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TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Bridge Management Systems for Strategic Asset Management

April 5, 2023

2:00 – 3:30 PM

NOVEMBER 2022 UPDATE

PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.

ENGINEERING
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REGISTERED CONTINUING EDUCATION PROGRAM

AICP Credit Information

1.5 American Institute of Certified Planners Certification Maintenance Credits

You must attend the entire webinar

Log into the American Planning Association website to claim your credits

Contact AICP, not TRB, with questions

Purpose Statement

This webinar will present the findings from a national scan aiming to help identify common features and approaches agencies are using to successfully implement systems within their TAMPs. Presenters will share the current uses and challenges of BMS in strategic asset management and in TAMP processes.

Learning Objectives

At the end of this webinar, you will be able to:

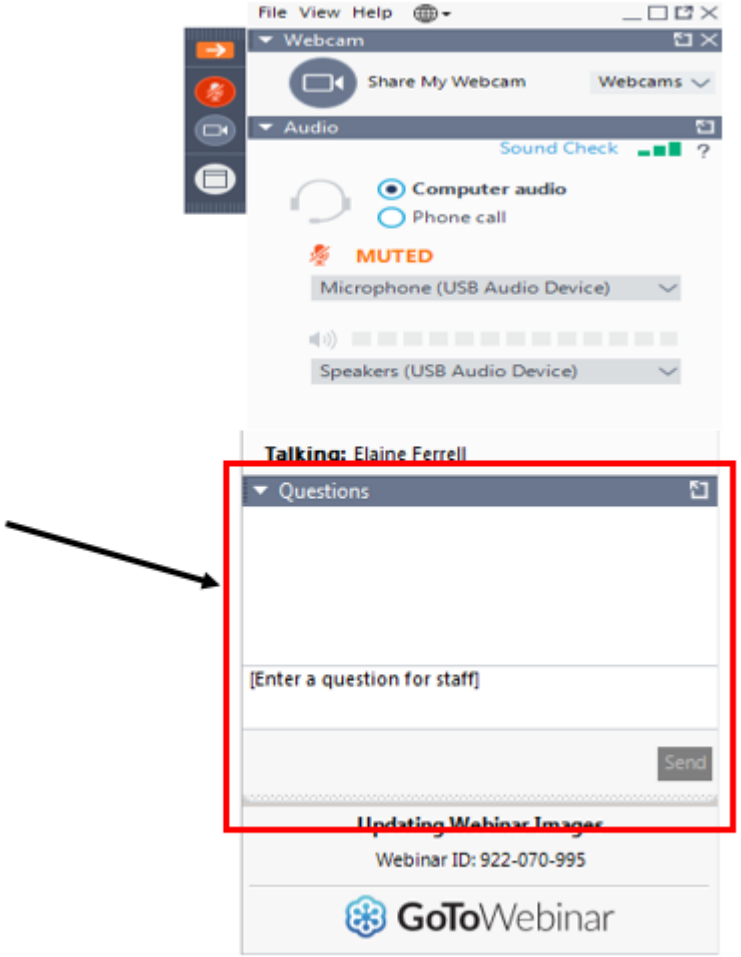
(1) Identify the current use of BMS in strategic asset management

(2) Identify various uses of BMS in TAMP processes

(3) Evaluate challenges of using BMS in TAMPs and asset management

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters

Michael Johnson
California DOT
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Minnesota State University, Mankato

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NCHRP 20-68A
US Domestic Scan Program

Overview of the Domestic Scan on Transportation Asset Management and Bridge Management

Domestic Scan 20-01
"Successful Approaches to Utilizing Bridge Management Systems for Strategic Decision Making in Asset Management Plans"

Findings, Conclusions and Recommendations

Başak Bektaş, Ph.D.
Assistant Professor of Civil Engineering
Minnesota State University, Mankato

ARORA and ASSOCIATES, P.C.
Consulting Engineers

35th ANNIVERSARY 1981 - 2016

Domestic Scan 20-01

"Successful Approaches to Utilizing Bridge Management Systems for Strategic Decision Making in Asset Management Plans"

- This scan was conducted as a part of NCHRP Project 20-68D, the U.S. Domestic Scan program

- The program was requested by the American Association of State Highway and Transportation Officials (AASHTO) Committee on Construction (SOC), with funding provided through the National Cooperative Highway Research Program (NCHRP)

NCHRP 20-68A
U. S. Domestic Scan Program

- The Program is a multi year project conducting 3-4 scans per year.
- Each scan is selected by AASHTO and the NCHRP 20-68D Project Panel
- Each scan addresses a single technical topic of broad interest to many state departments of transportation and other agencies
- The purpose of each scan and of Project 20-68D as a whole is to accelerate beneficial innovation by:
  - facilitating information sharing and technology exchange among the states and other transportation agencies
  - identifying actionable items of common interest

NCHRP Panel's General Guidance to the Scan Team

"This scan will help identify common features and approaches being used by agencies to successfully use BMS within the overall transportation asset management context. Particular attention will be given to examination of leading practices for predicting future bridge condition and developing deterioration curves. The Scan Team will investigate agency practices and case studies that illuminate such concerns as (1) data collection and management, (2) performance measure tracking and reporting, (3) use of component- and element-level data to track and forecast bridge condition, (4) usage of BMS data to convey condition information, and (5) agencies' knowledge transfer strategies to sustain staff qualified to operate their BMS."

NCHRP Panel's General Guidance to the Scan Team (Cont.)

" By documenting and sharing successful practices the scan team will produce a valuable resource for use by agencies in effectively integrating BMS data into their TAMP to successfully improve or preserve the condition of the assets and the performance of their system. The audiences for this information would include AASHTO Committee on Performance-Based Management, Committee on Bridges and Structures, asset management and bridge preservation staff within state, local or other transportation agencies."

Scan Team

Chad A. Allen, P.E. – Team Chair
Asset & Performance Manager
City of Seattle DOT

Kevin Marshia
Vermont Agency of Transportation

Richard W. Runyen, P.E. , Section Chief
Pennsylvania DOT

John L. Hibbard, P.E., Operations Division Director
Georgia DOT

Chester Kolota, P.E., Bridge Management Engineer
Maine DOT

Paul Vaught, Bridge Design Section
Louisiana DOTD

Edward N. Austin, P.E.
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Alabama DOT

C. Todd Springer, P.E., Program Manager
Bridge Maintenance and Management Program Area
Virginia DOT

Felix Padilla
State Bridge Inspection Engineer, Structure Operation Section
Florida DOT

Scott Neubauer, P.E. ,
Bridge Maintenance and Inspection Engineer
Iowa DOT

Rebecca Curtis, Bridge Management Engineer
Michigan DOT

Edward Lutgen
State Bridge Construction and Maintenance Engineer.
Minnesota DOT

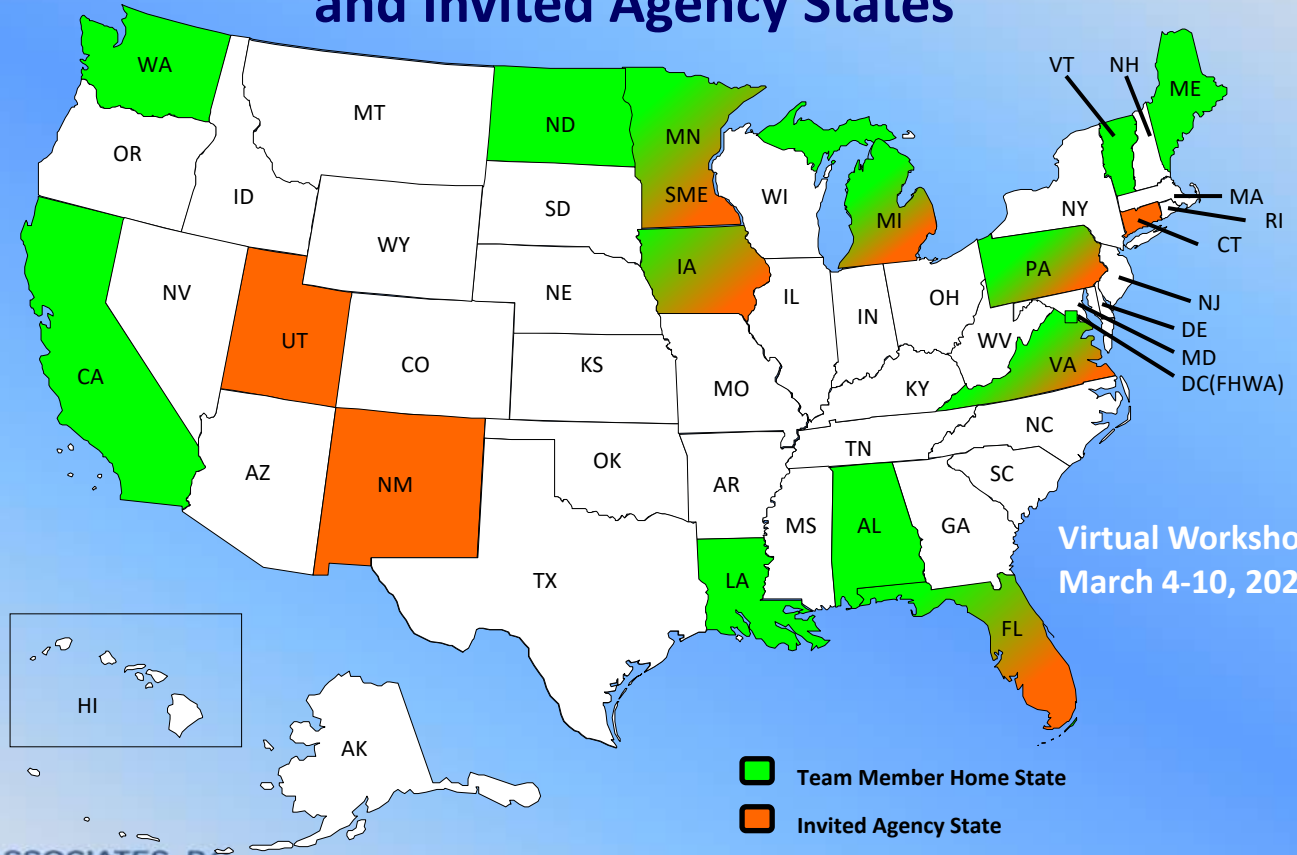
Mike Johnson, State Asset Management Engineer
California Department of Transportation

DeWayne Wilson, P.E. , Bridge Asset Management Engineer
Washington State DOT

Derek Constable, Bridge Management Engineer
FHWA - Office of Bridges & Structures

Başak Bektaş, Ph.D. - SME
Assistant Professor of Civil Engineering
Minnesota State University, Mankato

Scan 20-01 Team Members Home States and Invited Agency States



Virtual Workshop
March 4-10, 2021

ARORA and ASSOCIATES, P.C.
Consulting Engineers

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Findings by Focus Area

Data Collection and Management

- Custom inspection tools and databases.
- Established QC& QA processes but room for improvement.
- Development and use of data, models and tools led to identification of needs, such as collection of bridge preservation work data and additional data attributes.
- Great uses of GIS such as partially viewing risks.
- Identifying and collecting data attributes for risk is an area for improvement.

Performance Measure Tracking and Reporting

- Custom performance measures, which are mostly condition driven.
- Dashboards-visibility of information increases chances of increased/sustained funding.
- Long-term reporting of performance measures and analysis results inform long-term financial investment needs.
- There is a national need to better identify, quantify and combine risks into performance measures and integrate risk into overall asset management process.
- There is a need to better understand and model how much to invest in pavements versus bridges.
- Managing to a bridge health index may inform preservation decisions better, custom but few uses of Bridge Health Index.

Use of Component- and Element-Level Data to Track and Forecast Bridge Condition

- Component-level data (G/F/P) is mostly used, element-level data use is limited.
- Good/Fair/Poor does not cover all bridge conditions, use of SEVERE.
- Use of decimal GCRs for analysis and accounting for time within a GCR.
- Need: deterioration curves that factor variability in condition, age, environment or other significant variables.
- Element condition data to track condition and program maintenance needs.
- National need: Correlating element condition to GCRs with improved accuracy.

Use of BMS Data to Convey Condition Information

- Using GIS for supporting cross-asset project decisions or improved corridor management.
- Great charts/visuals that communicate both condition and change in condition trends (e.g., Michigan DOT Cycle of Life).
- Some agencies had great success in communicating with decision makers using BMS scenario analyses. They were able to make a case for increased funding and inform decision makers of future needs.

Agencies' Knowledge Transfer Strategies

- Hiring and sustaining qualified staff to operate BMSs is a shared challenge for all agencies.
- Commitment from upper management is needed to support strategies such as double filling (the person who is ready to retire trains the incoming person for a while), which will improve knowledge transfer.
- Agencies need time and opportunities for training and exploring BMSs, which are complex tools and require a learning curve.
- Documentation is key for knowledge transfer. Bridge management manuals and decision trees were great examples of documentation. However, documentation is not a top priority when agencies are understaffed.

Insights from Asset Management Practitioners

- Asset management contacts from Connecticut, Iowa, Minnesota, New Mexico and Utah responded.
- Information for setting performance management targets (PM2), TAMP life cycle planning requirements and TAMP investment scenarios are typically provided from the bridge management staff.
- BMS are used in various ways to gather or analyze agency data to provide these inputs, particularly to investigate the impact of alternative funding scenarios on the bridge network over time.
- TAMP risk management is typically not directly linked to BMS and falls under the agency asset management umbrella with exceptions.

Insights from Asset Management Practitioners

- BMS are not utilized to address the CFR 667 requirements directly.
- Establishment of funding levels for bridges and pavement: the TAMP, BMS analysis, a combination of both or other analysis?

The process varied and while BMS analysis informed the funding levels for some agencies, analysis outputs were utilized rather to inform future investment direction.

Insights from Asset Management Practitioners

- TAMP has influenced their bridge programs for the better.
  - Realization for needs, such as increased staffing and data-driven decision making, improving data quality, a shift to proactive AM approach instead of worst-first

Insights from Asset Management Practitioners

- Communications and any beneficial connections between the TAMP and BMS efforts?
  - Committees, groups with representation for improved communication and implementation.
  - Room for improvement.
- Does BMS inform treatment level investments?
  - BMS influences these decisions for a few agencies but typically the connection is missing.

Insights from Asset Management Practitioners

- How does the AM team work with the BMS owners and the bridge asset owners to develop a performance-based planning and programming (life cycle planning) approach?
  - This appears to be an area that most agencies are trying to improve upon.

Recommendations

- State and national bridge, pavement and asset management groups should coordinate and form task forces with shared membership or meet regularly to produce a roadmap to improve the use of BMS in asset management decision making and better coordination of BMS use within asset management.
- Agencies need to have a strategic vision and process to guide BMS and incorporate BMS information into overall asset management. Agencies that coordinate at a strategic level have better success.
- Executives should support hiring qualified staff, strategies to maintain agency knowledge, and research to support BMS implementation.

Recommendations

- Agencies should start exploring element condition data to identify, track and model bridge work.
- Data on cost and impact of bridge work needs to be systematically documented.
- Agencies should consider long-term analysis and scenario planning to inform long-term financial planning and improved communication with elected officials.
- Future data needs should be discussed and planned based on the recent TAMP development experience. Agencies should identify additional data needs that can be used to improve BMS modeling framework or consider refinement if data items are no longer helping with bridge management decision making.

Recommendations

- National and state research is needed on a variety of topics to improve BMS modeling. Main research topics are deterioration modeling, cost modeling, life cycle cost modeling, element to GCR conversion, developing element-based performance measures/health indices, risk modeling, developing alternative performance measures to better facilitate cross-asset resource allocation.
- Quality data is needed for good decision-making. Agencies should consider adapting good practices of QC and QA or add to existing practice.
- Asset and bridge management professionals need closer coordination and stronger collaboration to communicate a unified risk and performance-based message to secure funding to ensure future sustainability.
- There is a future opportunity for asset and bridge teams to perform internal cross-training to promote understanding, reduce silos, and enhance communications and knowledge transfer.

