MnROAD Benefits

Safer, Smarter, Sustainable Pavements through Innovative Research

Ben Worel

2015 NEPPP Meeting

April 30, 2015

Presentation Outline

Investment into Pavement Research

- **Current State of our Roadways (roads in poor condition)**
- **Research is needed to come up with the answers**
  - No new source of funding expected
  - Cannot continue to do the same things that got us here

- **Minnesota Trunk Highway System**

  11,963 miles (19,248 km) - Hot Mix Asphalt

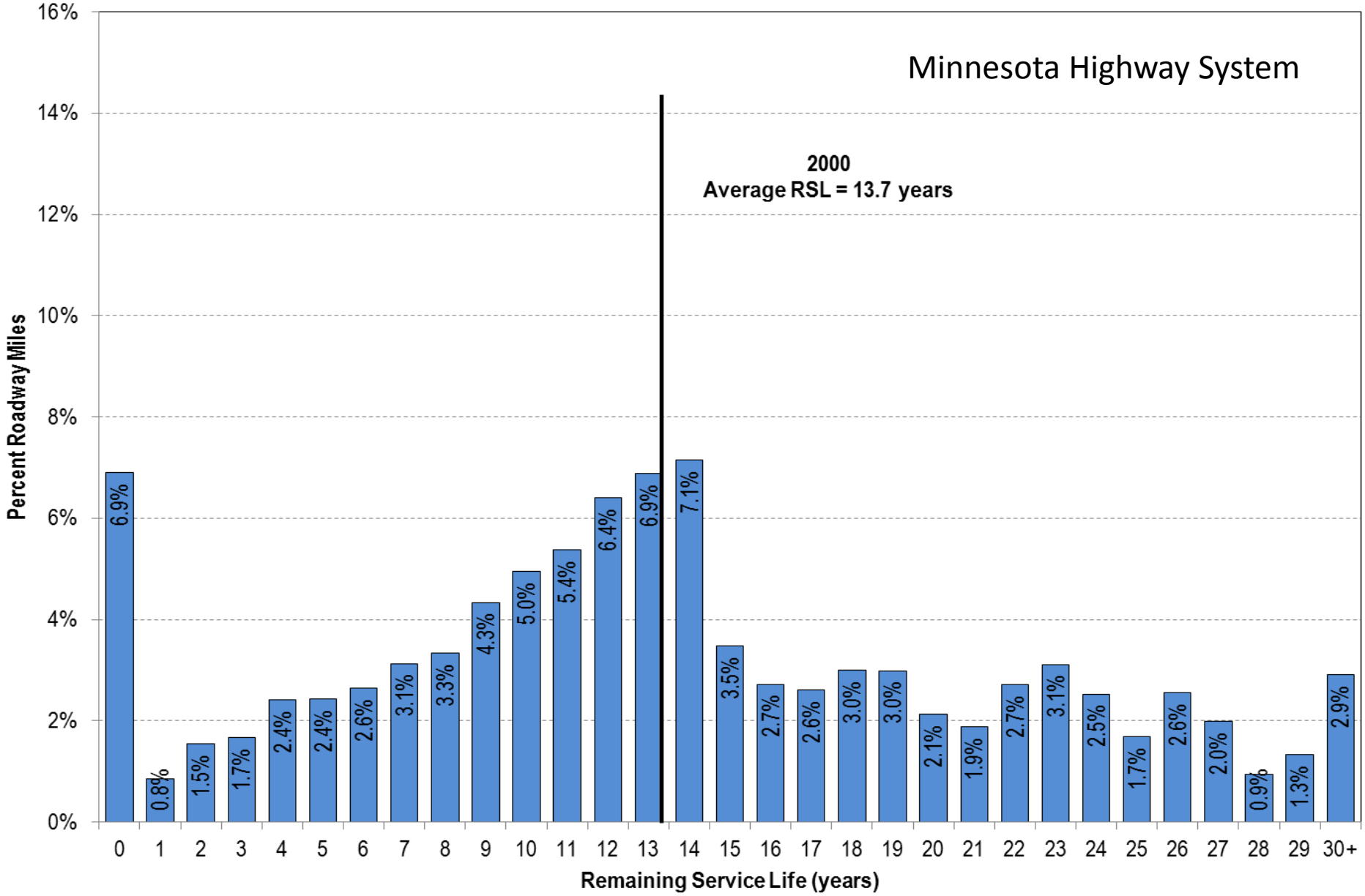
  + 2,259 miles (3683 km) - Portland Cement Concrete

