Rolling Wheel Deflectometer: Integrating Data in Pavement Management

U.S. Department of Transportation
Federal Highway Administration

Presented by:
Thomas Van, PE

Coming Up…

- Managing Pavements, Why Deflection
- Deflection Measurements
- State of the Practice
- Case Study
- Summary

Managing Pavements: Why Deflection?

- Cracking
- Rutting
- Ride Quality
- Material Failures
- Traffic

→ **Pavement Failures**

Managing Pavements: Why Deflection?

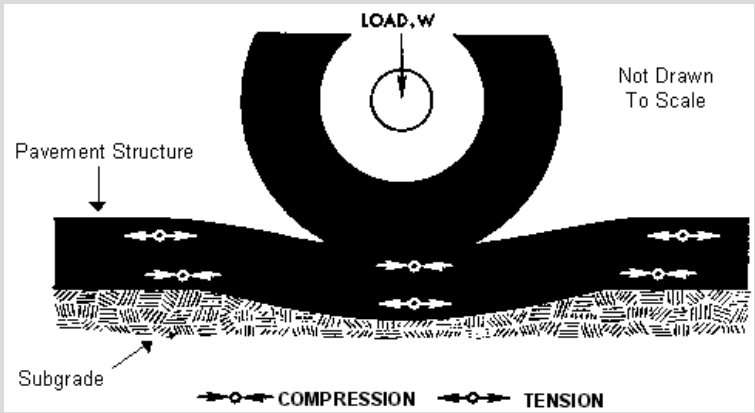
As an Indicator for Structure..

When will it needs attention?

Does Preservation make sense?

Did we figure traffic correctly?

Were there construction issues?

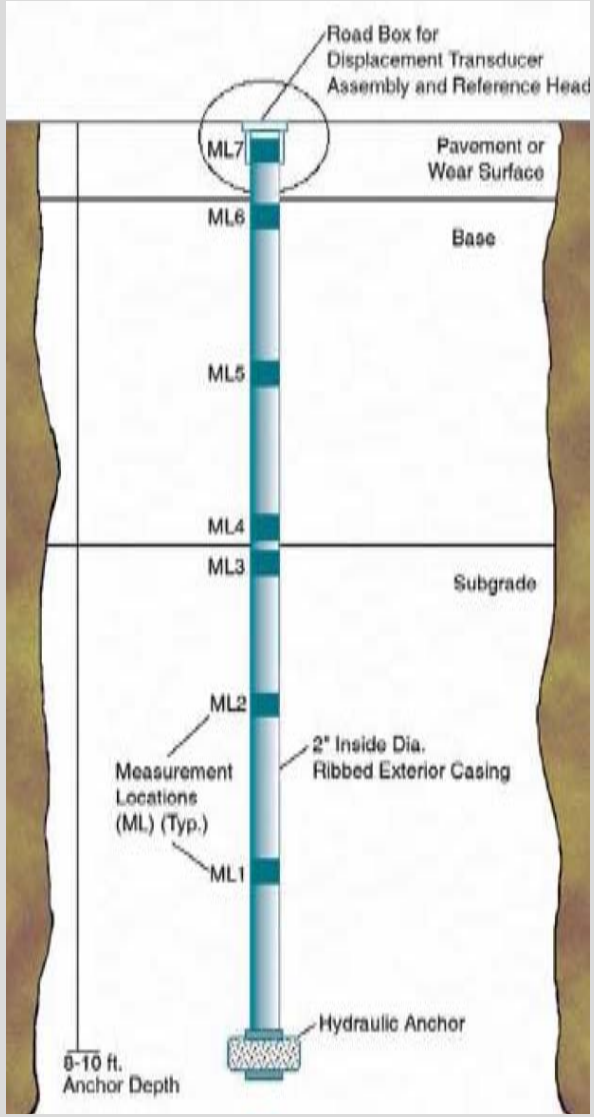


Measuring Deflection

Manual Methods:

Laboratory

Field



Measuring Deflection

Static Device Methods:

Benkelman Beam

Measuring Deflection

Static Device Methods:

LaCroix Deflectograph

Measuring Deflection

Static Device Methods:

Falling Weight Deflectometer

Measuring Deflection

Steady-State Vibratory Methods:

