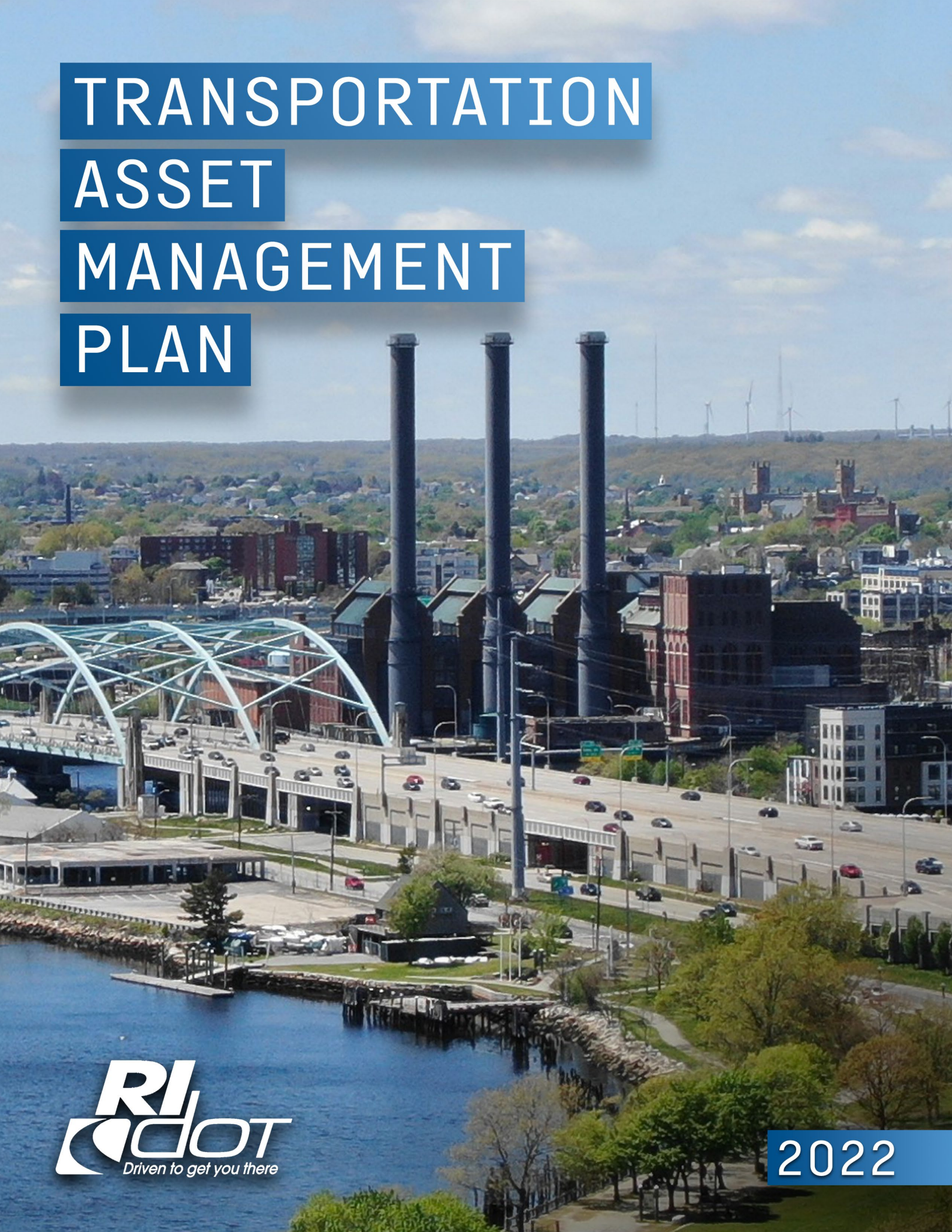
TRANSPORTATION ASSET MANAGEMENT PLAN



RIDOT
Driven to get you there

2022

Transportation Asset Management Plan

Rhode Island Department of Transportation

Dear Reader,

On behalf of Rhode Island Department of Transportation (RIDOT), I am pleased to present Rhode Island's second Transportation Asset Management Plan (TAMP). This document outlines the strategies, processes, and performance measures that inform smart investments in Rhode Island's National Highway System (NHS) roads and bridges.

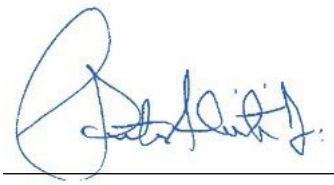
Since the passage of RhodeWorks in 2016, efficient asset management has been the guiding principle in every step taken by RIDOT to improve transportation infrastructure throughout the state. In 2019, RIDOT's first asset management plan was certified by Federal Highway (FHWA), and that same year, the Department began developing a map-based, asset-driven approach to transportation planning, now documented in the State Transportation Improvement Program (STIP).

Our new approach to asset management is working, and fast. In just four years, RIDOT has reduced the percentage of poor condition NBI-NHS bridges in the state from 24 percent to 16 percent. The Department has also moved with unparalleled speed to implement the Infrastructure Investments and Jobs Act (IIJA), accelerating more than 100 projects and committing $500 million over the next five years to improve pavement conditions.

This TAMP documents the strategies that guide our Department to make informed asset management decisions as we develop a 10-year plan to deploy the right treatment on the right assets at the right time. I'm proud of the progress we've made already, and this TAMP includes an implementation guide to inform our progress for the next decade.

With my signature, I certify that this Transportation Asset Management Plan for pavements and bridges on the National Highway System has been developed in accordance with 23 U.S.C. Parts 110 and 150 as well as 23 C.F.R. Parts 515 and 667. The Plan will continue to be reviewed on a biennial basis to ensure consistency with the planning processes documented herein, and the TAMP will be updated at least every 4 years in accordance with FHWA requirements.

Sincerely,



12-20-22

Peter Alviti Jr., P.E.,
Director, Rhode Island Department of Transportation

Date

ACKNOWLEDGEMENTS AND CONTACTS

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TABLE OF CONTENTS

EXHIBITS

EXHIBITS (continued)

This Transportation Asset Management Plan (TAMP) is a federally required document that provides a decision-making framework for the bridges and pavement that make up the National Highway System (NHS) in Rhode Island. Being good stewards of those assets and the public funding that sustains them are at the core of the accountability mission of Rhode Island Department of Transportation (RIDOT.)

The purpose of this TAMP is to document strategic and systemic processes to maximize asset life cycles and minimize capital costs by preserving roads and bridges through sustainable, resilient investments.

In the chapters that follow, this TAMP describes inventory conditions, performance targets, management strategies, and expenditure forecasts utilized by RIDOT and its partners to manage the NHS in the Ocean State. The TAMP is an essential tool for RIDOT in communicating its objectives, demonstrating the scale of its challenges, and describing the scale of its investments in roads and bridges.

The primary objective of the RIDOT is to facilitate the safe and efficient movement of people and goods by achieving and maintaining a State-of-Good-Repair (SOGR) for its network of roads and bridges.

Rather than deferring maintenance of its assets, RIDOT seeks to defer deterioration and costly rehabilitation by making the right investment at the right time and extending service life.

Operating in the second-most-densely-populated state in the country, RIDOT manages 1,176 bridges and more than 2,900 lane-miles of roadway. This network contributes crucially to the State's economy. Rhode Island has spent the four years since the certification of the 2019 TAMP implementing RhodeWorks, an unprecedented piece of legislation that provided capital funds to make risk and data-based investments in infrastructure.

1. PURPOSE OF THE TAMP

1.1 RIDOT's Asset Management Goals and Processes

RIDOT has established six goals for the Transportation Asset Management Plan (TAMP), informed by the progress made in the last four years and the stated objectives of FHWA. These goals shape the plans, processes, and proposals documented throughout this TAMP.

Exhibit 1.1 TAMP Goals

ACHIEVE AND MAINTAIN STATE OF GOOD REPAIR (SOGR)

This TAMP defines SOGR using the objectives, measures, and targets in Chapters 2 and 3. Pursuit of SOGR is the single largest influence on the Department's risk management, investment strategies, and financial planning.

PRESERVE AND IMPROVE PUBLIC SAFETY

By ensuring SOGR for its assets and building a performance-based planning culture, this TAMP supports then Department's commitment to reducing crashes, injuries, and fatalities for all users of the transportation system.

LEVERAGE TECHNOLOGY AND INNOVATION

This TAMP introduces and envisions new and refined data and data tools that support informed decision-making processes, including risk management, investment strategies, and financial planning.

PLAN FOR A SUSTAINABLE AND RESILIENT FUTURE

The Infrastructure, Investment, and Jobs Act (IIJA) of 2021 codified the Department's existing commitment to addressing climate change, sea level rise, riverine flooding, and other natural vulnerabilities of the transportation system.

IMPROVE THE PERFORMANCE OF THE TRANSPORTATION SYSTEM

This TAMP recognizes that enhancing asset performance requires improving project conception, design, and delivery. The Department envisions complete infrastructure projects that make the system as a whole more efficient and reliable..

EFFECTIVELY COMMUNICATE RIDOT'S ASSET MANAGEMENT APPROACH

RIDOT has designed this TAMP as a reference document for stakeholders and partners. Readers are meant to gain a better understanding of the Department's asset management process, including life cycle planning and strategic investment prioritization.

RIDOT's Division of Planning oversees the Asset Management Process by leveraging inputs from experts around the Department, and managing workflows to improve the efficiency of planning, programming, and life cycle management.

Exhibit 1.2 The Asset Management Process at RIDOT

STAKEHOLDERS	FUNCTIONS PERFORMED BY STAKEHOLDERS				DIVISION OF PLANNING ROLE
Asset Management Experts (AMEs) • *Pavement Engineering* • *Bridge Engineering* • *Traffic Safety* • *Stormwater* • *ITS and more!*	Inventory, Inspection, and Data Collection	Life Cycle Planning and Deterioration Modeling	Performance Target Setting and Evaluation	Investment Strategy Development and Asset Treatment Recommendation	**Collect** Information, Data, Plans, Strategies, and Recommendations
Capital Programming Team • *Planning (Lead)* • *Financial Management* • *AMEs* • *Scoping*	Financial Planning and Revenue Projection	Asset Treatment Review	Identify Candidate Projects/ Bundles	Define Program Spending Targets and Funding Gaps	**Review** Funding Availability, Asset Needs, Project Viability, and Performance Gaps
Project Development Team *Staff From:* • *Planning (Lead)* • *AMEs* • *Scoping* • *Project Management*	Apply Risk Assessment Methodology	Refine Candidate Project Scopes	Estimate Project Budgets and Schedules	Assign Project Prioritization Tiers	**Develop** Risk, Scoping, Budgeting, and Prioritization Methodologies
TIP Working Group *Leadership From:* • *Planning* • *AMEs* • *Project Management* • *Financial Management*	Review Proposed Capital Program	Monitor Program and Enterprise Risks	Address Multi-disciplinary Challenges	Approve Funding Authorization Requests	**Coordinate** Capital Program Submission, Risk Mitigation, Record Keeping, and Funding Allocation

OVERSIGHT: *Executive Team, Senior Leadership, and Division Managers*

The processes above support the efficient and effective management of the NHS in Rhode Island. RIDOT's NHS is illustrated in maps in the following pages: by Interstate status (Exhibit 1.3) and by jurisdiction (Exhibit 1.4).

1.2 NHS Network Maps

Exhibit 1.3 The NHS in Rhode Island by Interstate Status

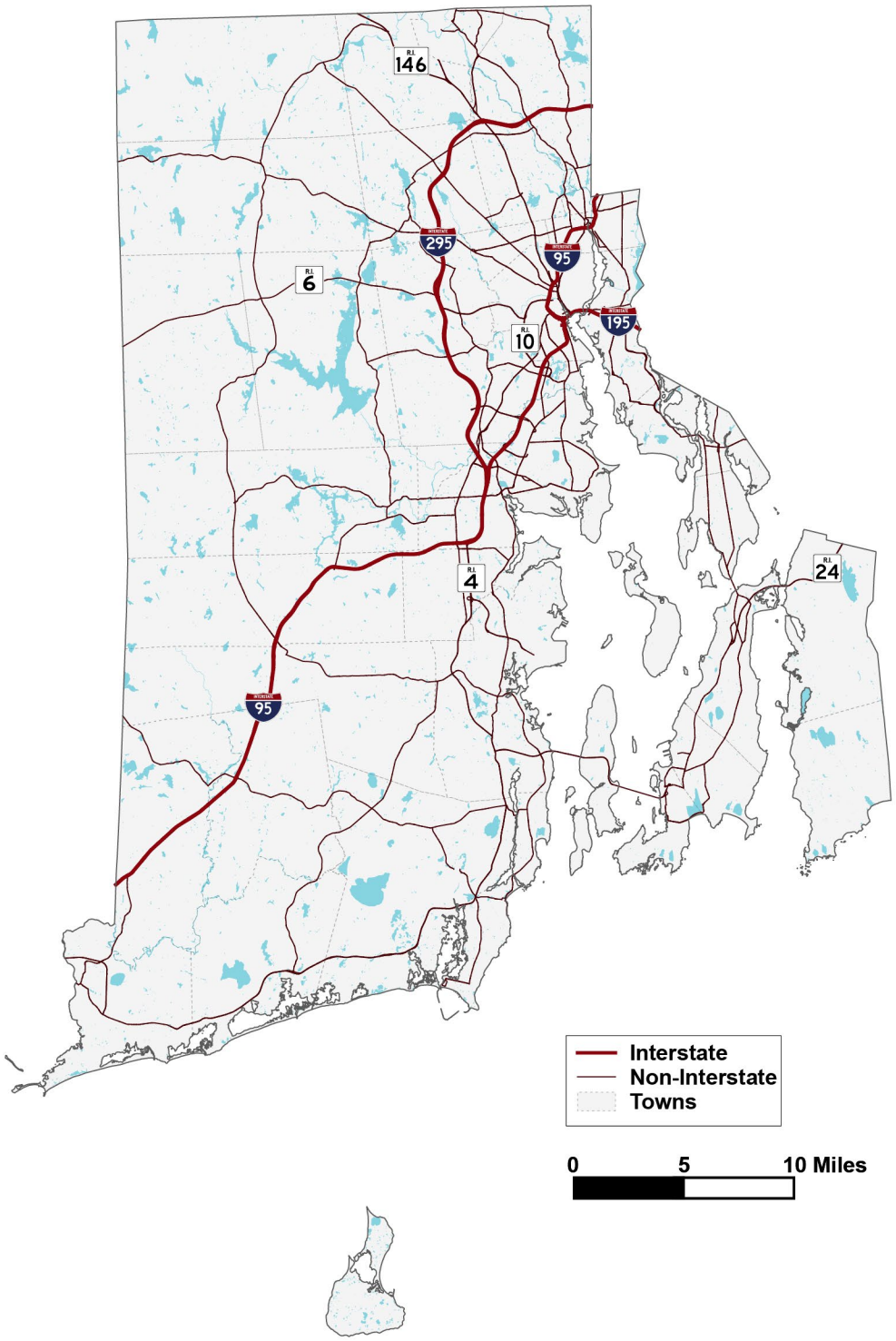
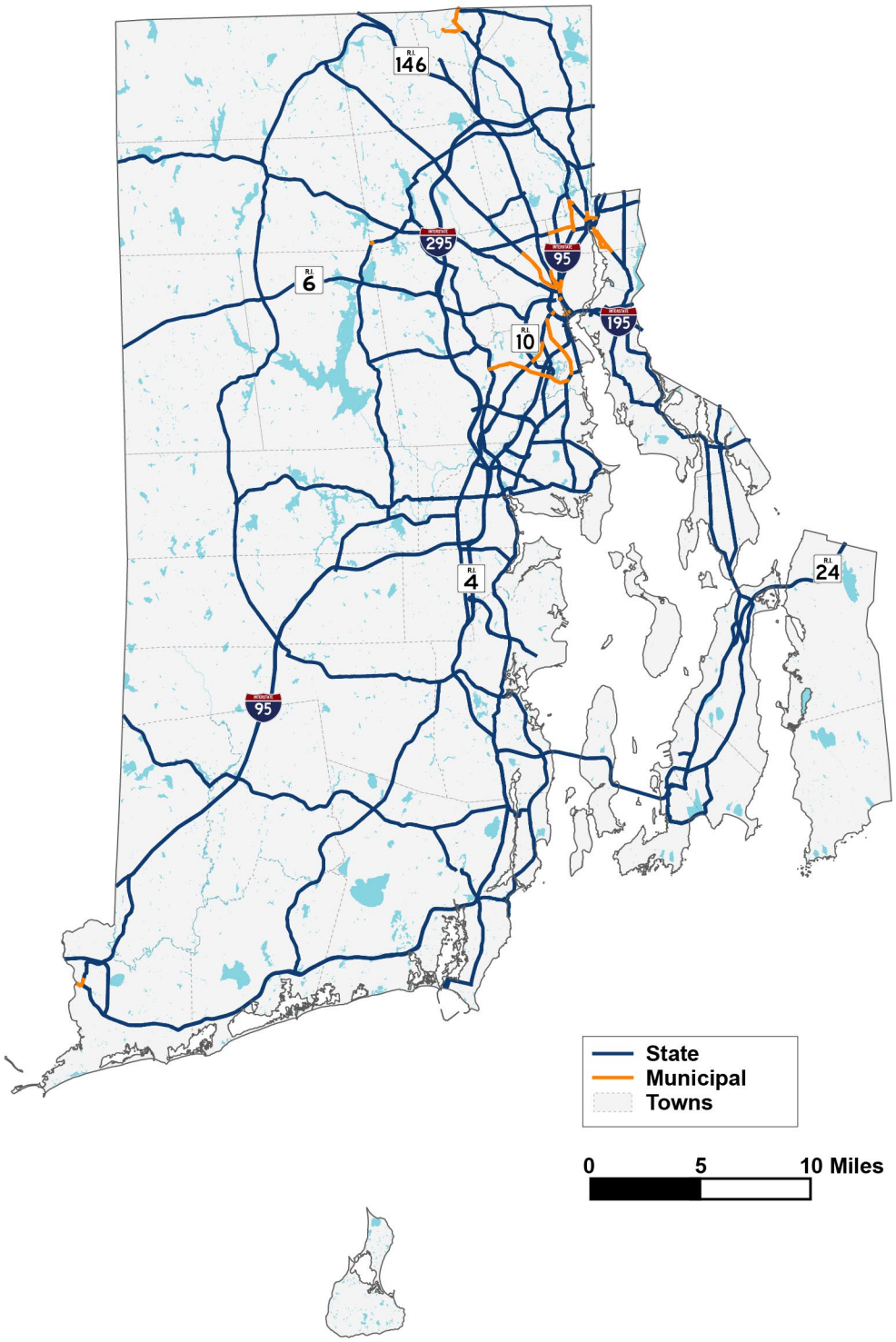


Exhibit 1.4 The NHS in Rhode Island by Jurisdiction



1.3 Organization of the TAMP

The remainder of this document is organized as follows:

- **Chapters 2 and 3 provide one-stop shops for NHS pavement (Chapter 2) and bridge (Chapter 3).** Each chapter establishes current condition through an inventory by jurisdiction. It then states RIDOT's two-year, four-year, and SOGR performance targets and assesses any gap that exists with forecasted condition under anticipated investment. Each chapter discusses life-cycle planning approaches, RIDOT's methodology for condition modeling, and RIDOT's planned investment strategy, all within the context of risk, uncertainty, and resiliency. Finally, each chapter computes the value of the assets and identifies process improvements for the next four years.

- **Chapter 4 presents RIDOT's risk assessment for NHS pavement and bridges.** The chapter discusses RIDOT's enterprise risk management posture and tolerance with focused discussions of funding constraints, environmental resiliency, price variability, and recruitment and knowledge retention. The chapter then presents a risk register that lists high-priority asset-level, program-level, and Department-level risks alongside RIDOT's approach for mitigating each. The chapter closes with a discussion of vulnerable assets that satisfies 23 CFR Part 667: *"Periodic Evaluation of Facilities Repeatedly Requiring Repair and Reconstruction Due to Emergency Events."*

- **Chapter 5 consists of a 10-year financial plan for RIDOT's NHS pavements and bridges.** The chapter establishes RIDOT's Federal and State funding sources and estimates a decade of revenues for each. It presents expected spending by FHWA work type, then assess funding gaps between expected revenue and need. The chapter closes with a discussion of funding on the municipal NHS.

- **Chapter 6 describes how this TAMP will be implemented at RIDOT.** This includes business process, organizational, data and technical, and other improvements.

Chapters 2-5 begin with a reference guide for the required elements of a TAMP as enumerated in 23 CFR § 515.7. Each pair of chapters is separated by a one-page fact sheet highlighting an improvement that RIDOT has made in its asset management practice to implement the 2019 TAMP.

FOCUS ON: Transportation Planning in Rhode Island

Transportation Planning for ground modes in Rhode Island is divided among four agencies.

Rhode Island is unique in the US in that the entire state is contained in a single MPO: **The Rhode Island Division of Statewide Planning**. The partnership between this body and RIDOT is critical to implement the TAMP through the annual TIP/STIP.

2. NHS PAVEMENT

Pavement assets are an integral component of the State surface transportation network and play an important role in serving the public. It is key that these assets are maintained in a serviceable condition to reduce travel times, minimize "wear and tear" on vehicles, and provide a safe travel experience to those using Rhode Island roadways.

RIDOT is required to report on the condition of its NHS pavement assets and meet minimum requirements for Intestate pavements and performance targets for all NHS pavements; this includes pavement assets that are not directly maintained by RIDOT. This chapter provides a summary and discussion that touches on four TAMP elements enumerated in 23 CFR § 515.7. A reference guide for these elements in the chapter is provided in Exhibit 2.1.

Exhibit 2.1 Reference Guide for NHS Pavement: FHWA Requirements for TAMP Relating to Performance Gap Analysis, Life-Cycle Planning, and Investment Strategies

SECTION	DESCRIPTION	PAGE
Performance Gap Analysis		
Exhibit 2.10	The State DOT targets for asset condition of NHS Pavement	p. 17
Section 2.3	The gaps, if any, in the performance of the NHS that affect NHS Pavement regardless of physical condition	p. 17
Exhibit 2.12	Alternative strategies to close or address the identified gaps	p. 18
Life Cycle Planning		
Section 2.2.1	Identification of deterioration models for NHS Pavement	p. 14
Exhibit 2.9	Potential work types across the whole life of NHS Pavement with their relative unit cost	p. 15
Section 2.2	A strategy for managing NHS Pavement by minimizing life-cycle costs while achieving condition targets	p. 12
Investment Strategies		
Section 2.3	Description of how investment strategies for NHS Pavement are influenced by Performance Gap Analysis	p. 17
Section 2.2.1	Description of how investment strategies for NHS Pavement are influenced by the Life-Cycle Planning process	p. 14
Section 2.2.1	Description of how investment strategies for NHS Pavement are influenced by the Risk Management process	p. 16
Section 2.2.1	Description of how investment strategies for NHS Pavement are influenced by the Financial Plan	p. 15

2.1 Inventory and Condition for NHS Pavement

As discussed previously, RIDOT is required to report up-to-date inventory and condition data for all NHS pavements, regardless of ownership. A pavement inventory provides information on key characteristics and conditions of pavements within the network. In this section, a description of the RIDOT's inventory and current NHS pavement conditions is provided.

2.1.1 Pavement Inventory

RIDOT's pavement inventory, for the purposes of the TAMP, includes all pavements on the NHS, regardless of ownership. NHS pavements are typically categorized into one of three categories: Interstate pavements, RIDOT-owned non-Interstate NHS pavements, and non-Interstate NHS pavements owned by other entities.

RIDOT owns and maintains a majority (94%) of the NHS network within the State, including the entire Interstate Highway system. The remaining percentage of the NHS network is owned by other entities within Rhode Island, summarized in Exhibit 2.2.

Exhibit 2.2 Rhode Island NHS Pavements by Owner

ASSET CLASS	JURISDICTION	OWNER	LANE MILES	% OF TOTAL LANE MILES
NHS Pavements	State Agencies	Rhode Island DOT	1,744.8	93.98%
		Rhode Island Turnpike and Bridge Authority	37.5	2.02%
		Quonset Development Corporation	3.7	0.2%
	City/Municipal Highway Agencies	City of Cranston	8.6	0.46%
		City of Newport	3.1	0.17%
		City of Central Falls	4.2	0.23%
		City of Pawtucket	15.2	0.82%
		City of Providence	30.6	1.65%
		Town of Westerly	1.3	0.07%
		City of Woonsocket	5.7	0.31%
		City of East Providence	1.2	0.06%
		Town of South Kingstown	0.7	0.04%
		Total	**1,865**	**100%**

2.1.2 Pavement Condition Metrics

To better understand and manage its pavement network, RIDOT collects information on pavement condition uses Pavement Structural Health Index (PSHI) and Highway Performance Monitoring System (HPMS) metrics to gauge condition and manage the system. Each metric type is collected for 1/10th mile pavement sections on an annual or bi-annual basis for mainline and limited access ramps, respectively. At RIDOT, the overall performance of a pavement section, based on federal performance definitions, is estimated using a PSHI conversion equation, or the "Rosetta Stone" for pavement condition for performance measurement and target setting only. The equation, which was developed by RIDOT pavement engineers, uses the pavement section's PSHI to identify the corresponding HPMS overall performance category (i.e., Good, Fair, or Poor condition). RIDOT reports HPMS metrics for the full extent of its NHS network to FHWA on an annual basis. However, the Agency primarily utilizes PSHI to drive performance projections and investment decisions mainly because, as the index is on a 0 to 100 scale, PSHI makes it easier for RIDOT to communicate its overall pavement performance to decision makers and the public.

