Transportation Asset Management

Matt Beran, Kent Miller, Mark Osborn
Nebraska Department of Transportation

TOPICS

- National Perspective
- Inventory and Condition
- Targets and Measures
- Life-Cycle Cost Analysis
- Risk Management

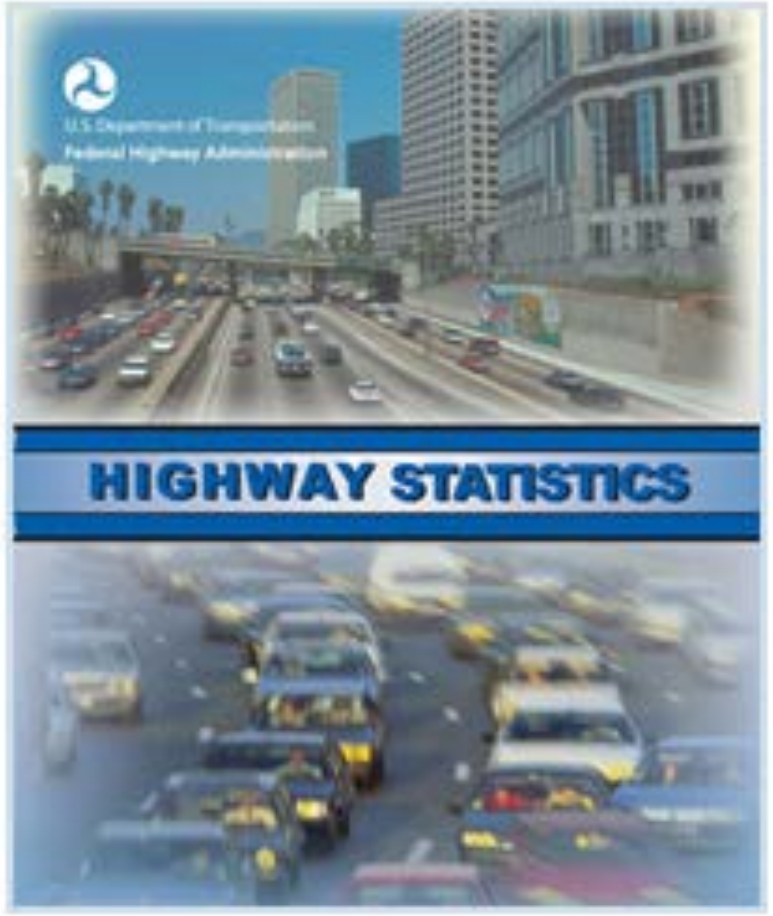
- FHWA
- HPMS
- NBI
- TAMP
- AASHTO
- Government Structure

FHWA - Federal Highway Administration

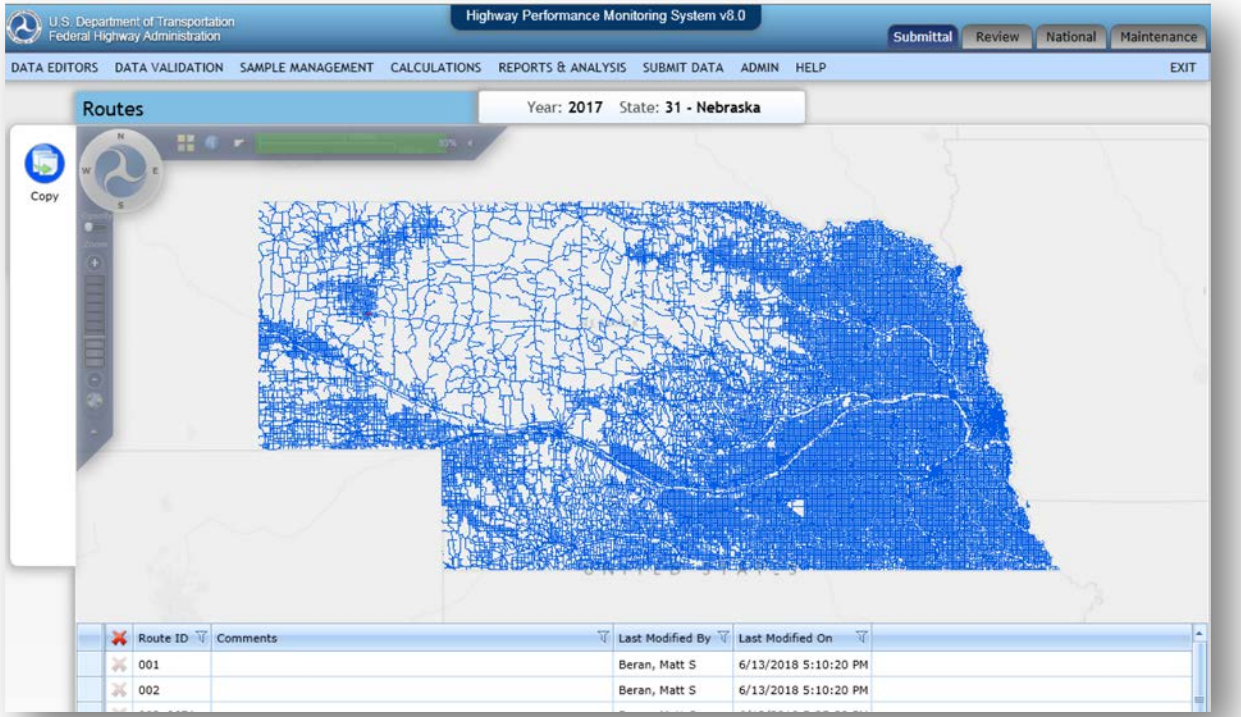
U.S. Department of Transportation
Federal Highway Administration

National Highway Statistics are available at:

https://www.fhwa.dot.gov/policyinformation/statistics.cfm



HPMS - Highway Performance Monitoring System



National Bridge Inspection Program

- All bridges are inspected at least every 24 months by certified inspectors
  - A risk based inspection frequency is an option for less frequent inspections of bridges that meet requirements
- Two Nationally standardized Inspection methods are required
  - General Condition (or NBI method) of major bridge components (deck, superstructure, substructure).
  - Element Level Inspection (or NBE method) – required since 2014 for NHS
    - Provides quantities of more detailed bridge “elements” by condition.
  - States also have agency defined inspection practices that vary by State
- All States make annual data submittals to the FHWA
  - Inspection data is available at https://www.fhwa.dot.gov/bridge/nbi.cfm

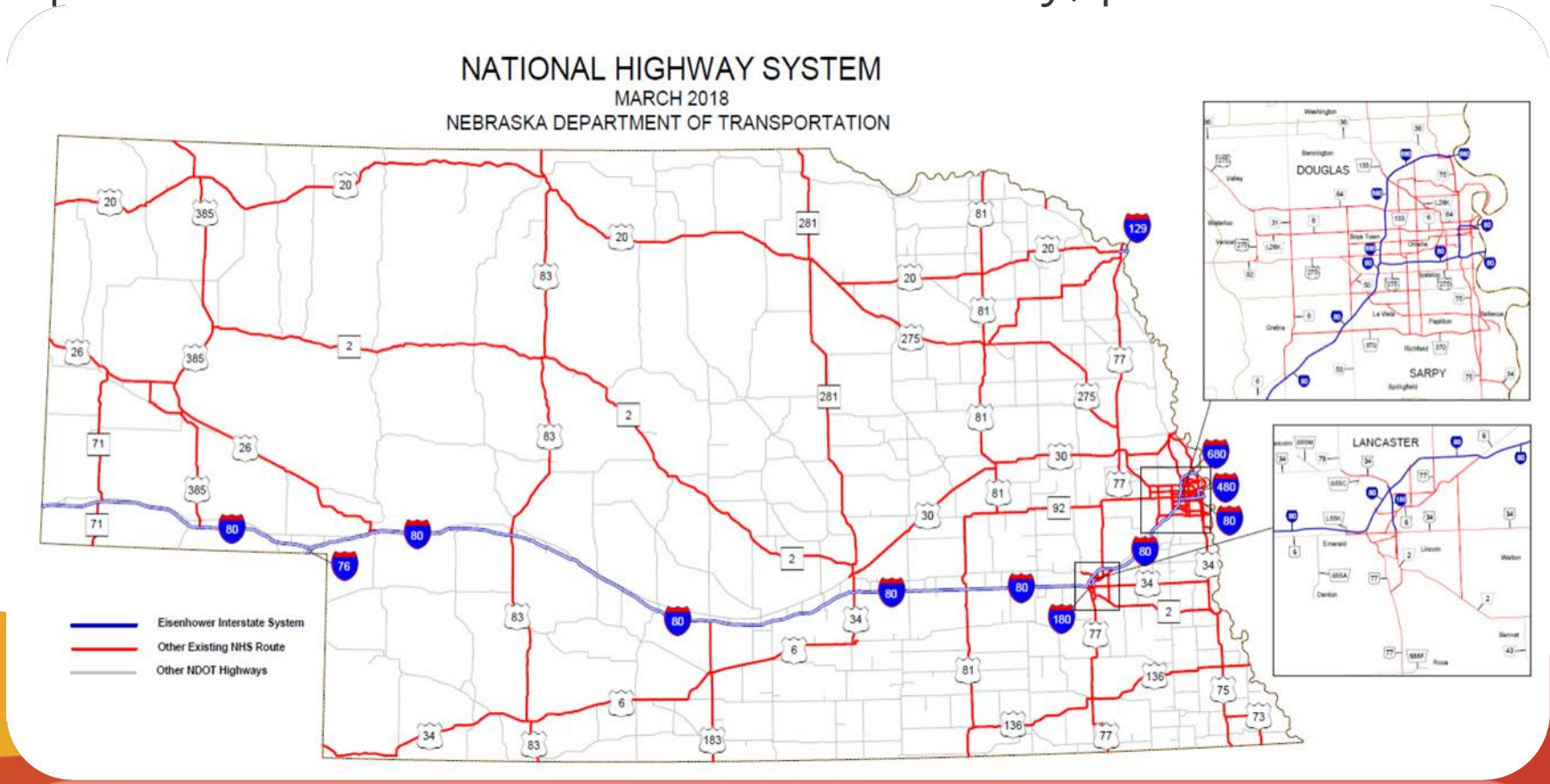
TAMP - Transportation Asset Management Plan

- The **Transportation Asset Management Plan (TAMP)** came about through requirements established by MAP-21 and FAST Legislation

- Requirement for states to develop a **risk-based asset management plan for the National Highway System (NHS)** to improve or preserve asset condition and system performances
- Final Rules were established **May 20, 2017**

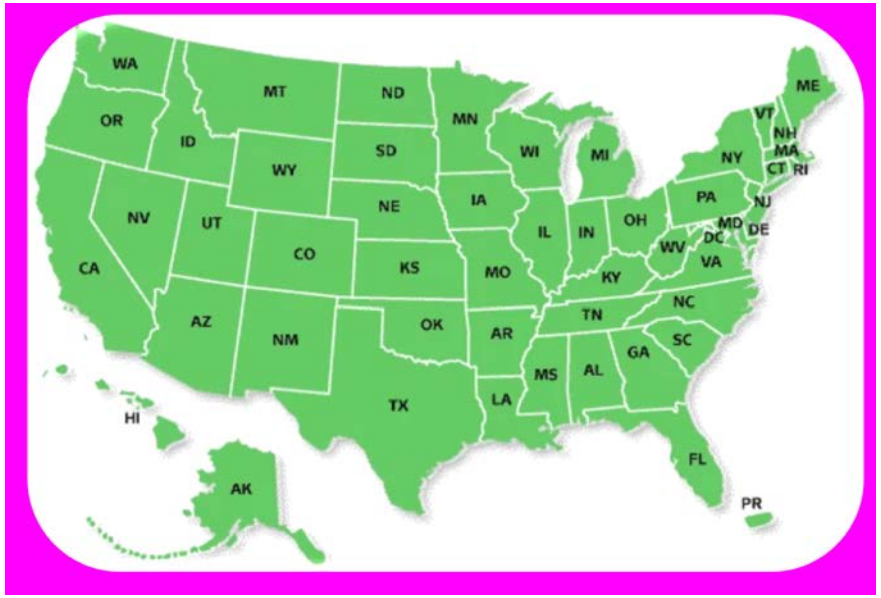
NHS - National Highway System

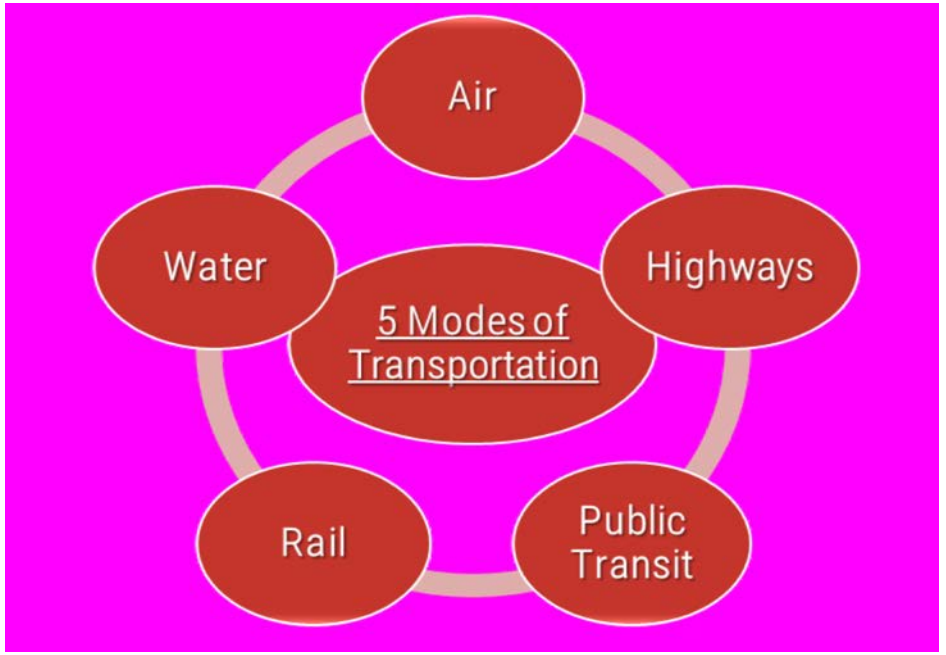
- Essential roads for United States mobility, economy and defense
- Goal is to optimize State use of Federal money, plan for risks



AASHTO - American Association of State Highway Officials

- Legislative Response
- Standards, Specifications and Guidance
- Software
- Training
- Research





AASHTO
THE VOICE OF TRANSPORTATION

AASHTO Services

- Legislative Response
- Standards, Specifications and Guidance
- Software
- Training
- Research