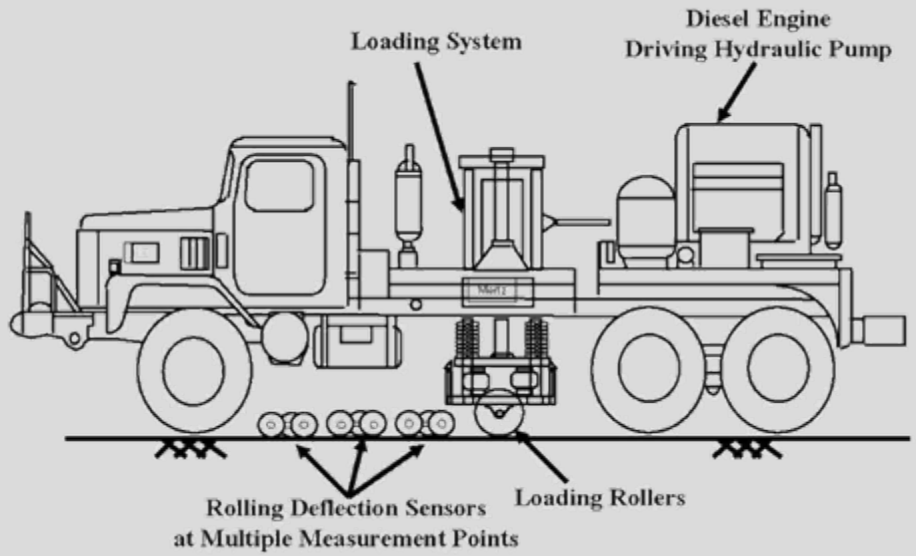
Dynaflect

Road Rater

Measuring Deflection

Dynamic Vibratory Device Methods:

Texas Rolling Dynamic Deflection (RDD)



Measuring Deflection

High-Speed Device Methods:

Danish Traffic Speed Deflectometer

Swedish Road Deflection Tester

American Rolling Wheel Deflectometer

The RWD

- Measures the continuous pavement deflection profile due to an 18-kip single axle truck load
- Provides a measure of the overall structural capacity of highway sections
- Information can be used for network-level evaluation and management
- Pre-screener for where to focus project-level efforts (i.e., FWD, coring, etc.)

RWD Benefits

- Increased safety. Does not require lane closures.
- Mixes with traffic stream. No interruption to traveling public.
- Operates over a broad range of speed (5 to 65 mph).
- High data collection productivity.
- Rapid data processing.