You can find the scan report below:

SCAN20-01.pdf (trb.org)

Further information on this scan and the NCHRP 20-68D U.S. Domestic Scan program is available at:

http://144.171.11.40/cmsfeed/TRBNetProjectDisplay.asp?ProjectID=1570

Or

http://www.domesticscan.org/

Questions?

pennsylvania

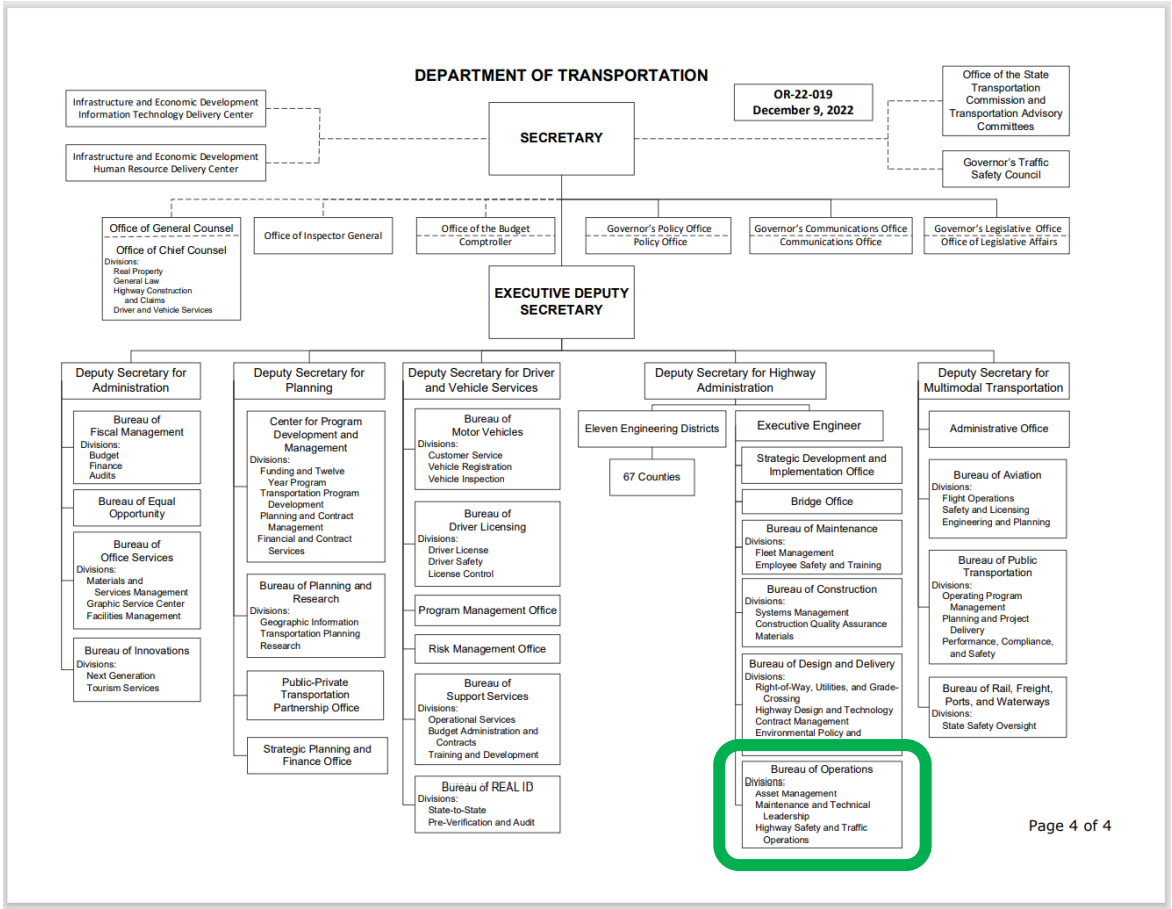
DEPARTMENT OF TRANSPORTATION

BMS Webinar

Justin Bruner, P.E.
Asset Management Engineer
PennDOT BOMO, Asset Management Division


40,000
Miles of Roadway
25,400
Bridges
$10.2 Billion
Budget
$2.4+ Billion
Annual Construction Contracts Awarded
11,375 Employees
7,200 Maintenance Employees
53
Transit Systems
64
Operating Railroads
pennsylvania
DEPARTMENT OF TRANSPORTATION
3
Ports
128
Public Use Airports
10.3 Million
Licensed Drivers & ID Holders
11.8 Million
Registered Vehicles
102 Billion
Annual Vehicle Miles Traveled
2,440
Miles of BicyclePA Routes
LB (8-18)

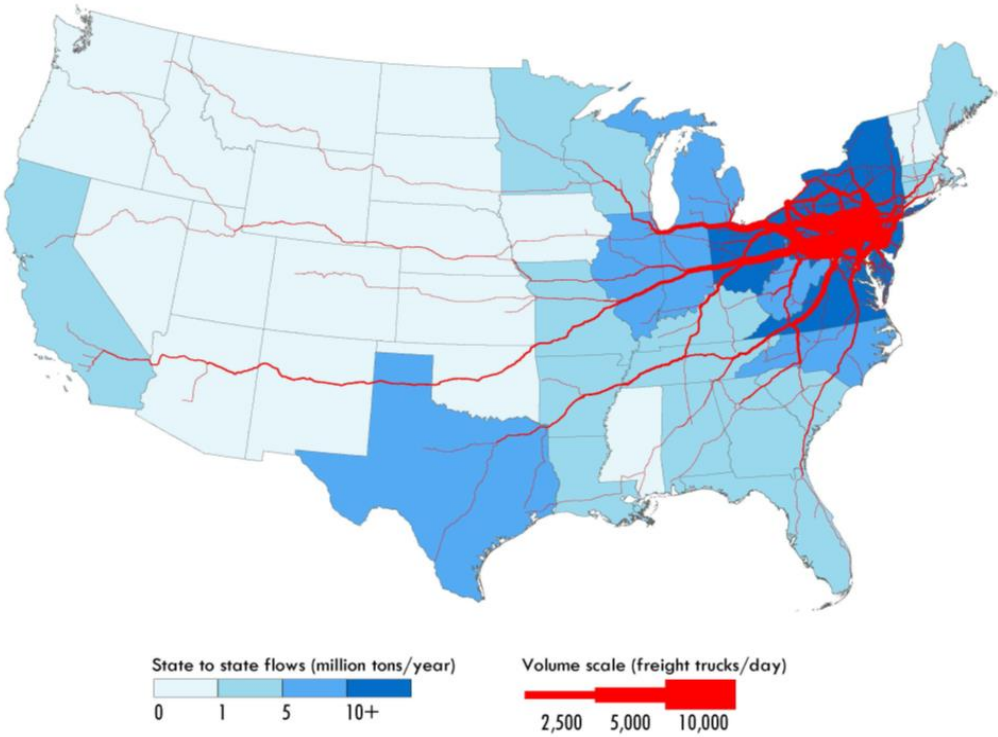
ORGANIZATION



BACKGROUND INFORMATION

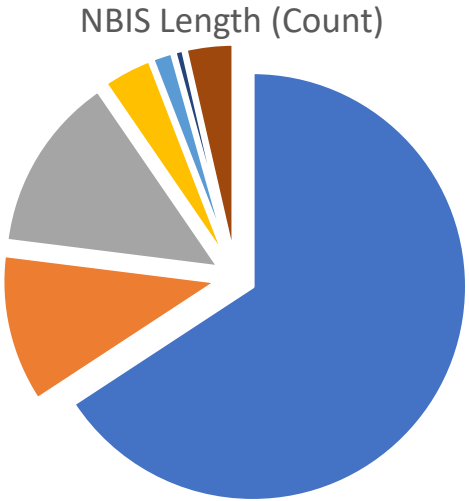
- **5th** in population in USA
- **Truck Traffic**: Carlisle, PA is a 10hr drive from 50% of the population in the US
- **86K** miles of streams, 6 rivers
- Oldest/largest inventory in NE:

  PA has more roads than all of the New England states combined!
- "Rust belt" member



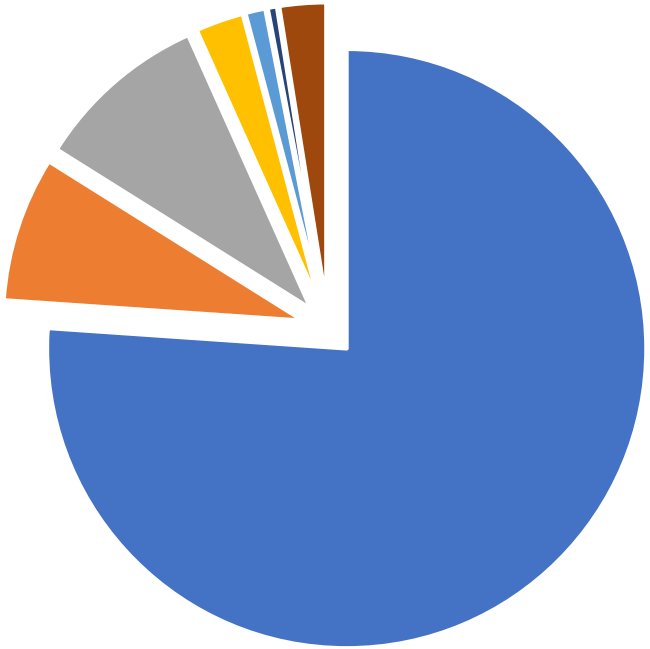
BACKGROUND INFORMATION

NBIS Length (>20’)



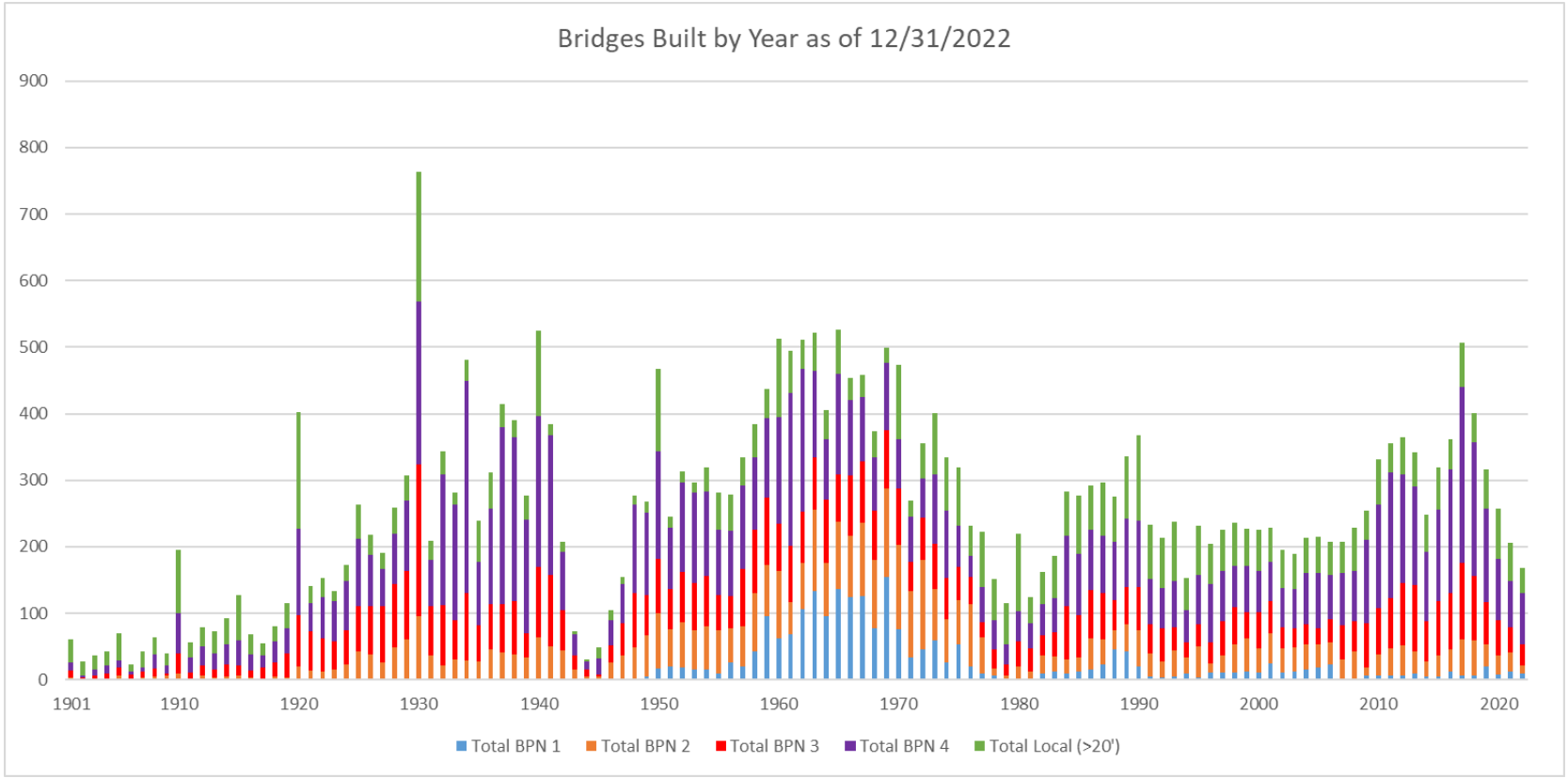
15K State, 8K other owners

All Bridges (>8’)



25K State, 8K other owners

BACKGROUND INFORMATION



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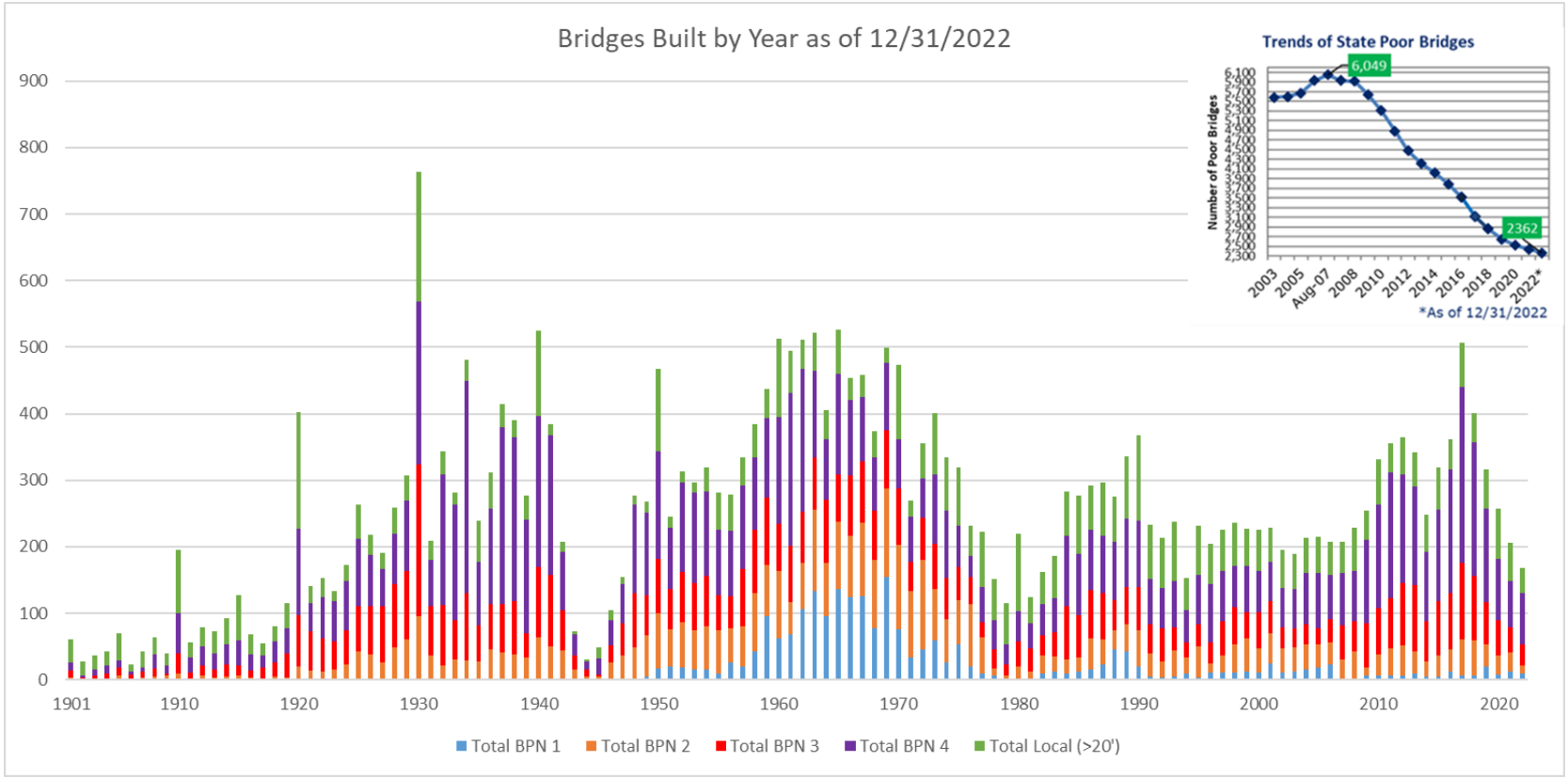
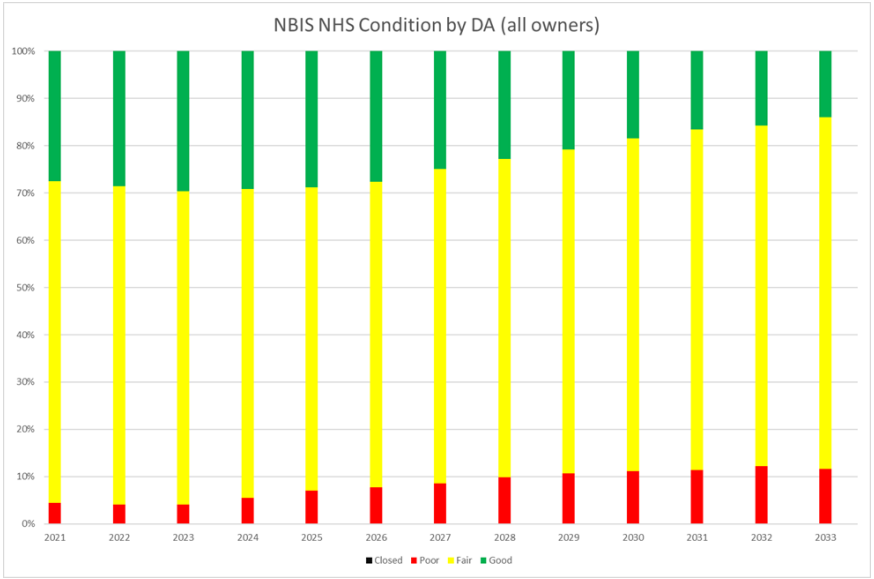
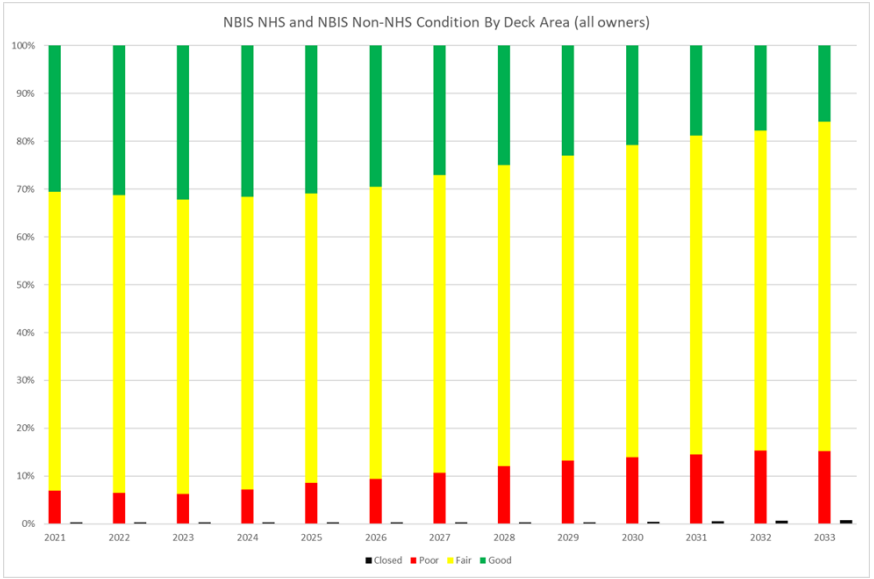