A description of each of the metric type is summarized in Exhibit 2.3.

Exhibit 2.3 Comparison of HPMS and PSHI Pavement Performance Metrics

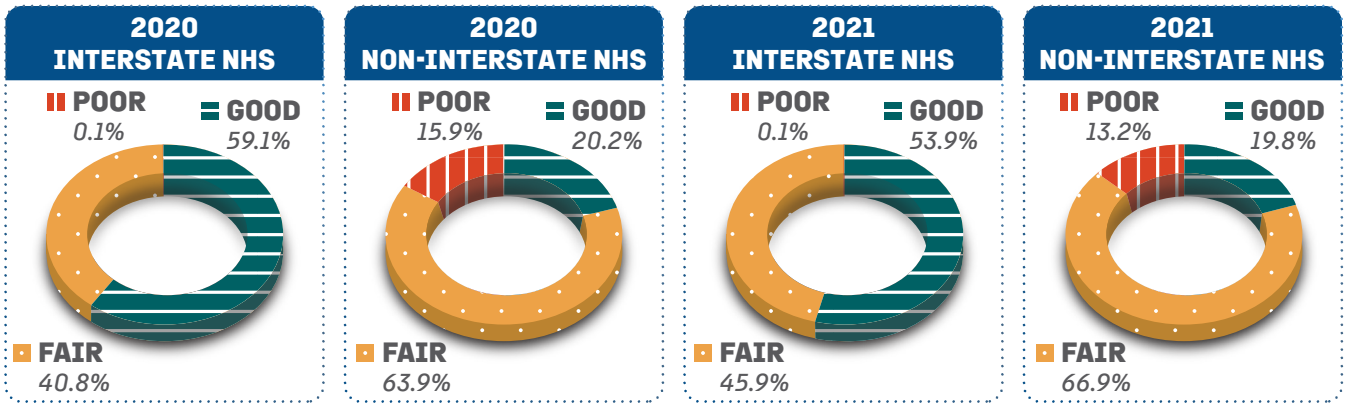
	HIGHWAY PERFORMANCE MONITORING SYSTEM (HPMS)	PAVEMENT STRUCTURAL HEALTH INDEX (PSHI)
DISTRESSES USED IN CALCULATION	☑ *INTERNATIONAL ROUGHNESS INDEX* ☑ *CRACKING PERCENT IN THE WHEELPATHS* ☑ *RUTTING (ASPHALT CONCRETE ONLY)* ☑ *FAULTING (JOINTED CONCRETE ONLY)*	☑ *ALLIGATOR CRACKING (16*)* ☑ *BLOCK CRACKING (10%)* ☑ *LONGITUDINAL CRACKING (7%)* ☑ *TRANSVERSE CRACKING (7%)* ☑ *PATCHING (20%)* ☑ *RUTTING (10%)* ☑ *INTERNATIONAL ROUGHNESS INDEX (30%)*
OVERALL PERFORMANCE CATEGORIES	**GOOD** *(PSHI ≥ 91)* **FAIR** *(PSHI 66-90)* **POOR** *(PSHI < 66)*	**EXCELLENT** *(≥ 90)* **GOOD** *(80-89)* **FAIR** *(70-79)* **POOR** *(60-69)* **FAILED** *(≤ 59)*
PRIMARY USES	• *MEETING FEDERAL REQUIREMENTS* • *SET PERFORMANCE TARGETS* • *COMMUNICATE TAMP PRIORITIES*	• *PROJECT PERFORMANCE* • *DRIVE INVESTMENT DECISIONS* • *COMMUNICATE WITH STAKEHOLDERS*

** PERCENTAGE OF TOTAL SCORE*

2.1.3 Pavement Condition

Based on the HPMS performance metrics described in the previous section, RIDOT calculated the percentage of its network in Good, Fair, and Poor condition using the Agency's 2020 and 2021 HPMS data[1], as depicted in Exhibit 2.4.

Exhibit 2.4 Condition of NHS Pavement Network Using Federal Metrics in 2020 and 2021



[1] Due to the fact that HPMS software is currently unavailable to states, 2020 is the last calendar year for which RIDOT has official FHWA performance data available. The 2021 figures are considered draft in nature, and require a successful software migration by FHWA to finalize. In the interim, RIDOT has provided both approved 2020 and preliminary 2021 figures. 2021 is also the first year in which RIDOT utilized a new pavement vendor for collection, so there are slight differences in methodologies and equipment across the two years.

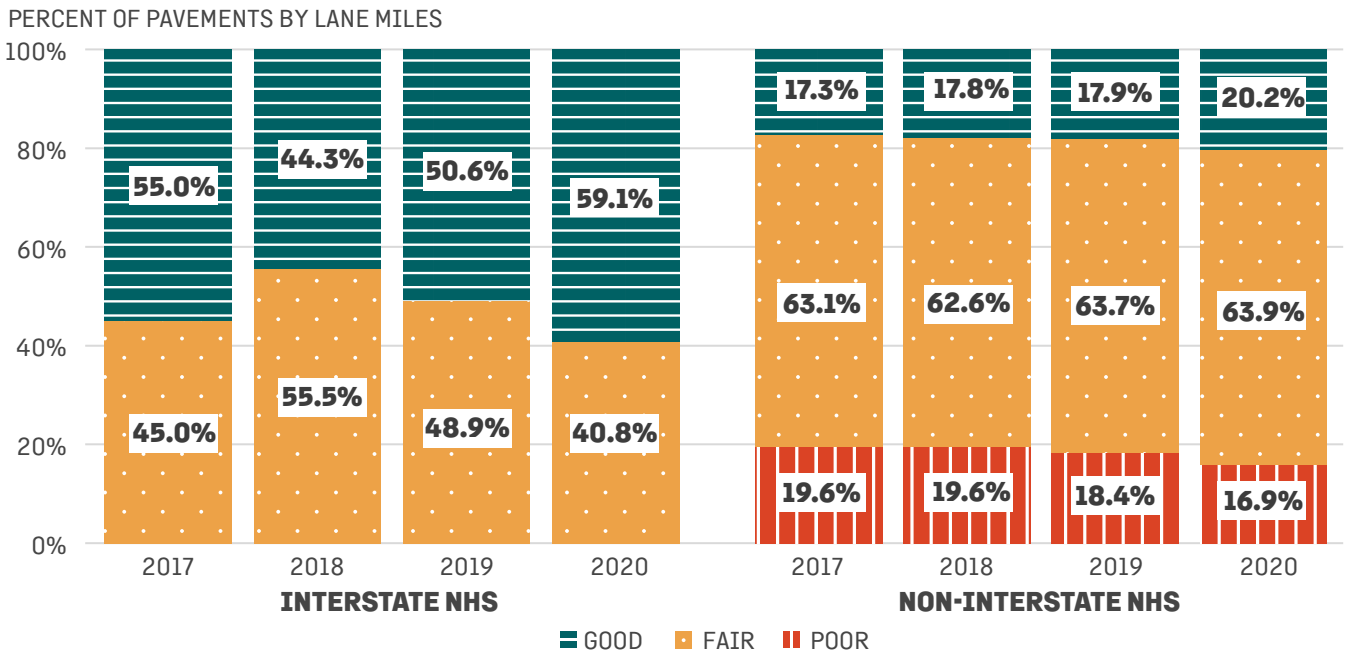
The condition of the entire NHS pavements by ownership is presented in Exhibit 2.5.

Exhibit 2.5 NHS Pavement by Owner and Condition, CY 2020

OWNER CATEGORY	% OF TOTAL	CONDITION (% LANE MILES)			
		% GOOD	% FAIR	% POOR	
RIDOT	94%	28.2%	59.3%	12.5%	
State Toll Authority	2%	45.7%	51.3%	2.2%	
City/Municipal/Townships	3.8%	-	80.5%	19.5%	
Other	0.2%	-	94.6%	5.4%	
NHS Total	**100%**	**27.8%**	**59.4%**	**12.8%**	

Since 2018, the condition of RIDOT's Interstate NHS pavement network has remained steady while the Non-Interstate NHS network has improved slightly, as shown in Exhibit 2.6.

Exhibit 2.6 IH and non-IH NHS Pavement Condition by Year, 2017-2020

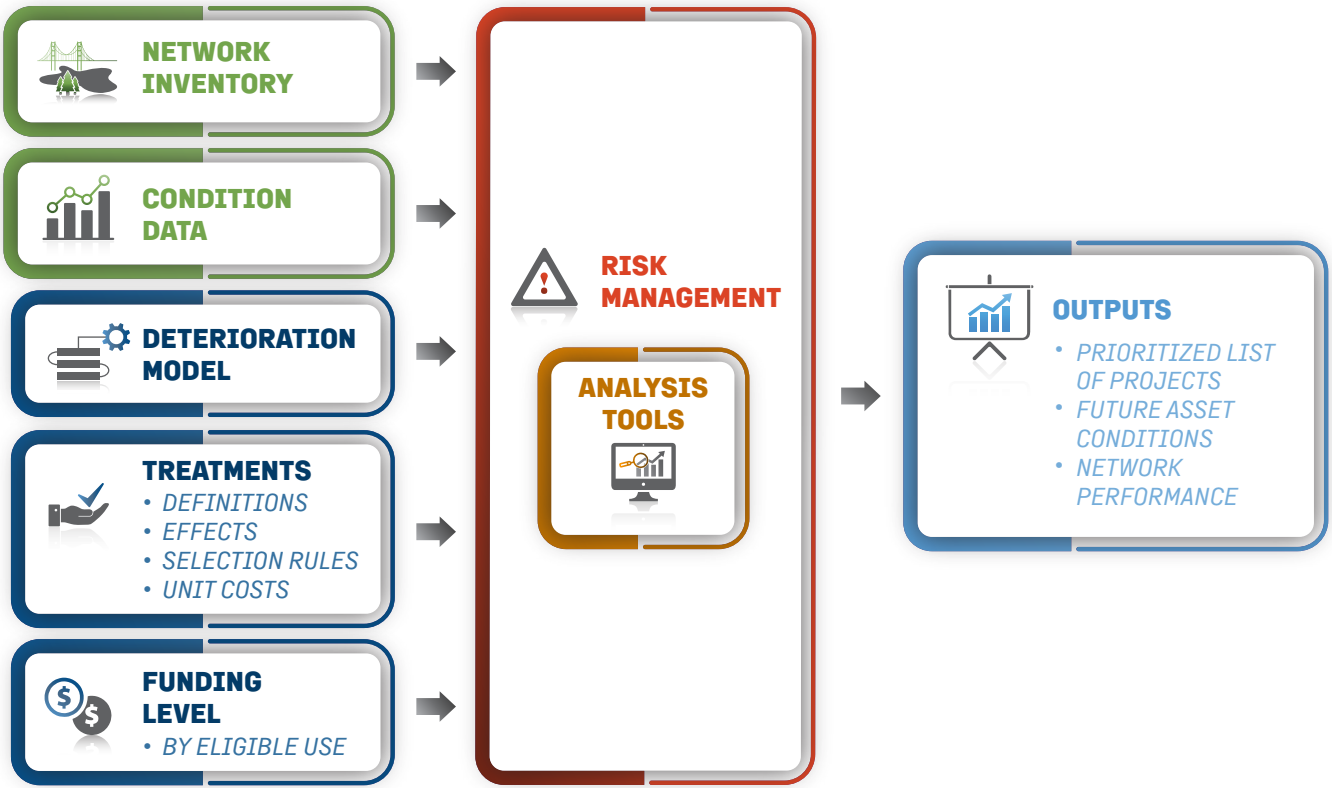


Due to Rhode Island's small size and density, relatively small lengths of roadway changing from one condition state to another can have significant impacts on overall performance in each category. This is particularly true on the Interstates.

2.2 Life Cycle Planning for NHS Pavement

Life cycle planning requires information on current and predicted network performance, financial constraints, engineering processes, and risks to estimate how the asset network will behave in the long-term and when and where RIDOT should treat the network to maximize performance while minimizing cost. For pavements, these types of analyses are conducted using RIDOT's pavement management system, dTIMs, as well as additional tools developed by RIDOT. The sections that follow provide information on the key inputs and considerations for life cycle planning on NHS pavements, as illustrated in Exhibit 2.7.

Exhibit 2.7 Schematic of a Pavement Management System



2.2.1 Key Inputs for Life Cycle Planning

Life cycle planning (LCP) relies on consistent, high-quality asset data to adequately predict future network performance. Those projections inform the Department's assumptions about asset conditions over time, which are used to develop and refine capital project limits, identify preservation candidates, and conduct performance gap analyses. The diagram above shows the relationships between key LCP Analysis inputs, and the following pages explain them in greater detail.

Network Inventory and Condition Data

RIDOT relies on network inventory and condition data—captured through data collection and field reviews—to meet the data needs of LCP. Data collection and field reviews typically focus on gathering information on three areas important for predicting performance: network inventory, pavement condition, and treatments applied to a section.

- *Data Collection Process:* Information on the network inventory (i.e., through lanes, section length, facility type, etc.) and condition (i.e., cracking, rutting, rideability (IRI), and patching), is collected using a data collection vehicle, depicted in Exhibit 2.9. Distresses are ranked by severity, illustrated on color-coded plan view photos, and quantified in tabular format. Mainline data for both NHS and "other" State roads is collected annually while limited access ramp data is collected bi-annually. Although data is collected by a contracted vendor, RIDOT checks the quality of the collected data on a regular basis using blind testing sites and data acceptance criteria as outlined in RIDOT's Data Quality Management Plan. In doing so, RIDOT ensures that data collected by the vendor is consistent and accurate throughout the collection season.

- *Field Review Process:* Field reviews capture any work/treatments applied to a pavement section. Using service requests, maintenance crew observations, and field inspections, RIDOT develops a list of preservation projects and at-risk routes throughout the year. The process, which is conducted on a quarterly basis, also captures events, such as potholes and utility cuts, that occur in-between data collection cycles. This information provides a more complete picture on the condition and needs of the pavement network.

Exhibit 2.8 Pavement Data Collection Vehicle

Deterioration Models

The collection of data on an annual basis has enabled RIDOT to develop deterioration models for its pavement performance over time. To develop the deterioration models using PSHI, RIDOT identified pavement groups—pavements with similar characteristics and expected performance—to account for differences in pavement deterioration based on traffic volume, pavement structure, and the presence of utilities. The results of the PSHI models are then converted from PSHI to HPMS condition metrics using the Agency's "Rosetta Stone". While the current deterioration models provide realistic predictions of network-level performance over time, RIDOT plans to continually refine its deterioration models to account for additional factors affecting performance such as the last treatment applied to a section and climatic factors—and to predict the overall performance of the pavement network using HPMS performance metrics, rather than PSHI.

DETERIORATION MODEL GROUPS

- *INTERSTATES*
- *OTHER FREEWAYS AND EXPRESSWAYS*
- *PRINCIPAL ARTERIAL (RURAL & URBAN)*
- *MINOR ARTERIAL (RURAL & URBAN)*
- *MAJOR COLLECTOR (RURAL & URBAN)*
- *MINOR COLLECTOR (RURAL & URBAN)*
- *LOCAL ROADS (RURAL & URBAN)*

Treatments

The timing and types of treatments applied to an asset impact the overall condition and expected life of that asset. Therefore, reporting on and quantifying the costs and benefits of given treatments is an important part of LCP. As RIDOT maintains a mature system of pavement assets, preservation, rehabilitation, and replacement are the most typical treatment categories employed by the State and accordingly, are the treatment categories used in RIDOT's life cycle planning process. These six treatment categories used by RIDOT (see Exhibit 2.9) correspond to the federally defined work types for pavements (23 CFR 515)— maintenance, preservation, rehabilitation, and reconstruction. Exhibit 2.9 provides a summary of the treatment work type, work type definition, typical treatment types under each work type, typical life extension in applying a treatment, and an average unit cost. Unit cost and life extension values represent generalized averages used for program analyses, project cost projections, and asset service life evaluations.

Exhibit 2.9 Pavement Treatments by FHWA Work Type

TREATMENT	DEFINITION	TREATMENT TYPES	TYPICAL LIFE EXTENSION (YEARS)	AVERAGE UNIT COST ($/Y²)
Maintenance	» Cyclical maintenance activities, including pothole repairs and pavement patching.	Pothole Repairs, Patching	1-5	<$10
Preservation, Level 1	» Standard cyclical and preventative maintenance activities, such as crack sealing. » Typically used on pavements rated in Fair or Good condition and is effective in mitigating cracking. » No structural capacity or rideability improvements result from this treatment category.	Chip Seal, Crack Seal	3-5	<$10
Preservation, Level 2	» Planned standard cyclical preservation activities such as thin overlay. » Typically used on pavements rated in Fair or Good in conjunction with Level 1 preservation treatments. » Can be applied in conjunction with leveling to improve rideability and structural capacity.	Thin Overlay/ PPEST	6-10	$12
Minor Rehab	» Planned cyclical treatments to rehabilitate pavements in Fair or Poor condition. » Typified by thin mill and overlay treatments up to approximately 3" in depth. » Improve structural capacity and rideability and can be used in conjunction with other treatments such as leveling and joint repair.	Mill & Overlay <3"	7-15	$26-30
Major Rehab	» Typically used on pavements in Fair or Poor condition. » Typified by deep mill and overlay or complete pavement replacement without repairs to the base layer. » Improve structural capacity and rideability.	Mill & Fill >3"	15-20	>$40
Replacement	» Full reconstruction or reclamation. » Used on failed pavement structure to restore rideability and structural capacity. » Differs from major rehabilitation in that replacement involves repairs to the pavement base layer.	Reclamation, Full Depth Replacement	25+	$50-150

Funding and Capital Program Information

LCP considers the funding available for each analysis year and therefore, utilizes information on the planned and expected capital investments to better predict the estimated network condition over time. Available NHS pavement funding, by FHWA federal work type, for the next ten years is summarized in the Chapter 5 Financial Plan.

Analysis Tools

Data collected and models developed by RIDOT are managed in the Deighton Total Infrastructure Management Systems (dTIMS), RIDOT's pavement management system. The system utilizes the 0.1-mile section-level inventory and condition data and deterioration models to predict network-level performance and inform project selection and target setting. Currently, RIDOT is in the process of updating its pavement management system from dTIMS 9.5 to dTIMS Business Analytics (BA). In doing so, the Agency hopes to improve upon the current capabilities of its pavement management system in selecting and formulating projects. Both the current and the proposed pavement management systems are key to conducting life cycle planning scenarios focused on improving performance while minimizing cost for the pavement network in the long run. However, as explained previously, dTIMS is not the only tool used to assess pavement needs and select capital program and preservation projects; field review and engineering judgement is used by RIDOT to verify or further evaluate dTIMS outputs.

RIDOT runs multiple analyses within dTIMS to evaluate the impact of different project packages and prioritizations. The software generates an incremental benefit-cost chart (IBC). There are three options for an optimized work program:

- *Maximize Benefits using IBC:* The "traditional" method using the efficiency frontier approach to find the combination of strategies over the network that maximize "benefits" within a constrained "cost." IBC calculations are based on:
  - The suite of treatments available to the system, defined in previous figures.
  - The traffic volumes in the area (AADT).
  - The expected pavement structural health index (PSHI) improvement that is realized by the proposed treatment.
  - The expected cost of various treatments.
- *Maximize Benefits using Other Criteria:* A more sophisticated use of the IBC method, described in the Advanced Users Guide of dTIMS.
- *Minimize Cost:* The objective is to find the strategy for each element that gives the lowest agency (ownership) cost.

Risk

RIDOT utilizes a risk-based approach to asset management and therefore, risks identified in the Agency's risk register (Chapter 4) inform investment planning and project selection. Specifically, as the Agency aims to address concerns related to poor materials and maintenance of pavements, damage by vehicles or equipment, inadequate drainage, freeze/thaw cycle damage, and extreme weather events, RIDOT continues to increase the amount of preservation on its pavement network each year. This business practice is being enforced and incorporated into LCP through the budget allocated to preservation in each analysis year.

The Agency has also begun to implement efforts focused on making its pavement system more resilient to extreme weather and flooding. RIDOT is currently performing pilots to test permeable pavement in areas where frequent flooding often makes the road impassable. In doing so, RIDOT is hoping to manage risk in areas where sea level rise may force managed retreat. If the pilot shows permeable pavement to be an effective and viable option, then RIDOT can begin to incorporate it as a treatment within its LCP processes.

2.2.2 Life Cycle Planning for NHS Pavement not owned by RIDOT

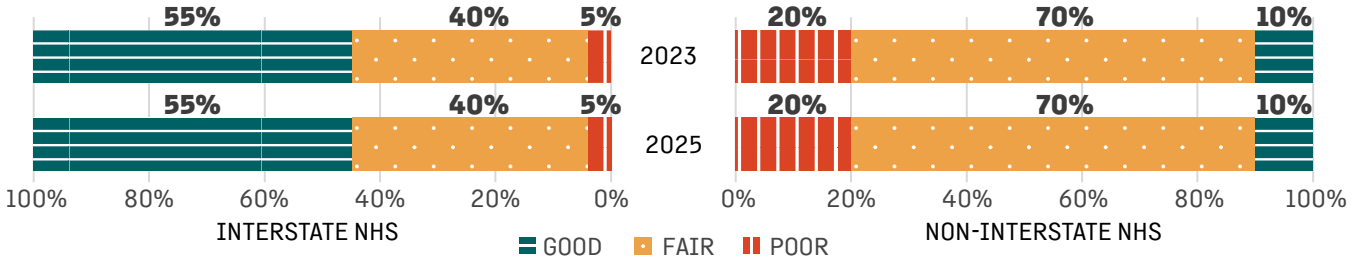
As described in the previous section, most NHS pavements are owned and maintained by RIDOT. However, for the remaining 6% of the NHS pavement network that is not owned by RIDOT, individual entities are tasked with conducting life cycle planning or similar processes to prioritize when and where to treat the NHS pavement network. For some cities and municipalities, LCP may be tied to the agencies' project selection and prioritization process; agencies may rely on the condition of their network to make decisions as to when and where to best apply treatments. This is especially true for agencies applying for low interest loans from the Rhode Island Infrastructure Bank. These loans focus on funding road improvements based on a pavement segment's ranking on RIDOT's priority list. However, the extent to which each agency utilizes LCP varies overall.

As RIDOT is required to meet performance targets for all the NHS, regardless of ownership, the Department does incorporate non-RIDOT owned pavements in its own LCP scenarios. In each of the scenarios discussed in the next section, analysis is conducted for all NHS pavement sections. However, non-RIDOT owned pavement sections are excluded from treatment selection as the investment levels for sections owned by other entities is not typically known. In doing so, RIDOT presents a conservative estimate of the state of its system over time.

2.3 Investment Strategies for NHS Pavement

FHWA requires that no more than 5% of RIDOT's Interstate lane-miles of pavement are in Poor condition. FHWA also requires that states establish and demonstrate progress in meeting 2023 and 2025 performance targets for the percentage of NHS lane-miles in Good and Poor condition (no targets are required for Fair, although it can be derived from the other two targets). RIDOT defined in the 2019 TAMP and reinforces here that pavement with PSHI greater than 70 is in a state-of-good-repair. The performance targets established for 2023 and 2025 are shown in Exhibit 2.10.

Exhibit 2.10 Performance Targets for NHS Pavement (HPMS)



The 2023 and 2025 targets are identical. The targets were selected by RIDOT based on experience in recent years in which pavement deterioration accelerated unexpectedly in several locations as a result of extreme weather, flooding, or other issues. Therefore, despite RIDOT's planned investments over the next several years, it is the Department's expectation that performance targets for pavement conditions will remain unchanged from 2023 to 2025.

RIDOT utilized the processes described in this chapter to conduct performance-based scenario analyses in which the Department's performance data, deterioration models, treatment information, and financial data were used to assess performance and financial needs over time. The Agency analyzed three LCP scenarios summarized in Exhibit 2.11.

Exhibit 2.11 Life Cycle Planning Scenarios for Pavement

SCENARIO	DESCRIPTION
Optimal Performance	Prioritizes unlimited funding to achieve and maintain a state of good repair for all NHS pavement assets.
Planned Performance	Reflects the Department's currently planned and projected constrained investment levels based on committed construction established by the STIP.
Deteriorating Performance	Reflects a $0 investment level that would allow the conditions of the State's pavement network to deteriorate. This scenario is unlikely and is therefore only included as a worst-case scenario for informational purposes.