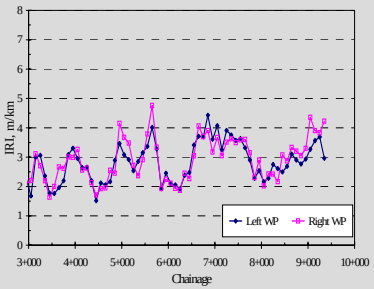
Potential

RWD Role in DOT Operations

Network-Level

PSI

IRI



RWD

10,000 lane-miles

Preservation

Rehabilitation or Reconstruction

100 lane-miles

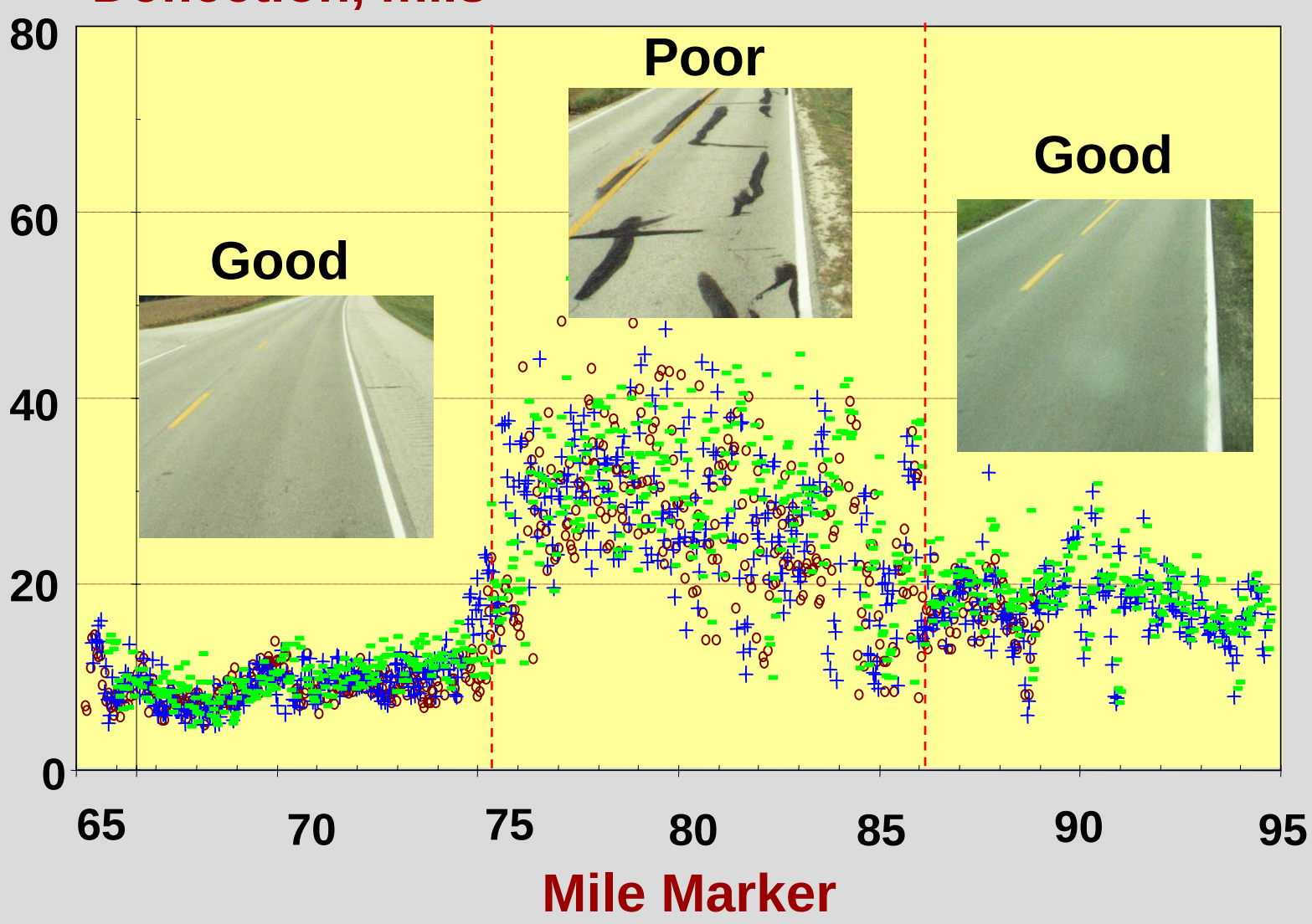
Project-Level

FWD

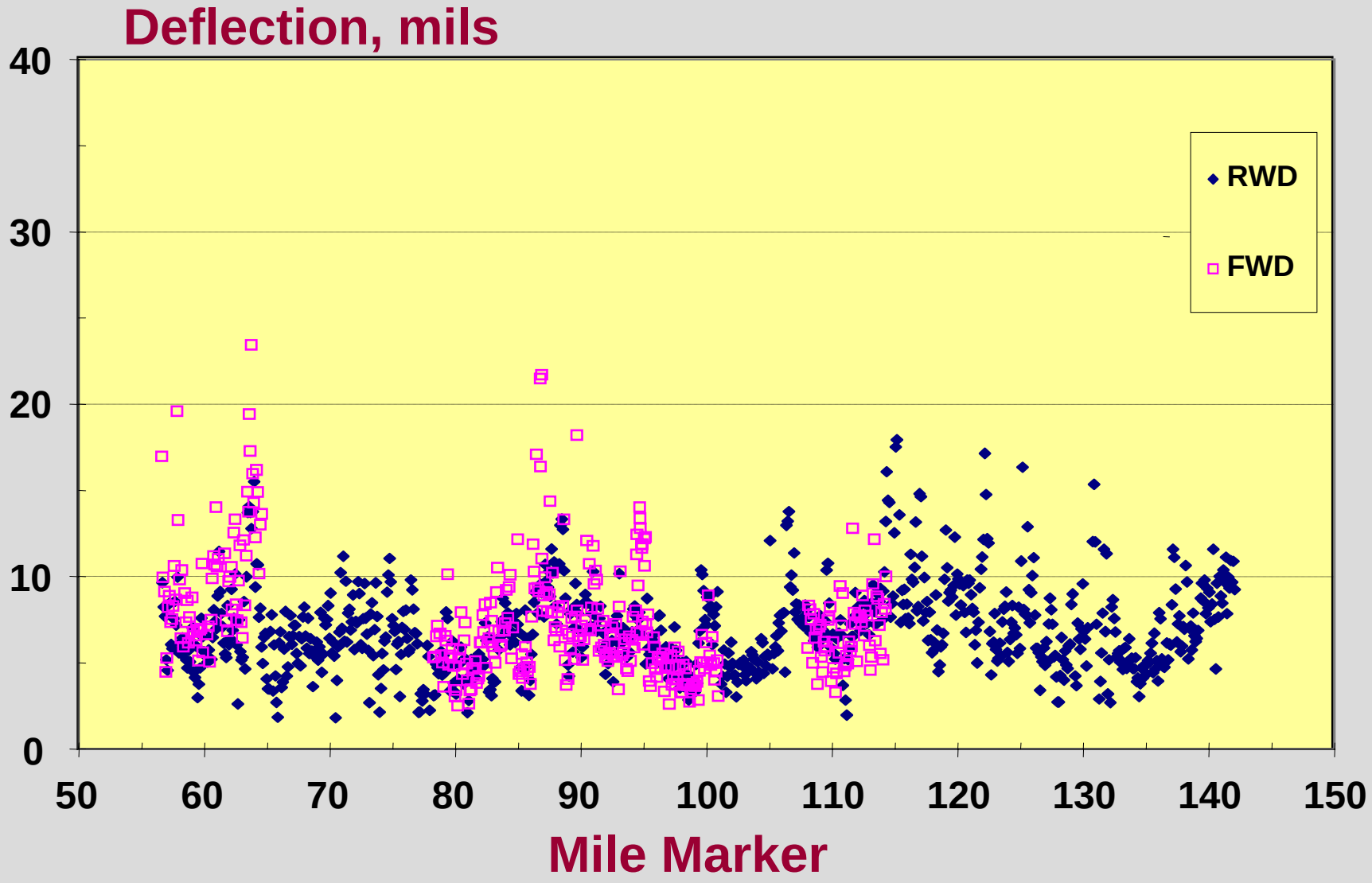
Coring

Lab

Indiana SR 1 – 3 Structures



Kansas – US 59


Deflection, mils
40
30
20
10
0
50
60
70
80
90
100
110
120
130
140
150
Mile Marker
RWD
FWD

Significant Difference Tests for Deflection Data

Sec	Route	County	Avg. d0 FWD (mils) *	Avg. d0 RWD (mils)	Length (mi)	p-value	Similar
