MnDOT Pavement Research

Safer, Smarter, Sustainable Pavements through Innovative Research

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Wisconsin Asphalt Pavement Association

December 2, 2015

We all have a stake in A TO B

Presentation Outline

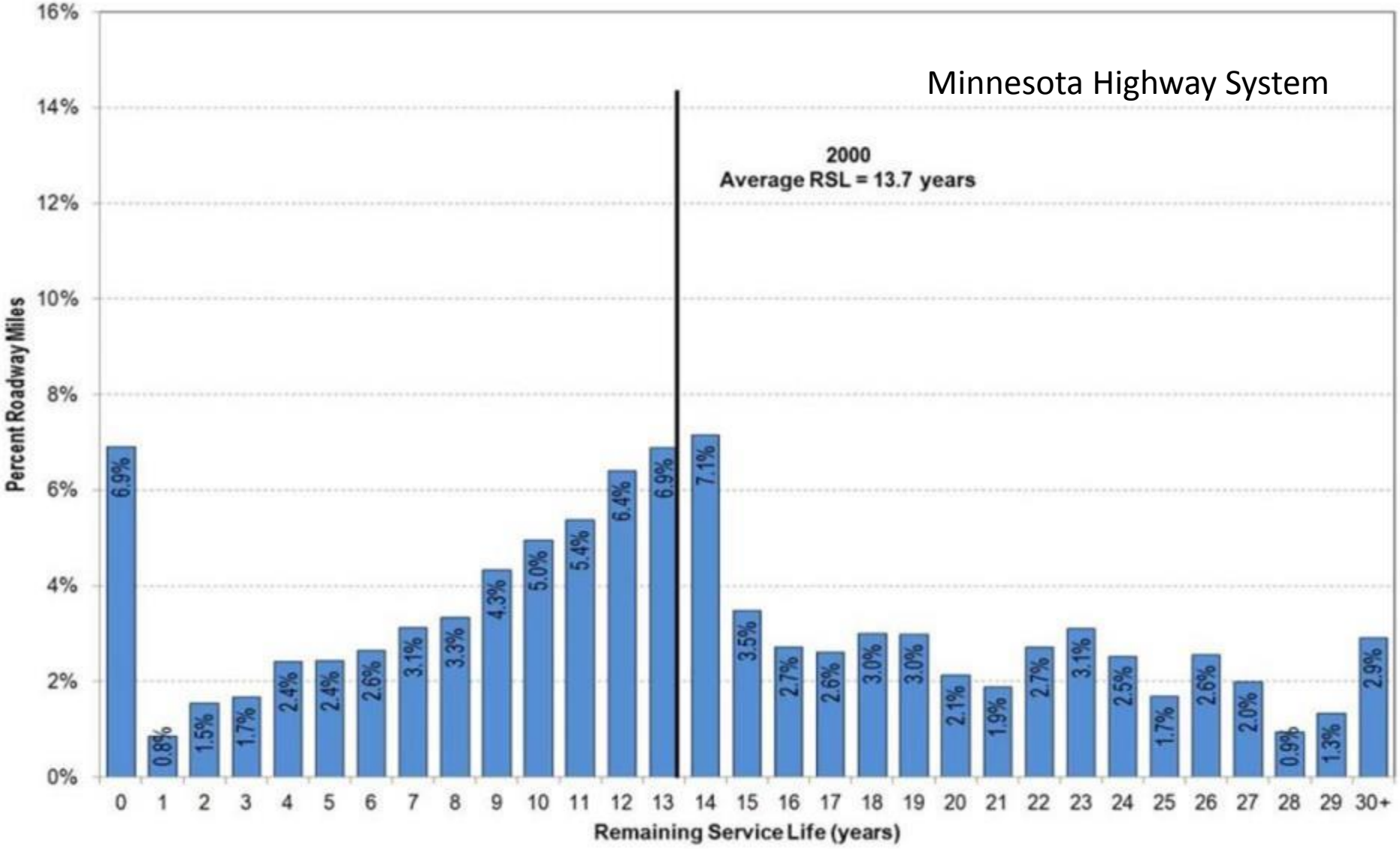
