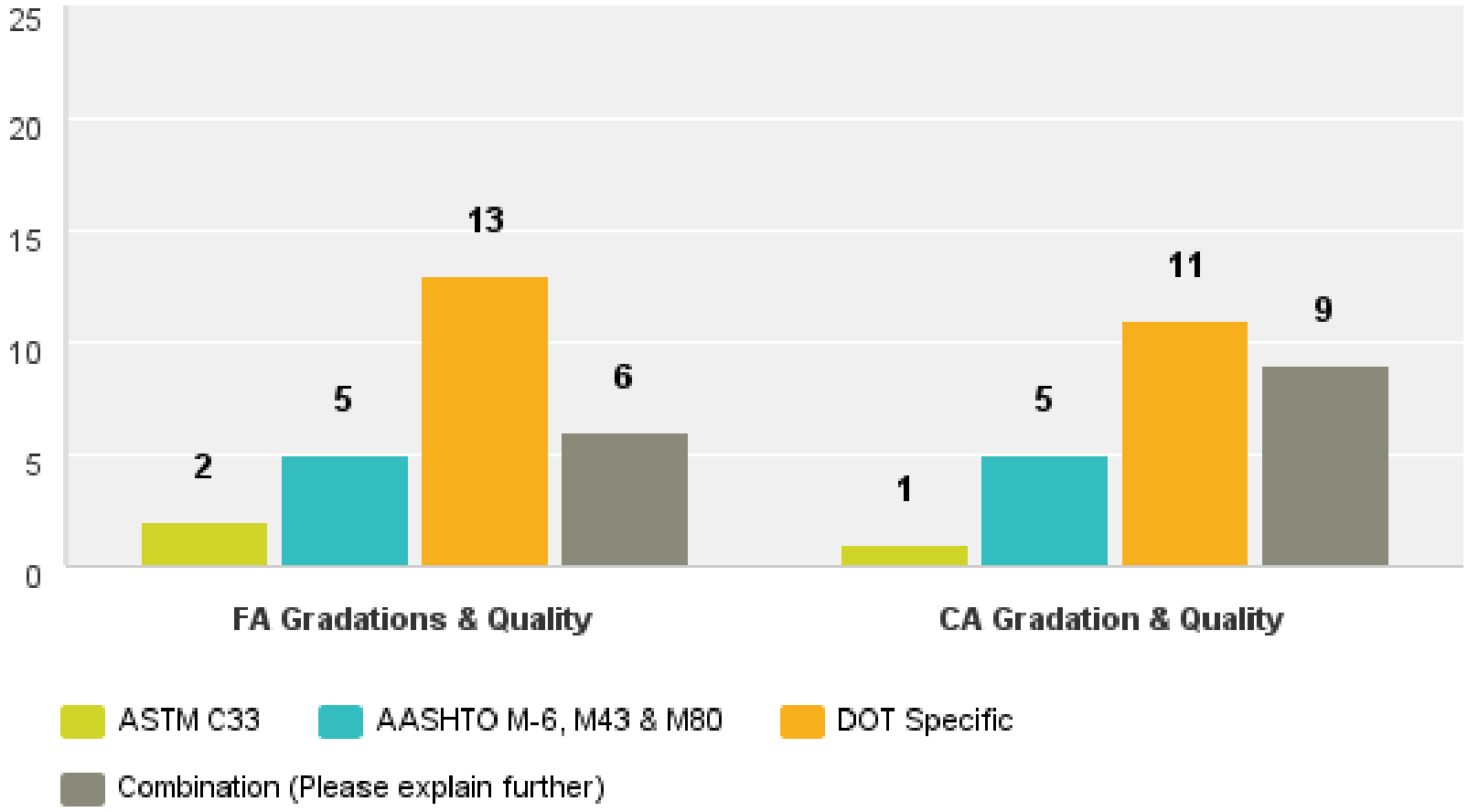
NCC AGGREGATE SURVEY

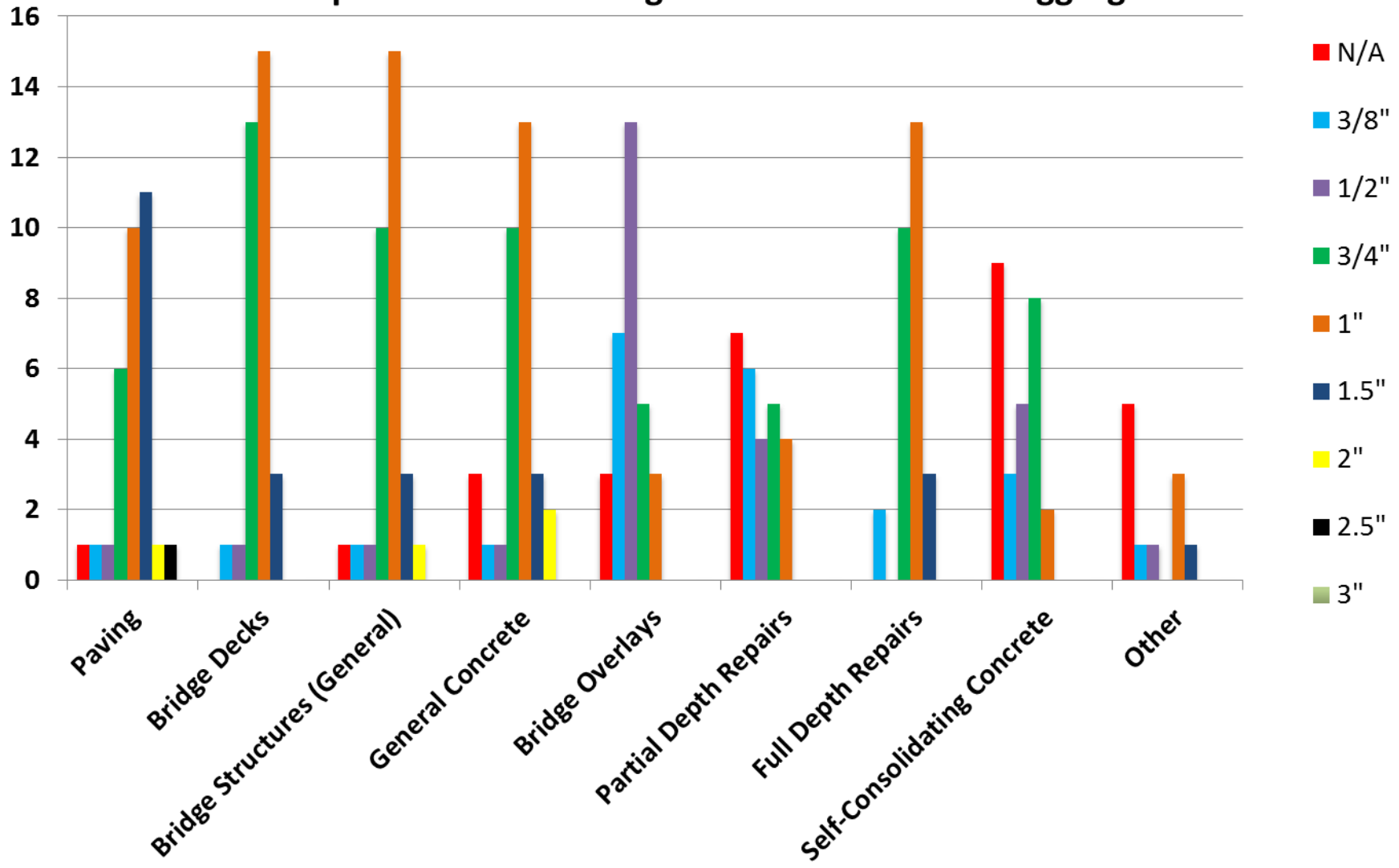
STATE REPORTS
FALL 2014 – OMAHA, NE

Q2 What specification do you follow for aggregate gradation requirements?

Answered: 26 Skipped: 1

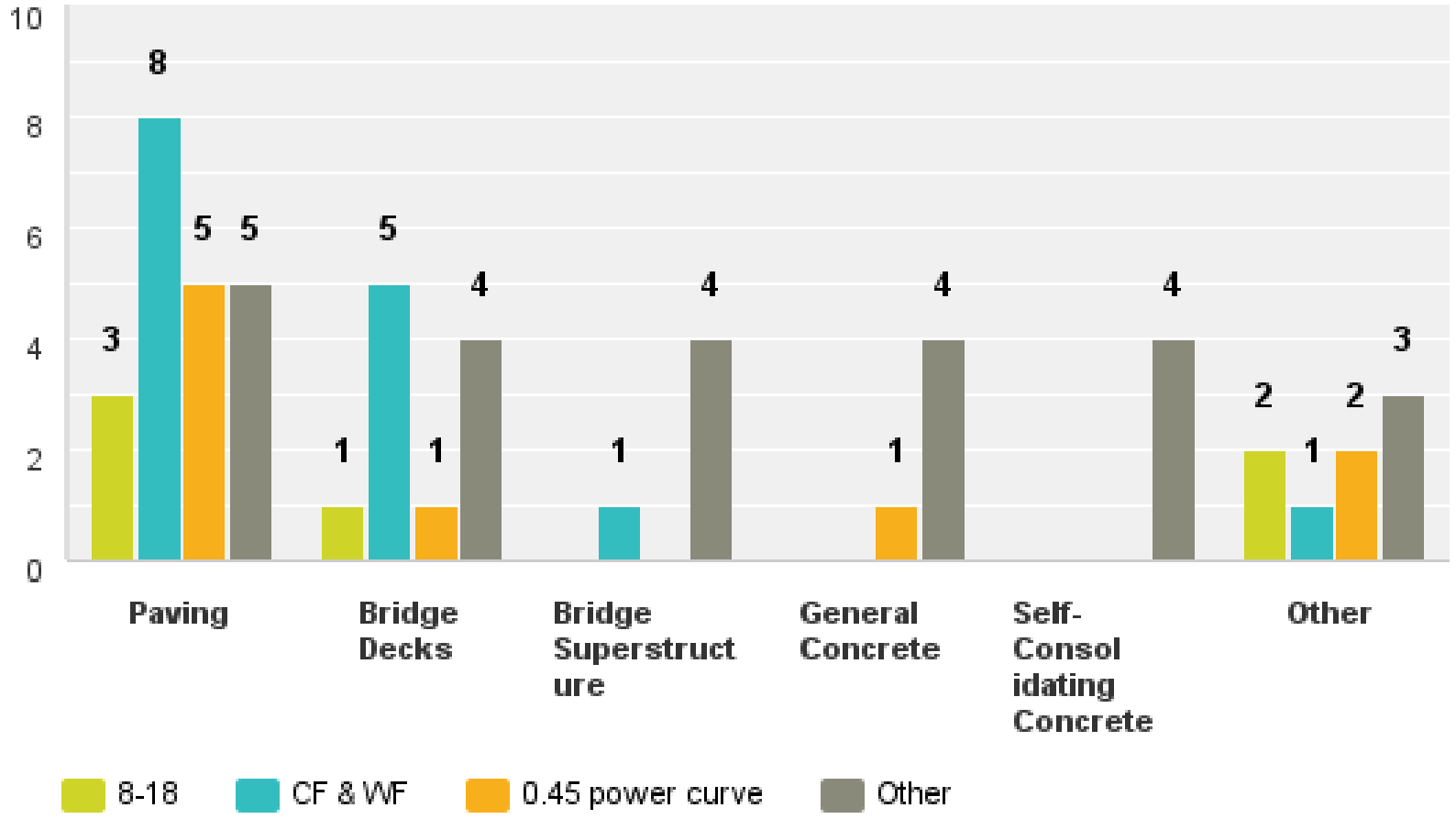


Q3: What is your nominal maximum aggregate size for different concrete applications? Nominal maximum aggregate size is defined at the top sieve size retaining 5% or more of coarse aggregate.



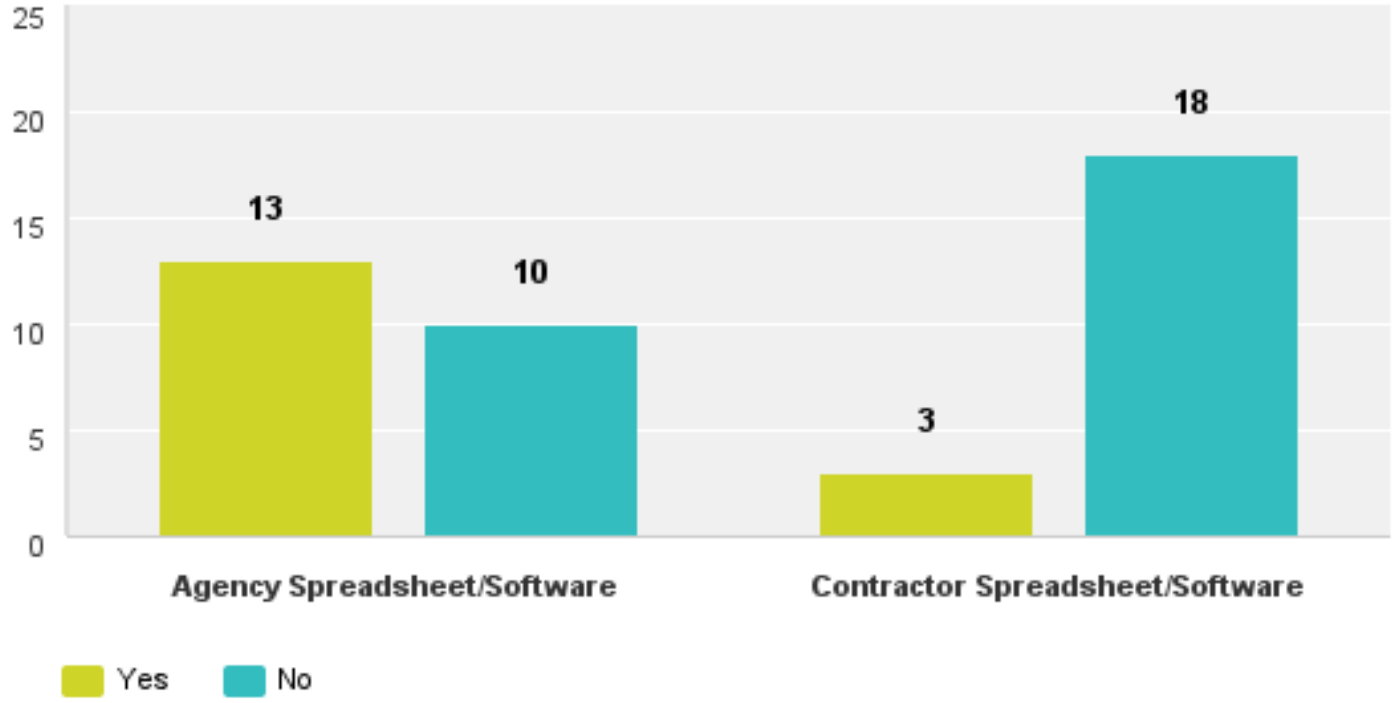
Q4 Do you require optimized gradations for any of your concrete mixes? Please check all that apply.

