

Instituting a Successful Approach to Bridge Management in Michigan

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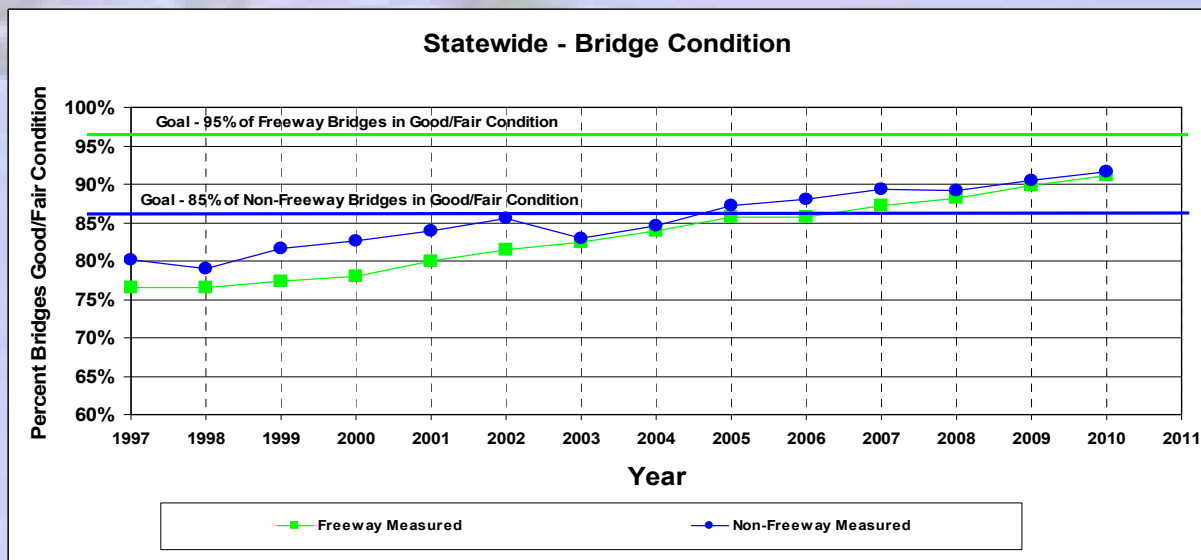
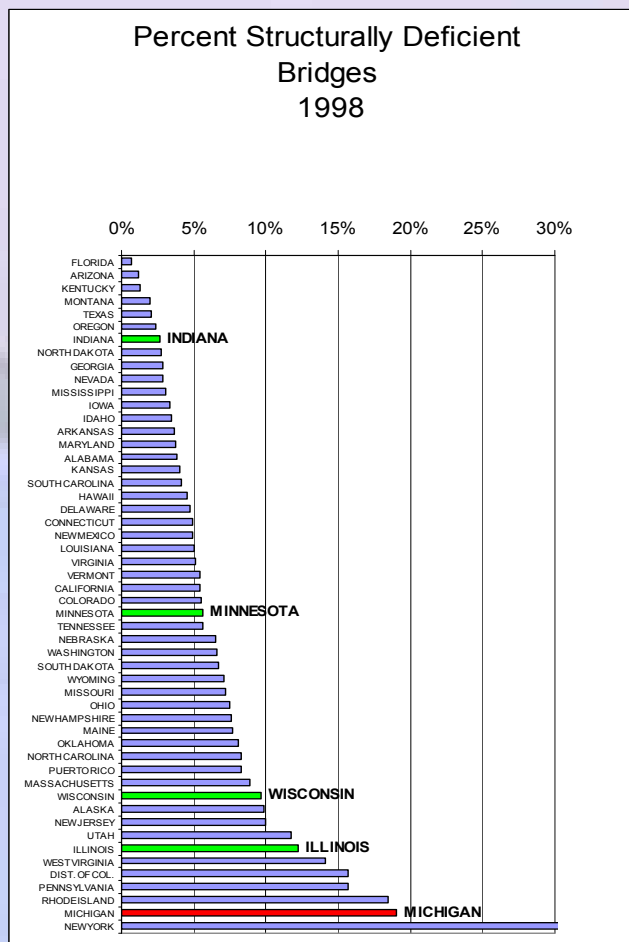
Conference (NBMIPC)

November 2, 2011



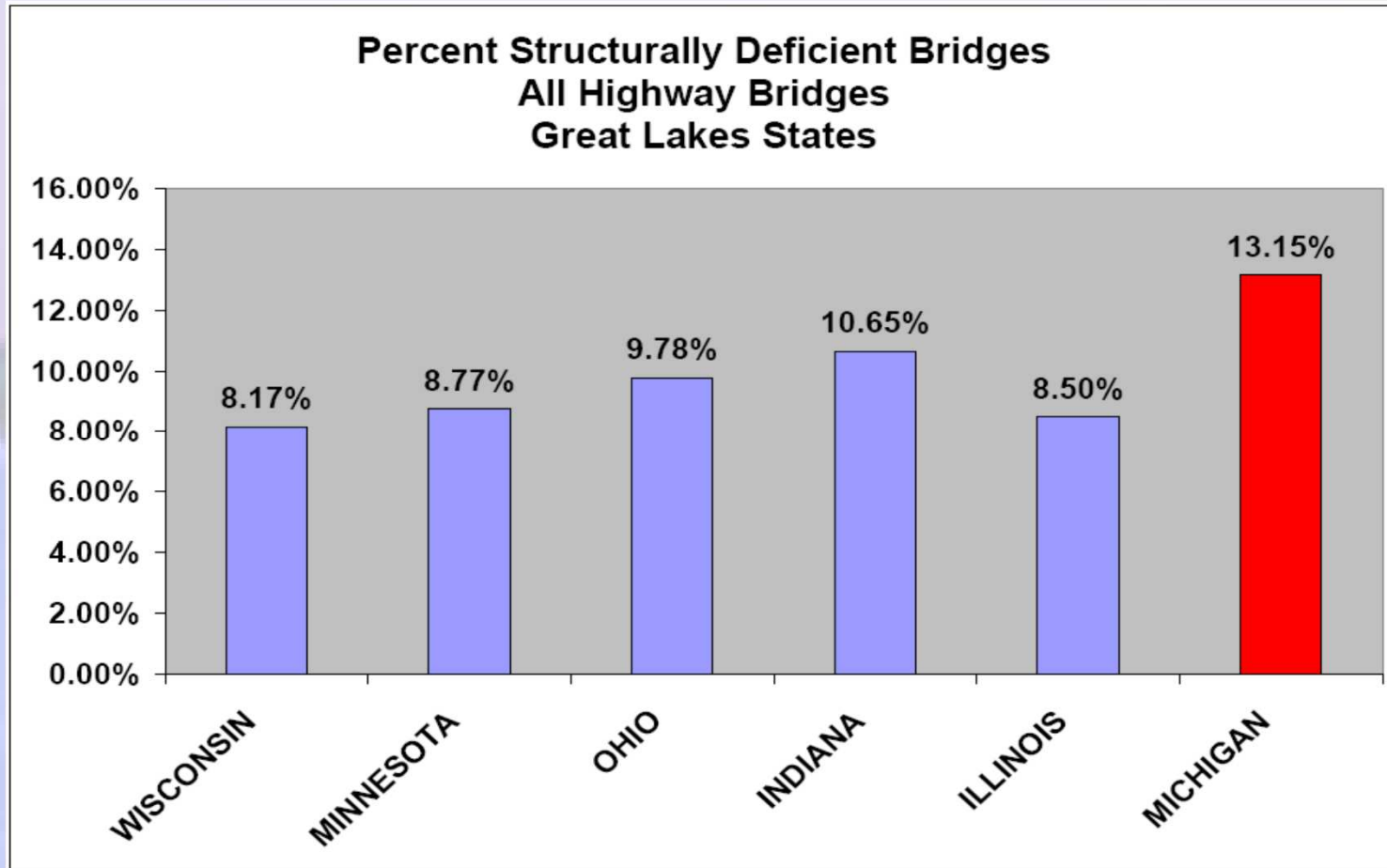
Why Successful?

