Use of Local Aggregates in SMA

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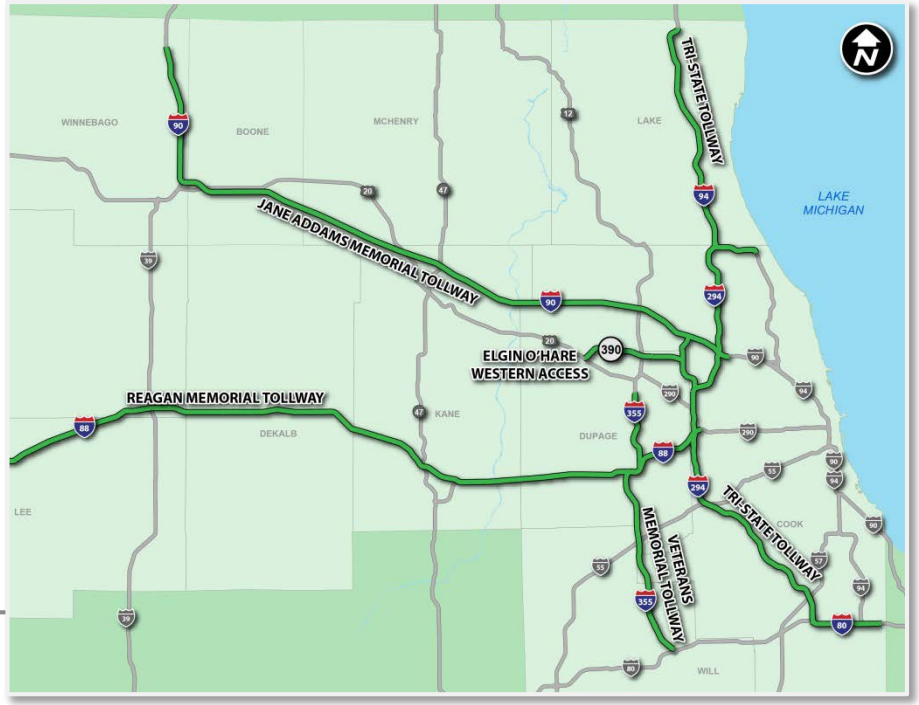
Illinois Tollway – Key Statistics

- 286-mile system comprised of four tollways
- Opened in 1958 as a bypass around Chicago to connect Indiana and Wisconsin
- Carries more than 1.4 million vehicles per day
- User-fee system
- No state or federal gas tax dollars used for maintenance and operations



Tollway SMA

- **Used for all mainline overlays**
- **2008-2009 – Full-depth asphalt – Jane Addams Memorial Tollway (I-90) in Rockford area**
- **2015 – Reagan Memorial Tollway (I-88) Rehabilitation**
  - 2005 – Rubbilized I-88 – Rochelle to Rock Falls
  - 6-inch asphalt overlay – Stage construction
  - 2015 – Remove 2-inch surface, replace with 6-inches of WMA, including a 2-inch warm-mix SMA surface

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Coarse Aggregates for Tollway SMA

- **Friction surface SMA –**
  - High traffic pavements and curves
  - Coarse aggregate: crushed steel slag, quartzite, granite or diabase / trap rock
- **Binder SMA and surface SMA**
  - Coarse aggregate: typically crushed gravel. (Also quartzite, granite, diabase / trap rock; crushed steel slag – surface only).
  - 2008 Friction evaluation – OK for Tangents

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Coarse Aggregates for Tollway SMA

- Friction aggregates – non-Illinois sources
- Crushed gravel – southern Wisconsin
- I-88 opportunity – evaluate local crushed gravel sources for use in SMA surface

Local Aggregates for Tollway SMA

- **Evaluation approach**
  - Identify potential sources
  - Aggregate breakdown
    - Micro-Deval testing
    - Gyratory compaction to N_{max}

Aggregate Source Selection

- Proximity to Tollway and/or I-88
- Aggregate products and gradations
- Willingness to participate

Aggregate Sources

- **Control**
  - Rock Road: Lathers crushed gravel (CM-14 and CM-16)
  - Michels: quartzite (CM-13 and CM-14)
- **Crushed Gravel**
  - Beverly Elgin (CM-14 and CM-16)
  - Lafarge Elburn (CM-14 and CM-16)
  - Meyer Algonquin (CM-16 and CM-11-scalped)
  - Thelen Antioch (CM-16 and CM-11-scalped)

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Aggregate Sources

- **Dolomite**
  - Vulcan Sycamore (CM-16 and CM-11-scalped)
  - Lafarge Fox River (CM-16 and CM-11-scalped)
  - Riverstone Osborn (CM-11-scalped)
  - Riverstone Milan (CM-16)
  - Macklin Rochelle (CM-16 and CM-11-scalped)
  - Hanson Thornton (CM-16 and CM-11-scalped)