Answered: 17 Skipped: 10

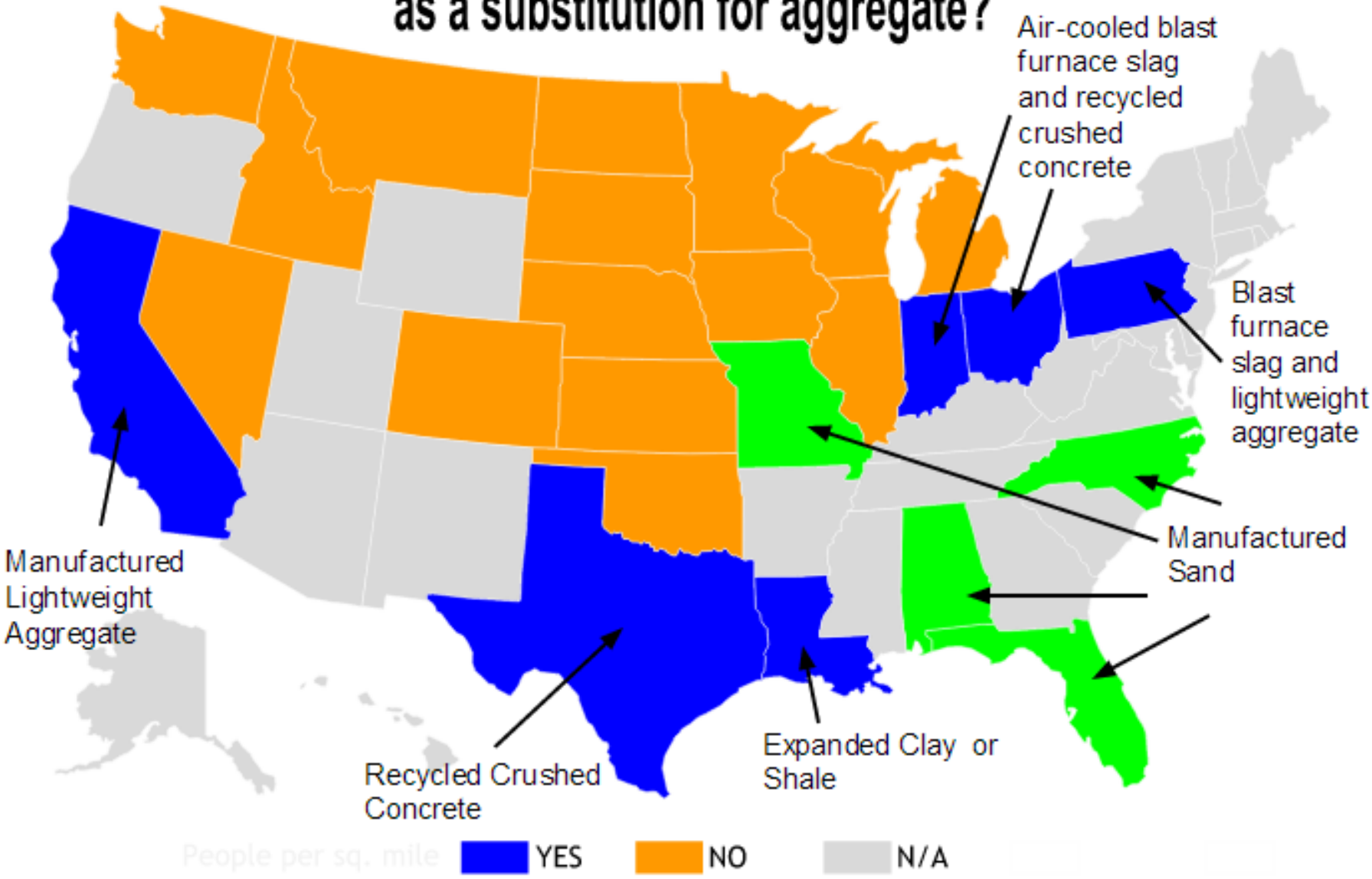


Q5 Do you have a spreadsheet or software that you use for optimized aggregate gradation mixes, and do you have one you require contractor to use? Please include a link to any spreadsheets/software for your optimized gradation spreadsheet/software that are available online.

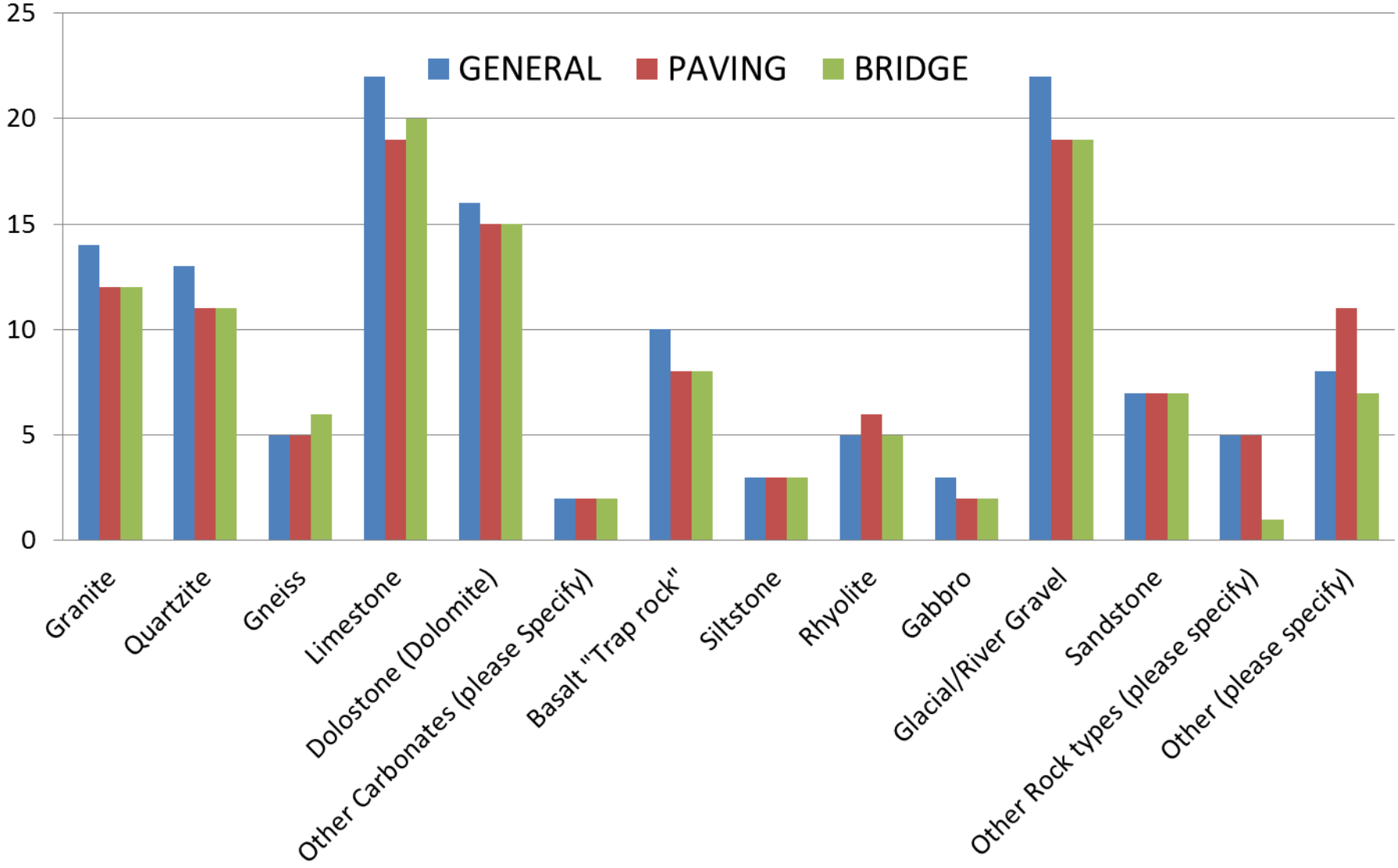
Answered: 24 Skipped: 3



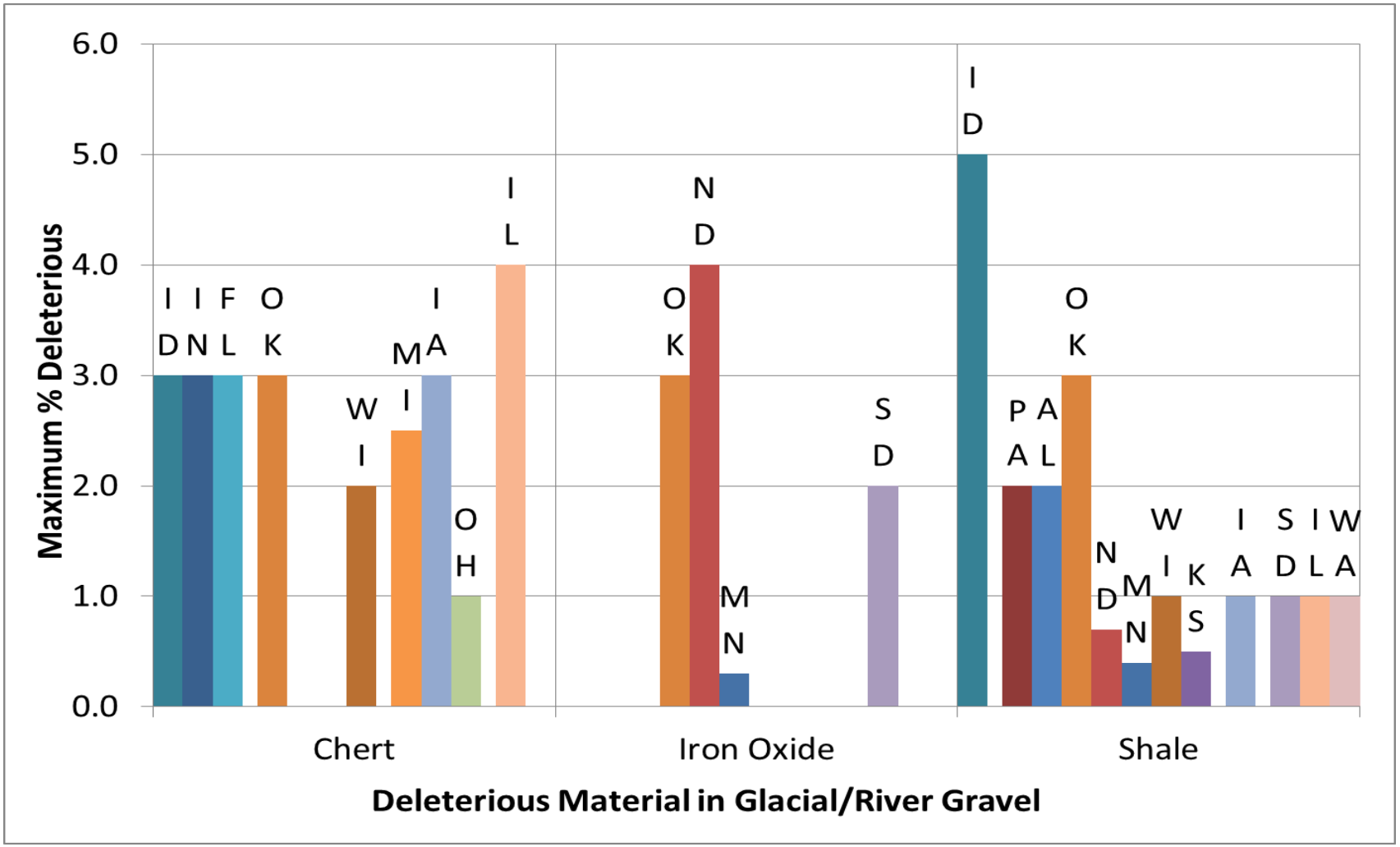
Q6: Do you allow any manufactured materials as a substitution for aggregate?



Q7, Q8, Q9: What types of coarse aggregates are used for CONCRETE in your state? Please check all that apply.

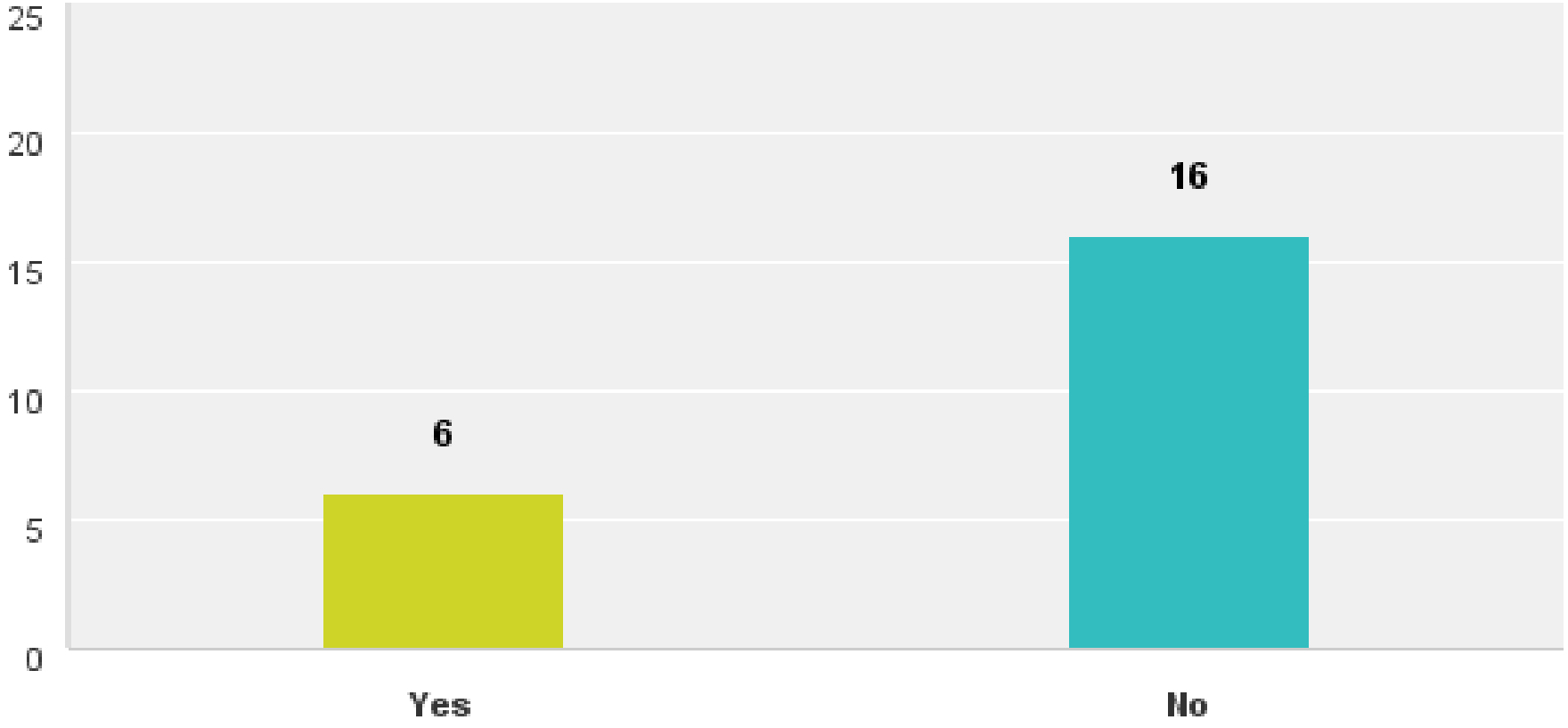


Q10: Within your Glacial /River Gravel what is the maximum % of the following (potentially) deleterious rock types do you allow?