In 1998 we were near worst in nation for bridge condition. In the last 12 years we improved bridge condition 13 percent



Have Benchmarks

Compare Ourselves with our Neighbors



Set Goals with Objectives and Performance Measures

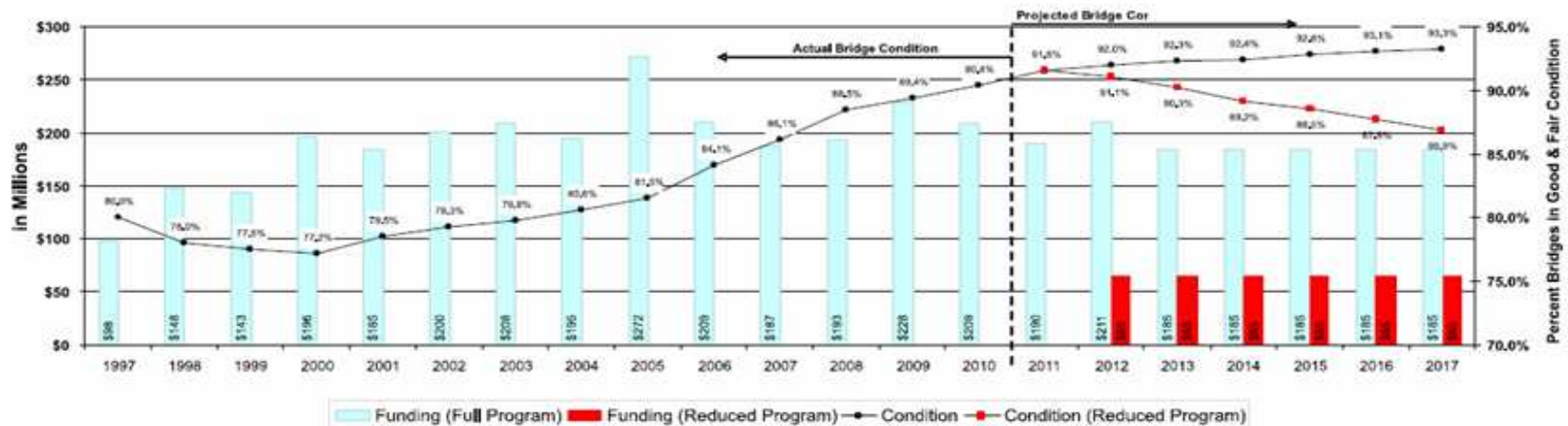


STRATEGIC INVESTMENT PLAN FOR TRUNKLINE BRIDGES

- Due to the poor condition of our bridges, in 1998 a strategic plan was developed and implemented.
- Network condition goals were established:
 - Immediately address the needs of 100% of structures of critical concern.
 - 95% freeway bridges in good or fair condition by 2008.
 - 85% non-freeway bridges in good or fair condition by 2008.

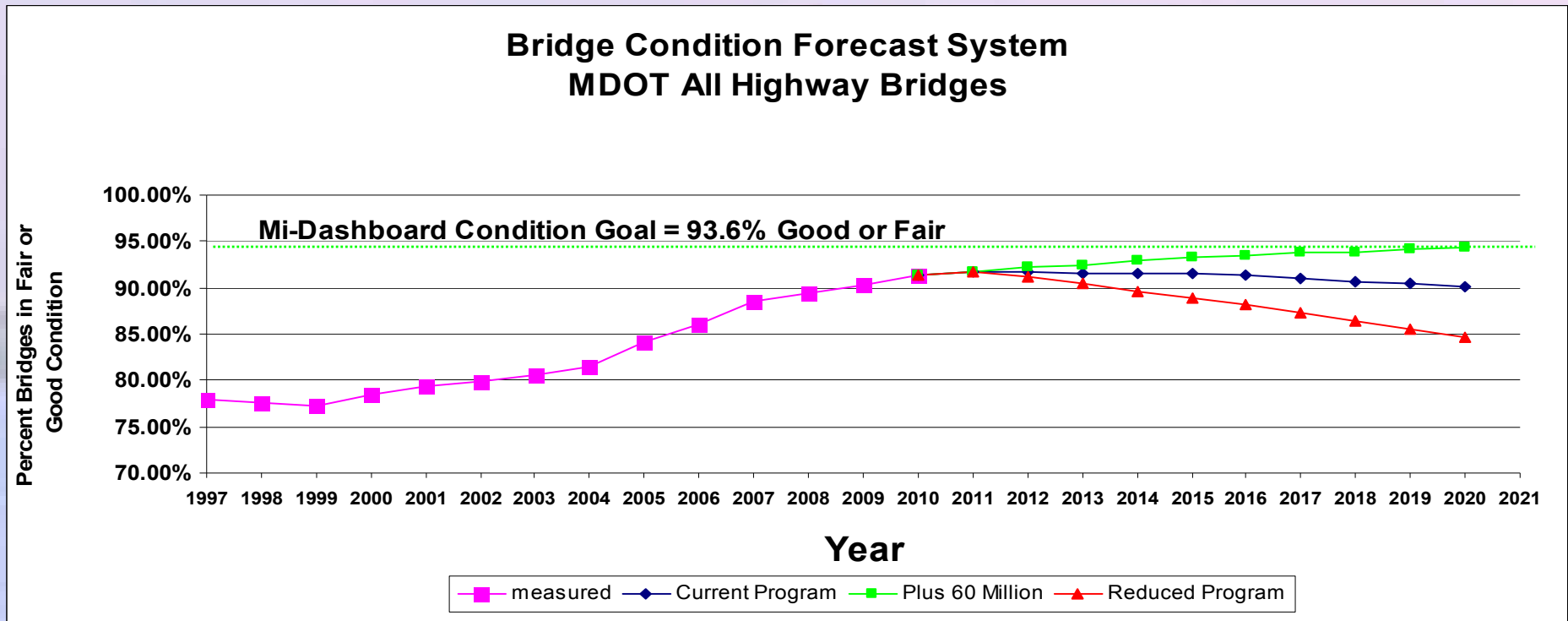
Monitor Condition and Have Ability to Forecast Bridge Condition