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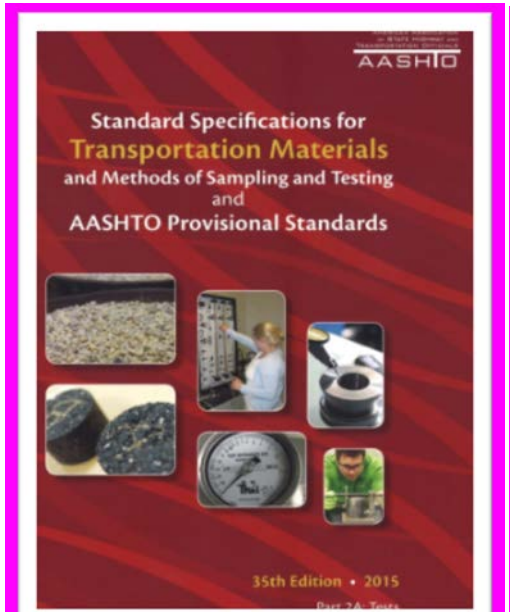
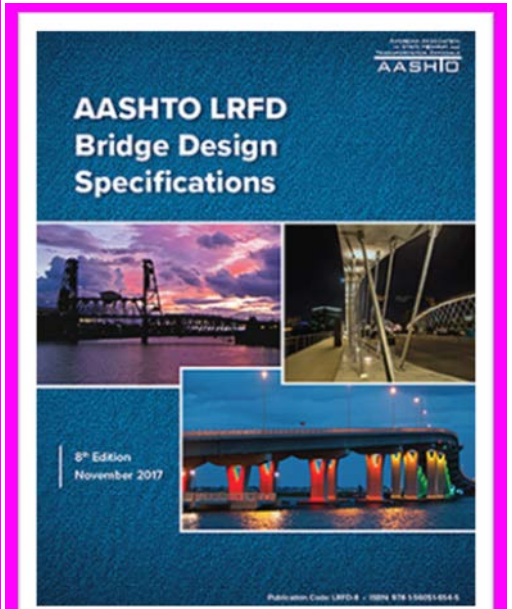
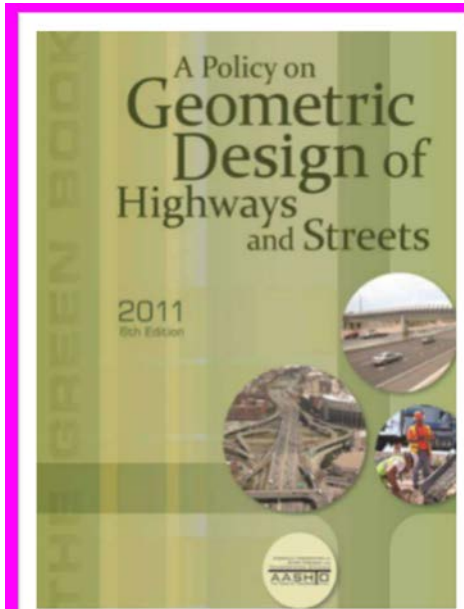




Standards & Specifications

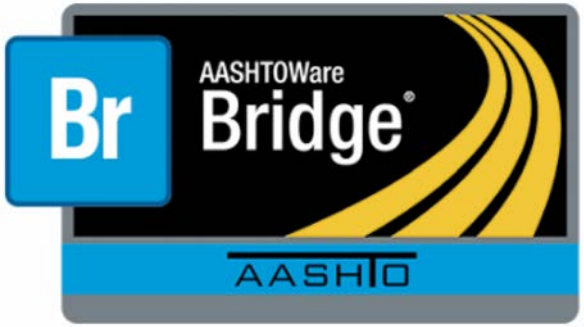


Guidance

Lab Accreditation

AASHTO Services

- Legislative Response
- Standards, Specifications and Guidance
- **Software**
- Training
- Research



AASHTO Services

- Legislative Response
- Standards, Specifications and Guidance
- Software
- **Training**
- Research

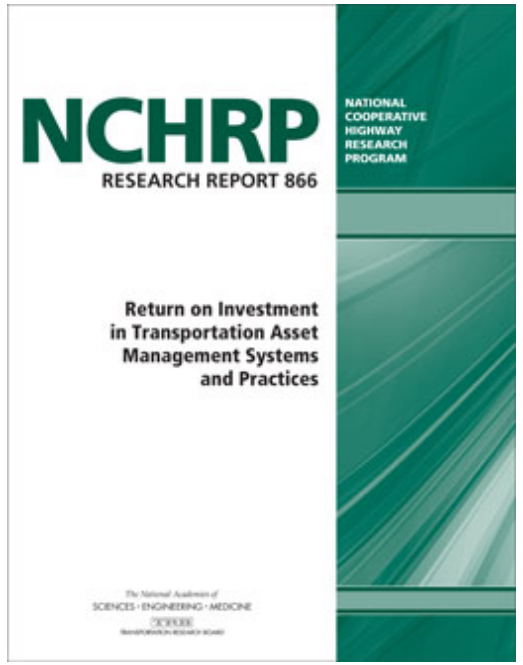
TRANSPORTATION CURRICULUM COORDINATION COUNCIL
AASHTO

- 190 Online Courses
- 35+ State Sponsors
- Construction, Materials, Maintenance, Pavements, etc.

AASHTO Services

- Legislative Response
- Standards, Specifications and Guidance
- Software
- Training
- Research

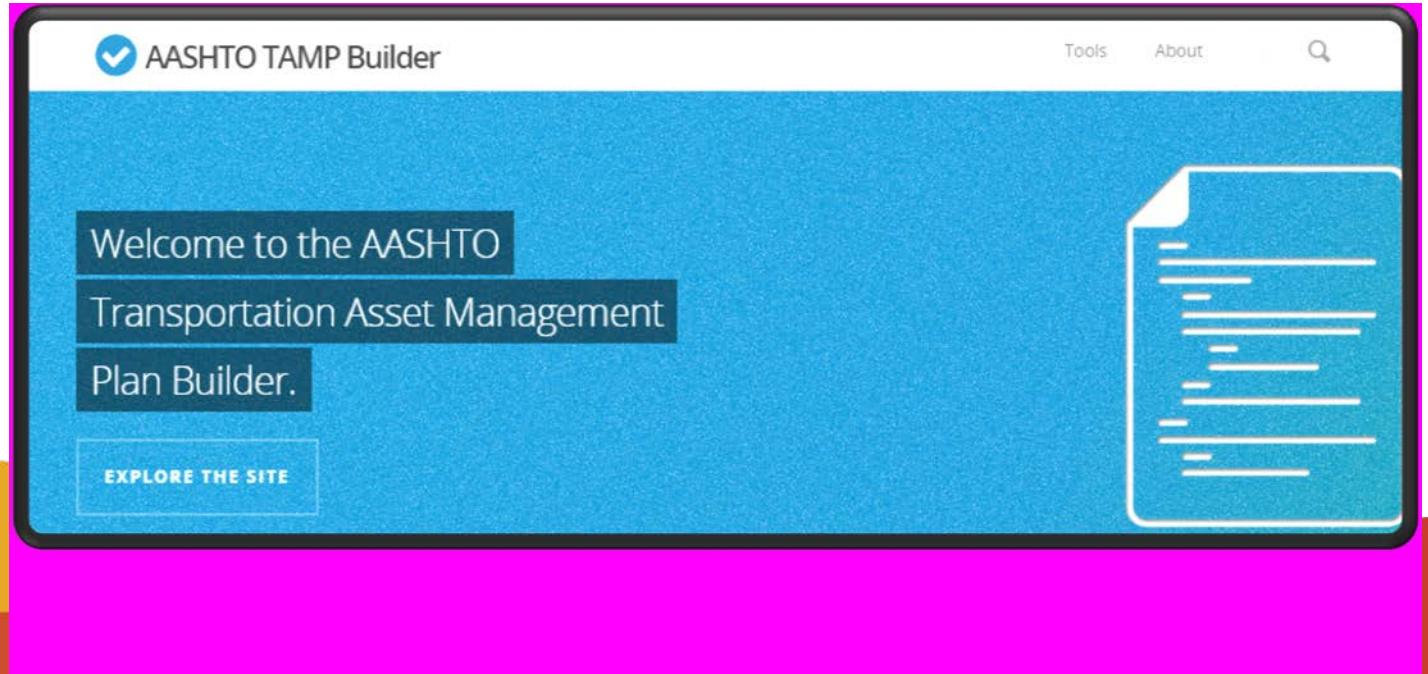
Sponsor and Administer National Research



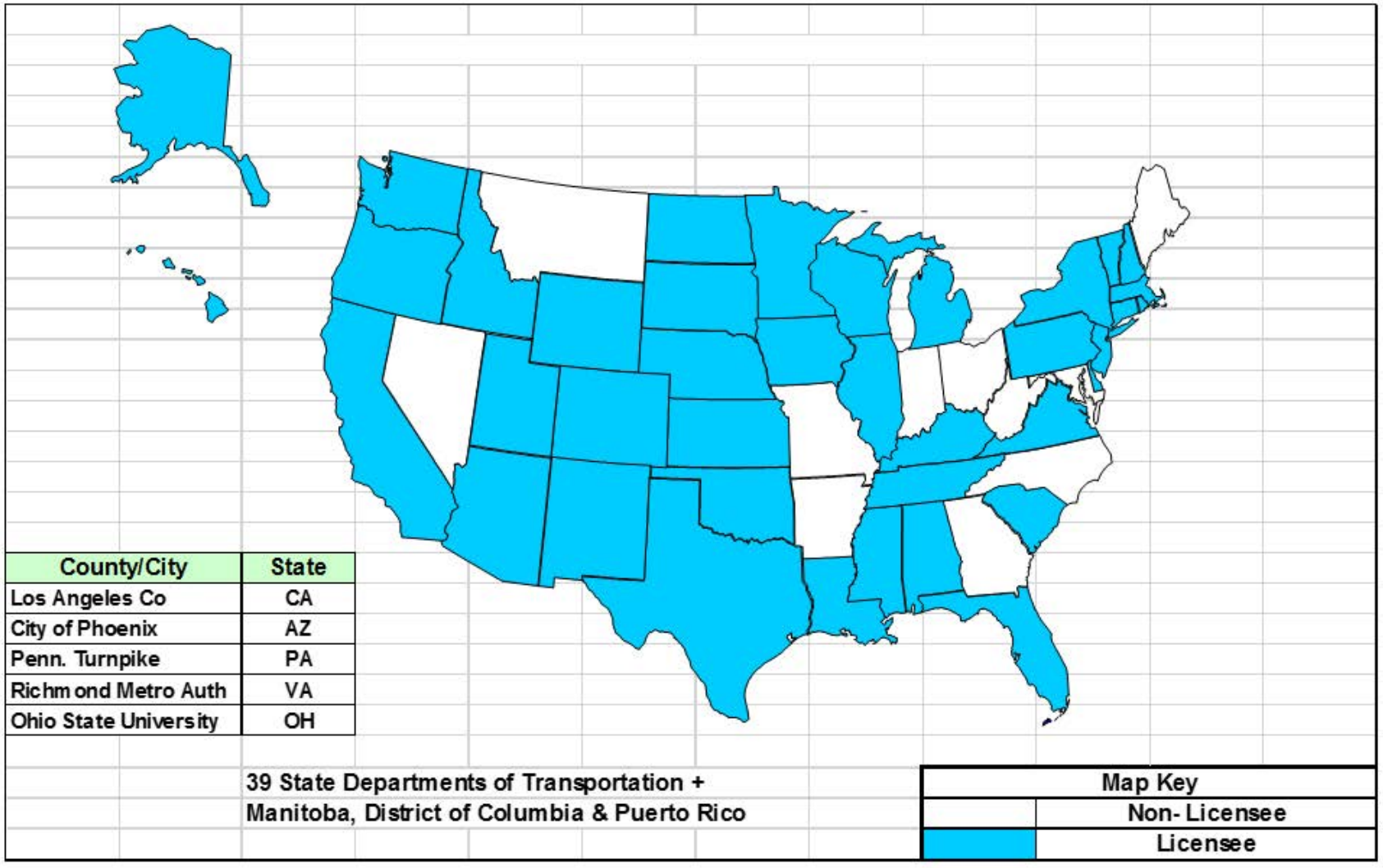
TRB
TRANSPORTATION RESEARCH BOARD
OF THE NATIONAL ACADEMIES

AASHTO

- Played a supporting role in the development of States Asset Management Plans.
- Provided resources and guidance through the AASHTO Tamp Builder: http://www.tamptemplate.org/existing-tamp/



Bridge Management - National Perspective - Use of AASHTOWare BrM – 2018 Licensees



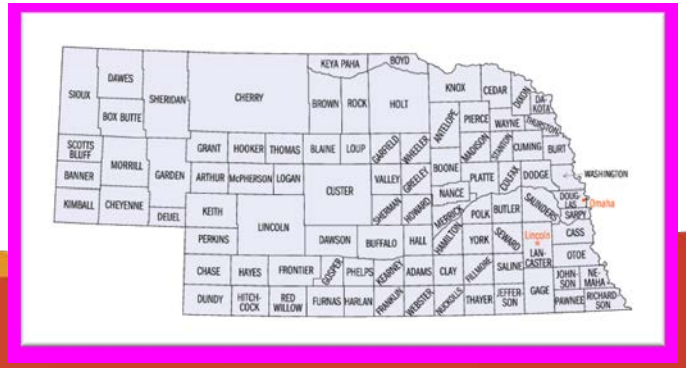
County/City	State
Los Angeles Co	CA
City of Phoenix	AZ
Penn. Turnpike	PA
Richmond Metro Auth	VA
Ohio State University	OH

39 State Departments of Transportation +
Manitoba, District of Columbia & Puerto Rico

Map Key	
	Non- Licensee
	Licensee

Government Structure

- Federal government (USA)
- State government – 50 states, District of Columbia, & Puerto Rico
- Nebraska – State system 10,000 miles, 3500 Bridges, 8 Administrative Districts, Central Office project planning
  - County government – 93 Counties
  - Municipalities/Cities – 529 Municipalities/Cities
  - Metropolitan Planning Organizations (MPO's)– 4 (For urban areas with populations greater than 75,000)



Role of Private Sector in Nebraska

- Roadway and Bridge Design – 50% of program or 35% of projects done by consultants
- Inspections
  - Construction inspection for some local projects
  - Bridge – routine safety inspections for some local system bridges
- Research
  - 1.7 million for in-state research (University of Nebraska)
  - 1.5 million for national research (TRB, NCHRP, Midwest Pooled Fund)
- Tolls – There are no privately owned toll roads in Nebraska
- Contracted work. Mowing, barrier repair, rest area maintenance

TOPICS

- National Perspective
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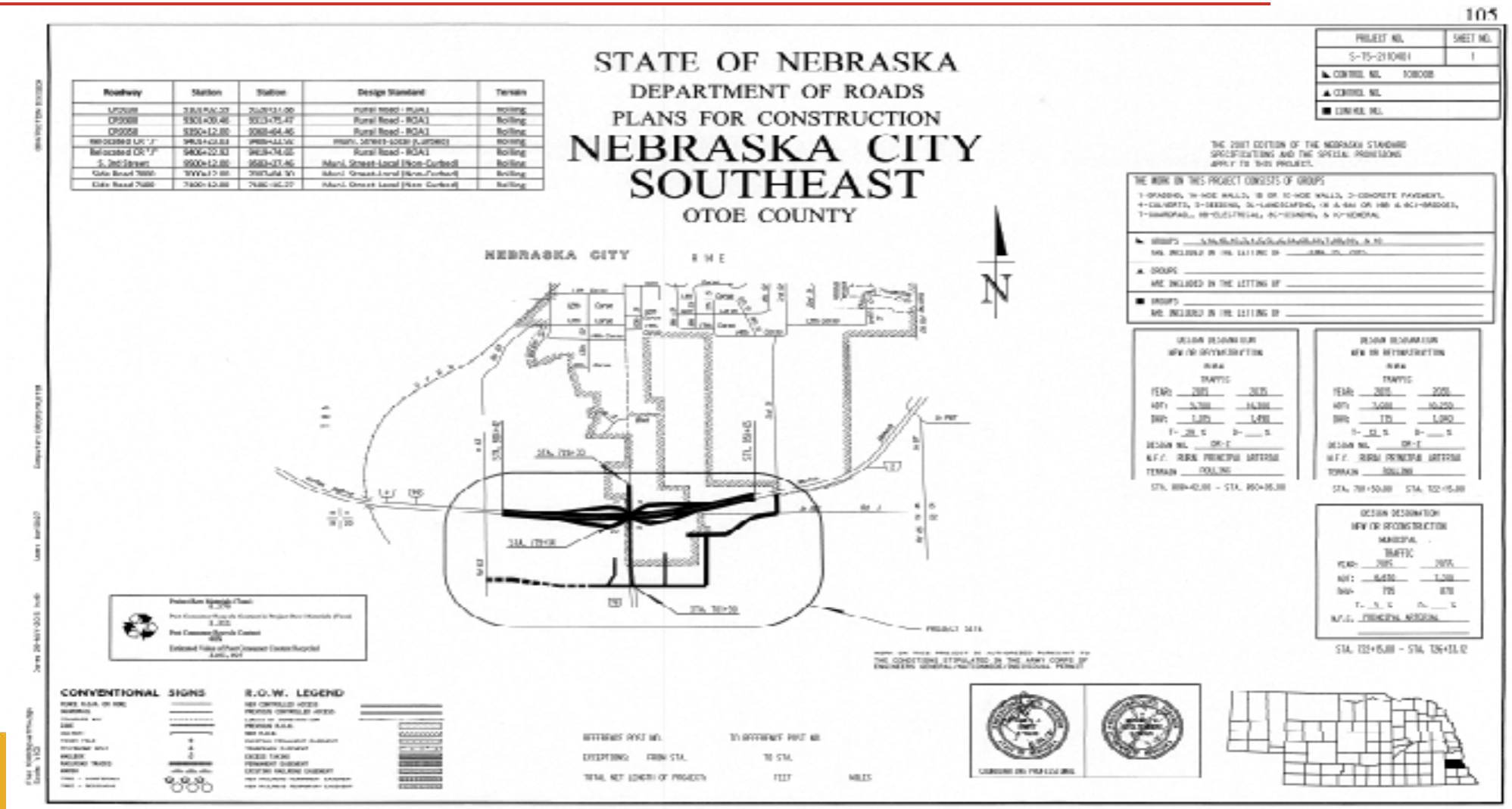
- Targets and Measures
- Life-Cycle Cost Analysis
- Risk Management