Exhibit 2.12 summarizes the analysis outcome at the end of the ten years. The output shows that RIDOT will not be able to maintain the current pavement conditions in the long term at the current funding levels. Specifically, Interstate NHS pavement classified as Good is projected to decline from 86.1% to 63.3% by 2030, while Poor will increase from 0% to 1.3%. Similarly, Non-Interstate pavement classified as Good is projected to decline from 30.5% to 21.3%, while Poor will increase from 9.6% to 15.8% in the same timeframe. Despite this anticipated decline, RIDOT would not be in default of the minimum federal requirements for Interstate pavements.

The optimal performance scenario shows significant improvements in pavement performance. Although this scenario exceeds what is currently available by over 50 percent, it offers insight into evaluating the suitable funding level to maintain current performance in the short-term and meet long-term goals. RIDOT uses this information to establish short-term and long-term targets for pavements while understanding the risks, financial needs, and future needs.

Exhibit 2.12 Forecasted Performance for Investment Strategy Scenarios for NHS Pavement, 2022 and 2031

SCENARIO	TOTAL COST ($MILLION)	INTERSTATE NHS				NON-INTERSTATE NHS			
		%GOOD		%POOR		%GOOD		%POOR	
		2020	2031	2020	2031	2020	2031	2020	2031
Optimal Performance	$1,446		92.8%		0.5%		60%		0.2%
Planned Performance	$913	86.1%	63.3%	0%	1.3%	30.5%	21.3%	9.6%	15.8%
Deterioration Performance	$0		10.6%		12.9%		2.2%		35.6%

Exhibits 2.13 to 2.16 show the estimated percentage of the NHS pavement network in Good and Poor condition for each of the three scenarios as well as the performance targets set by the Department for each.

Exhibit 2.13 Interstate Pavement Investment Scenarios – Good Condition

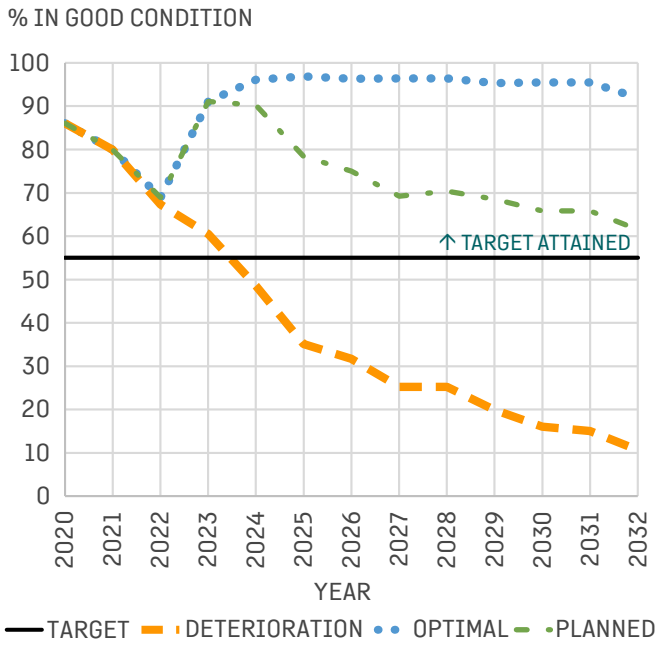


Exhibit 2.14 Interstate Pavement Investment Scenarios – Poor Condition

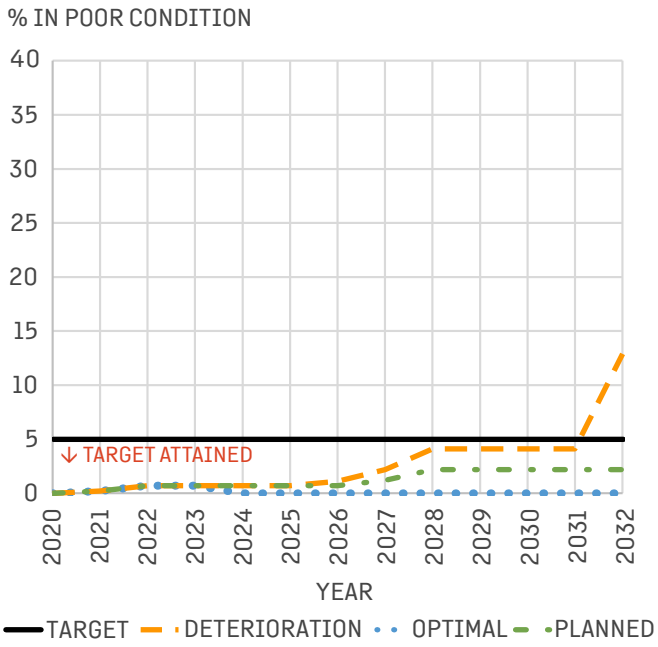


Exhibit 2.15 Non-Interstate NHS Pavement Investment Scenarios – Good Condition

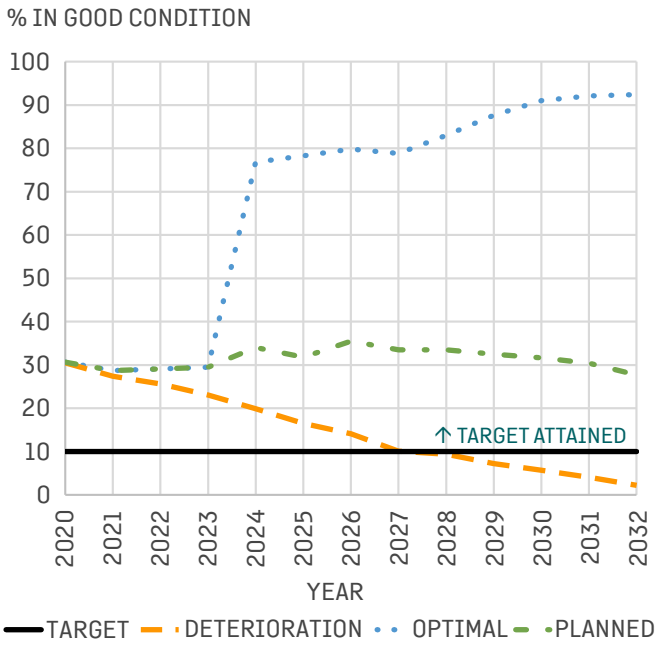
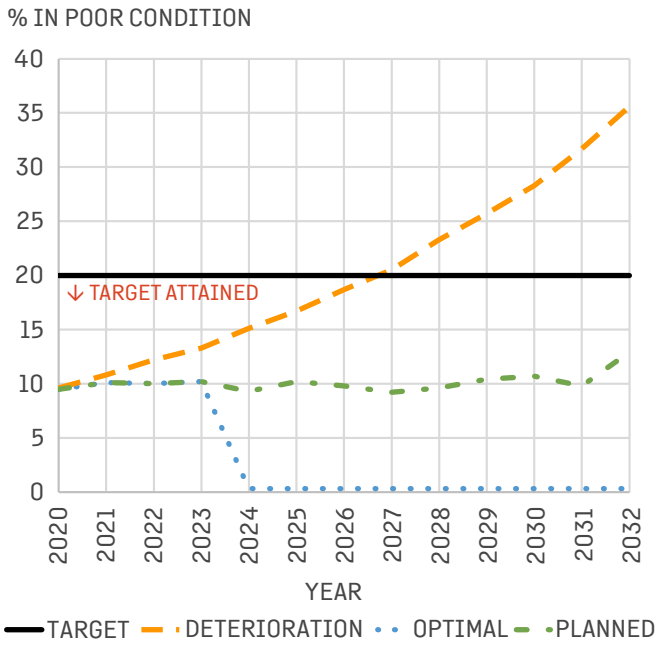


Exhibit 2.16 Non-Interstate NHS Pavement Investment Scenarios – Poor Condition



2.4 Pavement Process Improvement

As discussed throughout this chapter, RIDOT has made great strides in improving its pavement management and asset management processes. Since the 2018 TAMP, RIDOT has enhanced its project development process, formalized its deterioration models, and is in the process of implementing a new pavement management system. However, the Department aims to continuously improve its existing processes to better its overall TAM program. Specifically, RIDOT identified three areas of opportunity for pavement process improvement, each described below.

Data Systems and Tools

RIDOT has developed and implemented processes, tools, and systems that enable the Department to manage, assess, and analyze collected pavement data. Using dTIMS, the "Rosetta Stone", and other in-house tools, the Agency can conduct life cycle planning analyses and effectively predict pavement needs and performance over time. Specific areas of opportunity include:

- Improved deterioration modeling using individual federal metrics.
- Implementation of dTIMS BA.
- Formalized data management and documentation.
- Enhanced LCP processes that directly incorporate risk.
- Increased frequency in inspection of network roads to twice annually.

Project Scoping and Development

Since the previous iteration of the TAMP, RIDOT has worked to improve pavement project timing, scoping, and planning. RIDOT has developed a map-based, 10-year plan of programmed projects throughout the State[2], which has enabled RIDOT to consider other assets and other projects during the project implementation process. RIDOT has also developed a formalized process (p. 47) to better "pre-scope" projects for implementation, preparing reports analyzing the treatment needs, permitting challenges, and detailed cost estimates for each capital project to inform engineering work in the Division of Project Management.

Knowledge and Skills Management

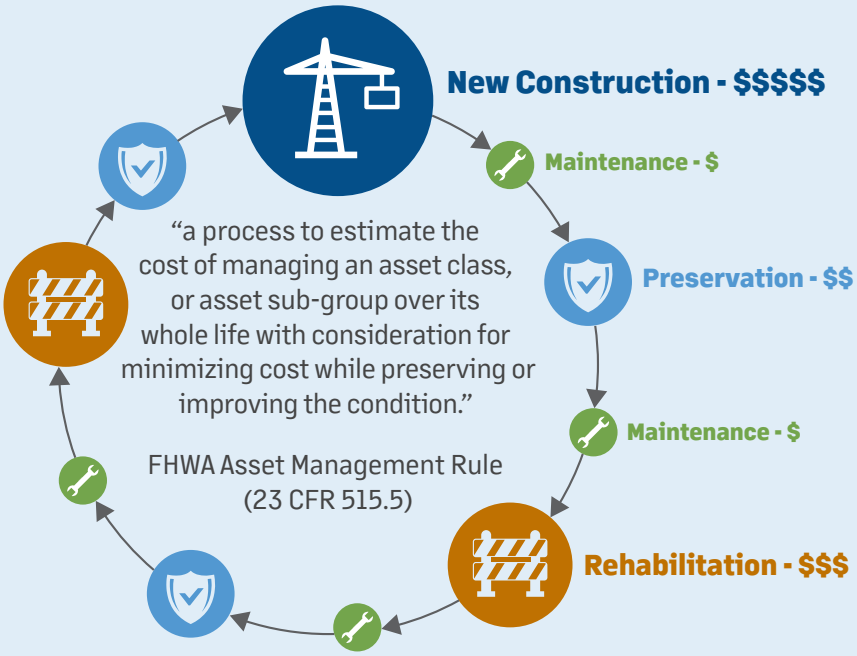
While RIDOT has strong institutional knowledge, there is a need to retain that knowledge in the face of a changing workforce. RIDOT would like to improve its knowledge and skills management practices within the area of pavement management and TAM by documenting existing processes, establishing a training program for pavement management and TAM, and investing in succession planning. In doing so, RIDOT will be able to retain existing skills and knowledge that are essential for advancing the TAM program.

Enhanced Preservation Program

Using service requests, maintenance crew observations, and field inspections, RIDOT develops a list of preservation projects and at-risk routes throughout the year. The process, which will be conducted on a quarterly basis, captures events, such as potholes and utility cuts, that occur in between data collection cycles. RIDOT hopes to enhance and further formalize the use of both the map-based, 10-year plan and the quarterly reporting process to improve the project prioritization and selection process moving forward.

[2] https://risegis.ri.gov/portal/home/item.html?id=a2122bbbf1434cd6b73d6b2216458c1b

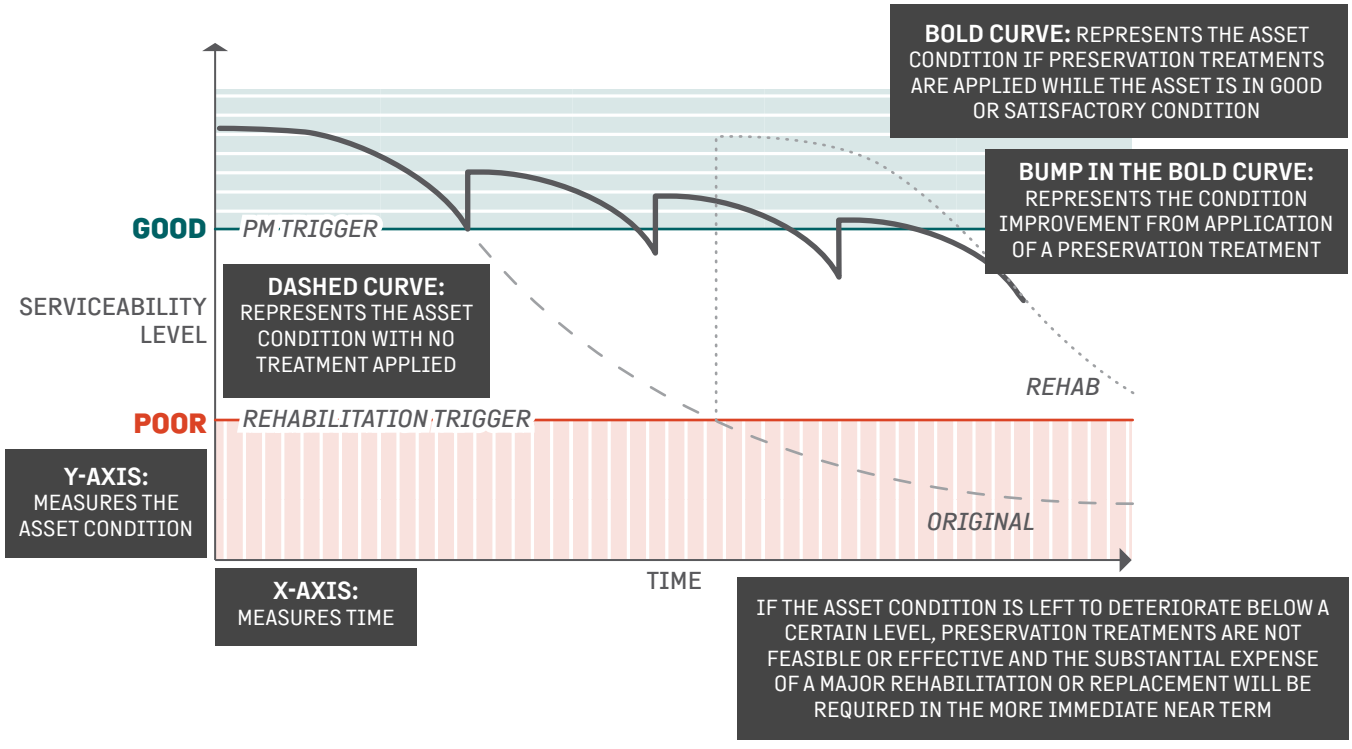
FOCUS ON: Life Cycle Planning



Life cycle planning recognizes that applying **the right treatment at the right stage in an asset's life cycle can have a profound effect** on the total cost to maintain an asset in SOGR over its whole life.

It is almost always more cost-effective to perform multiple, lower cost maintenance and preservation treatments than to allow an asset to deteriorate to the point of requiring a major rehabilitation or even complete replacement.

STYLIZED ILLUSTRATION OF ASSET CONDITION OVER TIME



3. NHS BRIDGES

This chapter provides a summary and discussion that touches on four TAMP elements enumerated in 23 CFR § 515.7. A reference guide for these elements in the chapter is provided in Exhibit 3.1.

Exhibit 3.1 Reference Guide for NHS Bridges: FHWA Requirements for TAMP Relating to Performance Gap Analysis, Life-Cycle Planning, and Investment Strategies

SECTION	DESCRIPTION	PAGE
Performance Gap Analysis		
Exhibit 3.14	The State DOT targets for asset condition of NHS Bridges	p. 37
Section 3.3.1	The gaps, if any, in the performance of the NHS that affect NHS Bridges regardless of physical condition	p. 36
Section 3.3.1	Alternative strategies to close or address the identified gaps	p. 35
Life Cycle Planning		
Section 3.2.1	Identification of deterioration models for NHS Bridges	p. 27
Exhibit 3.9	Potential work types across the whole life of NHS Bridges with their relative unit cost	p. 30
Section 3.2	A strategy for managing NHS Bridges by minimizing life-cycle costs while achieving condition targets	p. 26
Investment Strategies		
Section 3.3	Description of how investment strategies for NHS Bridges are influenced by Performance Gap Analysis	p. 35
Section 3.2.1	Description of how investment strategies for NHS Bridges are influenced by the Life-Cycle Planning process	p. 28
Section 3.2.1	Description of how investment strategies for NHS Bridges are influenced by the Risk Management process	p. 31
Section 3.2.1	Description of how investment strategies for NHS Bridges are influenced by the Financial Plan	p. 30

3.1 Inventory and Condition for NHS Bridges

This section summarizes the inventory and condition of NHS bridges in Rhode Island. Asset data are broken down into various levels of detail, including by ownership and structure age.

3.1.1 Bridge Inventory

The Rhode Island TAMP bridge inventory includes all National Bridge Inventory (NBI) bridges on the NHS. Based on Collected Year (CY) 2021 data, there are 422 of these NBI bridges on the NHS, which comprise 6,414,277 ft^2 of deck area.

What is a NBIS Bridge?

A bridge carrying a public road with a span greater than 20 feet as measured end-to-end along the direction of travel. Note, not all NBI bridges are on the NHS.

Why was NBIS established?

The primary purpose of NBI is to locate and evaluate existing bridge deficiencies to ensure the safety of the traveling public.

Exhibit 3.2 provides an inventory of these bridges grouped by owner. The following sections and exhibits also use CY 2021 data unless indicated otherwise.

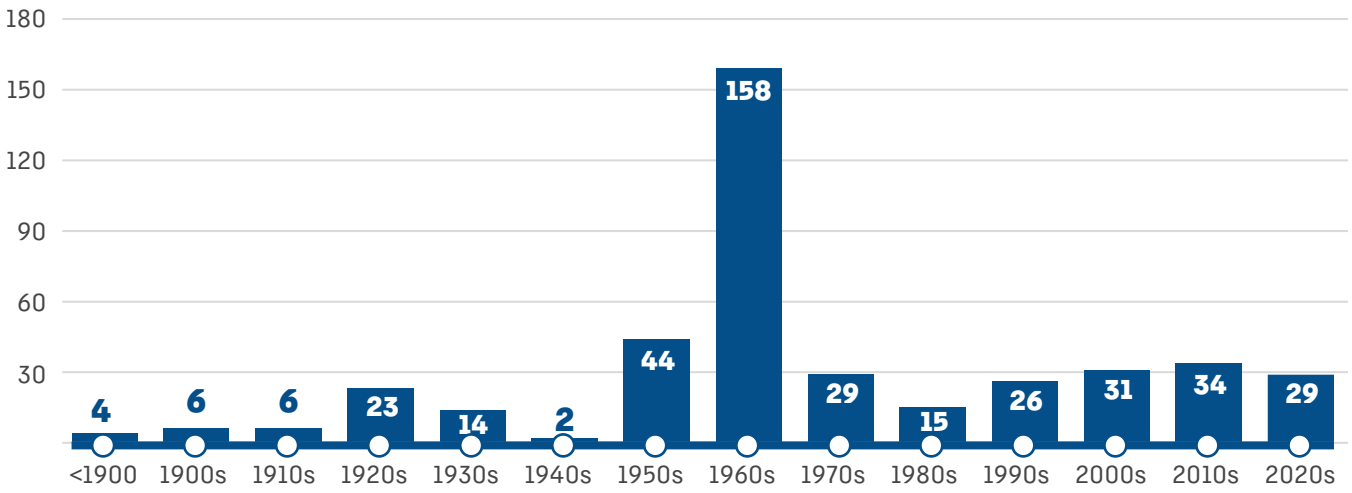
Exhibit 3.2 NHS Bridges in Rhode Island by Owner, CY 2021

OWNER	COUNT	DECK AREA (FT^2)	% OF TOTAL DECK AREA
RIDOT	387	4,593,547	72%
RITBA	14	1,571,353	24%
Providence	11	132,931	2%
Pawtucket	3	23,435	<1%
Woonsocket	2	29,384	<1%
Federal Agencies	2	39,105	<1%
RIAC	2	18,103	<1%
Quonset	1	4,330	<1%
Mobile Pipeline Company	1	2,089	<1%
Total	**423**	**6,414,277**	**100%**

Source: RIDOT Office of Bridge Engineering.

Rhode Island's NHS bridges are aging. Older bridges tend to have greater repair and rehabilitation needs and functional deficiencies such as lane and shoulder widths and railings that do not meet current standards. Over 60% of TAMP bridges, accounting for over 50% of bridge deck area, were constructed over 50 years ago, as shown in Exhibit 3.3.

Exhibit 3.3 NHS Bridges in Rhode Island by Decade Constructed



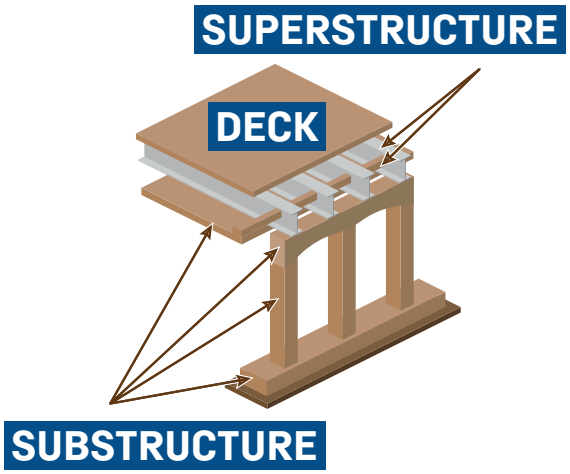
Source: RIDOT Office of Bridge Engineering.

RIDOT also maintains 204 Non-NHS NBI bridges that constitute nearly 1.2 million square feet of deck area (approximately 20% of RIDOT's total).

3.1.2 Bridge Condition Metrics

Per Federal law, Rhode Island DOT inspects all its NBIS bridges at least once every 24 months. RIDOT conducts yearly inspections of all NBIS bridges classified as "Poor" and all bridges posted with weight limits. Federal regulations require assignment of condition ratings to the major bridge components: deck, superstructure, and substructure. Culverts of 20 feet or more in length are also included in NBI and are rated as a single component. Each component receives a condition rating score on the scale provided in Exhibit 3.4, which also lists the condition measures used by the TAMP.

Exhibit 3.4 NBI Bridge Components and Condition Ranking System



SCORE	DESCRIPTION	MEASURE
9	Excellent	Good
8	Very Good	
7	Good	
6	Satisfactory	Fair
5	Fair	
4	Poor	Poor
3	Serious	
2	Critical	
1	Imminent Failure	
0	Failed	

The National Highway Performance Program (NHPP) measures set the overall condition of the bridge or culvert based on the lowest component rating [FHWA Rule, 23 CFR 490.409(b)]. If all three of the deck, superstructure, and substructure components of a bridge or the culvert component is rated 7 or above, the bridge is classified as being in Good condition. If the lowest component is rated 5 or 6, the bridge is classified as Fair condition, and if the lowest component is 4 or less, the bridge is classified as being in Poor condition. A bridge that is in Poor condition does not imply that it is unsafe; this just means that deficiencies have been identified that require maintenance, rehabilitation, or replacement. Bridges in Good or Fair condition are said to be in a "State of Good Repair." References to the RhodeWorks legislation frequently use the term "Sufficiency", which is equivalent to being in a State of Good Repair.

NBI bridge inspections in Rhode Island also include the assessment of the condition of individual elements that make up the major components (i.e., National Bridge Elements or NBEs). The element rating system has four condition states: good, fair, poor, and severe. Each portion of each element is assigned to one of these condition states. For example, a bridge deck is an element measured in square feet; inspectors measure and record the square feet in each of fair, poor, and severe condition states and assign the remainder of the deck area as being in the good condition state. The new NBIS inspection reporting specifications (Specifications for the National Bridge Inventory, March 2022) give guidance to inspectors for explicitly considering element level defects when assigning component condition ratings on the 0-9 scale.

3.1.3 Bridge Condition

The baseline condition of bridges on the NHS is presented in Exhibit 3.5. As of CY 2021, approximately 16.44% of the bridges by deck area on the NHS are in Poor condition. All but one of these bridges and 13,500 ft² of deck area is owned by RIDOT. All Rhode Island Turnpike and Bridge Authority (RITBA) bridges were in a State of Good Repair (SOGR).

