Stone Matrix Asphalt: Impact on Performance and LCCA

Richard Willis, National Asphalt Pavement Association

Illinois Bituminous Conference
December 12, 2018

NATIONAL ASPHALT
PAVEMENT ASSOCIATION

1ST INTERNATIONAL CONFERENCE ON

Stone Matrix Asphalt

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IN PARTNERSHIP WITH

ASPHALT INSTITUTE

AAPT Association of Asphalt Paving Technologists

TRB Transportation Research Board

U.S. TIRE MANUFACTURERS ASSOCIATION

WELCOME TO THE 1st International Conference on Stone Matrix Asphalt

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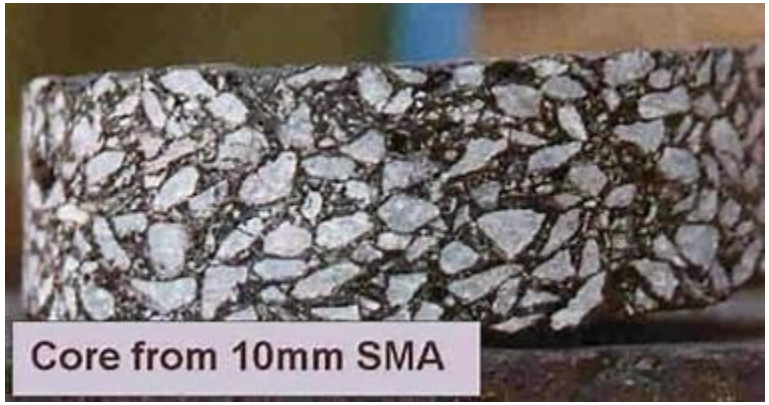
SMA – A Brief History



- Germany, 1968
  - 50th Anniversary
- United States, early to mid-90s
  - Wisconsin, Virginia, Maryland
- Europe vs. US
  - Europe – few changes since inception
  - US DOTs – Some changes since inception
  - US Private or P3 Roads – Many changes

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Why Does it Work?

The Right Ingredients

The Right Proportion

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Why Does it Work?

The Right Ingredients

- High quality stone
- Premium asphalt
- Something to prevent draindown
- Filler

The Right Proportion

- Gap graded mixture
  - Stone on stone contact
- Typically polymer modified at higher asphalt contents
- Draindown inhibiter
- Higher filler content

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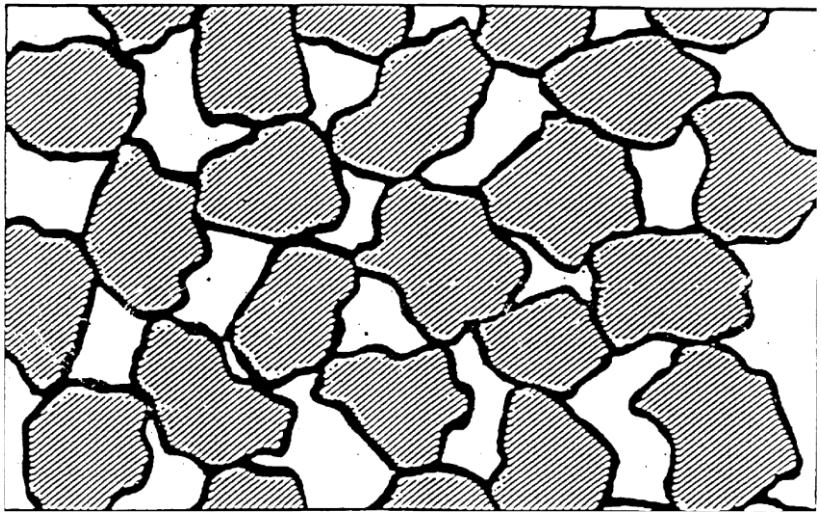
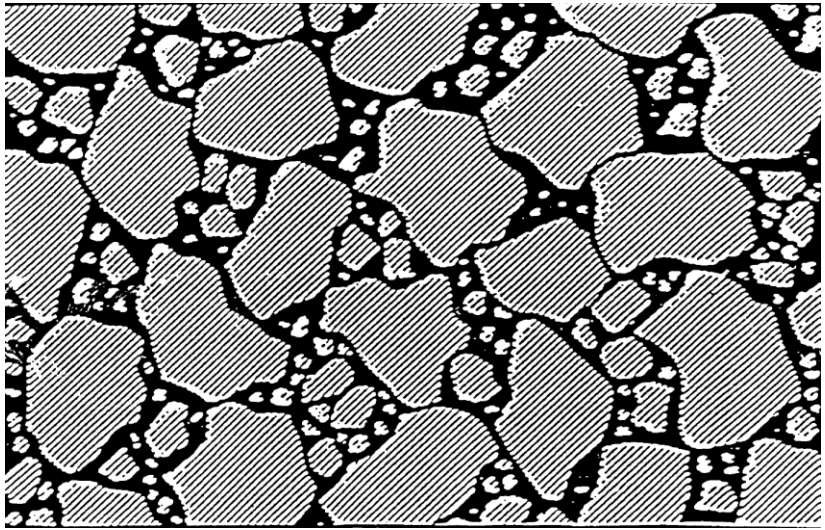
SMA Stone Structure

