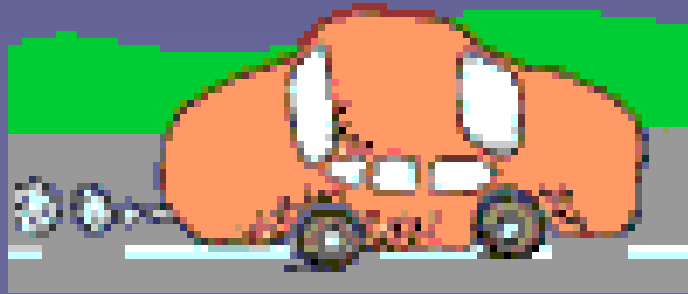


MnDOT's Experience with IRI Specifications



Spring 2013 NCC Meeting

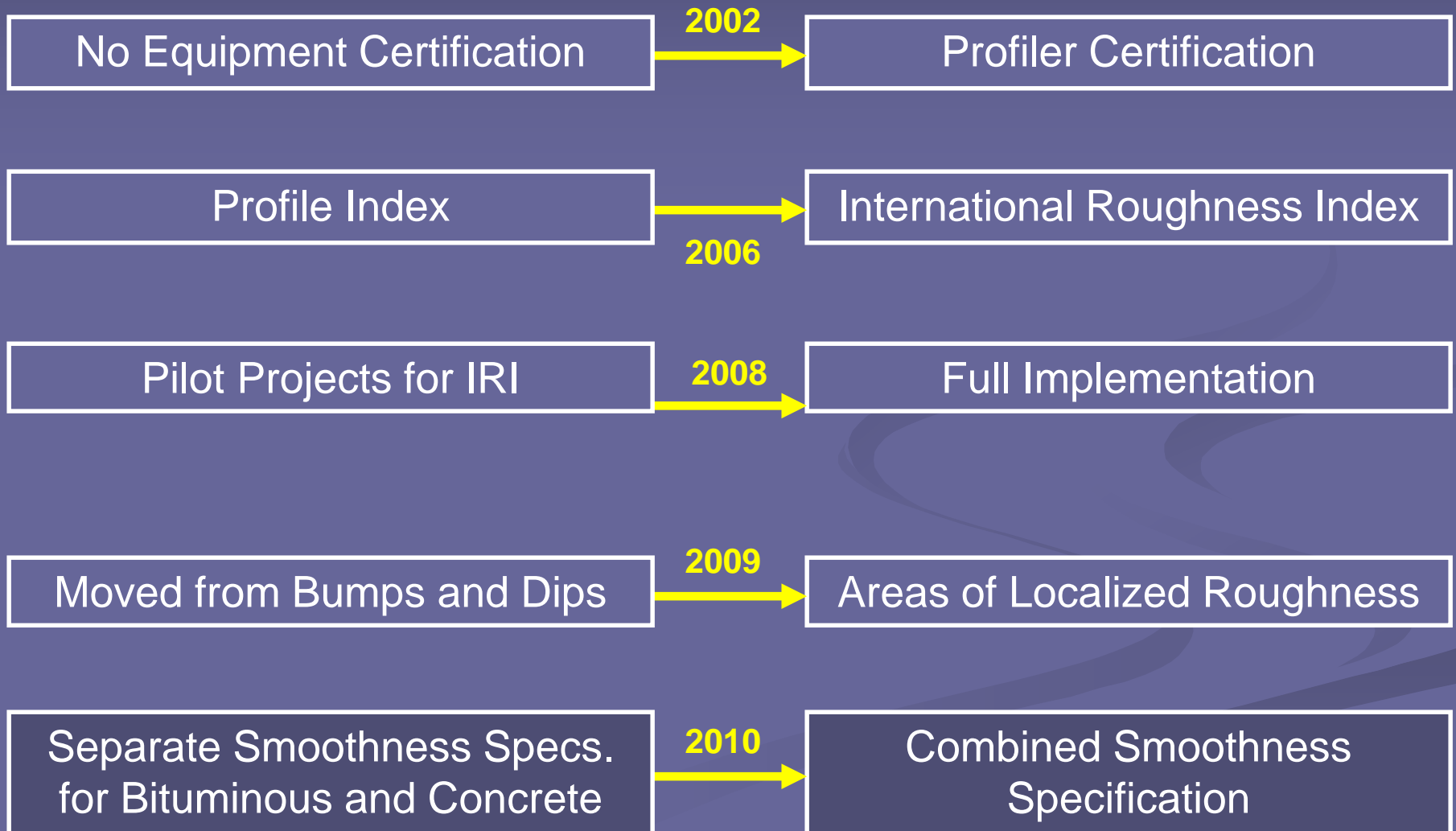
April 4, 2013

Philadelphia, PA

Maria Masten, P.E.

MnDOT Concrete Engineer

Evolution of Smoothness



How did we get here?

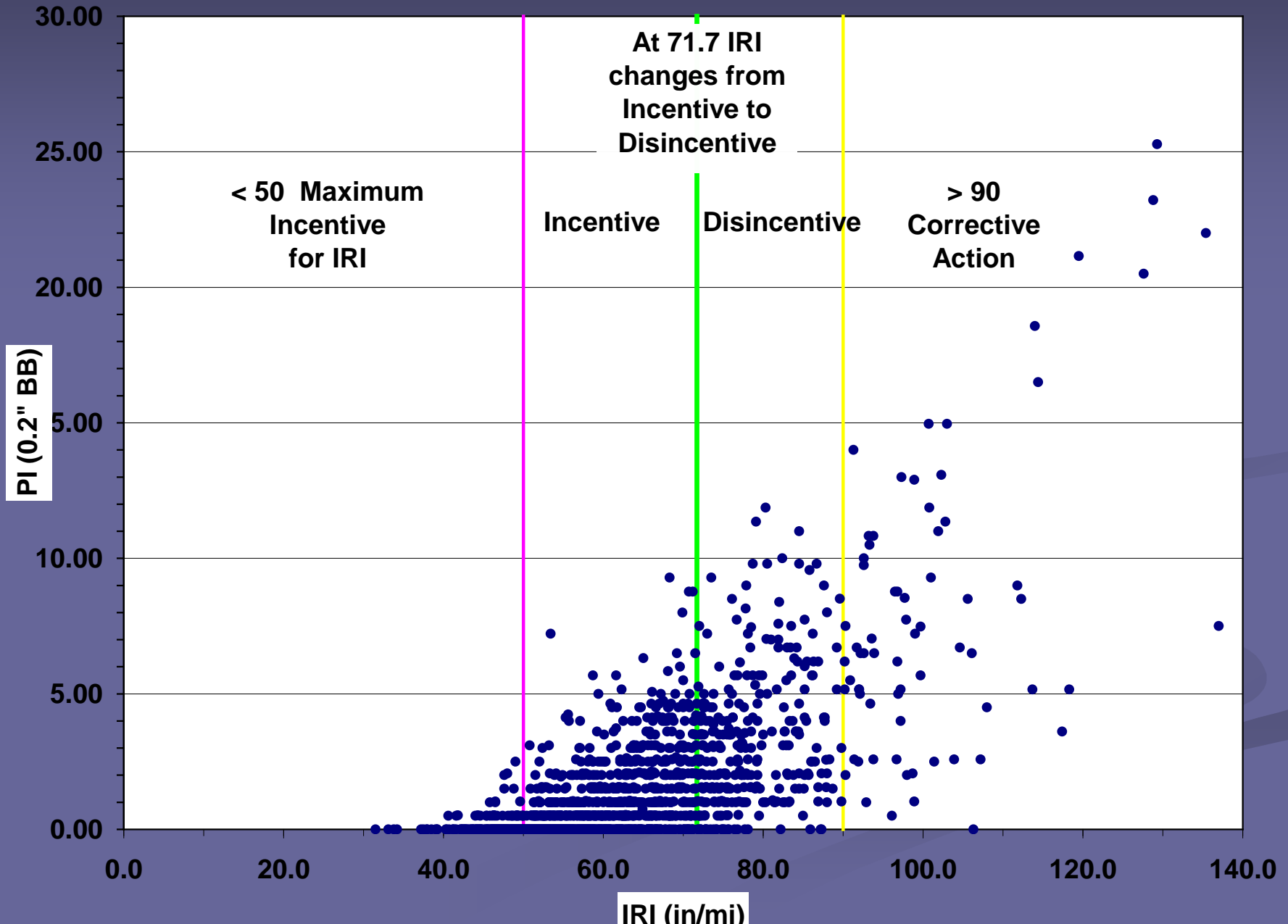
- PI Spec at 0.2 blanking band
- MnDOT never used zero blanking band – concerns with effect of texture on IRI value
- Initial goal was to not change incentive \$
- Contractor response...
 - We do not understand IRI
 - 50 inches/mile – we will never get it
 - Why change

2006 IRI Pilot Projects - Results

Project location	Project Length	Total IRI Incentive	Total PI Incentive
TH 212 in Glencoe (Passing Lane) (Driving Lane)	7.334 mi	\$44,194.31 \$47,734.83	\$54,542.21 \$52,935.84
TH 101 in Elk River (under construction)	~1000 ft	-\$2,076.74	\$892.19
CSAH 46 in Freeborn Cty (WB direction) (EB direction)*	5.957 mi	\$22,442.87 \$18,639.09	\$22,769.72 \$22,324.53

*Some of PI data unavailable – only compared \$ for like segments

2007 Contractor IRI vs. PI



IRI – Review of 2007 Contractor data

Segment IRI	Number of 0.1 mile segments	% of Total Segments
<50	207	13%
≥ 50 and <60	520	32%
≥ 60 and <71.7	519	32%
≥ 71.7 and <80	208	13%
≥ 80 and <90	99	6%
≥ 90	70	4%
All	1623	100%

- 77% of segments are in incentive
- For 2008, no \$\$\$ changes have been made to incentives

How much will a smooth road cost?