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Micro-Deval of Coarse Aggregates

- **AASHTO T327**
  - Aggregate breakdown (percent loss) in presence of water
  - Good identifier of pavement performance
  - “Mini” L.A. Abrasion
  - Repeatable test
  - Some agencies use in lieu of soundness

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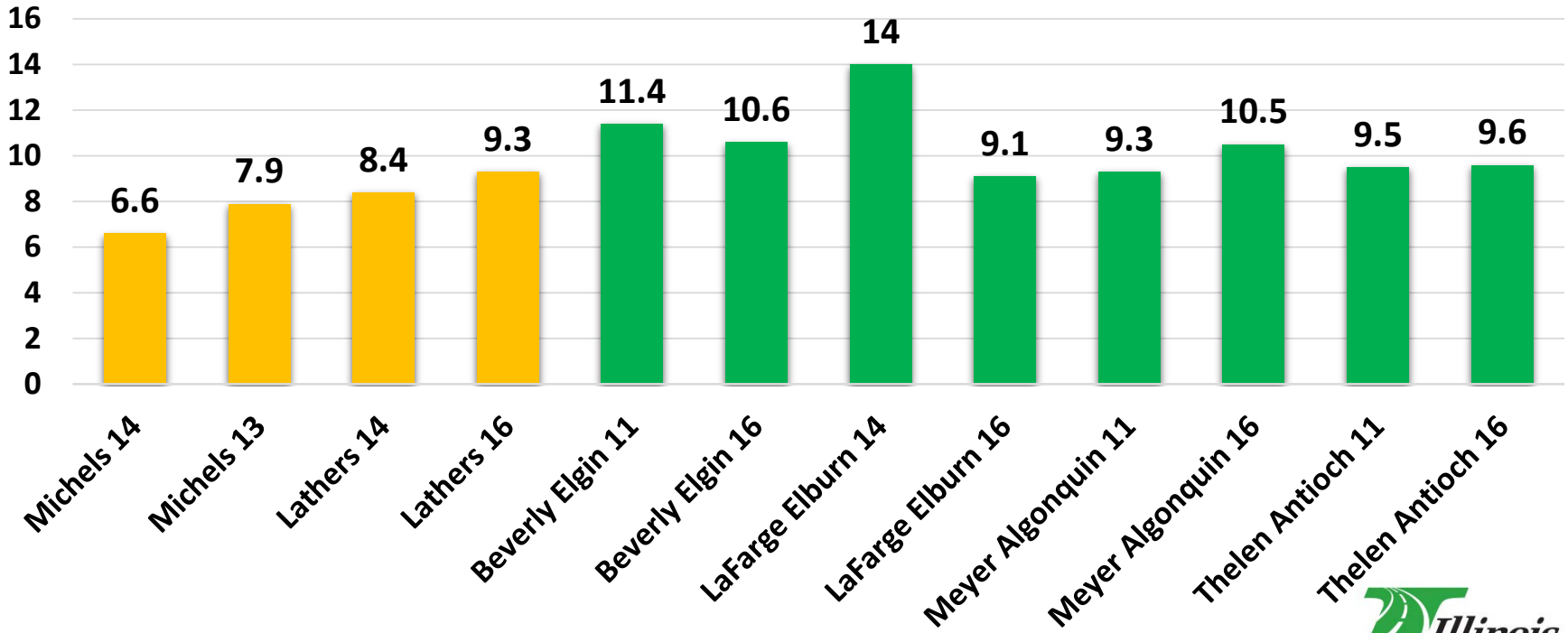
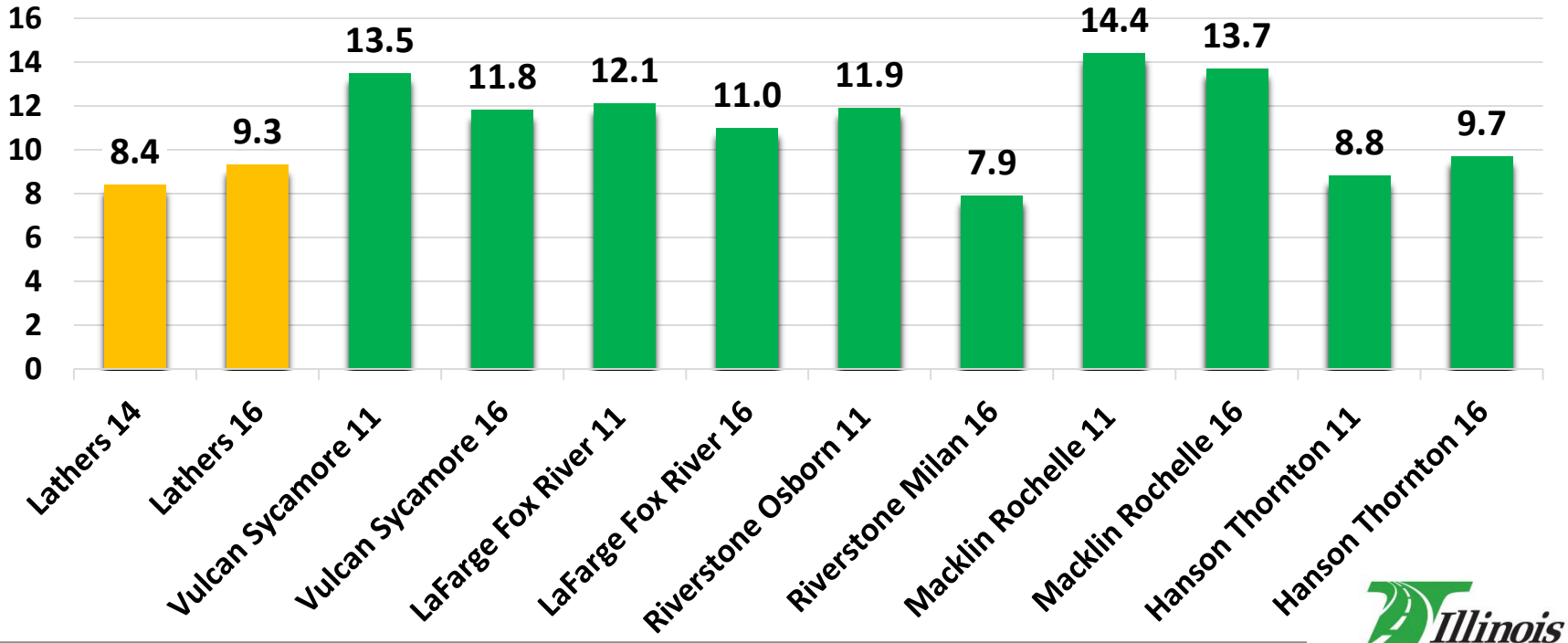
Micro-Deval Loss – Crushed Gravel