Exhibit 3.5 NHS Bridges by Owner and Condition, CY 2021

OWNER CATEGORY	DECK AREA	% OF TOTAL	CONDITION (BY DECK AREA, FT²)			
			% GOOD	% FAIR	% POOR	
RIDOT	4,593,547	72.05%	16.49%	60.98%	22.53%	
RITBA	1,571,353	24.65%	14.38%	85.61%	0.00%	
City/Municipal Highway Agency	185,750	2.91%	16.49%	76.24%	7.27%	
Other State Agency	24,522	0.38%	62.00%	38.00%	0.00%	
NHS Total	**6,375,172**	**100.00%**	**16.14%**	**67.41%**	**16.44%**	

Source: RIDOT Office of Bridge Engineering.

Owners of TAMP bridges in Rhode Island have achieved notable gains in bridge conditions in the State over the past five years. The imperative of addressing the backlog of bridges rated Poor limits the funding available to maintain bridges in Good condition.

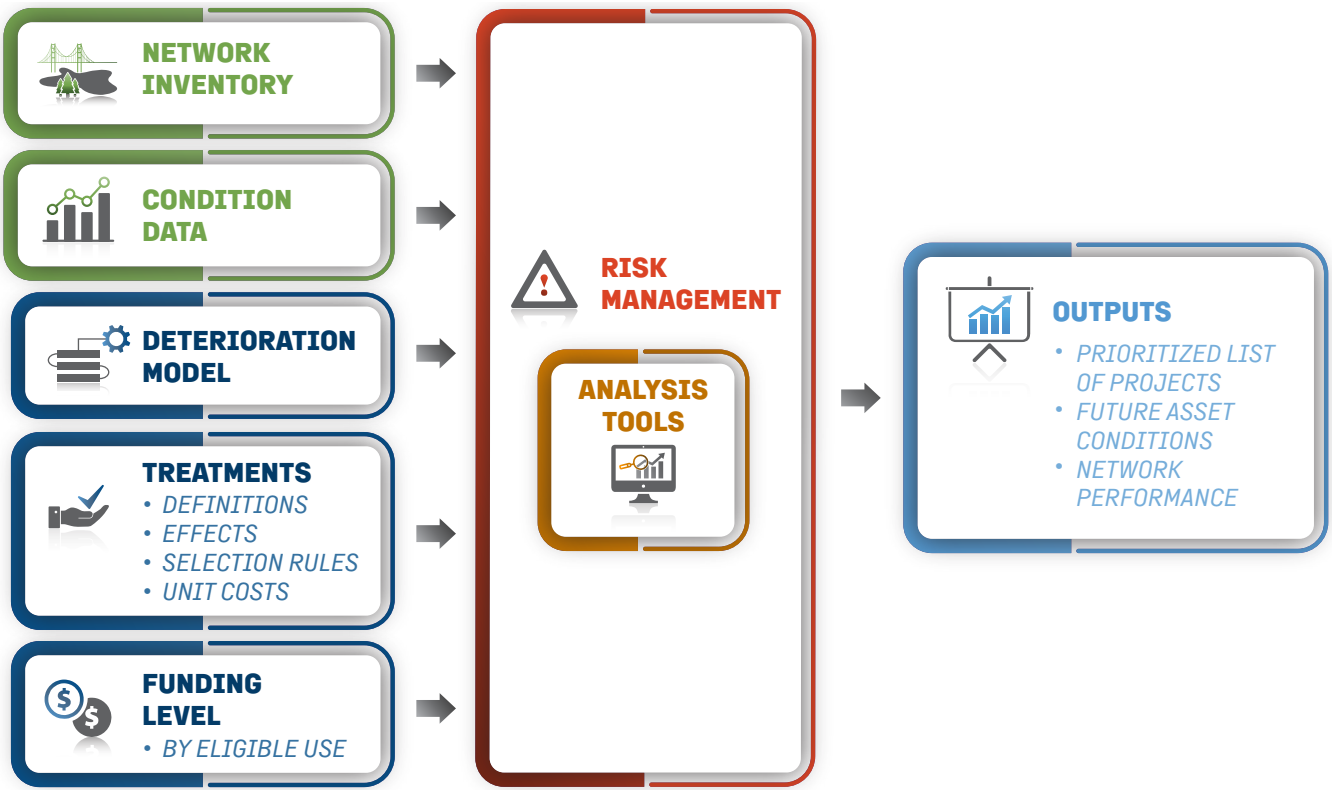
3.2 Life Cycle Planning for NHS Bridges

Performing life cycle planning at the network level requires engineering, economic, and financial analyses, all supported by RIDOT's bridge management system. The RIDOT bridge management system is a collection of databases, staff, software tools, institutional knowledge, and business processes that: (1) manage the variety of data on assets, (2) initiate projects, (3) develop life cycle plans and investment strategies, and (4) provide information and reports to federal authorities, external stakeholders, and other business units.

3.2.1 Key Inputs for Life Cycle Planning

A bridge management system uses inventory and condition data, performance objectives, deterioration models, financial information, and rules defining when different treatments should be applied, to determine the most cost-effective strategies for preserving or improving asset performance over the long term. A schematic depicting the relationship between these inputs is provided in Exhibit 3.6. AASHTOWare Bridge Management (BrM) is a key tool within RIDOT's bridge management system. All of the components shown in Exhibit 3.6 are embodied within BrM.

Exhibit 3.6 Schematic of a Bridge Management System



Life Cycle Planning Rules

BrM contains RIDOT's treatment selection rules in what BrM names Network Policies and Life Cycle Policies. Combined, the two sets of policies can be regarded as embodying RIDOTs life cycle planning rules.

- **Network Policies** contain the treatments and selection rules for the BrM optimizers to consider as eligible treatments in the search for the optimal set of treatments. The network policy rules facilitate computation by limiting the set of eligible treatments that the software must evaluate to those that make sense given the circumstances.
- **Life Cycle Policies** contain the treatment rules that BrM uses to calculate life cycle costs; they are not evaluated as options. An example Life Cycle Policy rule is: Replace the Bridge when the Superstructure Category Health Index is less than 43 and the substructure category health index is less than 55.

Network Inventory

Information that identifies and characterizes each bridge, including, among other items: geographic location; AADT; physical features such as structure type; material; geometric data such as structure length, lane width, detour length; year of construction; and appraisal information (e.g., load capacity, scour criticality ratings).

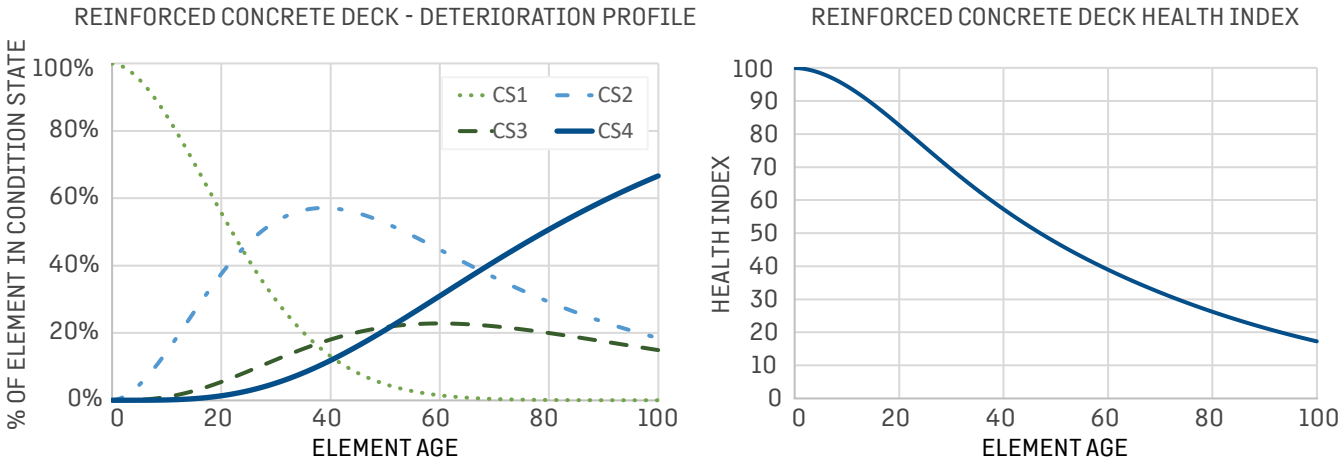
Inspection Condition Data

Inspection condition data consists of two sets of data: (1) General Condition ratings for major bridge components using the National Bridge Inspection Standards (NBIS) 0-9 scale. (2) Quantities in each of the four condition states (good-fair-poor-severe) for bridge elements. See Section 3.1.2 for more information on inspection and condition metrics.

Deterioration Model

Mathematical models used to project future bridge condition in the absence of any treatment. The deterioration models used in the RIDOT bridge management system are based on historical RIDOT bridge condition and work records. Deterioration models are specific to construction type and materials. RIDOT models deterioration of the detailed AASHTO element condition state data. The model parameters are specific to the condition state. For example, the quantity in each condition state is modeled as declining by a certain percentage to the next worse condition state each year. Exhibit 3.7 illustrates a x-year time path for the quantity in each condition state for a new reinforced concrete deck. Alongside the condition state quantity graph is a graph showing the time path of the element's "Health Index", which is a weighted combination of the modeled percentages in each condition state.

Exhibit 3.7 Example Deterioration Profile and Health Index



Treatments

Bridge treatments are the preservation, rehabilitation, and replacement actions that are analyzed and ranked in the analysis tools component. Treatment data needed by the modeling system include triggers, effects, and unit costs. Treatments by work type are provided with average unit cost in Exhibit 3.8. RIDOT's BrM configuration stands out for its extensive set of preservation treatments.

» *Treatment Triggers* – Treatment triggers are the inventory characteristics and inspection condition combinations that trigger the modeling system to select a treatment for evaluation in any given analysis year. These triggers embody, among other factors, RIDOT's life cycle planning rules. (See inset below)

» *Treatment Effects* – Treatment Effects (i.e., consequences) refers to the modeled changes in conditions resulting from implementing the treatment. The condition data used in treatment triggers and effects are the AASHTO element condition state quantities. Major component NBI General Condition Ratings are calculated from the element condition state quantities as a post-processing step within BrM. Treatment effects also include changes in other performance measures such as the risk score.

» *Treatment Unit Costs* – Treatment costs currently used in the analysis modules are order-of-magnitude, loaded unit costs for each treatment, as computed from historical RIDOT project costs. RIDOT applies a 3% inflation rate in its BrM modeling.

» *Work Candidates* – Besides having the software pick eligible treatments using treatment triggers, treatment needs identified during inspections are entered as "work candidates" and are evaluated within the analysis modules.

Exhibit 3.8 Bridge Treatments by FHWA Work Type

TREATMENT CATEGORY	DEFINITION	TREATMENT TYPES	IDEAL TREATMENT INTERVAL	AVERAGE UNIT COST ($/FT^2)
Maintenance	» Limited set of routine and reactive maintenance activities » Typical Condition Rating: 4-9 » Typical Condition Benefit: 0-1	» Collision Damage Repair » Mechanical Equipment » Electrical Equipment » Sweeping » Snow Removal	1 – 5 Years	$3-10
Preservation, Level 1	» Standard cyclical and condition-based preventive maintenance activities. Distinct from Maintenance and Preservation Level 2 in cost and scope. » Typical Condition: >6 » Typical Benefit: 0-1	» Maintenance Treatments + » Washing » Lubricating Bearings » Joint Repairs » Minor Concrete Repairs » Spot Painting	5-10 Years	$10-150
Preservation, Level 2	» Planned standard cyclical preservation activities on a single structure or group with limited improvement to the structural rating/condition of a bridge. » Typical Condition: >6 » Typical Benefit: 0-2	» Preservation Level 1 + » Full Painting » Waterproofing Membrane Replacement » Joint Replacement	5-20 Years	$150-250
Minor Rehab	» Elements in need of repair due to deferred maintenance on any part of a bridge. » May include repairs to multiple structural units. » Typical Condition: 5-6 » Typical Benefit: >1	» Preservation Level 2+ » Partial concrete deck repairs » Full deck replacement » Structural repairs, » General concrete repairs	20-30 Years	$250-500
Major Rehab	» Replacement of a structural unit, such as a pier, pier cap, or superstructure along with repair of other bridge elements. » Typical Condition: 5-6 » Typical Benefit: >2	» Minor Rehab+ » Superstructure replacement » Substructure replacement » Deck replacement » Significant steel or concrete repairs	30-50 Years	$500-1000+
Replacement	» Demolition and full replacement of a bridge. » Typical Condition: <5 » Typical Benefit: >3	» Major Rehab+ » Replacement of all structural components	50-75 Years	$750+

Exhibit 3.9 Estimated Average Bridge Treatment Cost Values

ELEMENT NAME	TREATMENT	COST PER	UNIT
Re Concrete Deck	Condition Improved	$ 25	Square Foot
Pre Concrete Deck	Condition Improved	$ 25	Square Foot
Pre Concrete Top Flange	Condition Improved	$ 25	Square Foot
Re Conc Top Flange	Condition Improved	$ 25	Square Foot
Steel Deck - Open Grid	Condition Improved	$ 100	Square Foot
Steel Deck - Conc Fill Grid	Condition Improved	$ 100	Square Foot
Steel Deck - Orthotropic	Condition Improved	$ 100	Square Foot
Re Concrete Slab	Condition Improved	$ 35	Square Foot
Timber Slab	Condition Improved	$ 120	Square Foot
Strip Seal Exp Joint	Replacement	$ 65	Linear Foot
Pourable Joint Seal	Replacement	$ 19	Linear Foot
Compression Joint Seal	Replacement	$ 70	Linear Foot
Assembly Joint With Seal	Replacement	$ 1,175	Linear Foot
Open Expansion Joint	Replacement	$ 25	Linear Foot
Assembly Joint Without Seal	Replacement	$ 1,175	Linear Foot
Other Joint	Replacement	$ 1,175	Linear Foot

Funding and Capital Program Information

The amount of funding available for each analysis year and projects that are already part of the planned program are captured as given inputs (they are not subject to review by the management system).

Analysis Tools

Network Optimization – The network optimization engine is run in "utility maximization" mode to select the combination of treatments that yield the highest benefit possible given the funding constraint. BrM creates a "Utility Score" to measure benefit. The utility score is a weighted combination of three categories of scores: bridge condition, risk, and life cycle cost. The life cycle cost score measures the future stream of costs that would accrue, given the action being evaluated. Actions with lower life cycle costs have higher life cycle cost scores. The risk scores capture non-condition characteristics that threaten the bridge's performance: channel condition and channel protection, vertical and horizontal clearances, load posting, scour criticality, fracture criticality, and waterway adequacy.

BrM uses the utility scoring functions and unit cost data and to calculate benefits and costs of each work candidate and eligible treatment alternative for each asset and each analysis year. The benefit of an alternative is measured as the change in utility compared to a do-nothing alternative. The benefit is scaled by a structure weight formula that scales up the benefit value for bridges with (1) higher AADT, (2) longer detour length, (3) bridge condition category is "Poor".

BrM maximizes benefits using "incremental benefit-cost analysis", which orders alternatives from highest to lowest incremental benefit-cost ratio (i.e., change in benefit divided by change in cost) and moves down the list until all funding for the year is exhausted.

Life Cycle Cost Analysis – RIDOT uses the BrM Life Cycle Cost Analysis module to evaluate treatment options for an individual bridge. The module applies RIDOT life cycle policies to an individual bridge to calculate, for a given initial treatment alternative, the full costs over the remaining design life of the bridge (typically 75 years).

Risk

Some aspects of risk are accounted for within the BrM modeling, namely those conditions that have risk scores. For example, actions that remove inadequate clearances and actions that address the scour rating register benefits by increasing the utility score. The risk score addresses the likelihood aspect of risk measurement. The structure weight formula captures the consequence side of risk measurement. The structure weight formula scales up benefits higher for more critical structures, where criticality is measured by AADT and detour length.

3.2.2 Life Cycle Planning Practices

The description of BMS components presented above is focused on the database and analytical functionality of AASHTOWare BrM. It is important to note that BrM is a decision-aid tool, not a decision-making tool. RIDOT bridge managers apply engineering expertise with regard to considerations like constructability and also accommodate other relevant considerations. These can include, for example, conflicts or synergies with other projects in the vicinity and other project benefits that might not be accounted for in BrM. These needs and benefits may include certain aspects of enhanced safety; improved mobility; and increased resilience in the face of hazards such as extreme weather, and increased vehicle loads, among others.

How are Potential Bridge Asset Management Projects Identified?

1. BrM network optimizer modeling – The network optimization described above identifies bridges that should receive treatments, what those treatments should be, and when they should be applied. These recommendations are then given closer evaluation by bridge Subject Matter Experts. Other considerations such as conflicts or synergies with other construction in the vicinity, other needs that may be met by the project, will factor into whether the work is advanced.
2. Needs elicited based on bridge subject matter experts (SME) augmentation of BrM project lists, as well as maintenance crew or public-identified issues.
3. Critical finding needs identified as part of inspections or emergent circumstances (e.g., extreme weather).

New bridge construction projects (i.e., constructing a bridge where one did not exist before—a rare occurrence in Rhode Island) do not originate in the Bridge Management System. They are initiated in from other transportation planning process. New bridges are added to the database and modeled within BrM after they are completed.

Up until recently, the bridge program was comprised of almost exclusively rehabilitation treatments, with only limited application of preservation treatments (e.g., painting). RIDOT found that many bridges were deteriorating to Poor condition before their designed lifespan. With the fairly recent increase in resources allotted to bridge management, RIDOT has been able to make more use of preservation treatments, thus allowing more bridges to reach their designed lifespans.

These preservation treatments are being performed on bridges currently in Good condition or at the "high end" of Fair, and not typically on those in Poor condition or at the "low end" of Fair unless there is a specific element causing the lower rating and the rest of the structure is in better overall condition. Additionally, these additional preservation treatments (e.g., painting, scour countermeasures, steel preservation) have been incorporated into BrM allowing RIDOT to understand the impacts upon a structure's performance in near real-time.

A shift into a more optimal (life cycle cost-minimizing) balance of preservation versus rehabilitation and reconstruction is not possible until RIDOT makes more progress in reducing its substantial backlog of bridges rated as Poor.

How does Life Cycle Planning account for Extreme Weather and Sea Level Rise?

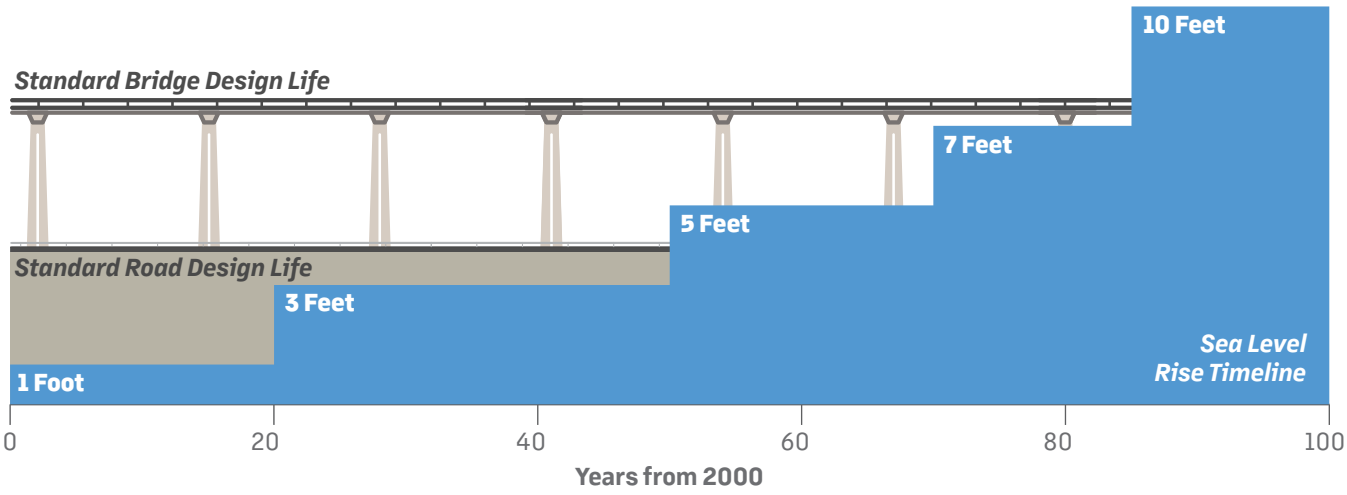
High water events, whether from flooding alone or flooding exacerbated by sea level rise, pose the risk of severe undermining of bridge foundations from scour. Culverts are also subject to scour and other damage from high water events. RIDOT has produced mapping tools that identify areas vulnerable to flooding, bridges vulnerable to sea level rise, and areas that have experienced repeated issues to isolate the identification of challenges and apply the appropriate measures; these factor into project prioritization during the development of the STIP.

Bridges that are identified as vulnerable to sea level rise are combined with other items as a project at that location or targeted as a potential resiliency project. RIDOT has made great progress in incorporating extreme weather, resilience into its asset management practices by the development and implementation of these mapping efforts. In the past, projects were being planned, then mapped, in comparison to mapping vulnerabilities, incidents, and events ahead of planning projects to better inform the asset life cycle management. There are pilot projects in place with towns that are experiencing the effects of extreme weather and climate hazards to identify mitigation actions and future decision making.

RIDOT is enhancing its scour plan of action to add plans for mitigation measures; a plan of action for monitoring measures is already in place.

Major renewals and replacements are designed for expected future conditions, which includes expected water levels and traffic loadings.

Exhibit 3.10 Asset Design Life Cycles vs. Sea Level Rise



There are multiple units within RIDOT addressing extreme weather and climate hazards. The stormwater management unit is responsible for extreme weather mitigation. The unit conducts hydraulic and hydrologic analyses to identify upgrades to the drainage system where needed. For more details, see Chapter 4.0 Risk Management.

3.2.3 Life Cycle Planning for NHS Bridges not owned by RIDOT

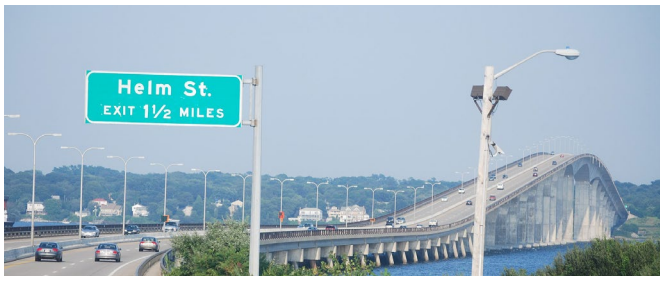
Rhode Island Turnpike and Bridge Authority (RITBA)

RITBA is responsible for maintaining 14 bridges and 1,568,294 ft^2 of deck area, 24% of the total NHS in Rhode Island. All RITBA structures rated Good or Fair in 2021. 97% of the deck area under RITBA's management is comprised of four large bridges connecting Aquidneck Island and Concanicut Island to the rest of the state.

Exhibit 3.11 Major Structures Owned and Operated by RITBA

Claiborne Pell Bridge
Year Built: 1969
Deck Area: 607,392

Sakonnet River Bridge
Year Built: 2012
Deck Area: 212,910



Jamestown-Verrazzano Bridge
Year Built: 1992
Deck Area: 544,122

Mount Hope Bridge
Year Built: 1929
Deck Area: 154,484

RITBA follows a well-established process to maintain a state-of-good-repair:

- A robust bridge inspection program that is complaint with FHWA standards including scour monitoring, underwater inspections, and regular reviews of inspections findings to identify action items;
- A comprehensive approach to identifying and programming larger preservation and rehabilitation projects in a Capital Program; and
- A new strategy of pursuing Federal grants to address key bridge needs or expedite the programming of projects.

Once an inspection is completed, RITBA reviews reports with consultants to support to confirm findings and prioritize needs. Critical findings are addressed as soon as practicable. Less critical findings can be scheduled to be addressed in later months or years by in-house crews, and findings that require further investigation, crew capacity, or funding become candidates for the Capital Program. Routine maintenance activities and those in response to inspection findings are logged in an activity reporting tool. In addition to responding to inspections, RITBA also identifies preservation and rehabilitation projects to maintain a state-of-good-repair and to preempt expensive deterioration.

RITBA's has recently secured an $82.5 million Federal grant to rehabilitate the Newport Pell Bridge, supporting a partial-depth deck replacement and the installation of a dehumidification system for cables and anchorages to prevent corrosion and extend the bridge's useful life. RITBA may pursue additional grants

authorized under the IIJA to accelerate additionally preservation projects to earlier years, including implementation of dehumidification measures on the Mount Hope Bridge.

An update of RITBA's 10-year Capital Program is anticipated in Fall 2022. Funding levels are not expected to be substantially different than those that have sustained a state-of-good repair on RITBA's bridges to this point. The updated Capital Program also highlights projects beyond the 10-year horizon to begin to communicate longer-term capital needs.

Other Owners

Other NHS bridge owners include municipal highway agencies, airport and development entities, as well as Federal and private entities. RIDOT works closely with other NHS owners to track the condition of their assets, and ensure their bridges remain serviceable.