Project Type	Project Length	Total Incentive at maximum bonus
Urban project with 4 lanes and center turn lane	1 mile (5 lanes)	\$44,500
2 lane undivided road	5 miles (2 lanes)	\$89,000
4 lane divided road	10 miles (4 lanes)	\$356,000
CPR – 2 lane undivided road	5 miles (2 lanes)	\$45,000

2399 Ride Specification (Combined Bituminous/Concrete)



Needed Certifications

Operator

Online Certification
Every 3 years



Equipment

Certified Yearly at MnROAD



Walking
Profiler

2013 Inertial Profiler Certificate

Date: _____

Serial #: _____

VIN: _____

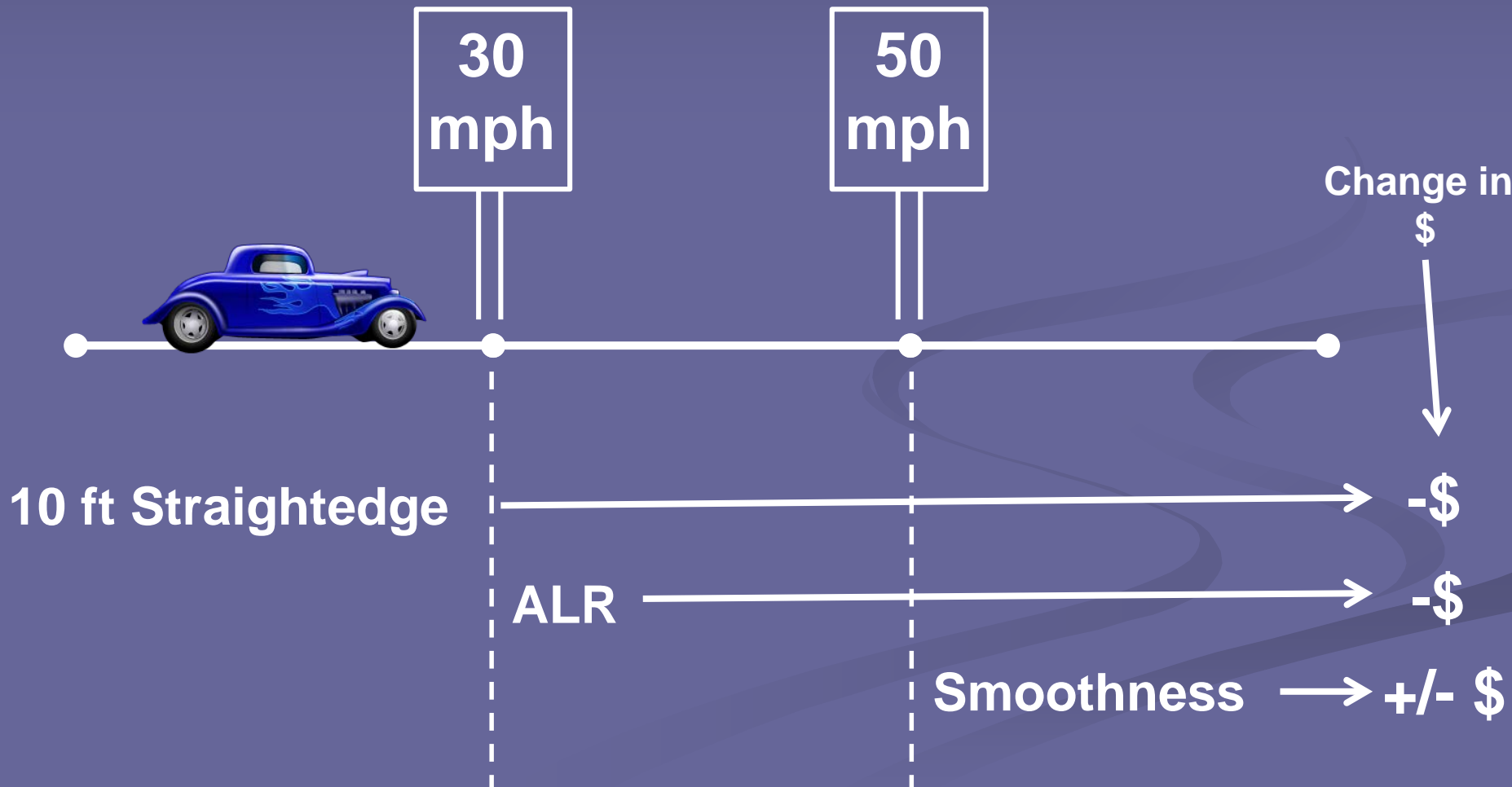
Manufacturer: _____

Software: _____

Signature: _____



What Part of the Specification Applies?



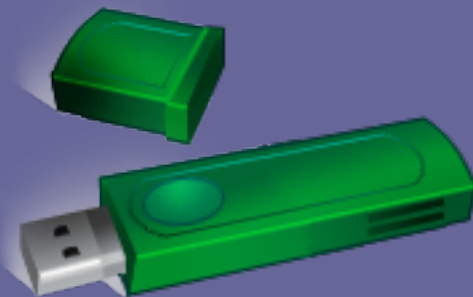
Smoothness Evaluation

- Both right and left wheel paths must be profiled at the same time with a certified Inertial Profiler.
- An IRI value will be computed for each wheel path, for each 0.1 mile segment, and then averaged. This average (MRI) will be used to calculate the segment pay adjustment.

Day of Profiling: Submittal

Profile Summary

Raw Data File
(* .ERD File)