Stone on Stone Structure



Filled SMA Structure



*Courtesy of Ray Brown

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It’s the Same … But Not Really

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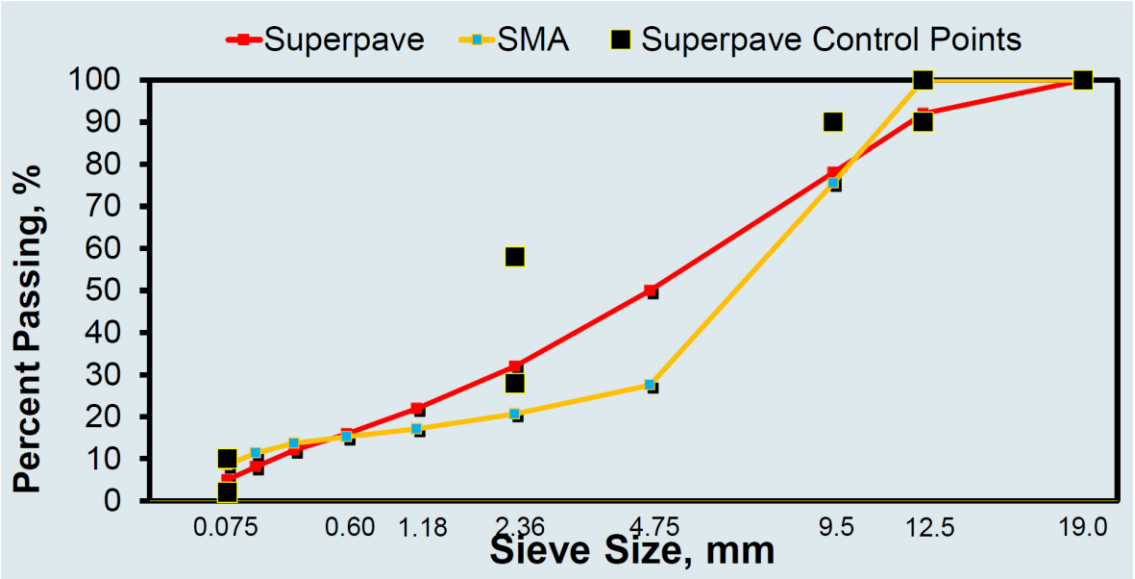
What Do These Ingredients/Proportion Provide

- Improved durability
  - Gap-graded agg
- Rutting resistance
  - Stone on stone contact
  - Polymer modification
  - High filler content