1	K-4	Wabaunsee	14.5 (06)	13.9	12	0.52	Yes
2	K-31	Osage	13.1 (02)	11.8	5	0.44	Yes
3		Wabaunsee	14.0 (03)	13.6	10	0.53	Yes
4	K-39	Neosho	17.7 (01)	19.7	2	0.58	Yes
5	US-54	Greenwood	11.1 (00)	8.7	12	0.03	No
6		Woodson	7.5 (03)	7.8	6	0.61	Yes
8		Morris	8.0 (04)	7.7	30	0.62	Yes
9		Osage	8.6 (05)	8.4	14	0.72	Yes
10	US-59	Allen	5.3 (04)	5.0	8	0.49	Yes
11		Anderson	6.6 (03)	6.6	15	0.94	Yes
12		Neosho	9.5 (01)	6.9	8	0.04	No

*** Year of FWD Testing**

Significant Difference Test for SN_{eff}

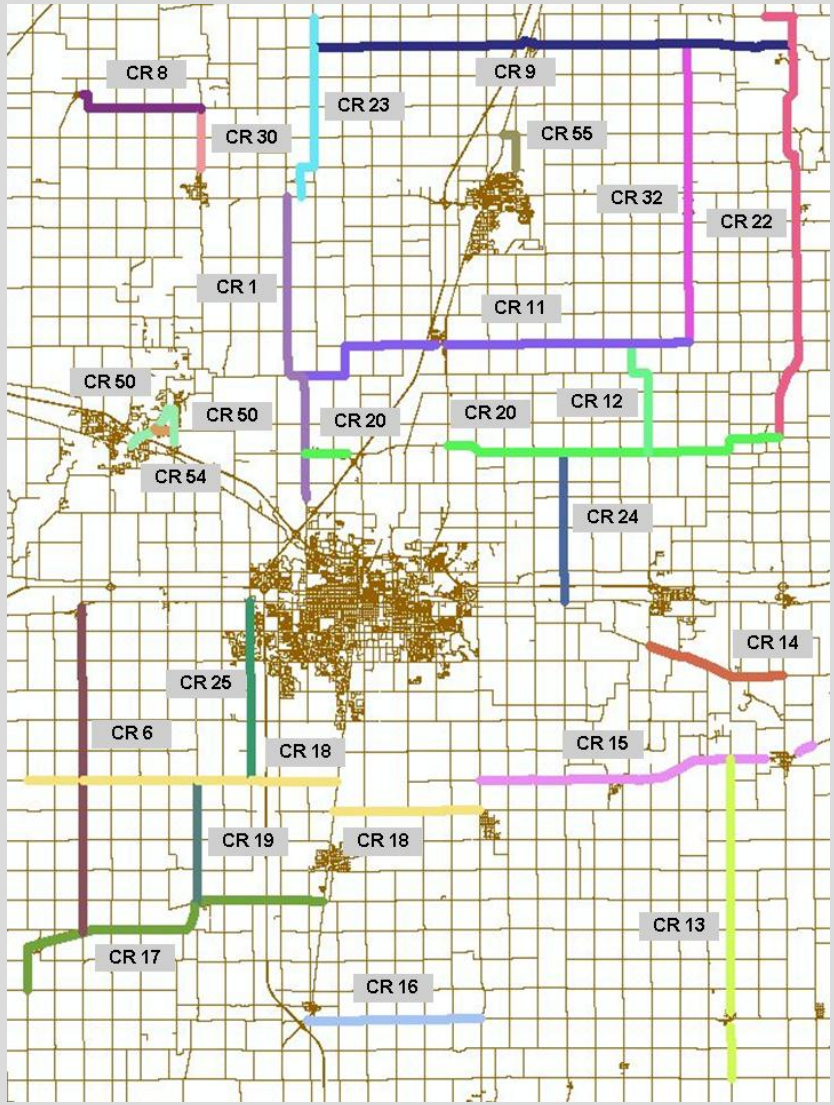
Sec	Route	County	FWD Mean SN_{eff} (*)	2006 RWD Mean SN_{eff}	Length (mi)	p-value	Similar
1	K-4	Wabaunsee	2.2 (06)	2.3	12	0.80	Yes
2	K-31	Osage	2.8 (02)	3.1	5	0.62	Yes
3		Wabaunsee	2.4 (03)	2.5	10	0.45	Yes
4	K-39	Neosho	1.7 (01)	1.5	2	0.10	Yes
5	US-54	Greenwood	3.5 (00)	4.1	12	0.05	No
6		Woodson	3.5 (03)	3.4	6	0.50	Yes
7	US-56	Douglas	2.3 (01)	3.8	12	<.0001	No
8		Morris	4.2 (04)	4.3	7	0.66	Yes
9		Osage	3.0 (05)	3.1	14	0.55	Yes
10	US-59	Allen	4.7 (04)	5.1	8	0.18	Yes
11		Anderson	5.2 (03)	5.0	15	0.50	Yes
12		Neosho	2.4 (01)	3.3	8	<.0001	No