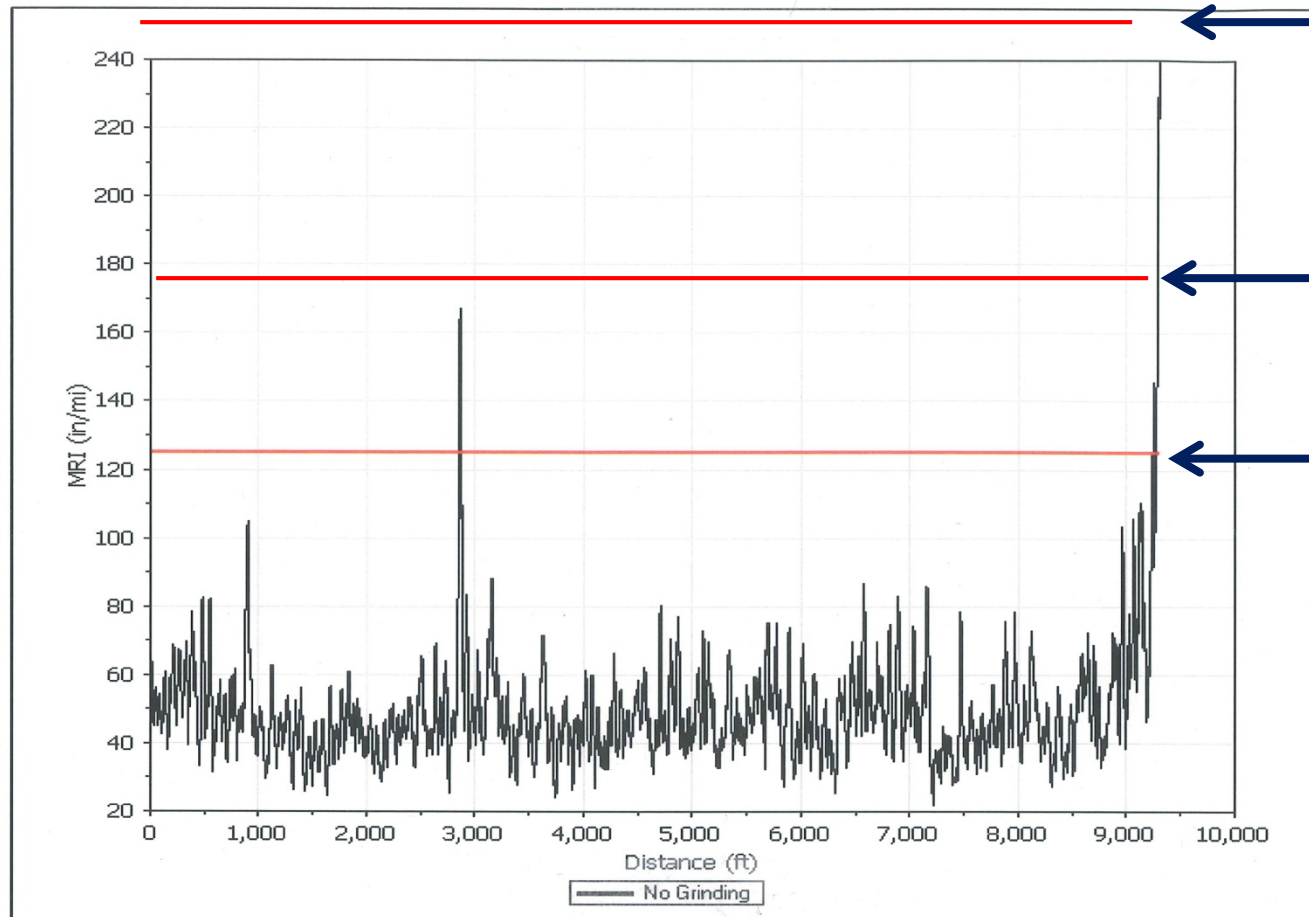


Ames Engineering Profiler		<- IRI Summary Track 1 ->			
From(ft.)	To	Dist	IRI(in\mi)		
0+00.0	5+28.0	528.0	42.86		
5+28.0	10+56.0	528.0	38.19		
10+56.0	15+84.0	528.0	43.49		
15+84.0	21+12.0	528.0	32.51		
21+12.0	26+40.0	528.0	38.71		
26+40.0	31+68.0	528.0	33.77		
31+68.0	36+96.0	528.0	35.93		
36+96.0	42+24.0	528.0	40.83		
42+24.0	47+52.0	528.0	58.90		
47+52.0	51+72.5	420.5	79.43		
51+72.5	54+18.3	245.8	Ignored		
54+18.3	59+46.3	528.0	51.98		
59+46.3	64+74.3	528.0	53.74		
64+74.3	70+02.3	528.0	54.06		
70+02.3	71+44.4	142.1	132.41		
71+44.4	74+58.6	314.2	Ignored		
74+58.6	79+86.6	528.0	68.39		
79+86.6	85+14.6	528.0	76.40		
85+14.6	86+46.0	131.4	152.87		
FILE		Total	8886.0	52.68	
C:\Jobs\2010 Bituminous\					
CALPRO SETTINGS		<- IRI Summary Track 2 ->			
From(ft.)	To	Dist	IRI(in\mi)		
0+00.0	5+28.0	528.0	52.00		
5+28.0	10+56.0	528.0	52.75		
10+56.0	15+84.0	528.0	70.96		
15+84.0	21+12.0	528.0	45.55		
21+12.0	26+40.0	528.0	47.07		
26+40.0	31+68.0	528.0	47.17		
31+68.0	36+96.0	528.0	47.82		
36+96.0	42+24.0	528.0	48.76		
42+24.0	47+52.0	528.0	76.53		
47+52.0	51+72.5	420.5	129.39		
51+72.5	54+18.3	245.8	Ignored		
54+18.3	59+46.3	528.0	60.32		
59+46.3	64+74.3	528.0	71.77		
64+74.3	70+02.3	528.0	73.11		
70+02.3	71+44.4	142.1	157.94		
71+44.4	74+58.6	314.2	Ignored		
74+58.6	79+86.6	528.0	77.45		
79+86.6	85+14.6	528.0	83.01		
85+14.6	86+46.0	131.4	149.32		
Total		8886.0	67.71		
PROFILER SETTINGS		<- IRI Summary Average ->			
From(ft.)	To	Dist	IRI(in\mi)		
0+00.0	5+28.0	528.0	47.43		
5+28.0	10+56.0	528.0	45.47		
10+56.0	15+84.0	528.0	57.23		

--Collection Time and Date--
Time: 10:14:46 Date: 05-20-2010

Within 5 Days of Completion of Paving: Smoothness Assurance Report

Data analyzed through Proval

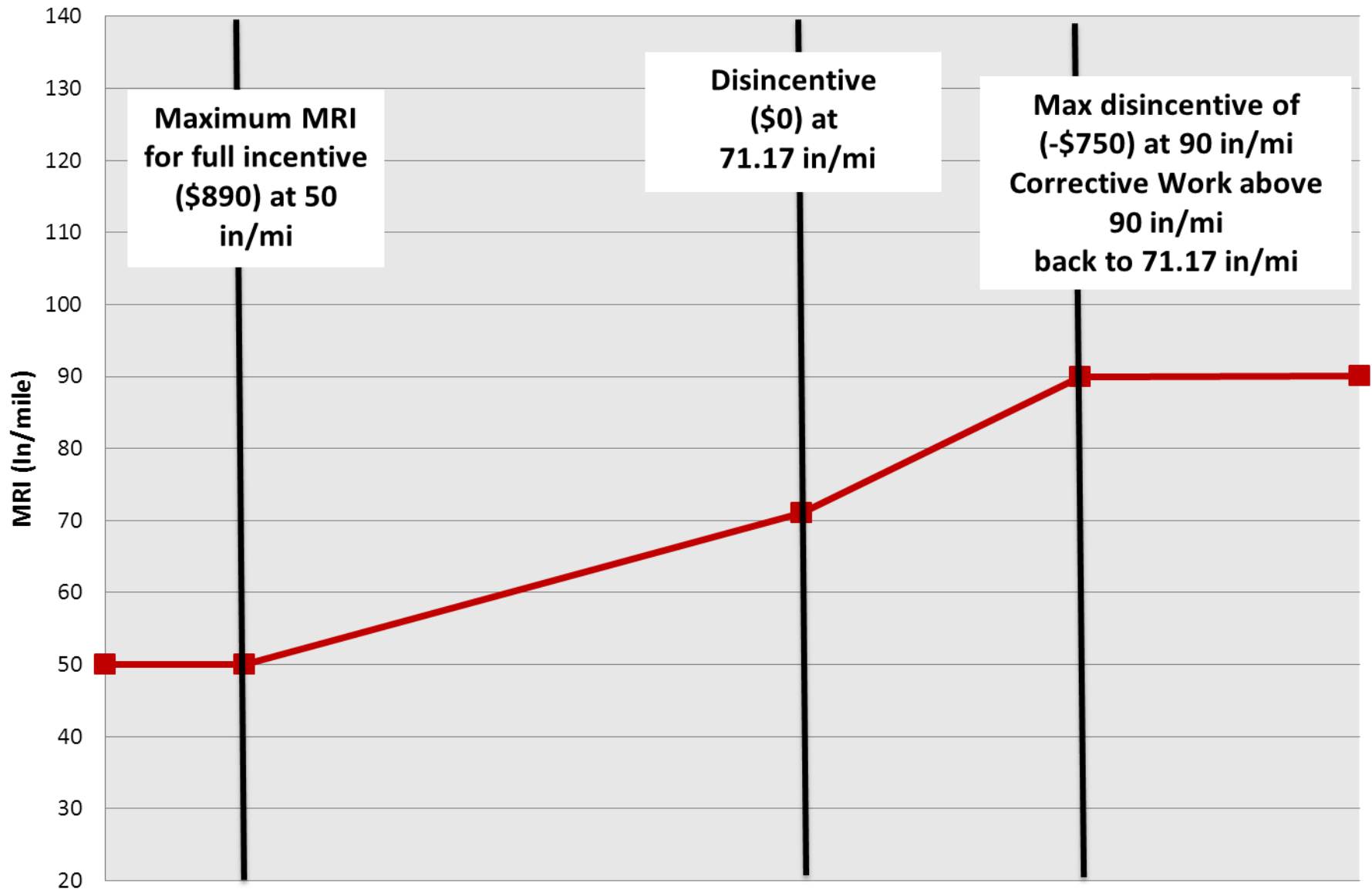


250

175

125
(inches/
mile)

Minnesota Smoothness Equation



Areas Excluded from Smoothness Evaluation

For All Pavements

Paving in areas with a posted vehicle speed less than or equal to 45 mph

Ramps and loops

Acceleration and deceleration lanes less than or equal to 1,000 ft. in length

Projects less than 1,000 ft. in length

Bridge decks and approach panels – the occurrence of bridges shall not interrupt the continuity determination

For Concrete Pavements

Intersections constructed under traffic – begin and end exclusion 100 ft. from the intersection radius

Areas of Localized Roughness (ALR)

- Measured using a 25 foot moving straightedge

- Bumps
- Dips
- Joints



**Table 2399-7
ALR Monetary Deductions and Corrective Work Requirements**

Equation	25ft [7.62 m] Continuous IRI, in/mi [m/km]	Corrective Work or Monetary Deduction, per linear 1.0 ft [0.3048 m]
HMA-A or HMA-B, and a posted vehicle speed > 45 mph [73 km/hr]	< 125.0 [1.97]	Acceptable
	≥ 125.0 [1.97] and < 175.0 [2.76]	Corrective work or \$10.00, as directed by the Engineer
	≥ 175.0 [2.76] and < 250.0 [3.94]	Corrective work or \$25.00, as directed by the Engineer
	≥ 250.0 [3.94]	Corrective work or \$100.00, as directed by the Engineer
PCC-A and a posted vehicle speed > 45 mph [73 km/hr]	< 125.0 [1.97]	Acceptable
	≥ 125.0 [1.97] and < 175.0 [2.76]	Corrective work or \$10.00, as directed by the Engineer
	≥ 175.0 [2.76] and < 250.0 [3.94]	Corrective work or \$25.00, as directed by the Engineer
	≥ 250.0 [3.94]	Corrective work as directed by Engineer

Areas Excluded from Smoothness and ALR Evaluation

For All Pavements

Paving in areas with a posted vehicle speed less than 30 mph

Turn lanes, crossovers

10 ft. on either side of obstructions in lane that obstruction is located

Side streets, side connections

150 ft. before intersections that end at a stop sign or a yield sign at a roundabout

For Concrete Pavements

Undoweled shoulders less than or equal to 10 ft. in width

Headers adjacent to colored concrete

Corrective Work

■ Before Corrective Work:

- Submit a written corrective work plan to the Engineer (Smoothness Assurance analysis)
- Do not begin corrective work before the Engineer approves the plan