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A Willingness to Learn

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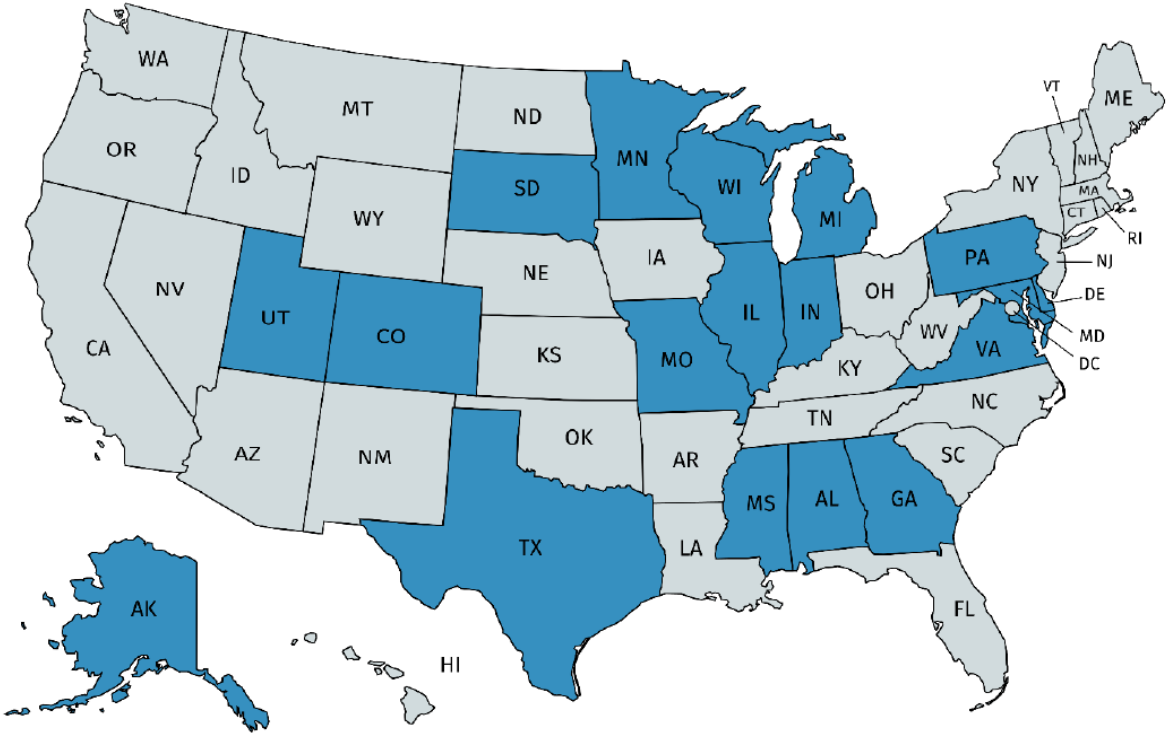
SMA Usage



*NCAT Report 18-03

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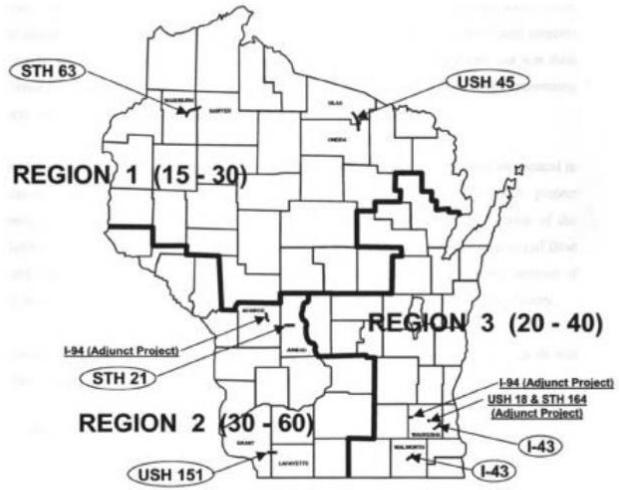
Wisconsin

WisDOT SMA Pilot Program

*Courtesy of Debbie Schwerman



Location of SMA Projects and Control Sections
Regions Separated by LA Wear Values