BACKGROUND INFORMATION

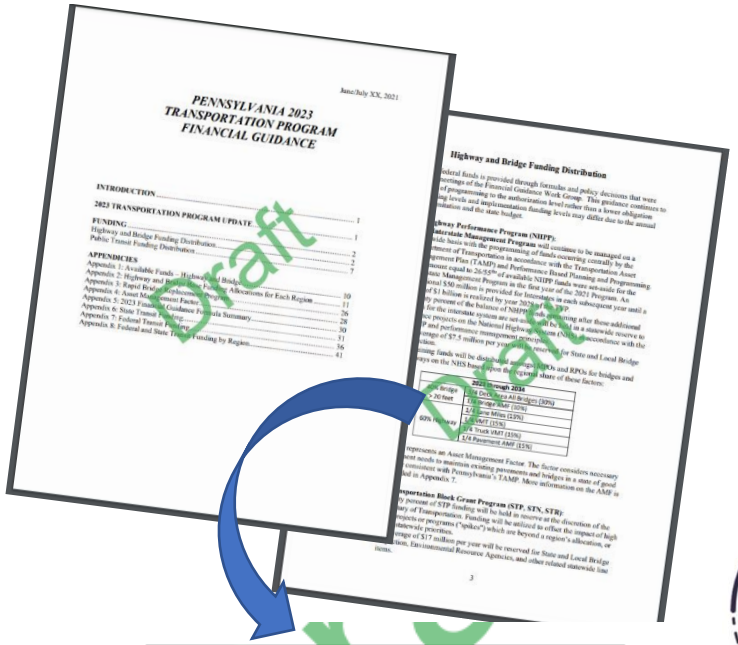
NHS



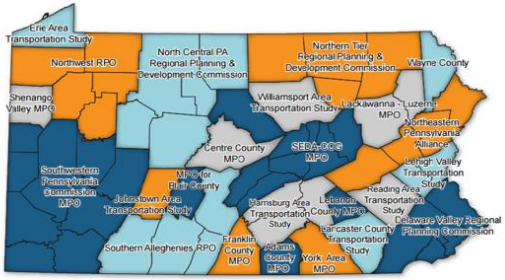


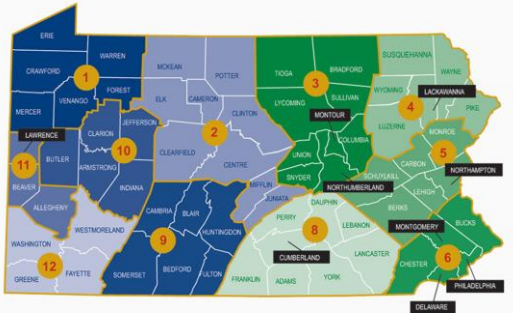
All networks

DISTRIBUTION

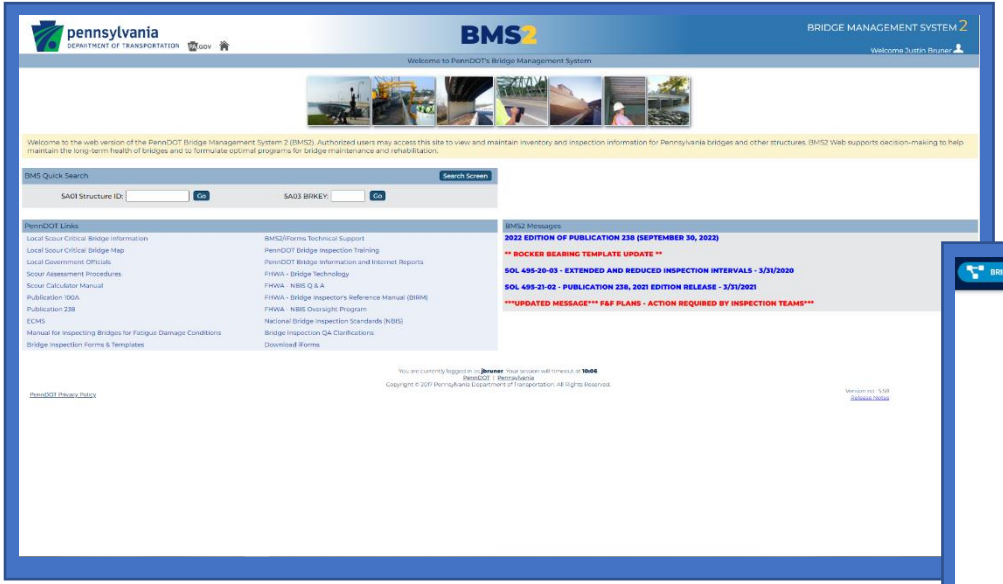


2023 through 2034	
40% Bridge > 20 feet	3/4 Deck Area All Bridges (30%)
	1/4 Bridge AMF (10%)
60% Highway	1/4 Lane Miles (15%)
	1/4 VMT (15%)
	1/4 Truck VMT (15%)
	1/4 Pavement AMF (15%)



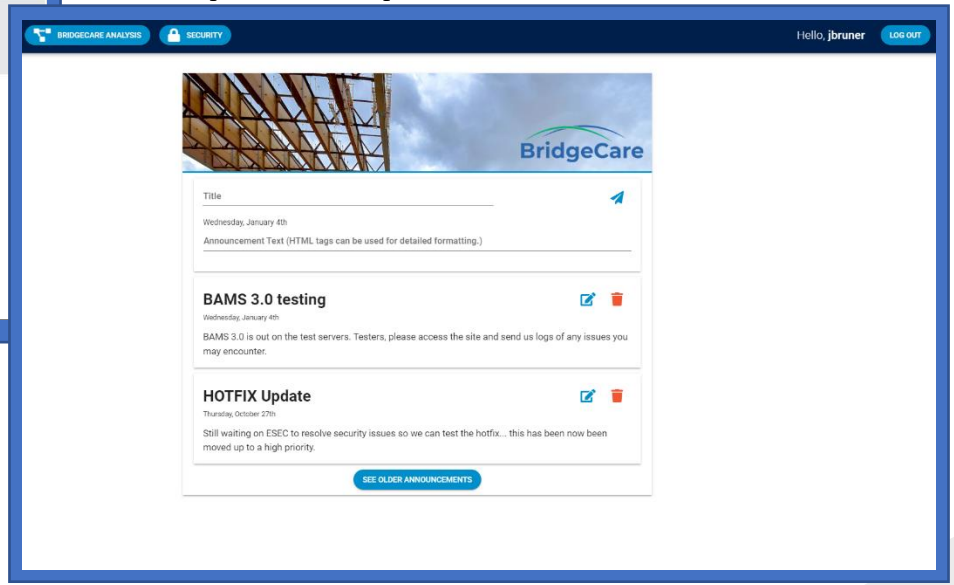


SYSTEM



Bridge Management System v2 (BMS2)

Bridge Asset Management System (BAMS)



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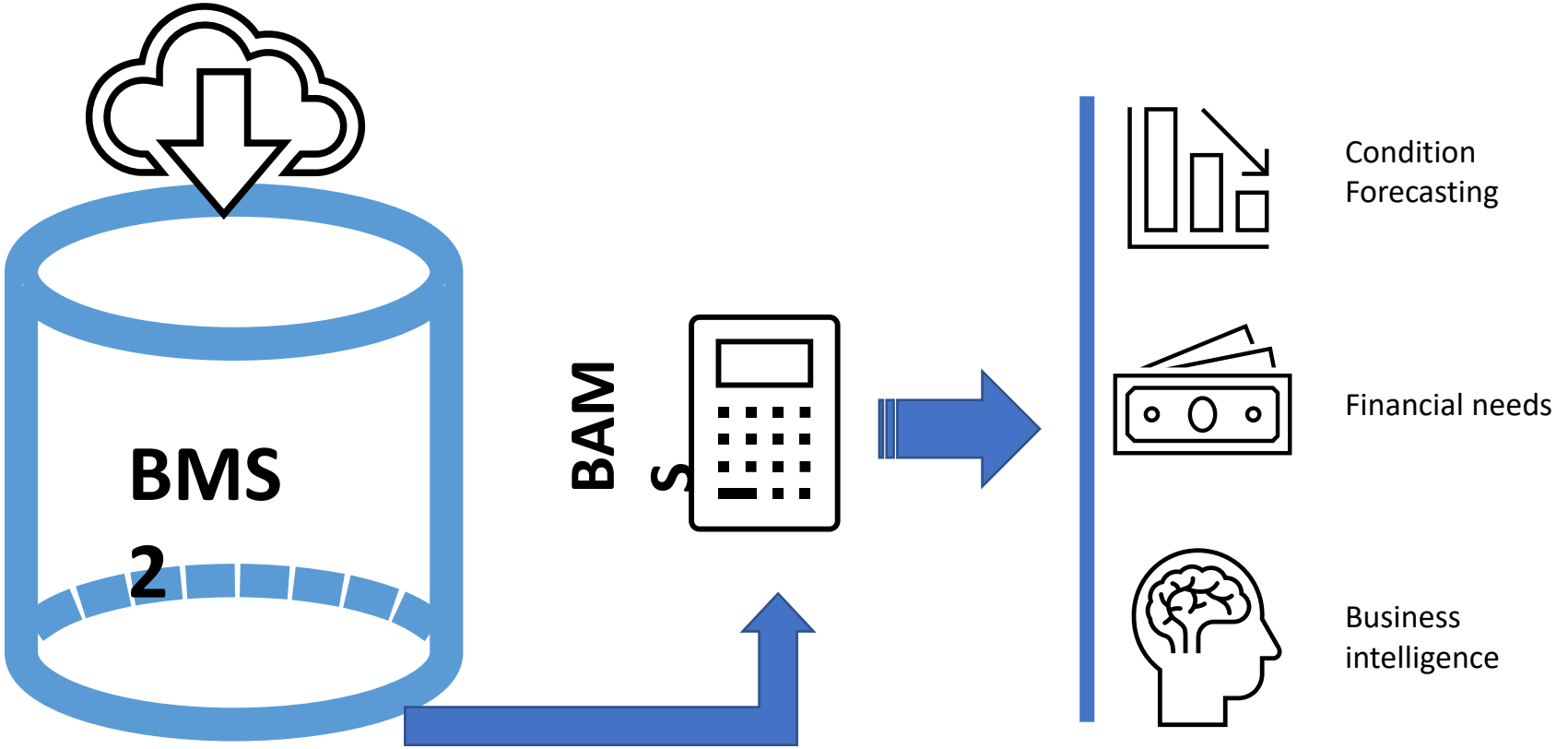
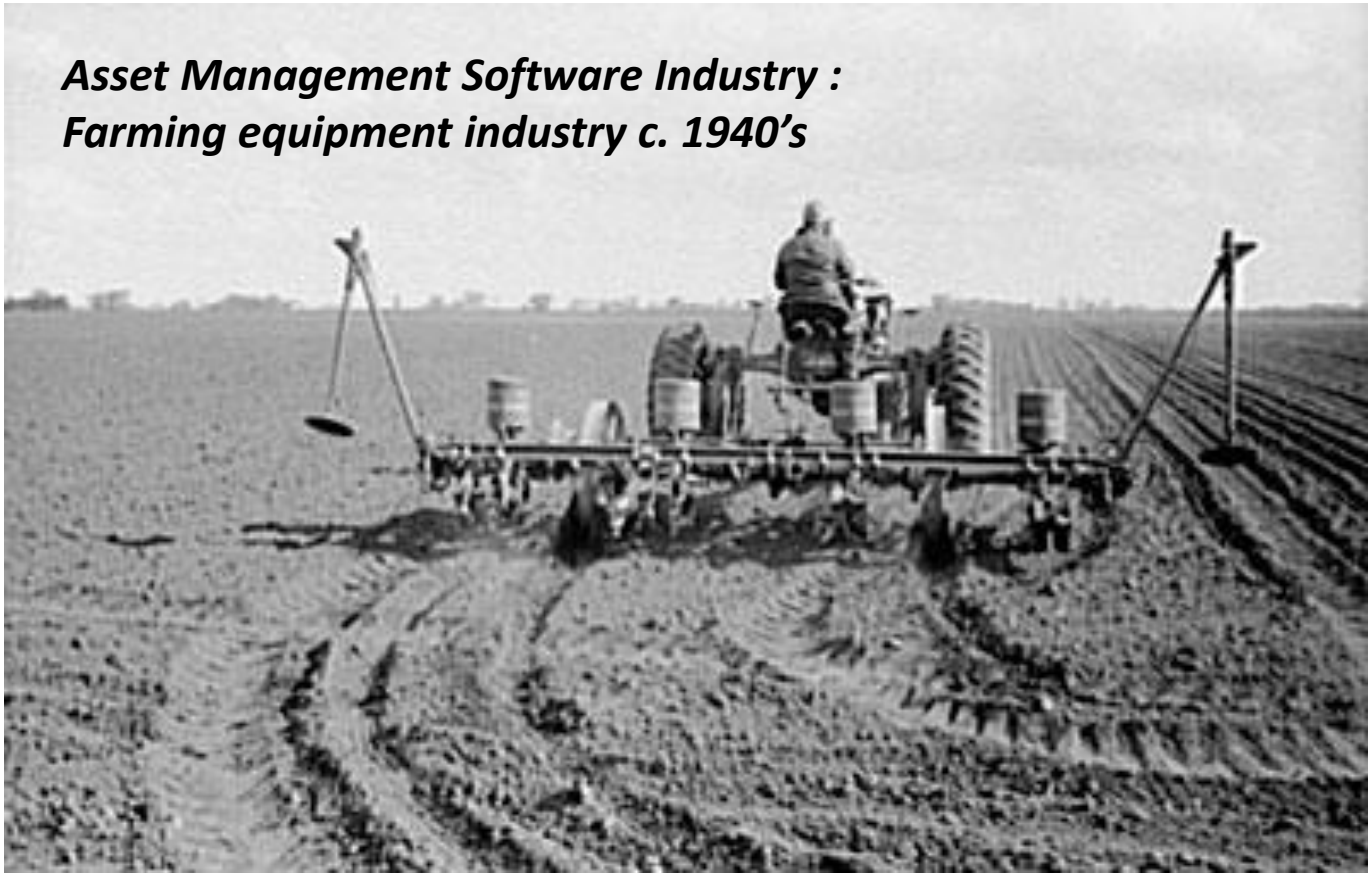
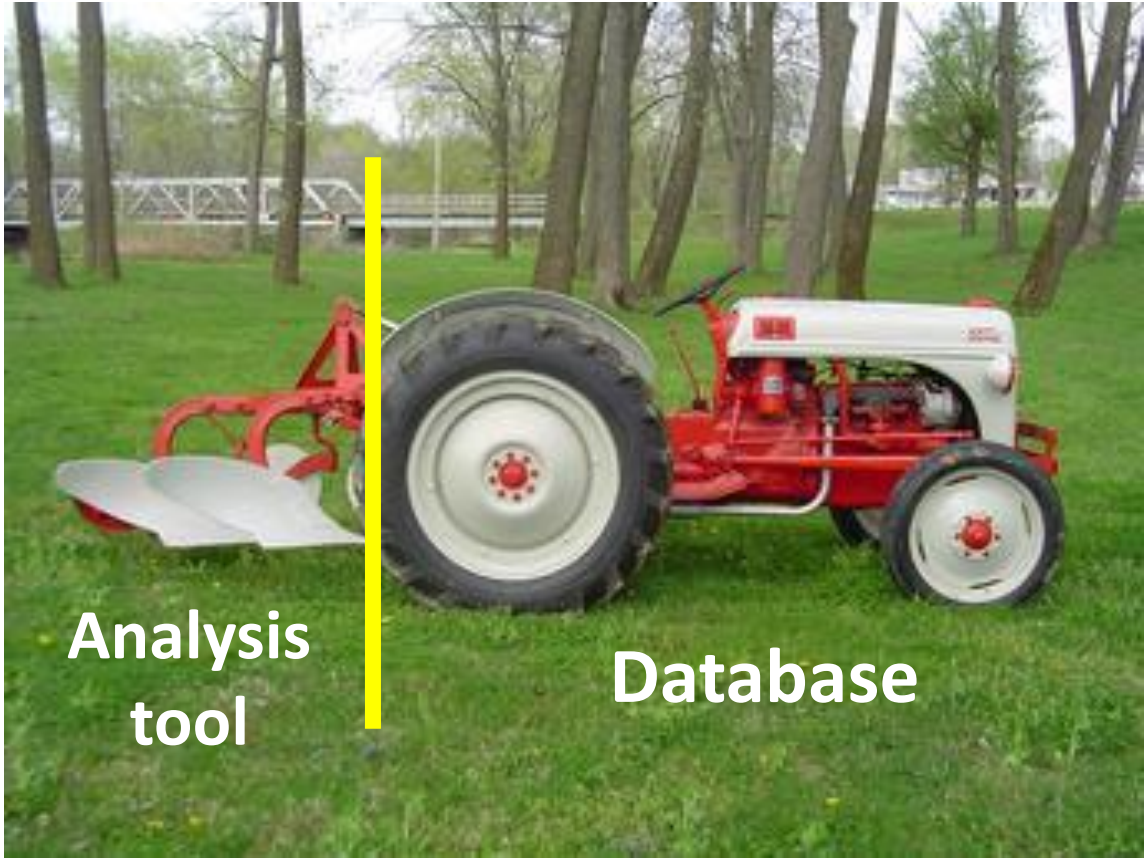