Pavement Inventory



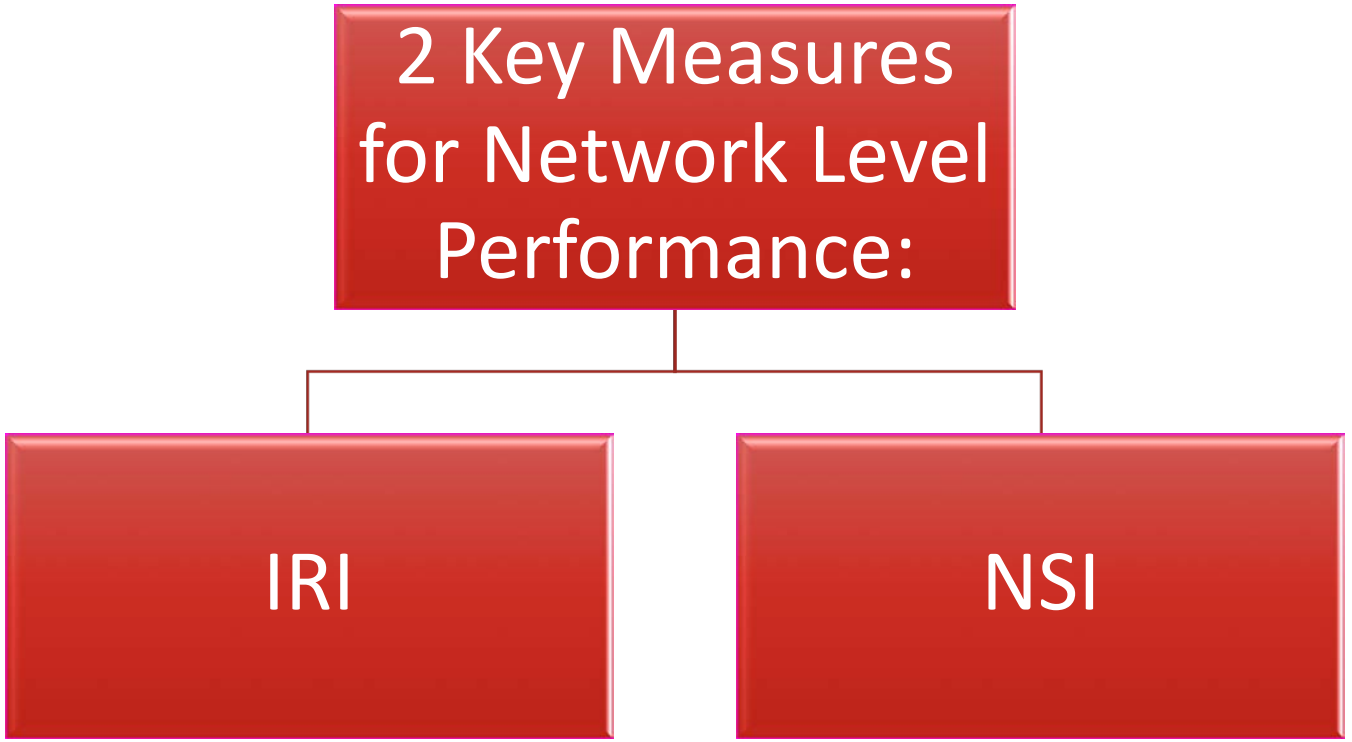
Pavement Condition

Automated Data Collection
(Rutting, Faulting, IRI, 3D Surface, Photos, & GPS data)

Manual Visual Ratings
(Cracking Distress)

*Collect all 10,000 Miles each year

Collection of Pavement Condition

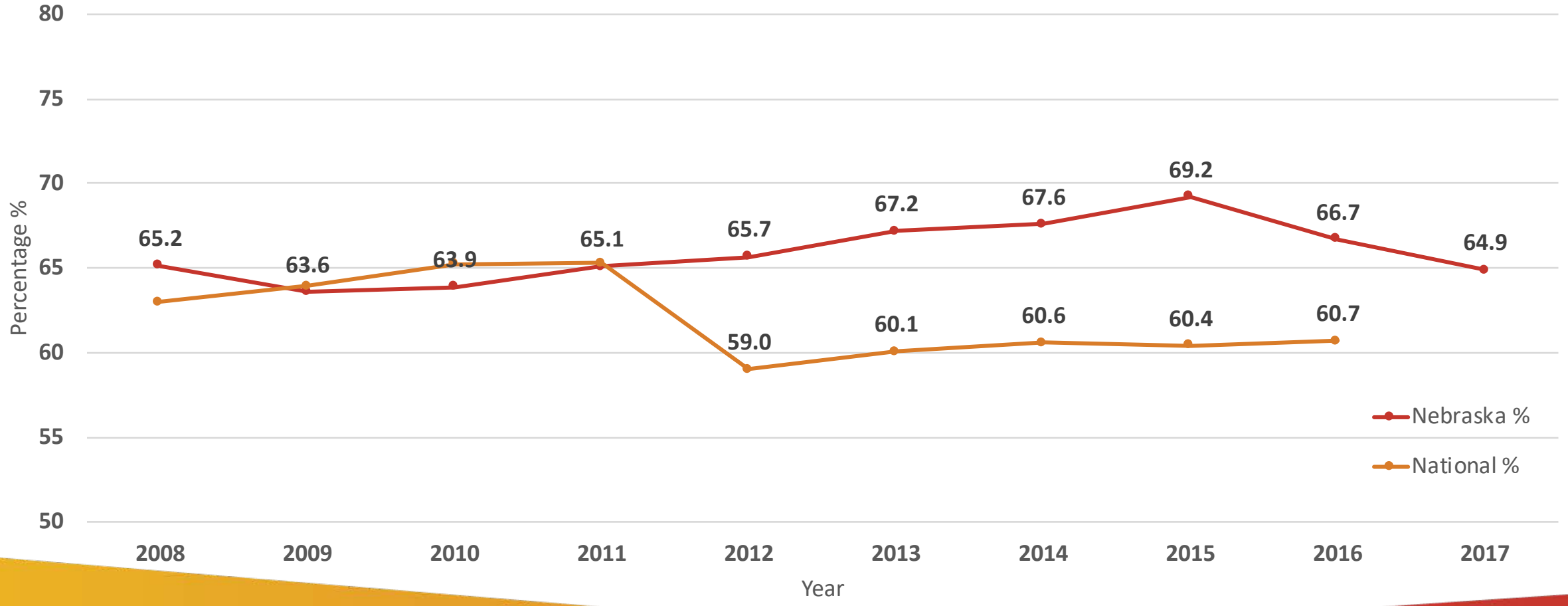


Pavement Condition Rating - IRI

- Why IRI?
  - This is how the general public evaluates our roads
  - Smoother roads are safer
  - Lowers vehicle operating cost
  - More enjoyable to drive on

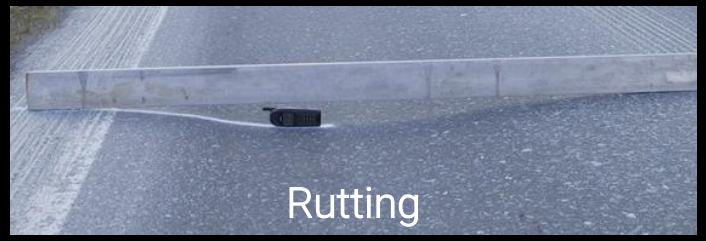
Pavement Condition Rating (IRI)

Goal 65% of NHS with IRI < 95 in/mi or < 1.5 m/km



Pavement Condition Rating – Nebraska Serviceability Index (NSI)

Asphalt NSI


Rutting

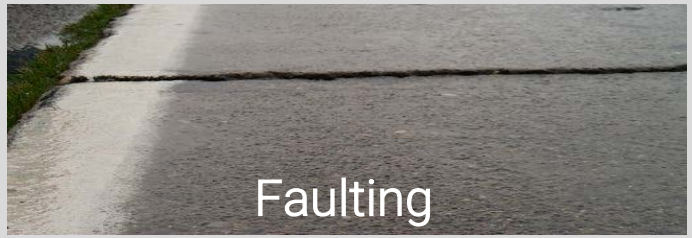

Longitudinal Cracking


Transverse Cracking


Alligator Cracking

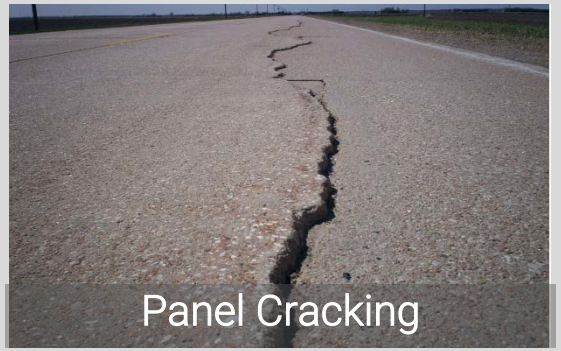

Failures

Concrete NSI


Faulting


Pattern Cracking (ASR)


Panel/Joint Spalls


Panel Cracking

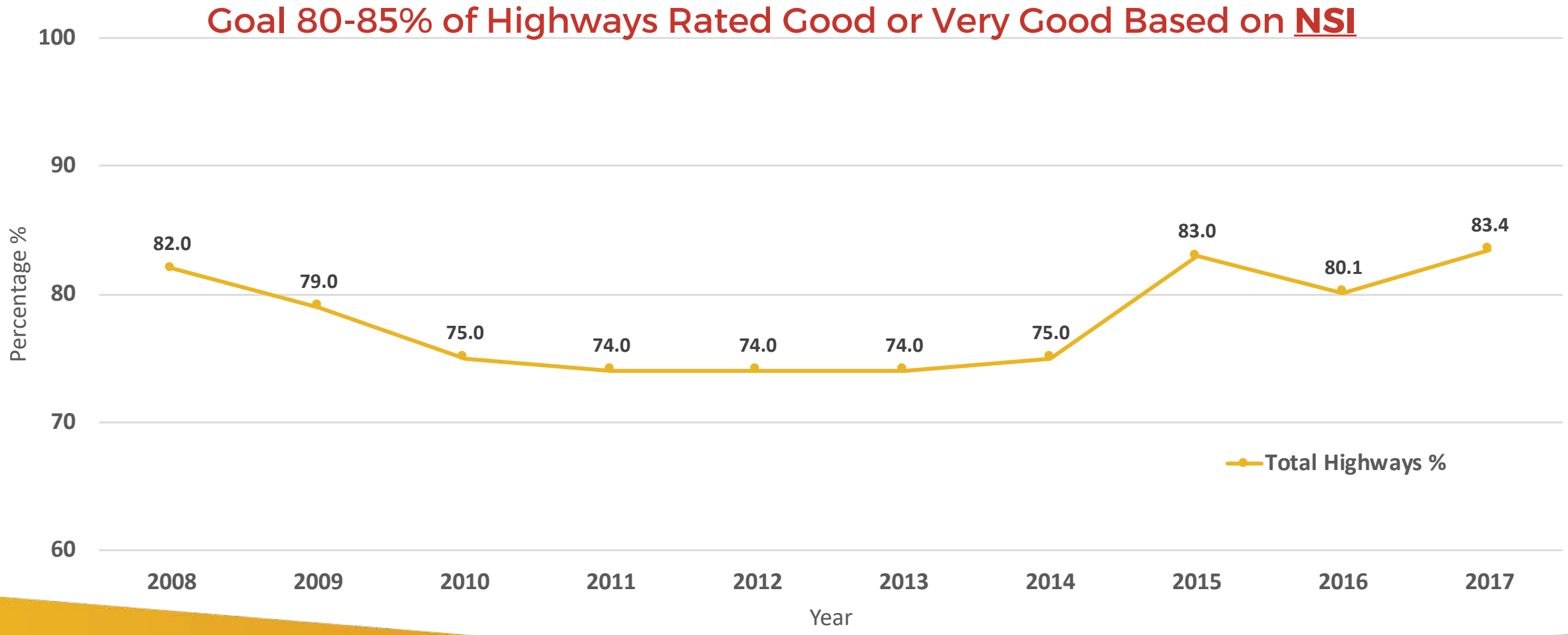

Panel/Joint Repairs

NSI Rating Scale

Nebraska Serviceability Index

Rating	Condition	Description
Very Good	90 - 100	Pavement like new
Good	70 - 89.99	Several years of service life remaining
Fair	50 - 69.99	Few years of service life remaining
Poor	30 - 49.99	Candidate for rehabilitation
Very Poor	0 - 29.99	Possible replacement

Pavement Condition Rating (NSI)



Bridge Inventory

- Data categories
  - Inventory
  - Condition
  - Geometry
  - Load carrying capacity
  - Construction history and proposed construction

Bridge Inventory

- Standard Good, Fair and Poor condition measures were established under MAP-21 regulations 23 CFR § 490.407 National performance management measures for assessing bridge condition.
  - Good Bridges – when the major bridge components are all in good condition or better.
  - Poor Bridges – when one or more of the major bridge components are in poor condition or worse.
  - Fair Bridges – all other bridges
  - Major Bridge Components – Bridge Deck, Superstructure, Substructure
- Nebraska performance can be seen here: https://dot.nebraska.gov/business-center/bridge/

TOPICS

- National Perspective
- Inventory and Condition
- Targets and Measures
- Life-Cycle Cost Analysis
- Risk Management
- Objectives
- Performance Measures & Targets

Nebraska's Asset Management Objectives

1. Maintain pavement and bridges in a state of good repair
2. Optimize budget expenditures
3. Meet or increase the expected life-span of the major assets