- **Factors investigated**
  - Traffic
  - Aggregate LA Wear
  - Stabilizer type & dosage
  - NMAS (5/8” vs. 3/8”)
  - Base material
- **Performance monitoring after 5 years**
- **Performance measures**
  - Pavement Distress Index (PDI)
  - Ride - IRI
  - Rutting/Cracking
  - Friction and Noise

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WisDOT SMA Pilot Program

*Courtesy of Debbie Schwerman

Detailed Project Information

Project	Base Pavement	ADT/Yr. Const.	Max Agg. Size	Hardness Region	LA Wear
I-43, Waukesha	CRCP	42,200 1992	3/8" (9.5 mm)	3	26
I-43, Walworth	JRCP	11,650 1993	5/8" (16 mm)	3	27
USH 151, Lafayette	AC over thin-edged PCC	6,350 1993	5/8" (16 mm)	3	38
STH 21, Juneau	AC over dense base over PCC	4,200 1994	3/8" (9.5 mm)	2	31
USH 45, Vilas and Oneida	AC	5,940 1993	5/8" (16 mm)	1	21
STH 63, Washburn	AC	5,872 1993	3/8" (9.5 mm)	1	24

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WisDOT SMA Pilot Project

*Courtesy of Debbie Schwerman

Construction Issues - Bleeding

- Higher temperature sensitivity observed for PMA mixes
  - Draindown above 305°F
  - Sticking in truck box below 290°F
- Projects constructed well before the invention of WMA/compaction aide additives

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Performance – Cracking and PDI *Courtesy of Debbie Schwerman

Test Sections (LA Wear Region)	% Cracking			PDI		
	Mean SMA	Mean Control	%Diff.	Mean SMA	Mean Control	%Diff.
STH 63 (Reg 1)	26	69	-63%	24	48	-51%
STH 21 (Reg 2)	72	78	-7%	20	27	-26%
I-43 Wauk. (Reg 3)	48	68	-29%	21	38	-45%
USH 45 (Reg 1)	11	12	-6%	19	13	49%
USH 151 (Reg 2)	52	67	-22%	25	30	-16%
I-43 Wal. (Reg 3)	6	38	-84%	18	47	-62%

- Pavement was surveyed pre-overlay. Cracking extent was used as a baseline to evaluate SMA effectiveness
- PDI = f(Cracking, Flushing, Ravelling, Rutting). PDI > 60 triggers rehab.