BMS 2
BAMS
Condition Forecasting
Financial needs
Business intelligence

SYSTEM



- Component level advancement
- Industry trend for sole-source provider
- Resultant "Vendor lock-in"

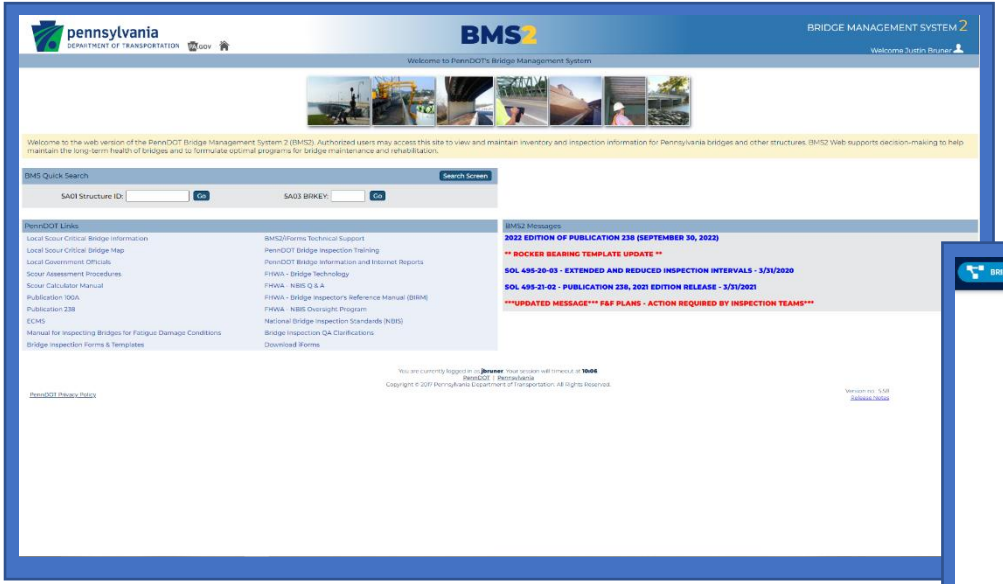
SYSTEM



SYSTEM

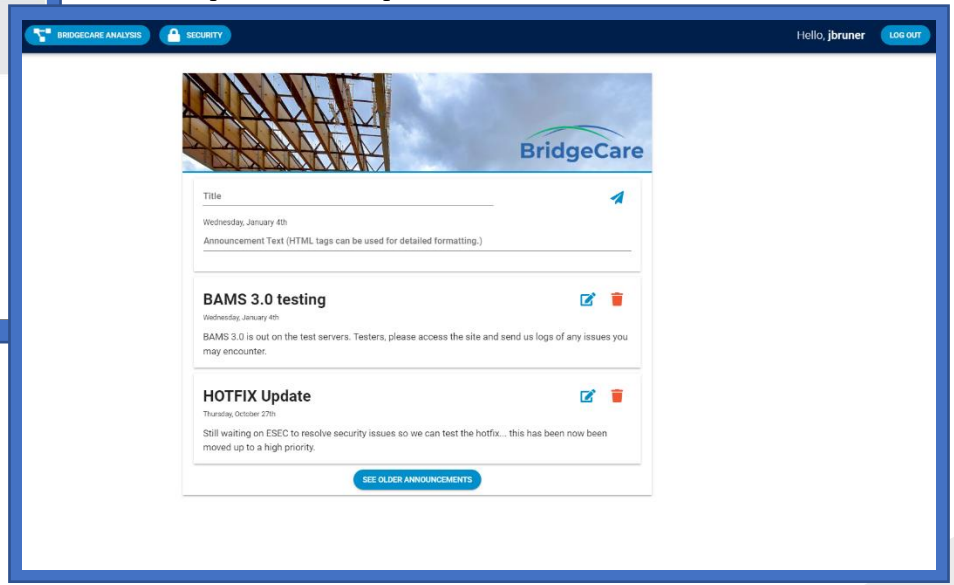
- 1950's- farming industry explosion due to standardized interface
- PennDOT AM software output requirement:
  - *Recommended treatment per asset, per year*
- **Goal: *actionable intelligence***

SYSTEM



Bridge Management System v2 (BMS2)

Bridge Asset Management System (BAMS)



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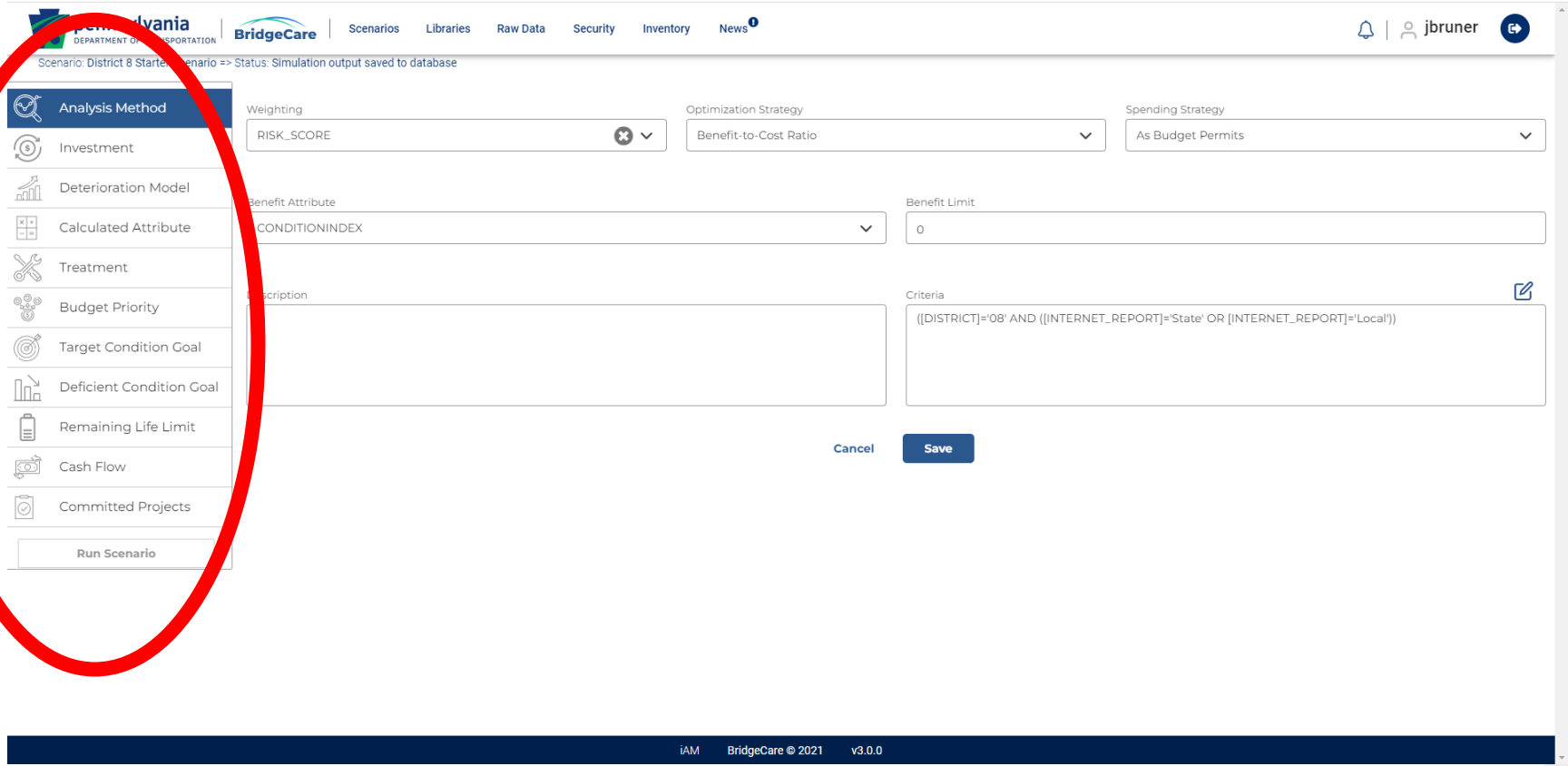
BridgeCare
Scenarios
Libraries
Raw Data
Security
Inventory
News
jbruner
Scenario: District 8 Starter Scenario => Status: Simulation output saved to database
Analysis Method
Investment
Deterioration Model
Calculated Attribute
Treatment
Budget Priority
Target Condition Goal
Deficient Condition Goal
Remaining Life Limit
Cash Flow
Committed Projects
Run Scenario
Weighting
RISK_SCORE
Optimization Strategy
Benefit-to-Cost Ratio
Spending Strategy
As Budget Permits
Benefit Attribute
CONDITIONINDEX
Benefit Limit
0
Criteria
([DISTRICT]='08' AND ([INTERNET_REPORT]='State' OR [INTERNET_REPORT]='Local'))
Cancel
Save
iAM
BridgeCare © 2021
v3.0.0

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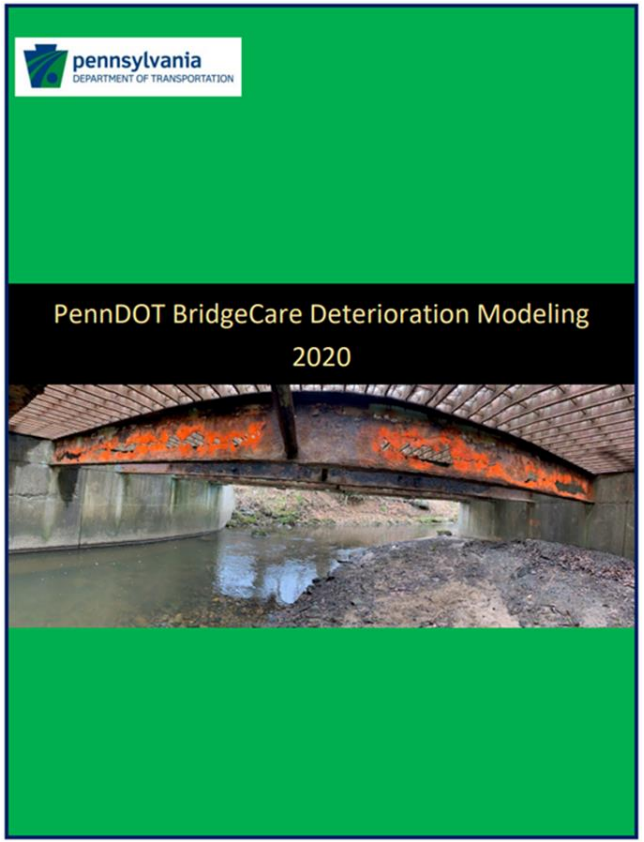
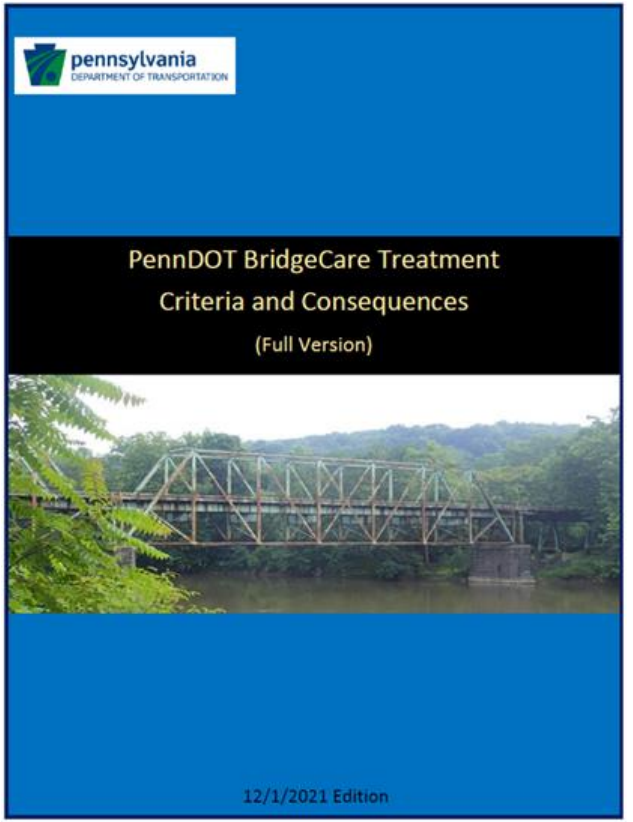
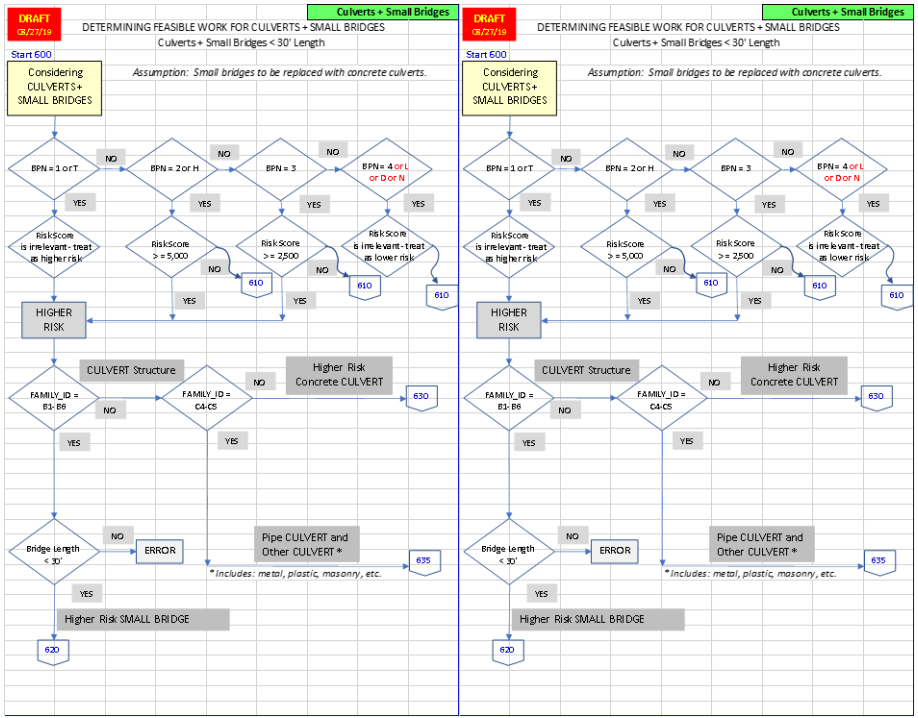

pennsylvania
DEPARTMENT OF TRANSPORTATION
PennDOT BridgeCare Deterioration Modeling
2020


pennsylvania
DEPARTMENT OF TRANSPORTATION
PennDOT BridgeCare Treatment
Criteria and Consequences
(Full Version)
12/1/2021 Edition