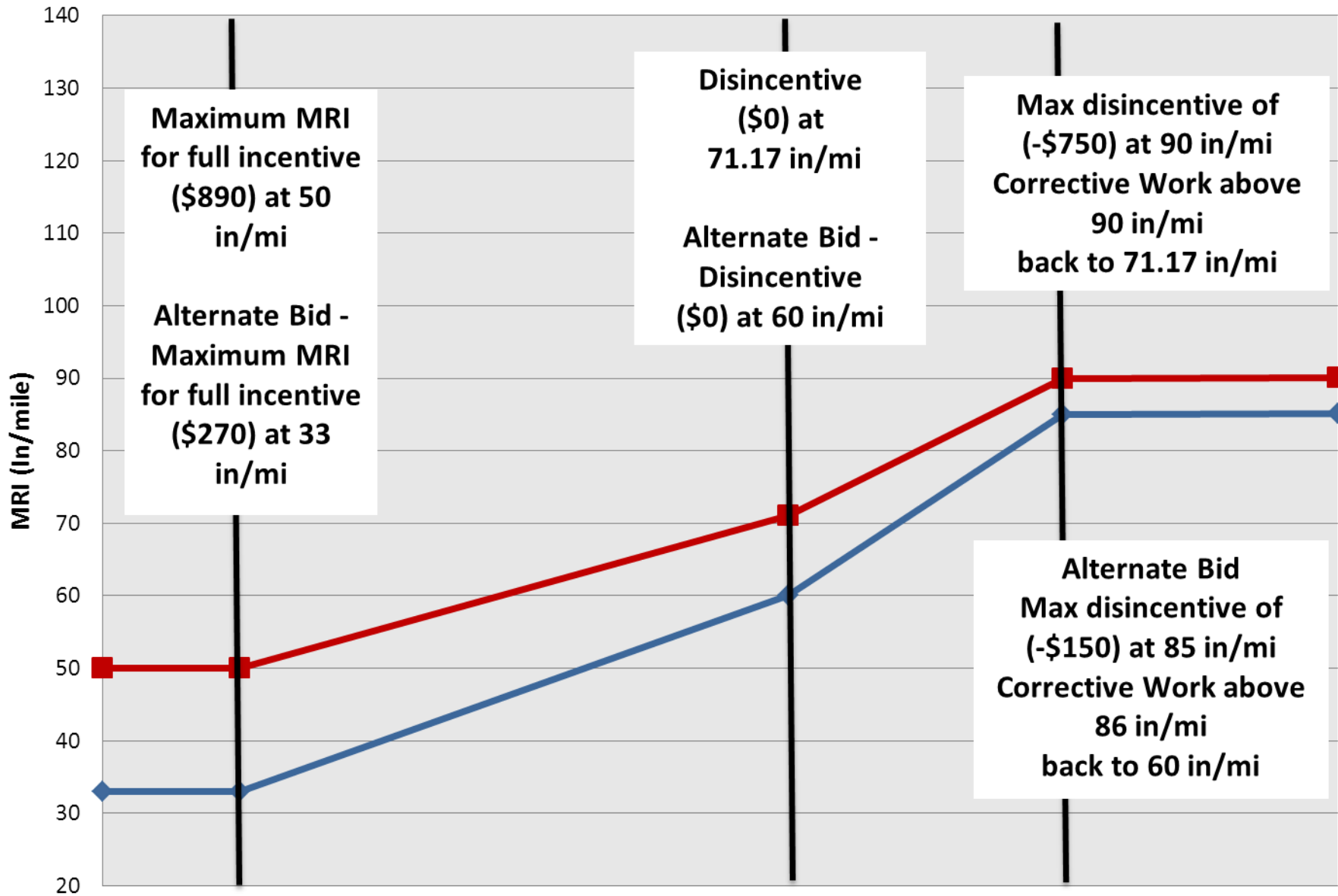
■ After profiling, submit:

- Paper ProVAL summary report indicating the results of the 'Smoothness Assurance: Short Continuous Histogram.
- Final spreadsheet summary in tabular form, with each 0.1 mi. segment occupying a row

Alternate Bid

- A single equation is used for both concrete and asphalt.
- The maximum incentive for one mile is \$2700 per lane-mile.
- A regular concrete project – the maximum incentive for one mile is \$8900 per lane-mile
- On average, asphalt currently has a \$700 per lane-mile bidding advantage with the current 2399 specification.

■ Minnesota ◆ Minnesota Alternate Bid



MAP-21

- Do we need urban IRI requirements
- Until combine concrete/bit spec – speed limit of 42 mph and greater had smoothness specs
- Asphalt pavements didn't require smoothness for 45 mph or less



Where are we now?

- It has been 5 years since we went fully into IRI
- This summer we will evaluate the ride data and look at revising incentive equations
- I expect we will raise the bar

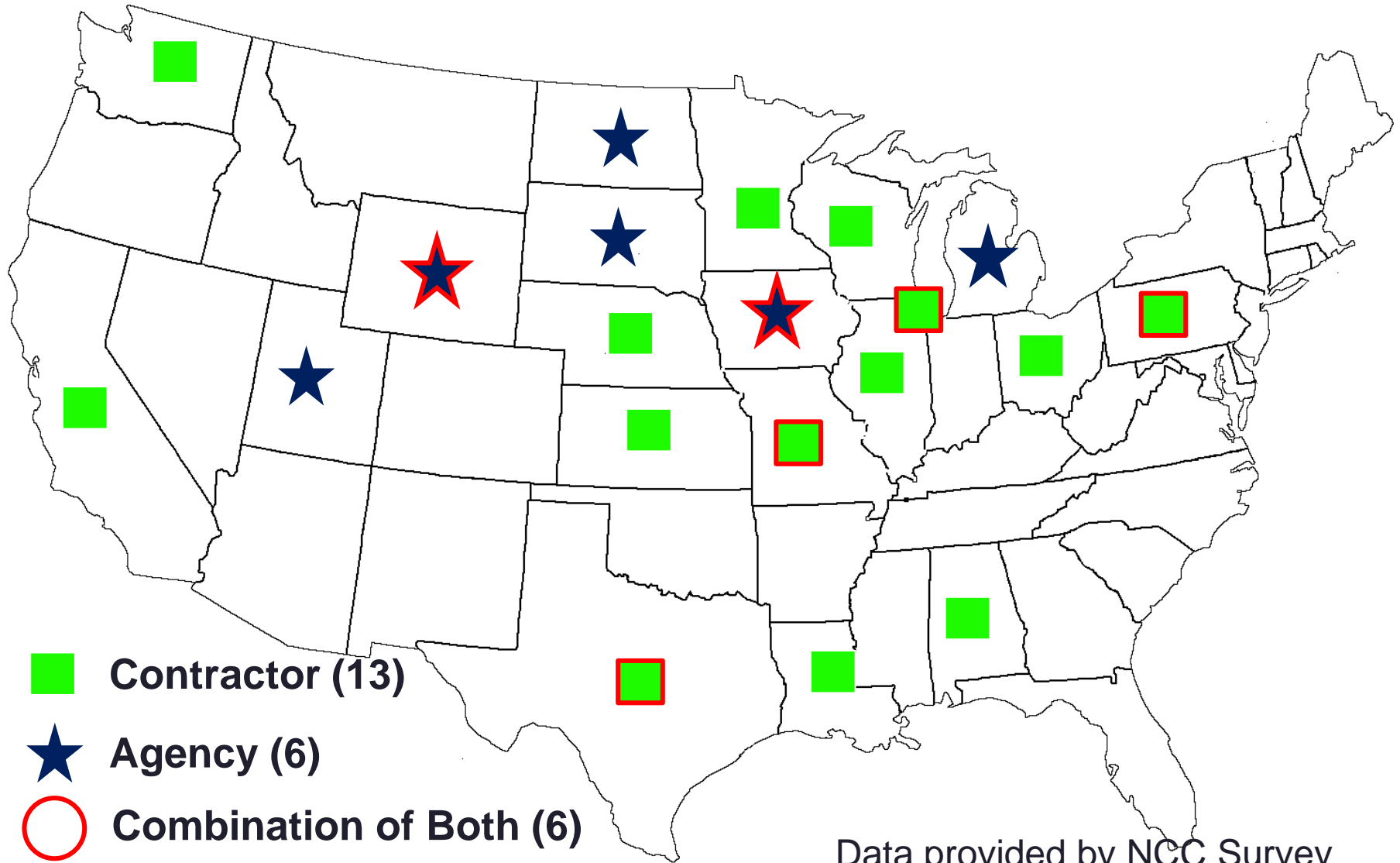
IRI Ride Specs Summary of State Reports

National Concrete Consortium

Philadelphia, PA

Spring 2013

Contractor vs. Agency Testing



Data provided by NCC Survey

When Contractor Testing...How often does the Agency check?

- 25% of all projects – CO
- 10% of all projects – IL
- 10% of each project – IA, NE
- 10% of lane miles – MO
- Within 90 days of data going in system – PA
- As necessary – LA, MN, TX
- Each profiler yearly - WI

When is testing done?

- Up to Contractor
 - CA, CO (QC), IL TW, LA, MN, MO, NE, OH, WI
- Daily
 - IA
- Completion of paving or major phase
 - CO, MI, ND, PA, SD, TX, UT
- Within 3 days of paving
 - IL
- Within 48 hours of paving
 - KS, WA

If not tested the day after paving, do you know how much difference there is by the time it is open to traffic?

