SCDOT CMRB and Other Paving Updates

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Overview

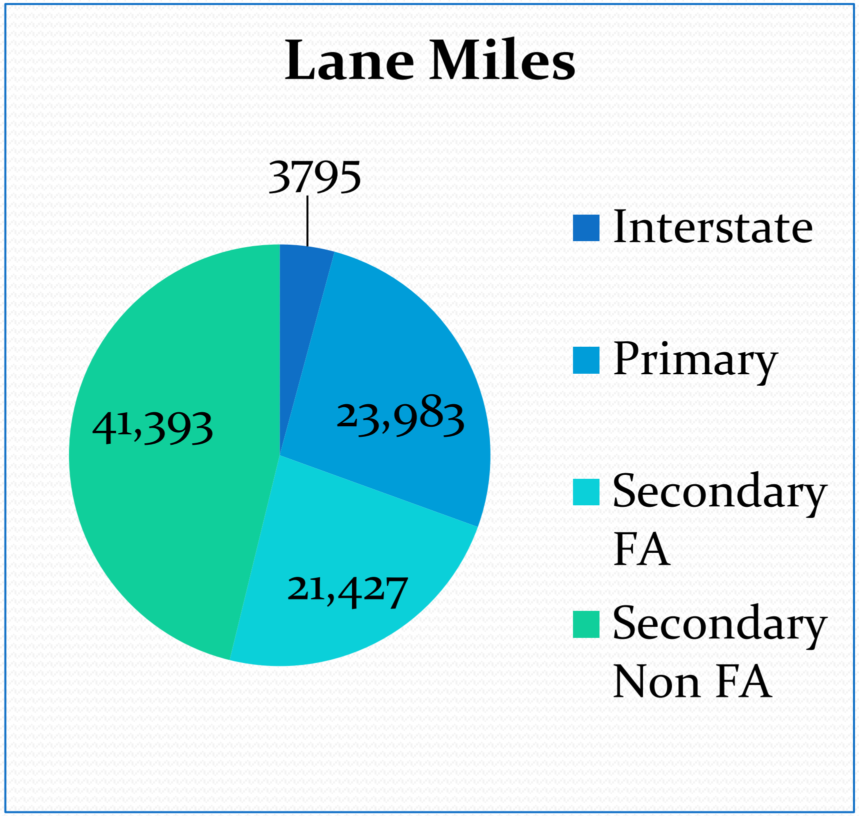
- System Needs
- Approach to a Solution
- History of FDR Program
- Past Procedures
- Moving Forward