  + 9 miles (14 km) – Untreated Gravel

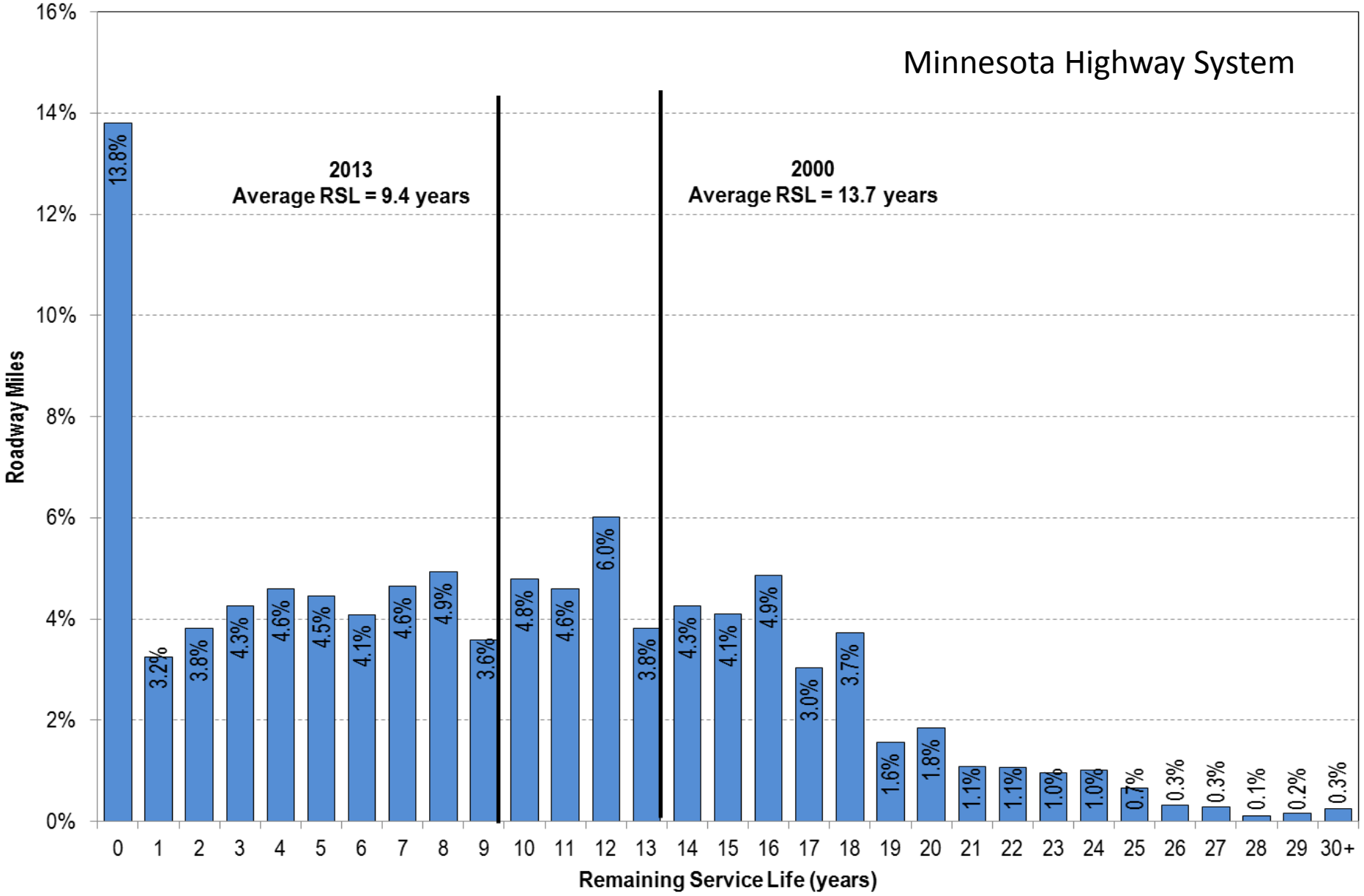
  = Total: 14,321 miles (23,042 km)