BRIDGE CONDITION RELATIVE TO FUNDING



MUST BE RESPONSIVE

Bridge Condition Forecast System



To receive an example copy of BCFS contact Dave Juntunen at juntunend@michigan.gov

Bridge Condition Forecast System

- Evaluates different mix of fixes (PM, Rehab, and Replacement)
- Compares different yearly budgets
- Uses average cost per deck area
- Deteriorates population of bridges using transition probabilities
- User sets “Preservation Path” - which bridges will be worked on and what end result is

Rehabilitation									
Bridge Condition Before Project									
0	1	2	3	4	5	6	7	8	9
			17.00%	33.00%	32.00%	18.00%			
Rehabilitation									
Moved to									
0	1	2	3	4	5	6	7	8	9
					30.00%	55.00%	15.00%		

BCFS uses Markov Chain Transition Probabilities to Deteriorate NBI Condition Ratings

3 Year Average												
Transition Probability Matrix										Percent		
	0	1	2	3	4	5	6	7	8	9		
9	0	0	0	0	0	0	0	0.0806452	0.3524194	0.5669355		
8	0	0	0	0	0	0.0070423	0.0035211	0.2130282	0.7764085	1.2213837		
7	0	0	0	0	0.0008929	0.0061095	0.0750529	0.9179448	2.7388835			
6	0	0	0	0.0014465	0.0056687	0.0447737	0.9481112	8.095806	3.9602673			
5	0	0	0	0.0041703	0.0527135	0.9431162	13.008661	12.056073				
4	0	0	0	0.0293359	0.9706641	11.835356	25.064734					
3	0	0	0.0065134	0.9934866	23.279647	36.90009						
2	0	0	1	106.07231	60.179737							
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Probability stay in that condition state (highlighted yellow)

When the entire element is in one condition state, you can monitor the transition probability that the element will drop more than one condition state. Example – Above 57% bridges that were rated 9 remained 9, 35% dropped to 8, and 8% dropped to 7.

BCFS at Region Level with Programmed Projects

2011							
NBI ID	Freeway or Non-Freeway	Structure Location Description	Structure Work Description	Project Cost	Major Work Type Code	Bridge Rating Before Project	Estimated Bridge Rating After Project
06041-S02	Freeway	US-23 EB CONN / M-13	Partial superstructure replacement	\$180,000	PM	4	4
09035-B03	Freeway	I-75 SB / PINCONNING RIVER	Bridge Replacement	\$185,380	Replacement	7	9
09035-B04	Freeway	I-75 SB / SAGANING RIVER	Dp Ovly, Widen, Rail, Pt&Rpr Steel bent,Sbstr Ptch	\$201,343	Rehab	4	6
09035-B05	Freeway	I-75 SB / TEBO DRAIN	Superstructure Replacement, Widening, Rip Rap	\$144,069	Replacement	7	8
09035-B08	Freeway	I-75 NB / TEBO DRAIN	Superstructure Replacement, Widening, Rip Rap	\$144,069	Replacement	6	8
09035-B09	Freeway	I-75 NB / PINCONNING RIVER	Bridge Replacement	\$189,860	Replacement	7	9
09035-B10	Freeway	I-75 NB / SAGANING RIVER	Dp Ovly, Widen, Rail, Pt&Rpr Steel bent,Sbstr Ptch	\$201,343	Rehab	4	6
09035-S11	Freeway	PREVO RD / I-75	Deep Ovly, Steel rpr, Pt, Substr Ptch, thrie bm	\$622,085	Rehab	5	6
09035-S12	Freeway	COGGINS RD / I-75	Deep Ovly, FD Patch, Railings, Substr Repr, Pt	\$2,085,229	Rehab	4	6
09035-S13	Freeway	PINCONNING RD / I-75	Deep Ovly, FD Patch, Railings, Substr Repr, Pt	\$394,046	Rehab	5	6
09035-S15	Freeway	I-75 SB / WHITE FEATHER RD	Deep Ovly, Widen				
09035-S17	Freeway	I-75 NB / WHITE FEATHER RD	Deep Ovly, Widen				
18033-S08	Freeway	MANN SIDING RD / US-127 SB	Concrete Beam				
25042-S01	Freeway	M-13 / I-69	Healer Seal, Jts,				
25085-S02	Freeway	GRAND TRAVERSE ST / I-69	Paint, P&H, Jt, C				
25085-S03	Freeway	CHURCH ST / I-69	Paint, P&H, Jt, C				
25085-S04	Freeway	BEACH ST (OLDM-56) / I-69	Paint, P&H, Jt, C				
25085-S05	Freeway	SAGINAW ST / I-69	Pt, P&H, Jt, Dk				
44044-S16	Freeway	BOWMAN ROAD / I-69	Paint, Exp Jts, A				
44044-S17	Freeway	BRISTOL ROAD / I-69	Paint, Exp Jts, A				
44044-S18	Freeway	I-69 EB / GRAHAM RD	Pt, Exp Jts, Gual				
44044-S19	Freeway	I-69 WB / GRAHAM RD	Pt, Exp Jts, Patc				
73101-S06-1	Freeway	I-675 NB / 6TH ST	Bridge replacem				
73101-S06-2	Freeway	I-675 SB / 6TH ST	Bridge replacem				
73101-S07-1	Freeway	I-675 NB / 5TH ST	Bridge replacem				
73101-S07-2	Freeway	I-675 SB / 5TH ST	Bridge replacem				
73101-S09-1	Freeway	I-675 NB / WARREN AVE	Bridge replacem				
73101-S09-2	Freeway	I-675 SB / WARREN AVE	Bridge replacem				