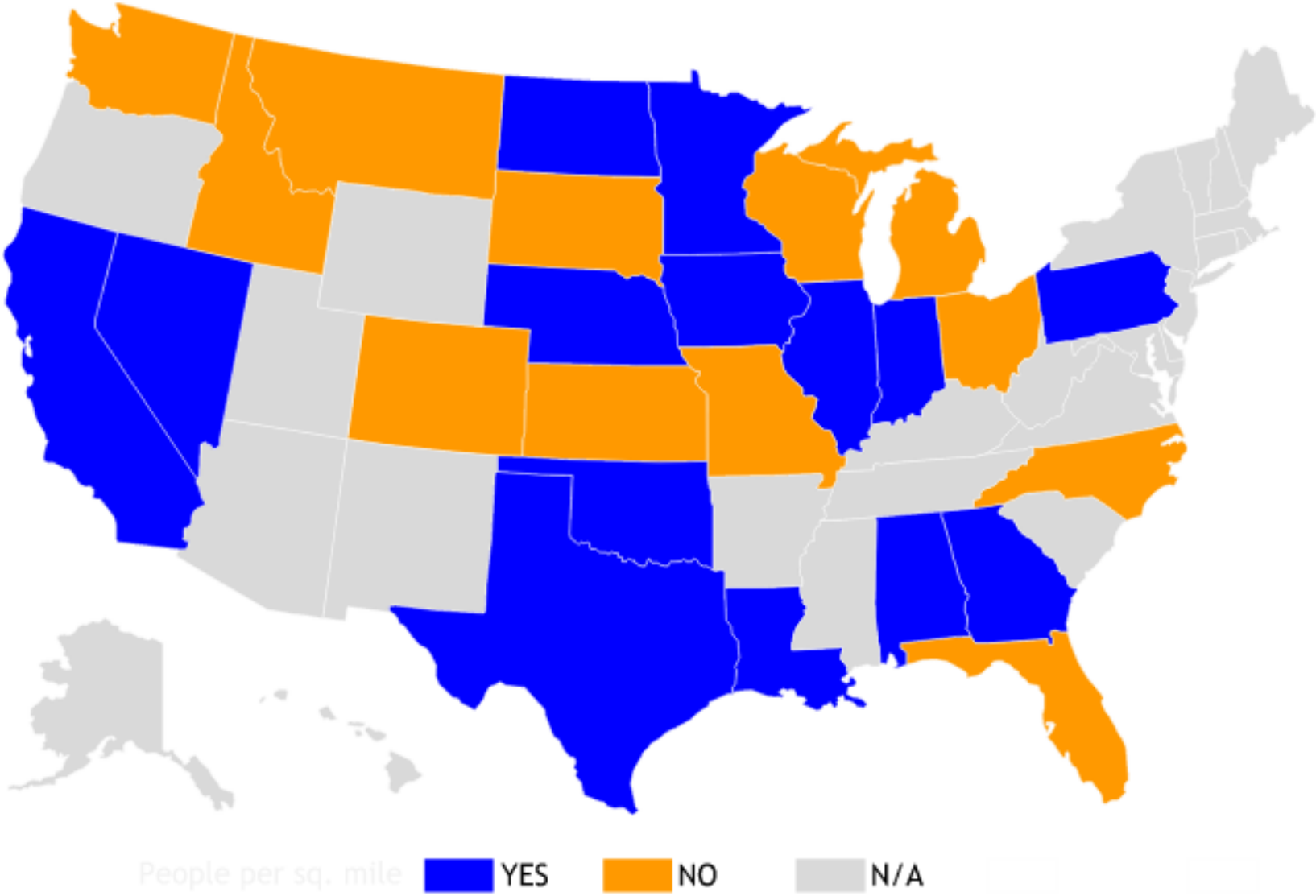


Q11 Within your Glacial /River Gravel, does the allowable % deleterious vary depending upon the use of the concrete?

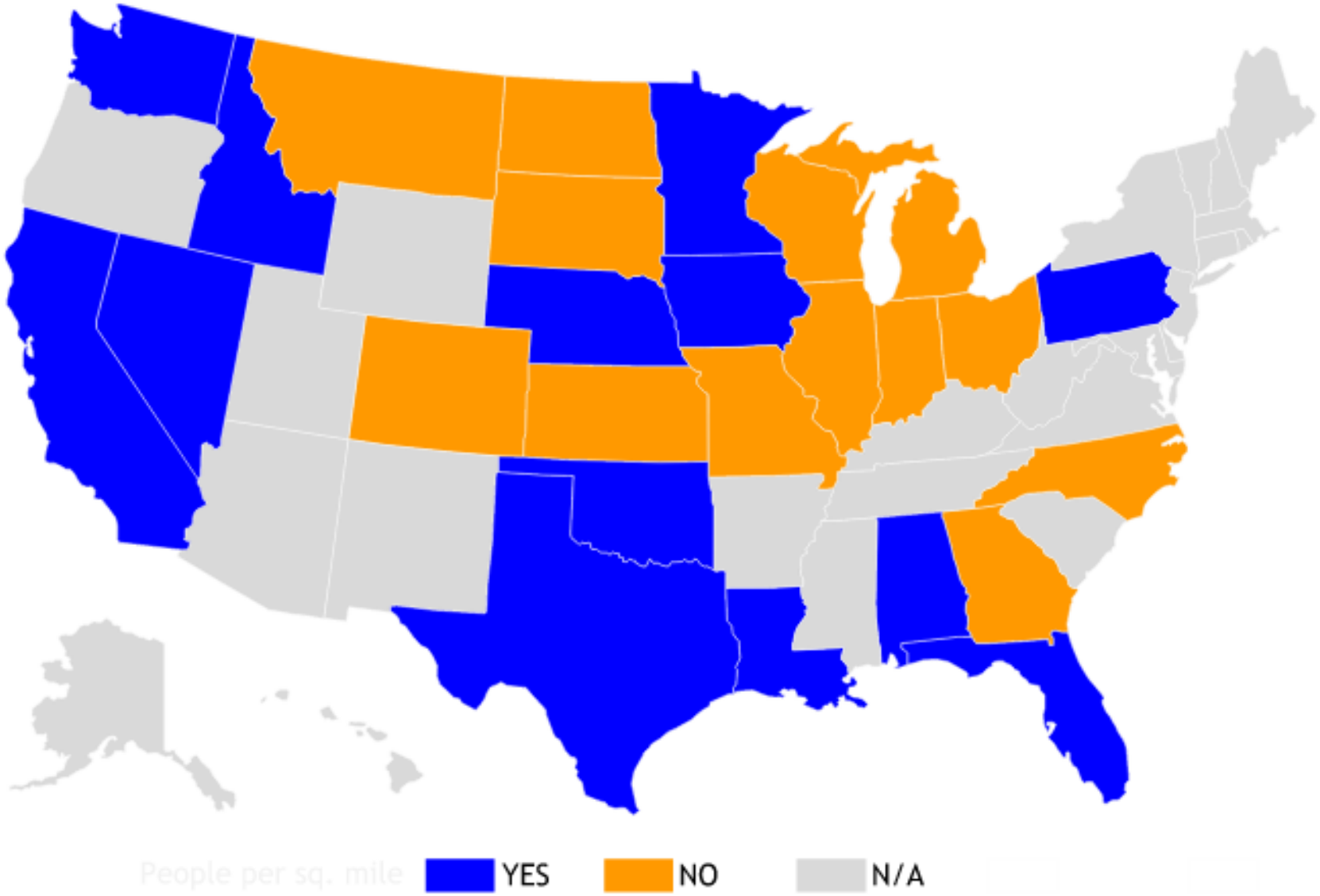
Answered: 22 Skipped: 5



Q12: Do you require washing the fine aggregate?

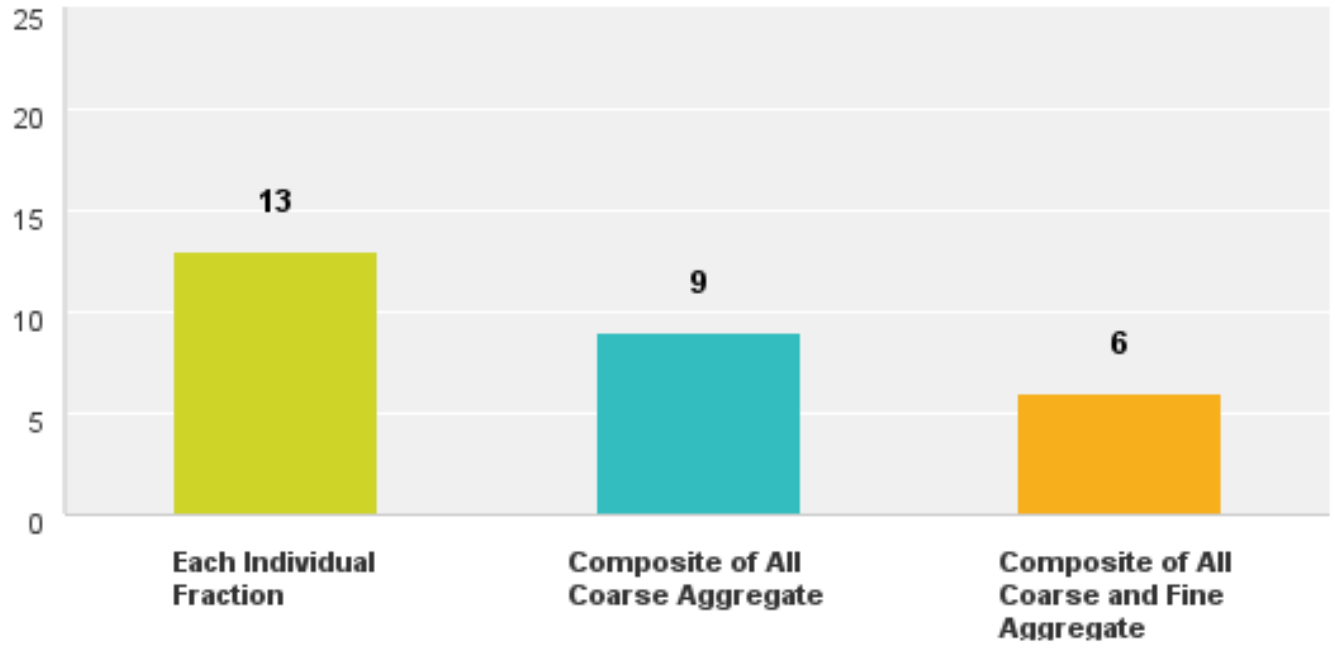


Q12: Do you require washing the coarse aggregate?

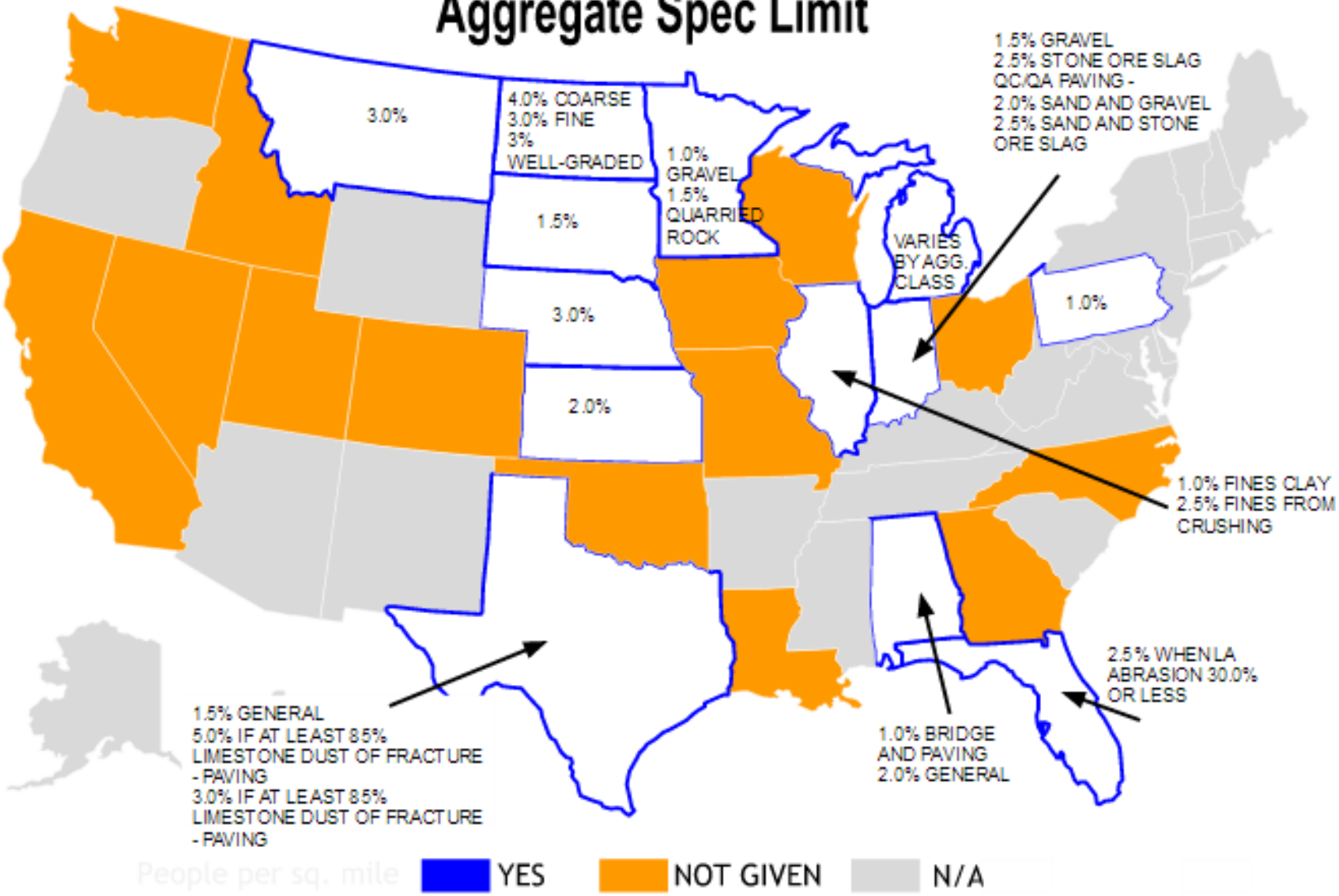


Q13 What is your specification for cleanliness of the coarse aggregate (% passing the #200 sieve)? Is it based on each individual fraction, a composite of all coarse aggregate, or a composite of all coarse and fine aggregate? Please specify your specification limit in the "Other" section below.