MnROAD Operations - Results / Benefits

Future Plans

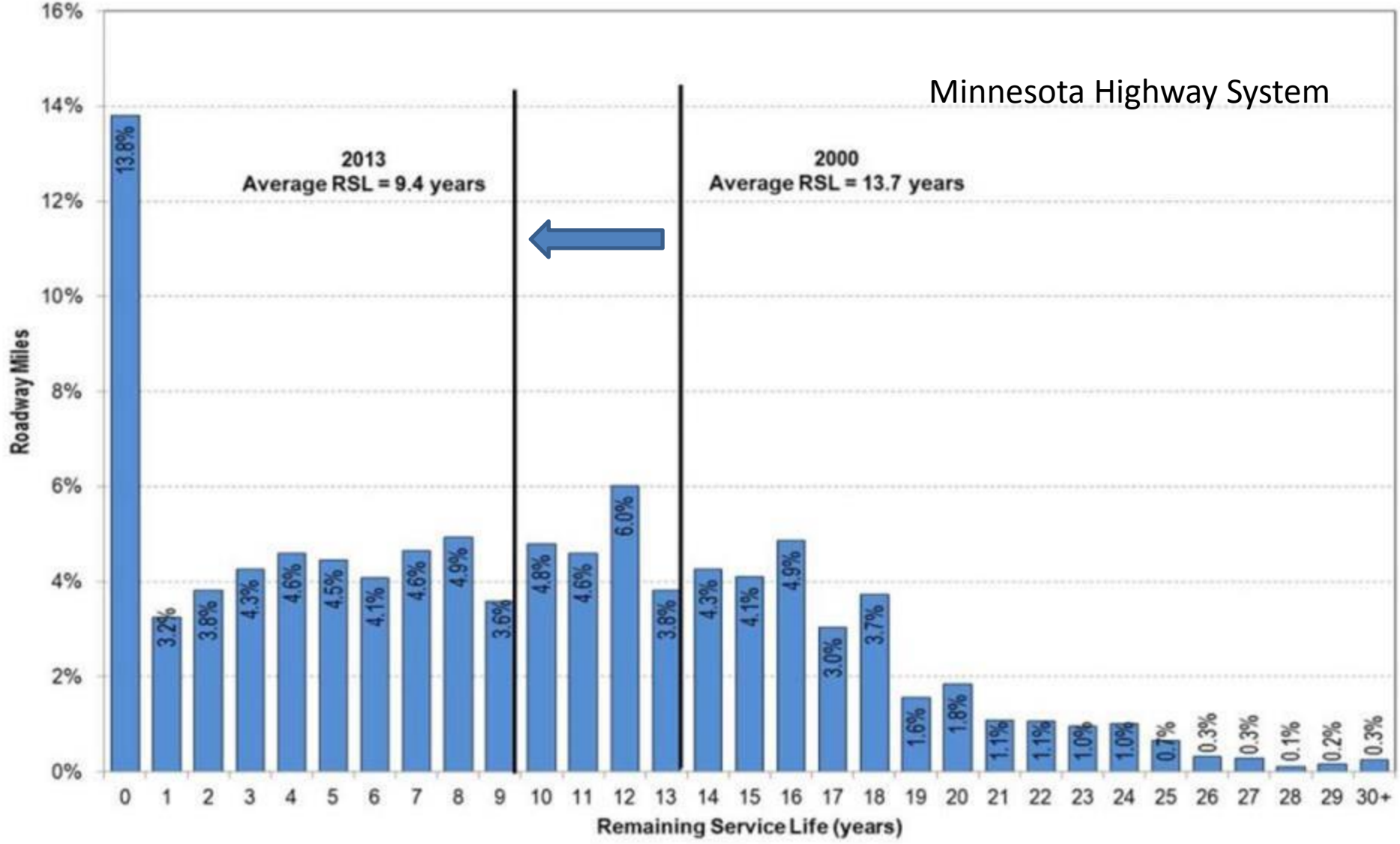
Pavement Condition

- **Current State of our Roadways?**
  - MnDOT Pavement Management Van
    - Surveys Done
      - Every Year State Roads
      - 25% of the CSAH Roadways