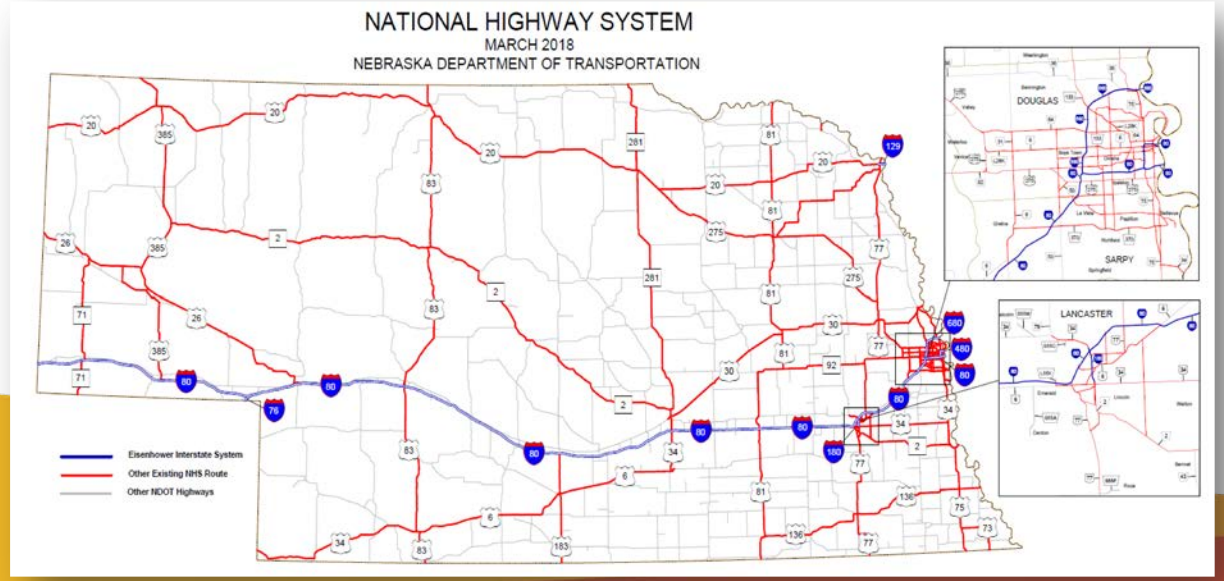
Pavement Performance Measure Targets

- Nebraska's historical performance target is a system wide average NSI of 84.7
  - Based on historical pavement condition and funding levels
- In 2017, NSI was 83.9
- Around 500 miles per year of Rehabilitation projects.
  - With a system of approx. 10,000 miles, every road would be addressed at least once every 20 years
- After 2008 recession, Nebraska moved from a worst first to a preservation strategy

500 Miles/Year
10,000 Miles
20 Year Cycle

State Performance Targets

Asset Type	Performance Measure	Target
Pavement	Weighted average NSI for the interstate system	≥86
	Weighted average NSI for the non-interstate NHS system	≥80



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MAP-21 Pavement Condition Ratings

- All 3 “Good” = Good
- If 2 or more “Poor” = Poor
- Anything Else = Fair

Rating	Good	Fair	Poor
IRI *(inches/mile)*	<95	***95-170***	***>170***
PSR* *(0.0-5.0 value)*	≥4.0	2.0-4.0	≤2.0
Cracking Percent *(%)*	<5	***CRCP: 5-10 Jointed: 5-15 Asphalt: 5-20***	***>10 >15 >20***
Rutting *(inches)*	<0.20	0.20-0.40	>0.40
Faulting *(inches)*	***<0.10***	0.10-0.15	>0.15

*PSR may be used only on routes with posted speed limit < 40mph.

National Pavement Performance Targets

Asset Type	Performance Measure	Target
Pavement	% of pavements on the interstate system in good condition	≥ 50
	% of pavements on the interstate system in poor condition	≤ 5
	% of pavements on the non-interstate National Highway System in good condition	≥ 40
	% of pavements on the non-interstate National Highway System in poor condition	≤ 10

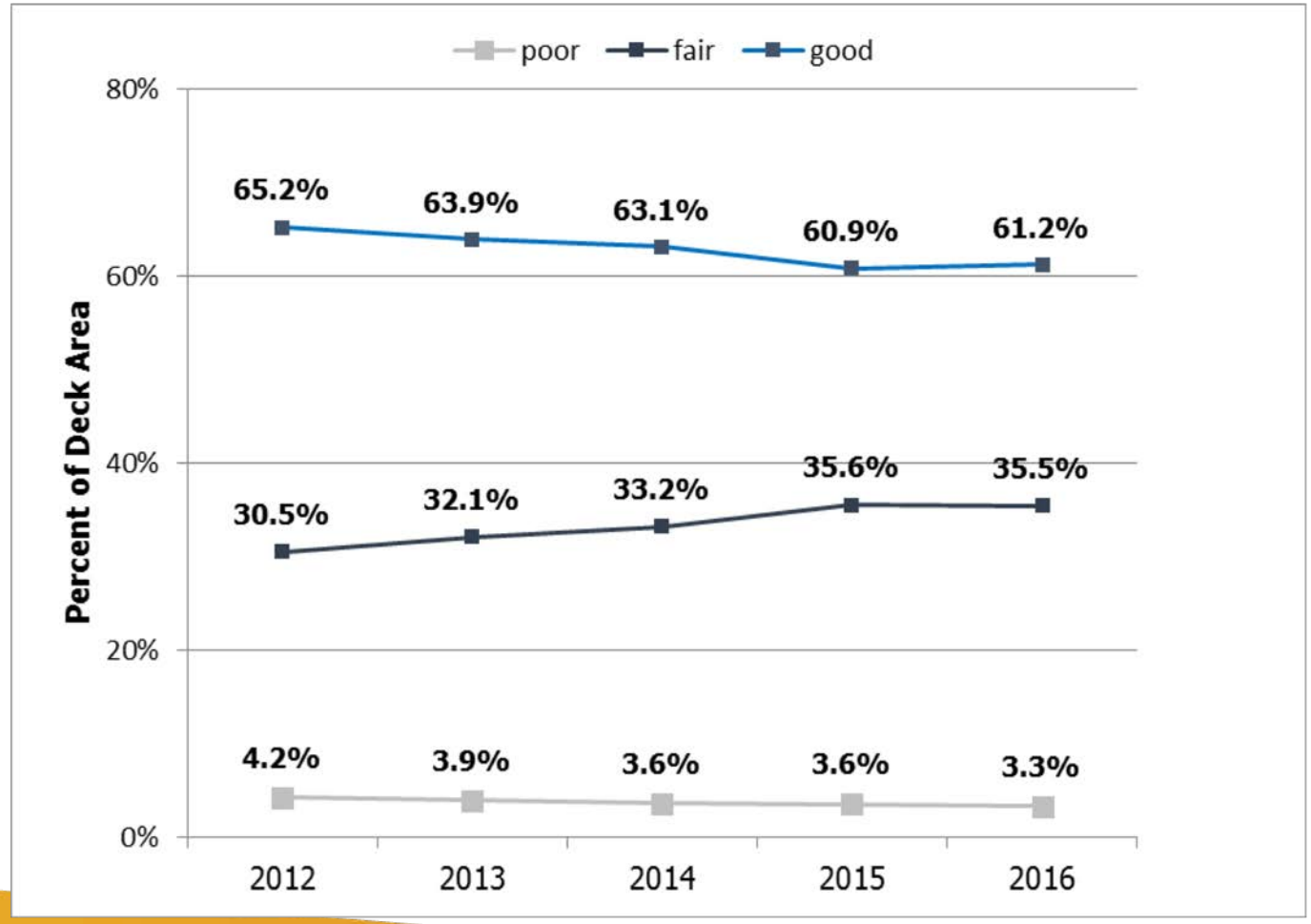
National Bridge Performance Targets

Asset Type	Performance Measure	Target
Bridges on NHS	% of bridge deck area in poor condition	Less than 10%
Bridges on NHS	% of bridge deck area in good condition	more than 55%

$$100 \times \frac{\sum_{p=1}^{\text{POOR}} [\text{Length} \times \text{Width}]_{\text{Bridge p}}}{\sum_{s=1}^{\text{TOTAL}} [\text{Length} \times \text{Width}]_{\text{Bridge s}}}$$

$$100 \times \frac{\sum_{g=1}^{\text{GOOD}} [\text{Length} \times \text{Width}]_{\text{Bridge g}}}{\sum_{s=1}^{\text{TOTAL}} [\text{Length} \times \text{Width}]_{\text{Bridge s}}}$$

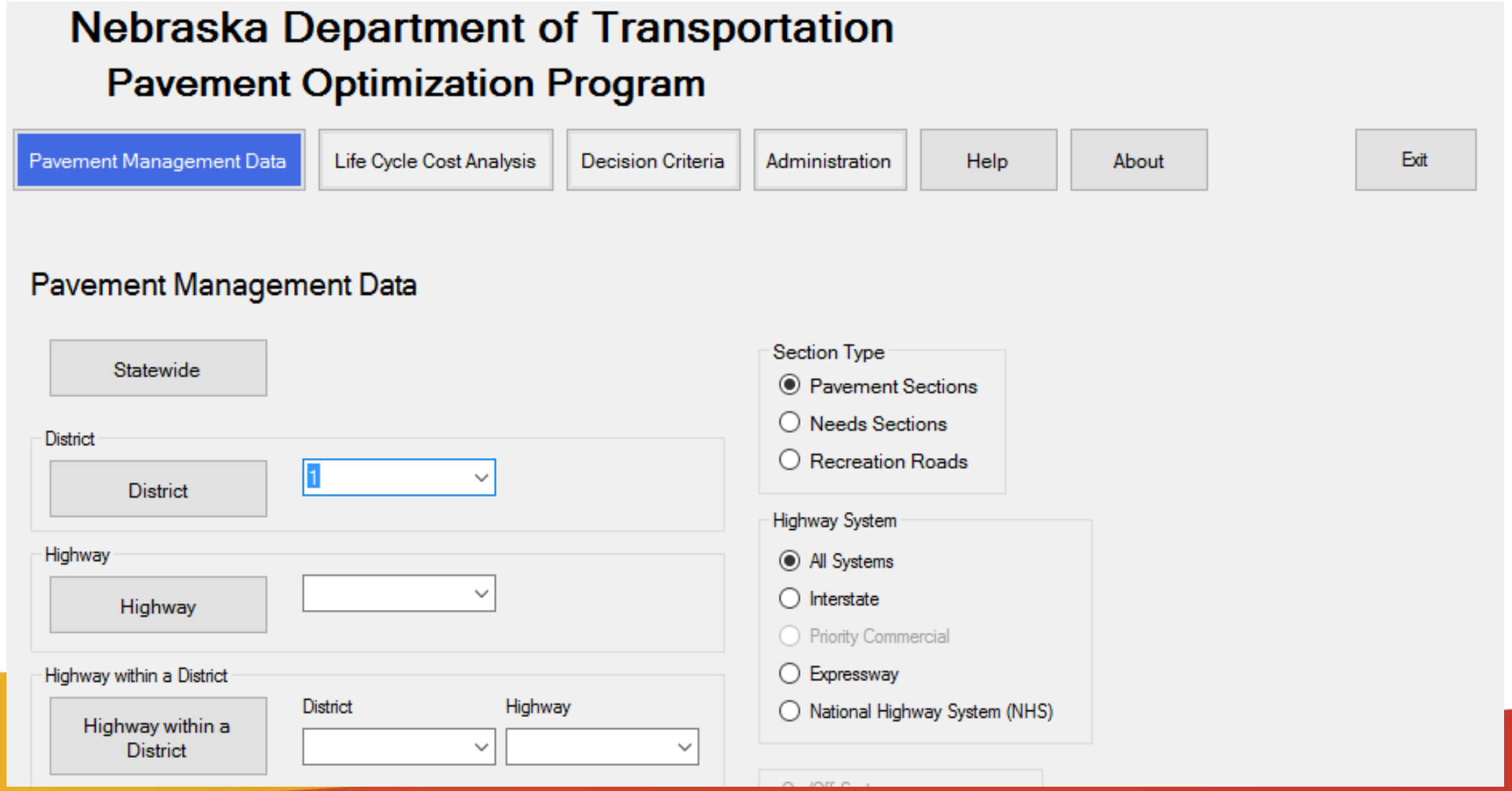
Nebraska Bridge Performance Historical Trends – Nebraska National Highway System



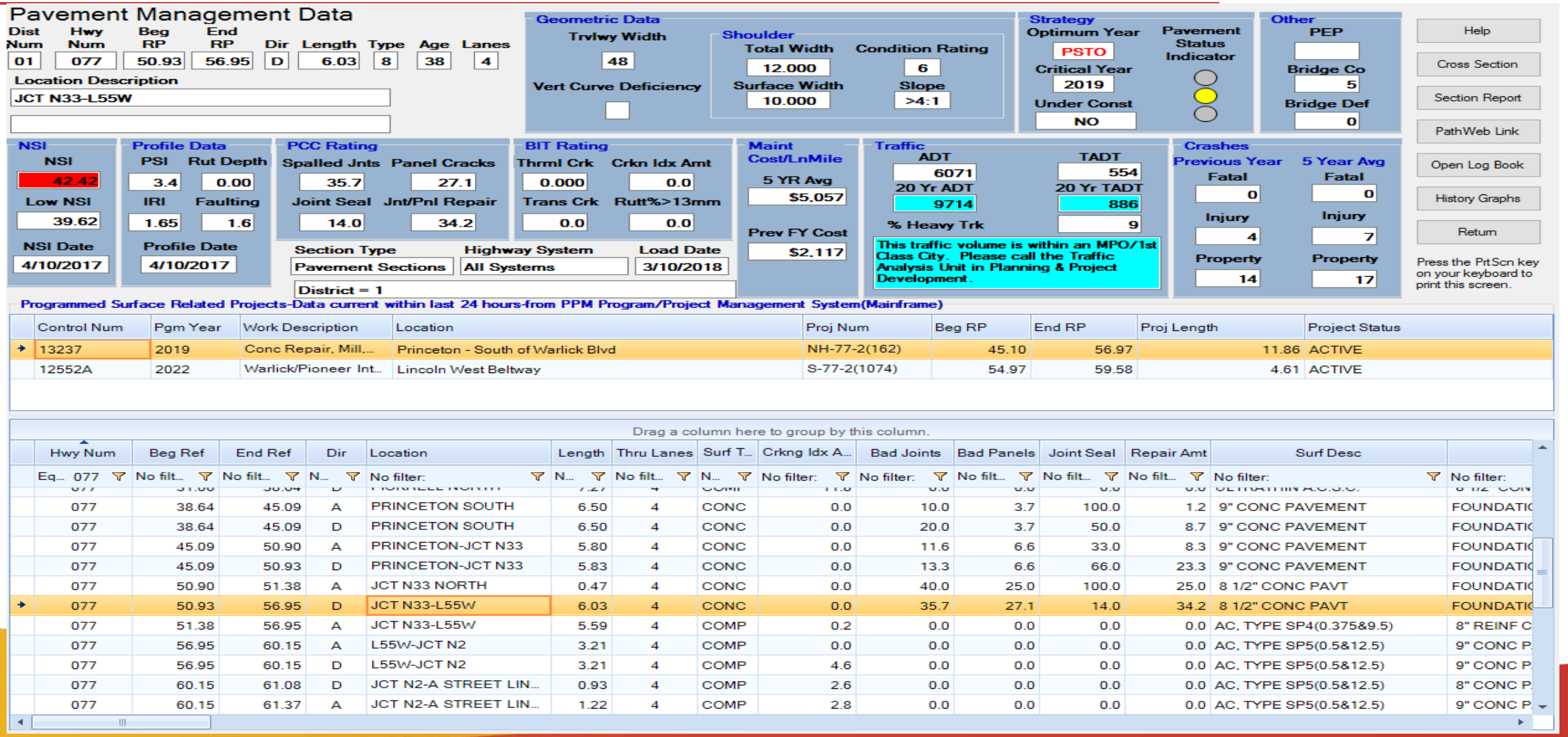
TOPICS

- National Perspective
- Inventory and Condition
- Targets and Measures
- Life-Cycle Cost Analysis
- Risk Management
- Deterioration factors
- Decision trees
- Life-cycle costs
- Life-cycle cost/benefit analysis
- Project candidates

Decision Making



Pavement Data



Pavement Management Data

Dist Num	Hwy Num	Beg RP	End RP	Dir	Length	Type	Age	Lanes
01	077	50.93	56.95	D	6.03	8	38	4

Location Description: JCT N33-L55W

Geometric Data: Trvlwy Width 48; Vert Curve Deficiency; Shoulder — Total Width 12.000; Surface Width 10.000; Condition Rating 6; Slope >4:1

Strategy: Optimum Year PSTO; Critical Year 2019; Under Const NO; Pavement Status Indicator

Other: PEP; Bridge Co 5; Bridge Def 0

NSI: NSI 42.42; Low NSI 39.62; NSI Date 4/10/2017

Profile Data: PSI 3.4; Rut Depth 0.00; IRI 1.65; Faulting 1.6; Profile Date 4/10/2017

PCC Rating: Spalled Jnts 35.7; Panel Cracks 27.1; Joint Seal 14.0; Jnt/Pnl Repair 34.2

BIT Rating: Thrml Crk 0.000; Crkn Idx Amt 0.0; Trans Crk 0.0; Rutt%>13mm 0.0

Maint Cost/LnMile: 5 YR Avg $5,057; Prev FY Cost $2,117

Traffic: ADT 6071; TADT 554; 20 Yr ADT 9714; 20 Yr TADT 886; % Heavy Trk 9

This traffic volume is within an MPO/1st Class City. Please call the Traffic Analysis Unit in Planning & Project Development.

