finance							
Internal	**Z(1)**	Coordination of funding/timing of funding availability derails projects	5	1	1	4	3	3	X	X	X	X	X	**12.0**
	Z(2)	Limited contractor availability reduces NOACA's ability to deliver projects	3	0	1	1	2	1		X				**3.0**
	AA	Poor data system functionality reduces NOACA's ability to deliver programs	2	0	4	3	0	2	X	X				**3.6**
	AB	Poor modeling system functionality reduces NOACA's ability to deliver programs	2	0	2	3	0	2						**2.8**
	AC	Poor data management reduces NOACA's ability to deliver programs	2	0	2	3	0	2	X	X				**2.8**
	AD	Staff training needs exceed available time or resources	3	0	1	1	1	1	X	X				**2.4**
	AE	Staff turnover reduces NOACA's ability to deliver programs	3	0	2	3	1	2	X	X	X	X	X	**4.8**
External	AF	System performance is not adequately communicated to stakeholders and the public	3	0	1	3	1	2	X			X	X	**4.2**

Event #	Description	Likelihood	Public Safety	Asset Cond. Impact	Regional Score	Mobility	Finance	Strengthen	Preserve	Build	Support	Enhance	Event Score
External					**Consequence**								
AG	Stakeholder and public opinion on system performance is not adequately collected or communicated	3	0	0	5	1	2	X		X	X	X	**4.8**
AH	Reputation damaged due to nonethical behavior	1	0	3	5	1	3	X	X		X	X	**2.4**
AI	ODOT suspends or stops pavement data collection	2	0	4	3	1	3		X				**4.4**
AJ	Federal officials mandate unfunded programs that reduce funds available for other programs	2	0	4	3	1	2		X			X	**4.0**
AK	Unprepared or inexperienced local authorities assume maintenance responsibilities due to state-level budgetary constraints	4	0	5	1	2	1	X					**7.2**
AL	State officials earmark or mandate capital projects	5	0	3	5	1	3			X	X	X	**12.0**
AM	Turnover in key leadership positions reduces NOACA's attention on asset management activities	3	0	1	5	1	3		X	X			**6.0**
AN	Failure to meet regulatory standards or performance targets leads to reduced flexibility with funds	2	0	1	4	1	2		X		X		**3.2**

Event #	Description	Likelihood	Public Safety	Asset Cond. Impact	Regional Score	Mobility	Finance	Strengthen	Preserve	Build	Support	Enhance	Event Score
AO	Poor project management decreases trust and ability to deliver programs	2	0	4	3	1	2		X				4.0
AP	Blue ribbon commission on transit findings mandates changes that impact highway and bridge funding	3	1	2	2	2	2			X			5.4
AQ	Poor contractor performance impacts project schedules and delivery	3	0	1	1	0	1				X	X	1.8
AR	Major events force change in priorities	5	0	1	5	3	3	X			X	X	12.0
AS	Lack of coordination between other infrastructure (water, electric, wastewater) deteriorates pavements and increases costs	4	0	1	2	2	4	X			X	X	7.2
AT	Terrorism or sabotage deliberately destroys pavements or bridges	1	5	2	4	4	4	X			X	X	3.8