Answered: 26 Skipped: 1

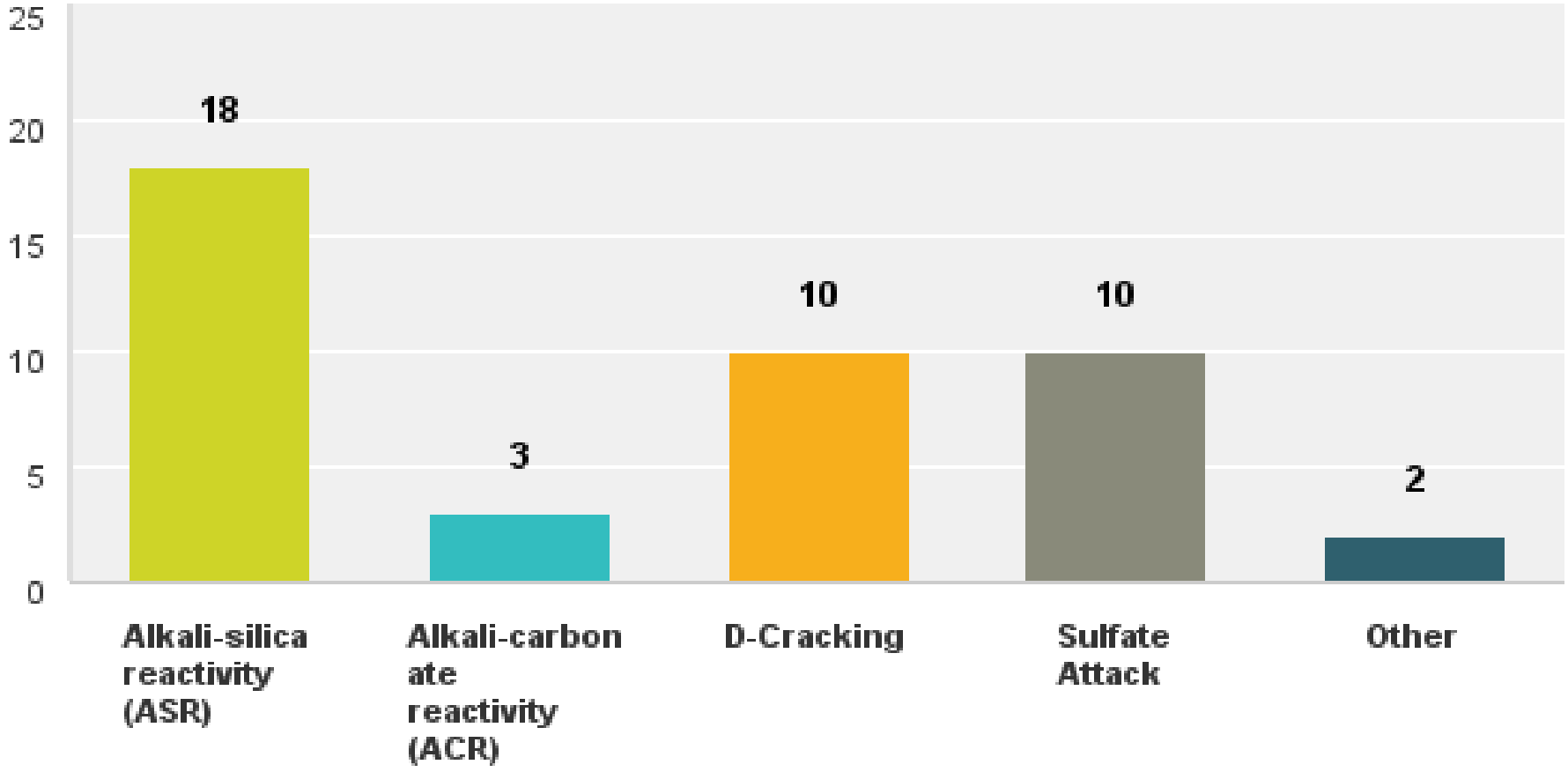


Q13: % Passing -#200 Sieve for Coarse Aggregate Spec Limit

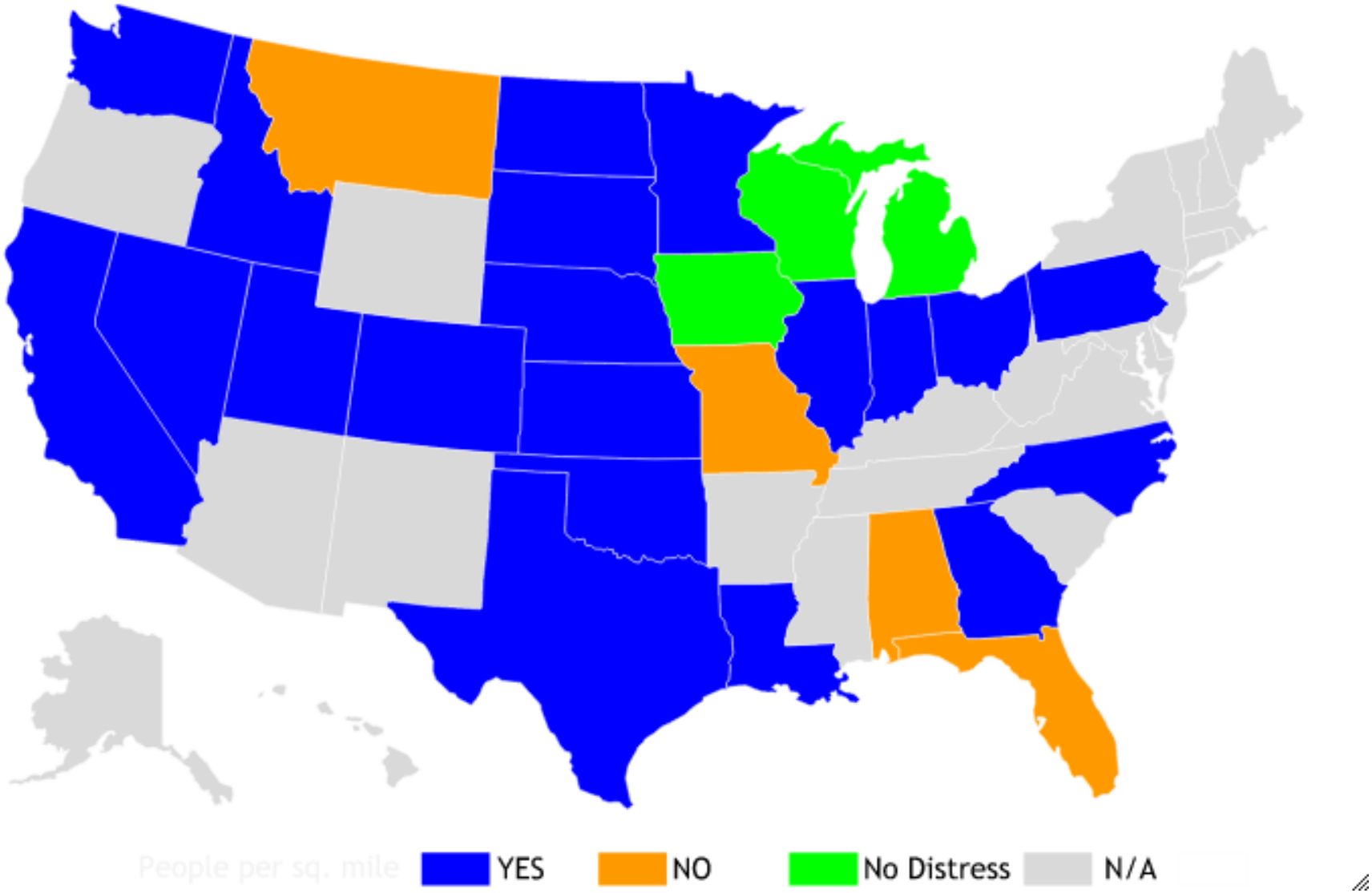


Q14 What types of Materials Related Distresses (MRD) does your DOT experience? Please check all that apply.

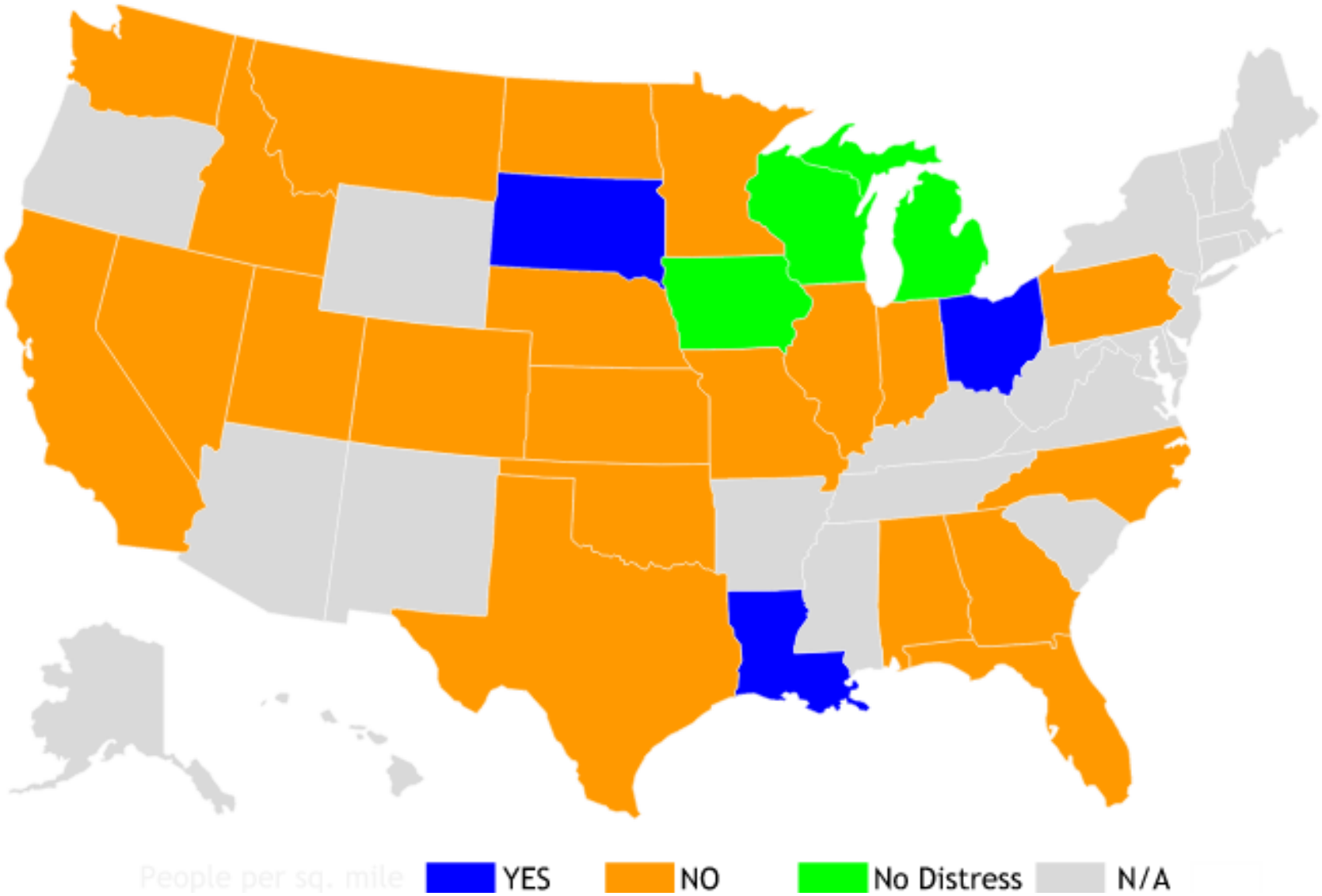
Answered: 24 Skipped: 3



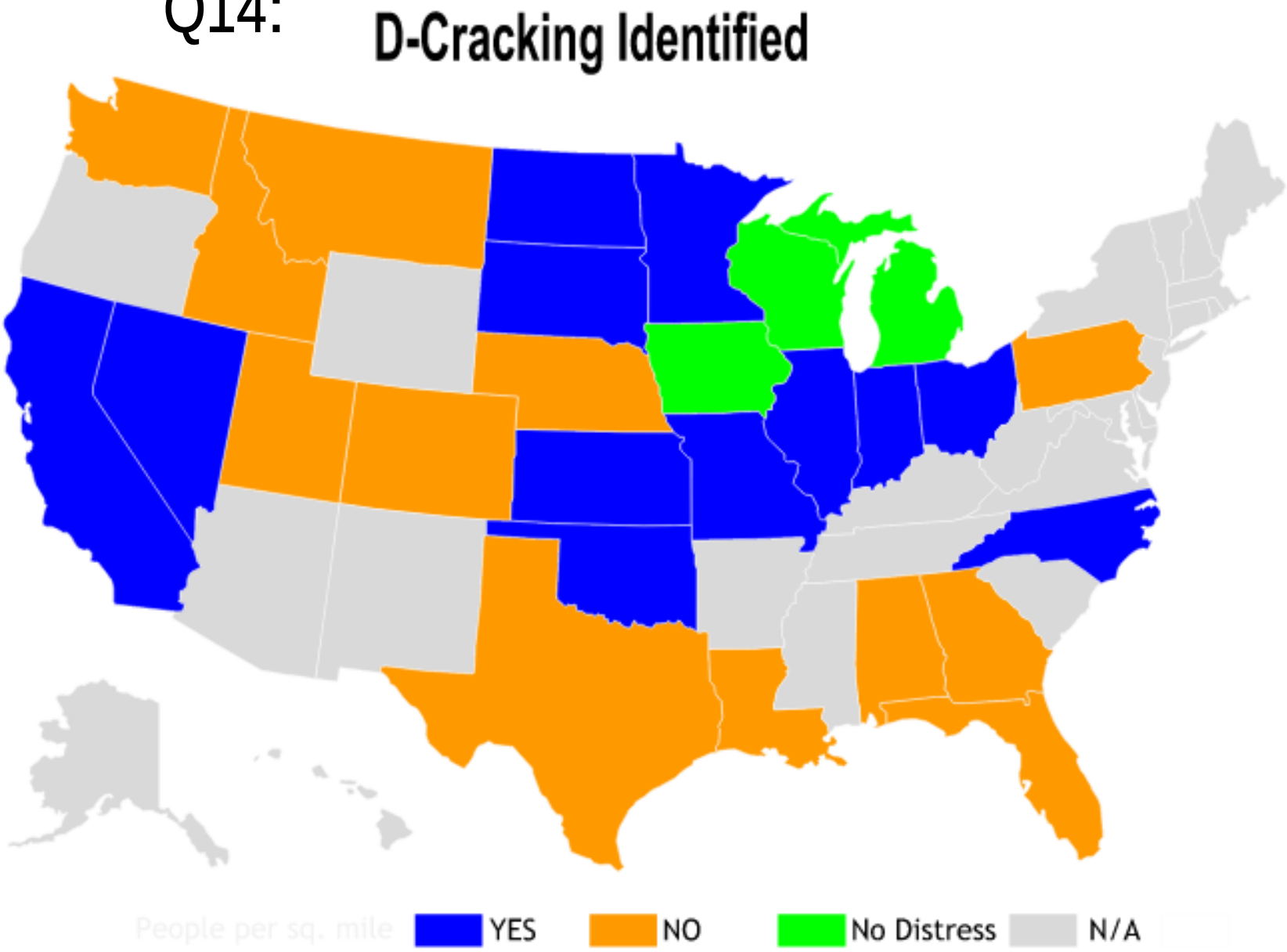
Q14: Alkali-Silica Reactivity (ASR) Identified



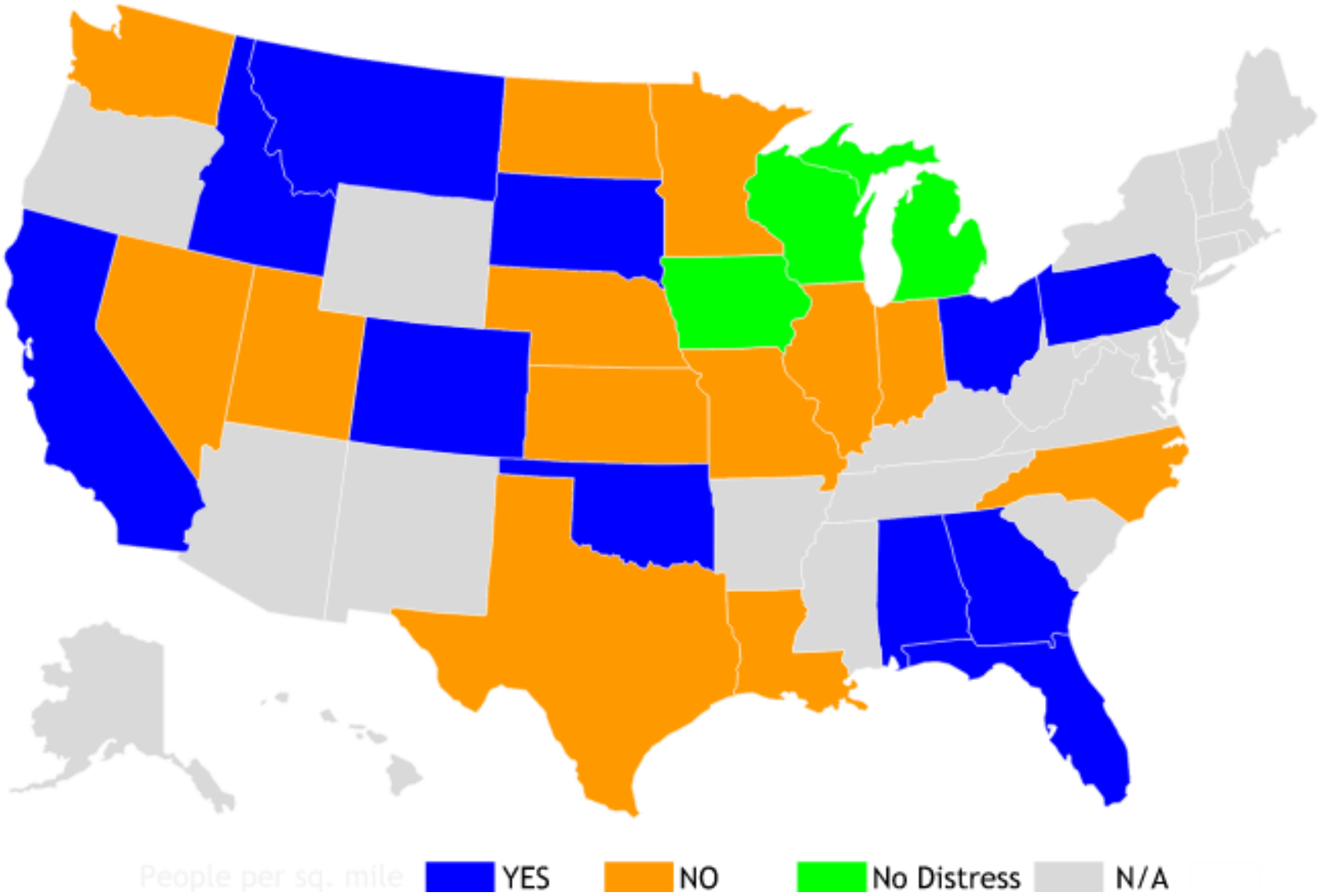
Q14: Alkali Carbonate Reactivity (ACR) Identified