Crashes: Previous Year — Fatal 0; Injury 4; Property 14. 5 Year Avg — Fatal 0; Injury 7; Property 17

Section Type: Pavement Sections; Highway System: All Systems; Load Date: 3/10/2018

District = 1

Help | Cross Section | Section Report | PathWeb Link | Open Log Book | History Graphs | Return

Press the PrtScn key on your keyboard to print this screen.

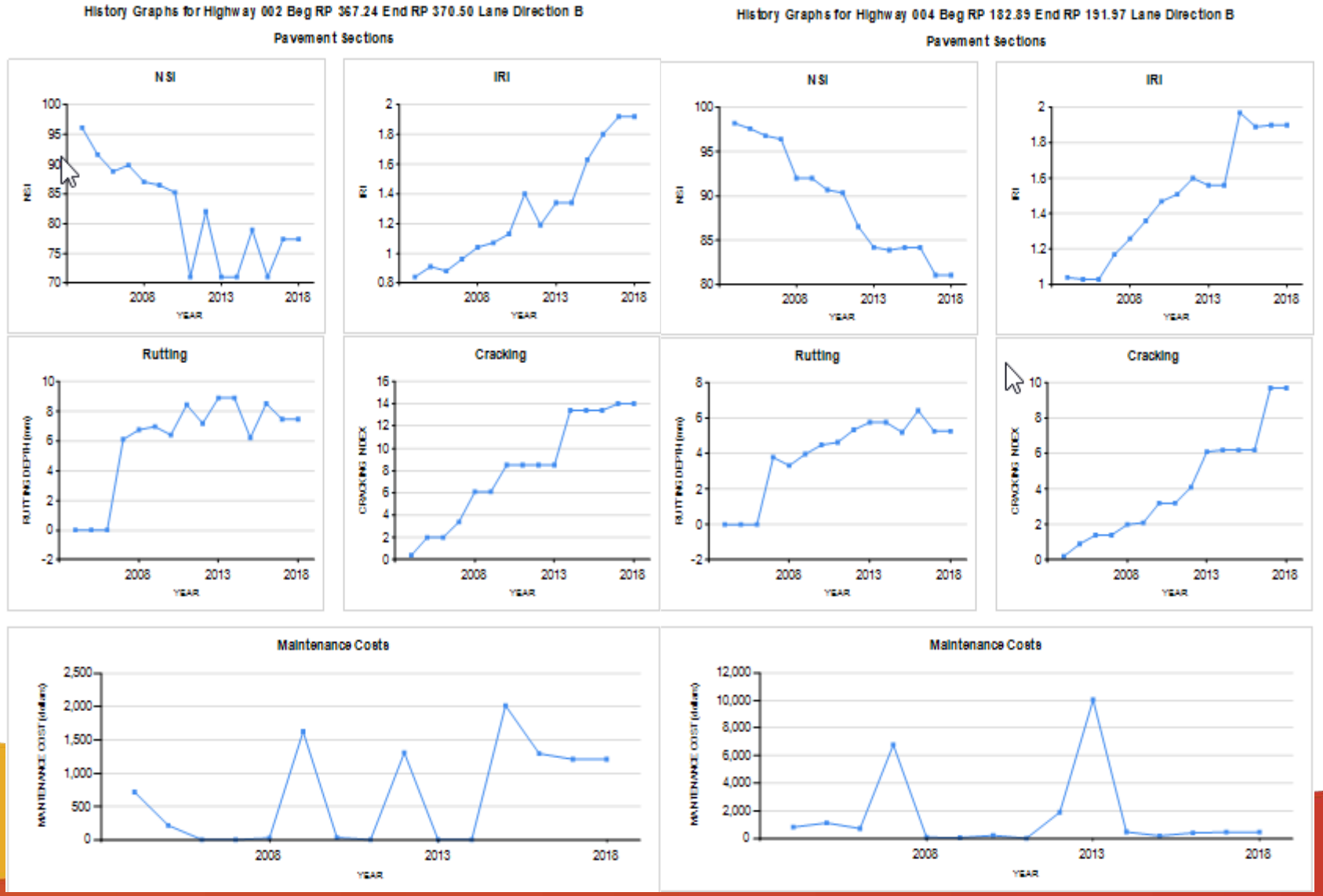
Programmed Surface Related Projects-Data current within last 24 hours-from PPM Program/Project Management System(Mainframe)

Control Num	Pgm Year	Work Description	Location	Proj Num	Beg RP	End RP	Proj Length	Project Status
13237	2019	Conc Repair, Mill,...	Princeton - South of Warlick Blvd	NH-77-2(162)	45.10	56.97	11.86	ACTIVE
12552A	2022	Warlick/Pioneer Int...	Lincoln West Beltway	S-77-2(1074)	54.97	59.58	4.61	ACTIVE

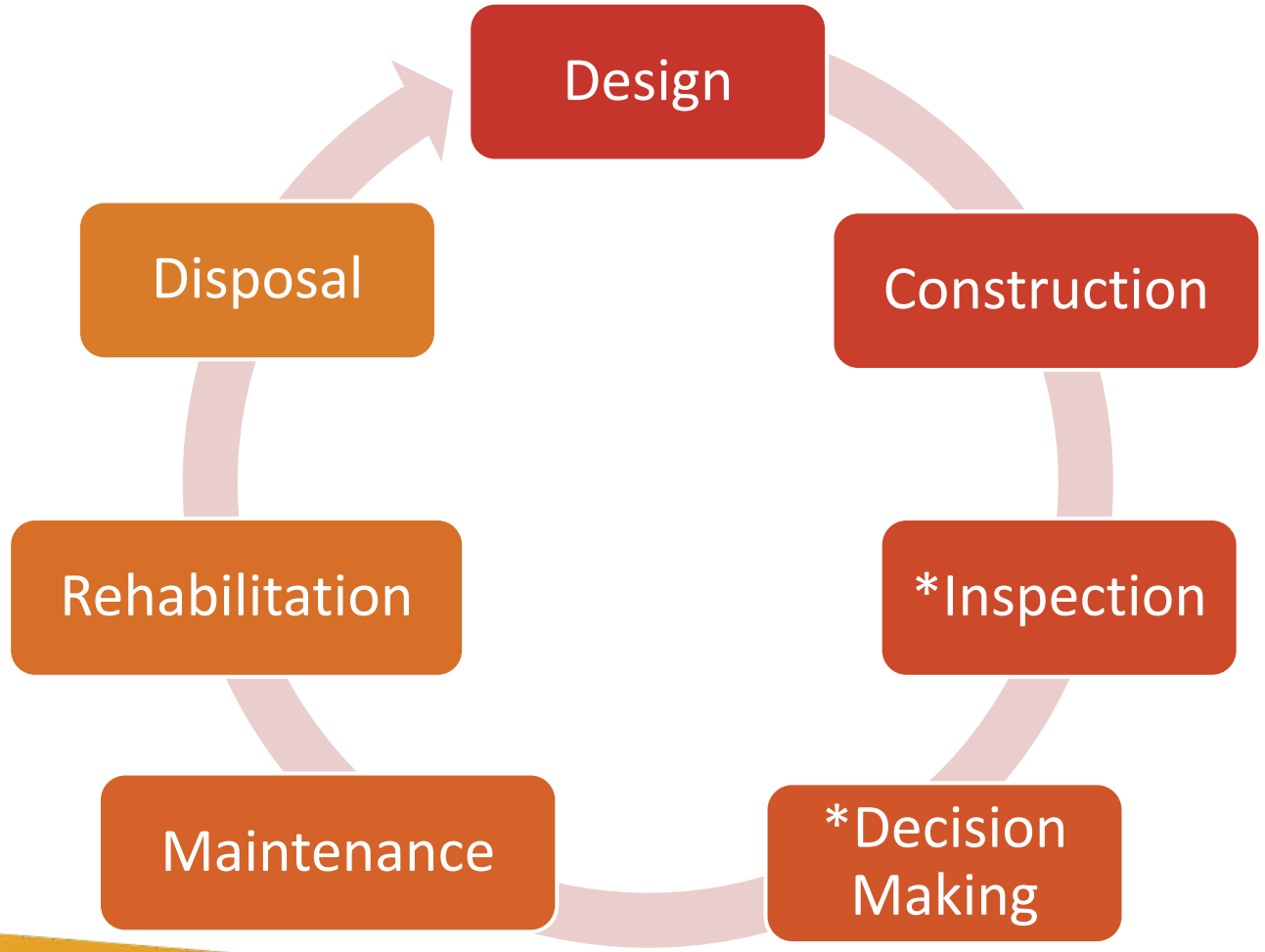
Drag a column here to group by this column.

Hwy Num	Beg Ref	End Ref	Dir	Location	Length	Thru Lanes	Surf T...	Crkng Idx A...	Bad Joints	Bad Panels	Joint Seal	Repair Amt	Surf Desc	
077	38.64	45.09	A	PRINCETON SOUTH	6.50	4	CONC	0.0	10.0	3.7	100.0	1.2	9" CONC PAVEMENT	FOUNDATIO
077	38.64	45.09	D	PRINCETON SOUTH	6.50	4	CONC	0.0	20.0	3.7	50.0	8.7	9" CONC PAVEMENT	FOUNDATIO
077	45.09	50.90	A	PRINCETON-JCT N33	5.80	4	CONC	0.0	11.6	6.6	33.0	8.3	9" CONC PAVEMENT	FOUNDATIO
077	45.09	50.93	D	PRINCETON-JCT N33	5.83	4	CONC	0.0	13.3	6.6	66.0	23.3	9" CONC PAVEMENT	FOUNDATIO
077	50.90	51.38	A	JCT N33 NORTH	0.47	4	CONC	0.0	40.0	25.0	100.0	25.0	8 1/2" CONC PAVT	FOUNDATIO
077	50.93	56.95	D	JCT N33-L55W	6.03	4	CONC	0.0	35.7	27.1	14.0	34.2	8 1/2" CONC PAVT	FOUNDATIO
077	51.38	56.95	A	JCT N33-L55W	5.59	4	COMP	0.2	0.0	0.0	0.0	0.0	AC, TYPE SP4(0.375&9.5)	8" REINF C
077	56.95	60.15	A	L55W-JCT N2	3.21	4	COMP	0.0	0.0	0.0	0.0	0.0	AC, TYPE SP5(0.5&12.5)	9" CONC P
077	56.95	60.15	D	L55W-JCT N2	3.21	4	COMP	4.6	0.0	0.0	0.0	0.0	AC, TYPE SP5(0.5&12.5)	9" CONC P
077	60.15	61.08	D	JCT N2-A STREET LIN...	0.93	4	COMP	2.6	0.0	0.0	0.0	0.0	AC, TYPE SP5(0.5&12.5)	8" CONC P
077	60.15	61.37	A	JCT N2-A STREET LIN...	1.22	4	COMP	2.8	0.0	0.0	0.0	0.0	AC, TYPE SP5(0.5&12.5)	9" CONC P

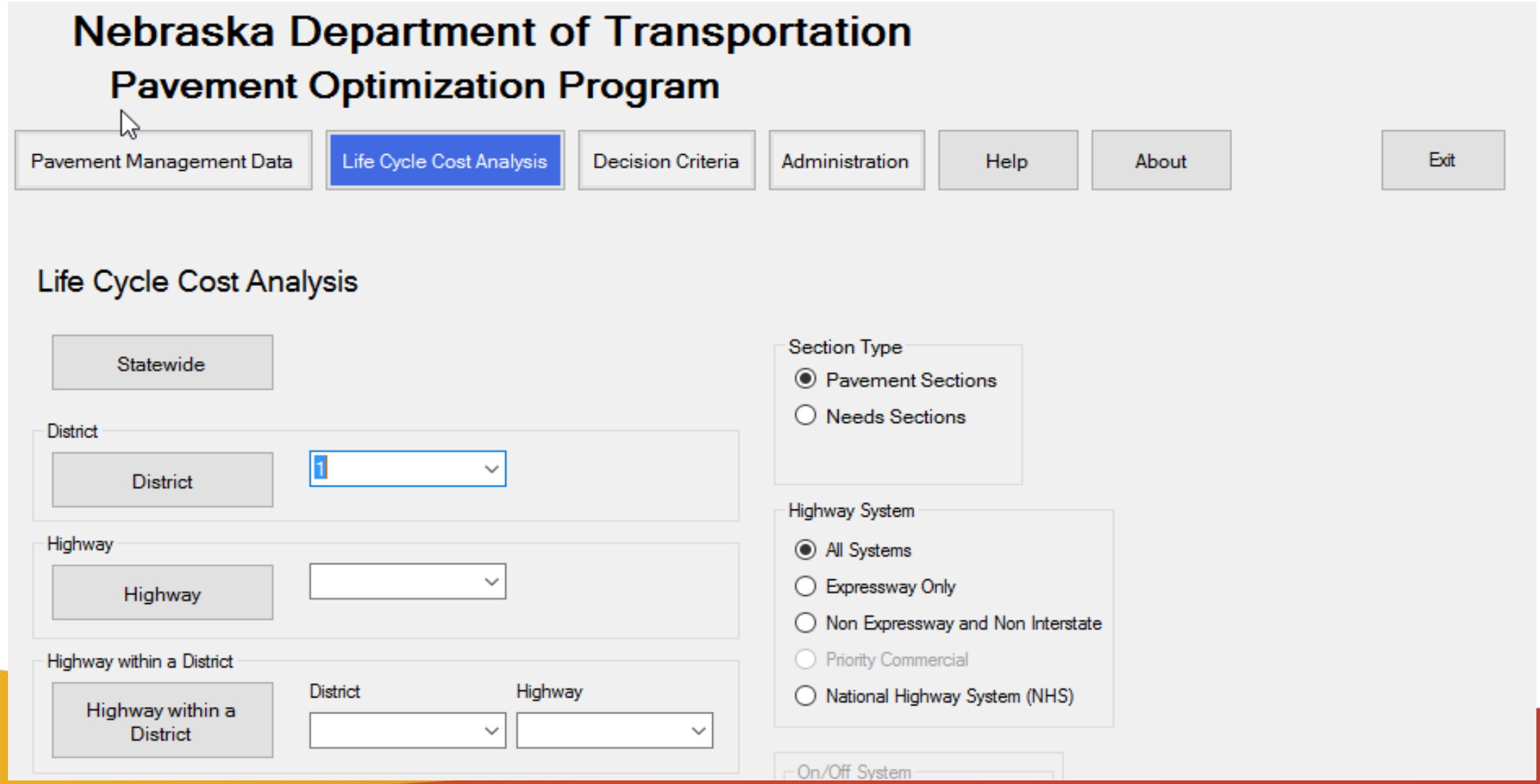
History Graphs



Life Cycle


Design
Construction
*Inspection
*Decision Making
Maintenance
Rehabilitation
Disposal