- **Total Roads in MN: 142,913 miles (229,996 km)**

Investment into Pavement Research

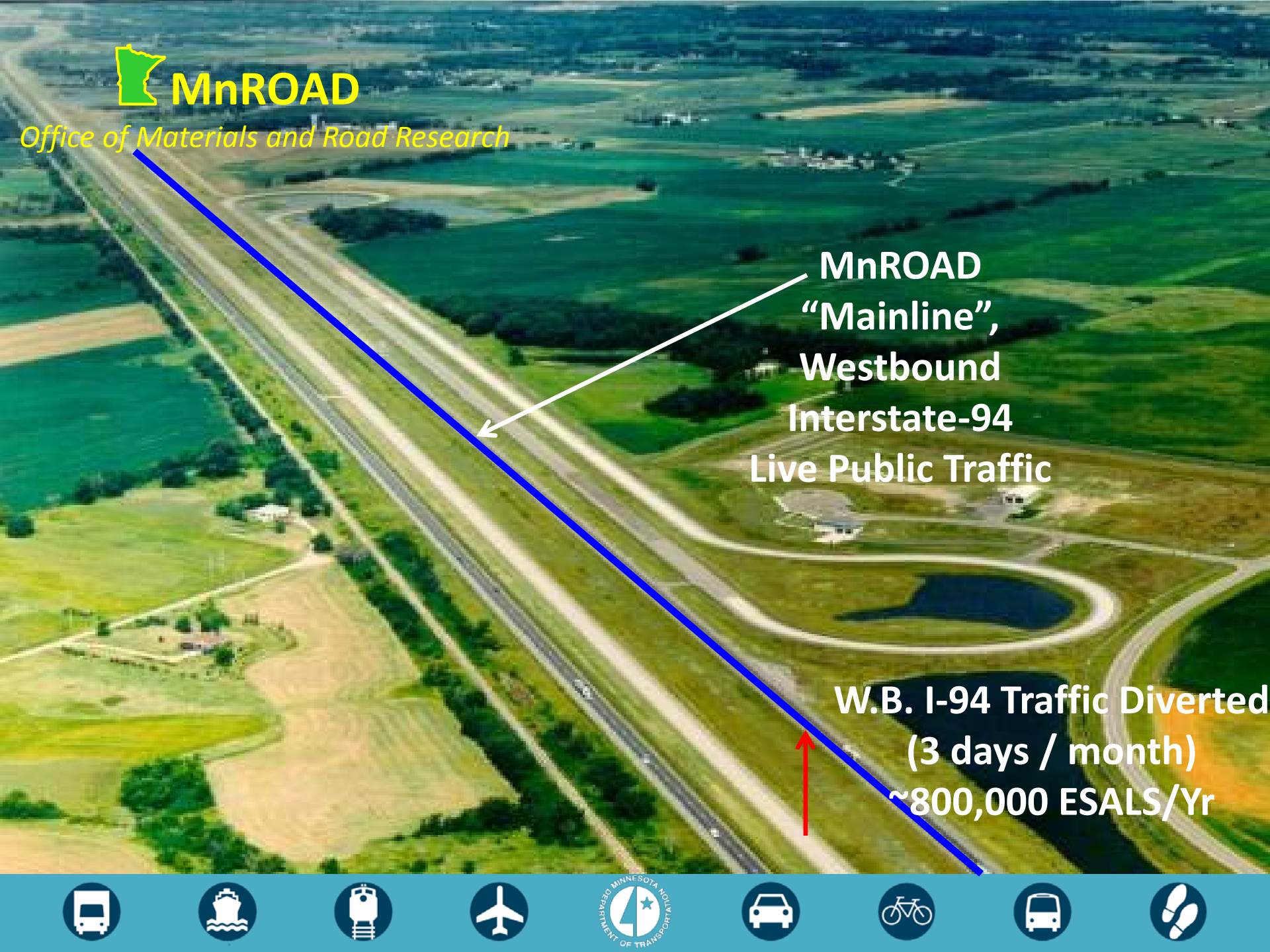


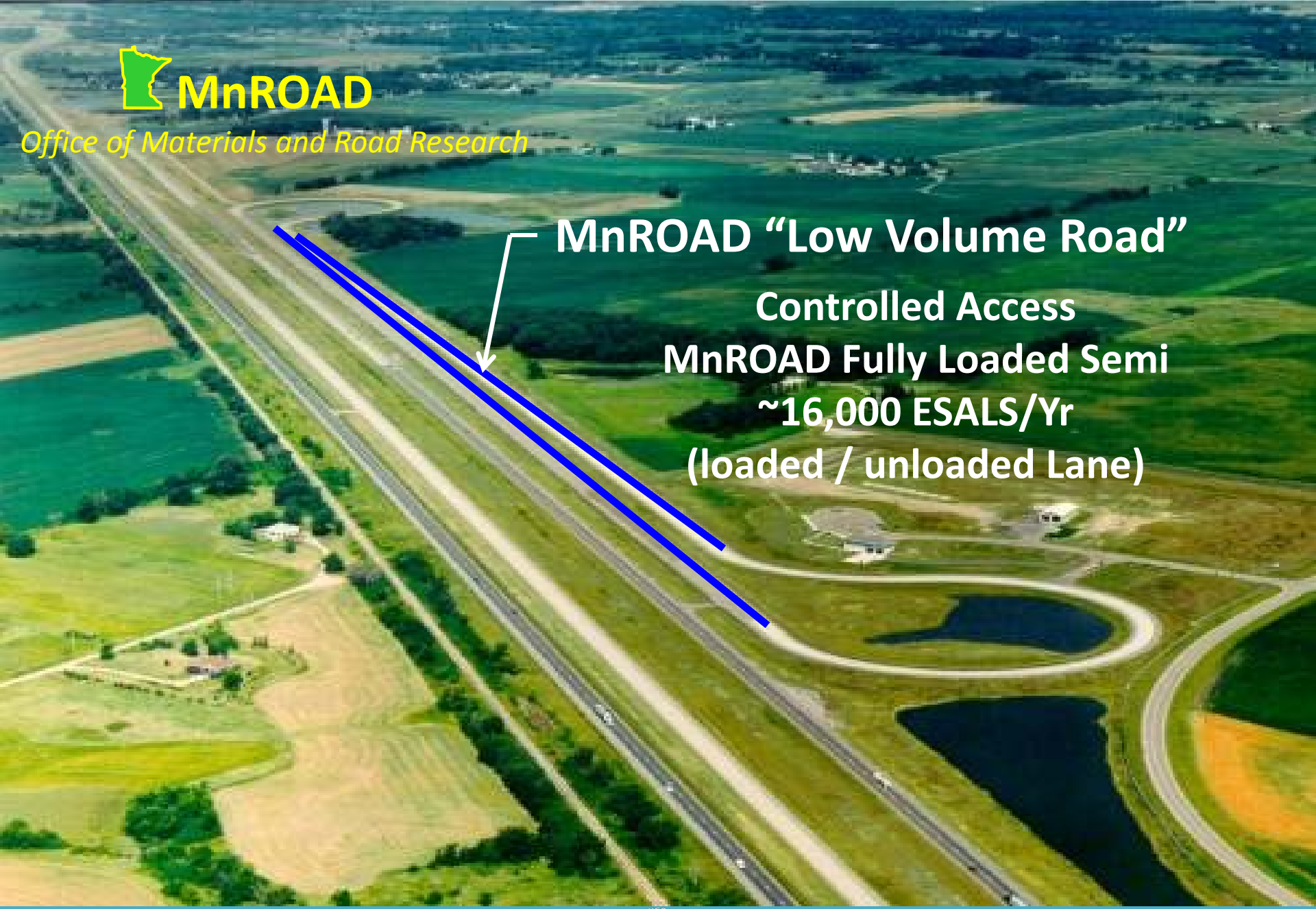
Investment into Pavement Research




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.
MINNESOTA DEPARTMENT OF TRANSPORTATION