* Year of FWD testing

CHAMPAIGN COUNTY RWD-BASED PMS IMPLEMENTATION

Background

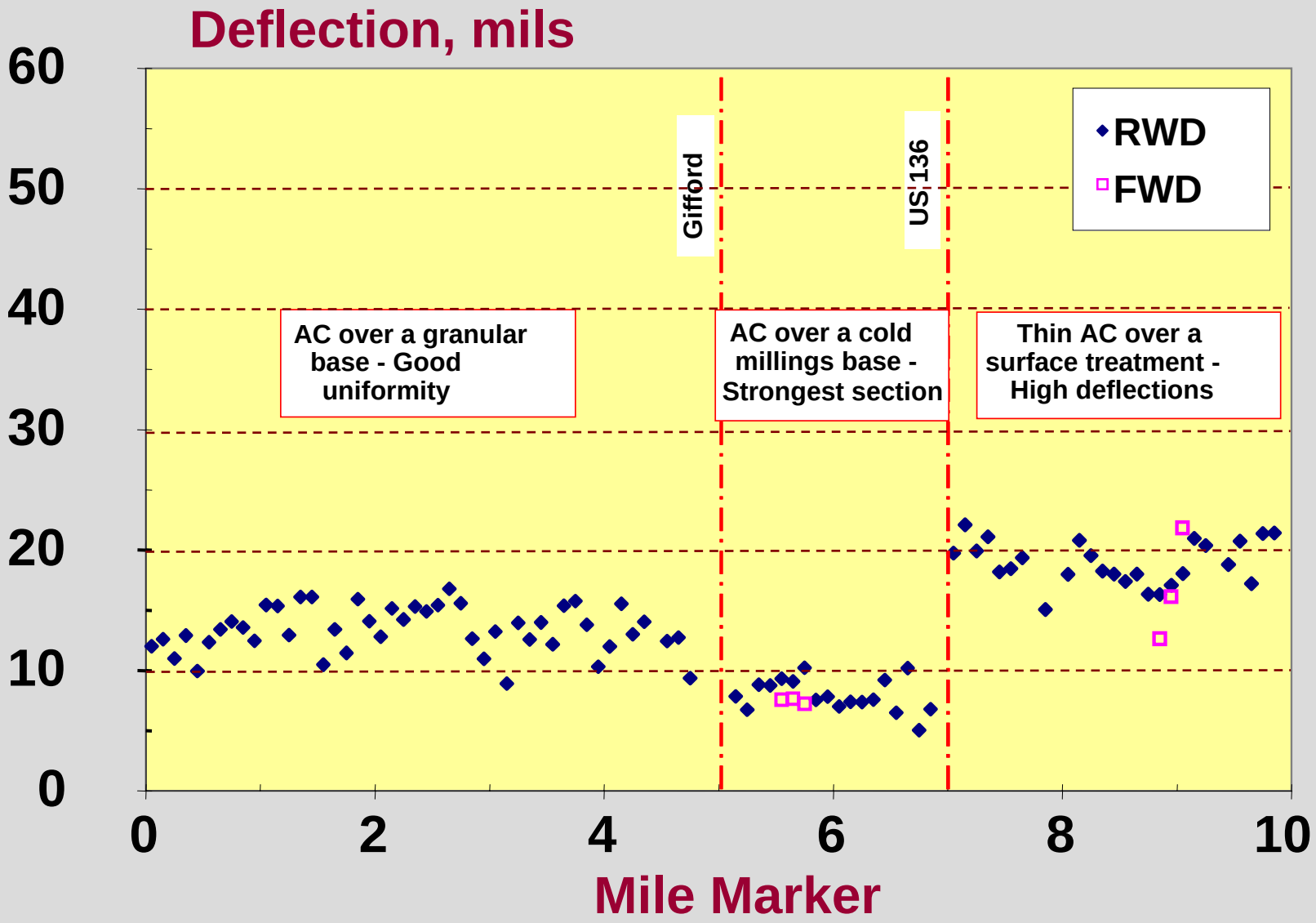
- Champaign County's network:
  - 400 lane-miles
  - Low-volume (farm-to-market) roads
  - Asphalt-surfaced. Multiple resurfacings
  - Variable surface, ride, and structural conditions
- Current highway budget is approximately $2M per year