Pavement Life Cycle Cost Analysis



Types of Analysis

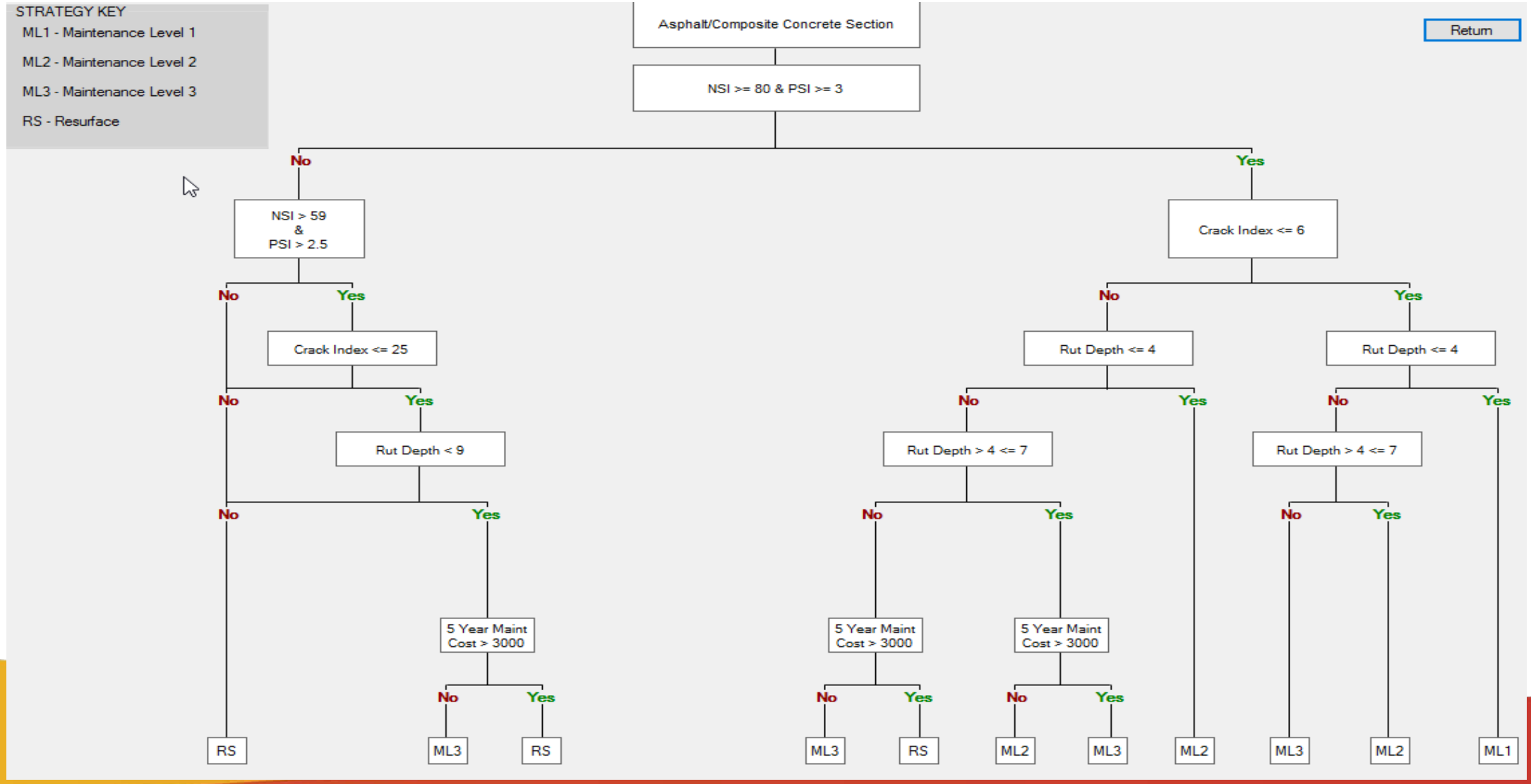
1. Users can compute the cost to maintain a selected NSI value over a selected number of years.
   - Answers the question “How much will it cost to maintain my system?”

2. Users can compute the resulting NSI value over a selected number of years, given a specific budget.
   - Answers the question “What will the condition of my system be if I spend X number of dollars?”

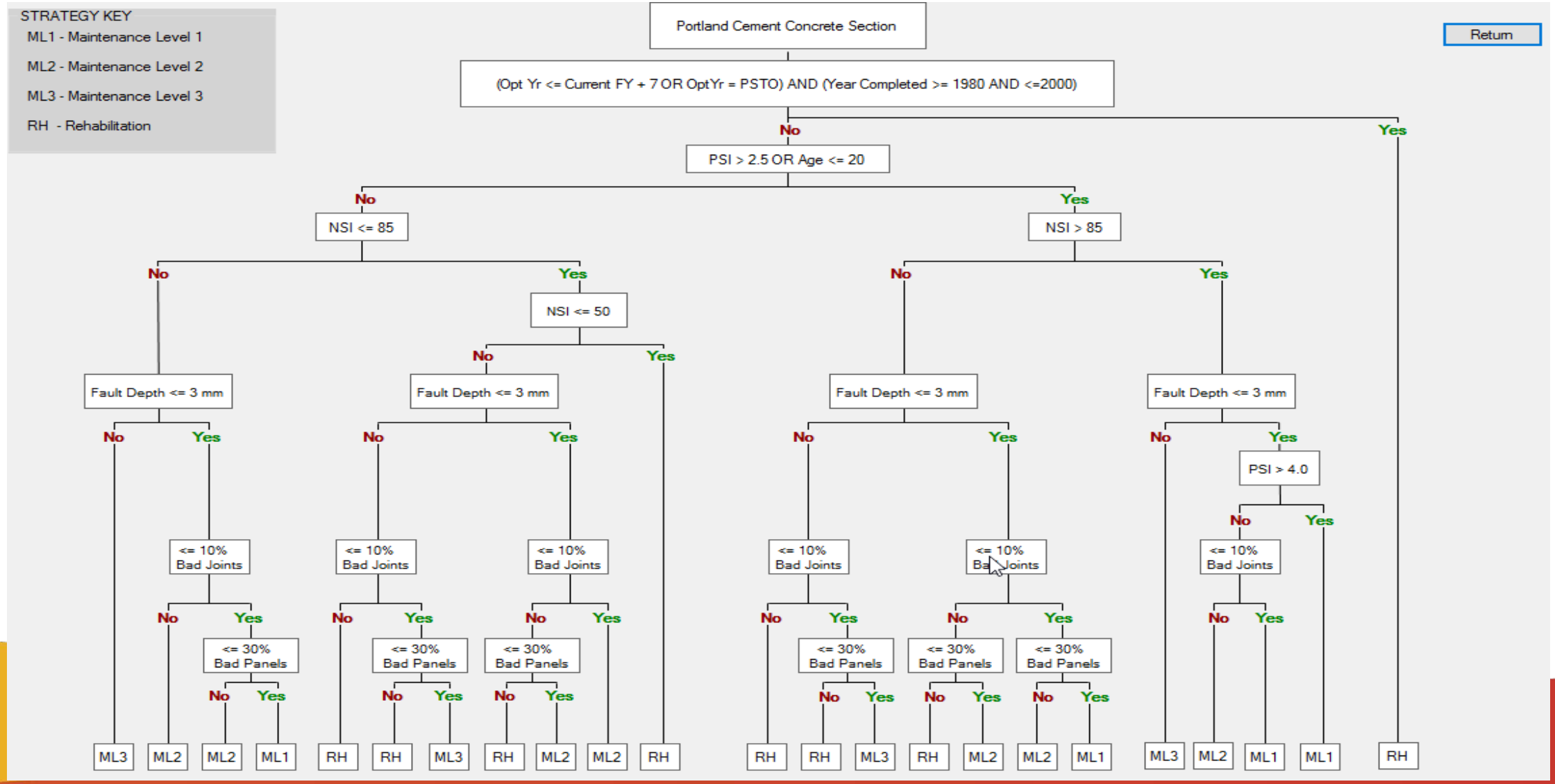
Pavement Analysis Factors

- Current condition ratings for age, NSI, PSI, cracking, rutting, and faulting
- Deterioration rates for NSI, PSI, cracking, rutting, and faulting
- Length, strategy types, and cost per mile for each strategy

Asphalt/Composite Decision Tree



Portland Cement Concrete Decision Tree

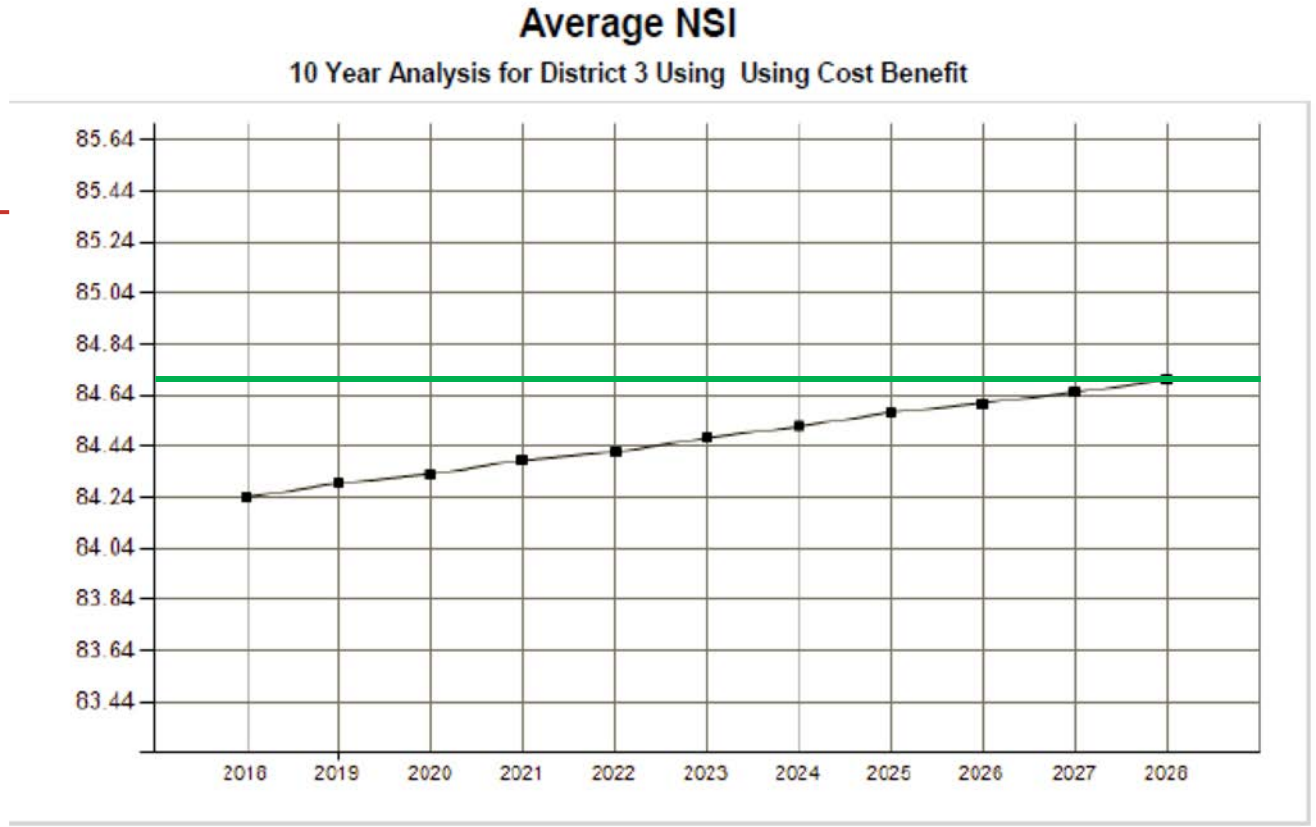


Strategies

Pavement Optimization Strategy Definitions

ML1AC Maintenance Level 1	This is a maintenance action that would cost approximately $8,000 per mile. Example: Crack Sealing, Fog Sealing, Skin Patching or Throw and Roll Patch.
ML2AC Maintenance Level 2	This is a maintenance action that would cost approximately $35,000 per mile. Example: Armor Coats, Chip Seal, Machine Patch or Mill and Armor Coat.
ML3AC Maintenance Level 3	This is a maintenance action that would cost approximately $155,000 per mile. Example: Mill and Overlay or Thin Overlays.
RS-AC Resurface	This is a resurfacing action with asphalt. The cost would be approximately $360,000 per mile.
ML1PCC Maintenance Level 1	This is a maintenance action that would cost approximately $36,000 per mile. Example: Joint Sealing and Crack Sealing
ML2PCC Maintenance Level 2	This is a maintenance action that would cost approximately $100,000 per mile. Example: Joint and Panel Repair with Joint Sealing
ML3PCC Maintenance Level 3	This is a maintenance action that would cost approximately $160,000 per mile. Example: Diamond Grinding and Panel and Joint Repair.
RH-PCC Rehabilitation	This is a rehabilitation action that would cost approximately $385,000 per mile. Example: Resurfacing. This section's future analysis will change to the asphalt/composite decision tree.

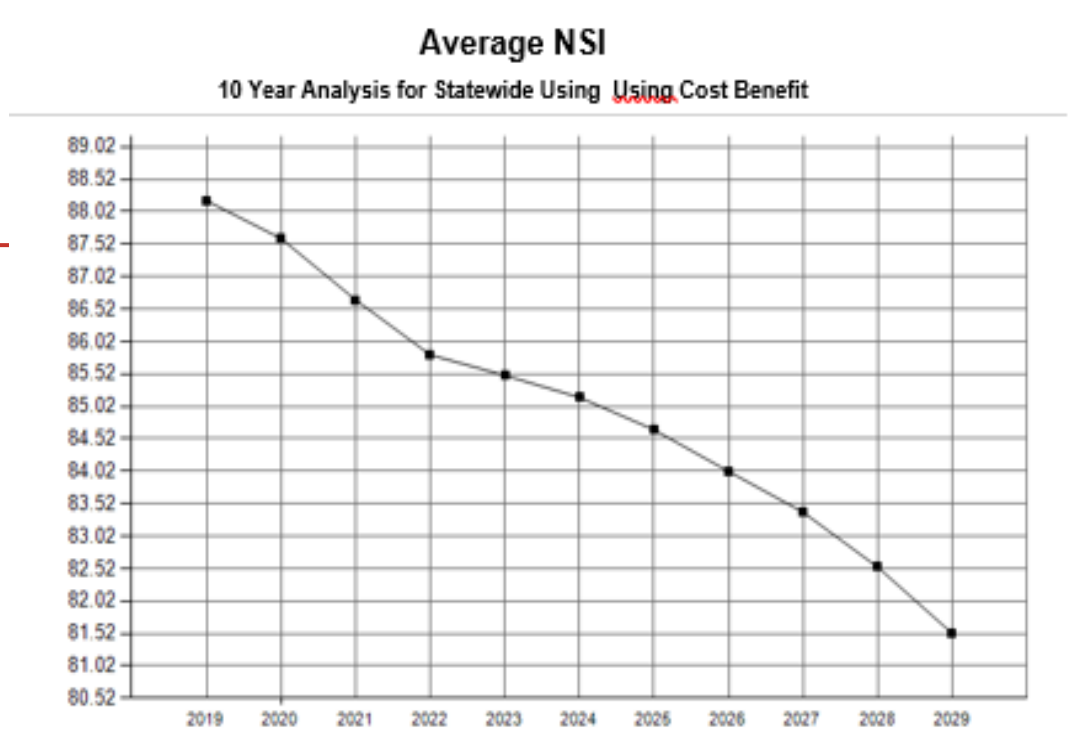
Outputs



84.7

YEAR	BUDGET	REMAINING BUDGET	AVE NSI	TOTAL IMPROVED MILES	NSI VERY GOOD >=90	NSI GOOD >=70 & <90	NSI FAIR >=50 & <70	NSI POOR >=30 & <50	NSI VERY POOR <30	RUTTING >=7 mm
2018	$0	$0	84.24	0.00	775.60	565.81	213.25	84.63	1.53	50.18
2019	$30,000,000	$11,460	84.29	111.46	773.48	574.57	252.40	40.05	0.32	91.71
2020	$38,100,000	$17,045	84.33	172.18	714.75	677.12	239.29	8.27	1.39	124.84
2021	$40,950,000	$98	84.38	194.49	713.28	668.62	224.53	33.00	1.39	121.53
2022	$37,000,000	$6,163	84.42	210.47	707.91	728.75	199.94	4.22	0.00	115.69
2023	$39,300,000	$9,065	84.47	258.74	540.77	915.41	167.00	17.64	0.00	109.35
2024	$41,480,000	$3,975	84.52	329.12	644.30	831.58	147.30	17.64	0.00	135.37
2025	$40,030,000	$545	84.57	361.79	552.76	909.05	161.37	15.38	2.26	218.20
2026	$39,400,000	$23,270	84.61	281.34	557.15	904.67	179.00	0.00	0.00	206.36
2027	$42,600,000	$23,660	84.65	302.74	579.26	890.50	171.06	0.00	0.00	145.40
2028	$43,900,000	$30,840	84.70	383.18	564.95	922.60	153.27	0.00	0.00	127.58