3.3 Investment Strategies for NHS Bridges

RIDOT's bridge investment strategies are guided by the Office of Bridge Engineering's three stated objectives:

1. Design, preserve, and maintain resilient bridges and culverts
2. Minimize the number of load-posted, load-restricted, and closed bridges
3. Reduce the percentage of NHS bridges in Poor condition to less than 10% by the end of 2025 (to meet the NHPP requirement).

The Office of Bridge Engineering uses various bridge management system tools to implement life cycle planning and formulate its investment strategy for the NHS. The details of the system (namely BrM supplemented by institutional knowledge and business processes) are summarized in Section 3.2; however, to support decision-making, different funding scenarios have been modeled within BrM for the TAMP.

3.3.1 Performance Modeling and Gap Analysis

RIDOT Office of Bridge Engineering applied the following three funding scenarios within the BrM network optimization module to estimate resulting network performance (Percent Good/Fair/Poor by deck area) for each year of the TAMP analysis period, 2022-2031.

Exhibit 3.12 Funding Scenarios for NHS Bridges

SCENARIO	DESCRIPTION
Optimal Performance	Prioritizes achieving and maintaining a state of good repair for all NHS pavement assets.
Planned Performance	Reflects the Department's currently planned and projected investment levels based on committed construction and line-item funding established in the STIP. The allocation of this planned funding among the FHWA work types (maintenance, preservation, rehabilitation, and reconstruction) is presented in Chapter 5: Financial Plan.
Deteriorating Performance	Reflects a $0 investment level that would allow the conditions of the State's bridge network to deteriorate. This scenario is unlikely and is therefore only included as a worst-case scenario.

The conditions of the TAMP (i.e., NHS) bridges are modeled as part of the full network of bridges, consistent with RIDOT's approach to managing its bridges regardless of their NHS designation. Conditions of TAMP bridges are pulled out and subtotaled to create the performance results for the NHS. RITBA bridges are not subject to modeling for treatment alternatives within the network optimizer. RIDOT adds in RITBA NHS bridge deck area to the other NHS deck area with the assumption that the RITBA will apply the resources needed to maintain these bridges in Fair condition throughout the analysis period.

Exhibit 3.13 Forecasted Performance for Investment Strategy Scenarios for NHS Bridges, 2022 and 2031

SCENARIO	TOTAL COST ($MILLION)	%GOOD		%POOR	
		2020	2031	2020	2031
Optimal Performance	$3,878	17.1%	48.7%	19.1%	1.4%
Planned Performance	$2,736		43.7%		5.1%
Deterioration Performance	$0		7.7%		24.8%

Exhibit 3.14 shows the estimated percentage of the NHS bridge network in a State of Good Repair (Good or Fair condition) for each of the investment scenarios along with the RIDOT performance objective of greater than 90% in a State of Good Repair. The investment dollar amounts shown are annual averages for the entire RIDOT bridge program, including spending on non-NHS RIDOT bridges, but excluding RITBA spending.

Exhibit 3.14 NHS Bridge Investment Scenarios—Percent in a State of Good Repair

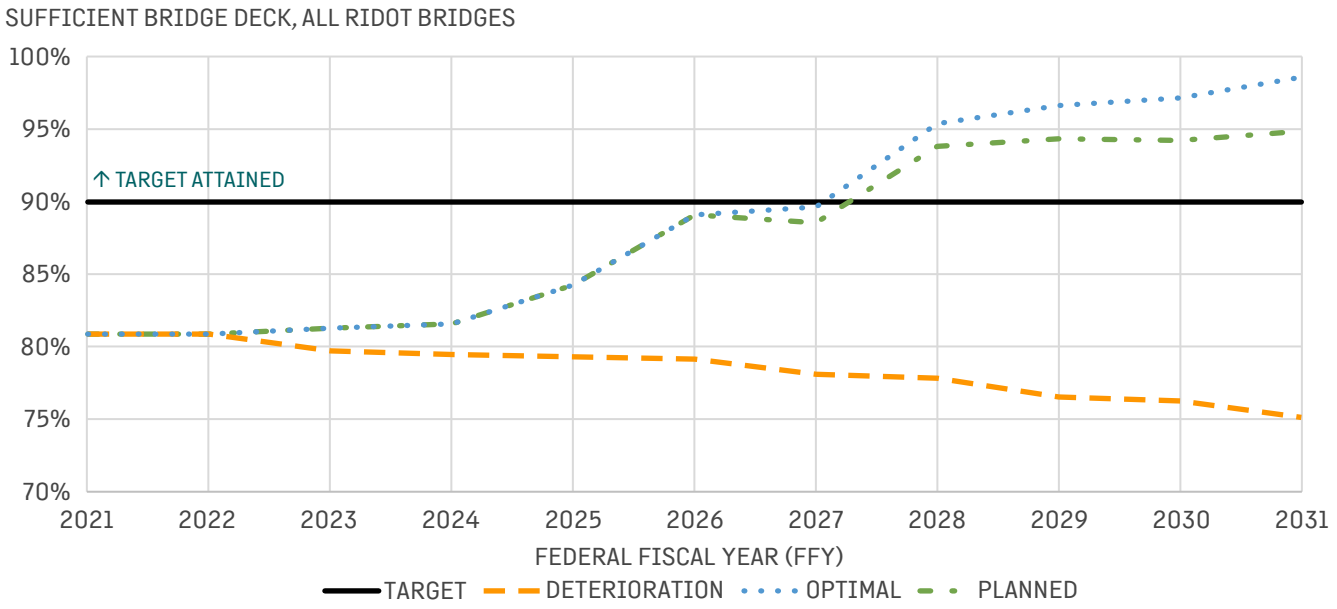


Exhibit 3.14 reveals a performance gap between the CY2022 baseline of 80.9% in a State of Good Repair and the performance objective. Furthermore, performance has been increasing since 2020 and is expected to further increase, with RIDOT meeting the 90% target threshold in 2028 under the Planned and Optimal scenarios. Under the Deterioration scenario, RIDOT will see performance degrade over time, remaining below the target throughout the analysis period.

Because it takes several years to develop a bridge rehabilitation or replacement project, the early years of the TAMP analysis period are limited to projects that are already programmed. This limitation, combined with the two-year lag from funding to recorded performance benefits, is reflected in the overlap of the Planned and Optimal scenarios in the years 2022-2026.

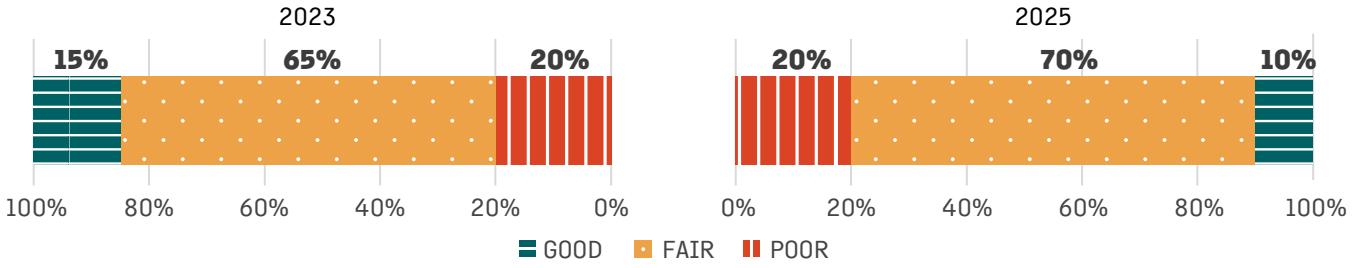
3.3.2 NHPP Two and Four-Year Targets

Under FHWA Rule, section 490.407(c), States must establish and demonstrate progress in meeting two- and four-year targets for the percentage of NHS deck area rated Good and rated Poor (no targets are required for Fair, though it can be derived from the other two). Bridge conditions in the next four years are beyond the discretion of project selections that can be made in the present; they are determined by projects that will be completed within less than four years, which means they will have been initiated in the past year or past several years. Large complex bridge projects can take many years from need identification to completion. RIDOT examined its bridge modeling performance results for the planned performance scenario to select the targets shown below in Exhibit 3.15. The targets reflect that RIDOT funding and past life cycle planning practices have put TAMP bridges on a path towards achieving the state's State of Good Repair goal.

Exhibit 3.15 Baseline Condition and Performance Targets for NHS Bridges

CONDITION MEASURE	BASELINE (CY2021)	TWO-YEAR (CY 2023)	FOUR-YEAR (CY 2025)	LONG-TERM GOAL
Percent Good, by Deck Area	16.14%	20.5%	24.5%	≥90%
Percent Fair, by Deck Area*	67.41%	64.0%	64.4%	
Percent Poor, by Deck Area	16.44%	15.5%	11.1%	<10%

*Not explicitly a target, but imputed from the combination of targets for Good and Poor.



3.4 Bridge Process Improvement

As discussed throughout this chapter, RIDOT has made great strides in improving its bridge management and asset management processes. Since the 2018 TAMP, RIDOT has strengthened the interconnectivity of its work-flow management; and made great strides towards improving and maintaining Rhode Island's NHS bridges in a state of good repair. RIDOT has already refined its deterioration models, expanded its bridge preservation activities, and defined new processes to ensure its bridges are being safely and efficiently maintained. However, the Department has identified several opportunities for continued growth and improvement over the next several years.

Implementing Updated Bridge Inspection and Management Standards

FHWA has issued rulemaking updating bridge inspection and data management/reporting standards under 23 CFR §650. The Department has completed a point-by-point assessment of work and changes to procedure that will be required in order to comply with the new rules. High-priority items include:

- **Clarification of ownership and responsibilities among entities |** The new rules require new written agreements for bridges that cross state lines or jurisdictional borders within Rhode Island, documenting which entity is primarily responsible for inspection and tracking. RIDOT is pursuing these agreements with Connecticut, Massachusetts, RITBA, and others.
- **Expansion of the NBI to new structures |** Structures required for inclusion on future editions of the NBI include privately-owned bridges connected to a public road on both ends, temporary bridges, and bridges under construction. RIDOT is required to either inspect these structures or to "cause them to be inspected".
- **New record-keeping |** On the human side this includes records for inspector skills, qualifications, and reporting lines. On the structure side this includes scour appraisals, inspection frequency, and weight posting.

Data Systems and Tools

RIDOT has linked AASHTOWare BrM to its VUEWorks maintenance management system to feed life cycle planning information directly into work orders. The next step in this integration is to allow data to flow in the opposite direction, allowing work reports in VUEWorks to update the BrM database.

Knowledge and Skills Management

While RIDOT has strong institutional knowledge, there is a need to retain that knowledge in face of a changing workforce. RIDOT would like to develop new bridge maintenance positions with specialties and artisan skills, including steelwork, masonry, joint repair, and painting. Furthermore, RIDOT intends to work with labor unions to develop function-based training for bridge preservation activities beginning in Winter, 2023.

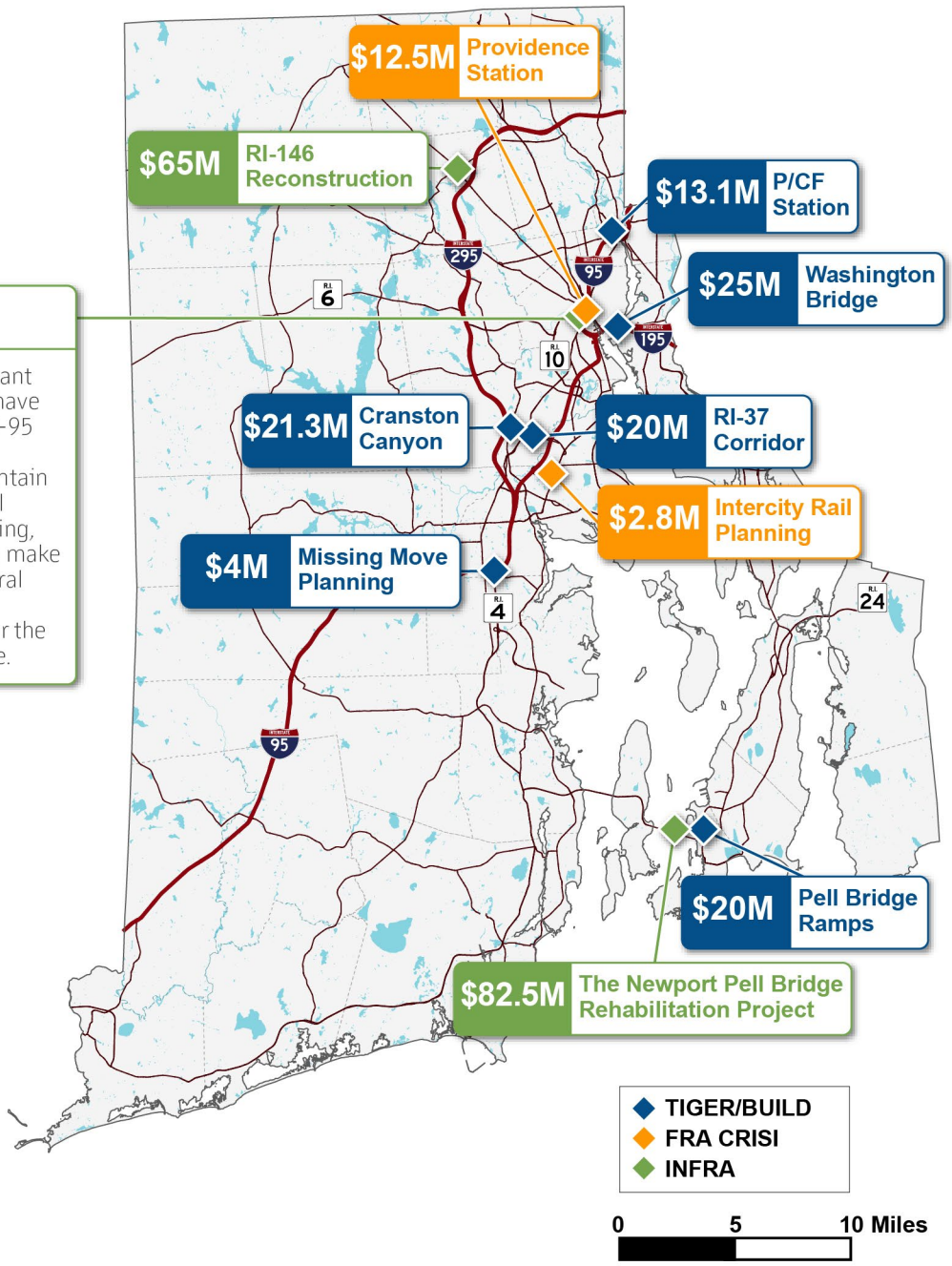
FOCUS ON: Federal Discretionary Grants

RIDOT started aggressively pursuing discretionary Federal grants in 2016 for projects where the funding would drastically improve the final product.

Since 2016, RIDOT has won **13 grants**, setting a **national standard for a small state**.

$60.4M I-95 NB Viaduct

For example: absent grant funding, RIDOT would have needed to rebuild the I-95 viaduct in Providence in-kind in order to maintain mobility on this critical artery. With grant funding, RIDOT has been able to make geometric and structural improvements to fully prepare the highway for the next 75 years of service.



4. RISK MANAGEMENT

Accounting for uncertainty is essential to objective asset management. This chapter establishes RIDOT's key risk management strategies and discusses risks that directly cause asset damage, interrupt service, or hold the Department back from implementing its NHS pavement and bridge programs and meeting its performance objectives and targets. The chapter closes with a discussion of vulnerable assets that satisfies 23 CFR Part 667: "*Periodic Evaluation of Facilities Repeatedly Requiring Repair and Reconstruction Due to Emergency Events.*"

What is Risk?

Federal regulation defines risk as "the positive or negative effects of uncertainty or variability upon agency objectives."[2]

Major risks to NHS bridges and pavement may include environmental conditions, financial risks like budgetary uncertainty, operational risks like asset failure, and strategic risks like compliance challenges.

A reference guide for Federally-required elements of a TAMP Risk Management Plan is provided in Exhibit 4.1.

Exhibit 4.1 Reference Guide: FHWA Requirements for a Risk Management Plan

ITEM	DESCRIPTION	PAGE
Section 4.1	Identification of risks that can affect condition of NHS pavements and bridges and the performance of the NHS	p. 41
Section 4.2	An assessment of the identified risks in terms of the likelihood of their occurrence and their impact and consequence if they do occur	p. 42
Exhibit 4.4	An evaluation and prioritization of the identified risks (Risk Register)	p. 43
Section 4.4	An approach for monitoring and plan for mitigating the top priority risks	p. 48
Section 4.5	Summary of the evaluations of facilities repeatedly damaged by emergency events carried out under part 667 of this title that discusses, at a minimum, the results relating to the State's NHS pavements and bridges	p. 49

In general, the RIDOT enterprise risk management process is top-down. Senior Leadership monitor principal risk categories and solicit input and support from managers and staff to inform strategic decisions using the framework in Exhibit 4.2.

[3] https://www.ecfr.gov/current/title-23/chapter-I/subchapter-F/part-515

Exhibit 4.2 Framework for Risk Management at RIDOT

4.1 Identification of risks that can affect condition of NHS pavements and bridges and the performance of the NHS

In May 2022, RIDOT's Division of Planning hosted an Asset Management Risk Workshop which included representation from the Offices of Capital Programming, Asset Information Systems, Pavement Engineering, Bridge Engineering, Stormwater Management, Project Management, and Traffic Safety.

The group developed a risk register that includes three risk tiers:

- **Asset Risks** involving damage to bridges, pavement, tunnels, and pedestrian ramps and can pose a direct danger to travelers. Examples include weather (extreme and routine), natural disasters, vehicle impacts, and damage from failure of co-located assets, such as drainage and utilities.
- **Program Risks** impacting RIDOT's ability to deliver projects and meet program performance objectives. These include organizational and systemic inefficiencies, data and technical limitations, and cost variability of labor and materials.
- **Department Risks** affecting RIDOT's ability to perform its basic functions and serve its customers. These may include revenue and staffing/skills uncertainty.

Following the completion of the Risk Workshop, a list of identified risks were circulated for comment and edited for clarity.

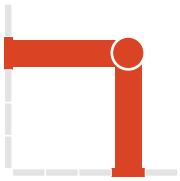
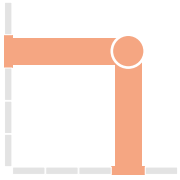
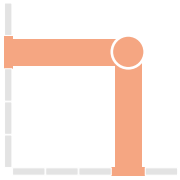
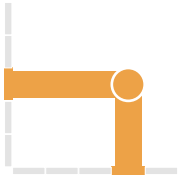
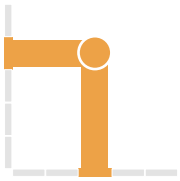
4.2 Evaluation and Prioritization of Identified Risks

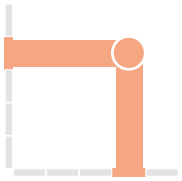
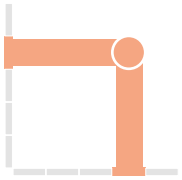
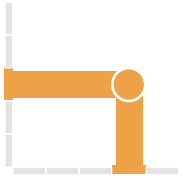
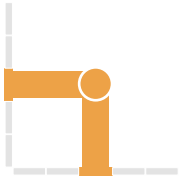
Risks were prioritized using the risk matrix below, such that the potential consequences of each risk are determined by the simple formula Impact x Likelihood = Consequence, as shown in Exhibit 4.3. The risk register in Exhibit 4.4 lists each risk in order of consequence.

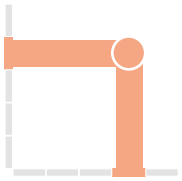
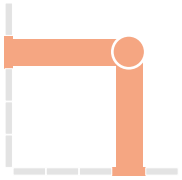
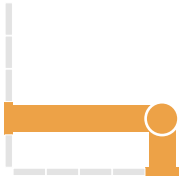
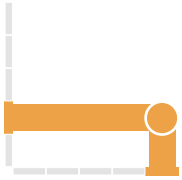
Exhibit 4.3 Risk Consequence Matrix

	LIKELIHOOD		UNLIKELY	POSSIBLE	LIKELY	ALMOST CERTAIN
	IMPACT	DESCRIPTION	THE EVENT COULD POSSIBLY OCCUR, BUT IS UNLIKELY AT THIS TIME.	THE EVENT COULD OCCUR UNDER SPECIFIC CONDITIONS AND SOME OF THOSE CONDITIONS ARE CURRENTLY EVIDENCED.	THE EVENT IS MOST LIKELY TO OCCUR IN MOST CIRCUMSTANCES.	THE EVENT IS EXPECTED TO OCCUR IN MOST CIRCUMSTANCES OR IS HAPPENING NOW.
IMPACT	**Catastrophic**	Potential for multiple deaths & injuries, substantial public & private cost.				
	Major	Potential for multiple injuries, substantial public or private cost and/or foils agency objectives.				
	Moderate	Potential for injury, property damage, increased agency cost and/or impedes agency objectives.				
	Minor	Potential for moderate agency cost and impact to agency objectives.				
	Insignificant or Neutral	Potential impact low and manageable with normal agency practices.				

Exhibit 4.4 RIDOT Risk Register

ASSET RISKS			
RISK		MITIGATION LEAD	MITIGATION ACTION
Climate change contributes to more significant coastal sea-level rise, riverine flooding, drainage issues, and accelerated asset deterioration. Consequence: *Very High*		Bridge/Pavement Engineering	Leverage geospatial tools and inspection reports to identify at-risk assets.
		Planning	Work with municipalities to identify alternatives for climate change mitigation.
		Stormwater	Invest $100M over 10 years to improve Stormwater Quality and ensure compliance with Clean Water Act.
		Stormwater	RIDOT Planning and Stormwater are partnering to work through the PROTECT guidance and identify opportunities to accelerate major drainage projects to reduce flooding risk around the state.
		ITS	Incorporate emissions-reduction technology into capital projects during planning stage.
Poor materials or maintenance lead to unexpected asset deterioration. Consequence: *High*		Bridge/Pavement Engineering	Increase frequency of pavement coring, inspection, and evaluation.
		Planning	Increase funding dedicated to preservation and maintenance activities.
		Planning	Improve pavement management processes to direct additional funding towards routine treatments and triage.
		Project Management	Closely monitor materials used by contractors during construction, punch list, and closeout processes.
Inadequate drainage leads to water damage on pavements and bridges. Consequence: *High*		Stormwater Management	Per the Consent Agreement, direct $10 million per year to stormwater management and drainage projects.
		Planning	Integrate stormwater management and drainage into capital projects, either through an expanded scope or an "immediate needs" contract.
		TIP Working Group	Coordinate drainage and stormwater management work and make high-level decisions.
		Bridge Inspection Team	Report inspection findings weekly to Planning in order to coordinate immediate response if needed.
Strikes by vehicles or equipment damage pavements and bridges. Consequence: *Medium*		Bridge Engineering	Identify locations for overhead sensors during inspection.
		Traffic Safety	Manage overhead sensor installation contracts.
		Customer Service	Receive public feedback about damage to the network and route that information within the Department.
		Planning	Ensure funding is available for overhead sensor installation.
A sudden weight posting closes a significant bridge to truck traffic. Consequence: *Medium*		Bridge Engineering	Conduct regular inspections of high-impact bridges.
			Partner with State Police to ID overweight vehicles
		Planning	Increase inspection frequency in response to inspection reports.
		TIP Working Group	Coordinate response to pressing issues.

PROGRAM RISKS			
RISK		MITIGATION LEAD	MITIGATION ACTION
The price/availability of labor and materials is unpredictable. Consequence: *High*		Project Management	Include cost estimation parameters in the Blue Book.
		Project Management	Ensure that line items and action change orders are reasonable and necessary.
		Planning	Make funding adjustments to accommodate budget fluctuations
Observed asset conditions and needs change as projects are funded and designed. Consequence: *High*		Bridge Engineering	Review the draft bridge work program in BrM to confirm that modeled deterioration aligns with recommended treatments.
		Planning	Increase funding for preservation activities and establish mechanisms to address a wide variety of needs, including state-funded preservation, Federally-funded preservation, and immediate needs funding to respond to critical findings from inspection.
		Payment Engineering	Increase frequency of pavement field inspection and regular monitoring of asset conditions to anticipate cyclical fluctuations in performance.
RIDOT sees political pressure to divert funding from its stated priorities. Consequence: *Medium*		Planning	Communicate the extent and scale of the challenge in maintaining pavement and bridges through presentations to local advisory councils and stakeholder groups.
		Planning	Increase outreach to towns to anticipate future local needs and work them into pre-existing projects.
		Senior Leadership	Coordinate the Department's needs with the General Assembly, Governor's Office, and other stakeholders in the state budget process to secure the resources required to deliver on the Department's asset management objectives.
Environmental requirements are uncertain or change (e.g., endangered species). Consequence: *Medium*		Planning and Environmental	Give advance notice of projects to the Environmental Division to investigate environmental constraints and revise project scopes years ahead of design and construction. By integrating environmental elements earlier, the Department can develop more reliable budgets and schedules.
		Environmental	Publish and maintain a Stream Crossing Manual and stormwater control plans.
		Environmental, Cultural Resources, Natural Resources	Monitor Federal regulations and changing conditions to minimize disruptions in the project development process.