Q14:

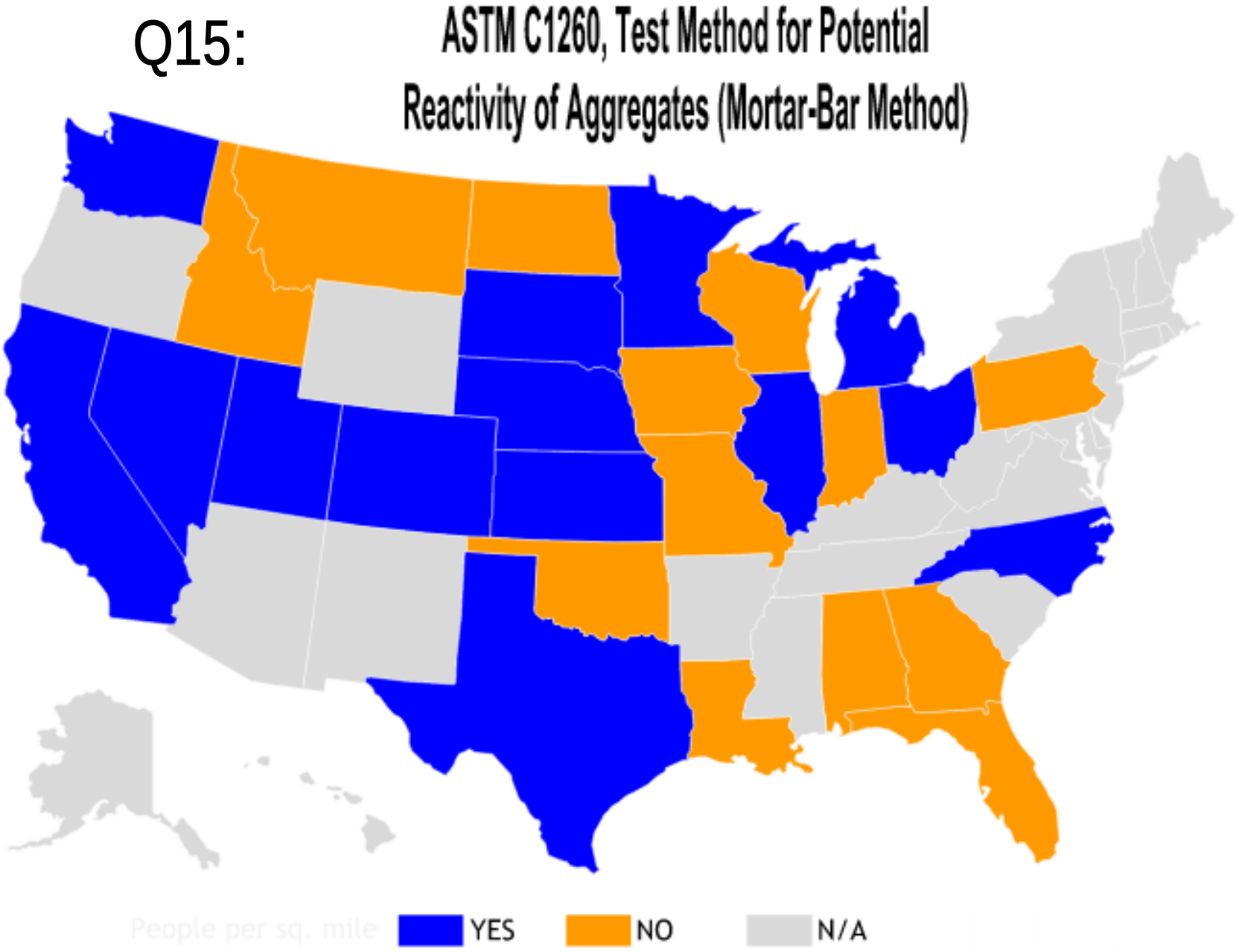

D-Cracking Identified
People per sq. mile
YES
NO
No Distress
N/A

Q14: Sulfate Distress Identified

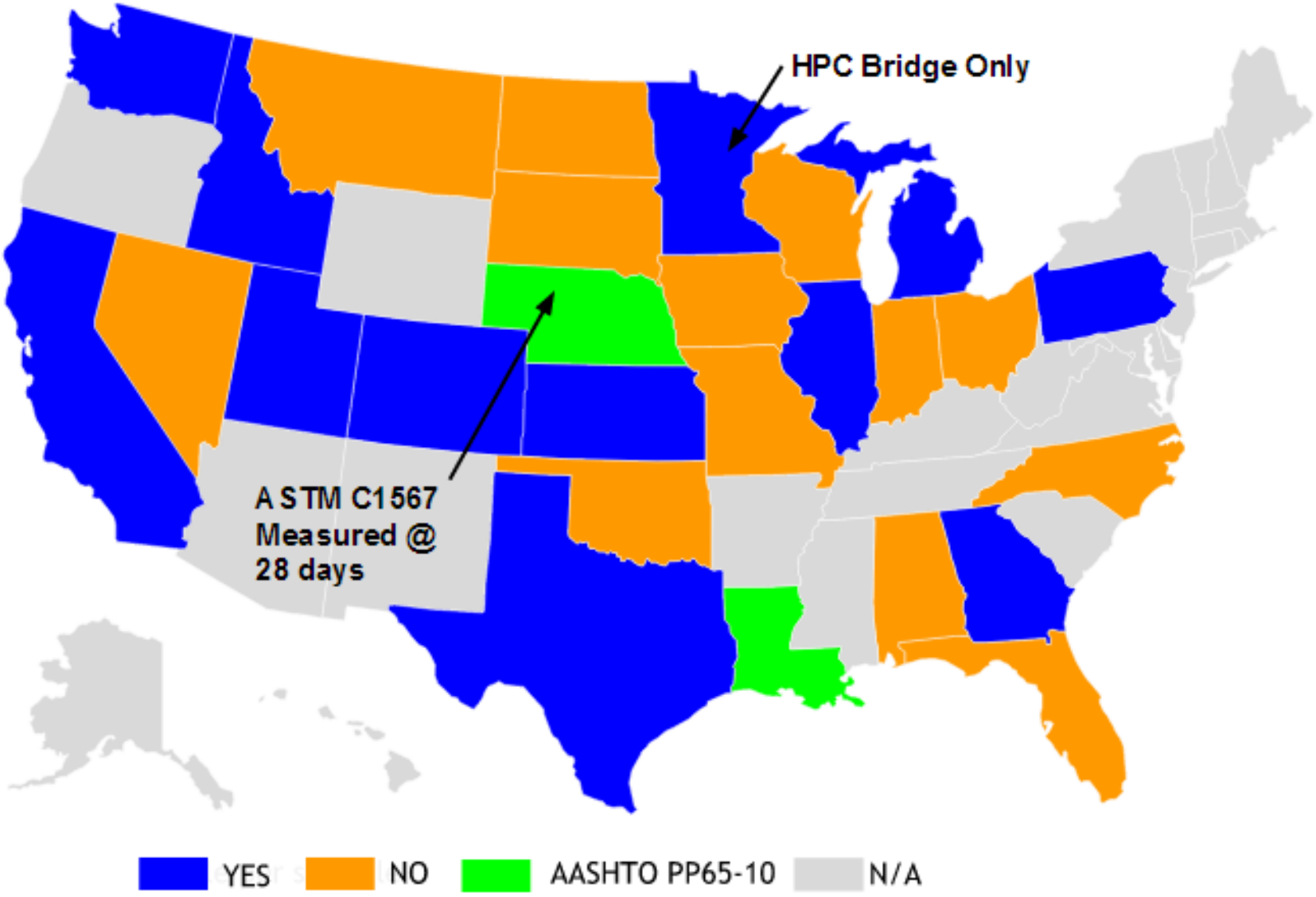


Q15: WHAT TYPES OF TESTS DO YOU PERFORM TO SCREEN POTENTIAL AGGREGATE DURABILITY OR REACTIVITY ISSUES?

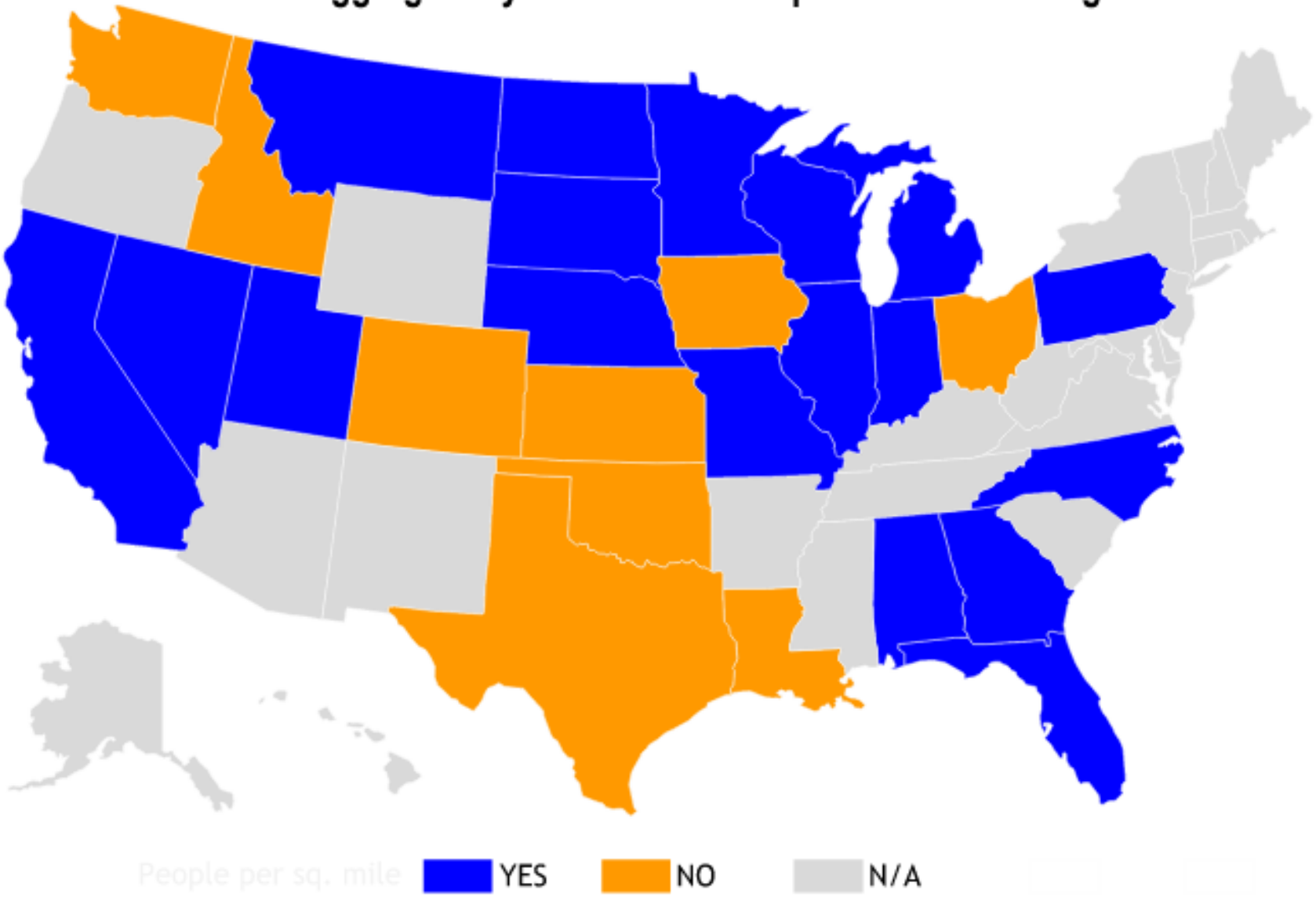
Q15:


ASTM C1260, Test Method for Potential
Reactivity of Aggregates (Mortar-Bar Method)
YES
NO
N/A

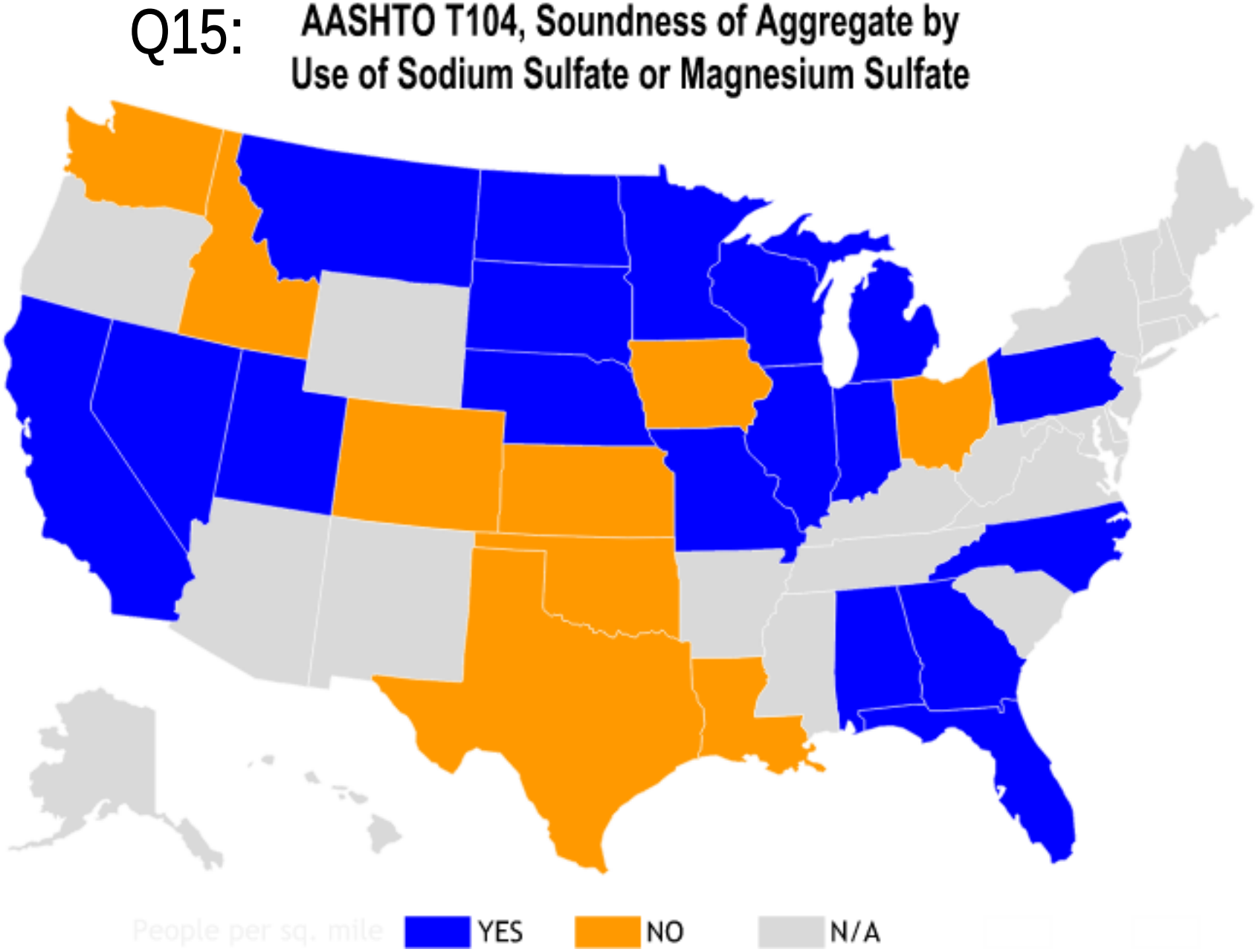
Q15: **ASTM C1567, Test Method for Determining the Potential Alkali-Silica Reactivity of Combinations of Cementitious Materials and Aggregate (Accelerated Mortar-Bar Method)**