Outputs



YEAR	BUDGET	REMAINING BUDGET	AVE NSI	TOTAL IMPROVED MILES	NSI VERY GOOD >=80	NSI GOOD >=70 & <80	NSI FAIR >=60 & <70	NSI POOR >=30 & <60	NSI VERY POOR <30	RUTTING >=7 mm
2019	$0	$0	88.19	0.00	6,047.24	2990.42	862.38	211.25	3.57	139.74
2020	$200,000,000	$1,215	87.61	966.69	4,955.52	4129.18	1010.01	19.25	0.90	288.64
2021	$200,000,000	$2,193	86.67	843.23	4,318.95	4893.35	864.28	36.59	1.69	452.93
2022	$200,000,000	$2,275	85.82	873.62	4,000.67	5286.66	737.37	88.47	1.69	670.97
2023	$200,000,000	$133	85.50	2,104.35	3,754.41	5555.38	781.24	23.53	0.30	590.09
2024	$200,000,000	$340	85.16	1,435.72	3,988.55	5474.45	614.61	36.67	0.58	583.29
2025	$200,000,000	$2,940	84.66	1,727.99	3,359.74	6150.95	558.90	44.69	0.58	989.50
2026	$200,000,000	$13,563	84.02	1,461.03	3,198.93	6100.85	766.54	41.98	6.56	1620.20
2027	$200,000,000	$6,718	83.39	2,419.73	2,898.14	6015.78	1192.64	8.02	0.28	2220.39
2028	$200,000,000	$17,355	82.55	1,686.61	2,849.66	5598.18	1658.72	8.02	0.28	1991.40
2029	$200,000,000	$185	81.52	1,141.62	2,462.49	5872.42	1771.65	8.02	0.28	1707.32
Grand Totals/Averages			84.69		35,787.06		9,955.96		13.14	
	$200,000,000			14,660.59		55,077.20		315.24		11,114.73

Output – Candidate lists

District 1
Pavement Sections

Selected Projects Based on 10 Year Life Cycle Cost Analysis
Sorted by Hwy and Ref Post

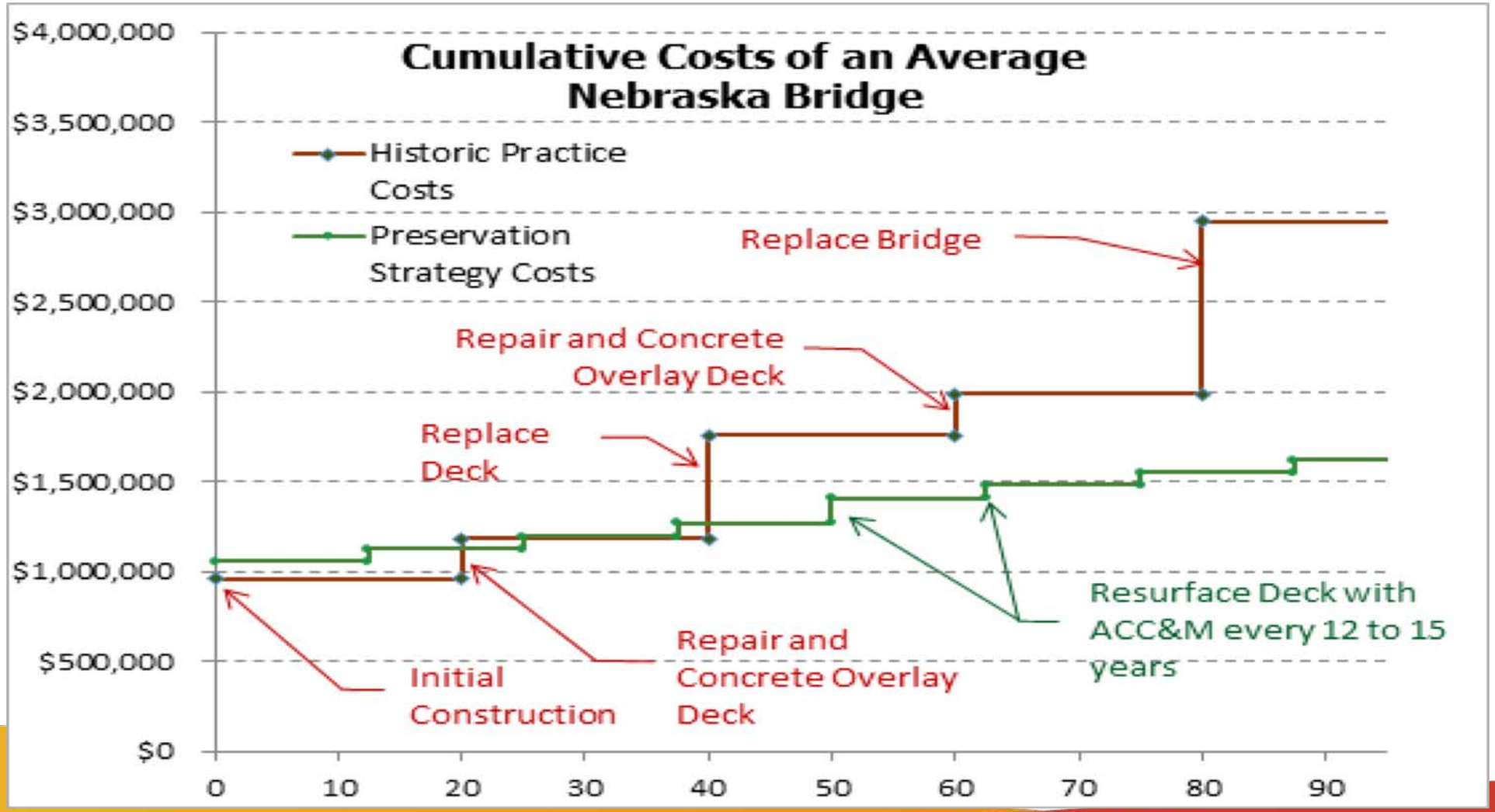
Selected Candidate Years: 2019, 2020, 2021, 2022, 2023, 2024, 2025, 2026, 2027, 2028
Selected Strategies: All Strategies

HWY NUM	BEGIN REF. POST	END REF. POST	LANE DIR	LENGTH	LOCATION	RANK	STRATEGY	CANDIDATE YEAR	EST. COST	NSI BEFORE STRATEGY	NSI AFTER STRATEGY	PROGRAM YEAR
001	2.38	7.31	B	4.93	ELMWOOD-MURDOCK	3.10	RS-AC	2025	$1,774,800	50.00	100.00	
001	7.31	12.91	B	5.60	MURDOCK-JCT N50	3.10	RS-AC	2025	$2,016,000	50.00	100.00	
002	456.63	456.80	B	0.17	S US77 INTERCHANGE	1.51	ML1PCC	2019	$9,180	70.00	75.00	2023
002	456.63	456.80	B	0.17	S US77 INTERCHANGE	2.51	ML1PCC	2028	$9,180	57.00	62.00	2023
002	464.89	471.44	A	6.55	LINCOLN-JCT N43	2.90	ML1PCC	2019	$235,800	89.64	94.64	2023
002	464.89	471.44	D	6.55	LINCOLN-JCT N43	2.90	ML1PCC	2020	$235,800	88.44	93.44	2023
002	471.44	476.93	A	5.49	W JCT N43 - JCT S66A	2.96	ML1PCC	2019	$197,640	95.20	100.00	
002	471.44	476.93	D	5.49	W JCT N43 - JCT S66A	2.54	ML1PCC	2020	$197,640	95.99	100.00	
002	476.93	483.89	A	6.95	UNADILLA WEST	2.91	ML1PCC	2019	$250,200	94.72	99.72	
002	476.93	483.89	D	6.95	UNADILLA WEST	2.91	ML1PCC	2019	$250,200	96.96	100.00	
002	483.89	491.92	A	7.89	UNADILLA EAST	2.96	ML1PCC	2019	$284,040	96.40	100.00	
002	483.89	491.92	D	7.89	UNADILLA EAST	2.76	ML1PCC	2020	$284,040	95.67	100.00	
004	122.60	126.54	B	3.93	DAYKIN WEST	3.11	RS-AC	2025	$1,414,800	52.50	100.00	
004	126.54	133.58	B	7.03	DAYKIN EAST	3.58	RS-AC	2028	$2,701,278	43.00	100.00	
006	292.03	292.28	B	0.25	MILFORD WEST	3.10	RHPCC	2023	$96,250	49.95	100.00	2020
006	292.03	292.28	B	0.25	MILFORD WEST	2.27	ML1AC	2027	$2,000	89.25	91.75	2020
006	292.28	292.96	B	0.68	MILFORD	3.11	RS-AC	2026	$261,290	48.00	100.00	2024
006	292.96	293.72	B	0.77	MILFORD	12.61	RHPCC	2019	$296,450	23.55	100.00	2020
006	293.72	296.30	B	2.56	MILFORD NORTH	3.11	RS-AC	2023	$1,169,920	50.00	100.00	2020
006	309.06	311.44	A	2.36	JCTL55K-JCTUS77	2.97	RS-AC	2019	$1,078,520	50.96	100.00	
006	309.06	311.44	D	2.36	JCTL55K-JCTUS77	2.80	RS-AC	2020	$1,021,290	54.06	100.00	
006	311.44	312.77	A	1.39	JCTUS77-SUNVALLEY BLVDLINCOLN	13.08	RHPCC	2019	$535,150	26.56	100.00	
006	311.44	312.77	D	1.39	JCTUS77-SUNVALLEY BLVDLINCOLN	3.17	RHPCC	2019	$535,150	48.01	100.00	
006	314.52	315.59	D	1.04	10TH & CORNHUSKER HWY EAST LINCOLN	3.42	RS-AC	2028	$374,400	45.00	100.00	
006	315.59	316.48	A	0.92	33RD ST WESTLINCOLN	2.90	RHPCC	2022	$531,300	52.22	100.00	
006	315.59	316.48	D	0.92	33RD ST WESTLINCOLN	2.74	RHPCC	2020	$354,200	55.86	100.00	

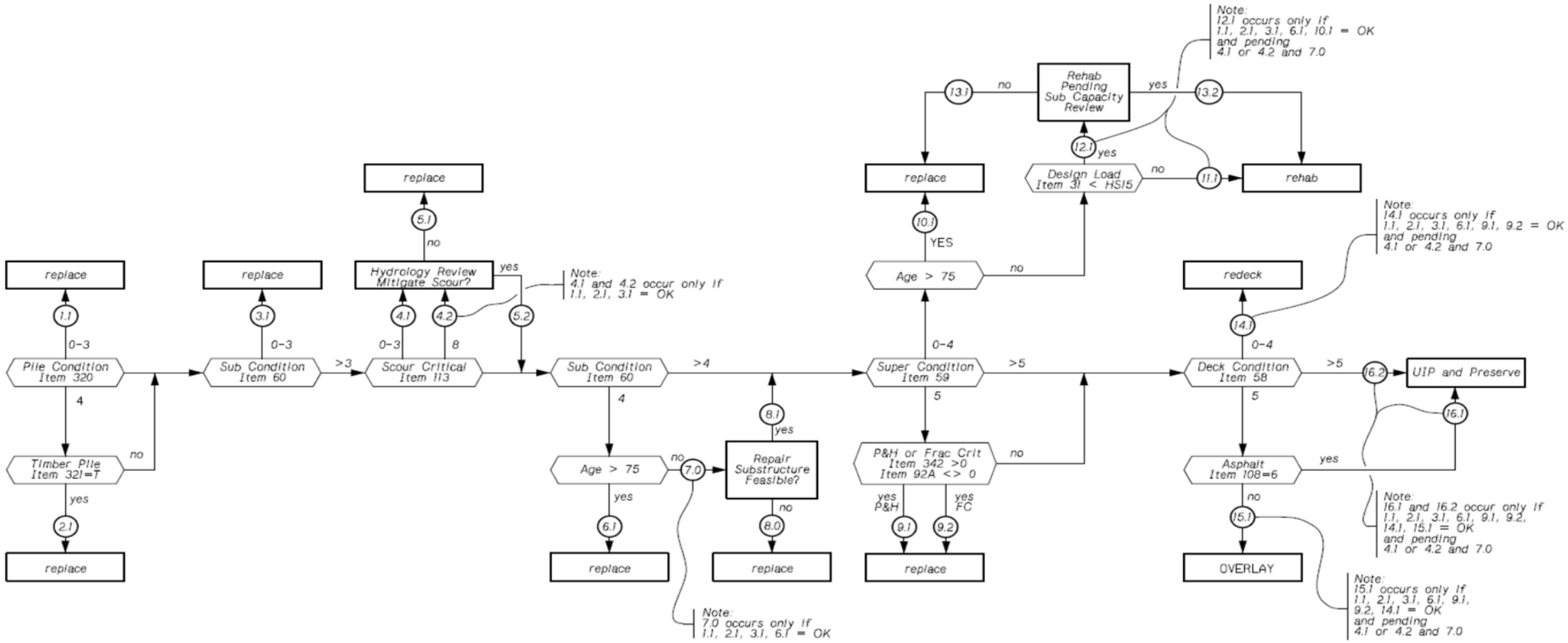
Bridge Life Cycle Cost Analysis

- At the project level, Life Cycle Cost Analysis (LCCA) is used to choose between competing alternative strategies.
  - A typical case for project-specific LCCA would be to compare a shorter duration, lower initial cost repair to a longer duration, higher initial cost strategy.
- Bridges for which there is no cost-effective repair strategy become replacement candidates (replacement is the most cost effective strategy).
- Information about the FHWA LCCA software RealCost is available at: https://www.fhwa.dot.gov/infrastructure/asstmgmt/lccasoft.cfm
- On the network level, common repair strategies are compared to find cost-effective categories of repair actions.