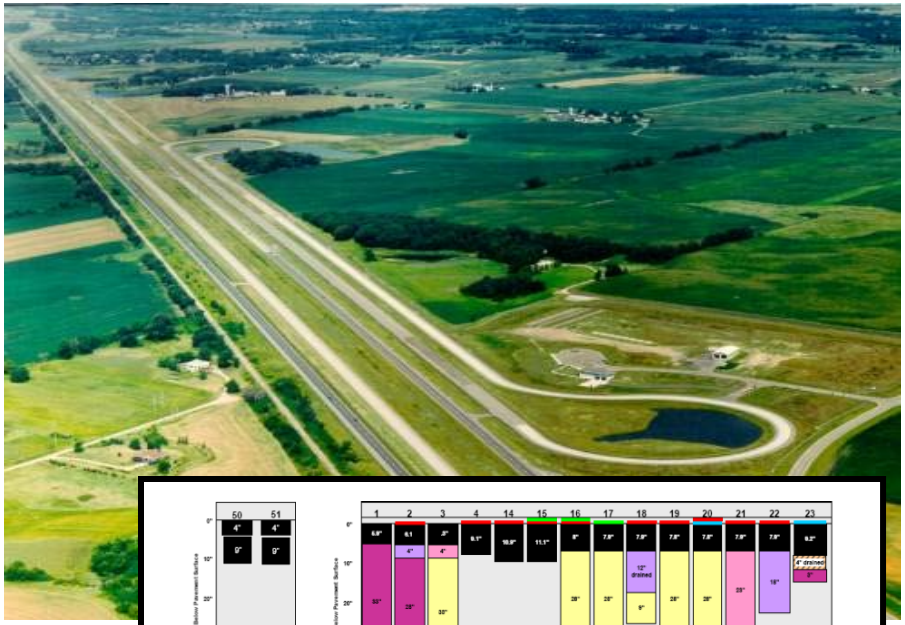

MnROAD
Office of Materials and Road Research
Existing I-94
EB HMA ~ 1,000K ESALS
WB PCC ~ 200K ESALS


MnROAD
Office of Materials and Road Research
MnROAD
"Mainline",
Westbound
Interstate-94
Live Public Traffic
W.B. I-94 Traffic Diverted
(3 days / month)
~800,000 ESALS/Yr

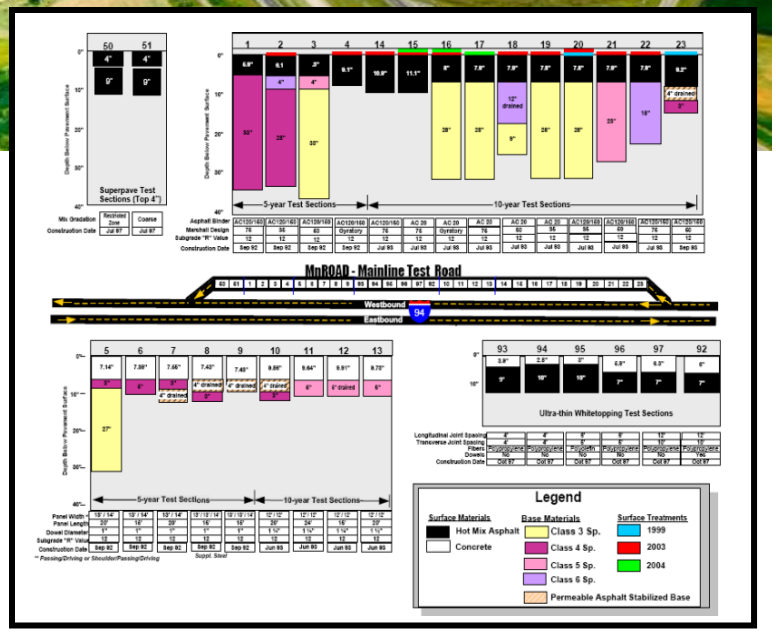

MnROAD
Office of Materials and Road Research
MnROAD "Low Volume Road"
Controlled Access
MnROAD Fully Loaded Semi
~16,000 ESALS/Yr
(loaded / unloaded Lane)

MnROAD

- **Major Experiments**
  - Phase I (1994-2006)
  - Phase II (2007-2016)
  - Future Phase III (2016 - 2026)