SYSTEM



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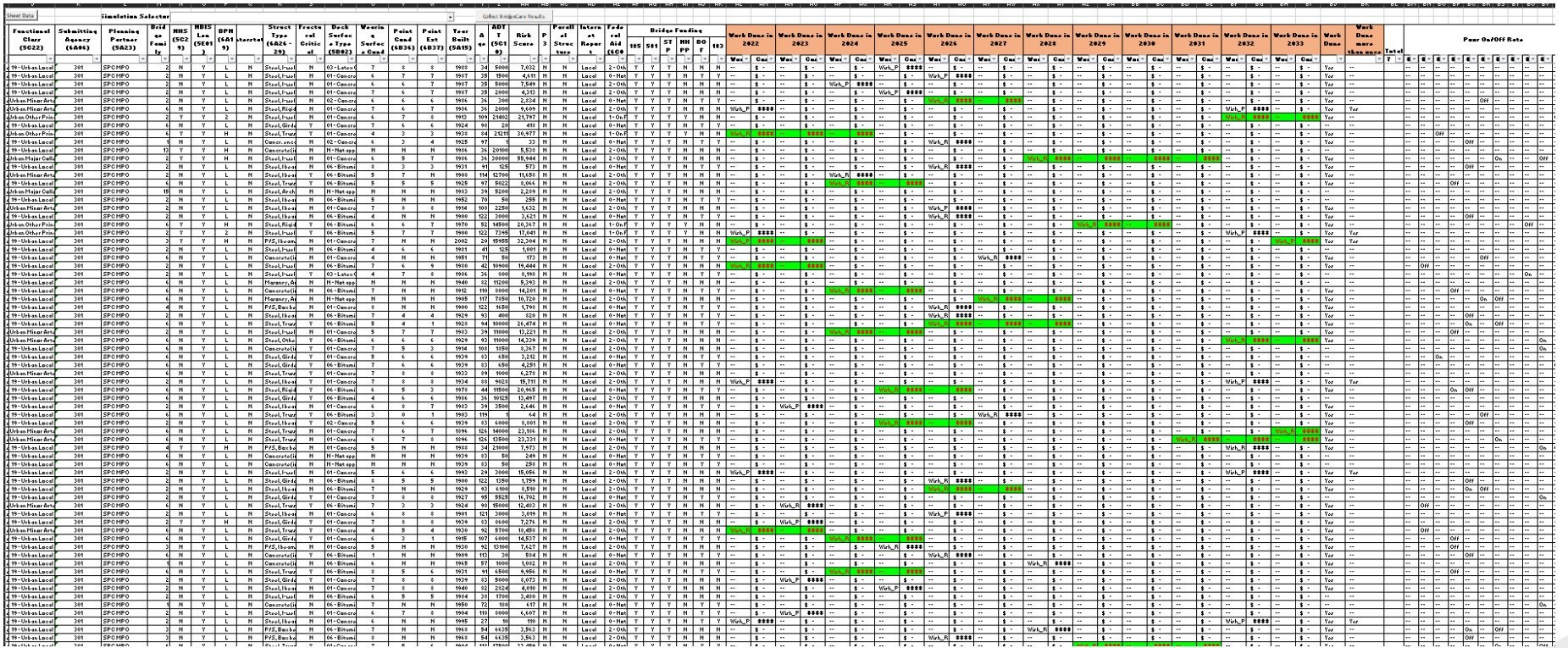
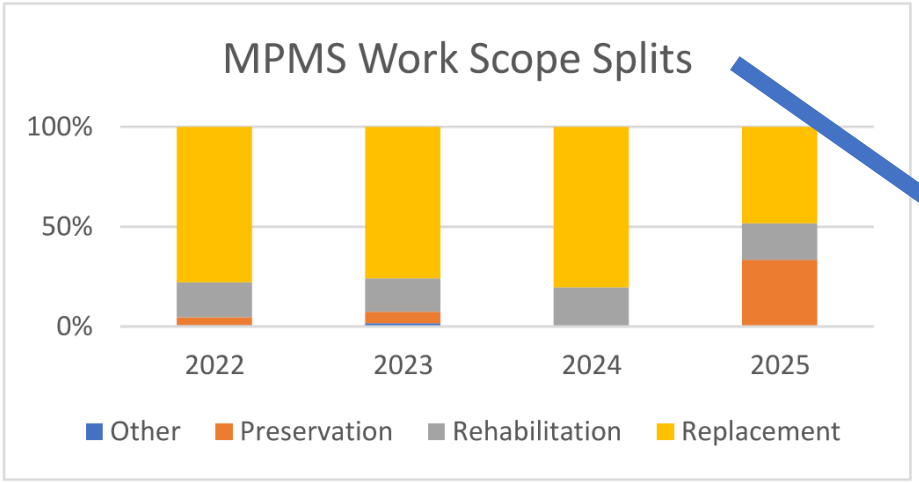
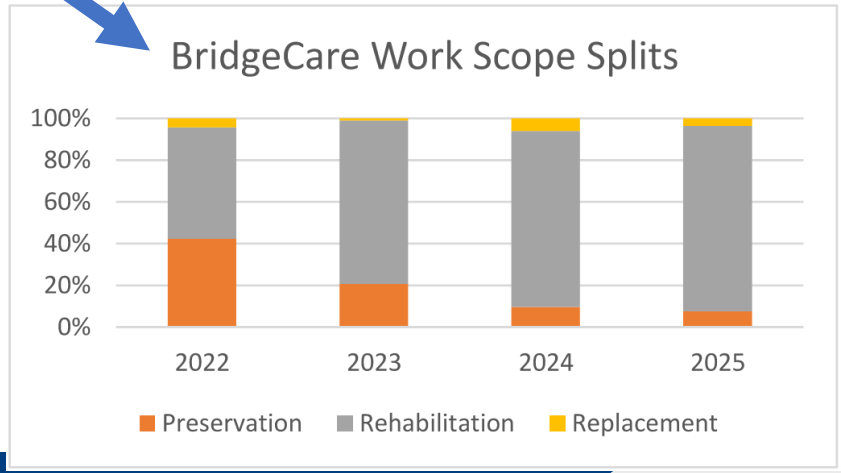
OUTPUTS



BRIDGE PLANNING

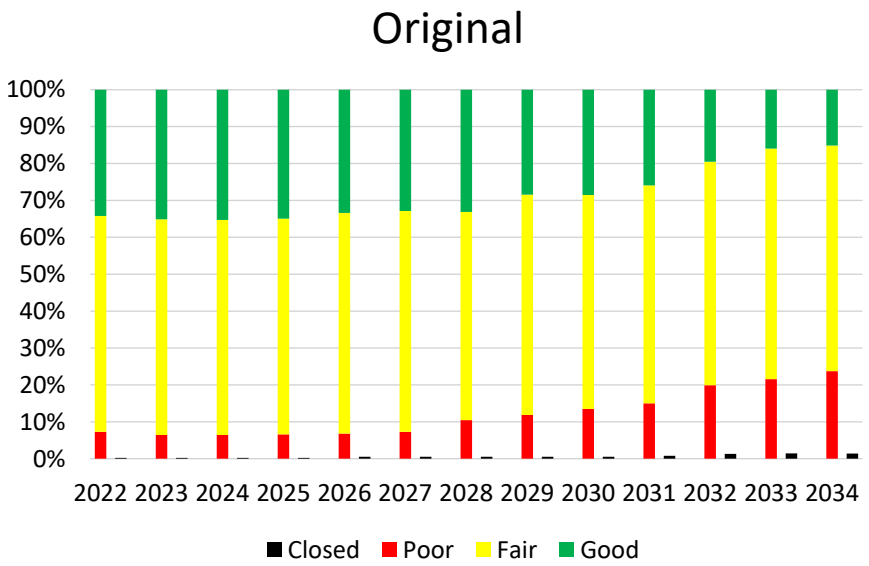
- Steps to implement LLC change

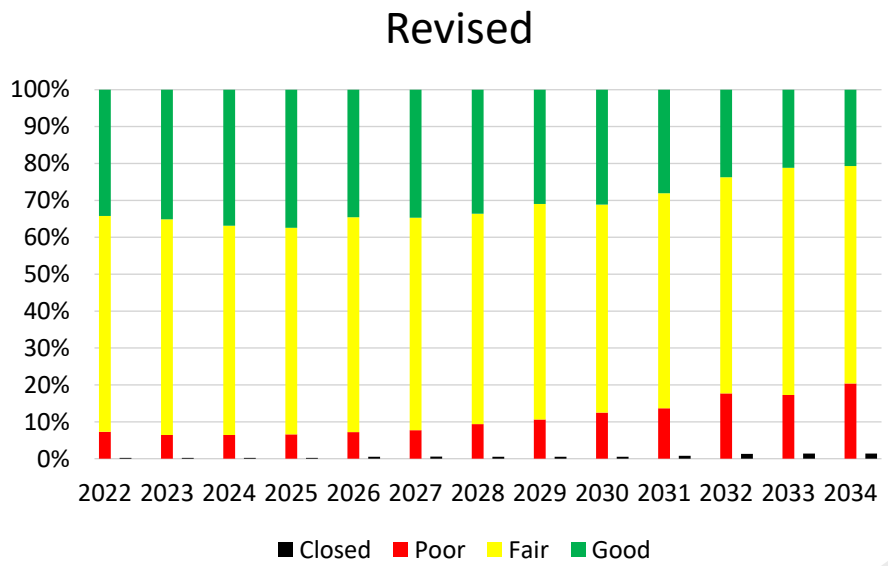




BRIDGE PLANNING

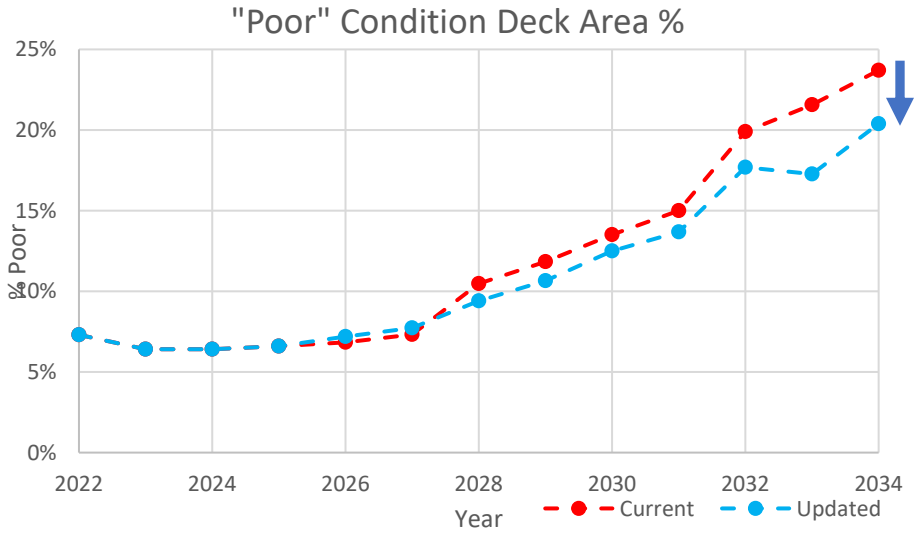
- Currently on Franklin TIP (Program Costs in MPMS) vs Revised

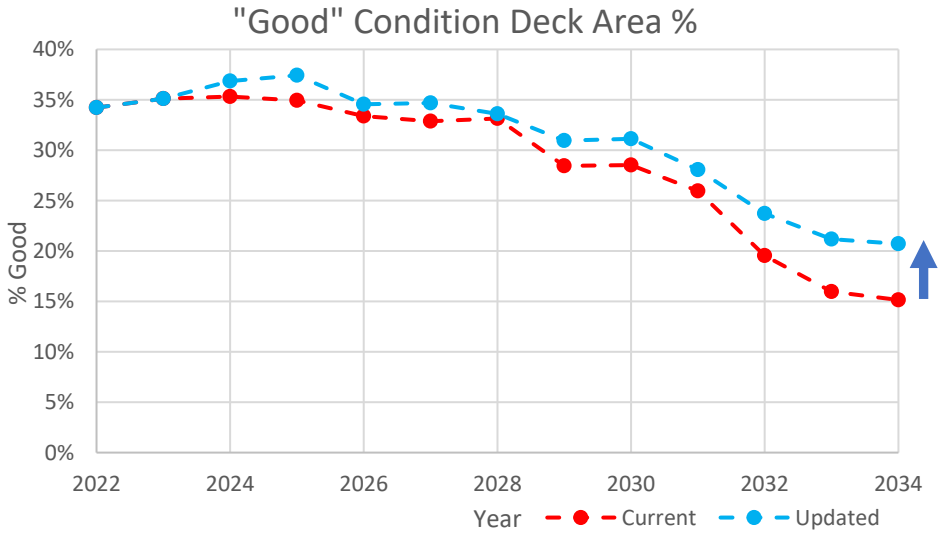




BRIDGE PLANNING – TIP UPDATE

- Currently on TIP vs Updated (Franklin only)





Base 14% reduction in “Poor” bridges at same funding levels

Base 37% increase in “Good” bridges at same funding levels

SYSTEM

BAMS

BR 388

TYP 1 2 3 4 5 6 7 8

SR 1012

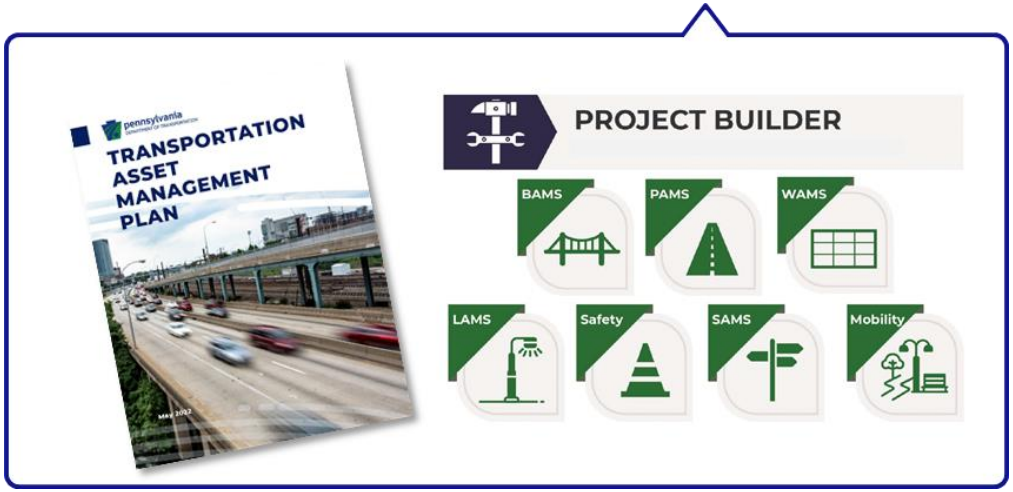
SR 1012

PAMS

Human process

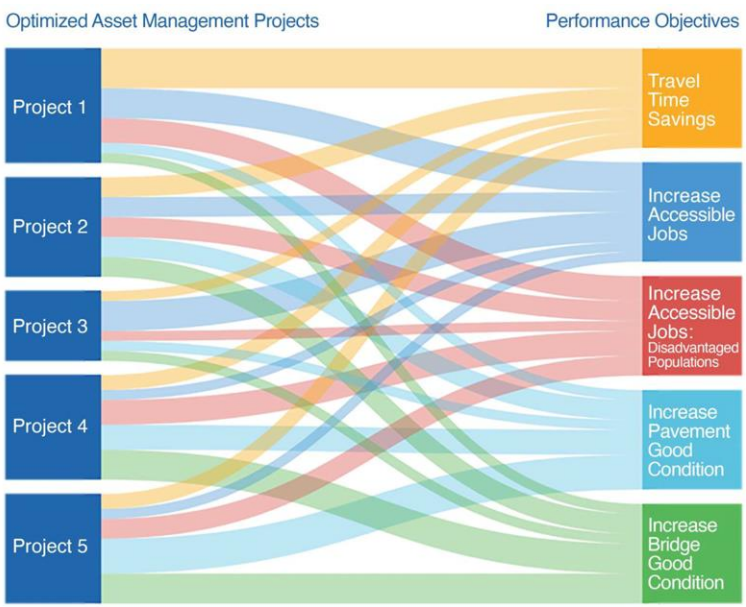
SYSTEM

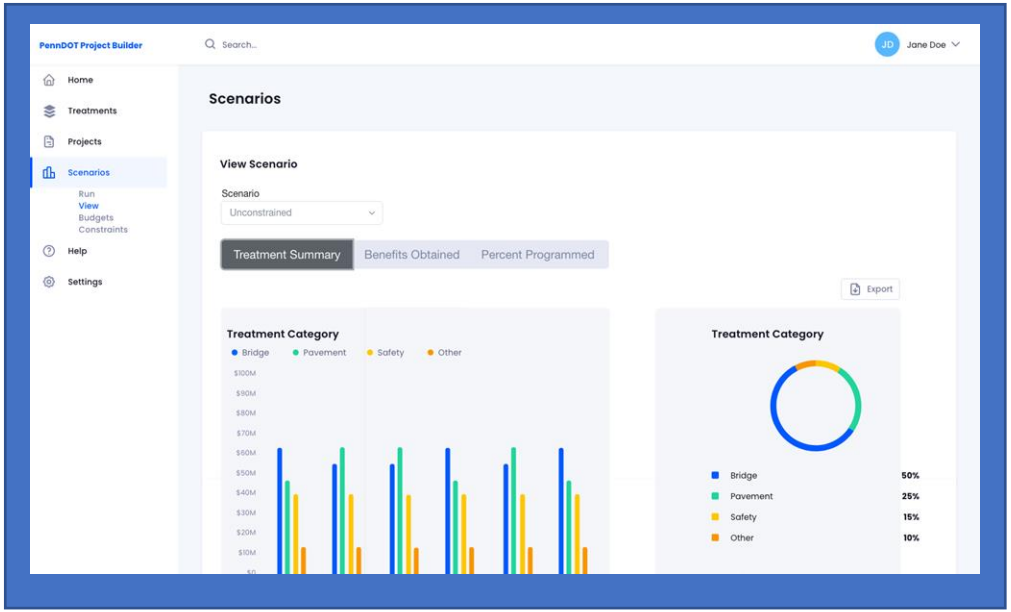

National Goals
Long Range Transportation and 12-Year Program Plan Goals
Performance Measures and Targets
Project Prioritization
• MPO/RPO CMP and LRTP
• Safety Plans
• TAMP
Statewide Transportation Improvement Program (STIP)


pennsylvania
TRANSPORTATION ASSET MANAGEMENT PLAN
PROJECT BUILDER
BAMS
PAMS
WAMS
LAMS
Safety
SAMS
Mobility