Investment into Pavement Research



Investment into Pavement Research

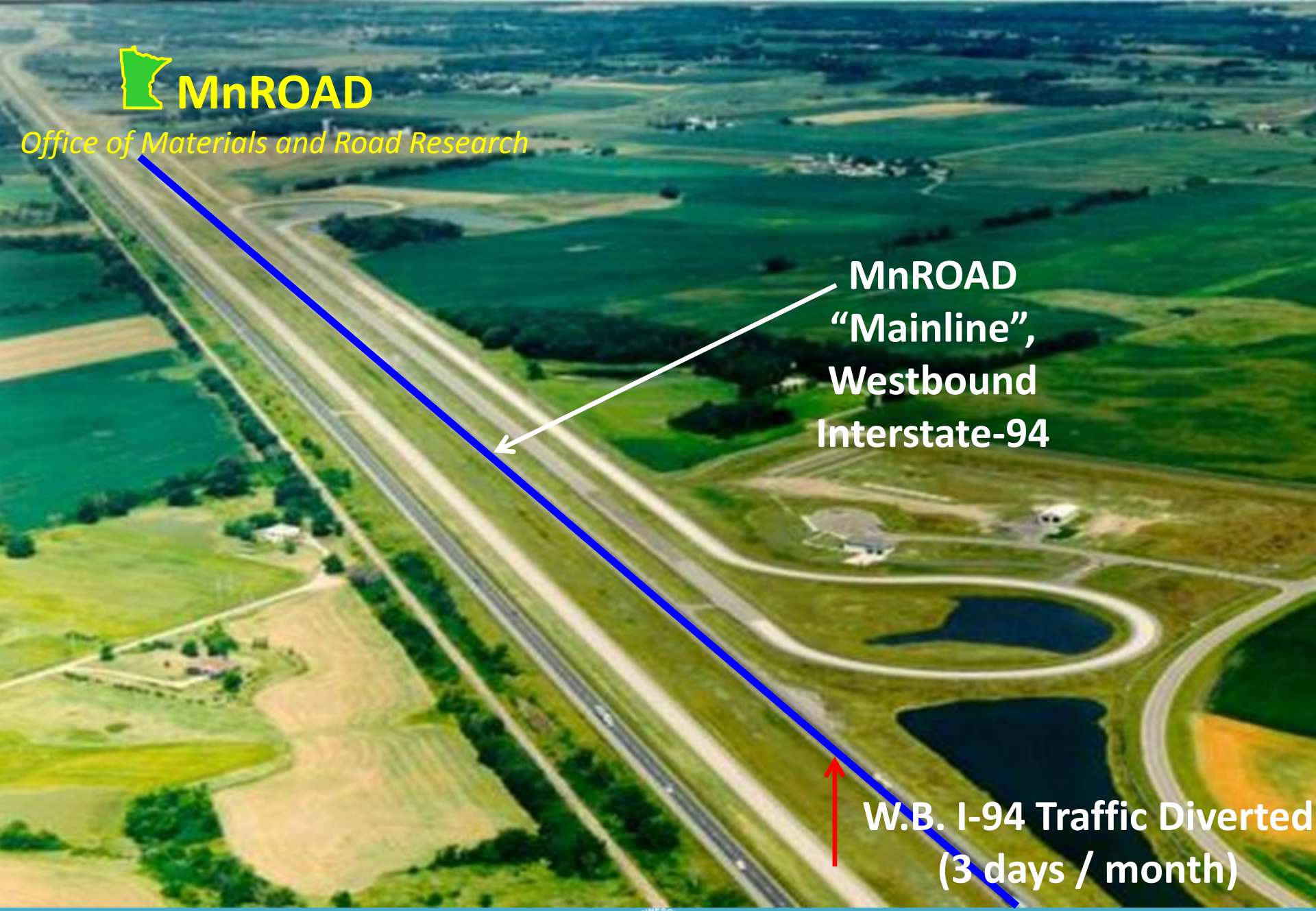


MnROAD

Office of Materials and Road Research

A long-term accelerated pavement testing facility that gives researchers a unique, real-life laboratory to study and evaluate the performance of materials used in roadway construction.