Micro-Deval Loss – Dolomite



Degradation Evaluation

- Aggregate substituted into an existing mix design at optimum asphalt content
- Samples gyrated to N_{max} = 225 gyrations
- Voids analysis
- Extraction gradation
- Hamburg of N_{225} samples - 20,000 cycles

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Degradation Evaluation

Control Aggregates		
	Michaels Quartzite	Lathers Crushed Gravel
N_{80} Voids	3.5	3.8
N_{225} Voids	2.2	2.0
P200, Loose	8.1	7.7
P200 @ N_{80}	9.3	9.2
P200 @ N_{225}	9.5	9.1

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Degradation Evaluation

Crushed Gravel			
	Beverly Elgin	**Meyer Algonquin**	**Thelen Antioch**
N_{80} Voids	3.6	3.1	3.2
N_{225} Voids	1.8	1.8	1.6
P200, Loose	8.1	7.7	7.8
P200 @ N_{80}	9.1	8.9	8.7
P200 @ N_{225}	9.4	9.4	9.1

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Degradation Evaluation

Dolomite				
	Riverstone	Macklin Rochelle	Vulcan Sycamore	Hanson Thornton
N_{80} Voids	3.6	3.8	3.7	3.8
N_{225} Voids	1.2	1.5	1.4	1.6
P200, Loose	8.1	8.1	8.1	8.1
P200 @ N_{80}	8.0	9.5	9.9	9.9
P200 @ N_{225}	9.4	10.8	10.0	10.6

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Degradation Evaluation

- Samples gyrated to N_{max} = 225 gyrations
- Hamburg of N_{225} samples – 20,000 cycles
- Inconclusive results – all mixes (quartzite, crushed gravel, dolomite) had rut depths between 2.52 and 3.17 mm

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Spec - Crushed Gravel for SMA

- **L.A. Abrasion – less than 28 percent loss**
- **Micro-Deval loss**
  - Single source: less than 12.0 percent
  - Coarse Aggregates: Design weighted average < 9.5 percent (includes coarse FRAP) – AOK, proceed with mix design
  - If design weighted average 9.5 to 11.9 percent:
    - Conduct mix design – optimum AC @ 3.5 percent Air Voids
    - Air voids at optimum AC and $N_{225} \geq 2.0$ percent

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How does this compare?

- **NCHRP 557 (aggregate tests for HMA) –**
  - M-D: Max loss of 15 recommended
- **AASHTO T327 (M-D for coarse aggregate)**
  - 17-18 for HMA surface course (Max 21 for lower courses)
- **AASHTO M325 (Standard for SMA)**
  - Max L.A. Abrasion = 30*

    * higher values have been successful

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Longitudinal Joint Performance

Longitudinal Joint Performance

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Thank You