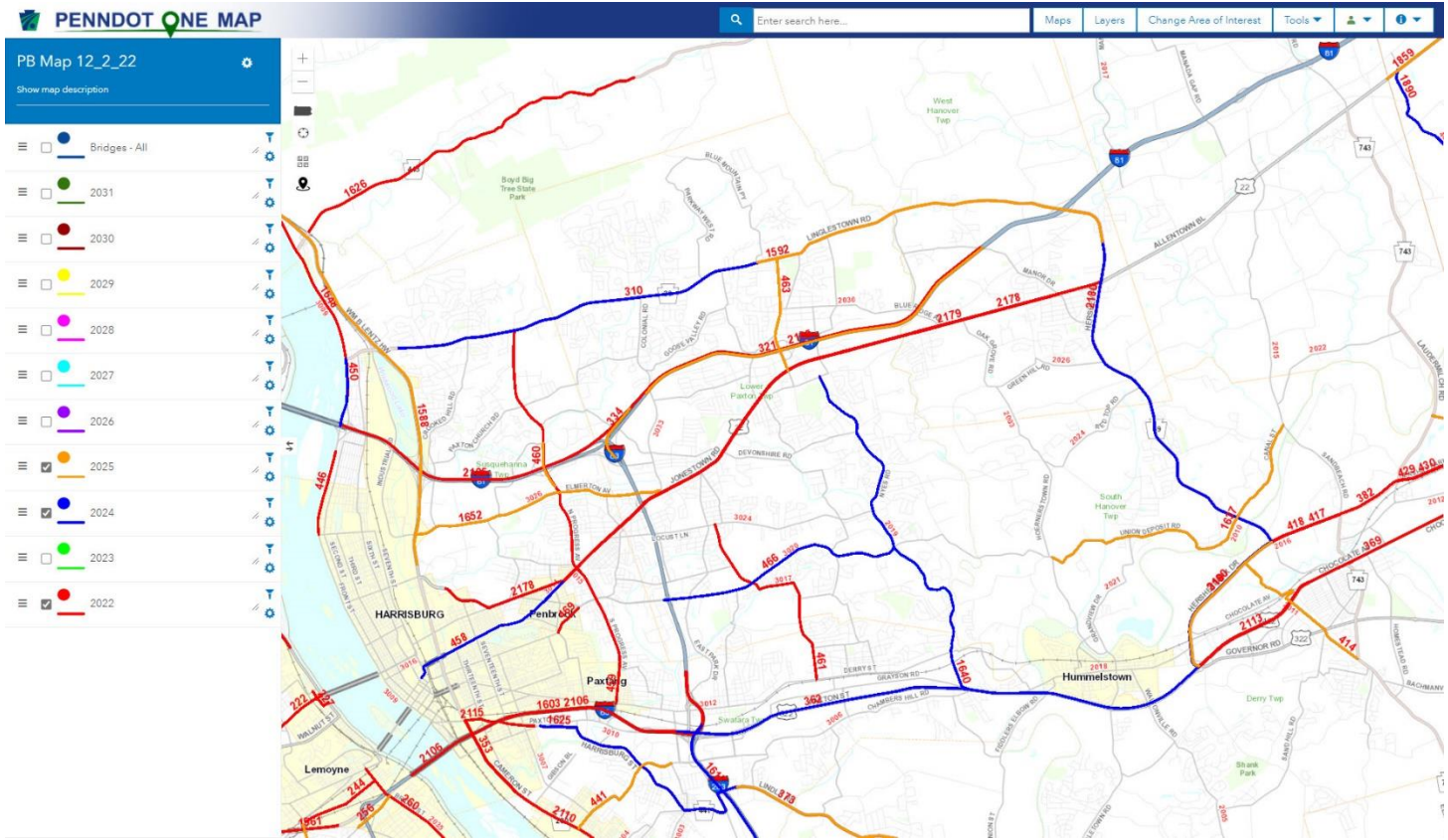
SYSTEM

PROJECT BUILDER





SYSTEM


PENNDOT ONE MAP
Enter search here...
Maps
Layers
Change Area of Interest
Tools
PB Map 12_2_22
Show map description
Bridges - All
2031
2030
2029
2028
2027
2026
2025
2024
2023
2022
HARRISBURG
Penbrook
Paxtang
Lemoyne
Hummelstown
West Hanover Twp
Lower Paxton Twp
South Hanover Twp
Derry Twp
Swatara Twp
Boyd Big Tree State Park
Shank Park

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DEPARTMENT OF TRANSPORTATION

VDOT'S BRIDGE MANAGEMENT SYSTEM EXPERIENCE

Bridge Management Systems for Strategic Asset Management

TRB Webinar

Massoud Nasrollahi, P.E., Ph.D.
Bridge Management Systems and Performance Measurement Section

April 5, 2023

AGENDA

AGENDA

- Bridges in Virginia / VDOT
- VDOT Organization
- Legislation Accomplishments
- Bridge Management System
- Asset Management Plans
- Program Delivery
- Challenges

Bridges in Virginia

District	Number of Structures by District, Highway System and Category											
	NBI				NBI on NHS				All Structures			
	I	P	S&U	Total	I	P	S&U	Total	I	P	S&U	Total
1 Bristol	164	527	1,317	2,008	164	175	2	341	216	955	2,215	3,386
2 Salem	139	458	1,236	1,833	137	231	4	372	210	826	2,038	3,074
3 Lynchburg	0	411	931	1,342	0	217	1	218	0	663	1,416	2,079
4 Richmond	364	578	1,039	1,981	363	362	24	749	520	782	1,313	2,615
5 H. Roads*	381	383	674	1,438	377	238	82	697	462	466	810	1,738
6 F'burg*	45	177	329	551	45	112	7	164	80	254	497	831
7 Culpeper	84	245	715	1,044	83	95	4	182	120	495	1,094	1,709
8 Staunton	253	454	1,160	1,867	250	153	2	405	431	826	2,233	3,490
9 NOVA*	297	411	885	1,593	294	331	33	658	389	556	1,374	2,319
Total	1,727	3,644	8,286	13,657	1,713	1,914	159	3,786	2,428	5,823	12,990	21,241

District	Area of Structures by District, Highway System and Category (Millions of Square Feet)											
	NBI				NBI on NHS				All Structures			
	I	P	S&U	Total	I	P	S&U	Total	I	P	S&U	Total
1 Bristol	1.5	3.5	2.4	7.4	1.5	1.7	0.0	3.2	1.6	3.7	2.7	8.0
2 Salem	1.3	4.0	3.0	8.3	1.3	2.4	0.0	3.7	1.4	4.2	3.2	8.8
3 Lynchburg	0.0	3.9	2.5	6.4	0.0	2.5	0.0	2.5	0.0	4.0	2.6	6.6
4 Richmond	5.9	9.0	4.4	19.3	5.9	7.1	0.4	13.3	6.1	9.2	4.5	19.9
5 H. Roads	10.9	15.3	4.2	30.5	10.9	12.6	1.6	25.1	11.0	15.4	4.3	30.7
6 F'burg	0.4	2.9	1.2	4.5	0.4	2.0	0.1	2.6	0.4	3.0	1.2	4.6
7 Culpeper	0.8	1.4	1.5	3.8	0.8	0.7	0.0	1.6	0.8	1.5	1.7	4.0
8 Staunton	2.5	3.2	2.9	8.6	2.5	1.6	0.0	4.1	2.6	3.4	3.2	9.2
9 NOVA	8.0	6.1	5.8	19.8	7.9	5.3	0.5	13.7	8.0	6.2	6.0	20.3
Total	31.3	49.4	27.8	108.5	31.2	35.9	2.7	69.8	32.0	50.6	29.5	112.1

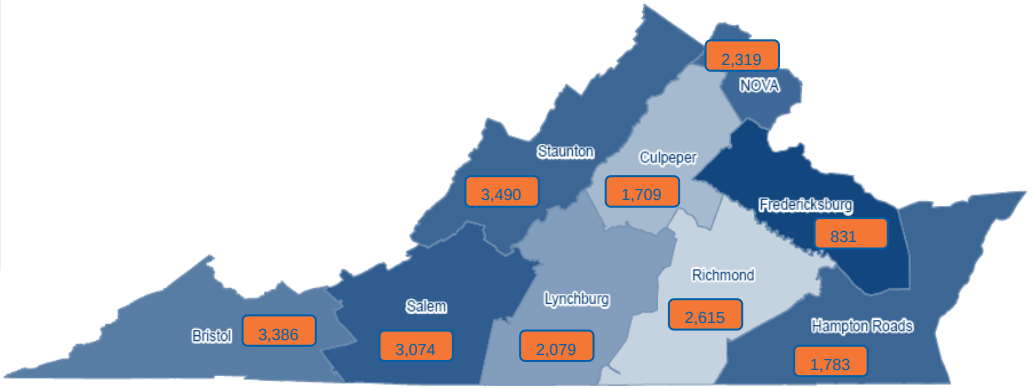
Excludes Federal Responsible Structures

2021 VA State of the Structures and Bridges Report
https://www.virginiadot.org/info/bridges/state-of-structures-and-bridges.asp

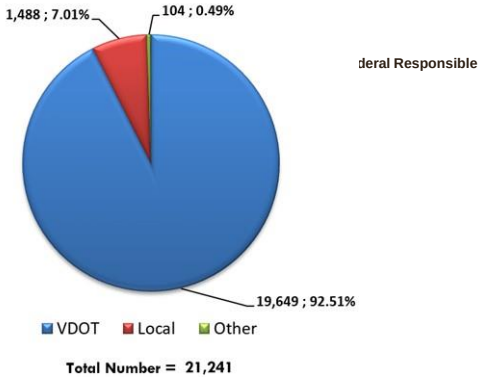
State of the Structures and Bridges
Fiscal Year 2021
July 1, 2020 – June 30, 2021
Prepared By: Structure and Bridge Division, Virginia Department of Transportation

Comments and or questions may be directed to:

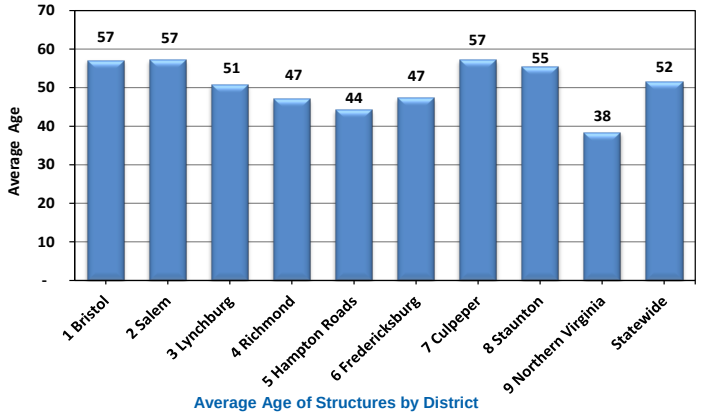
Kendal R. Walus, P.E., State Structure and Bridge Engineer
Virginia Department of Transportation — 1401 East Broad Street, Richmond, VA 23219
Telephone: 804-786-4575 Email: Kendal.Walus@VDOT.Virginia.Gov



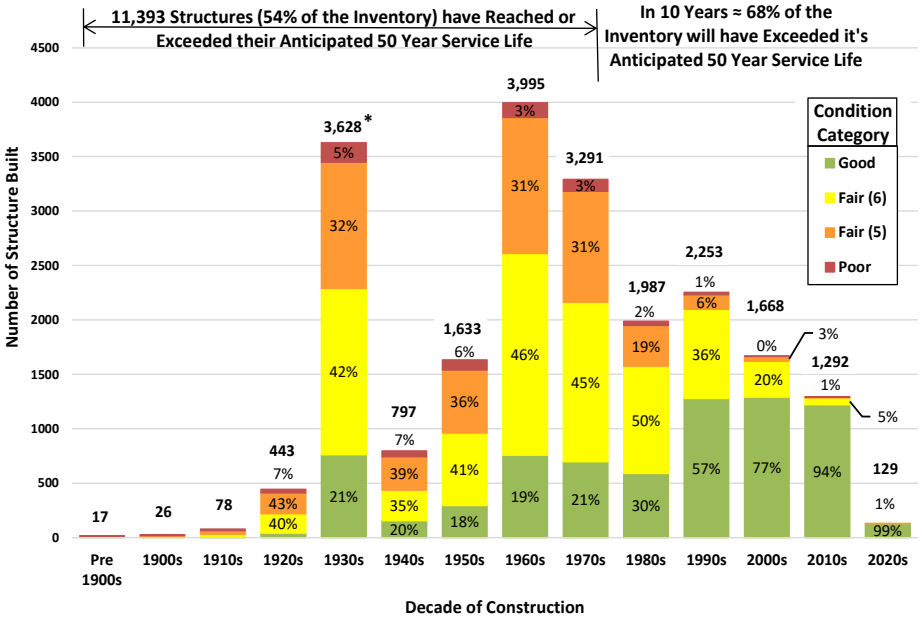
Bridges in Virginia



deral Responsible



Average Age of Structures by District



Count of Structures Built by Decade and Condition Percentage by Count

VDOT Organizational Structure (bridge program)

Central Office (Structure & Bridge Division)

- Engineering Services (standards and specifications)
- Maintenance/Management (Project Funding/Selection, Dashboards, TAMPS, Guidance)
- Project Delivery
- Safety Inspection (& Load Rating)

NINE (9) DISTRICT OFFICES (Structure & Bridge Sections)

- Maintenance (Contracted Work & State Force Bridge Crews)
- Safety Inspection
- Project Delivery

Virginia Transportation Research Council

Extensive Coordination:

- Divisions - Location & Design, Infrastructure Investment, Operations, Maintenance, Safety & Security, Local Assistance, Materials, Construction, etc.
- Localities

Legislation Related to Bridges
(General Assembly, Commonwealth Transportation Board)

- **State Force Bridge Crews**
  - M&O Program (state funds)
  - Crews in all nine districts
  - Focus on shorter bridges and culverts on lower volume secondary roads

- **State of Good Repair Bridge Program**
  - $225M+/- per year for VDOT & Locality-owned bridges
  - Eligible: NBI bridges and culverts in poor condition **(trying to expand to include minimum GCR = 5)**
  - Prioritization Formula

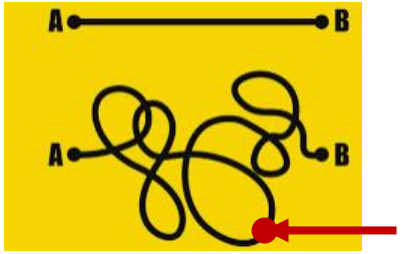
- **State Performance Measures (focusing more on preservation)**

- **Special Structures**
  - 30-year program

Bridge Management Tools at VDOT

- **In-House Tools**
  - VDOT BMS Tool (Python & Component Based)
  - Virginia Structure Priority Score (Excel & Component Based)
  - Other Various Tools (SQL Developer, Excel, & Component & Element Based)
- **AASHTOWare BrM**
  - Data collection and storage **(Digital Bridge Inspection Reporting)**
  - Standing up the BMS modeling functionality

What were the sequential steps you have followed thus far?



We are exactly here! Discovery process. Standards/Reqs Changed. Software Evolved.

BMS - Lessons Learned

TIERED LEVELS OF DEVELOPMENT (WHERE ARE YOU?)

- **Basic**
  - **Basic use of Component Data**
- **Intermediate (system level, ball park)**
  - **Extensive use of Component Data**
  - **Extensive use of Component Data, and use some Element Data**
- **Advanced (best for to model preservation actions, Structure Level)**
  - **Extensive use of Element Data**
  - **Better structure level decisions require the following:**
    - Robustly identifying and modeling local & global environments *
    - Robustly identifying and modeling protective elements (ADEs)
    - Use of a structure Health Index based on service life and valuation of the elements*
    - Robust GCR (NBI) conversion profiles (GCR, G-F-P Perf. Metrics) *

VDOT

Make sure you have consistent and good quality Element Data for ALL structures

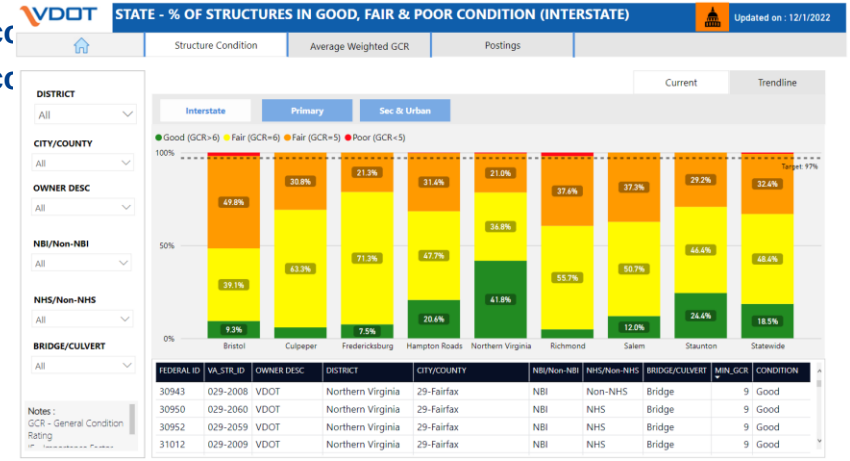
Performance Management Metrics

- **Average general condition rating, weighted by the Importance Factor, is greater than 5.6 in the year 2070.**

- **Percentage of bridges in fair and good Condition, weighted by count, is greater than the following limits:**
  - **Interstate:** **97% in fair or good condition**
  - **Primary:** **93% in fair or good co**
  - **Secondary/Urban:** **90% in fair or good co**

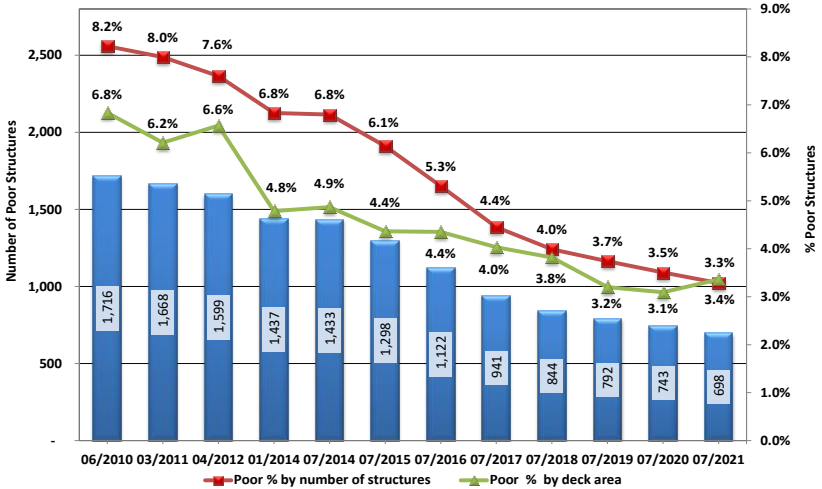
- **No bridges on the Interstate system with weight restrictions and posting**