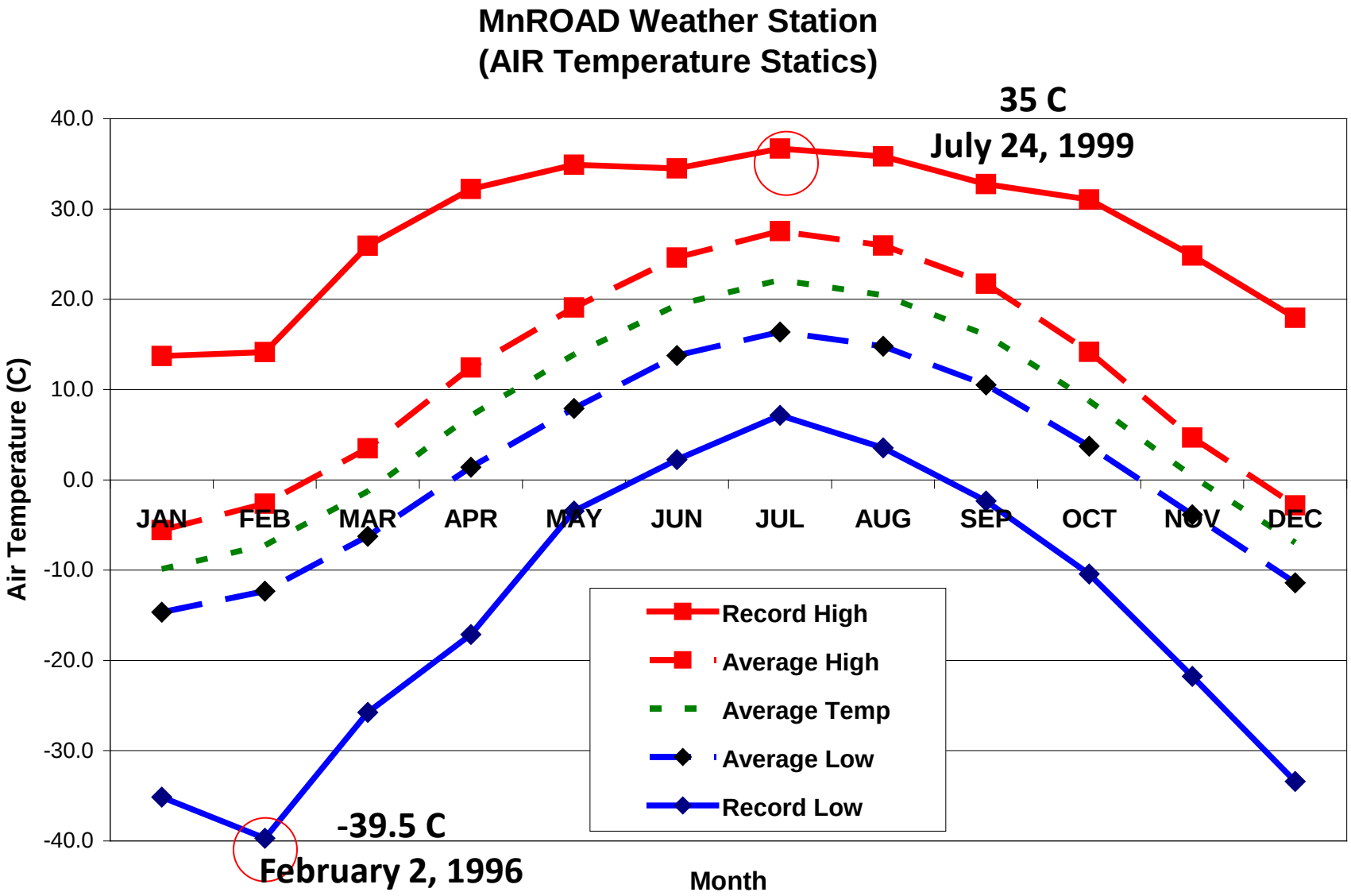
- **Layout and Designs**
  - Mainline / Low Volume
  - Asphalt / Concrete / Aggregate
  - 3,5,10 Year Designs
  - Accelerated Findings
  - Low Impact / Risk to the public