DEPARTMENT RISKS			
RISK		MITIGATION LEAD	MITIGATION ACTION
RIDOT sees uncertainty in Federal and State funding and guidance. Consequence: *High*		TIP Working Group	Follow legislative changes both through interpersonal connections, legislation tracking software, and weekly meetings to coordinate Department-wide responses.
		Senior Leadership	Keep an open line of communication with the FHWA Rhode Island Division Office to seamlessly implement regulatory changes, authorize new funding, and meet all federal requirements on capital projects.
Concurrent projects conflict with one another causing traffic delays or coordination issues. Consequence: *High*		Process Stakeholders as in Ex. 1.2	Evaluate the geographic distribution of projects before programming them to minimize overlapping work zones.
		Planning	Maintain a Corridor Projects Program in the STIP to manage co-located projects together.
		Planning and Project Management	Create "bundles" of capital projects to reduce the number of unique contracts, teams, and variables to manage around the state.
		Traffic Management Center	Monitor travel delays and install equipment to notify the public of changes in traffic patterns.
		Construction Management	Maintain map service of ongoing projects, personnel, and key contacts to efficiently and safely manage work zones and contractors.
Data systems (e.g., servers) fail or are isolated from one another. Consequence: *Medium*		Asset Information Services Team	Migrate systems to Amazon Web Services (AWS) in partnership with Rhode Island State IT.
		Asset Information Services Team	For systems that cannot be migrated to AWS, use IIJA funds to purchase new centralized servers.
		Asset Information Services Team	Develop the Statewide Intake Framework for Transportation (SWIFT) with the long-term goal of facilitating project submission from municipalities, project scoring, and project management.
		Asset Information Services Team	Maintain a data warehouse as a redundant access point for mission-critical information from multiple best-of-class systems.
RIDOT struggles to hire, retain, or replace knowledgeable staff. Consequence: *Medium*		Rhode Island Division of Human Resources	Ensure that starting salaries, cost-of-living adjustments, and retention bonuses are competitive with DOTs in neighbor states.
		Senior Leadership	Post high-turnover roles at RIDOT on a rolling basis with no defined application deadline to encourage applicants at all times of the year.
		RIDOT	Participate in construction and engineering industry career days.
		RIDOT	Maintain apprenticeship programs in partnership with the Construction Industries of Rhode Island (CIRI).

4.3 Mitigation Plan for Top Priority Risks

Exhibit 4.4 listed mitigation actions underway to manage all of RIDOT's risk factors. But for the top-priority concern in each category, planning for the future helps the Department reduce exposure and build towards a more resilient future. This section summarizes plans and proposed next-steps to remediate top-priority risk factors over the next four years.

4.3.1 Principal Asset Risk: Environmental Resiliency

Rhode Island has 400 miles of coastline and large inland watersheds, leaving its infrastructure vulnerable to the impacts of Climate Change. Riverine flooding, sea level rise, and storm surge pose serious threats to the efficient management of key assets' life cycles, especially in coastal communities like Bristol, Newport, Jamestown, and Warren. Extreme storms are also becoming more frequent, threatening the whole state. In 2022 alone, Providence experienced its snowiest day on record, and two separate late-summer floods that shut down portions of I-195, I-95, and US-6/RI-10 for several hours.

RIDOT has the following plans to make Rhode Island more resilient:

- **Research:** RIDOT has partnered with the Harvard Kennedy School (HKS) to develop a matrix of environmental resiliency treatment options for vulnerable assets. Future SPR projects will advance this matrix to create a set of planning tools for the state and local communities to leverage in transportation planning.
- **Planning:** Beginning in 2023, RIDOT will advance a Carbon Reduction Plan (CRP) to expand resiliency efforts and comply with IIJA requirements. RIDOT and the Division of Statewide Planning (RIDSP) are currently collaborating to expand the scope of services supporting the Statewide Travel Demand Model to conduct mesoscale analyses documenting the impact of RIDOT projects on greenhouse gas emissions. RIDOT is also considering adopting a Resilience Improvement Plan (RIP) to support USDOT's objectives under the PROTECT Program.
- **Mapping:** RIDOT is integrating GIS data on stormwater with its larger GIS platform to incorporate drainage, water quality, and stormwater treatment elements into capital projects. When fully implemented, this will reduce the risk of budget and schedule overruns while reducing pollution from runoff and constructing a resilient transportation system.
- **Technology:** Since 2019, RIDOT and RIDSP have collaborated with Esri to develop the Statewide Intake Framework for Transportation (SWIFT), a digital portal to manage transportation project proposals. SWIFT contains a "Project Readiness" module which leverages geospatial data to flag items of complexity for applicants, including sea-level rise. Expected to be fully deployed by 2024, SWIFT will completely digitize the project intake workflow and inform more reliable schedule estimates informed by asset management data.
- **Investment:** RIDOT has expanded its investments in congestion mitigation and greenhouse gas emissions reduction and will continue to do so. In 2022, RIDOT deployed IIJA funds to create new programs integrating

advanced technologies into capital projects and support modeling initiatives at the project, local, and state levels. Projects have already begun to reduce congestion at 44 locations around the state and resurface miles of shared-use path across the state, supporting greener forms of transportation. And, of course, RIDOT is committing more than $100 million over a 10-year period to ensure compliance with the Clean Water Act and a number of remedial measures under a consent decree with the Environmental Protection Agency (EPA).

4.3.2 Principal Program Risk: Price Variability

RIDOT must monitor the cost fluctuation of construction inputs and maintenance materials, in particular steel, asphalt, and diesel fuel. RIDOT limits variability on steel and fuel prices without a change order to 5% of the budgeted amount, but change orders may be sought both up and down. In addition, RIDOT sees price variability as a result of scoping failures such as unexpected site conditions; quantity adjustments for labor and materials; and unbuildable design proposals.

To ensure that projects remain on-budget, RIDOT will:

- **Track Data:** Through the Department's Project Management Portal (PMP), weighted average unit prices (WAUP) of key resources are tracked over time. WAUP serves as a baseline for RIDOT, which adjusts estimates using engineering judgment to account for non-contractor costs (such as project management) and inflation. The Department will continue to coordinate the use of WAUP data to update and improve scoping tools and estimates to anticipate financial difficulties brought on by price volatility. In addition, RIDOT is developing a successor system to PMP that will incorporate new functionality for electronic document storage and approval workflow tracking.
- **Bundle Projects:** The Divisions of Planning and Project Management have begun to meet regularly to coordinate the combining of projects by work type and location to lower administrative costs and achieve economies of scale.
- **Refine Pre-Scoping:** RIDOT has established a pre-scoping process managed by the Division of Planning. On-call consultants assess the scope and needs of capital projects (RIDOT prepares preservation scopes in-house), generate a quantity-based cost estimate, produce a photo gallery of existing conditions, and develop a readiness matrix of risks to inform the project schedule. As a result, RIDOT's scoping teams now begin engineering, design, and permitting work from a more informed position, and RIDOT can make more reliable estimates of project costs. The Department will continue to refine this process and evaluate projects several years in advance of planned design timelines to improve project delivery.

4.3.3 Principal Department Risk: Funding Constraints

Shortfalls in funding are RIDOT's most critical risk. Decades of underfunding and insufficient planning have left needs far outpacing available funds, even with the historic increase in federal funding enabled by the IIJA. RIDOT has taken several steps to mitigate uncertainty in Federal and State funding levels, and will continue to do the following over the next four years:

- **Federal Funding Risk Mitigation:** RIDOT recognizes the benefits that can be realized through major investments like the Infrastructure Investments and Jobs Act (IIJA), but funding is rarely stable for more than a few years at a time. RIDOT works closely with regional and national partners to lobby for positive long-term solutions to potential shortfalls. In addition, RIDOT works to maximize its share of Federal funding by:
  - ***Applying for Grants:*** RIDOT maintains a pipeline of under-funded grant-eligible projects to ease the application process for discretionary funding when a Notice of Funding Opportunity (NOFO) is issued.
  - ***Staying Prepared for Additional Funding:*** RIDOT maintains a running list of executable projects to maximize the utility of August Redistribution funds and, in recent years, allocation of Bridge Rehabilitation and Reconstruction through annual THUD appropriations.
  - ***Efficiently Maintaining Contracts:*** RIDOT's Project Management Division works to ensure that projects are completed on-time, and on-budget. When projects are completed under budget, the Divisions of Planning and Financial Management coordinate to close out contracts and free up unused federal funds for future deployment.
- **State Funding Risk Mitigation:** RIDOT does not have capital funding sources dedicated by statute and therefore must consistently lobby at the state level to compete for resources. The Department is reducing its exposure to state funding shortfalls by:
  - ***Evaluating Alternatives to Fuel Tax Dependency:*** The gas tax revenue that funds RIDOT operations is projected to fall due to improving fuel economy of vehicles. RIDOT is evaluating alternative funding streams to ensure its operations remain fully funded even as fuel consumption patterns change.
  - ***Demonstrating the Impact of Transportation Investment:*** RIDOT relies on Rhode Island Capital Plan (RICAP) funds to matching Federal formula distributions, but RICAP is only available as a spillover from the State's Rainy Day Fund, The Department is working to demonstrate the impact of transportation investment by tracking several key metrics in its Quarterly Report, including bridge condition improvements, safety metrics, and transit ridership.

4.4 Approach for Monitoring Top Priority Risks

RIDOT coordinates its enterprise risk management and monitoring efforts through two regular meetings including staff and managers from across the Department. Both meetings were established to implement the 2019 TAMP Objective of "Coordinating Effectively Across Divisions."

- **Recurring Asset Stakeholder Meetings**
  - **TIP Working Group:** A management-level, interdisciplinary weekly meeting including representation from Planning, Project Management, AMEs, Financial Management, Transit, Safety, and Real Estate. Agenda items include anything that impacts financial planning, programming, federal legislation, or project development.
  - **RhodeWorks Meetings:** An executive-level weekly meeting to pick up issues that cannot be resolved at the TIP Working Group and track progress on Department-wide initiatives.

Asset and Program-Level risks are typically resolved at the TIP Working Group, while Department-level risks are typically addressed at RhodeWorks. FHWA has recommended that RIDOT develop an action plan. This TAMP will serve as the basis for that action plan.

4.5 Vulnerable Assets (Part 667)

As required by the Final Rule, RIDOT has conducted a study of assets damaged in declared emergencies between January 1, 1997 and December 31, 2021, pursuant to 23 CFR Part 667. Specifically, the Department has:

- Identified the location of infrastructure repairs associated with emergency events declared by the Governor or President since January 1, 1997.
- Maintained the inventory of locations with every new declared event.
- For any locations damaged more than once, identified the root cause of the vulnerability and developed a mitigation strategy. RIDOT must complete this step before developing any new projects in these locations.

A list of declared emergency events in Rhode Island since 1997 is provided in Exhibit 4.5.

RIDOT has assessed that no assets were damaged by more than one of these events.

Exhibit 4.5 Declared Emergencies in Rhode Island, 1997-2022

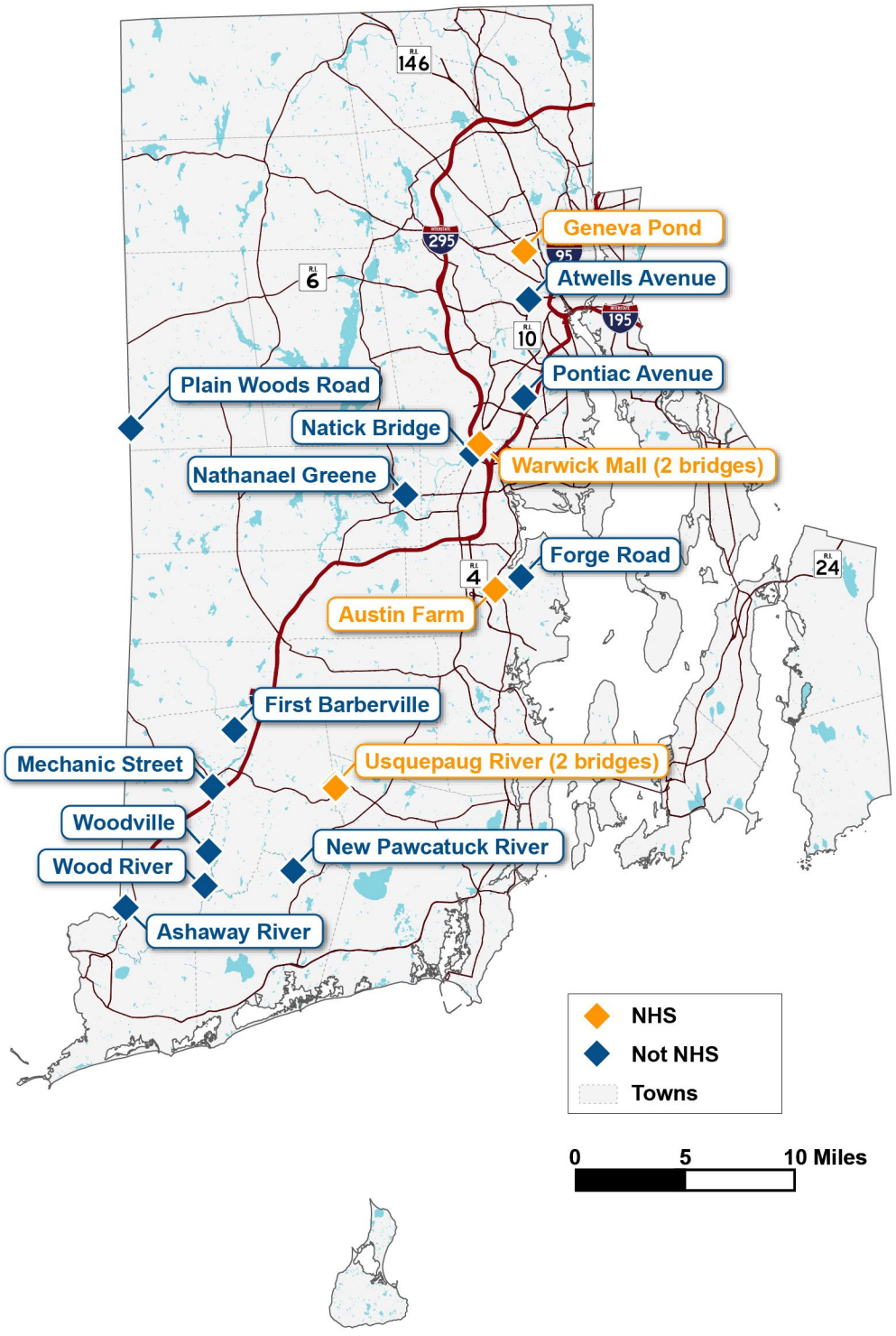
ID	DATE	TYPE
EM-3182-RI	March 27, 2003	Snowstorm
EM-3203-RI	February 17, 2005	Snowstorm
EM-3255-RI	September 19, 2005	Hurricane Katrina Evacuation
DR-1704-RI	May 25, 2007	Severe Storms, Inland and Coastal Flooding
EM-3311-RI	March 23, 2010	Severe Storms and Flooding
EM-3334-RI	August 27, 2011	Hurricane Irene
EM-3355-RI	October 29, 2012	Hurricane Sandy
DR-4107-RI	March 22, 2013	Severe Winter Storm and Snowstorm
DR-4212-RI	April 3, 2015	Severe Winter Storm and Snowstorm
EM-3440-RI	March 13, 2020	COVID-19
EM-3563-RI	August 21, 2021	Hurricane Henri
DR-4653-RI	January 28-29, 2022	Severe Winter Storm and Snowstorm

RIDOT's Office of Bridge Engineering maintains a "watch list" of bridges known to be threatened by Scour and Storm Surge events. Across the state, 107 bridges have been identified as Scour Critical, and 112 bridges are likely to be impacted by storm surges.

Ahead of extreme weather events, RIDOT dispatches maintenance and inspection personnel to strategic locations around the state close to the at-risk assets. Staff will wait out the storms in a safe location, then visit each bridge to conduct inspections assessing immediate damage to rectify any issues as quickly as possible.

A map of bridge locations impacted by the events in Exhibit 4.5 is provided in Exhibit 4.6.

Exhibit 4.6 Bridges Impacted by Declared Emergencies in Rhode Island, 1997-2022



FOCUS ON: Developing the STIP

Projects in the STIP are prioritized based on:

Asset Management. Does the project meet the asset management objectives specified in the TAMP? Projects that meet the TAMP objectives will:

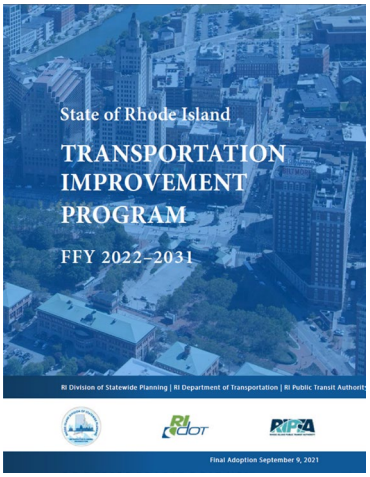
- Achieve and maintain a state of good repair for all of Rhode Island's transportation assets, beginning with NHS bridges and pavement
- Improve public safety by making safety improvements on state bridges and roadways

Project Readiness. Is it the right time to do the project based on asset conditions and needs? Projects that are ready:

- Have clear, well-defined permitting needs
- Have an agreed-upon scope and limits

Risk Level. Is the project low-risk, or are there significant risks associated with the project, such as potential exposure to environmental impacts? Projects that are low-risk will not be subject to:

- Sea-level rise and other environmental risks
- Extensive coordination with utility companies, Amtrak or other rail carriers
- Disturbing historic and/or cultural areas, assets, or districts
- Complex levels of environmental permitting
- Significant levels of archaeological investigation



Funding Availability. Is sufficient funding available to support completion of the project? For a project to be funded, there must be:

- The proper type of funding available to support the work required
- Enough funding to see a project to completion without interruption

Opportunity. Do extenuating circumstances present an opportunity to complete the project? Opportunities may include:

- Opportunities to utilize special funding from federal grants or other programs
- Collaboration and/or consensus with other stakeholders on project scope and delivery

Decision-Making Flowchart for STIP Investments

A project's inclusion in the STIP does not represent an allocation or obligation of funds. Project sponsors must work cooperatively with RIDOT, RIPTA, or the federal agencies to guarantee the federal funding identified in the STIP. The STIP may be revised after it is adopted.

5. FINANCIAL PLAN

A reference guide for Federally-required elements of a TAMP Financial Plan is provided in Exhibit 5.1.

Exhibit 5.1 Reference Guide: FHWA Requirements for a Financial Plan

ITEM	DESCRIPTION	PAGE
Exhibits 5.2 and 5.3	The estimated cost of expected future work to implement investment strategies contained in the asset management plan, by State fiscal year and work type.	p. 52
Exhibit 5.4	The estimated funding levels that are expected to be reasonably available, by fiscal year, to address the costs of future work types.	p. 53
Section 5.2	Identification of anticipated funding sources	p. 53
Exhibits 5.7 and 5.8	Estimate of the value of the agency's NHS pavement and bridge assets and the needed investment on an annual basis to maintain the value of these assets.	p. 59, p. 60

5.1 Cost of Future Work

This section summarizes planned spending between 2022 and 2032 for NHS pavement and bridges in FHWA's four categories of work. The information is drawn from the 2022-2031 STIP, represents RIDOT's consideration of uncertainty, risk, and vulnerability, and is informed by the life cycle management systems and processes described in the prior chapters.

Exhibit 5.2 shows the planned 10-year trend in spending on NHS pavement.

Exhibit 5.2 NHS Pavement Spending by FHWA Work Type, 2022-2031 (millions)

FHWA WORK	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	TOTAL
Maintenance	$10	$10	$10	$11	$11	$11	$11	$11	$11	$11	**$107**
Preservation	$15	$13	$5	$11	$11	$11	$11	$11	$11	$11	**$107**
Rehabilitation	$76	$79	$79	$77	$82	$57	$48	$42	$43	$28	**$611**
Reconstruction	$16	$15	$7	$12	$10	$7	$5	$8	$1	$7	**$88**
Total	**$117**	**$117**	**$102**	**$111**	**$113**	**$85**	**$74**	**$71**	**$66**	**$57**	**$913**

Exhibit 5.3 shows the planned 10-year trend in spending on NHS bridges.

Exhibit 5.3 NHS Bridge Spending by FHWA Work Type, 2022-2031 (millions)

FHWA WORK	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	TOTAL
Maintenance	$26	$27	$27	$27	$28	$28	$28	$29	$29	$29	**$278**
Preservation	$31	$32	$31	$31	$29	$30	$40	$39	$44	$47	**$354**
Rehabilitation	$109	$150	$172	$122	$154	$118	$112	$121	$87	$89	**$1,236**
Reconstruction	$113	$160	$146	$125	$109	$118	$58	$19	$11	$9	**$868**
Total	**$278**	**$369**	**$377**	**$305**	**$321**	**$294**	**$239**	**$208**	**$170**	**$175**	**$2,736**

5.2 Future Funding Levels

This section will briefly describe the sources of funding that feed RIDOT's investments in NHS pavement and bridges. It will then present a 10-year forecast and forecasting methodology for each. The funding sources will be divided between Federal and State.

Total revenue for the 2022-2031 period is provided in Exhibit 5.4. The revenues below also include funds potentially available for investments in non-NHS bridges and pavement, and other spending types including but not limited to the Highway Safety Improvement Program (HSIP), investments in stormwater management, transit, and active transportation modes. These revenue projections do not include operational spending, pass thrus, or funds dedicated to debt service payments.

Exhibit 5.4 RIDOT's Capital Revenue, 2022-2031 (millions)

FHWA WORK	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031	TOTAL
Federal	$389	$414	$416	$387	$281	$286	$292	$298	$304	$310	**$3,378**
State	$174	$192	$189	$185	$174	$177	$181	$185	$188	$192	**$1,837**
Other	$10	$5	$3	$8	$5	$5	$5	$5	$6	$6	**$58**
Total	**$572**	**$611**	**$608**	**$581**	**$460**	**$469**	**$479**	**$488**	**$498**	**$508**	**$5,273**

5.2.1 Federal Funding Sources

The primary sources of Federal funding for RIDOT's NHS pavement and bridges include:

- **Federal Highway Formula Funds |** Pursuant to the Infrastructure Investments and Jobs Act (IIJA), all 50 states and the District of Columbia receive annual apportionments from FHWA. During the first year of any new surface transportation reauthorization bill (such as 2022 for IIJA), RIDOT assumes that formula distributions and obligation limits to Rhode Island will be a consistent share of the total national allocation, allowing it to project the next five years based on the national total. USDOT sets an obligation limitation for each state which typically limits RIDOT to obligating between 85 and 90 percent of its apportioned federal funding each year. RIDOT's formula distribution is only guaranteed up to the Obligation Limit. Formula distributions are disbursed across several programs, each with their own rules, set-asides, and regulations.

- **Discretionary Grants |** RIDOT aggressively pursues discretionary grants to close funding gaps in major capital projects. The Department requests funding from USDOT through formal applications including plans, budgets, schedules, and graphics. Notable recent grant awards include $60 million for the I-95 Northbound Providence Viaduct, and $65 million to reconstruct RI-146. These grants are mapped on p. 39.

- **Grant Anticipation Revenue Vehicle (GARVEE) Bonds |** GARVEE Bonds are an innovative financing method supported by FHWA which allows eligible entities to issue bonds backed by future federal-aid funding. Obligations of federal formula funds are used to make debt-service payments on GARVEE issuances, which can be used to accelerate construction on projects which would otherwise be infeasible due to

obligation limitations. RIDOT has made use of FHWA's GARVEE program twice in the past 10 years, issuing $300 million in 2016 to support RhodeWorks and another $200 million in 2020 to support major capital projects in the Providence region.

» **Special Appropriations |** Other federal funds are directed to RIDOT through several other avenues that fall outside the preceding three categories. These funds may be distributed annually, by statute, or under special circumstances. Examples include:

– **August Redistribution |** August Redistribution is an annual process which allows states to apply for additional obligation limit from USDOT, up to and occasionally in excessive of their annual formula apportionment. RIDOT aggressively pursues August Redistribution funding, which must be allocated to projects that are ready to proceed to construction within a few months of obligation.

– **Bridge Formula Program (BFP) |** The IIJA authorized $5.5 Billion for "bridge replacement, rehabilitation, preservation, protection, and construction." 75 percent of these funds are directed to replacing bridges in poor condition, and 15 percent must be set aside for use on off-system bridges. BFP funds are not subject to the state's annual obligation limitation. In FFY2022, RIDOT's allocation was $50.99 Million.