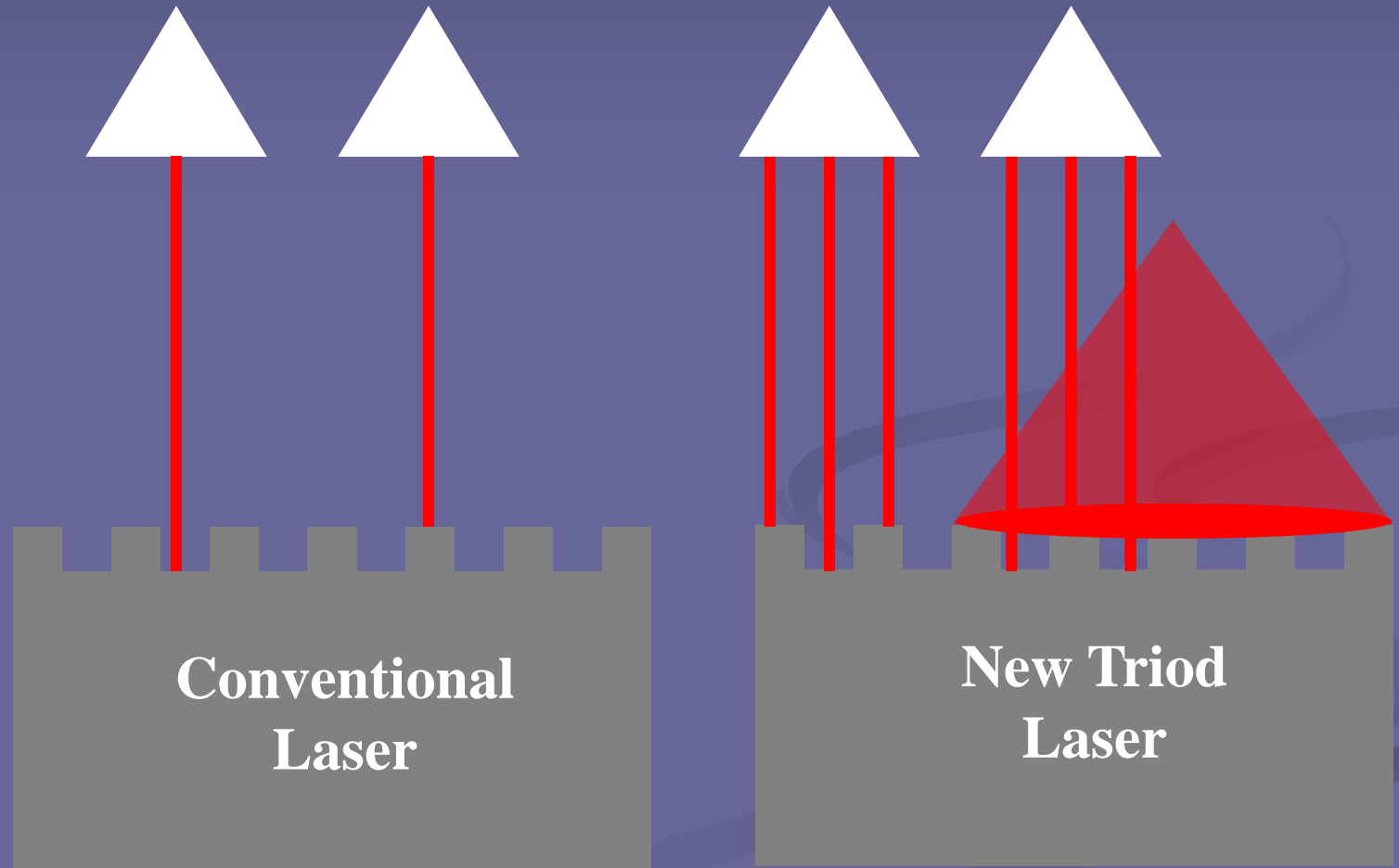
- Colorado

- Gets slightly smoother ~ 0 to 5 in/mi HRI

- Louisiana

- Within ± 6 in/mi up to 6 months after paving

Concrete Texture Impacts on Profile Measurements



Do you see an influence on the type of pavement texture?

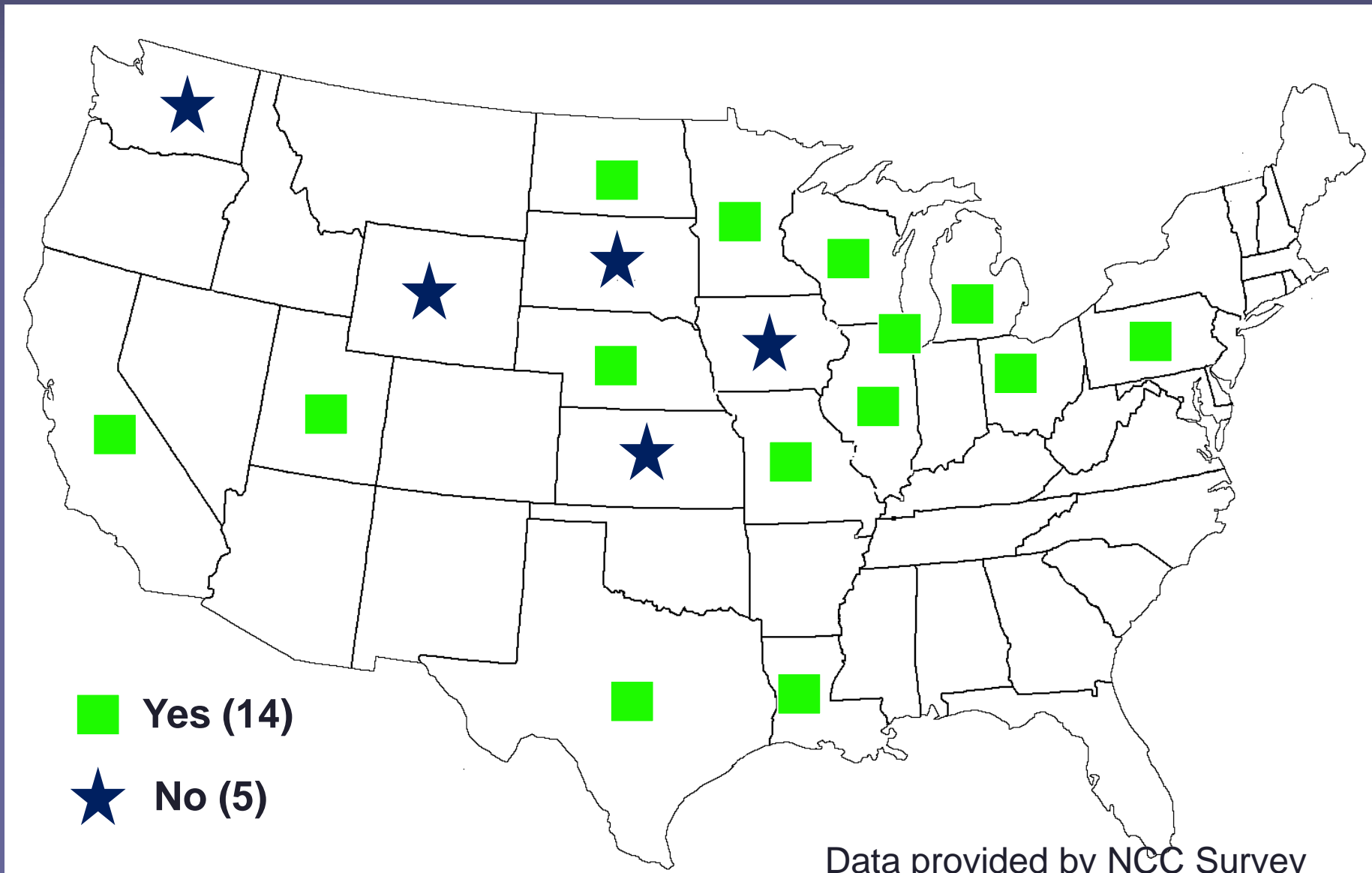
- Use line laser - No difference
 - CA, MN, MO, OH
- Single Point Laser
 - 5 to 30 in/mi (CO)
- Longitudinal tining has influence
 - MI, TX

What equipment/laser setup are you using for concrete?

■ Inertial Profilers

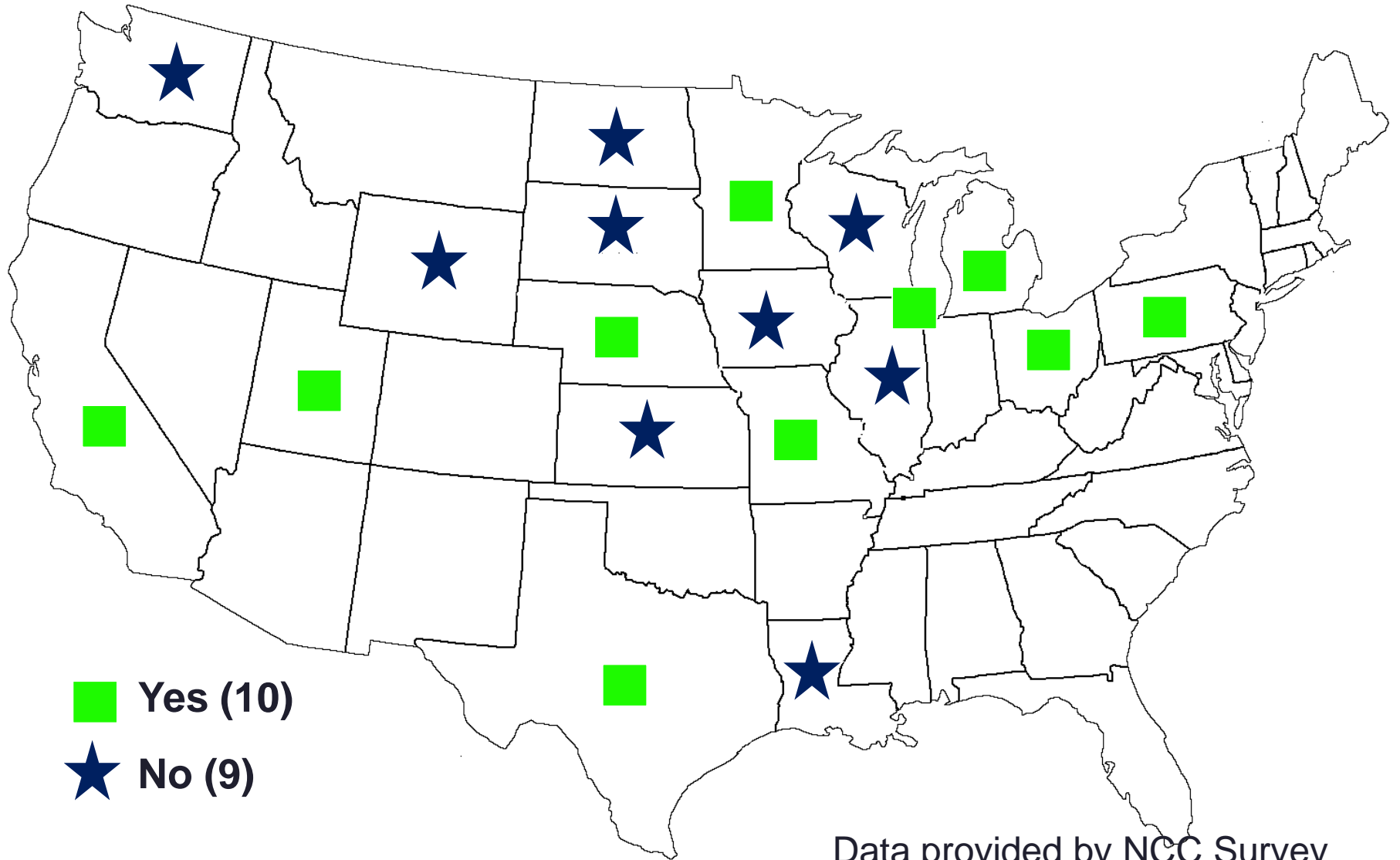
- Roline – CA, CO, MI, ND, NE, OH, SD, WI
- Triod or Roline Lasers – MN
- Single Point, Wide Spot, Triod, or Roline – IL, TW, LA, PA, TX
- California Profilograph Simulation – IL, UT