2011										
Count PM Projects.....	11									
Total PM Project Cost.....	\$3,195,653									
Percent PM (Cost).....	22.1%									
Count Rehab Projects.....	7									
Total Rehab Project Cost.....	\$4,588,868									
Percent Rehab (Cost).....	31.7%									
Count Replacement Projects.....	10									
Total Replacement Project Cost.....	\$6,690,378									
Percent Replacement (Cost).....	46.2%									
Total Project Cost.....	\$14,474,899									
Replacement - Count										
Bridge Rating Before Project										
	0	1	2	3	4	5	6	7	8	9
	0	0	0	3	10	4	8	3	0	0
Estimated Bridge Rating After Project										
	0	1	2	3	4	5	6	7	8	9
	0	0	0	0	1	2	14	1	2	8

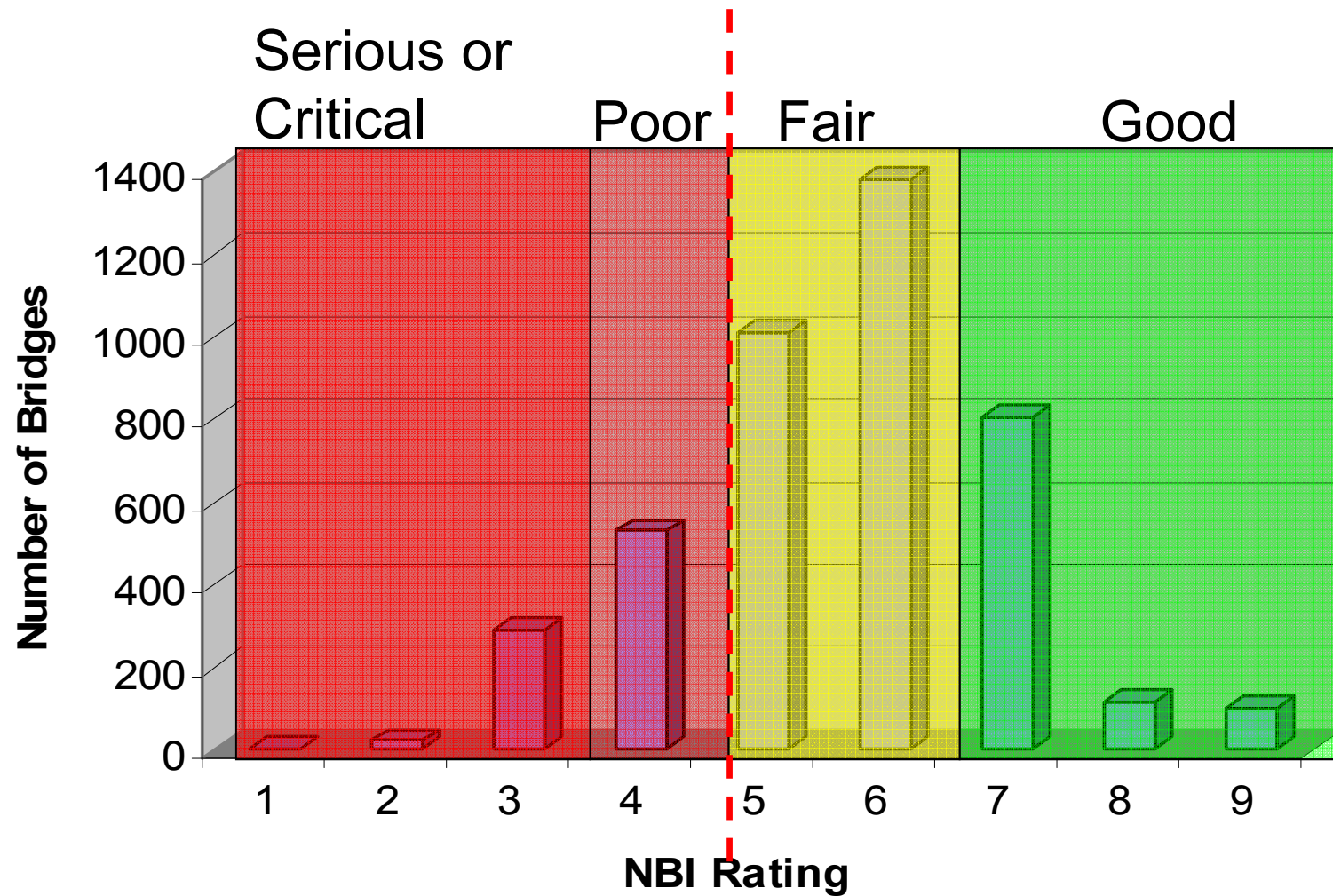
MDOT Call For Projects

“Establish a Mix of Fixes”

- **Bridge Strategy is updated each year**
 - Monitor progress towards bridge goals for each region.
- **Money allocated to Regions based upon need**
 - MDOT Allocates 20% Funds to preventive Maintenance, 30% rehabilitation, and 50% Replacement
- **Bridge CFP sub team reviews region strategy and projects.**
- **Bridge program is coordinated with road and safety programs.**

To be relevant your BMS must be integrated into your project selection process

Categorizing Bridge Condition

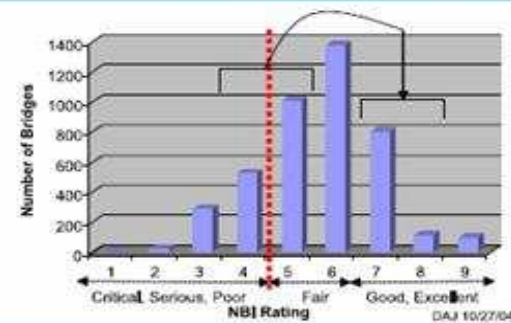


Preservation is a Very Important part of Our Overall Bridge Management System

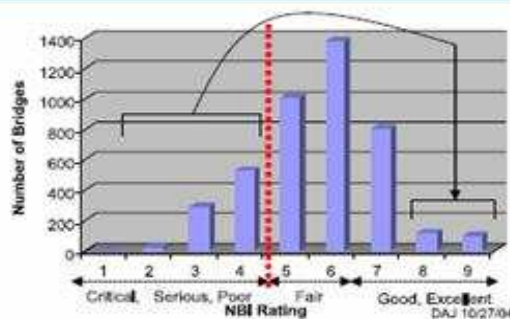
BRIDGE CONDITION FORECAST SYSTEM (BCFS)

- Uses NBI (National Bridge Inspection) ratings to measure the bridge network condition.
- Uses current condition of network as a starting point.
- Uses estimated bridge network deterioration rates based on deterioration rates in recent years.
- Uses a mix of fixes based upon a strategic selection of Replacement, Rehabilitation, and Capital Preventative Maintenance projects.
- Uses average construction costs for bridge projects.