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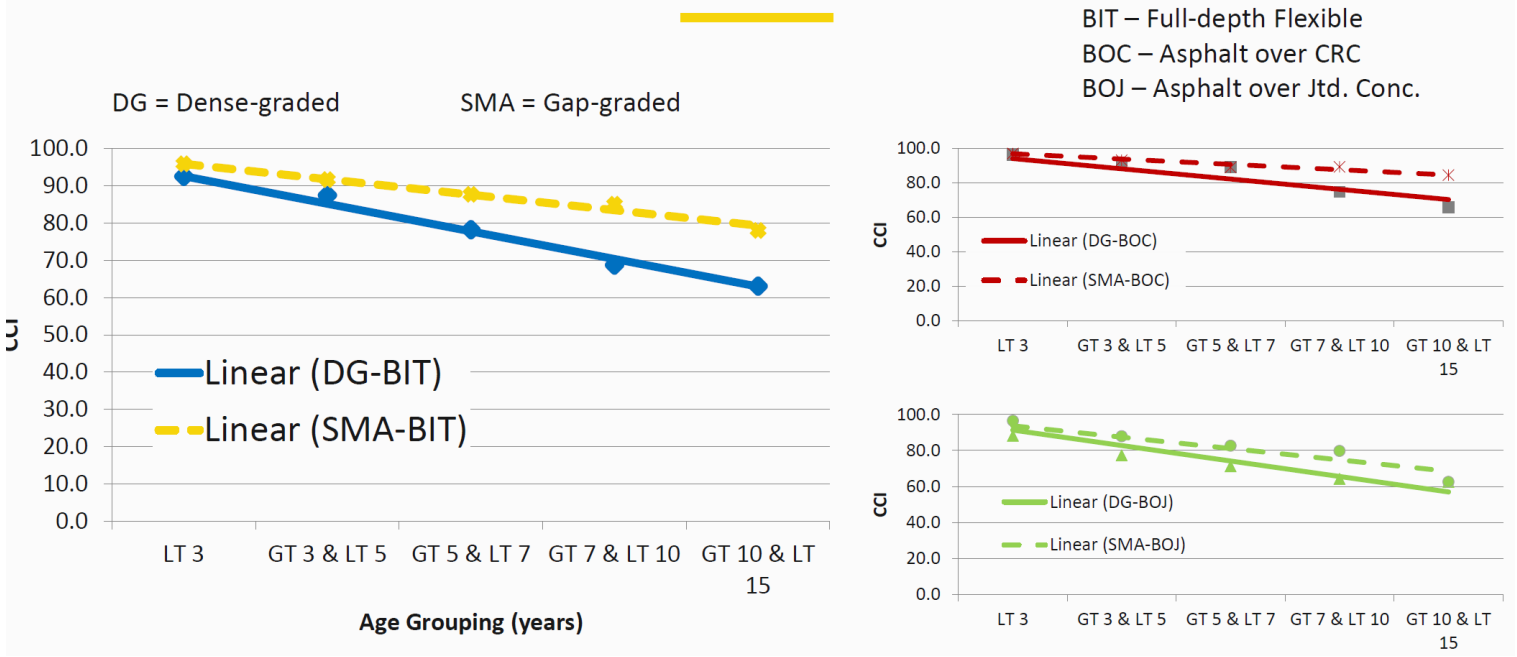
Virginia's Experience



*Courtesy of Trenton Clark

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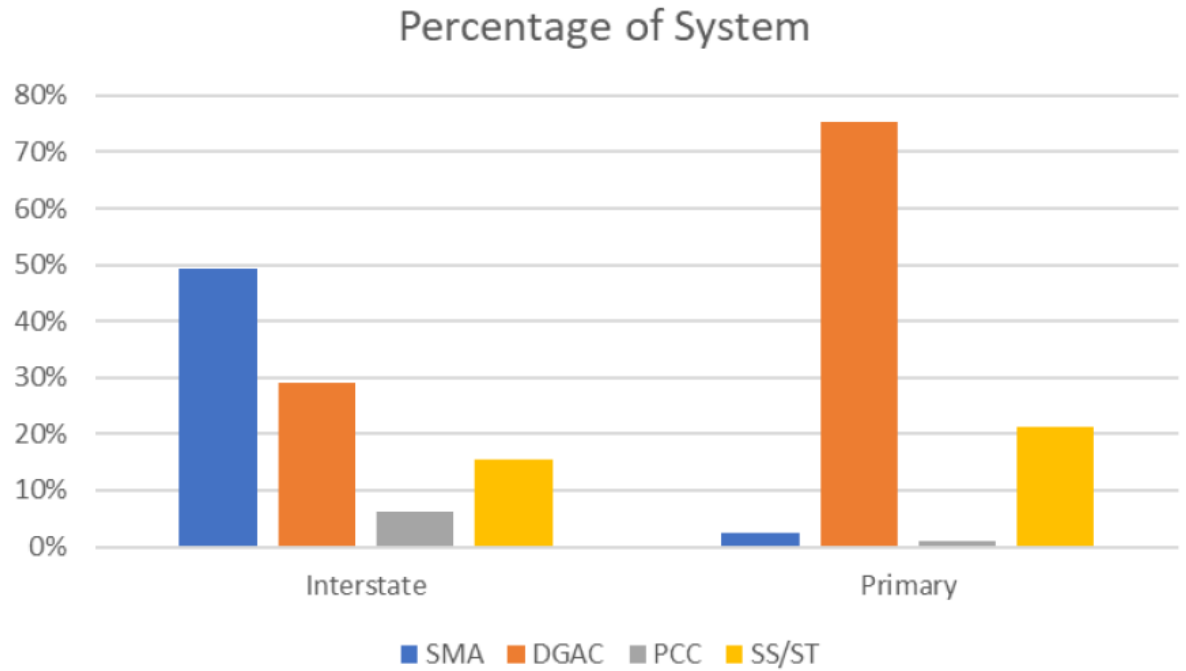
Virginia's Experience