MnROAD Operations

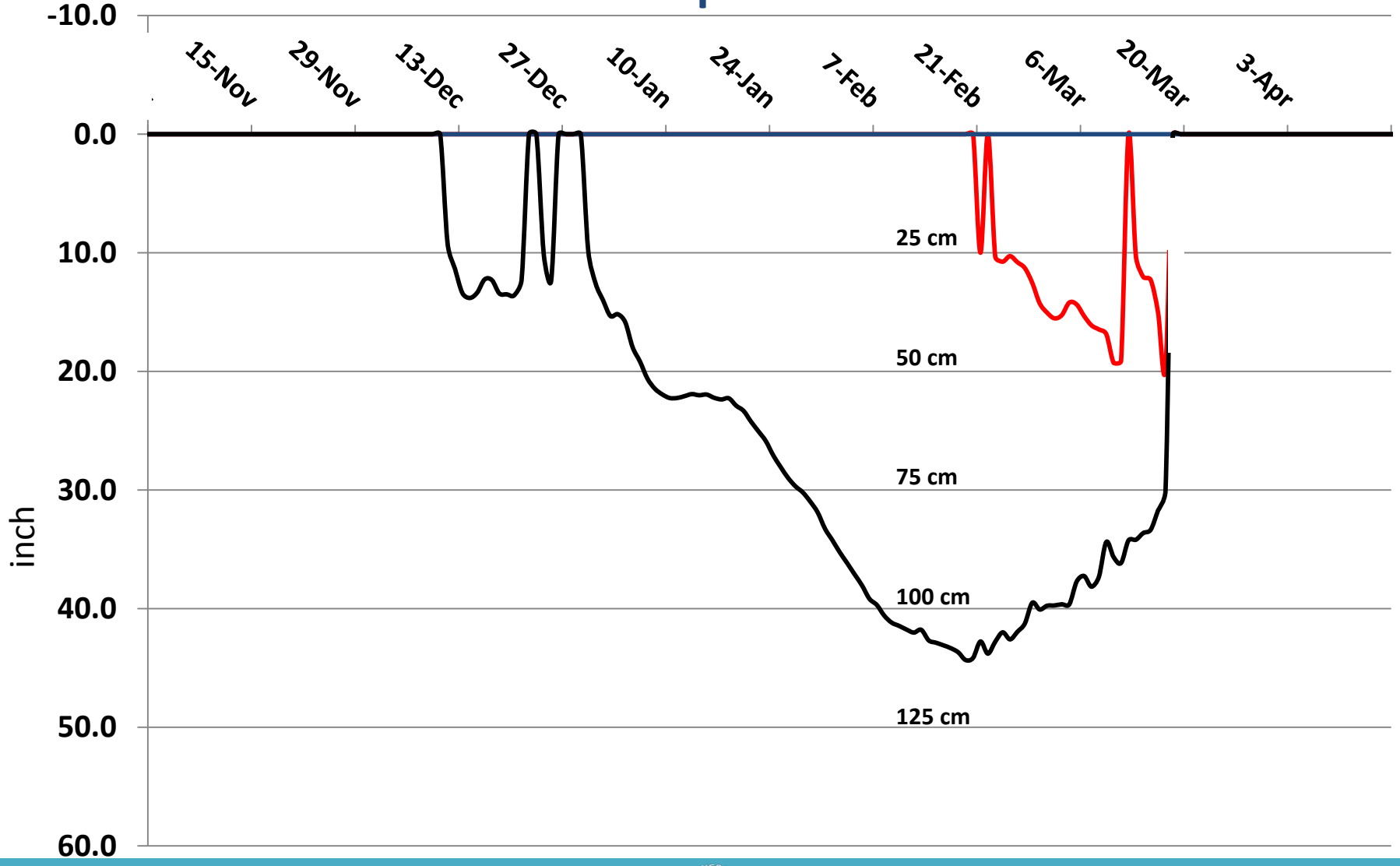
- **Staffing ~20 Road Research (7 FTE MnROAD)**
- **Research Development**
- **Construction**
- **Performance Monitoring**
  - Cracking / Rutting / Ride
  - Deflection (FWD), …..
- **Sensors**
  - Static (Environmental)
  - Dynamic (Traffic Loading)
- **MnROAD Database**
- **Technology Transfer**
- **Traffic Loadings**