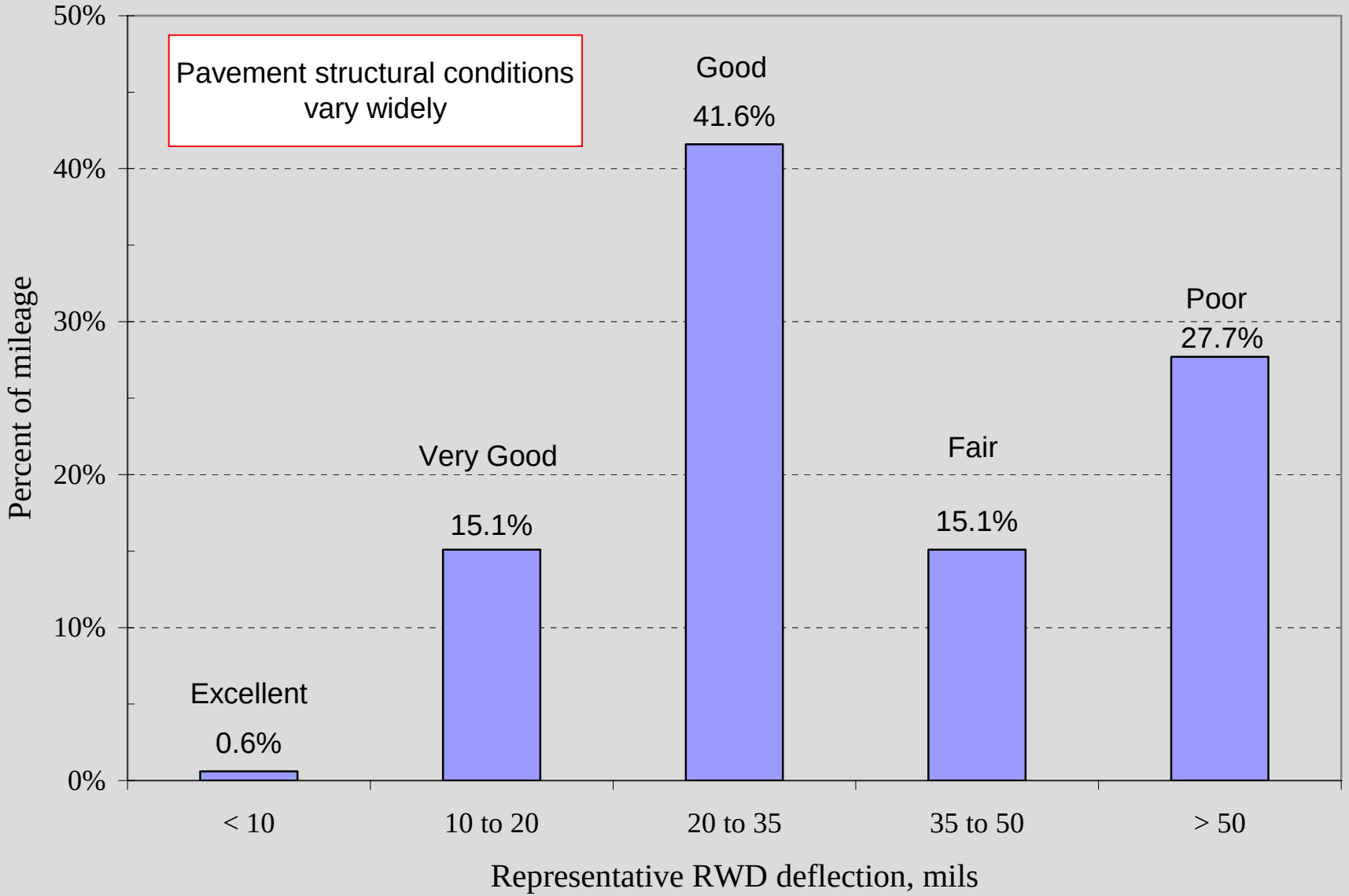
Key Inputs

- RWD
- Video images
- Smoothness data
- Construction history
- Traffic
- Cost data