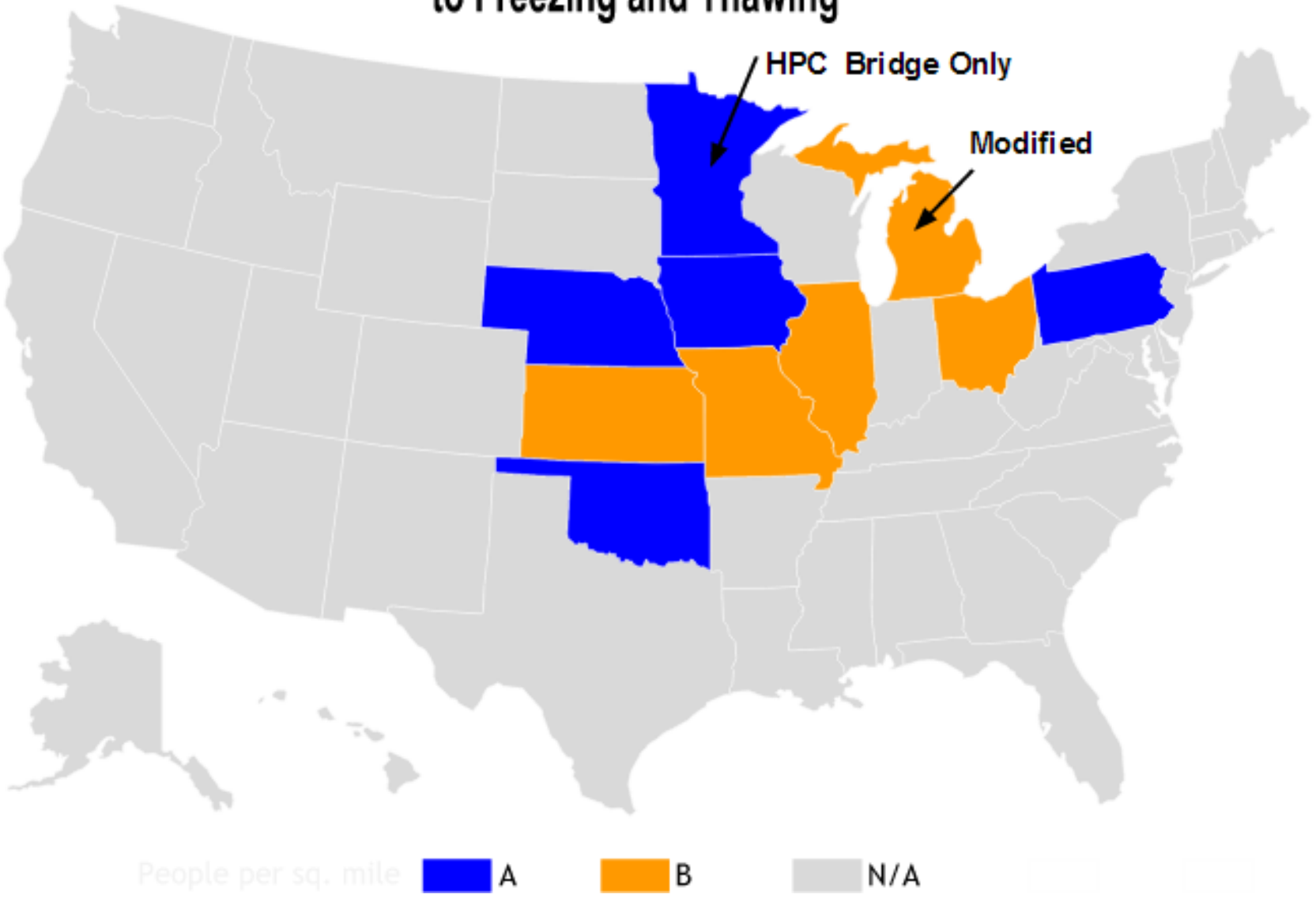
AASTHO T96/ASTM C 131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine



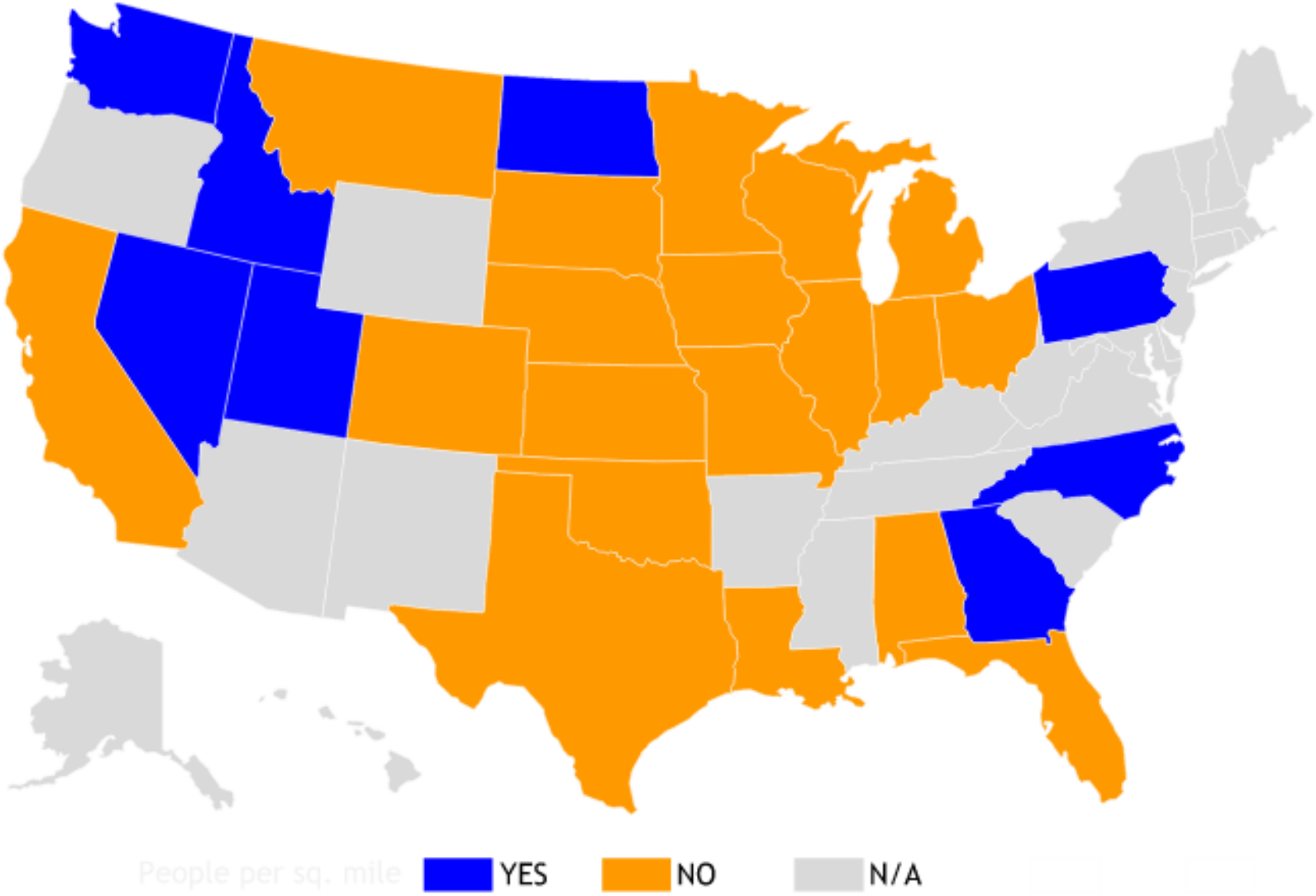
Q15:


AASHTO T104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate
YES
NO
N/A

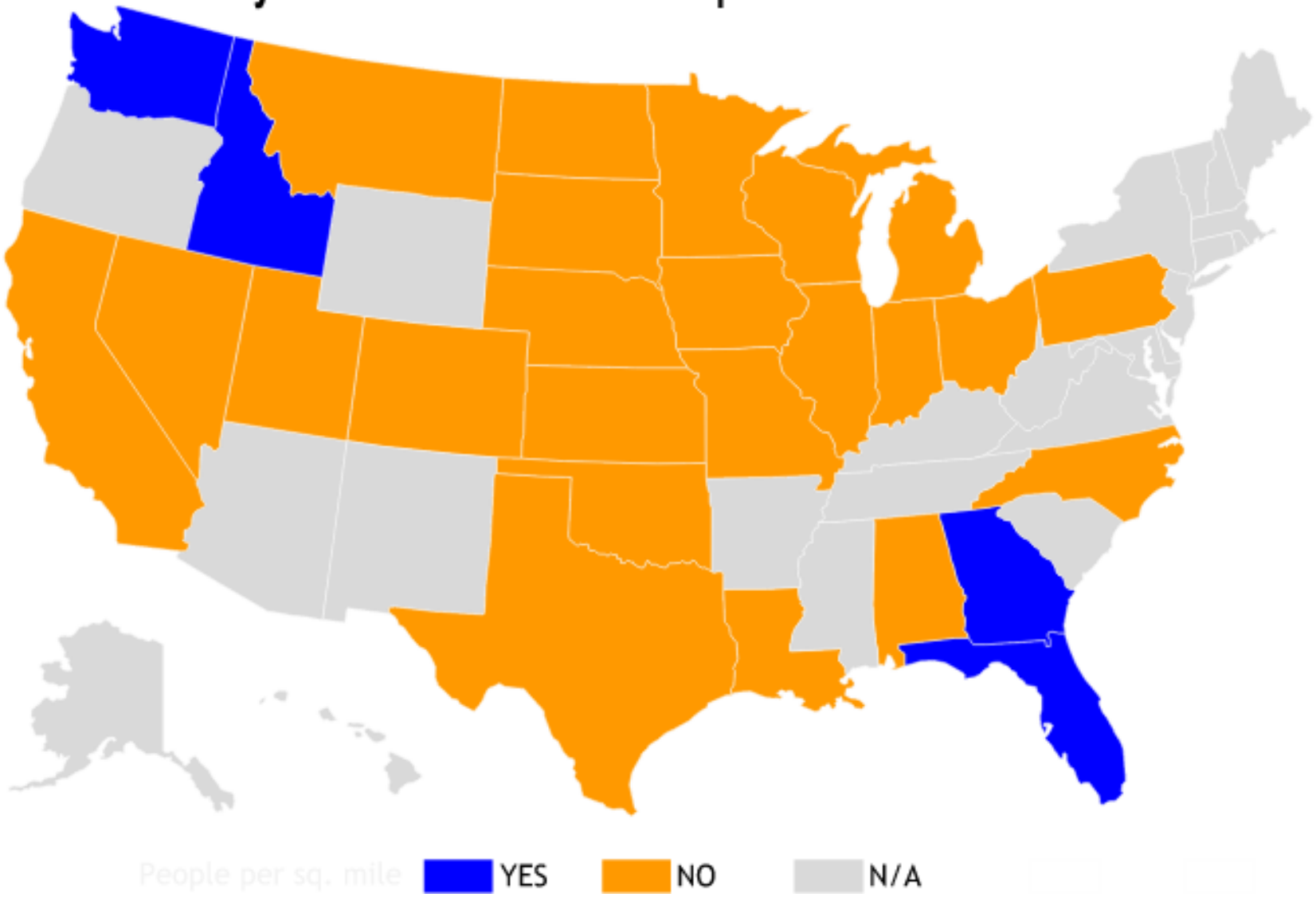
Q15: ASTM C666, Test Method for Resistance to Freezing and Thawing



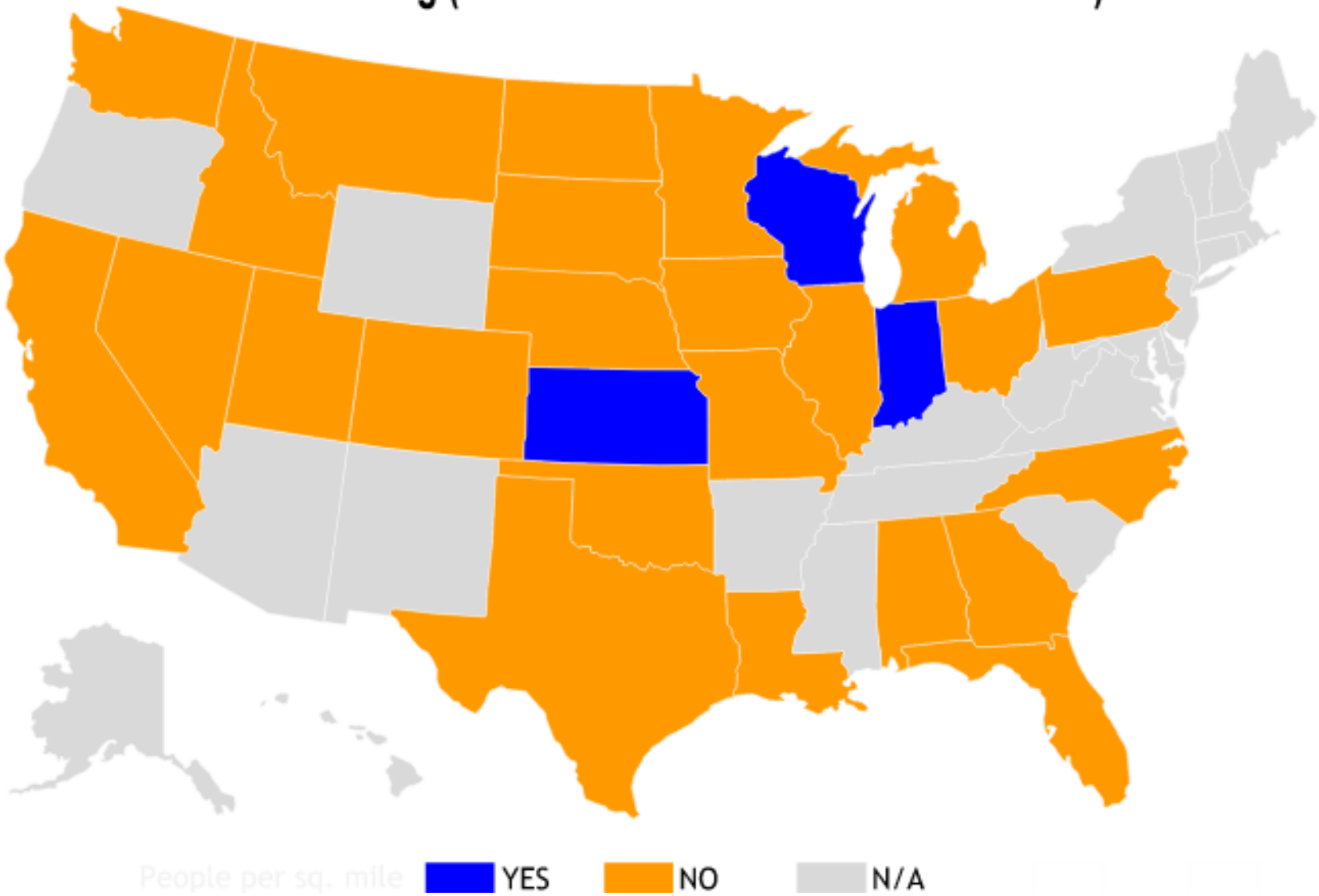
AASHTO T303, Accelerated Detection of Potentially Deleterious Expansion of Mortar Bars Due to Alkali-Silica Reaction