Equipment Certification

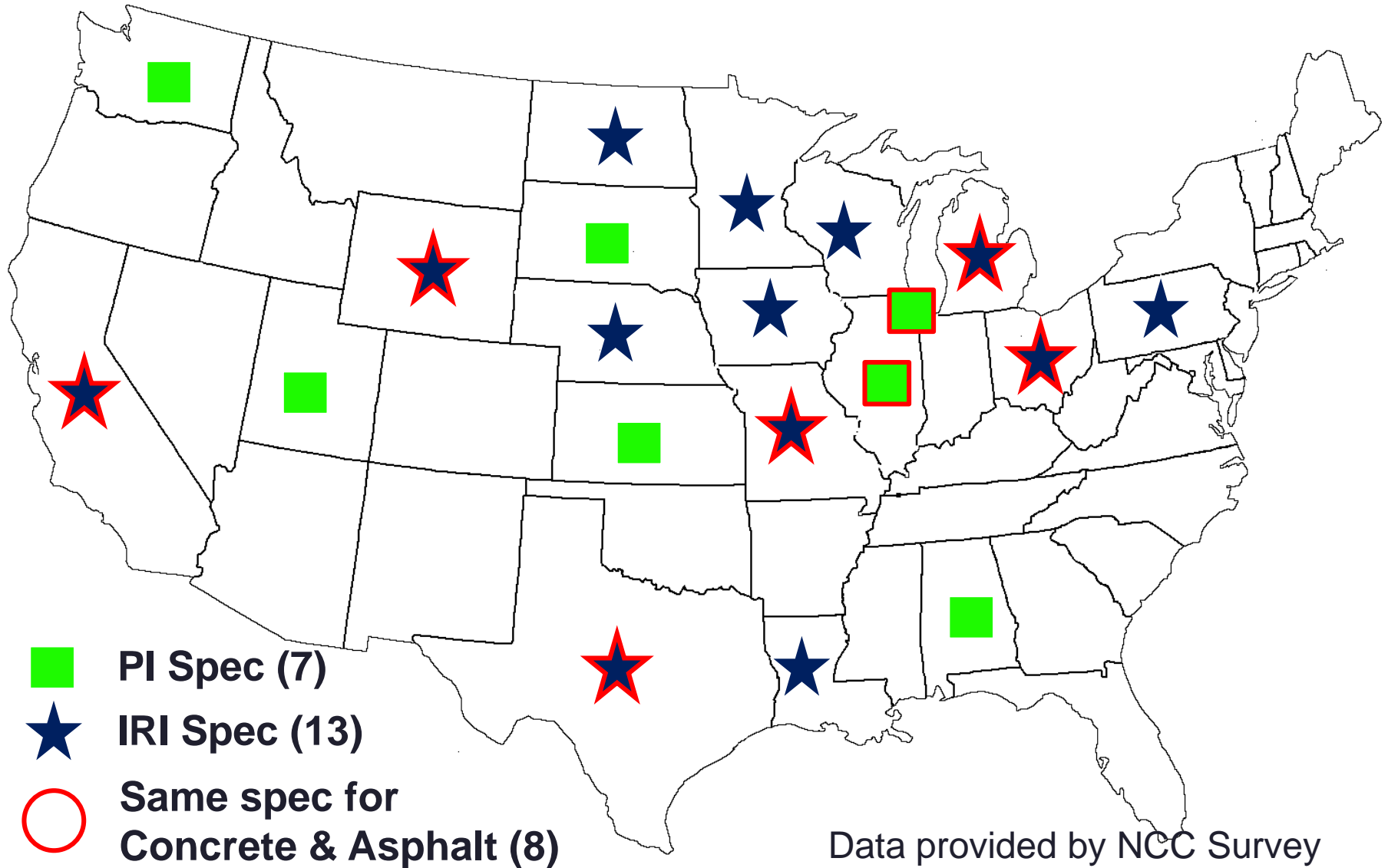


Data provided by NCC Survey

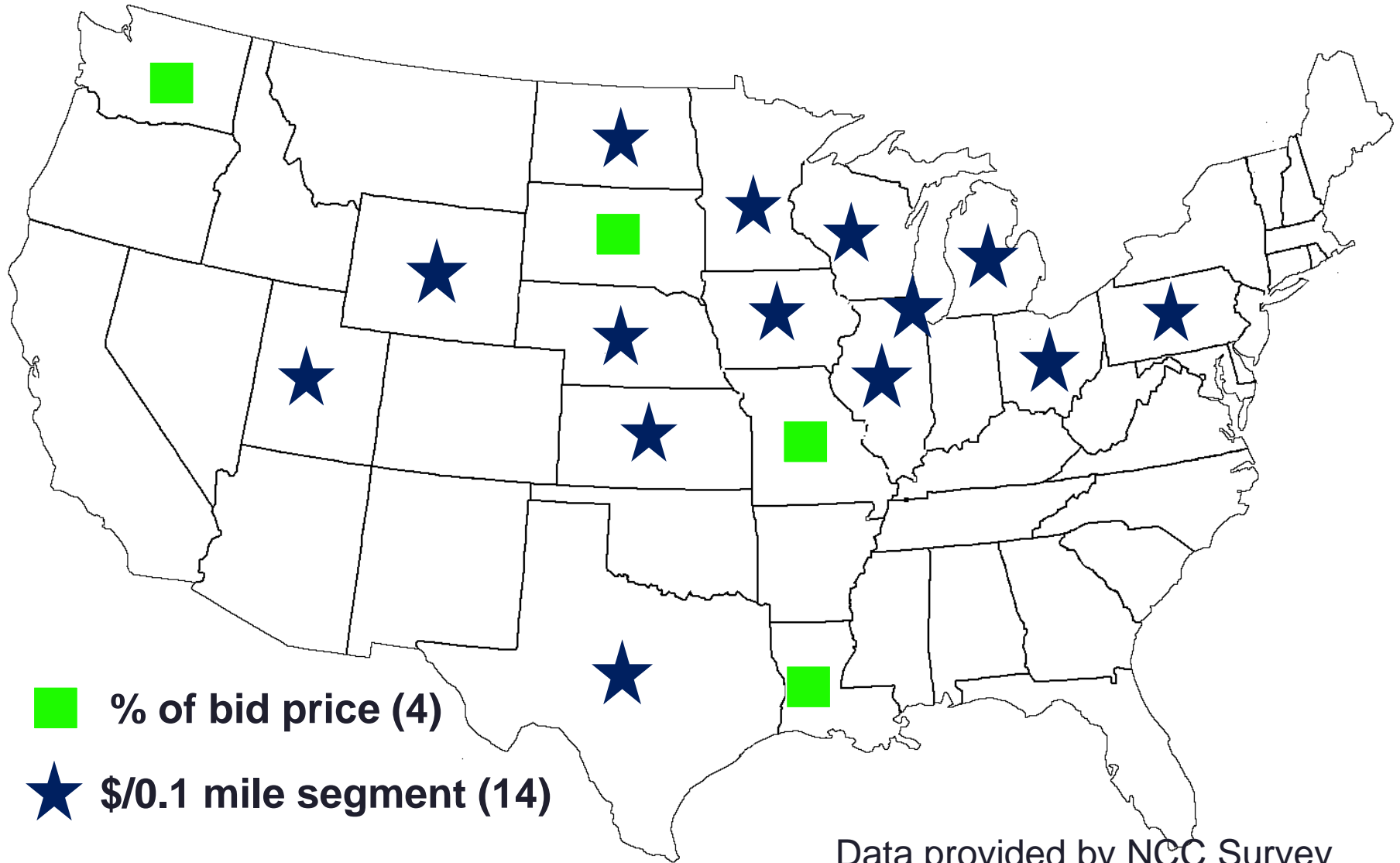
Operator Certification



IRI Spec vs. PI Spec

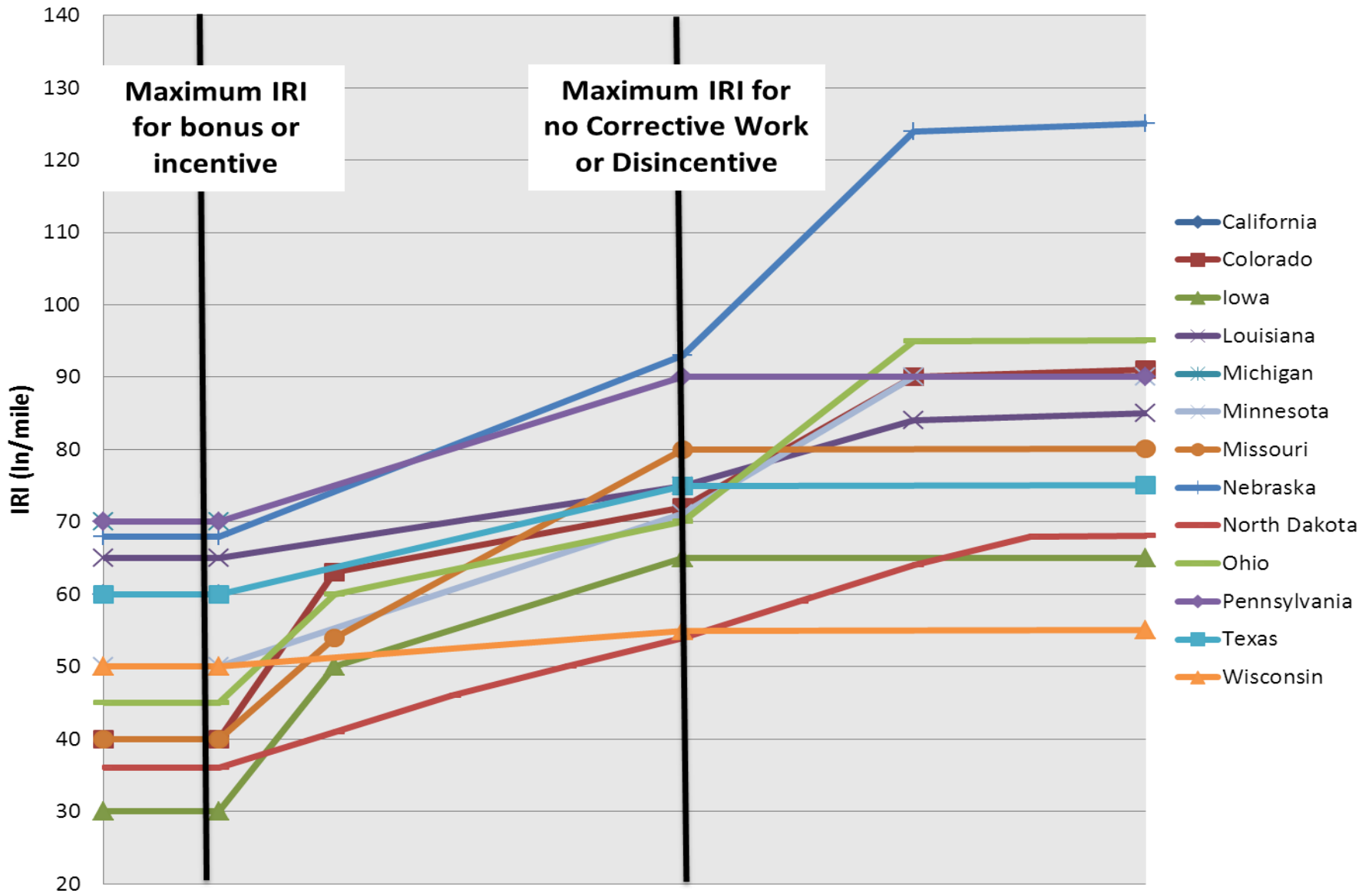


What do you base your incentive payments on?