MnROAD Air Temperatures



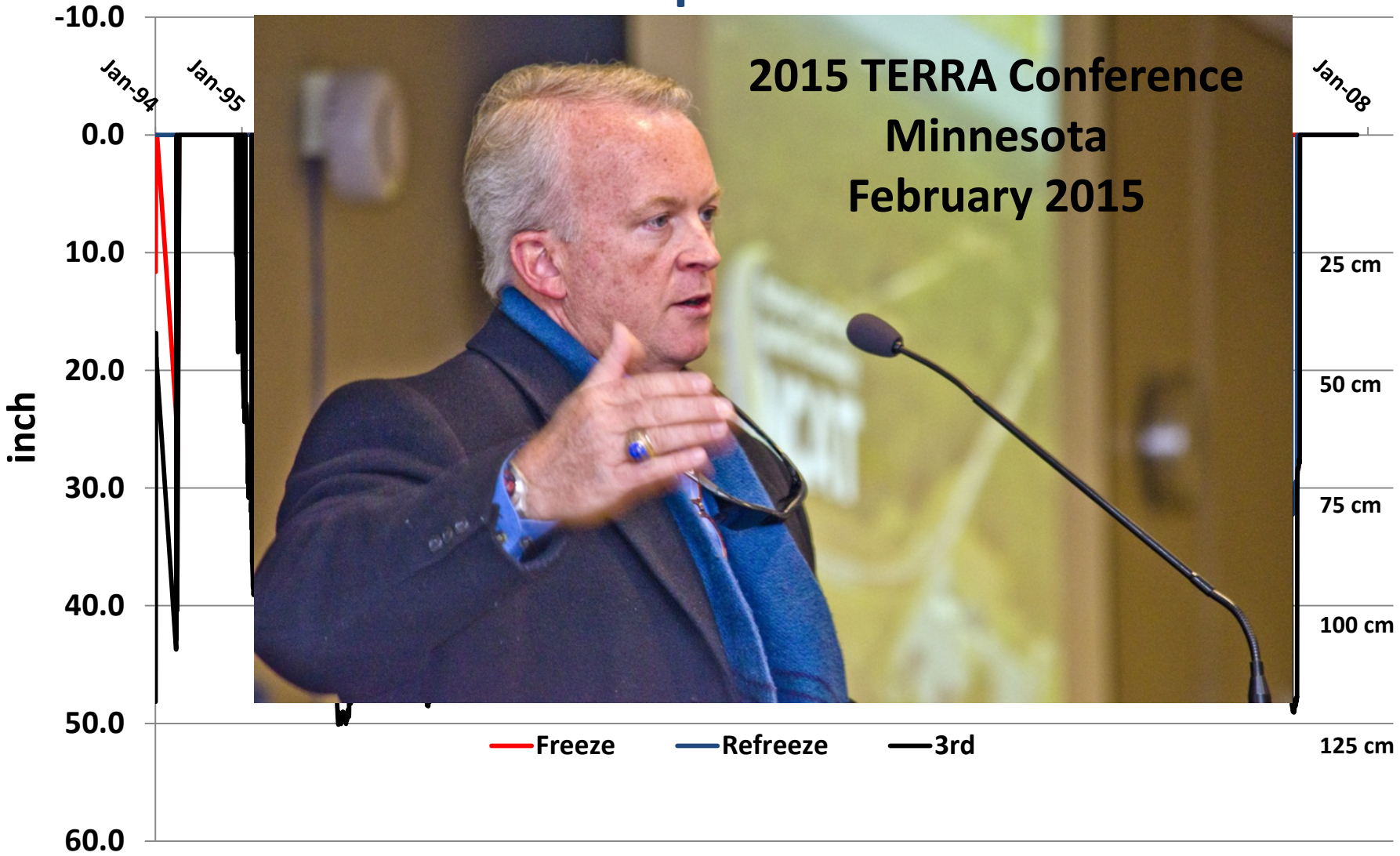
MnROAD - Cell 23

2001 Thermal Couple Calculated Frost

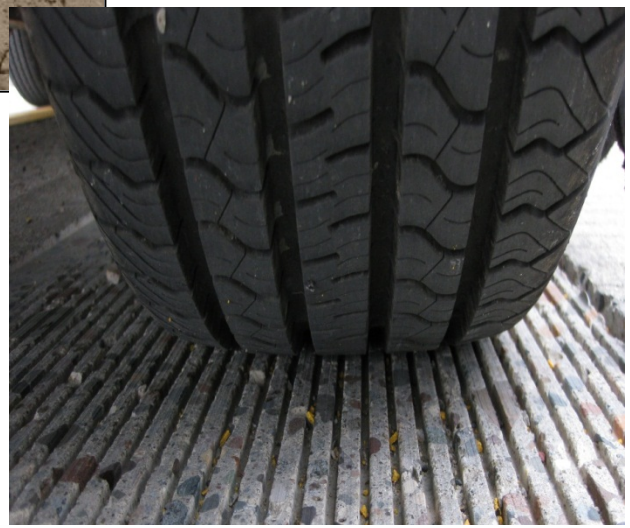


MnROAD – Cell 23

Thermal Couple Calculated Frost



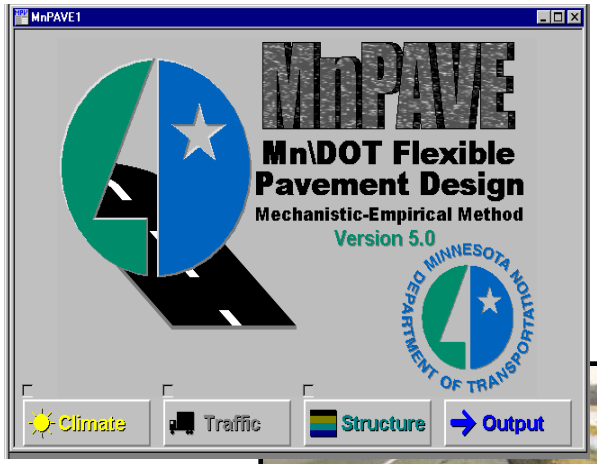
MnROAD Benefits



- **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)



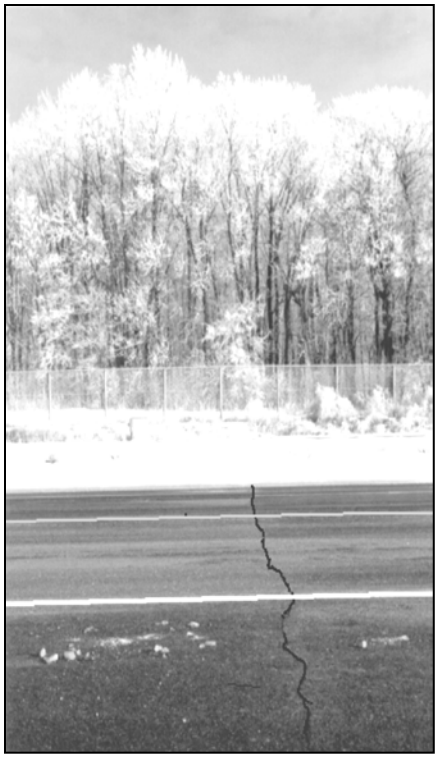
- **Seasonal Load Limits**
  - Spring Restrictions / Winter Overloads
- **Improved Design Methods**
  - Flexible & Rigid Updated Designs
    - Environment Drives Pavement Performance
    - Current Designs are too Conservative
- **Sealing Pavement / Shoulder Joints**

MnROAD Phase-II (2007-2016)
Concrete Benefits

- **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)

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
- **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