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Others Nearby

- Missouri uses SMA
  - Contractors can innovate with recycled materials such as RTR and some RAP
- Maryland
  - Secretary Rahn – “Why wouldn’t you use SMA?”
- Georgia
  - Experimenting with different aggregate properties to still maintain performance

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To Fiber or Not to Fiber …

- WMA additives
- Recycled tire rubber
- Recycled asphalt shingles
- What next???

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NAPA/NCAT Study on Performance

Summary – Flexible Pavements

Highway Agency	Performance Measure	Predicted Service Life (Years)		SMA Life Extension (Years)
		SMA	Superpave	
Alabama DOT	Pavement Condition Rating	16.2	16.6	-
Colorado DOT	Rutting Cracking	17.0	17.4	-
Georgia	PACES Rating	16.0*	11.0*	**5.0**
Maryland SHA (Interstate)	Rutting Cracking Index	24.8	26.9	-
Maryland SHA (Principal Arterial)	Rutting Cracking Index	32.2	24.0	**8.2**
Minnesota DOT	Ride Quality Index Surface Rating	16.6*	11.3*	**5.3**
Virginia DOT	Critical Condition Index	19.0	14.4	**4.6**

*Note: * PMS data from a limited number of pavement sections*

*Courtesy of Fan Yin

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NAPA/NCAT Study on Performance

Summary – Composite Pavements

Highway Agency	Performance Measure	Predicted Service Life (Years)		SMA Life Extension (Years)
		SMA	Superpave	
Illinois Tollway	Overall Condition Rating Survey	13.5	9	**4.5**
Maryland SHA (Principal Arterial)	Rutting Cracking Index	21.8	19.6	**2.2**
Michigan DOT	Overall Distress Index	22.2	21.3	**0.9**
Pennsylvania DOT (Interstate)	Overall Pavement Index	21.1*	22.2	-
Pennsylvania DOT (Non-Interstate)	Overall Pavement Index	24.5*	11.0	**13.5**
Virginia DOT	Critical Condition Index	23.1	12.8	**10.3**

*Note: * PMS data from a limited number of pavement sections*

*Courtesy of Fan Yin

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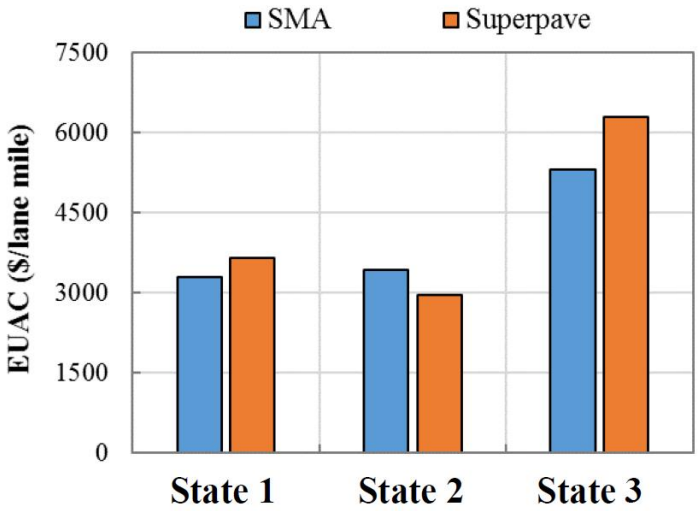
NAPA/NCAT Study on Performance

LCCA Case Study Summary



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What's Coming

- A new SMA Best Practices Manual from NAPA
- Updated SMA page on NAPA Website
  - New reports
  - Conference presentations
- Webinar on NAPA/NCAT study – Jan 28, 2019

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Thank you!

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