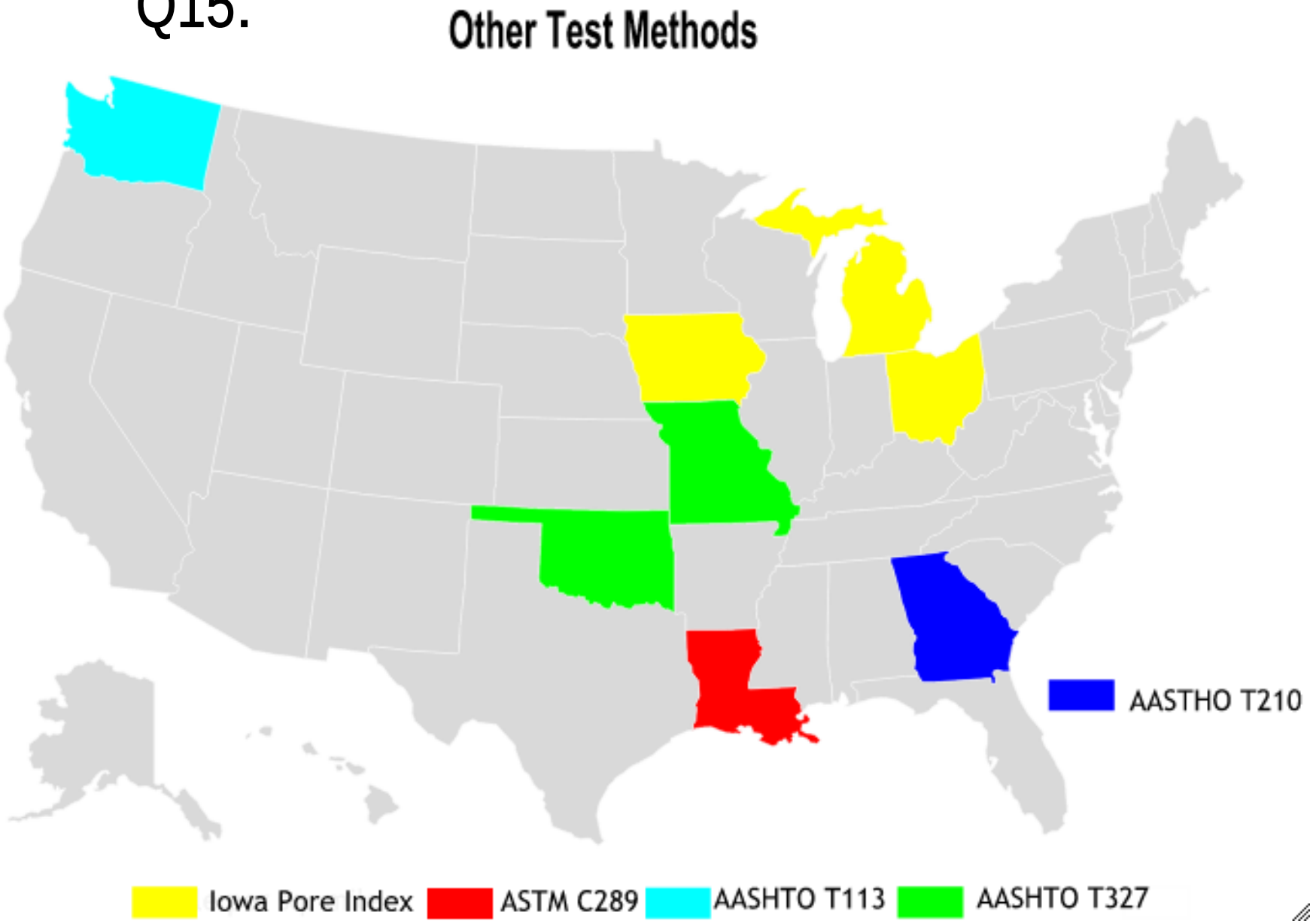
Q15: ASTM C1012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution



Q15: AASHTO T 103 Soundness of Aggregates by Freezing and Thawing (Procedure A Total Immersion in Water)



Q15:


Other Test Methods
AASTHO T210
Iowa Pore Index
ASTM C289
AASHTO T113
AASHTO T327

Iowa DOT – Quality Number for Durability

- Durability is based on various chemical testing (XRF and XRD) combined with pore index value to give an overall quality number.

Summary of all responses

- Bonus questions
  - Responses provided on back of handout

- Summary of all state responses available on the website along with all other meeting presentations (81 pages)

- http://www.cptechcenter.org/ncc/TTCC-NCC-2014.cfm

MINNESOTA DOT – AGGREGATE STATE REPORT

Maria Masten, MnDOT

MnDOT Aggregate Durability History

- Primary modes of failure:
  - D-cracking
  - Alkali-Silica Reactivity

MnDOT Mitigation of D-Cracking

- Extensive research was completed in the late 80's – early 90's including many field performance reviews.
- Determined that best method of mitigation was to limit the %carbonate in the gravel sources and the %absorption in the limestone sources
- MnDOT knew they were eliminating some acceptable sources

MnDOT Mitigation of D-Cracking

- New Specification Limits were as follows:
  - Natural Gravel Coarse Aggregate – Maximum of 30% carbonate
  - Limestone Coarse Aggregate – Maximum absorption of 1.75%
- Have looked at different methods to qualify aggregates
  - Freeze-thaw testing
  - Hydraulic fracture testing
  - Iowa Pore Index Test Method (current study)

MnDOT Mitigation of ASR

- In the mid 90's, MnDOT experienced some rapid deterioration of a fairly new (~7 years old) concrete pavement
- Additional investigation noted ASR type cracking
- MnDOT disallowed the use of certain types of quartzite, used pre-approved stockpiles for paving, performed ASTM C1293 on the more reactive coarse aggregates
- Established minimum SCM requirements based on ability to mitigate expansion in fine aggregate

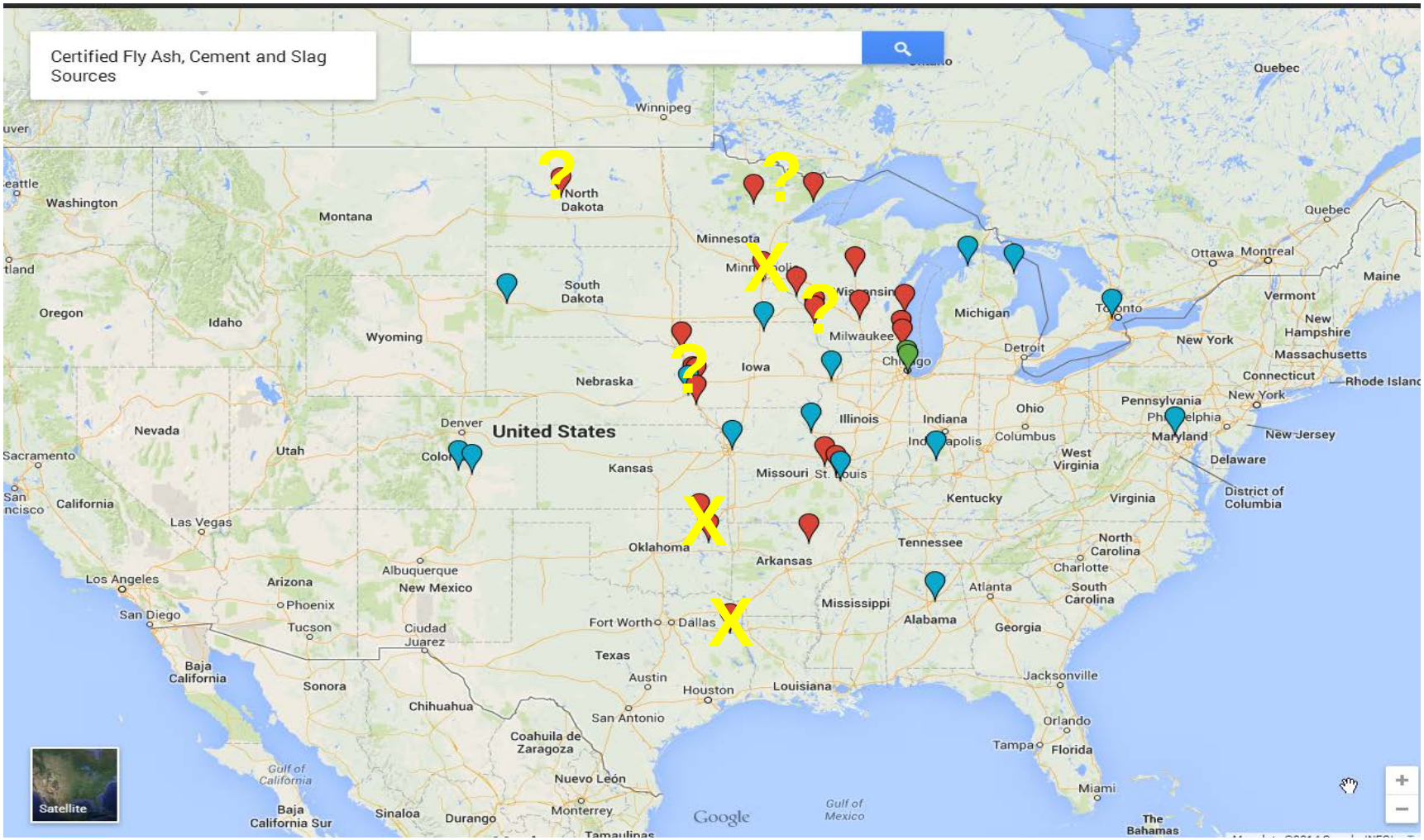
MnDOT Current Mitigation Requirements for ASR

Table 2301-2 Fine Aggregate ASR Mitigation Requirements	
14-day Fine Aggregate Expansion Limits	**Mitigation Requirement**
≤ 0.150	The Department will accept the fine aggregate with or without a mitigator
> 0.150 – 0.250	Mitigate the fine aggregate with 35 percent slag or at least 20 percent fly ash
> 0.250 – 0.300	Mitigate the fine aggregate with 35 percent slag or 30 percent fly ash in accordance with 3115, “Fly Ash for Use in Portland Cement Concrete,” modified with at least 66.0 percent SiO_2 + Fe_2O_3 + Al_2O_3 on a dry weight basis and at least 38.0 percent SiO_2
> 0.300	The Department will reject the fine aggregate

Transportation and Regulation Issues

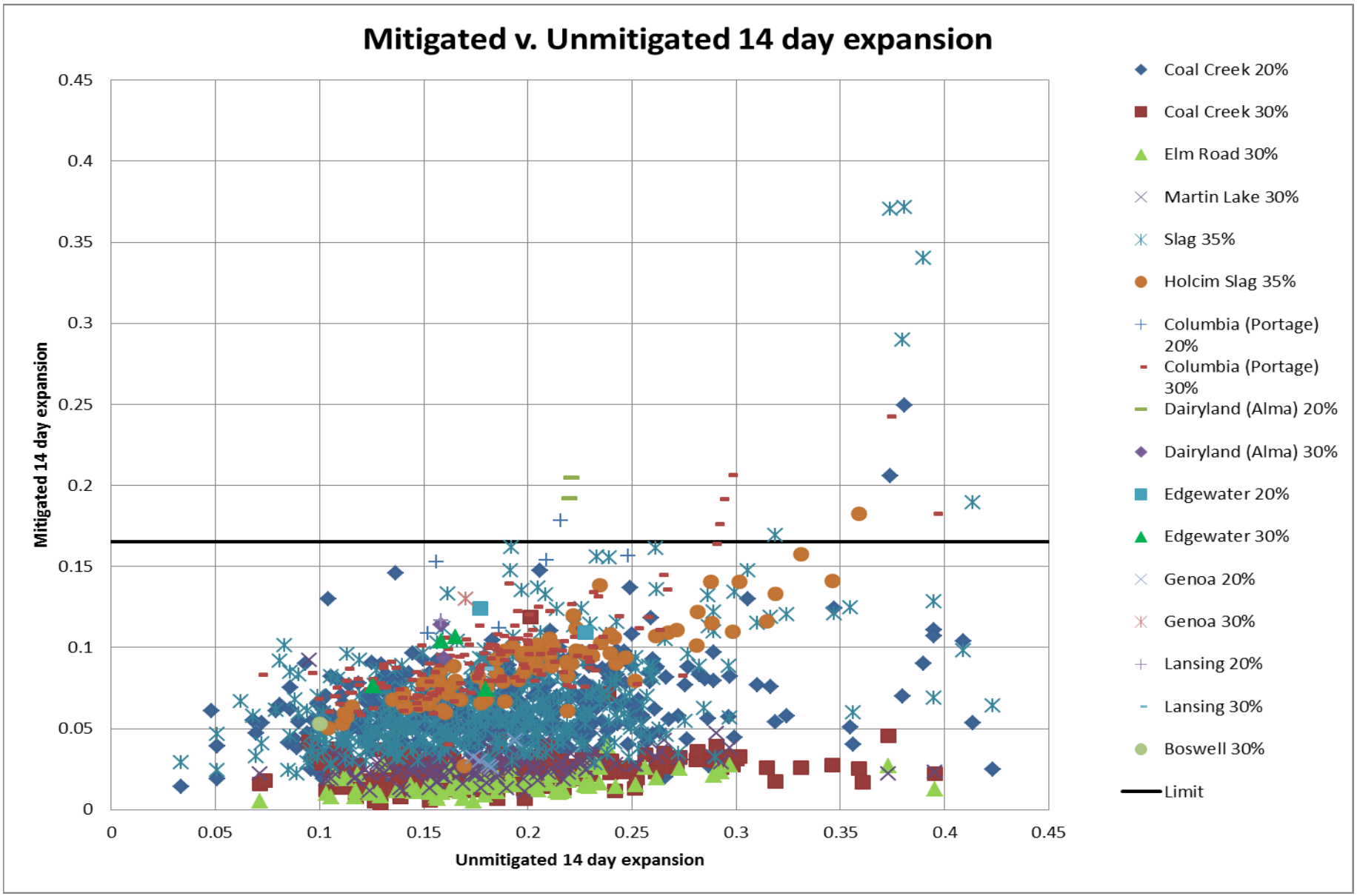
- The railroads are controlling supply to MN
- Delivery is unreliable (unless hauling unit trains (100+ cars)
- Delivering coal to power plant is not consistent either
- Conversion to natural gas
- Current Specifications push toward higher quality fly ash (Class F)