MnROAD
Office of Materials and Road Research
Existing I-94


MnROAD
Office of Materials and Road Research
MnROAD
"Mainline",
Westbound
Interstate-94
W.B. I-94 Traffic Diverted
(3 days / month)


MnROAD
Office of Materials and Road Research
MnROAD "Low Volume Road"
Controlled Access

MnROAD Traffic Loadings

Low Volume Road

5-axle Tractor-Trailer Truck
80,000 Inside Lane = 5 days/week
Outside Lane Environmental

Rigid ~ 25,500 ESALs/yr
Flexible ~ 16,000 ESALs/yr

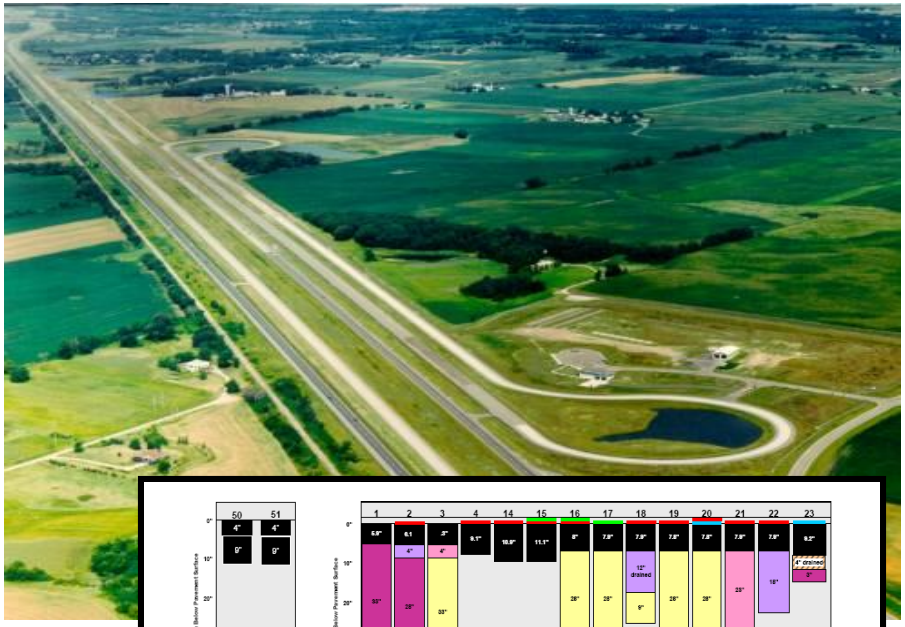
Interstate Mainline

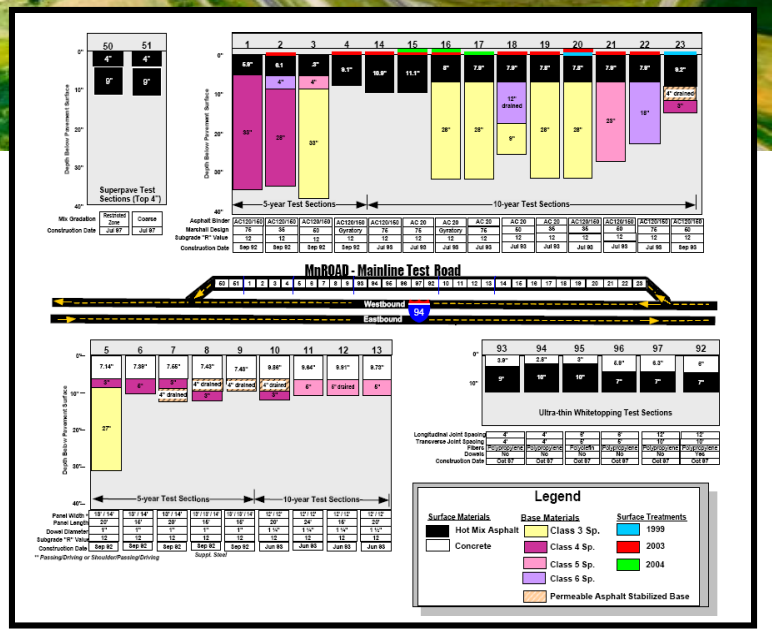
I-94 WB Public Traffic
29,700 AADT -- 13% HCAADT (2013)