– **National Electric Vehicle Infrastructure Program (NEVI) |** The IIJA also authorized $1 Billion to "provide dedicated funding to States to strategically deploy EV charging infrastructure and establish an interconnected network to facilitate data collection, access, and reliability."[4] NEVI Funds are also not subject to the state's annual obligation limitation, and in FFY2022, RIDOT's NEVI allocation was $3.38 million. RIDOT's EV Infrastructure Deployment Plan was approved by FHWA in September 2022.

– **Bridge Rehabilitation |** Since 2019, Rhode Island and several other states have received several infusions of funding for bridge rehabilitation and replacement from the Highway Improvement Program. RIDOT has leveraged these funds to advance several major projects, most notably the rehabilitation of the Henderson Bridge.

Federal revenues were calculated using the following assumptions:

» Annual growth is presumed to be 2%, the difference between 2022 and 2023 apportionments.

» The obligation authority for formula funding is projected to be allocated at approximately 90% of apportionments, following the example from FFY2022 of 90.22%.

» All other programs authorized under IIJA, such as the Bridge Formula Program (BFP) are assumed to continue over a 10-year period, with annualized 2% growth beginning in FFY2026.

[4] The National Electric Vehicle Infrastructure (NEVI) Formula Program Guidance (dot.gov) p. 5 https://www.fhwa.dot.gov/environment/alternative_fuel_corridors/nominations/90d_nevi_formula_program_guidance.pdf

FHWA formula programs and their acronyms:

- National Highway Performance Program (NHPP)
- Surface Transportation Block Grant Program (STBG)
- Highway Safety Improvement Program (HSIP)
- Railway-Highway Crossings Program (RHCP)
- Congestion Mitigation and Air Quality Improvement Program (CMQ)
- Metropolitan Planning Program (MPO)
- Carbon Reduction Program (CRP)
- National Highway Freight Program (NHFP)
- Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation Formula Program (PROTECT)

5.2.2 State Funding Sources

The primary sources of State funding for RIDOT's NHS pavement and bridges include:

- **Gas Tax |** Rhode Island's gas tax is $0.34 per gallon in FY2022. By statute,[5] the majority of the revenue is allocated to RIDOT, though segments are withheld for other uses including RIPTA, the Elderly/Disabled Transportation Program, and maintenance of the Sakonnet River Bridge by RITBA.

- **Rhode Island Capital Plan (RICAP) |** The RICAP fund is established in the State Constitution. Every year, 3% of the state's general revenues are deposited into a "Rainy Day Fund" (RDF). Once the total value of the RDF reaches 5% of the estimated total resources, surplus revenue is deposited into the RICAP fund.[6] This structure means that the amount of funding available to support RICAP projects fluctuates from year to year, but it remains an essential source of funding for non-federal match in RIDOT projects.

- **Rhode Island Highway Maintenance Account (RIHMA) |** RIHMA is the repository for all transportation-related funds formerly allocated to the general fund and is dedicated by Statute to programs designed to eliminate structural deficiencies of State bridge, road, and maintenance systems and infrastructure.[7] RIDOT and RIPTA depend on RIHMA funds to support non-federal match on capital projects and supplement the costs of program administration and maintenance. RIDOT receives approximately $80-$100 million per year from RIHMA.

- **Toll Revenue |** Truck-only tolling authorized by RhodeWorks in 2016 provided approximately $44 million annually, directed by Statute to repair and replacement of bridges. While the program was still in development, RIDOT and RITBA were sued by the American Trucking Associations, Cumberland Farms, M&M Transport Services, and New England Freight on the grounds that the tolls were discriminatory and unconstitutional. In September 2022, a federal judge ruled in the Plaintiffs' favor, determining that "the statute's tolling regime is unconstitutional under the dormant Commerce Clause of the United States Constitution" and ordering a stoppage in collections. An appeal to the decision is pending.

5 http://webserver.rilin.state.ri.us/Statutes/TITLE31/31-36/31-36-20.htm
6 FY24-28 Capital Budget Process Memo-2.pdf (ri.gov) https://omb.ri.gov/sites/g/files/xkgbur751/files/2022-05/FY24-28%20Capital%20Budget%20Process%20Memo-2.pdf
7 http://webserver.rilin.state.ri.us/Statutes/TITLE39/39-18.1/39-18.1-5.htm

RIDOT tracks estimates of revenues from the Rhode Island Budget Office and notes major funding source fluctuations. Should funding substantially shortfall the estimates, RIDOT can lobby the Governor or State Legislature for additional funding or can issue revenue bonds through a statewide referendum (as it did in 2020 and 2021 during COVID-19). The RIDOT Planning Office estimates matching needs and works with the Financial Management Office to estimate the size of fully-State-funded projects.

State revenues were calculates using the following assumptions:

- Annual growth is presumed to be 2%, based on the expectation that the State Budget process will successfully identify sufficient state funding to keep up with the anticipated increase in federal funds
- Truck Toll Revenues are assumed to be $0 for the time being, pending an appeal to the 2022 federal ruling striking down the RhodeWorks All-Electronic Truck Tolling Program
- State funding dedicated to operations is assumed to be stable and in step with modest inflation (2% annual growth) over 10 years. RIDOT is aware that motor fuel tax revenues are projected to decline over time with increased adoption of hybrid and electric vehicles, and the Department is committed to identifying policy solutions to close the emerging funding gap.

5.2.3 Other Sources of Revenue

Other sources of RIDOT capital funding include land sales, local revenue, and third-party revenue secured on a project-by-project basis through agreements with outside partners.

5.3 Funding Gap Analysis

5.3.1 Funding Gap Analysis for NHS Pavement

Exhibit 5.5 presents funding needs, anticipated spending, and gap for NHS pavement. Need is derived directly from dTIMS model results. As the model is imperfect, some of its projections are inconsistent with RIDOT practice and engineering judgement, such as an unrealistic single-year spend on pavement preservation in 2024 and the lack of any modeled pavement maintenance need before 2024. RIDOT is consistently working to improve its models and anticipates that these issues will be addressed over the coming years.

Despite modeling noise, the analysis below demonstrates that RIDOT has a significant need for additional pavement spending, particularly in lower-order treatments like maintenance and preservation. If additional resources are not allocated to these treatments—which prevent accelerated pavement deterioration—RIDOT will likely need to increase its outyear spending on Rehabilitation and Reconstruction as well, areas where modeled need is more

immediately met by planned spending. RIDOT will utilize the results of this analysis to advocate for additional pavement support, particularly from state funds which can be deployed more expediently than federal dollars.

Exhibit 5.5 Funding Gap Analysis for NHS Pavement (millions)

		2022	2023	2024	2025	2026-2031	TOTAL
Maintenance	Need	$9.90	$10.30	$10.50	$11.00	$94.10	**$135.90**
	Spending	$9.90	$10.40	$10.50	$10.60	$65.60	**$106.80**
	Gap	-	-	$0.10	$0.50	$28.60	**$29.10**
Preservation	Need	$14.90	$12.80	$275.70	$12.90	$144.90	**$461.10**
	Spending	$14.90	$12.80	$4.90	$11.30	$63.00	**$106.80**
	Gap	-	-	$270.80	$1.60	$81.90	**$354.30**
Rehabilitation	Need	$43.30	$65.80	$212.80	$89.40	$361.30	**$772.50**
	Spending	$76.20	$79.20	$79.30	$77.10	$299.60	**$611.50**
	Gap	-	-	$134.60	$13.30	$54.90	**$202.80**
Reconstruction	Need	$18.60	$35.70	$21.80	-	-	**$76.10**
	Spending	$15.80	$14.60	$7.20	$11.60	$38.50	**$87.70**
	Gap	$2.80	$21.10	$14.60	-	-	**$38.60**
Total	**Gap**	**$2.80**	**$21.10**	**$420.20**	**$15.30**	**$165.30**	**$624.80**

Under a "full" or unlimited funding scenario, RIDOT would make significant investments in preservation work around the state, and advance major rehabilitation projects on arterial roads which must be staggered under the STIP scenario due to funding constraints. However, because Rhode Island is such a small and densely populated state, there are limits to the amount of construction that can be reasonably managed concurrently on the NHS. Even with unlimited funding, additional projects would need to be spaced and timed accordingly to avoid significant delays or disruptions in regular traffic patterns. This challenge is more acute with pavement than bridges because work zones are often longer and more difficult to manage for linear assets.

5.3.2 Funding Gap Analysis for NHS Bridges

Exhibit 5.6 presents funding needs, anticipated spending, and gap for NHS bridges. Much like pavement, in a full funding scenario, RIDOT would expand bridge maintenance and preservation efforts to ensure that all of its NHS bridges—including all of the structures rehabilitated or replaced under RhodeWorks—can reach their full life expectancy. Another key priority would be the advancement of several major bridge rehabilitation projects currently scheduled to begin in year 5 or later of the Department's 10-year plan. However, many of the Department's most vulnerable structures remaining in poor condition are large, urban spans over Amtrak's Northeast Corridor (NEC). RIDOT has struggled in recent years to secure sufficient Amtrak staff to support major projects over rail lines. As bridge conditions deteriorate, this problem will become more acute, and even unlimited funding alone could not rectify this challenge.

The results of this analysis also indicate that RIDOT should reconsider its allocation of resources to bridge rehabilitation and replacement in the outyears (FFY2026 and beyond). Ongoing major capital projects on I-95, US-6, RI-10, and RI-37 account for a significant share of near-term rehabilitation and replacement spending, but in the

outyears, BrM projections indicate a need for increased spending to meet demands based on bridge deterioration projections. RIDOT will use the results of this analysis to inform future updates to proposed bridge spending in the STIP, particularly with respect to planning and budgeting projects beginning in future years with a scope of rehabilitation or replacement.

Exhibit 5.6 Funding Gap Analysis for NHS Bridges (millions)

		2022	2023	2024	2025	2026-2031	TOTAL
Maintenance	Need	$34.20	$35.90	$36.30	$36.60	$227.69	**$370.69**
	Spending	$25.60	$26.90	$27.20	$27.40	$170.56	**$277.66**
	Gap	$8.60	$9.00	$9.10	$9.20	$57.14	**$93.04**
Preservation	Need	$42.00	$43.70	$42.80	$42.10	$317.01	**$487.61**
	Spending	$30.50	$31.70	$31.10	$30.60	$229.94	**$353.84**
	Gap	$11.50	$12.00	$11.80	$11.60	$87.07	**$133.97**
Rehabilitation	Need	$136.00	$187.40	$214.60	$152.20	$851.04	**$1,541.24**
	Spending	$109.00	$150.30	$172.00	$122.10	$682.29	**$1,235.69**
	Gap	$27.00	$37.20	$42.60	$30.20	$168.75	**$305.75**
Reconstruction	Need	$112.80	$160.50	$146.30	$125.30	$933.17	**$1,478.07**
	Spending	$112.80	$160.50	$146.30	$125.30	$323.60	**$868.50**
	Gap	-	-	-	-	$609.57	**$609.57**
Total	**Gap**	**$47.10**	**$58.20**	**$63.40**	**$51.00**	**$922.50**	**$1,142.0**

5.4 Funding for the Municipal NHS

Rhode Island does not have any formal, dedicated programs to provide funding directly to municipalities to manage the NHS. However, there are several mechanisms operated by RIDOT and its partners that provide some support for investments by local partners in NHS assets.

- **Local Public Agency (LPA) Subrecipient Program |** RIDOT provides oversight and support to municipalities, non-profits, and other local public agencies in administering "subrecipient" projects. Typically supporting construction of assets outside the highway right-of-way, subrecipient projects are subject to agreements between RIDOT and other agencies which require the recipient to follow state and federal regulations throughout the project design and construction process. RIDOT allocates a predetermined amount of funding to the subrecipient, and any additional costs are borne by the subrecipient. Recent LPA projects have completed Safe Routes to Schools (SRTS) enhancements, constructed shared-use paths, and repaired railway crossings. LPA projects may also include enhancements to the municipally-owned NHS, or other NHS assets critical to local communities.

- **Rhode Island Infrastructure Bank (RIIB) |** Established by the General Assembly in 1989, the RIIB is a financing hub for local agencies to secure low-interest loans to support infrastructure projects. The Bank supports sewer tie-ins, municipal resilience, water quality protection, road construction, and more. RIDOT reviews the Bank's approved list of projects and provides oversight and inspection as required. The RIIB can also be used to support work on the NHS.

5.5 Valuation of NHS Assets

5.5.1 Valuation of NHS Pavement

As part of the TAMP, RIDOT is mandated to estimate the total value of its primary assets—NHS pavements and bridges. Asset value refers to the monetary value of a given asset, based on the size, age, condition, or other attributes, and helps to communicate the value of the assets RIDOT is managing year over year.

To estimate the value of its NHS pavements, RIDOT used the condition-based asset value approach to estimate the remaining asset value. Unlike the replacement value approach, this method estimates the assets' remaining value based on existing condition of the asset and the remaining service life left in the pavement. As the name implies, the replacement value method estimates the cost of constructing a new pavement without accounting for asset deterioration, whereas the remaining value approach estimates the cost to replace the depreciated or deteriorated asset.

To estimate the remaining value, RIDOT used the 2020 inventory and condition data.

- To capture the total NHS pavement area RIDOT is responsible for, it was assumed that a lane mile of pavement is equivalent to 7,040 square yard, while climbing lanes, ramps, and paved shoulders, which were not included in the HPMS reported mileage, account for an additional 50% of the pavement area in each pavement condition category.
- To account for the conditions in the value estimation, it was assumed that pavements in good, fair, and poor conditions have remaining service life of 90% (lost 10% of replacement value), 75% (lost 25% of replacement value), and 25% (lost 75% of replacement value), respectively. Finally, an average reconstruction cost of $100/square yard was used.

Exhibit 5.7 provides a summary of the asset value in each condition category. In total, the estimated remaining asset value of RIDOT's NHS pavements is $ 306 million.

Exhibit 5.7 Estimated Value of NHS Pavement in Rhode Island (millions)

PAVEMENT CONDITION	TOTAL LANE MILEAGE*	ESTIMATED REPLACEMENT VALUE	ESTIMATED REMAINING ASSET VALUE
Good	306.9	$216.0	$194.4
Fair	211.8	$149.1	$111.8
Poor	0.7	$0.5	$0.1
Total	**519.4**	**$365.6**	**$306.4**

*Includes climbing lanes, ramps, and paved shoulders.

5.5.2 Valuation of NHS Bridges

RIDOT calculates the remaining value of its bridges as a factor of the number of years remaining in design life given the structures current condition state:

- The department designs bridges for a design life of either 50 or 75 years, during which they are expected to pass through phases of good, fair, and poor condition. For example: a bridge with a 50-year design life is expected to fall into poor condition after approximately 40 years.
- RIDOT determines the percentage of replacement value remaining for the structure as a baseline given how many years the bridge is expected to remain its current condition state and all subsequent states if allowed to deteriorate.
- As RIDOT will intervene with maintenance and preservation activities, and as bridges deteriorate at unique rates in practice, the remaining service life of structures is recalculated regularly in BrM, often at request of the Department of Administration in its role of reporting on the total value of state assets.

Exhibit 5.8 provides the replacement and remaining value of NBI structures owned by RIDOT, including both bridges and culverts, differentiated by NHS and non-NHS assets. RIDOT currently estimates that its NBI structures are valued at approximately $1.9 billion, representing approximately 43% of their replacement value.

Exhibit 5.8 Estimated Value of NHS Bridges in Rhode Island (millions)

	NHS	NON-NHS	TOTAL NBI
50-Year Design Life			
Replacement Value	$2,686.70	$611.36	$3,298.06
Remaining Value	$833.93	$154.70	$988.64
75-Year Design Life			
Replacement Value	$882.54	$176.15	$1,058.69
Remaining Value	$728.50	$153.24	$881.74
Total			
Replacement Value	$3,569.24	$787.51	$4,356.75
Remaining Value	$1,562.43	$307.95	$ 1,870.38

5.6 Investment Strategies' Alignment with 23 CFR

RIDOT's investment strategies and project prioritization processes are generally documented in the STIP[8] and reiterated throughout this document (FOCUS ON: DEVELOPING THE STIP, p 51). In addition, unique strategies for investing in NHS pavements and bridges are also discussed in Chapters 2 (p 17) and 3 (p 35) respectively. However, pursuant to the requirements of 23 CFR 515, this section of the TAMP provides a description of how RIDOT's investment strategies are influenced by the following:

1. Performance gap analysis.
2. Life-cycle planning.

[8] https://planning.ri.gov/stip

3. Risk management analysis.
4. Anticipated available funding and estimated cost of expected future work types associated with various candidate strategies.

This section directly addresses the key influences on existing investment strategies. It further establishes the ways in which investment strategies will be revised in the future to address deficiencies identified in the development of this TAMP.

5.6.1 Influences on Existing Investment Strategies

23 CFR 515.9 (f)

An asset management plan shall discuss how the plan's investment strategies collectively would make or support progress toward:

1. Achieving and sustaining a desired state of good repair over the life cycle of the assets,
2. Improving or preserving the condition of the assets and the performance of the NHS relating to physical assets,
3. Achieving the State DOT targets for asset condition and performance of the NHS in accordance with 23 U.S.C. 150(d),[a] and
4. Achieving the national goals identified in 23 U.S.C. 150(b).[a]

[a] https://www.govinfo.gov/content/pkg/USCODE-2020-title23/pdf/USCODE-2020-title23-chap1-sec150.pdf

The investment strategies that led to the "Planned" investment scenarios analyzed in Chapters 2, 3, and 5 were directly informed by:

- **RhodeWorks**, which mandates performance and reporting requirements for state roads and bridges;
- **RIDOT's 2019 TAMP,** which conducted performance gap, life cycle planning, risk, and financial analyses and outlined implementation strategies to improve asset management in Rhode Island;
- **Moving Forward RI 2040**,[9] Rhode Island's Long-Range Transportation Plan, which established a series of goals, objectives, and priorities to inform a unified planning approach for the next two decades;
- **The FFY2022-2031 STIP**, which includes a vision, goals, and development process for prioritizing projects and investments; and
- **FHWA's "Policy on Using Bipartisan Infrastructure Law Resources to Build a Better America**,"[10] which established eight criteria for "investments and projects that align with the BIL and will help Build a Better America" that were implemented by Revision 2 to the STIP, which deployed all five years of IIJA funding for RIDOT.

[9] https://planning.ri.gov/planning-areas/transportation/long-range-transportation-plan
[10] https://www.fhwa.dot.gov/bipartisan-infrastructure-law/building_a_better_america-policy_framework.cfm

A complete listing of major implementation steps taken to advance asset management objectives is included in Chapter 6 (p 66). However, key adjustments to investment strategies since 2019 include:

- **A Renewed Focus on Preservation and Maintenance |** RIDOT has increased its preservation activities to slow asset deterioration and optimize life cycles for NHS bridges and pavements.
- **A Prioritization on Efficiency in Project Delivery |** Using a map-based approach to project planning, RIDOT has developed a program of "Corridor" projects combining bridge and pavement investments into single contracts, reducing project conflicts and procurement timelines.

5.6.2 Impact of TAMP Analyses on Future Investment Strategies

Because this TAMP was a complete overhaul of RIDOT's 2019 TAMP, the Department developed all-new Performance Gap Analyses, Life Cycle Planning Deterioration Models, Risk Management Analyses, and Financial Plans. As a result, RIDOT has identified several opportunities for future investment strategy enhancements.

Performance Gap Analysis

The performance gaps analyses documented in each asset chapter evaluated three scenarios for NHS bridges, pavements and assets: a "planned" scenario reflecting the FFY2022-2031 STIP as of Revision 6 (November 2022), a deterioration scenario with no further investment, and an "optimal funding" scenario with no upper bound on investment.

The performance analyses demonstrated that both the "planned" and "optimal" scenarios allow RIDOT to meet its performance targets within the 10-year window. However, the analyses also identified deficiencies in the "planned" scenario. Exhibit 5.9 documents areas of deficiency and recommended actions for RIDOT to adjust its investment strategies.

Exhibit 5.9 Opportunities for Improvement in RIDOT Investment Strategies for NHS Pavement and Bridge

ASSET CLASS	ISSUE	CORRECTIVE ACTIONS
Pavement	» Share of interstate NHS in good condition falls after 2024	» Increase investments in interstate preservation » Evaluate needs for additional capital investments on the interstate in the outyears of the STIP (FFY2026-2031)
Pavement	» Share of non-interstate NHS in Poor condition begins to increase after 2027	» Evaluate timing of non-interstate capital investments after 2026 to determine whether scoping needs to be accelerated » Increase budget for Pavement Immediate Action line item to ensure funding is available to address pavements that fall into poor condition unexpectedly
Bridge	» Share of bridges in Fair condition begins to increase after 2028	» Identify candidate projects for acceleration in the outyears of the STIP to ensure deterioration of asset class does not resume after performance objective is met

Life Cycle Planning

The guiding concept of the life cycle planning strategies in Chapters 2 and 3 is summarized on page 21, which notes that "life cycle planning recognizes that applying the right treatment at the right stage in an asset's life cycle can have a profound effect on the total cost to maintain an asset in SOGR over its whole life." To realize that

principle, RIDOT identified several process improvements for the management of each asset class. The ones with the most direct impact on investment strategies include:

- Doubled inspection frequency for network roads.
- Enhancements to the Pavement Preservation Program, including quarterly reporting.
- Issuance of indefinite duration/indefinite quantity (ID/IQ) contracts to support bridge preservation activities.

Risk Management

The risk management plan described in Chapter 4 establishes a framework for evaluating risk. It also identifies several risks at the Asset, Program, and Department levels, and mitigation strategies to address them. All risks outlined in Chapter 4 directly influence RIDOT's investment strategies, and as Section 4.4 explains, RIDOT uses recurring stakeholder meetings to monitor risks and coordinate strategic actions to respond or limit exposure as required.

Beyond the strategies identified in Chapter 4, RIDOT also continuously monitors and evaluates risks to project delivery. Perhaps the most direct influence of risk management on the Department's Investment Strategies comes in the form of RIDOT's Project Prioritization and Investment Risk Assessment Tool. The tool consists of a series of questions, which, if answered in the affirmative, may predict a delay to a project's schedule or potential problems in its administration.

During the deployment of IIJA funding in early 2022, RIDOT utilized the Risk Management Processes described in Chapter 4 to develop an eight-part framework, provided in Exhibit 5.10, for assessing risk to project and budget schedules specifically. This step was taken to ensure that the Department's acceleration of more than 100 projects would result in a smooth delivery through the design, construction, and closeout phases. The goal of this additional risk assessment is to ensure that all program adjustments proposed as a result of IIJA funding could be enacted efficiently. This tool is now continuously utilized in evaluating proposed changes to the Department's 10-Year Plan.

Exhibit 5.10 RIDOT Framework for Assessing Project Management Risk

Anticipated Available Funding and Estimated Cost of Expected Future Work Types

As Section 5.2 describes, this TAMP includes projections for federal and state revenues available for investment in capital projects, preservation, and maintenance.

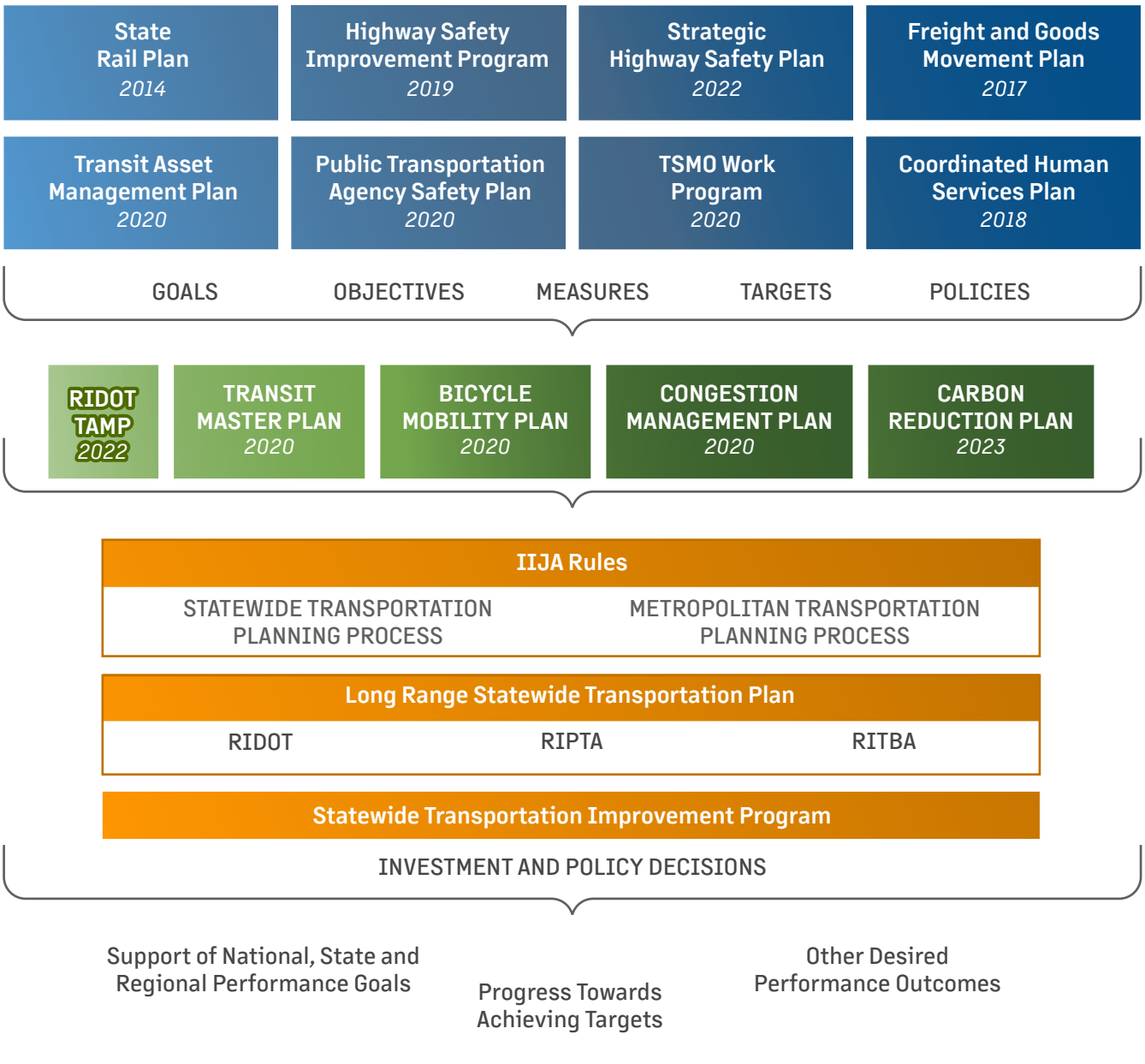
Revenue projections were calculated by estimating all anticipated RIDOT funding sources over time, and subtracting the anticipated spending dedicated to operational costs including staff salaries, debt service payments, pass throughs, inspection costs, research, planning, training, and all other spending which does not directly target enhancement of asset conditions.