Current MnDOT Certified Sources

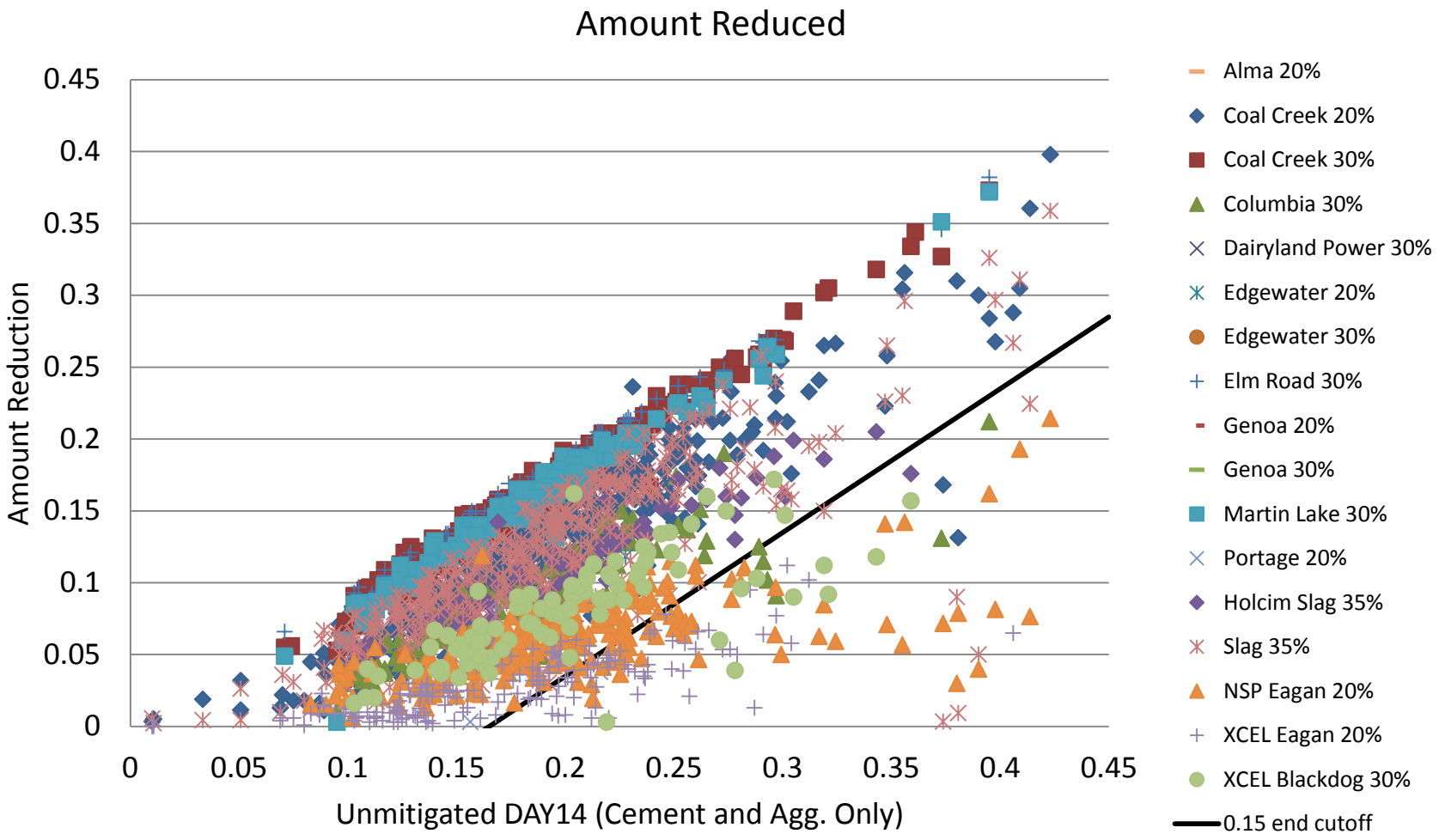


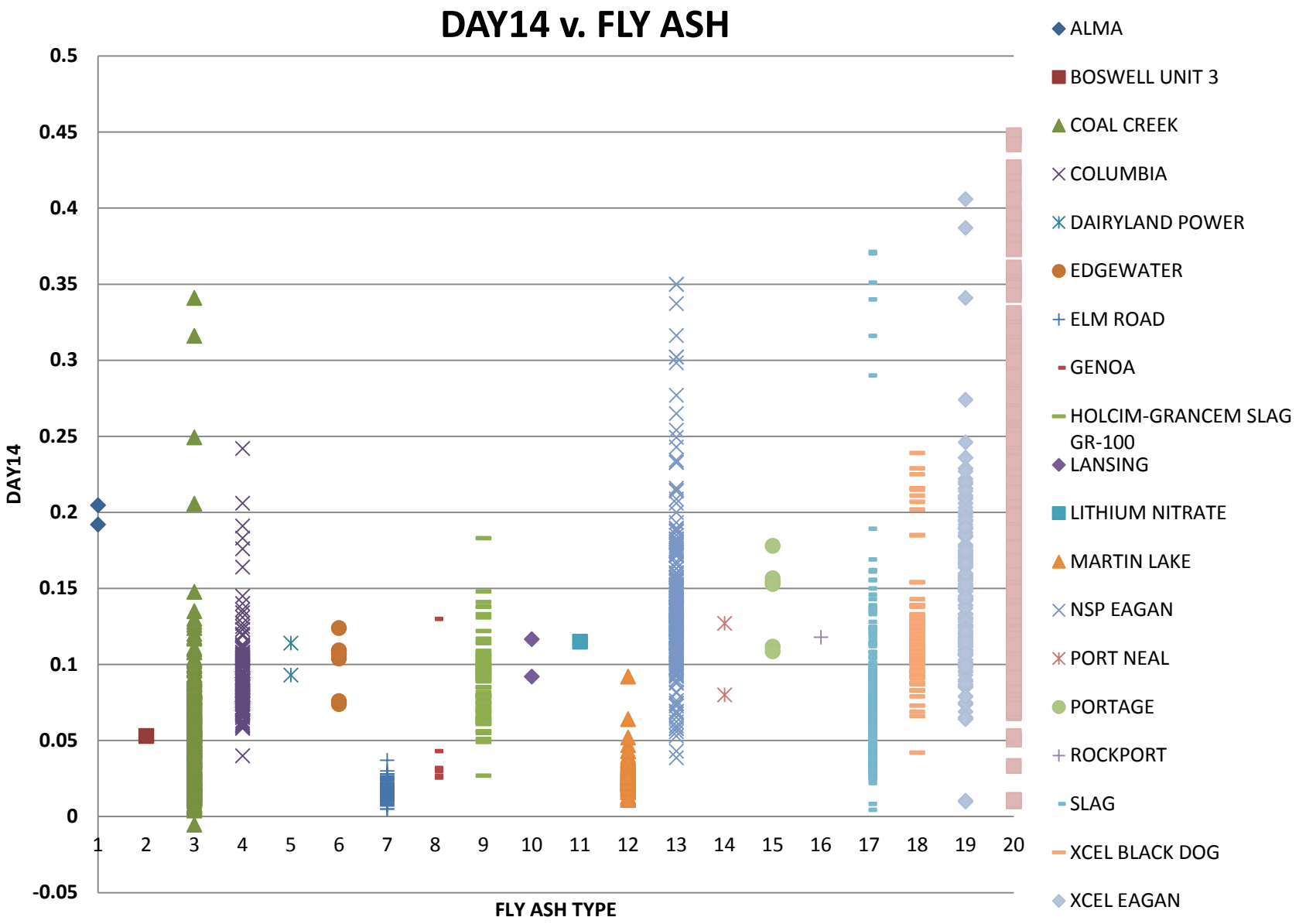
Current Efforts

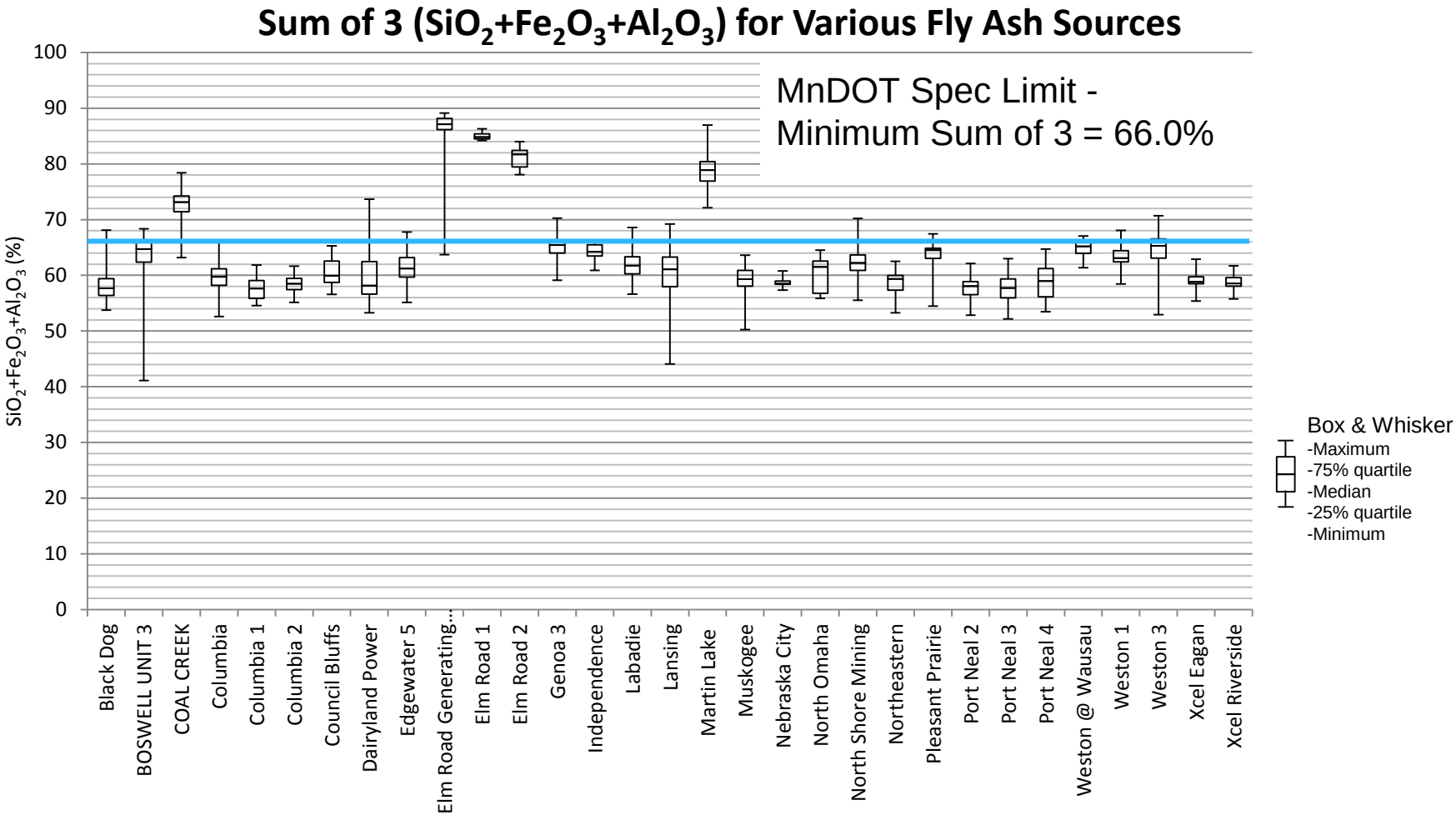
- MnDOT is re-evaluating our requirements for ASR mitigation
- Reviewed over 3400 tests ranging from 1999 – 2014
- ASTM C-1260 MnDOT Modified (14 day expansion)


Mitigated v. Unmitigated 14 day expansion
Mitigated 14 day expansion
Unmitigated 14 day expansion
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
0.45
Coal Creek 20%
Coal Creek 30%
Elm Road 30%
Martin Lake 30%
Slag 35%
Holcim Slag 35%
Columbia (Portage) 20%
Columbia (Portage) 30%
Dairyland (Alma) 20%
Dairyland (Alma) 30%
Edgewater 20%
Edgewater 30%
Genoa 20%
Genoa 30%
Lansing 20%
Lansing 30%
Boswell 30%
Limit

Mitigation Efforts of various SCM's




DAY14 v. FLY ASH
DAY14
0.5
0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
-0.05
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
17
18
19
20
FLY ASH TYPE
ALMA
BOSWELL UNIT 3
COAL CREEK
COLUMBIA
DAIRYLAND POWER
EDGEWATER
ELM ROAD
GENOA
HOLCIM-GRANCEM SLAG GR-100
LANSING
LITHIUM NITRATE
MARTIN LAKE
NSP EAGAN
PORT NEAL
PORTAGE
ROCKPORT
SLAG
XCEL BLACK DOG
XCEL EAGAN


Sum of 3 (SiO_2+Fe_2O_3+Al_2O_3) for Various Fly Ash Sources
MnDOT Spec Limit -
Minimum Sum of 3 = 66.0%
SiO_2+Fe_2O_3+Al_2O_3 (%)
100
90
80
70
60
50
40
30
20
10
0
Black Dog
BOSWELL UNIT 3
COAL CREEK
Columbia
Columbia 1
Columbia 2
Council Bluffs
Dairyland Power
Edgewater 5
Elm Road Generating...
Elm Road 1
Elm Road 2
Genoa 3
Independence
Labadie
Lansing
Martin Lake
Muskogee
Nebraska City
North Omaha
North Shore Mining
Northeastern
Pleasant Prairie
Port Neal 2
Port Neal 3
Port Neal 4
Weston @ Wausau
Weston 1
Weston 3
Xcel Eagan
Xcel Riverside
Box & Whisker
-Maximum
-75% quartile
-Median
-25% quartile
-Minimum

Current Efforts

- Reduce minimum SCM based upon ability to mitigate (less conservative – but more economical???)
- Fly Ash that meet the minimum Sum of 3 at 66% would only require 20% substitution instead of 30%
- What ternary options could be allowed?

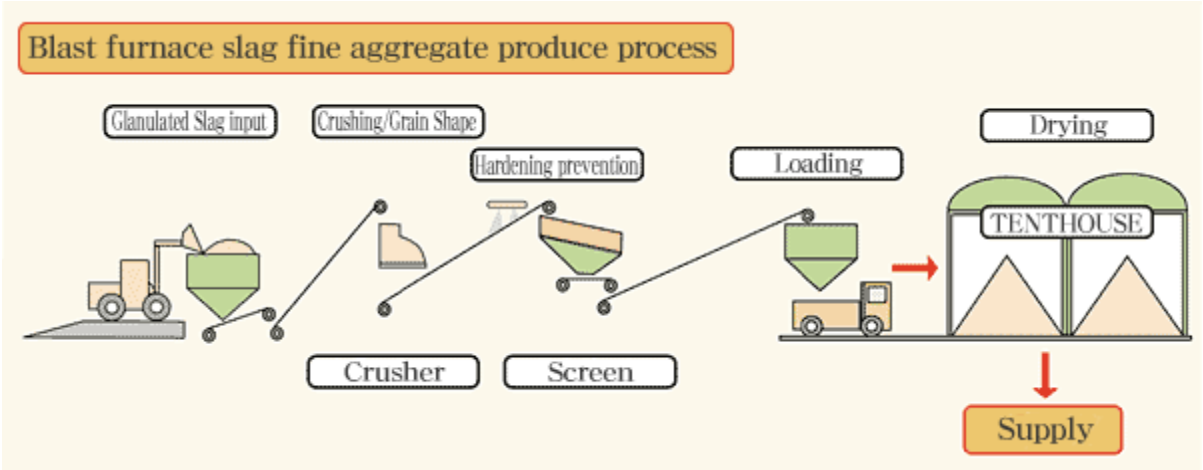
- This changes may ease the pain – but transportation issues will continue to be a battle.

INDIANA DOT – AGGREGATE STATE REPORT

Tony Zander, INDOT

Indiana DOT – Use of Manufactured Aggregates
Air cooled blast furnace slag

- Air cooled blast furnace slag is a by product from the steel mills.
- The slag can make up the entire coarse aggregate portion of the PCC.



Indiana DOT – Use of Manufactured Aggregates Recycled Concrete Coarse Aggregate

- INDOT is currently completing research to determine what amount of recycled concrete could be used as a partial substitution for the coarse aggregate.
- The current research project is SPR-3309 **"Using Recycled Concrete Aggregate in Concrete Pavements to Reduce Material Costs"**
- The specification for use of recycled concrete coarse aggregate has not been written.

Photo Credit: Herington Times

Indiana DOT – Use of Manufactured Aggregates Lightweight expanded shale or expanded slag

- Currently investigating the use of lightweight expanded shale or expanded slag as a partial substitution for fine aggregate in high performance bridge deck concrete.
- The purpose of the lightweight fine aggregate is to provide internal curing for the HPC.
- The material is a manufactured product that is not washed but the stockpiles will be wetted with sprinklers prior to delivery. Delivered material requires further pre-wetting (i.e. soaking) for 48 hours and then drained prior to batching in the HPC.
- INDOT has developed and Indiana Test Method (ITM 222) for determining SGF and absorption (lab & field)

Indiana DOT – Screening Procedures for Aggregate Durability

- Initial quality check follows AASHTO T 103, Procedure A; however, the Department may allow acceptance based on testing for Sodium Sulfate Soundness per AASHTO T 104 or Brine Freeze Thaw Soundness per ITM 209 (see following link to Indiana Test Methods) http://www.in.gov/indot/div/mt/itm/pubs/209_testing.pdf

Indiana DOT – Screening Procedures for Aggregate Durability

- For coarse aggregate used in PCCP the aggregate must meet the requirements of Freeze and Thaw Beam Expansion per ITM 210 (see following link to Indiana Test Methods) http://www.in.gov/indot/div/mt/itm/pubs/210_testing.pdf

Indiana DOT – Research Using Hydraulic Fracture as a screening tool

- INDOT is currently completing research to determine whether Aggregate F/T Durability can be measured by a hydraulic fracture test.
- The current research project is SPR-3402 **"Hydraulic Fracture Test (HFT) to Determine Aggregate Freeze-Thaw Durability**
- The degree of implementing a HFT procedure has yet to be determined, but may have value for evaluating the quality of recycled concrete as a coarse aggregate, as well as aggregate produced from a natural deposit.