Importance Factor:
- **NHS**
- **ADT, FADT, ADTT, Detour**
- **Corridors of Statewide Significance**



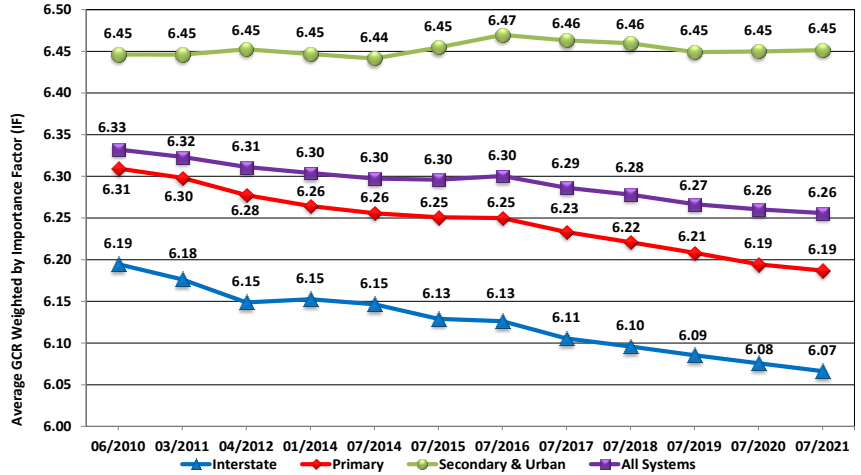
Changes in Performance Metrics

Previous: Worst First (Poor/SD): 1,716 to 698



Multi-Year Performance History of Percentage of Poor Structures on All Systems

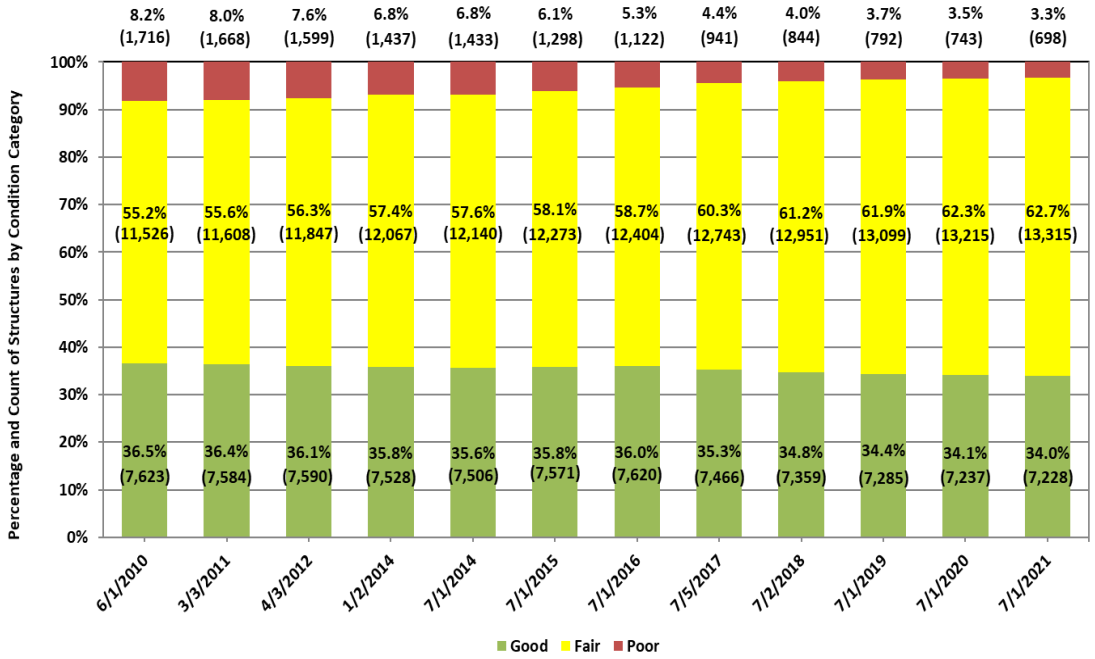
Current/New: Average GCR Weighted by IF: 21,241



Multi-Year Trend of Average GCR Weighted by Importance Factor by Highway System

While the number of structures in poor condition improved, the average condition weighted by IF, has declined.

Focus on Replacement



Condition Changes

No. Poor – Decreased

No. Fair – Increased

No. Good – Decreased

Overall Annual Bridge Funding Scenario as of 2019

Maintenance and Operations Program		**$215M**	
State of Good Repair Program		**$225M**	
		Total	**$440M**
Fixed Costs:			
Inspection		**$38M**	
Routine Maintenance	**$10M**		
Emergencies	**$8M**		
Special Structures		**$0 (Work to paid for through a dedicated fund)**	
Total Fixed Cost	**$56M**		

Total available to program for actual structure work: $440M - $56M = $384 M +/- per year

Does not include P3s, toll roads, road safety & capacity, etc.

Performance Management Metrics (Overall Funding Scenario Used In Modeling)

Maintaining budget of $384M per year to program for actual structure work

- Construction Program (capital improvements)
- Maintenance and Operations Program

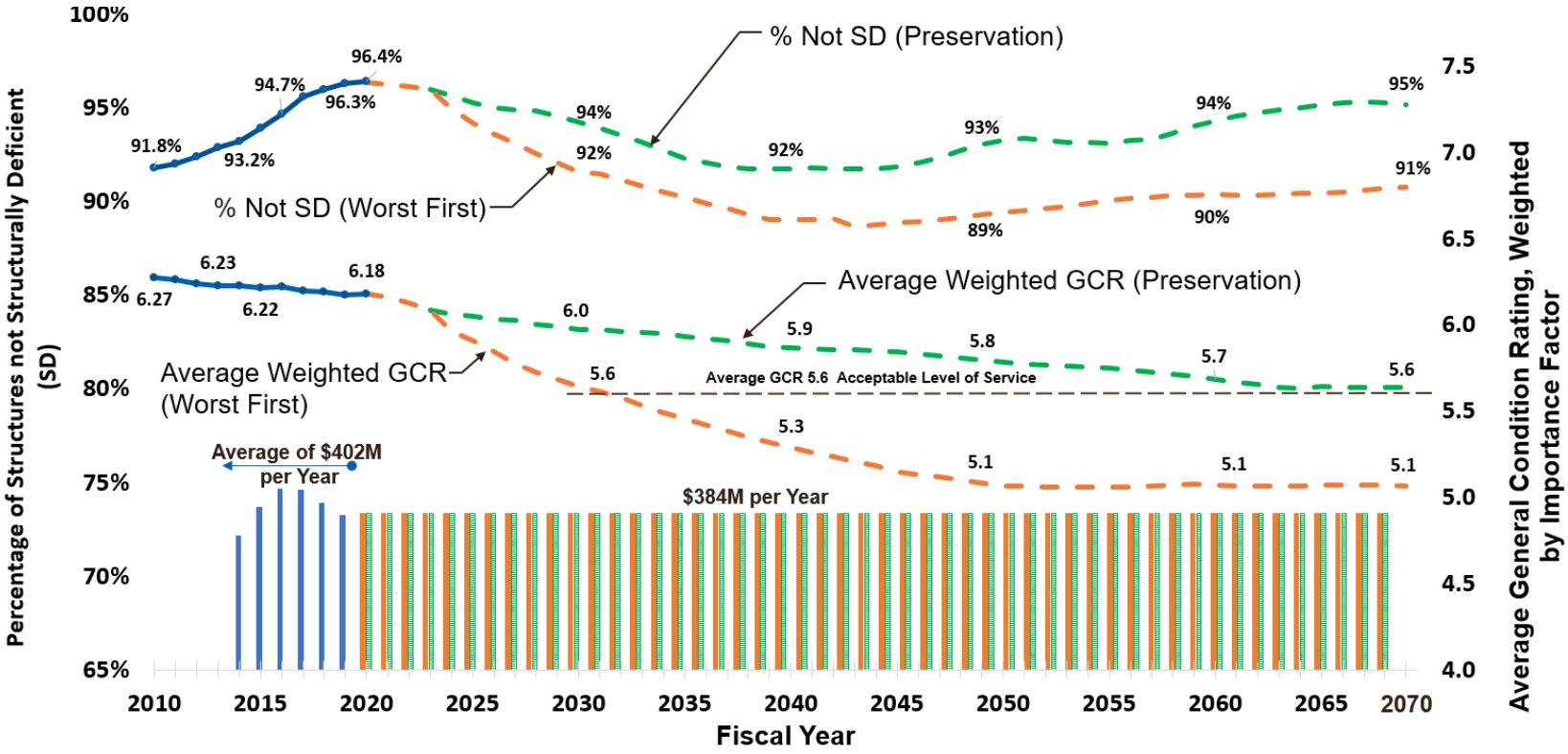
Preservation Activities and Investment Levels Evaluated (75%)

- Deck Repair and Preservation (Overlays & Joints) – ($110M/Year)
- Superstructure Repair (Beam Ends) and Preservation (Coating) ($91M/Year)
- Substructure Repair and Preservation ($70M/Year)
- Culvert (Liners) ($17M/Year)

Replacement Activities (25%)

- Replacement (components or whole structures) ($96M/Year)

50-Year Outlook Comparing Preservation to "Worst First" (All Systems)



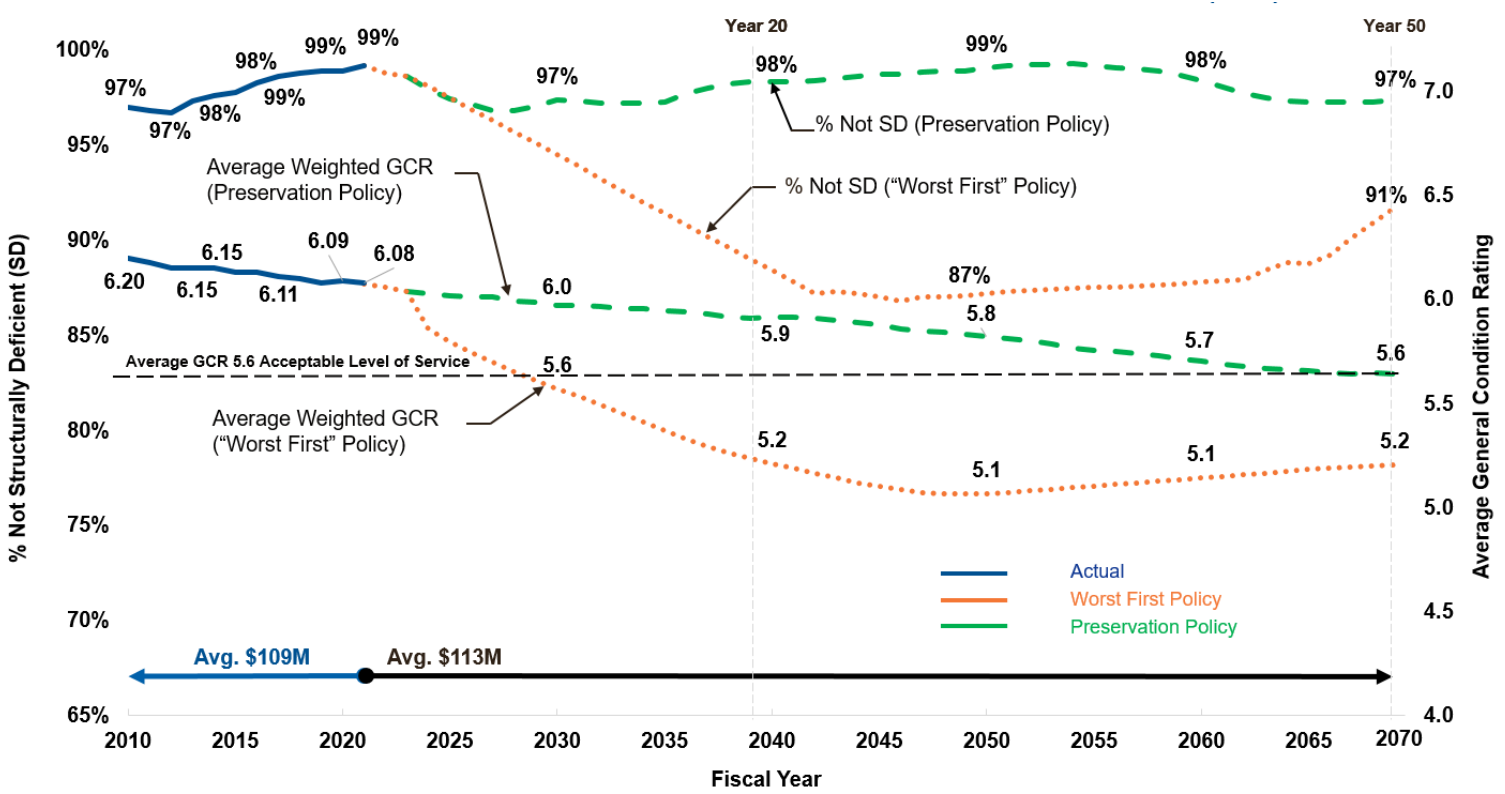
Actual

Results w/ Current Approach

Results with Proposed Approach

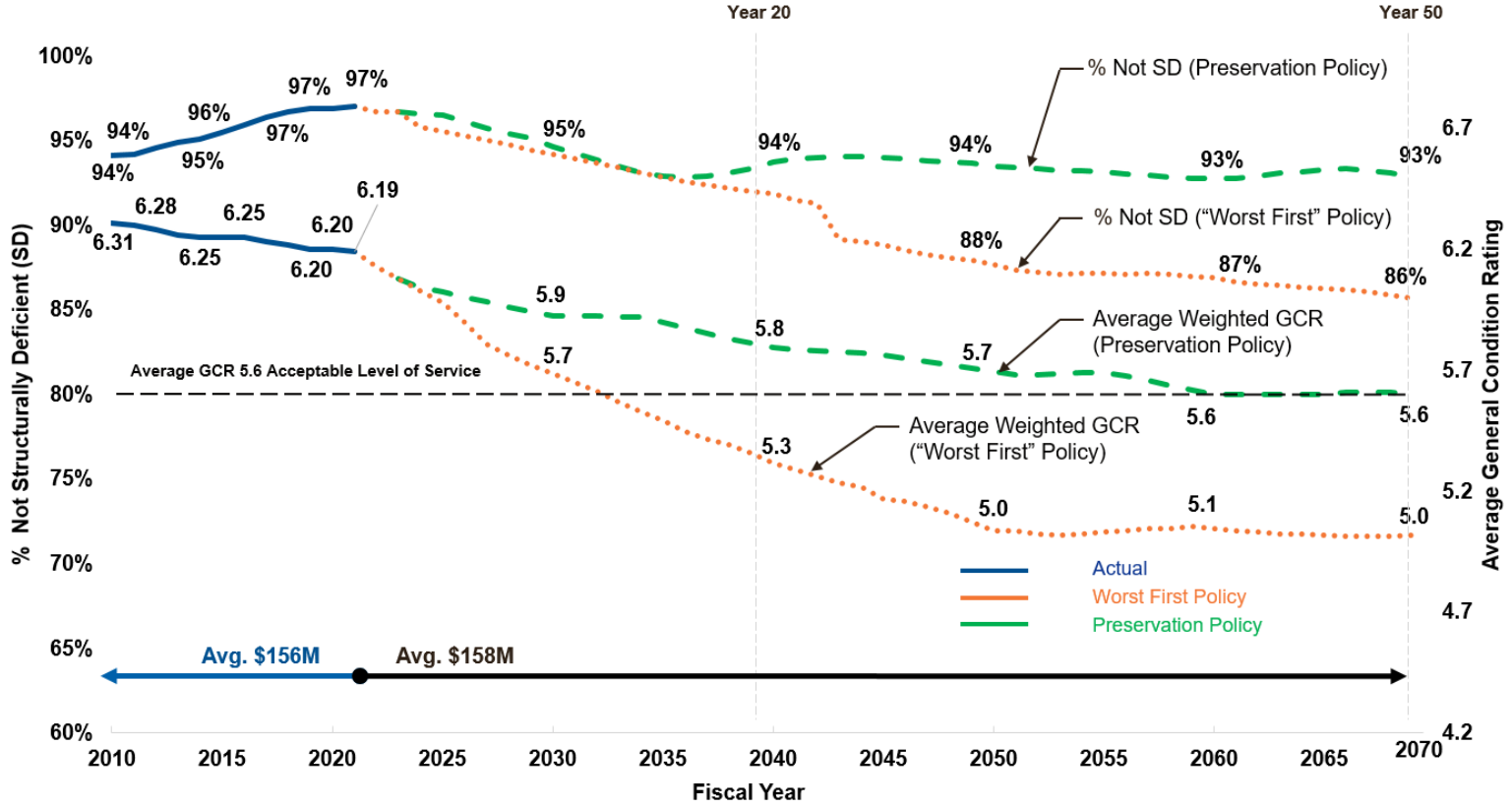
- All Future Expenditures Are in 2019 Dollars
- Excludes Special Structures

50-Year Outlook Comparing Preservation to "Worst First" (Interstate System)