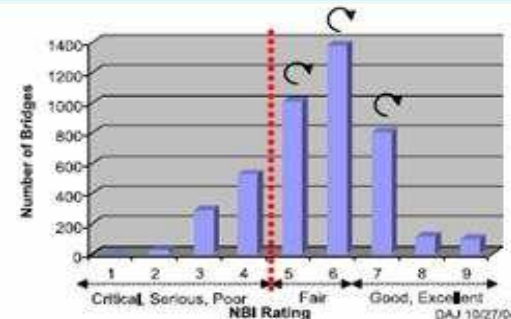
REHABILITATION (\$500 - 700 THOUSAND)



REPLACEMENT (\$1.2 - \$1.8 MILLION)



PREVENTIVE MAINTENANCE (\$200 - \$300 THOUSAND)

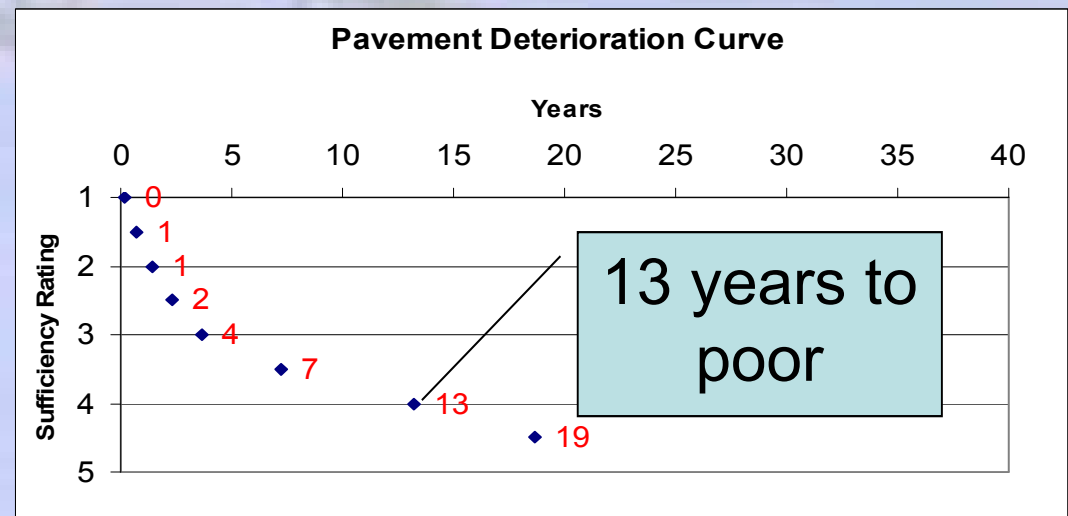
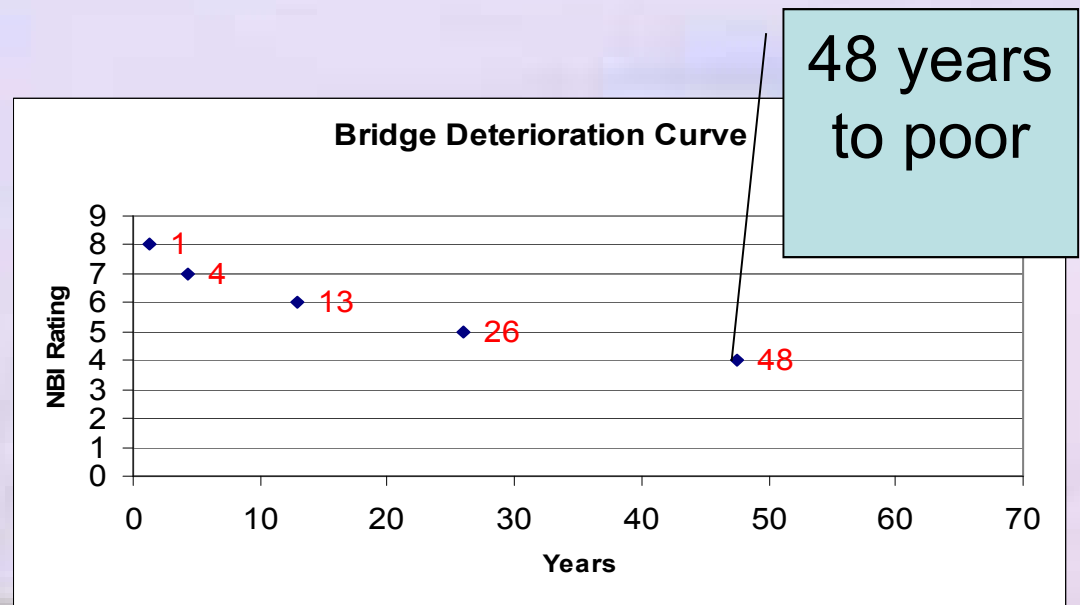


“Big Bridges” Need Special Management and Dedication of Funds

- Complex bridges, including movable bridges, post tensioned segmental concrete bridges, and bridges with larger deck area (over 100,000 square feet) are inspected and managed by a statewide “Bridge Operations Unit” based out of Lansing.
- Goal is to always maintain these bridges in good or fair condition