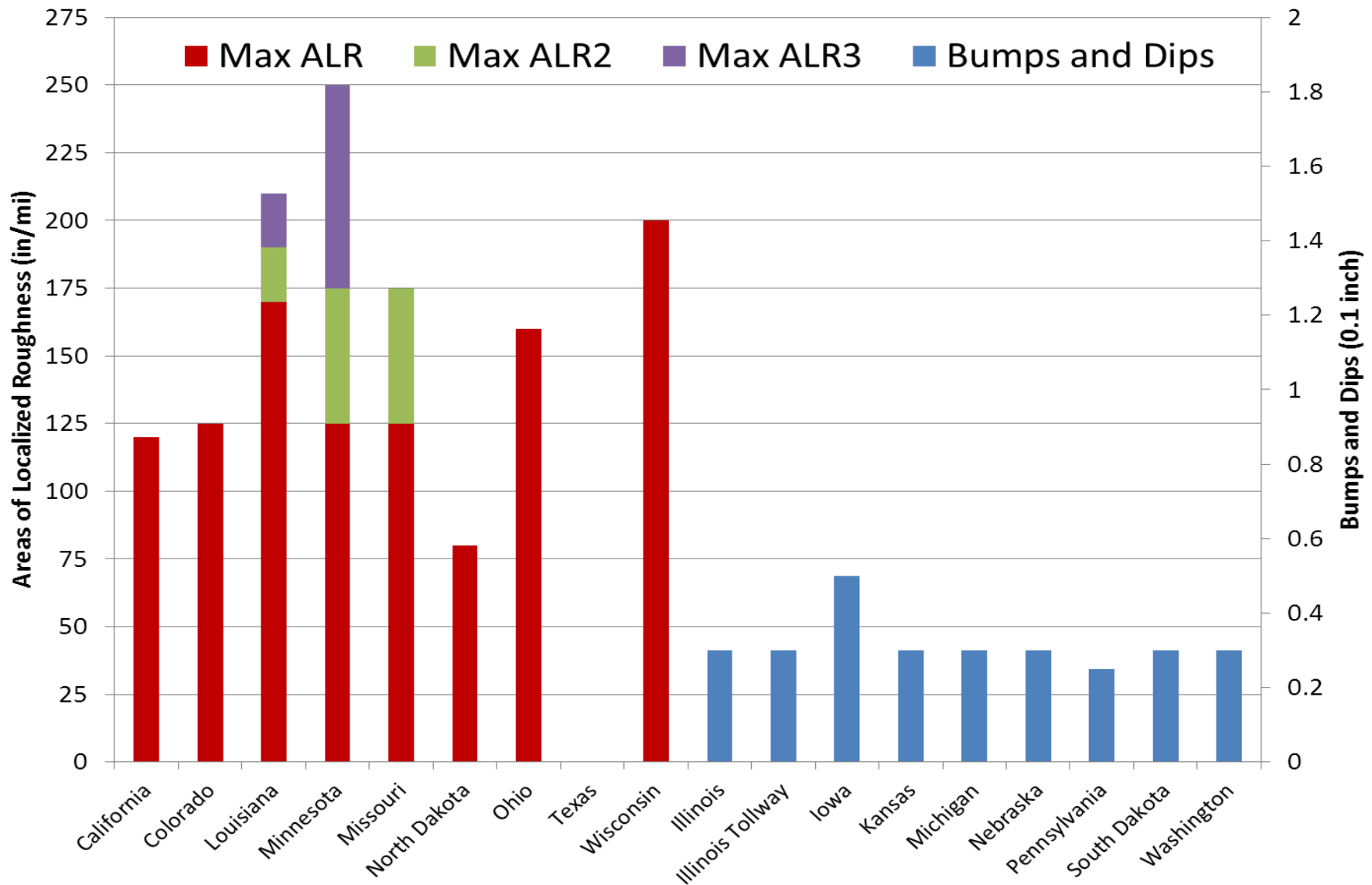


Data provided by NCC Survey

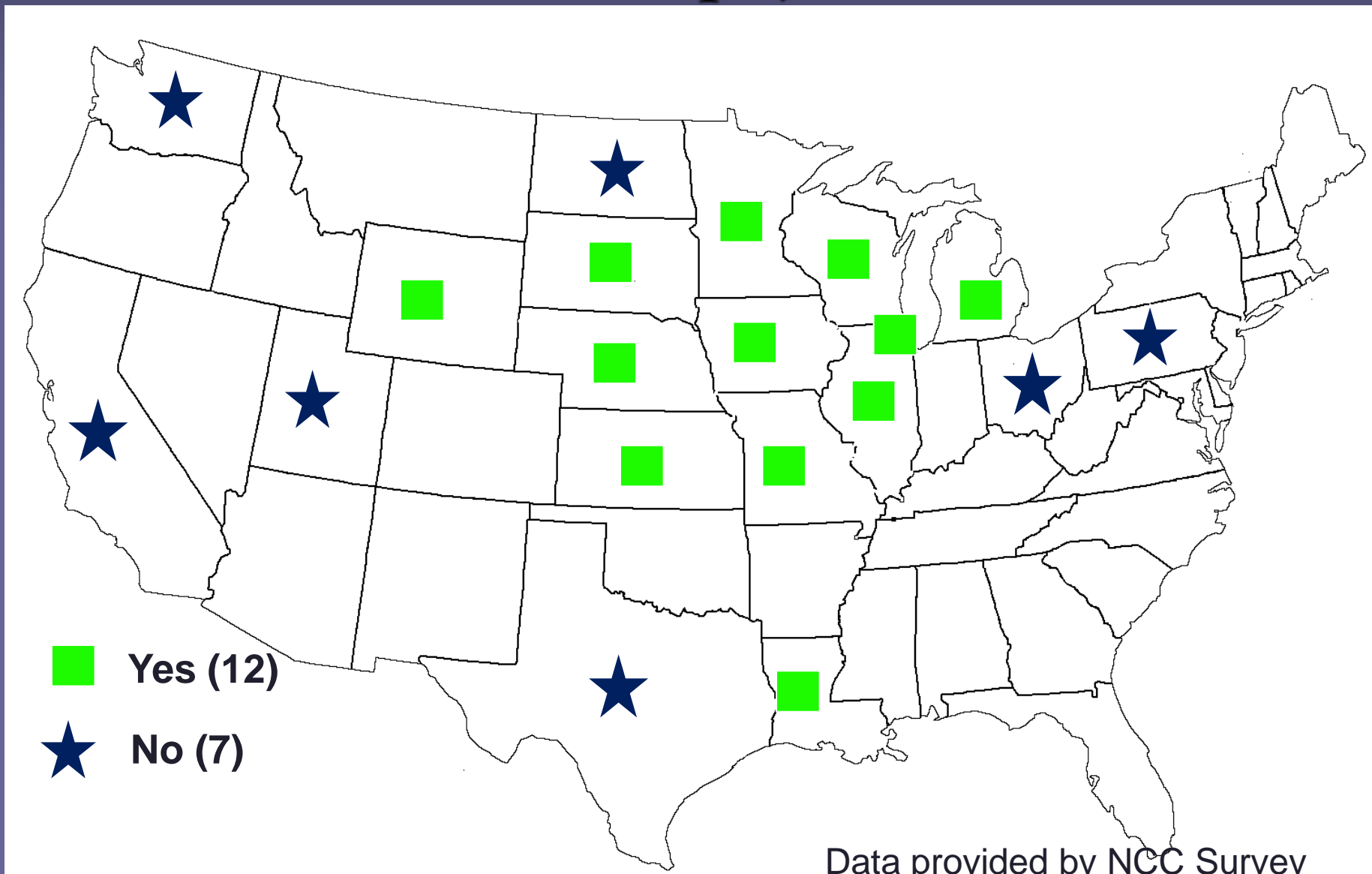
International Roughness Index



Localized Roughness vs. Bumps and Dips



Different Spec for Mid-Speed Urban (40-50 mph)?



Data provided by NCC Survey

Do you require Proval?