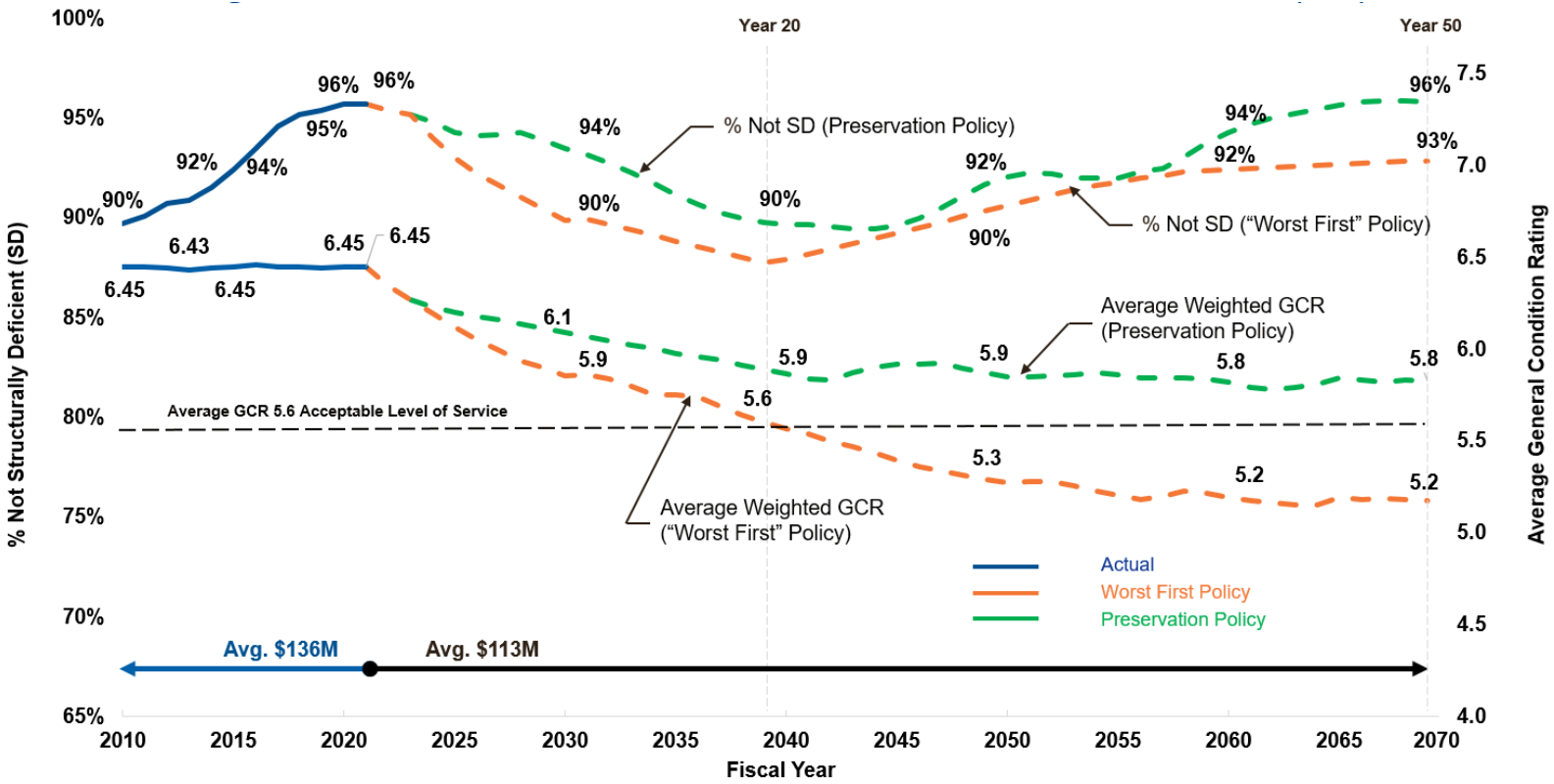
- All Future Expenditures are in 2019 Dollars
- Excludes Special Structures

50-Year Outlook Comparing Preservation to "Worst First" (Primary System)



- All Future Expenditures are in 2019 Dollars
- Excludes Special Structures

50-Year Outlook Comparing Preservation to "Worst First" (Secondary System)



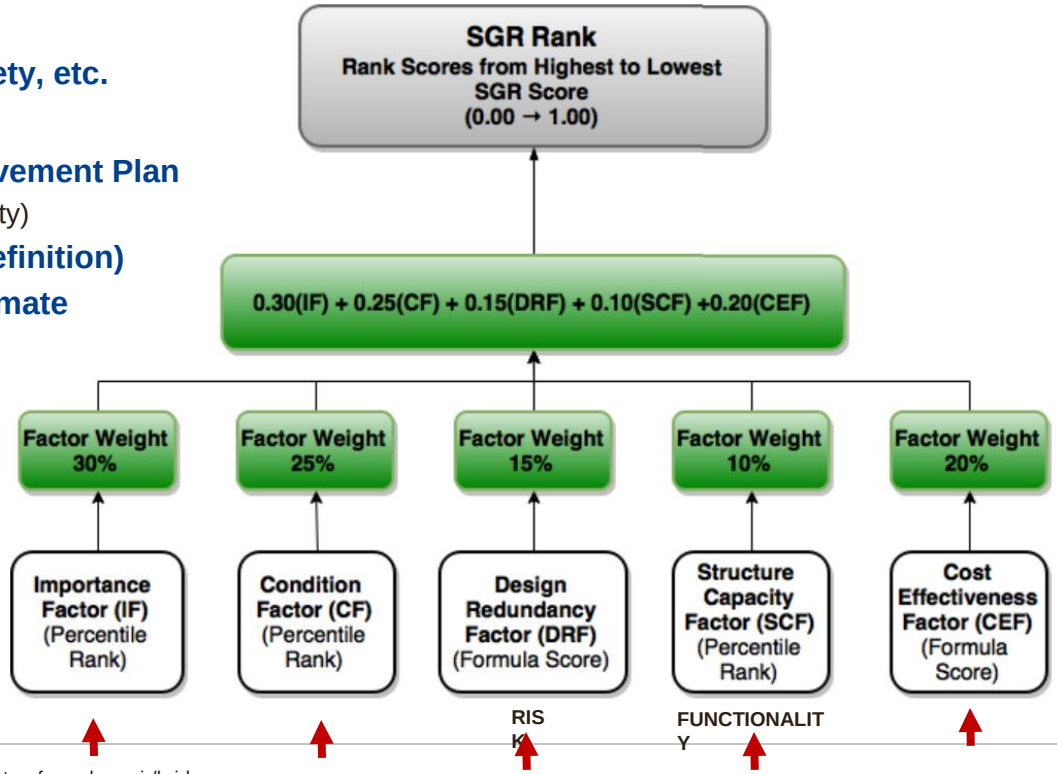
- All Future Expenditures are in 2019 Dollars
- Excludes Special Structures

Evolution of Risk Objectives

- **Currently**
  - Scour
  - Seismic
  - Fracture Critical
  - Fatigue
  - Elsewhere: Functionality ~ vertical clearance, waterway adequacy
- **Future (Virginia is a coastal state exposed to extreme weather)**
  - Sea Level Rise
  - Storm Surge (more severe, interaction with sea level rise)
  - Riverine Flooding (slower moving hurricanes, longer duration of major precipitation)
- **Future Assessment Requires New Data**
  - Exposure: Local & regional exposure, & increased severity of weather
  - Additional Inventory data: Location of structure, air relief holes, weight of superstructure & fixity to substructure, clearance off water, navigation clearance, substructure type, foundation type
  - Importance of route: hurricane evacuation (recovery) route, NHS, COSS, ADT, ADTT, detour, etc.
  - Other data: Ability to raise road/structure, scour defects, settlement defects

State of Good Repair Bridge Program

- **Construction Program (capital Improvement)**
  - **Replacement & rehabilitation (in kind)**
  - **Other programs fund road capacity, safety, etc.**
- **Virginia Structure Priority Score**
  - **Project selection for our Six Year Improvement Plan**
    - does not apply M&O Program (leave flexibility)
  - **Site specific scoping (10% +/- Project Definition)**
  - **Scoping sets the project scope and estimate**
  - **Use BMS, site specific data, & scope**
  - **Multiple objectives -> prioritize projects**
- **Eligibility**
  - **VDOT & Locality Owned**
  - **NBI structures in poor condition**
  - **(trying to add Min GCR = 5)**



Challenges

- Inspection standards and modeling software: constant change (good & bad)
- Bridge management modeling software: National consistency of the standards/requirements
- Advanced BMS (structure level / preservation actions)
  - Modeling using elements: good / consistent data
  - Health Index: service life and valuation based *
  - Local & global environments: Collect data and model the environments *
  - GCR (NBI) conversion profiles: Robust (GCRs, G-F-P Performance Metrics) *

  * VDOT has submitted RNSs to TRB AKT50 Bridge and Structures Management Committee
- Data
  - Quality
  - Collect New Data
    - Risk (extreme weather)
    - Advanced BMS
- Skilled staff
  - Experienced bridge engineer
  - Strong data science skills

THANK YOU!

Questions?

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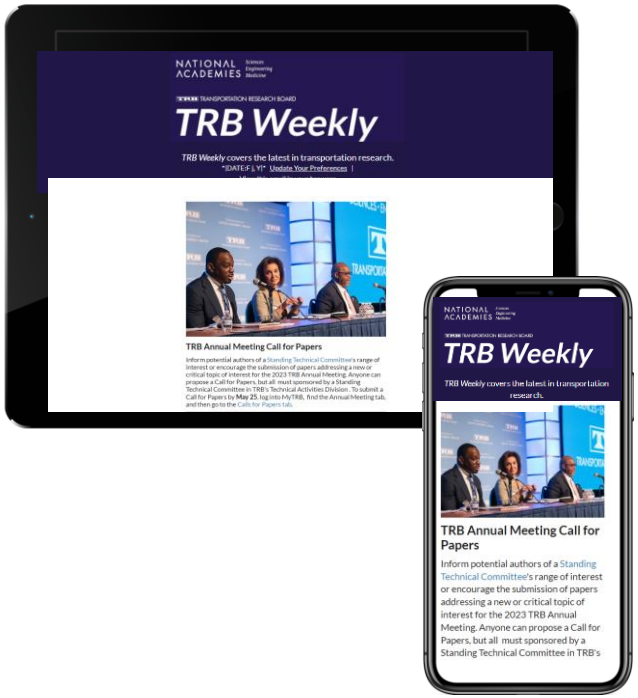

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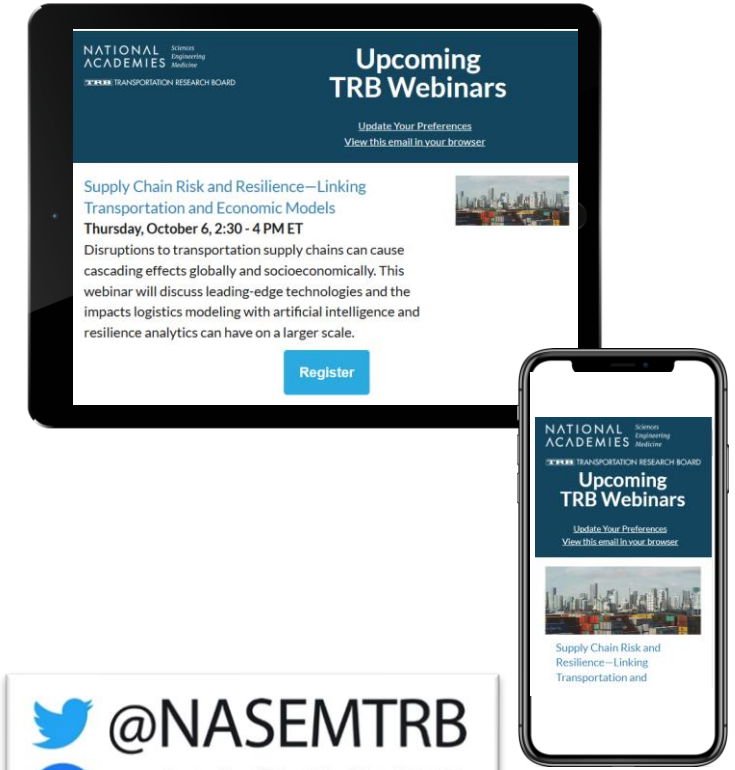

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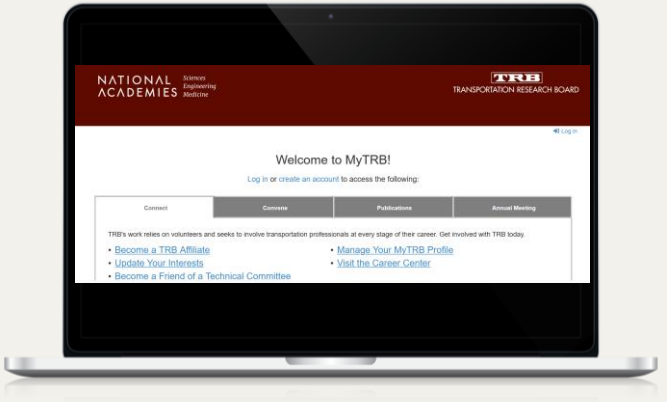

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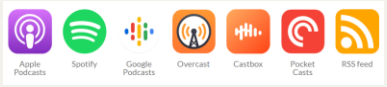

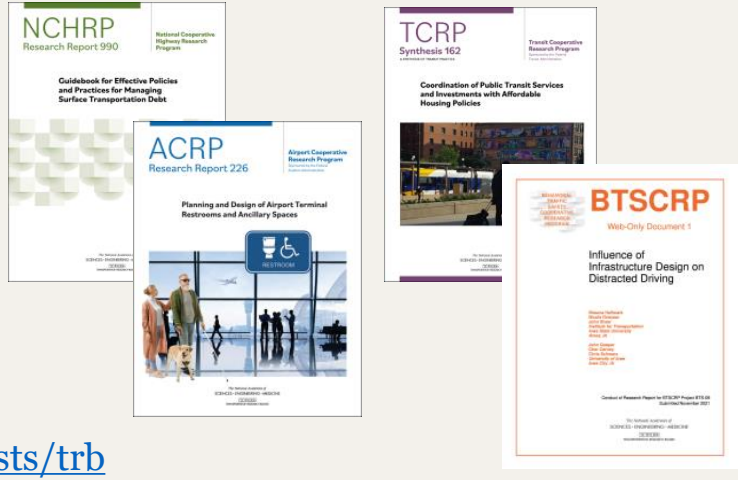

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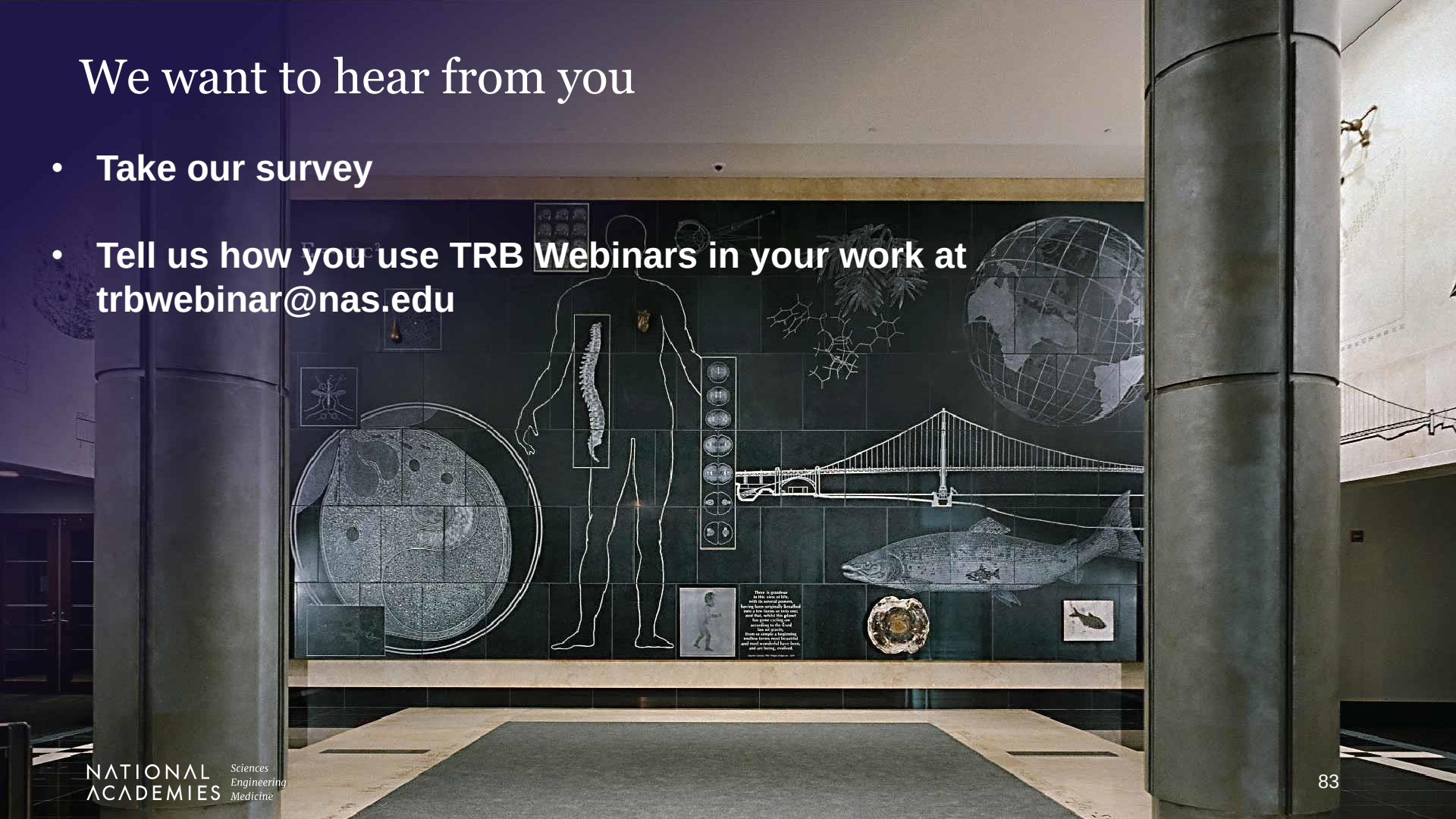

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