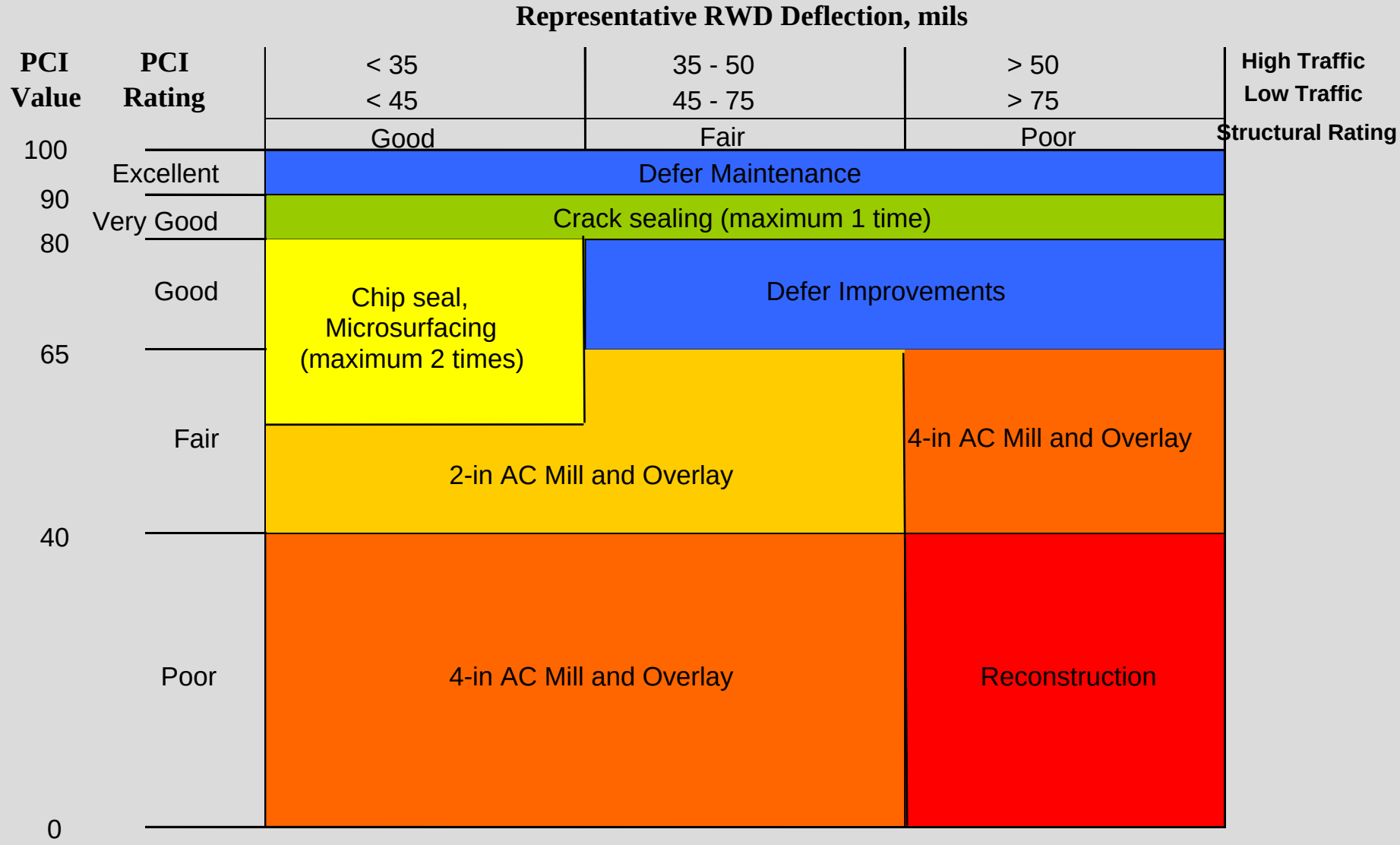
County Road 32



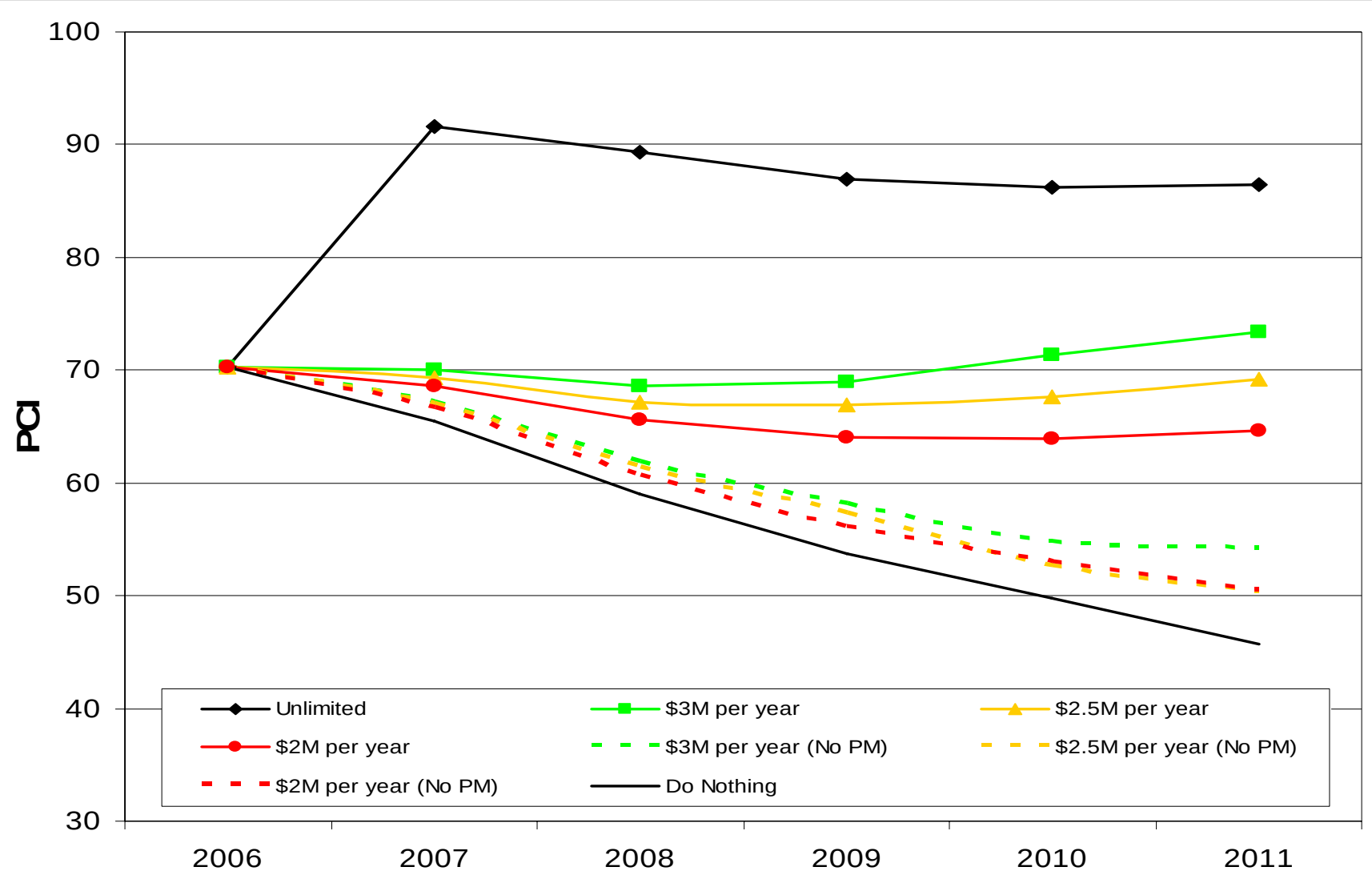
Structural Conditions



Complete Treatment Matrix



Network Condition vs. Funding



PMS Results

- Produced a 5-year maintenance and rehabilitation plan
  - Prioritized projects
  - Recommended treatments
- RWD helped identify the most appropriate treatment for each road
  - Pavement preservation
  - Functional improvement
  - Structural improvement
- 5-year budget analysis showed the consequences of various funding scenarios

SUMMARY

Conclusions

- It’s not just about Ride Quality!!
- Cracking and Rutting are important parameters.
- Pavement Structure is too important to ignore.
- Don’t abandon the proven methods.

Conclusions

- RWD is an effective means of measuring continuous pavement deflections and structurally characterizing pavement sections
- Accuracy and repeatability are suitable for network- and project-level evaluation
- Compares well to other references (i.e., FWD data)
- Can be used in PMS to optimize treatment selection, candidate projects, and funding allocation

Updates

- RWD is now available for commercial testing. ARA is the service provider.
- Two pilot programs have been funded in 2008, anticipating more in 2009.
- Focusing testing on states that are interested in incorporating RWD data into their PMS activities

Thank You!

For more information, please contact:

Thomas Van, FHWA
thomas.van@dot.gov
202-366-1341