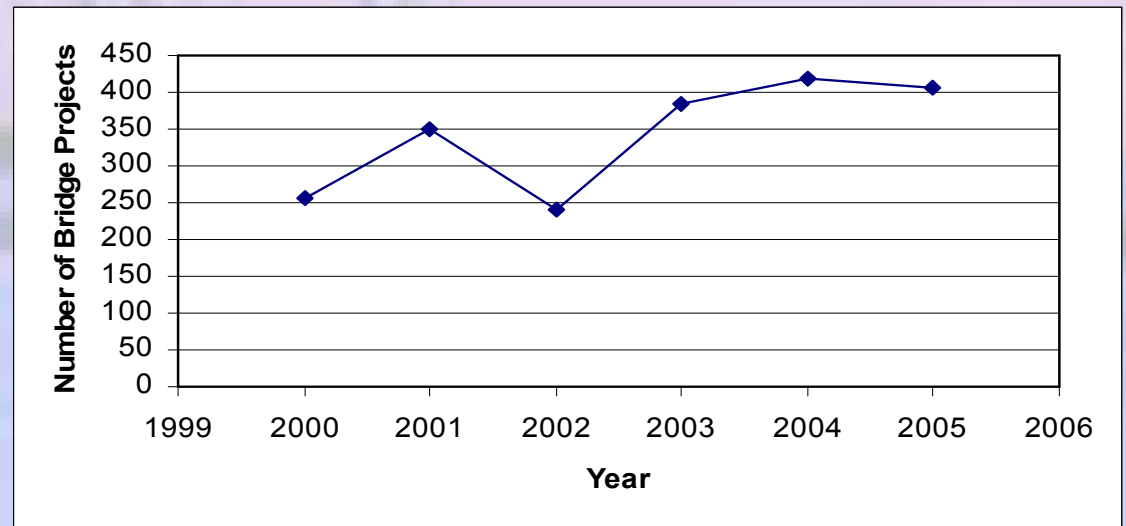


Bridges deteriorate much slower than roads, so coordinate bridge work with the road work.



As we build our preventive maintenance program, each year we work on more bridges.

- MDOT statewide
 - Touch each bridge every 15 years.
- University Region
 - Touch each bridge every 10 years



Implementing preservation is harder than developing it through your BMS

Performance Measure

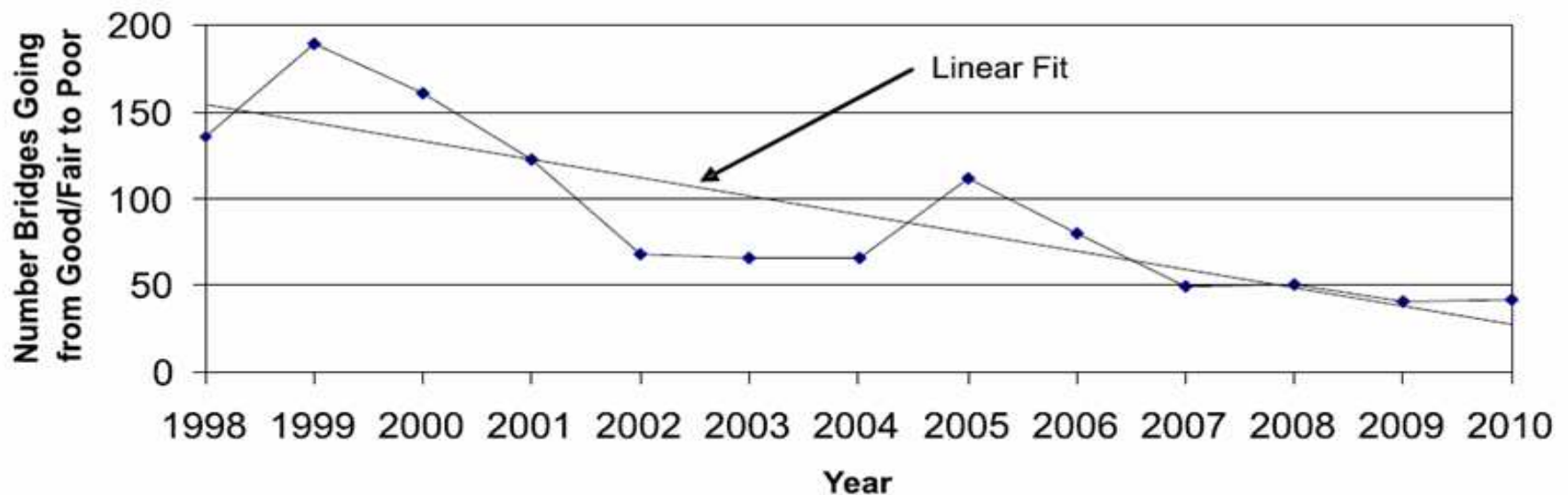
Counting number of bridge projects per year and what type of projects.

- MDOT 2005 Construction Program
 - Replacement
 - 59 Projects
 - Rehabilitation
 - 133 Projects
 - Preventive Maint.
 - 206 Projects