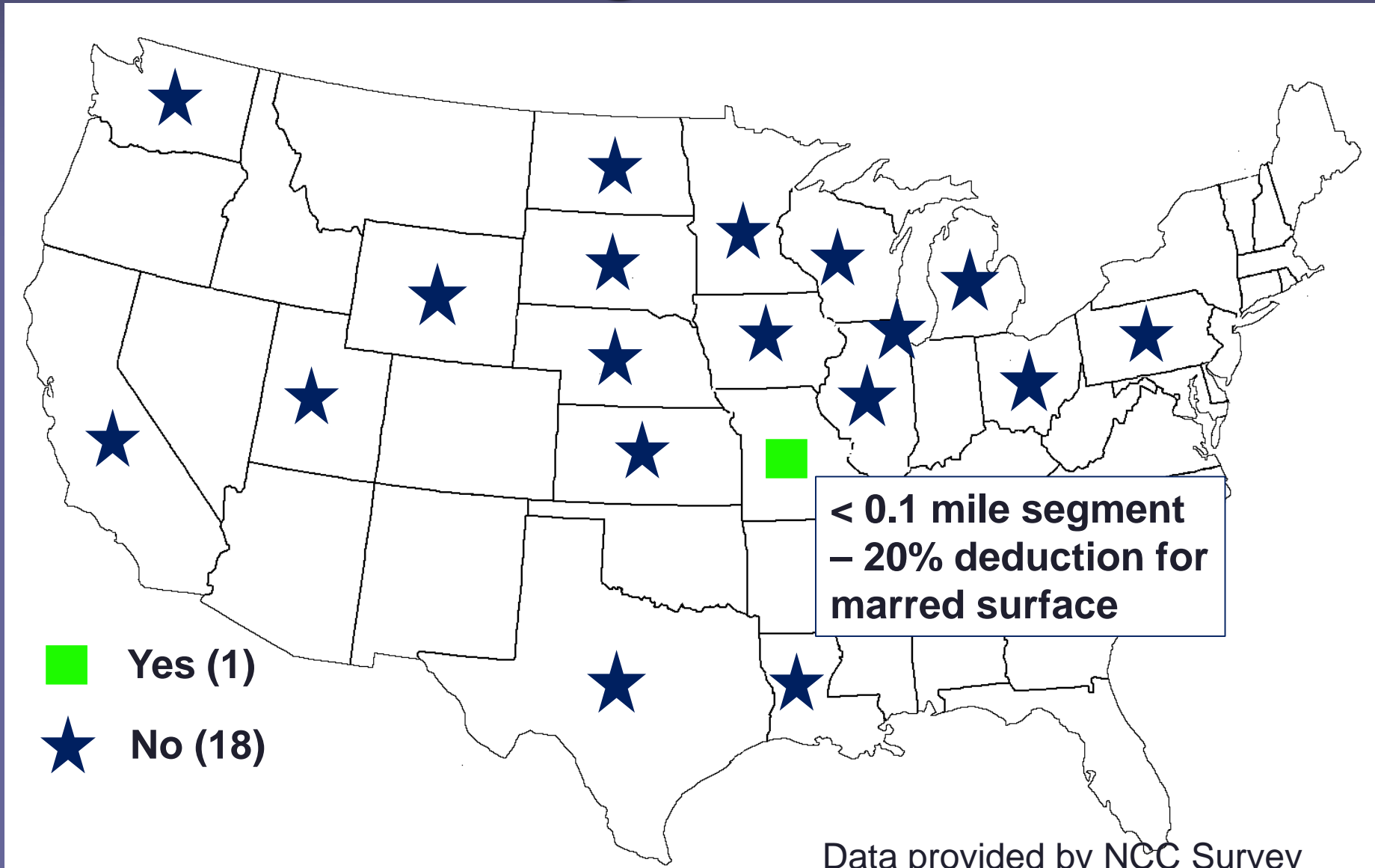
- Yes

- All states that use IRI generally use or encourage

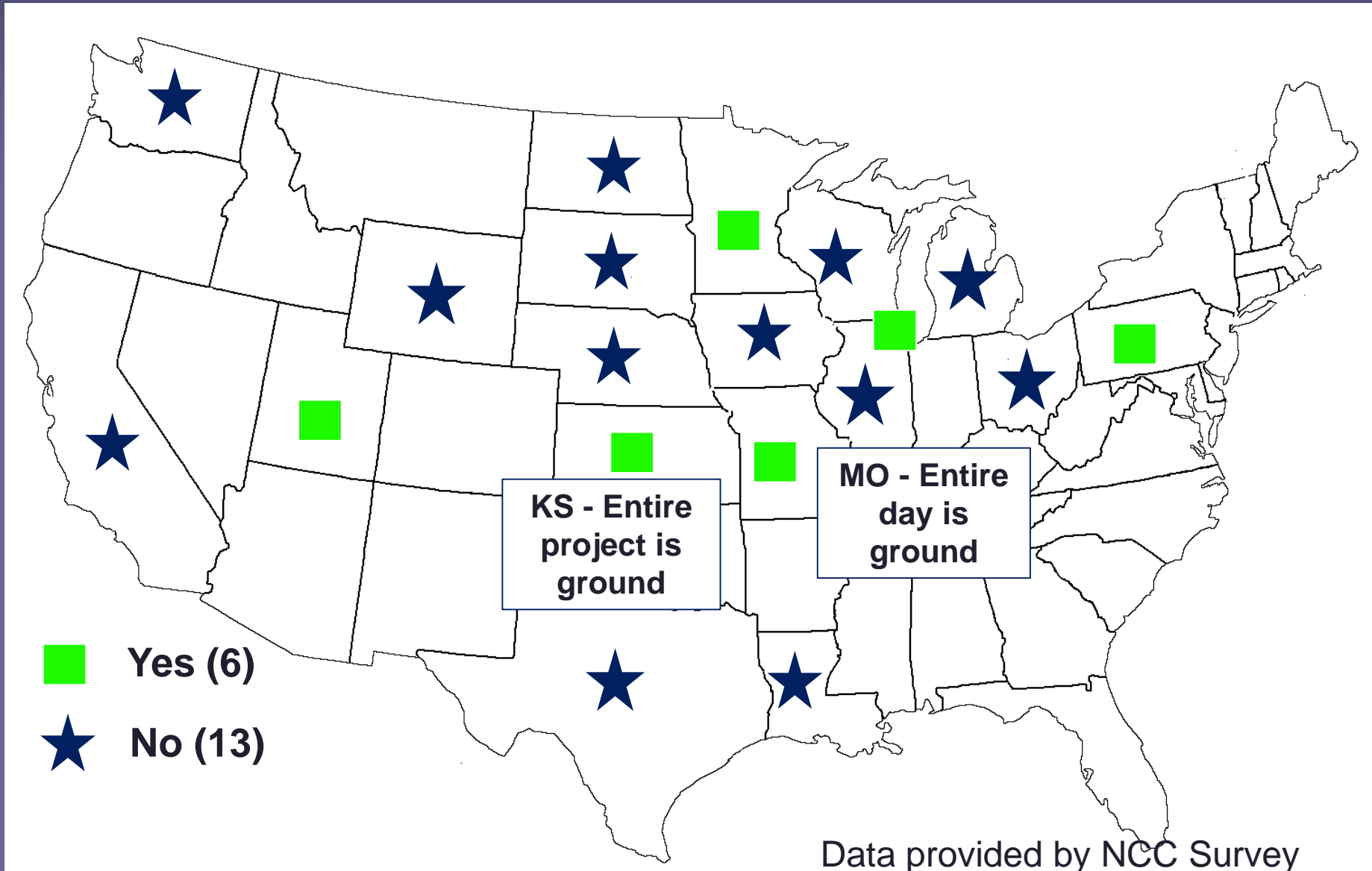
- No

- TX has own software

Any Additional Deductions for Grinding to Meet IRI



Can section be re-profiled to attain smoothness bonus?



Thanks!

Questions??