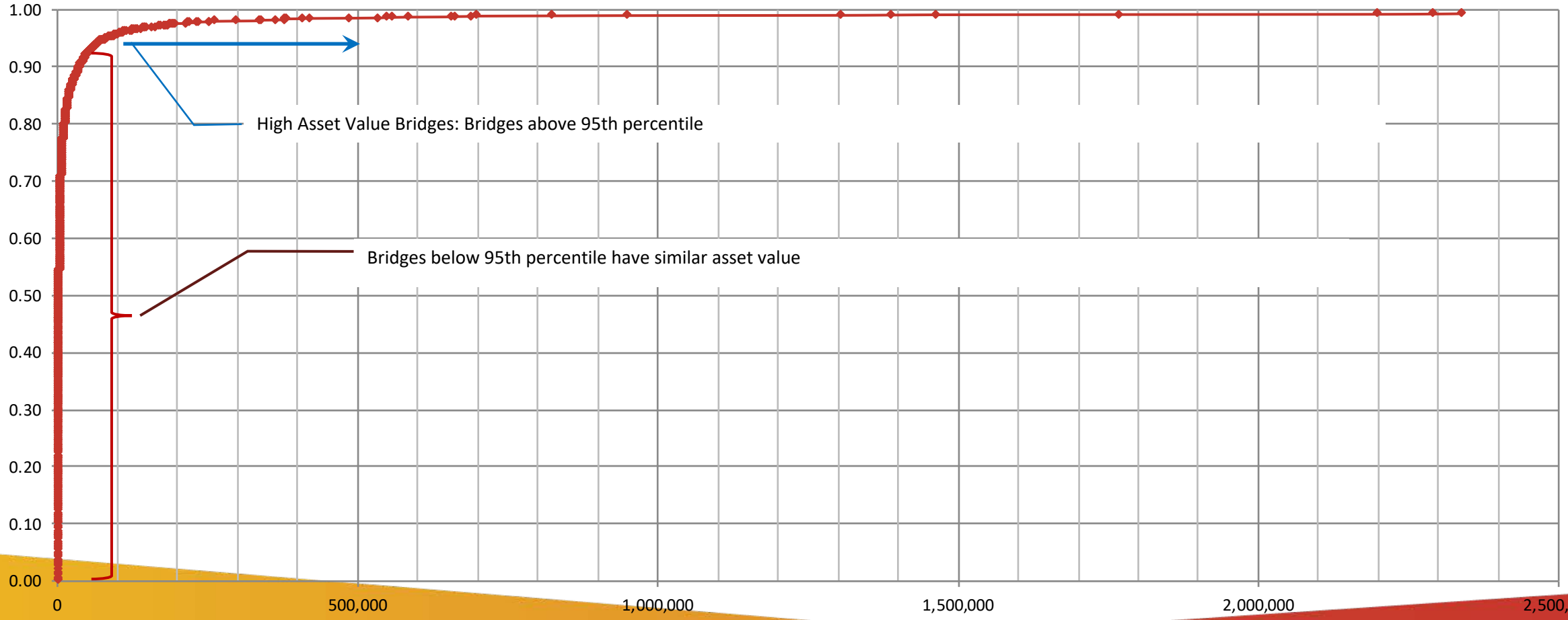
Bridge Life Cycle Cost Analysis



Bridge Major Work Candidates



Bridge High Asset Value Preservation Candidates



TOPICS

- National Perspective
- Inventory and Condition
- Targets and Measures
- Life-Cycle Cost Analysis
- Risk Management
- Risk Definition
- Common Risk Areas
- NDOT Risk Workshop

CFR 515.7–Risk (Definition)

73264 Federal Register / Vol. 81, No. 205 / Monday, October 24, 2016 / Rules and Regulations

characteristics and function (*e.g.*, concrete pavements or asphalt pavements.)

Bridge as used in this part, is defined in 23 CFR 650.305, the National Bridge Inspection Standards.

Critical infrastructure means those facilities the incapacity or failure of which would have a debilitating impact on national or regional economic security, national or regional energy security, national or regional public health or safety, or any combination of those matters.

Financial plan means a long-term plan spanning 10 years or longer, presenting a State DOT's estimates of projected available financial resources and predicted expenditures in major asset categories that can be used to achieve State DOT targets for asset condition during the plan period, and highlighting how resources are expected to be allocated based on asset strategies, needs, shortfalls, and agency policies.

Investment strategy means a set of strategies that result from evaluating various levels of funding to achieve State DOT targets for asset condition and system performance effectiveness at a minimum practicable cost while managing risks.

Life-cycle cost means the cost of managing an asset class or asset sub-group for its whole life, from initial construction to its replacement.

Life-cycle planning means a process to estimate the cost of managing an asset class, or asset sub-group over its whole life with consideration for minimizing cost while preserving or improving the condition.

Minimum practicable cost means lowest feasible cost to achieve the objective.

NHS pavements and bridges and NHS pavement and bridge assets mean Interstate System pavements (inclusion of ramps that are not part of the roadway normally traveled by through traffic is optional); NHS pavements (excluding the Interstate System) (inclusion of ramps that are not part of the roadway normally traveled by through traffic is optional); and NHS bridges carrying the NHS (including bridges that are part of the ramps connecting to the NHS).

Performance of the NHS refers to the effectiveness of the NHS in providing for the safe and efficient movement of people and goods where that performance can be affected by physical assets. This term does not include the performance measures established for performance of the Interstate System and performance of the NHS (excluding the Interstate System) under 23 U.S.C. 150(c)(3)(B)(i)(II)&(III)–(V).

Performance gap means the gap between the current asset condition and State DOT targets for asset condition, and the gaps in system performance effectiveness that are best addressed by improving the physical assets.

Risk means the positive or negative effects of uncertainty or variability upon agency objectives.

Risk management means the processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance.

Program (STIP) has the same meaning as defined in § 450.104 of this title.

Work type means initial construction, maintenance, preservation, rehabilitation, and reconstruction.

§ 515.7 Process for establishing the asset management plan.

A State shall develop a risk-based asset management plan that describes how the NHS will be managed to achieve system performance effectiveness and State DOT targets for asset condition, while managing the risks, in a financially responsible manner, at a minimum practicable cost over the life cycle of its assets. The State DOT shall develop and use, at a minimum the following processes to prepare its asset management plan:

(a) A State DOT shall establish a process for conducting performance gap analysis to identify deficiencies hindering progress toward improving or preserving the NHS and achieving and sustaining the desired state of good repair. At a minimum, the State DOT's process shall address the following in the gap analysis:

(1) The State DOT targets for asset condition of NHS pavements and bridges as established by the State DOT under 23 U.S.C. 150(d) once promulgated.

(2) The gaps, if any, in the performance of the NHS that affect NHS pavements and bridges regardless of their physical condition; and

(3) Alternative strategies to close or address the identified gaps.

(b) A State DOT shall establish a process for conducting life-cycle planning for an asset class or asset sub-group at the network level (network to be defined by the State DOT). As a State DOT develops its life-cycle planning process, the State DOT should include future changes in demand; information on current and future environmental conditions including extreme weather events, climate change, and seismic activity; and other factors that could impact whole of life costs of assets. The State DOT may propose excluding one or more asset sub-groups from its life-cycle planning if the State DOT can demonstrate to FHWA the exclusion of the asset sub-group would have no material adverse effect on the development of sound investment strategies due to the limited number of assets in the asset sub-group, the low level of cost associated with managing the assets in that asset sub-group, or other justifiable reasons. A life-cycle planning process shall, at a minimum, include the following:

(1) The State DOT targets for asset condition for each asset class or asset sub-group;

(2) Identification of deterioration models for each asset class or asset sub-group, provided that identification of deterioration models for assets other than NHS pavements and bridges is optional;

(3) Potential work types across the whole life of each asset class or asset sub-group with their relative unit cost; and

(4) A strategy for managing each asset class or asset sub-group by minimizing its life-cycle costs, while achieving the State DOT targets for asset condition for NHS pavements and bridges under 23 U.S.C. 150(d).

(c) A State DOT shall establish a process for developing a risk management plan. This process shall, at a minimum, produce the following information:

(1) Identification of risks that can affect condition of NHS pavements and bridges and the performance of the NHS, including risks associated with current and future environmental conditions, such as extreme weather events, climate change, seismic activity, and risks related to recurring damage and cost, as identified through the evaluation of facilities repeatedly damaged by emergency events carried out under part 667 of this title. Examples of other risk categories include financial risks such as budget uncertainty; operational risks such as asset failure; and strategic risks such as environmental compliance.

(2) An assessment of the identified risks in terms of the likelihood of their occurrence and their impact and consequence if they do occur;

(3) An evaluation and prioritization of the identified risks;

(4) A mitigation plan for addressing the top priority risks;

(5) An approach for monitoring the top priority risks; and

(6) A 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.

(d) A State DOT shall establish a process for the development of a financial plan that identifies annual costs over a minimum period of 10 years. The financial plan process shall, at a minimum, produce:

(1) The estimated cost of expected future costs to implement investment strategies contained in the asset management plan, by State fiscal year and work type;

(2) The estimated funding levels that are expected to be reasonably available, by fiscal year, to address the costs of future work types. State DOTs may estimate the amount of available future

Risk means the positive or negative effects of uncertainty or variability upon agency objectives.

Risk management means the processes and framework for managing potential risks, including identifying, analyzing, evaluating, and addressing the risks to assets and system performance.

Identifying Risks – Common Risk Areas

Environmental Conditions

High-Risk, High-Value Assets

Financial

Legal or Compliance

Demand

Information or Decision

Operational

Hostile Acts, Malfeasance, Accidents

Risk Matrix

Risk Matrix with Impact and Likelihood Definitions			Likelihood				
			Rare	Unlikely	Likely	Very Likely	Almost Certain
			Less than once every 10 years	Once in more than 3 but less than 10 years	Once between 1-3 years	Once a year	Several times a year
Impact	Catastrophic	Potential for multiple deaths & injuries, substantial public & private cost.	Medium	Medium	High	Very High	Very High
	Major	Potential for multiple injuries, substantial public or private cost and/or foils agency objectives.	Low	Medium	Medium	High	Very High
	Moderate	Potential for injury, property damage, increased agency cost and/or impedes agency objectives.	Low	Medium	Medium	Medium	High
	Minor	Potential for moderate agency cost and impact to agency objectives.	Low	Low	Low	Medium	Medium
	Insignificant	Potential impact low and manageable with normal agency practices.	Low	Low	Low	Low	Medium

Risk Matrix

Consequence	Likelihood increasing →	none (0)	rare (1)	unlikely (2)	likely (3)	very likely (4)	almost certain (5)
more negative ↑	Catastrophic (-5)	None	Low Negative Risk	Medium Negative Risk	High Negative Risk	Very Negative Risk	Extreme Negative Risk
	Major (-4)	None	Low Negative Risk	Medium Negative Risk	Medium Negative Risk	High Negative Risk	Very Negative Risk
	Moderate (-3)	None	Low Negative Risk	Medium Negative Risk	Medium Negative Risk	Medium Negative Risk	High Negative Risk
	Minor (-2)	None	Low Negative Risk	Low Negative Risk	Low Negative Risk	Medium Negative Risk	Medium Negative Risk
	Insignificant (-1)	None	Low Negative Risk	Low Negative Risk	Low Negative Risk	Low Negative Risk	Medium Negative Risk
	None (0)	None	None	None	None	None	None
more positive ↓	Some benefit (1)	None	Low Positive Risk	Low Positive Risk	Medium Positive Risk	Medium Positive Risk	High Positive Risk
	Significant benefit (2)	None	Low Positive Risk	Low Positive Risk	Medium Positive Risk	High Positive Risk	Extreme Positive Risk
	Major benefit (3)	None	Low Positive Risk	Medium Positive Risk	High Positive Risk	High Positive Risk	Extreme Positive Risk

NDOT hosted 2-Day Executive Meeting

- Identify Risks
- Categorize Risks
- Assess Likelihood and Impact
- Establish Mitigation Strategies

Thank You!

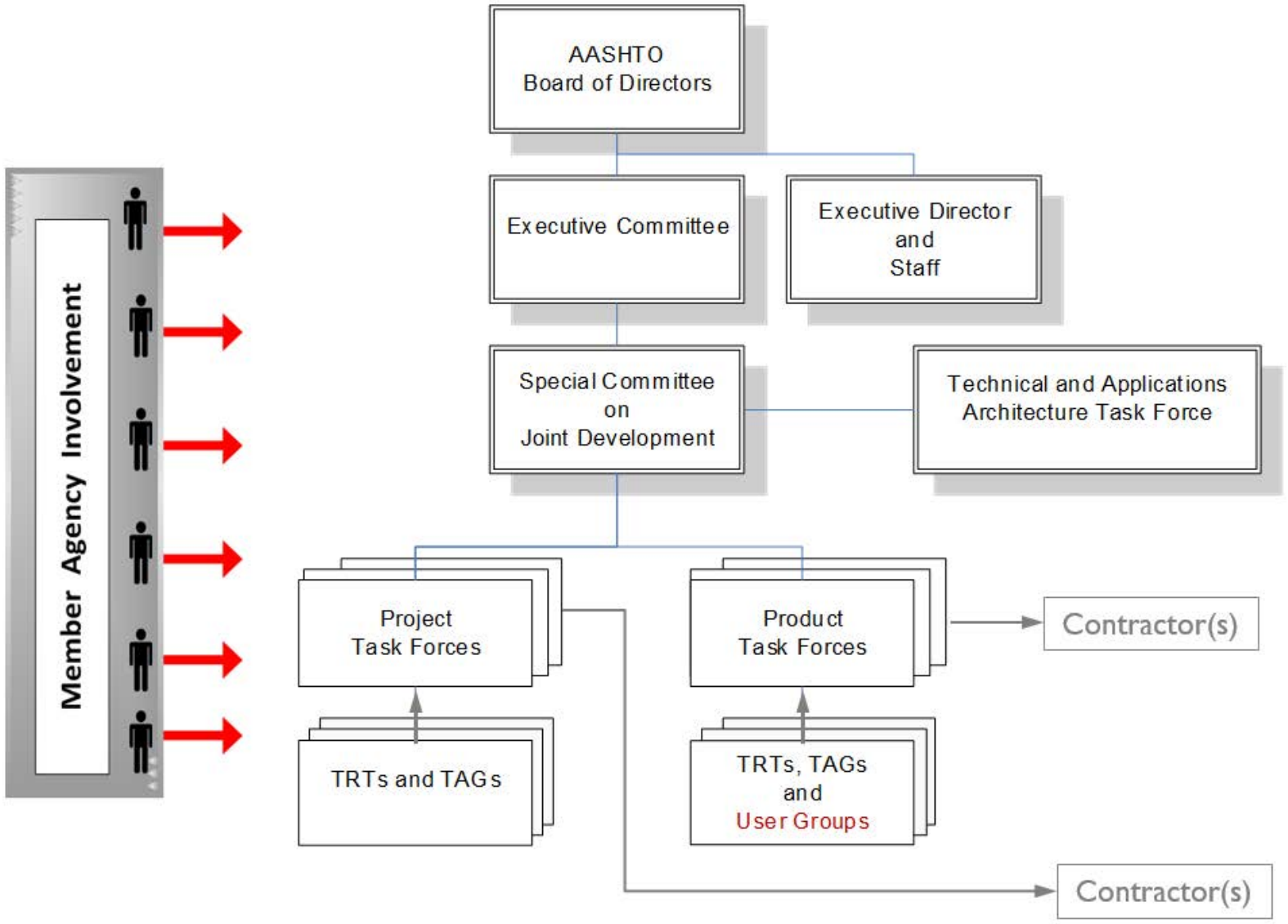
AASHTOWare Project @ NDOT

- Estimation (Currently Implementing, Production Spring 2019)
- Bids
- Preconstruction
- Civil Rights and Labor
- SiteManager (Const/Materials + LIMS)
- SiteXchange
- Data Analytics

AASHTOWare Project – Materials @ NDOT

- Contract Materials Acceptance Tracking
  - Contract Specific Testing Regimen
  - Specification Testing and Verification
  - QA/QC Program Tracking
  - Reporting (Daily, Weekly, Contract QA)
  - Sample Workflow (Field -> Lab)
  - Materials Sampling/Testing Certification Tracking
- Materials Characteristics Data Analysis
- Automated Approved/Qualified Product List
- Document Management System Integration

AASHTOWare Program Management



Why Use AASHTOWare?

- Incorporates “best practices”
- Users share solutions and costs
- License fees cover overall expenses ensure software products are kept current with technology and functional requirements
- Each product is self-supporting
- Non-profit operation
- Management and oversight by agency (DOT) personnel
- AASHTO staff project management/assistance

AASHTO

- Coordinates and supports State Transportation interests and needs.
- Gathers responses from State Agencies to Legislative actions
  - Played a supporting role in the development of States Asset Management Plans.
  - Provided resources and guidance through the AASHTO Tamp Builder: http://www.tamptemplate.org/existing-tamp/
- Coordinates some research activities for inter-State research projects
- Coordinates software development and management for DOT's
  - AASHTOWare software development and support is guided by DOT and other users
    - Products for Project delivery, Pavement, Bridge and Safety

Bridge Management - National Perspective - Use of AASHTOWare BrM