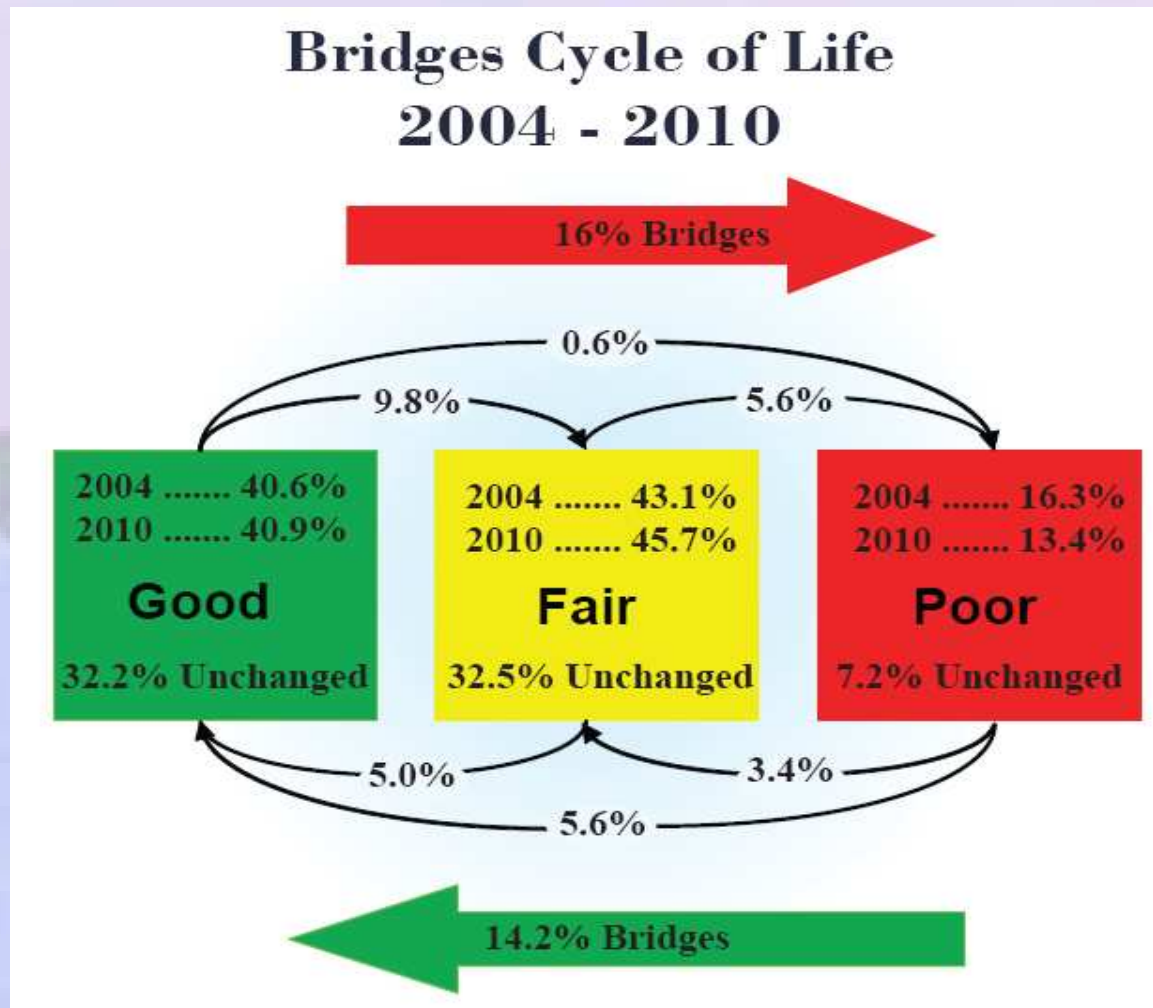


Performance Measure for Preservation Monitor Bridges Dropping to Poor (Structurally Deficient)

DETERIORATION RATE STATEWIDE TRUNKLINE BRIDGES



Bridge Cycle of Life



Is your Bridge Management System:

- Network/Strategic Level
 - NBI Bridge Condition ratings work well
 - Managing your “network” of bridges
 - Information for high level, executive, legislature, transportation commission.
- Project Level
 - Pontis elements work well
 - Prioritizing bridge projects
 - Managing bridge elements
 - Information for bridge engineers and practitioners
 - A project level BMS must have good need indicators

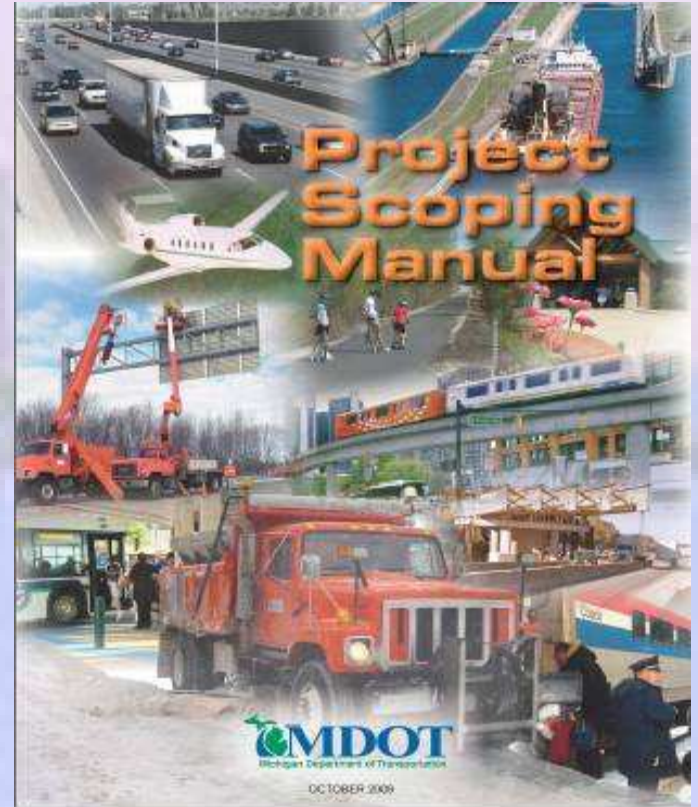
What is a need indicator?

- Data collected during the routine bridge inspection that identifies a specific work type activity.
- Example – Expansion joint leaking identifying repair or replacement



Preservation Projects Need Detailed Scopes to determine “fix”

- The routine (visual) bridge inspection is not enough to determine actual bridge project needs.
- Sometimes it takes a hands on inspection to locate areas of deterioration
 - Chain drag bridge deck
 - Sound concrete surfaces
 - Measure section loss of corroded beams
- Compare costs of different fixes (sometimes using life cycle cost analysis)



Develop Guides for Projects Given Condition (Know your need indicators)

- Separate matrix provided for decks with epoxy coated rebar

BRIDGE DECK PRESERVATION MATRIX – DECKS WITH EPOXY COATED REBAR (ECR)

DECK CONDITION STATE				REPAIR OPTIONS	POTENTIAL RESULT TO DECK BSIR		ANTICIPATED FIX LIFE
Top Surface		Bottom Surface			Top Surface BSIR #58a	Bottom Surface BSIR #58b	
BSIR #58a	Deficiencies % (a)	BSIR #58b	Deficiencies % (b)				
≥ 5	N/A	N/A	N/A	Hold (c) Seal Cracks/Healer Sealer (d)	No Change	No Change	1 to 4 years
	≤ 5%	> 5	≤ 2%	Epoxy Overlay	8, 9	No Change	10 to 15 years
	≤ 10%	≥ 4(k)	≤ 25%(k)	Deck Patch (e)	Up by 1 pt.	No Change	3 to 10 years
4(k) or 5	10% to 25%(k)	4(k)	10% to 25%(k)	Shallow Concrete Overlay (h, i)	8, 9	No Change	20 to 25 years
				HMA Overlay with waterproofing membrane (f, h, i)	8, 9	No Change	8 to 10 years
		2 or 3(k)	> 25%(k)	HMA Cap (g, h, i)	8, 9	No Change	2 to 4 years
≤ 3(k)	>25%(k)	4(k) or 5	2% to 25%(k)	Shallow Concrete Overlay (h, i)	8, 9	No Change	10 years
				HMA Overlay with waterproofing membrane (f, h, i)	8, 9	No Change	5 to 7 years
		2 or 3(k)	>25%(k)	HMA Cap (g, h, i)	8, 9	No Change	1 to 3 years
				Replacement with Epoxy Coated Rebar (ECR) Deck	9	9	60+ years

- (a) Percent of deck surface area that is spalled, delaminated, or patched with temporary patch material.
 (b) Percent of deck underside area that is spalled, delaminated or map cracked.
 (c) The "Hold" option implies that there is on-going maintenance of filling potholes with cold patch and sealing of incipient spalls.
 (d) Seal cracks when cracks are easily visible and minimal map cracking. Apply healer sealer when crack density is too great to seal individually by hand. Sustains the current condition longer.
 (e) Crack sealing can also be used to seal the perimeter of deck patches.
 (f) Hot Mix Asphalt overlay with waterproofing membrane. Deck patching required prior to placement of waterproofing membrane.
 (g) Hot Mix Asphalt cap without waterproofing membrane for ride quality improvement. Deck should be scheduled for replacement in the 5 year plan.
 (h) If bridge crosses over traveled lanes and the deck contains slag aggregate, do deck replacement.
 (i) When deck bottom surface is rated poor (or worse) and may have loose or delaminated concrete over traveled lanes, an In-depth inspection should be scheduled. Any loose or delaminated concrete should be scaled off and false decking should be placed over traveled lanes where there is potential for additional concrete to become loose.
 (k) Contact C&T's Bridge Operations section if a deck with epoxy coated rebar in poor condition is identified.