Rigid ~ 1.2 Million ESALs/yr
Flexible ~ 0.8 Million ESALs/yr

MnROAD Test Facility

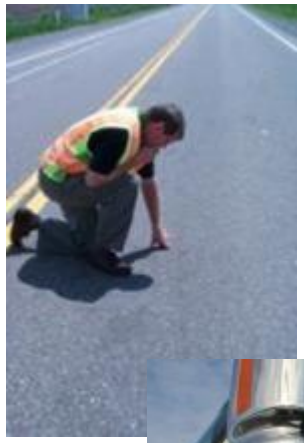
- **Initial Development**
- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Future Phase III (2016 - 2026)
- **Layout and Designs**
  - Mainline / Low Volume
  - Asphalt / Concrete / Aggregate
  - 3,5,10 Year Designs
  - Accelerated Findings
  - Low Impact / Risk to the public





MnDOT - Road Research Staffing

- **~19 Road Research Staff**
  - **Maplewood Staff**
    Asphalt
    Concrete = 12 FTE
    Design
  - **MnROAD Operations**
    @ MnROAD = 3 FTE
    @ Maplewood = 4 FTE
  - **Student Workers**



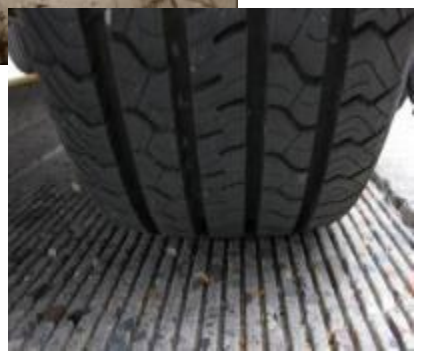



MnROAD Operations

- **Research Development**
- **Construction**
- **Performance Monitoring**
  - Cracking / Rutting / Ride
  - Deflection (FWD), …..
- **Sensors**
  - Static (Environmental)
  - Dynamic (Traffic Loading)
- **MnROAD Database**
- **Technology Transfer**
- **Traffic Loadings**

Types of Benefits

- **Direct**
  - Savings of materials
  - Sustainable
- **Indirect**
  - Time savings and quality
- **Avoidance**
  - Don’t do that on the system
- **Demonstration**
  - Confidence to try something new



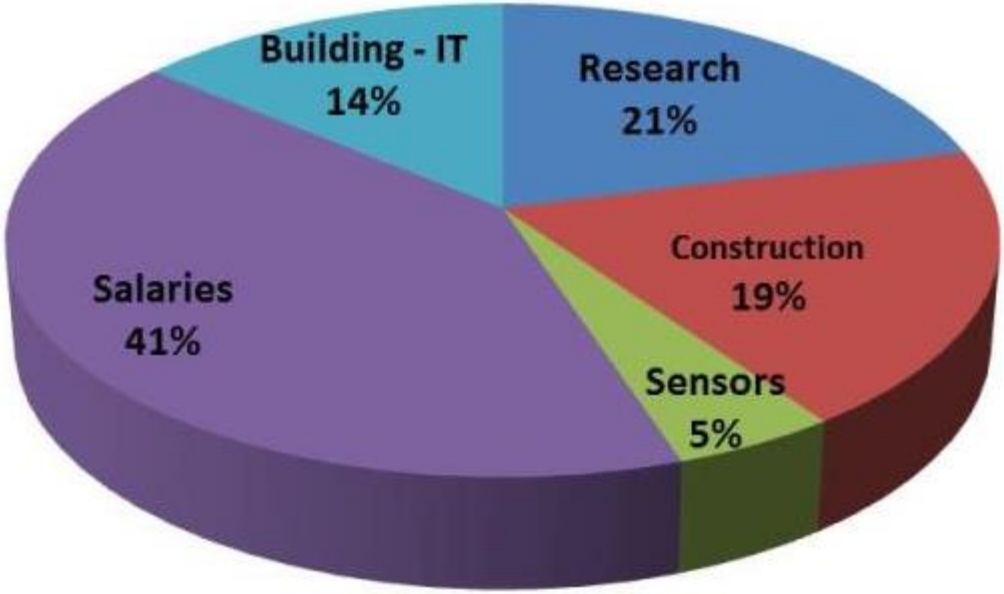
MnROAD Phase-I (1994-2006) Benefits

Saves $33 million Annually
(Savings from 2006-2018)

- **Seasonal Load Limits**
  - Spring Restrictions / Winter Overloads
- **Improved Design Methods**
  - Flexible & Rigid Updated Designs
    - Environment Drives Pavement Performance
    - Current Designs are too Conservative
- **Sealing Pavement / Shoulder Joints**