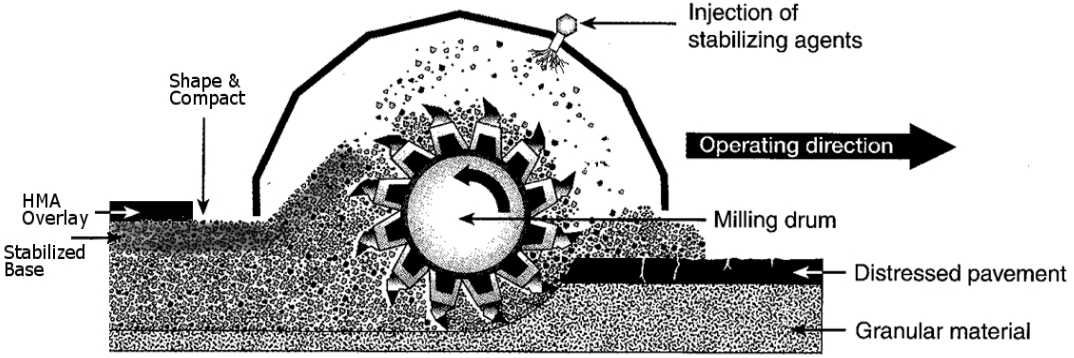
MnROAD Phase-II (2007-2016)

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 - Stabilization using High Carbon Fly Ash**
  - $ 0.1 Million
    (Insurance for construction delays)
- **Savings – Full Depth Reclamation**
  - $ 0.5 million
    (Proven design and life extending benefits)

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
  - Better understanding of the asphalt aging
  - Flexible Microsurfacing

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

- **Savings – Diamond Grinding**
  - $ 3.5 million
    (Bernard's economic analysis 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)

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

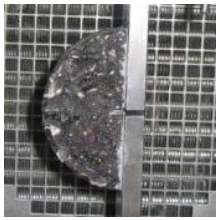
National Pavement Preservation Study Northern Efforts

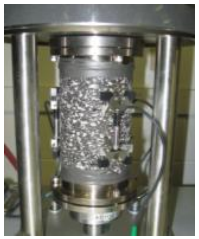
- **Currently 6+ Northern States**
  - Similar treatments (North) / (South)
    - MnDOT Specs / Emulsions + Similar Sections
    - Thin Overlays and Surface Treatment
  - Low Volume Roadway (157th Street)
  - High Volume Roadway (US-10)

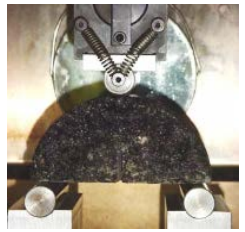
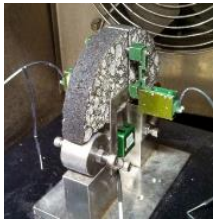
  - NCAT Contracted “Surface Treatments”
  - MnDOT Contracted “Thin Overlays”
  - Construction 2015 or 2016

National HMA Cracking Performance Test Northern Efforts

- **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.

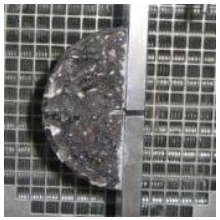



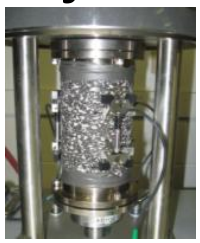


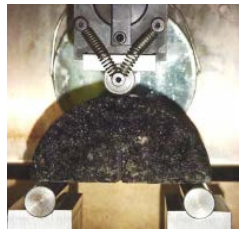
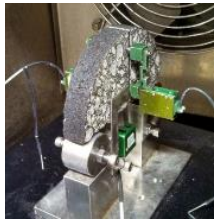




National HMA Cracking Performance Test Northern Efforts

- Southern States → Top Down Focus
- Northern States → Low Temp / Reflective Cracking
  - Select ~8 mix designs
    - L-M-H Fracture Energy, Range of Binder Replacement
    - Innovative Mixes, ……..
  - MnROAD Cell Availability
    - New Construction (8 new cells)
    - Rehab of HMA (2 cells + 3 miles old EB I-94)
    - Rebab of PCC (3 Cells ML + 1 Cell LVR + 2 miles old WB I-94)
  - May tie to TERRA to join in a complete effort



MnROAD Past Investment

- **9 Year Average Funding = $2.75 million**
- **Funded by**

- **National Facility**
  - Increase outside funds
  - Increase outside use

National MnROAD and NCAT Efforts
(looking for your participation)

- **NCAT Pooled Fund**
  - Alabama DOT Lead
  - MnROAD Partnership Focus on
    - Pavement Preservation @ 120K/yr
    - National HMA Cracking Performance Test @ 210K/yr
  - http://www.pooledfund.org/Details/Study/496

National Pooled Fund

Minnesota Department of Transportation

National Center for Asphalt Technology NCAT at AUBURN UNIVERSITY

TERRA Transportation Engineering and Road Research Alliance

Partnering for Roadway Innovation

- **TERRA Pooled Fund**
  - Minnesota DOT Lead with MnROAD Test Facility
  - TERRA and past MnROAD pooled fund states
  - Expected to be 150K/yr
  - Focus on
    - 2014 Peer Exchange Research Needs
    - Research Other important needs
    - Pavement Preservation Efforts (Starting Year-4)

- **Legislative Funding also being pursued**

Discussion