Pontis Reports

- Possible projects with estimate of cost (unlimited budget)
- Future Poor Bridges (predicts what year a bridge will become poor (2012 – 2031))

Facility	Feature Int	Future Predicted Conditions			
		Year To Turn Poor	Deck	Super	Subst
M-50	TUPPER RIVER	2012	0	6	6
M-66	GRAND RIVER	2030	4	5	5
HASTINGS RD	I-96	2030	4	6	5
NASH HWY	I-96	2012	4	6	6
MORRISON LAKE RD	I-96	2012	3	5	6
JORDAN LAKE RD	I-96	2018	4	5	6
I-96 EB	GRAND RIVER & MARKET	2012	4	4	6
I-96 WB	GRAND RIVER & MARKET	2020	4	6	6
I-96 EB	CSX RR (ABN)	2020	4	5	5
I-96 WB	CSX RR (ABN)	2020	4	5	5
M-66 NB	I-96	2012	4	6	6
M-66 SB	I-96	2028	4	6	5
SUNFIELD RD	I-96	2030	4	6	5
I-96 EB	PORTLAND RD	2012	4	6	6
I-96 WB	PORTLAND RD	2020	4	6	6

Facility	Feature	Action	Element	Item Cost	Proj Cost	Proj Type
M-32	BEAN CREEK	Paint	Pnted Stl Girder /Bm	42,641	42,641	CPM
US-23	THUNDER BAY RIVER	Rehab Elem	Misc Bridge Railing	6,865	7,189	CPM
		Rehab Elem	Sidewalk	324		
US-23	LONG LAKE CREEK	Repl Elem	Reinf Conc Girder/Bm	10,104	12,290	Replace
		Min Repair	Reinf Conc Girder/Bm	1,379		
		Rehab Elem	Reinf Conc Culvert	807		
M-68	PIGEON RIVER	Paint	Pnted Stl Girder /Bm	47,366	47,366	CPM
US-23	LITTLE BLACK RIVER	Rehab Elem	Misc Bridge Railing	6,862	6,862	CPM
I-75 NB	D&M RR (ABN)	Epoxy Ovly	Conc Dk Thn Epoxy Ov	39,123	42,290	CPM
		Rehab Elem	Fixed Bearing	3,167		

Pontis – Next Steps

- Agency rules need to be made more robust
- Would like to be able to aggregate project-level recommendations to the categories of CPM, Rehab, and Replacement.
- Need to be able to specify a mix of fixes in those same three categories and let Pontis recommend the best projects that meet the criteria set by the user.

There is always a level of risk when doing preventive maintenance and rehab.



What level of repair to you do? Repair beam ends or replace beam?



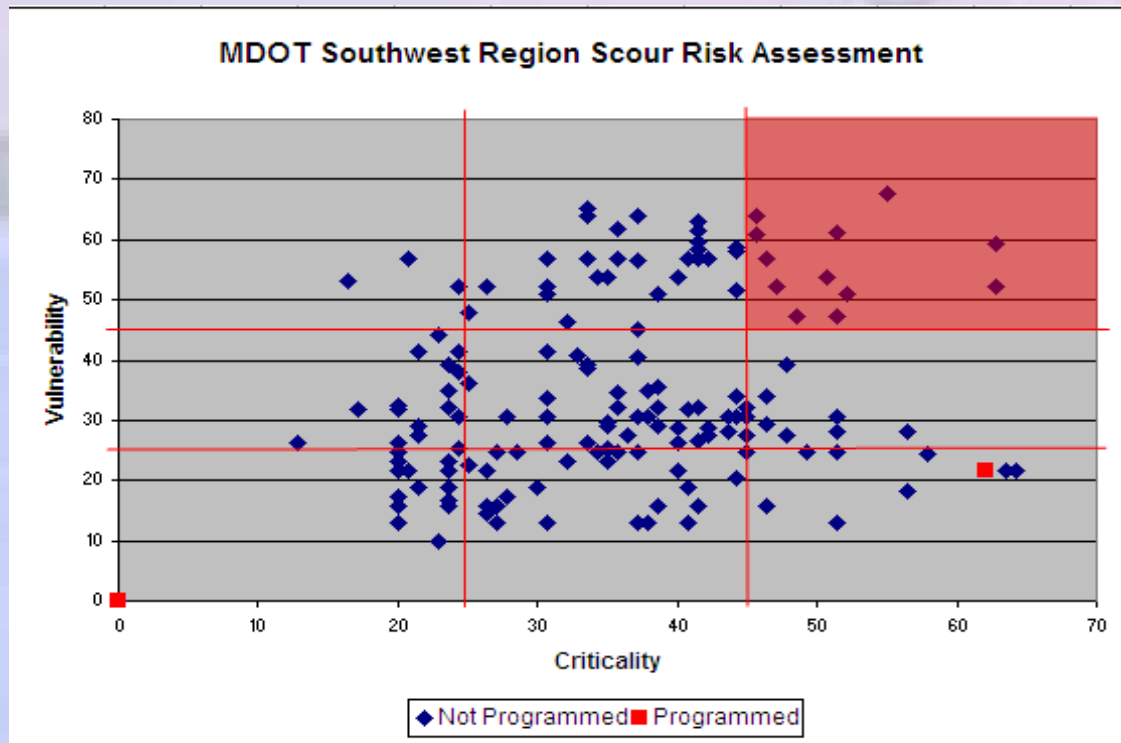
Look for hidden damage.

Coordinate your capital program with your routine maintenance program (done by maintenance crews)



Prioritize Using Risk Assessment

NCHRP Project 20-07/Task 151B



Bridge preservation is harder than simple replacement.



But, it is worth the effort. Thank You