MnROAD Phase-II (2007-2016) Summary

- **MnROAD Costs (9 yr avg)**
  - Benefits Report
  - $2.75 million / year



- **Savings ~ $10.3 million/yr**

Whitetopping	→ $ 1.9 million
LTC	→ $ 2.3 million
Stabile and Drainable	→ $ 4.7 million
Recycled Unbound Materials	→ $ 0.8 million
Full Depth Reclamation	→ $ 0.5 million
Stabilization using High Carbon Fly Ash	→ $ 0.1 Million

- **Estimated Savings greater than overall Costs (Beneficial)**

MnROAD Phase-II (2007-2016)
Asphalt Benefits

- **Asphalt Materials**
  - Use of Warm Mix
  - Better understanding on modification
  - Developing a performance test for LTC
  - Use of Recycled materials
- **Savings – Low Temperature Cracking**
  - 2.3 million / year
    (Reduced cracking / less maintenance / better performance)

Low Temperature Cracking

- **TPF-5(132) Pooled Fund**
  - National mix test and specification
  - HMA cells and other state roadways
  - University of Minnesota Lead
- **Observations**
  - Fracture Energy we are able to measure
  - Changes noticed for
    - Aggregate Type
    - Aggregate Gradation Size
    - Binder Grade
    - Binder Modification
    - Air Voids
    - Use of Recycle
- **Benefits**
  - Fracture energy key to thermal cracking but other cracking?
  - Give engineers more insight in the materials they select

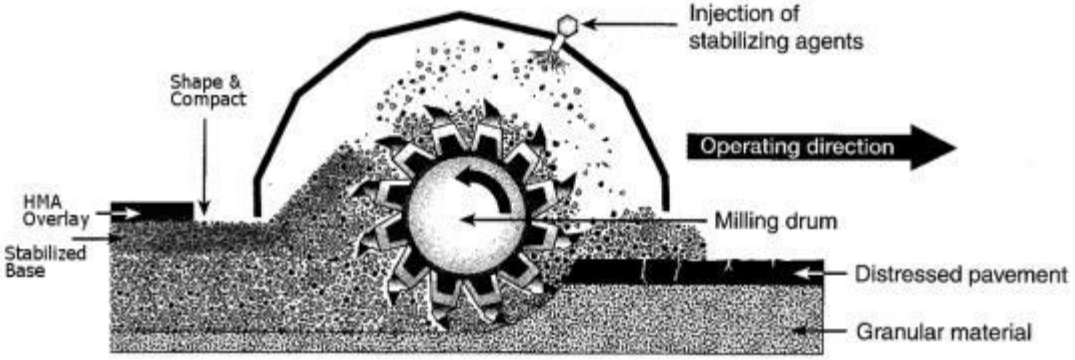
MnROAD Phase-II (2007-2016)

Unbound Benefits

- **Unbound Materials**
  - Importance of drainage / Performance
- **Savings – Stabile and Drainable**
  - $ 4.7 million
    (Reduced deterioration of HMA cracks and PCC joints – maintenance)
- **Savings – Recycled Unbound Materials**
  - $ 0.8 million
    (More sustainable material selection vs virgin materials)
- **Savings – Full Depth Reclamation**
  - $ 0.5 million
    (Proven design and life extending benefits)
- **Savings - Stabilization using High Carbon Fly Ash**
  - $ 0.1 Million
    (Insurance for construction delays)

Full Depth Reclamation

- **Road Science Partnership**
  - 3 Cells (mainline)
  - 1 Cell (LVR)
- **Observations**
  - 2.75” Interstate surface on engineered FDR
  - Engineered emulsion provides a balance stiffness and flexibility.
- **Benefits**
  - Design method for HMA Full depth repairs
  - Design method for distressed pavements
  - Sustainable practice



MnROAD Phase-II (2007-2016) Pavement Preservation Benefits

- **Pavement Preservation**
  - High Volume Chip seals
  - https://www.youtube.com/watch?v=Ol5R7n8zGoc
  - Flexible Microsurfacing
  - Better understanding of the asphalt aging

- **Savings – Diamond Grinding**
  - $ 3.5 million

    (Economic analysis shows a savings of ~100,000 mile for amount of future noise walls and height based on OBSI)