The cost of future work types has been estimated in conjunction with the Department's AMEs and the Division of Project Management. Average unit costs for future treatments are documented in Exhibits 2.9 and 3.8. These costs were deployed by each of the Department's Asset Management Systems (dTIMS and BrM) to generate the data presented in Section 5.3, which demonstrates a considerable funding gap for both bridges and pavement which varies by treatment over time.

RIDOT continuously evaluates its investment strategies and updates cost estimate methodologies and tools based on recent bids. The Divisions of Planning and Project Management work together to maintain "blue sheet" (project scheduling) and "green sheet" (project budgeting) spreadsheets and tools that use recent bid data to update assumptions about project milestone delivery expectations and expected costs. These data also inform updates to the average treatment unit costs discussed in Chapters 2 and 3, and in turn, RIDOT's Performance Gap Analysis modeling. RIDOT has also partnered with Esri to develop project intake software which will, among other things, apply this TAMP's average unit treatment cost data to inform project cost estimation using geospatial registration to estimate the cost of a project based on its geographic footprint.

FOCUS ON: The Rhode Island Universe of Plans

A TAMP that addresses NHS Pavement and Bridges addresses only a one portion of the Rhode Island transportation system. Through the STIP and State budget process, investment strategies for the NHS must be weighed and traded off against investments in other critical public interests. The graphic below is a sampling of the many planning documents being updated and implemented every day that touch transportation in Rhode Island.



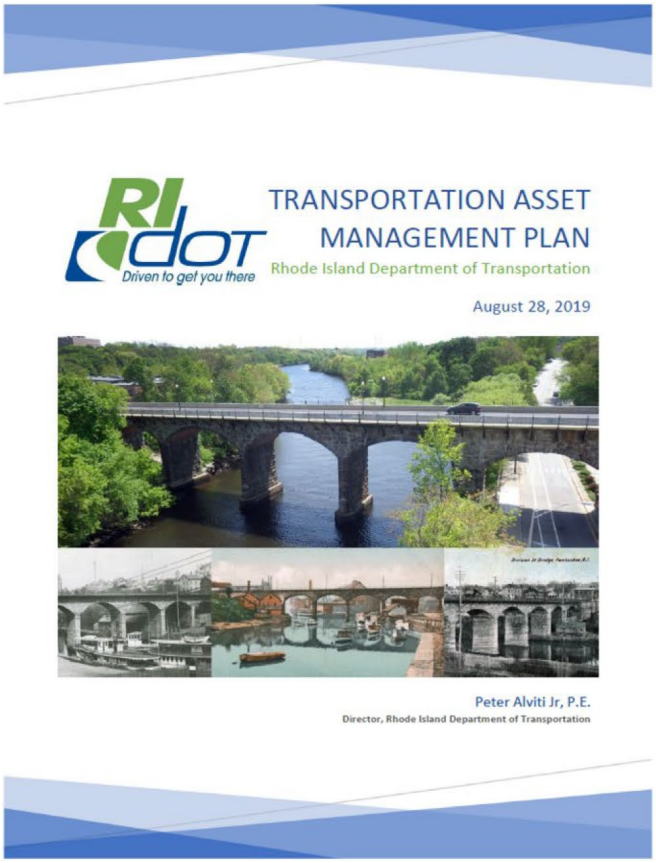
6. IMPLEMENTING THE TAMP

RIDOT intends the TAMP to be a living document that can be updated and referenced over a four-year lifespan. This chapter places this document in the context of RIDOT's continuing evolution in integrated performance, asset, and risk management. It first describes advancements made by the Department in response to the 2019 TAMP, then proceeds to address the major points of growth in that document identified by the FHWA Baseline Assessment (both shown in Exhibit 6.1). Finally, it lays out concrete paths for further maturation that are realistic and achievable by the time of the 2026 TAMP Update.

6.1 The TAMP as a Living Document

Following the certification of the 2019 TAMP, FHWA produced "baseline assessments" for each state, grading the success of their proposed asset management processes relative to the CFR requirements and other states.

Exhibit 6.1 2019 RIDOT TAMP and FHWA Baseline Assessment



TRANSPORTATION ASSET MANAGEMENT PLAN

Rhode Island Department of Transportation

August 28, 2019

Peter Alviti Jr, P.E.
Director, Rhode Island Department of Transportation

A Baseline Assessment of TAMP Enhancement Opportunities

U.S. Department of Transportation
Federal Highway Administration

RHODE ISLAND DEPARTMENT OF TRANSPORTATION

In order to better inform the FHWA and the States on existing and evolving practices using asset management principles, the FHWA engaged a consultant to review each State's 2019 asset management plan and compare each plan to concepts found in the new AASHTO Transportation Asset Management (TAM) Guide and the TAM Gap Analysis Tool (developed under NCHRP 08-90). This review will enable FHWA and States to identify what practices are currently being employed by peer organizations and provide readily available information that may be of use to States looking to enhance their own TAMPs. This review is not intended to be, nor is it to be construed as, a reflection of State compliance with FHWA regulatory requirements.

The assessment captured two types of information from the TAMPs: content and degree of coverage. The content information was captured and summarized on a national basis to enable FHWA to answer questions regarding the inclusion of certain pieces of information in the initial TAMPs. For example, the FHWA found that 25 State DOTs included the National Highway System (NHS) in their TAMPs and 27 State DOTs extended their TAMPs to include the entire State-maintained system.

The second type of information assessed the degree to which an extensive range of performance and asset management topics were covered in the initial TAMPs submitted by State DOTs. These topics were rated using the 1 to 5 scoring system shown in the Assessment Key, which describes the extent to which these practices were included in the TAMP and are being used. A score of 5 indicates that the practice was described fully in the TAMP and there was evidence those practices were being used in the agency. A score of 1 indicates that coverage of the topic was not found in the TAMP. The topics in this category will be used by FHWA in the future as one way of determining whether TAMP practices are evolving, but they can also be used by State DOTs to identify areas for enhancing future TAMPs.[1]

Assessment Key

- **Average score of 1.0** (not covered in the TAMP)
- **Average score of 2.0** (Language provided, but practices do not appear to be implemented)
- **Average score of 3.0** (The agency is actively taking steps to put practices in place)
- **Average score of 4.0** (The agency is using the practice and there is evidence of progress in area)
- **Average score of 5.0** (The practice is in place and is implemented into agency practices)

The results for your State DOT are presented in this document and organized under the following nine topic areas, which closely align with the minimum TAMP content defined in 23 CFR 515.9:

1. General TAMP Maturity.
2. Inventory and Condition Data.
3. Performance Management and Monitoring.
4. Performance Gap Analysis.
5. Life Cycle Planning.
6. Risk Management.
7. Financial Planning.
8. Investment Strategies.
9. TAMP Implementation and Integration.

Within each area, the tables list the topics that were evaluated and the results for both your State (Column 1) and all States combined (Column 2). The scores reflect averages for all items considered in each topic area, rounded to the nearest whole number. The information in

1 Except for any statutes and regulations cited, the contents of this report do not have the force and effect of law and are not meant to bind States or the public in any way. This report is intended only to provide information regarding existing requirements under the law or agency policies. Specifically, this report compares the State's TAMP to two non-binding sources, the new AASHTO Transportation Asset Management (TAM) Guide and the TAM Gap Analysis Tool (developed under NCHRP 08-90).

FHWA 2019 Certified TAMP Evaluation ▸ Rhode Island Department of Transportation Page 1

FHWA's Baseline Assessment of the 2019 TAMP identified several specific areas where RIDOT's practice and document could grow for 2022. RIDOT has addressed these to the greatest degree possible. They include:

Little documentation of coordination between the TAMP and the long-term financial plan | RIDOT has begun this growth process in this document, which documents new processes for informing our life-cycle planning and investment strategies. RIDOT plans for those processes to inform the next LRTP update.

Little documentation of an alignment between the TAMP and other Federally-required plans | This TAMP includes multiple "Focus" pages that address this point. "FOCUS ON: Developing the STIP" (p. 51) ties the TAMP to capital planning, while "FOCUS ON: The Rhode Island Universe of Plans" (p. 65) ties the TAMP to Federally required planning efforts for bicycle, pedestrian, and transit infrastructure.

Little documentation of an alignment between the TAMP and investments planned by owners of the local-NHS | A reference guide to discussion of the locally-owned NHS in this document is provided in Exhibit 6.2.

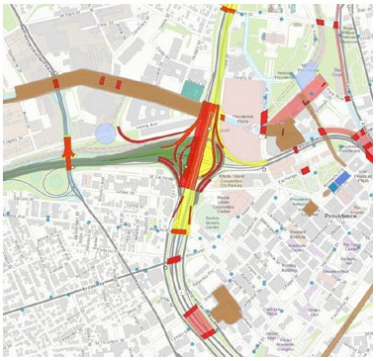
RIDOT needs to coordinate more efficiently with its municipal and State partners on non-State-owned bridges and pavement | RIDOT has provided real-time access to bridge owners on the condition and maintenance needs for their bridges using the BrM user interface. Owners can review location, condition, and work identified through life cycle planning. For pavement projects, RIDOT has established an Outreach team that coordinates with local stakeholders beginning early in the planning process and allows RIDOT to incorporate local feedback during project development.

Exhibit 6.2 Reference Guide: Municipal NHS

ITEM	DESCRIPTION	PAGE
Exhibit 2.2	Inventory of NHS Pavement by individual owner	p. 9
Exhibit 3.2	Inventory of NHS Bridges by individual owner	p. 23
Exhibit 2.4	Condition of NHS Pavement by owner category	p. 11
Exhibit 3.5	Condition of NHS Bridges by owner category	p. 25
Exhibit 4.4	Acknowledgment of municipal role in climate resiliency	p. 43
Exhibit 4.4	Highlighting SWIFT's role in project intake/alignment with municipalities	p. 45
Section 5.4	Discussion of funding for the municipal NHS	p. 57

6.2 Notable Accomplishments Since 2019

RIDOT has matured significantly since 2019 in several areas:



Tools for project intake and crosswalking with assets | As a step of implementing the 2019 TAMP and to apply the risk-based approach in the TAMP during the annual STIP process, RIDOT has implemented the "Bundler". The bundler's database crosswalks projects to assets, with a polygon for every structure, segment of pavement, sign, and ITS asset among others. In implementing the 2022 TAMP, the Division of Statewide Planning will add new modules for project intake, scoring, and evaluation to create the Statewide Intake Framework for Transportation (SWIFT).

A new commitment to preservation | RIDOT has found that in nearly every year spending on preservation is lower than expected and spending on rehabilitation and replacement is higher than expected. RIDOT is addressing this problem by expanding the pavement preservation program using both new Federal funding from IIJA and state funds. RIDOT has begun issuing indefinite duration/indefinite quantity (ID/IQ) contracts for preservation activities on bridges in good and fair condition, reducing the task implementation timeline from three months to two weeks.

A more complete PMS | RIDOT has maintained and improved its PMS and other asset management systems discussed in 2019. The Department has enhanced its project development process to deliver more efficient corridor improvements, driven by improved deterioration modeling and analysis. The Pavement Engineering team has engaged the state's Department of Information Technology (DoIT) to approve a transition from dTIMS 9.5 to dTIMS BA.

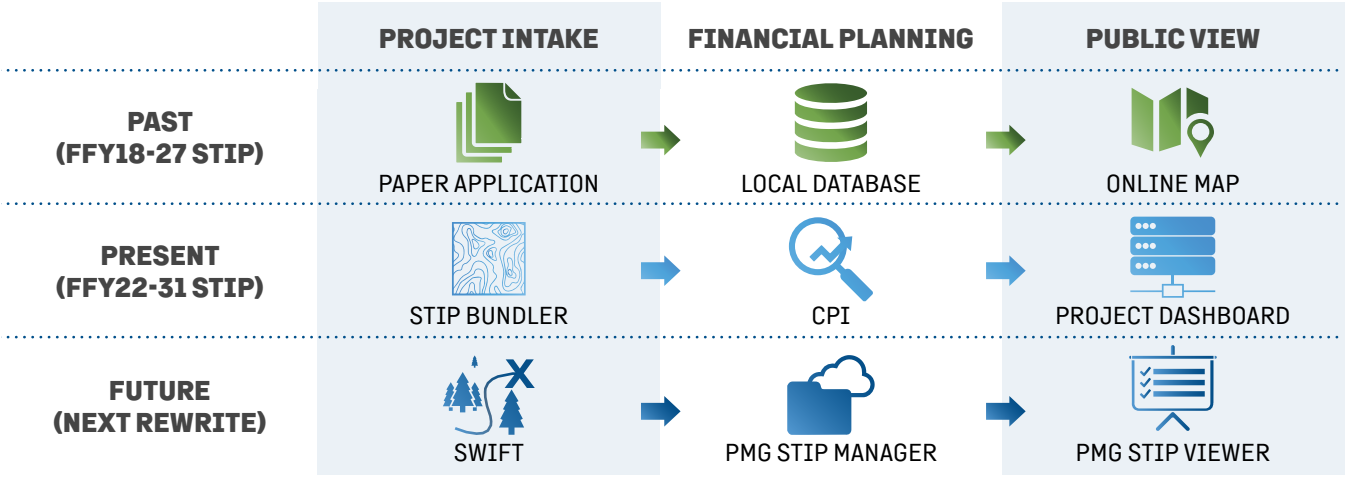
A national thought leader in BMS development and implementation | RIDOT has completed proposed improvements to AASHTOWare BrM in terms of data intake, deterioration modeling, life cycle planning, and internal and external user interface. Data from BrM is now available as work assignments to Bridge Maintenance staff and as snapshots to non-DOT bridge owners, including RITBA, RIAC, and municipalities. Through it all, RIDOT has stayed at the forefront of the national conversation around BrM and contributed substantially to pilot projects and innovation.

6.3 RIDOT in the Digital Future

RIDOT and the Division of Statewide Planning (RIDSP) are preparing to adopt a fully-digitized project intake process. The "E-STIP" will build a comprehensive capital project planning and programming platform that incorporates project intake, financial planning, and public access.

The past, present, and future states of this system are illustrated in Exhibit 6.3.

Exhibit 6.3 Past, Present, and Future Capital Project Support at RIDOT



Project solicitations for the previous ten-year plan (FFY2018-2027) were collected through paper applications that were combined and manually entered into Microsoft Access, then eventually mapped. Conflicts could thus only be identified after the paper applications were digitized.

To develop the FFY2022-2031 STIP, RIDOT staff created an ArcGIS Online Web Application known as the "Bundler" which included polygons representing bridge, pavement, safety, and other major assets. Using the mapping interface, RIDOT staff worked to optimize projects given funding and scheduling constraints. The bundler also allowed RIDOT to assess such issues as ROW access, historic districts, and project harmonization to evaluate risk factors during the earliest stages of project planning. Funding was compiled using a "Capital Programming Interface" (CPI) capable of automatically tracking and reporting asset-level changes made in the Bundler. Once the STIP was adopted, RIDOT and RIDSP launched a public dashboard to view project information that has been accessed over 6,000 times.

In 2019, RIDOT and RIDSP also began to work with two vendors—PMG Software Professionals and Esri—to develop a fully digitized E-STIP software suite. The system will consist of three unique software applications sharing common, Esri-based map services of asset and project limits. Esri is developing the Statewide Intake Framework for Transportation (SWIFT), which will be used to manage project solicitations from municipalities, project scoring, evaluation, and scope development. SWIFT builds on the Bundler's core functionality by automating several laborious manual processes and installing geoprocessing modules to inform project readiness and budgeting.

When SWIFT launches, it will replace the RIDOT Bundler and information will pass from SWIFT to PMG STIP Manager, where funding is allocated and amendments to the STIP are tracked and processed. Finally, data will be passed to STIP Viewer for easy access to local partners and the public.

STIP Manager launched in late 2021 and replaced the CPI. Testing is ongoing for both SWIFT and STIP Viewer. Both are expected to launch during 2023.

6.4 Improving the Consistency Determination Process

As part of the certification process for this TAMP, RIDOT has proposed to FHWA that the ensuing annual Consistency Determination processed be improved.

Pursuant to 2022 guidance from FHWA-RI, RIDOT will implement the following improvements to the consistency determination process beginning in 2023:

- RIDOT will present updated condition projections for planned spending scenarios. The baseline projections are included in this TAMP in exhibits 2.13 through 2.16 (Pavement), and 3.13 (Bridges).
- RIDOT will include graphs of NHS condition performance over the preceding 3 to 5 years so FHWA-RI can review trend lines and evaluate how recent investment decisions have supported steady progress towards short- and long-term state-of-good-repair targets.
- Until such time that RIDOT adopts a financial system capable of differentiating between NHS and non-NHS expenditures, RIDOT will continue to submit spending for global expenditures including both NHS and non-NHS along with a baseline reference of planned expenditures at the time this TAMP was developed.

6.5 Concluding Thoughts

Since the passage of RhodeWorks in 2016, efficient asset management has been the guiding principle in every step taken by RIDOT to improve transportation infrastructure throughout the state. This TAMP documents the strategies that guide the department to make informed asset management decisions as it develops a 10-year plan to deploy the right treatment at the right time.

This TAMP presents the strategic and systematic processes that maximize asset life cycles and minimize capital costs by preserving roads and bridges through sustainable, resilient investments. The TAMP documents the ways in which the department pursues its primary objective of facilitating the safe and efficient movement of people and goods by achieving and maintaining SOGR for its network of roads and bridges.

Beyond this primary objective, this TAMP also serves other goals: leveraging technology and innovation; planning for a sustainable and resilient future by addressing risk and vulnerability; improving the performance of the transportation system; and effectively communicating RIDOT's asset management approach.

Per federal policy, RIDOT plans to publish the next edition of the TAMP in 2026 and every four years thereafter. In the interim, it will use the annual Consistency Determination process to document progress toward the performance targets in this document. The department anticipates that this TAMP will be a frequent point-of-reference for all stakeholders in a resilient, safe, and productive transportation system for Rhode Island.

FOCUS ON: TAMP Implementation Checklist

Throughout the TAMP, RIDOT has laid out specific activities for the next ten years that will help the department achieve its asset management goals. They are consolidated here for reference.

PAVEMENT

- Improve deterioration modeling for pavement using individual federal metrics.
- Implement dTIMS BA.
- Formalize pavement data management and documentation.
- Enhance LCP processes for pavement to directly incorporate risk.
- Increase frequency in inspection of pavement on network roads to twice annually.
- Document existing asset management processes for pavement.
- Establish a training program for pavement asset management.
- Advocate for additional pavement funding, with a focus on state funds.

BRIDGES

- Clarify the ownership and maintenance responsibility for bridges among entities.
- Expand the NBI to include bridges that are privately owned but accessed via public roads; temporary; or under construction.
- Keep records now required for bridge inspector skills, qualifications, and reporting lines.
- Develop the capability for VUEWorks to update the BrM database directly.
- Develop new bridge maintenance positions with specialties and artisan skills, including steelwork, masonry, joint repair, and painting.
- Advocate for additional bridge spending on rehabilitation and replacement beyond current large projects (I-95, US-6, RI-10, RI-37).

ENTERPRISE

- Develop planning tools for state and local communities focused on resiliency.
- Develop a federally-compliant Carbon Reduction Plan (CRP).
- Draft a Resilience Improvement Plan (RIP).
- Fully integrate GIS data on stormwater to incorporate drainage, water quality, and stormwater treatment elements into capital projects.
- Invest in succession planning for asset management experts.
- Deploy the Statewide Intake Framework for Transportation (SWIFT) to RIDOT's production environment.
- Develop a successor system to the PMP that will incorporate new functionality for electronic document storage and approval workflow tracking.

A. GLOSSARY

The Federal Highway Administration (FHWA), seeking to satisfy Federal Law in the Fixing America's Surface Transportation (FAST) Act of 2015 and the Bipartisan Infrastructure Law (BIL) of 2021, has required that the TAMP:

- Comply with 23 CFR 515, which sets the content required for a risk-based transportation asset management plan (TAMP) to be updated every four years beginning in 2018.
- Summarize RIDOT's progress toward data and risk-based management of its pavements and bridges on the National Highway System (NHS).
- Describe how RIDOT considers extreme weather and resilience in life-cycle planning, investment strategy, and risk management.

Asset management plan means a document that describes how a State DOT will carry out asset management[11] as defined in this section. This includes how the State DOT will make risk-based decisions from a long-term assessment of the National Highway System (NHS), and other public roads included in the plan at the option of the State DOT, as it relates to managing its physical assets and laying out a set of investment strategies to address the condition and system performance gaps. This document describes how the highway network system will be managed to achieve State DOT targets for asset condition and system performance effectiveness while managing the risks, in a financially responsible manner, at a minimum practicable cost over the life cycle of its assets. The term asset management plan under this part is the risk-based asset management plan that is required under 23 U.S.C. 119(e)[12] and is intended to carry out asset management as defined in 23 U.S.C. 101(a)(2).[13]

11 https://www.ecfr.gov/current/title-23/chapter-I/subchapter-F/part-515
12 https://www.govinfo.gov/link/uscode/23/119
13 https://www.govinfo.gov/link/uscode/23/101

Exhibit A.1 Definitions of Common Terminology

AAFS	Asset Analytics and Forecasting System | NHDOT's name for dTIMS and other related systems, visualizations, and analytics.
BIL	Bipartisan Infrastructure Law (also the IIJA)
CFR	Code of Federal Regulations | A codification of the general and permanent rules published in the Federal Register by the Executive departments and agencies of the Federal Government, based on an interpretation of the U.S. Code.
dTIMS	Deighton Total Infrastructure Management System
FHWA	Federal Highway Administration
GACIT	Governor's Advisory Commission on Intermodal Transportation | Consisting of the five Executive Councilors in NH and the Commissioner of NHDOT, the Commission advises the Governor on transportation topics.
GARVEE	Grant Anticipation Revenue Vehicle | Bonds or other financing that will be repaid using expected future federal funding
IIJA	Infrastructure Investment and Jobs Act (also the BIL)
MPO	Metropolitan Planning Organization | There are 4 MPOs in NH: Nashua Regional Planning Commission, Rockingham Planning Commission, Southern NH Planning Commission, and Strafford Regional Planning Commission.
SAB	State Aid Bridge, also known as the Bridge Aid Program, a state funded, application-based program that provides assistance to municipalities for bridges.
SB 367	Senate Bill 367 | Legislation in NH that primarily increased the road toll (gas tax) by 4.2 cents per gallon to support bond payments for the I-93 Improvement project.
STIP	State Transportation Improvement Program | A 4-year document that is updated biennially and combines the products of 4 TIPs and the TYP into a statewide fiscally constrained list of Federally aided or regionally significant projects.
TIFIA	Transportation Infrastructure Finance and Innovation Act | Credit assistance for qualifying projects from the US Department of Transportation.
TIP	(Regional) Transportation Improvement Program | A program of projects that is financially constrained and managed by an MPO. The 4 MPOs in NH produce TIPs that are integrated into the STIP.
TYP	Ten Year Transportation Improvement Plan | A 10-year program of all transportation projects, updated biennially, approved by GACIT, the Legislature, and signed into law by the Governor, most recently for 2023-2032.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