    (assumes 7 jobs @ 5 miles job from past years MnDOT data)

Optimal Timing of Preventive Maintenance for Addressing Environmental Aging in HMA Pavements

- **TPF-5(153) Pooled Fund**
  - Asphalt Institute
  - MnROAD test cells and other sections
  - Lab aging study with coring of roadways treated yearly

- **Observations**
  - The optimal timing to prevent aging of the asphalt is 1 year after HMA placement

Implements of Husbandry

- **TPF-5(148) Pooled Fund**
  - Effects of farm equipment on roadways
  - 3 Cells – (HMA 7 and 9 ton and thin PCC)
- **Observations**
  - More damage in the afternoon
  - More damage with roads without shoulders
  - Larger equipment tends to show greater damage than a 5-axle tractor-trailer
  - Equipment manufacturers are moving towards smaller tanks
- **Benefits**
  - Wisconsin is implementing local meetings to stress communication of the issues, use of one-way roads, morning travel, road improvements
  - Potential for high savings of the local roadway system

MnROAD Phase-II (2007-2016)
Concrete Benefits (sorry)

- **Concrete Materials**
  - Improved Concrete Overlay Design
  - Use of Recycled Materials in PCC
  - Use of Fibers
  - Concrete Repairs
- **Savings – Whitetopping**
  - $1.9 Million / year
    (thinner designs utilized)

National Research Initiatives

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

Minnesota Department of Transportation

National Pavement Preservation Study

Development of a National Cracking Test

National Pavement Preservation Study

- **Partnership**
  - MnROAD (North) / NCAT (South) Test Tracks
    - Offsite Low and High Volume Road Installations
    - Concrete and Asphalt Focus
    - Past/Current MnROAD Cells
  - FP^2 / National Center for Pavement Preservation
  - Government / Academia / Industry involvement
- **Goals**
  - National Study (Climatic zones)
  - Provide consistently collected data / analysis
  - Quantify the life extending benefits

Minnesota Department of Transportation

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

FP^2

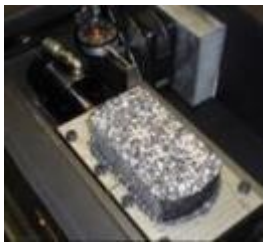
ncpp National Center for Pavement Preservation MICHIGAN STATE UNIVERSITY DEPARTMENT OF CIVIL & ENVIRONMENTAL ENGINEERING

National HMA Cracking Performance Test

- **Partnerships**
  - Utilize both MnROAD / NCAT Test Tracks
    - Top Down / Reflection / LTC cracking Efforts
    - Range of cracking potential mixes over Asphalt and Concrete
    - Battery of testing of many different existing tests Nationally
- **Goals**
  - We need tests and criteria that relate to performance.
  - We need tests that are practical for both mix design verification and quality control testing purposes.
  - We need tests that accommodate recycled materials, new and future additives, and combinations.








NRRA
National Road Research Alliance

Goals:

- Strategic Implementation Through Cooperative Pavement Research
- Focus on regional and national needs
- Foster innovation through membership from states, academia and industry
- Ensure the development of implementable products for road owners
- Create an effective technology transfer program
- Direct 2017 MnROAD construction (MnDOT $2.5 million contribution)
- *Developed around a 2014 National PEER Exchange*

MnROAD
Safer, Smarter, Sustainable Pavements Through Innovative Research

Currently Soliciting this Pooled Fund → Looking for your involvement!

Pooled Fund Solicitation

http://www.pooledfund.org/Details/Solicitation/1410

Currently Minnesota / Wisconsin / Michigan has joined

Structure

Sets research objectives, goals and project selection

Project Teams - Develops Recommendations and carries out critical efforts for NRRA

<u>Associates/Academia</u> - Provide innovative solutions to the State and Local identified research problem by participating in the project teams.(at $2K per year)

Project Teams

National Road Research Alliance

Technology Transfer Team

Webinars
Training
Implementation Series
Shovel Ready Technologies
Pavement Conference

Communications Team

Newsletters
Web site
Outreach

<u>Each Team</u>

Chaired by Executive Member with
Executive, Associate, and Academic membership

Thank You

We all have a stake in A TO B