South Carolina System

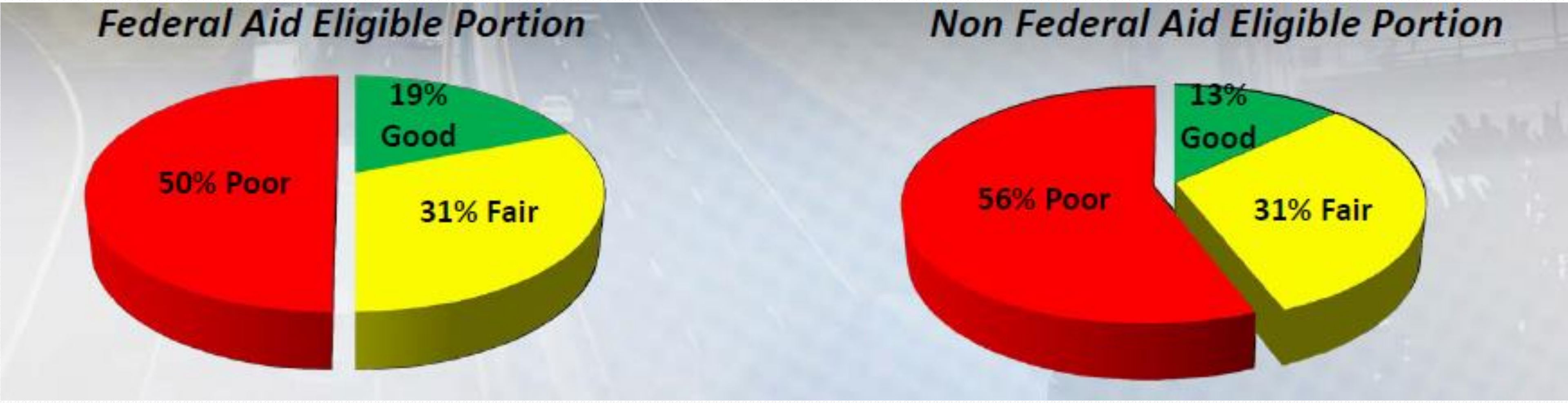
2015 State of the Pavement

- Pavement System
  - 4th Largest in Country
  - 41,377 Centerline Miles
  - 90,598/ lane miles
  - Primaries and Secondaries Carry 70% of Traffic

Lane Mile Breakdown



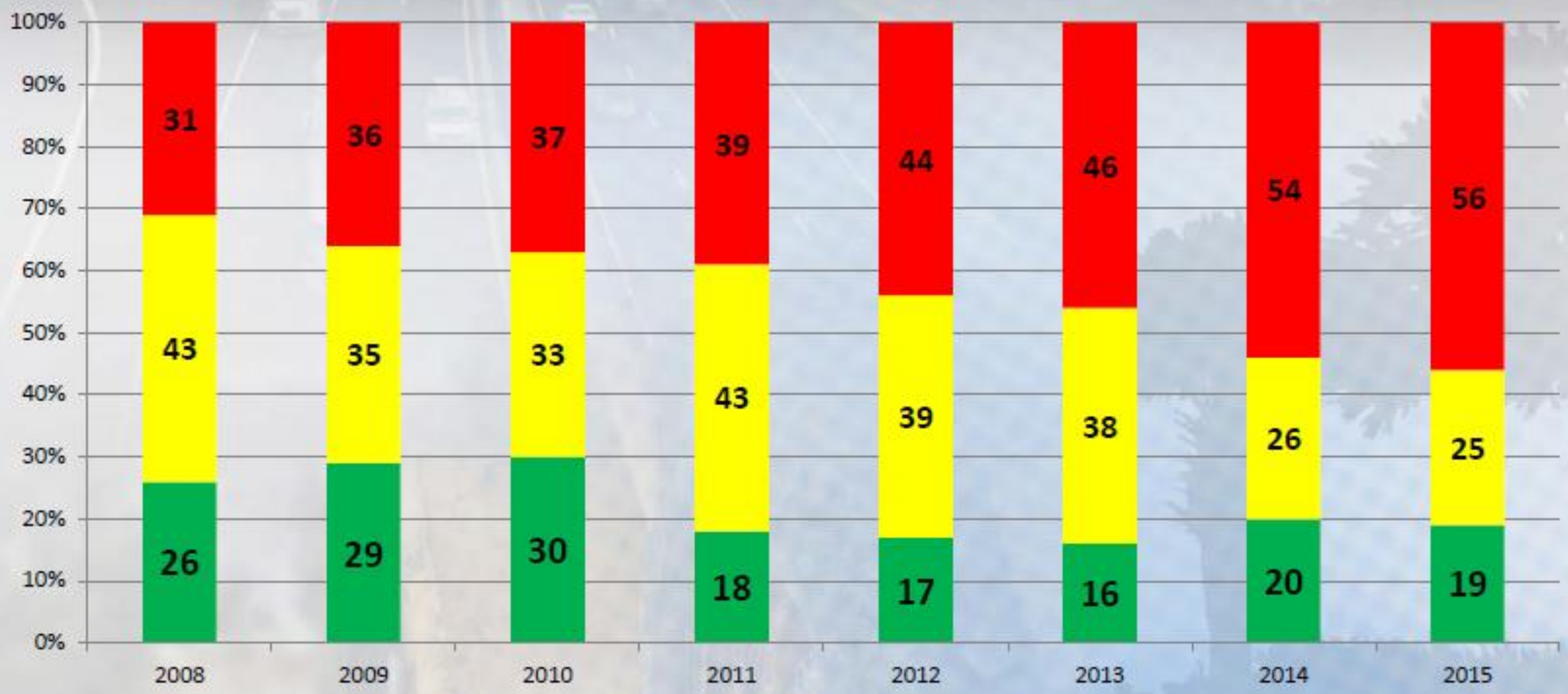
South Carolina Secondary System



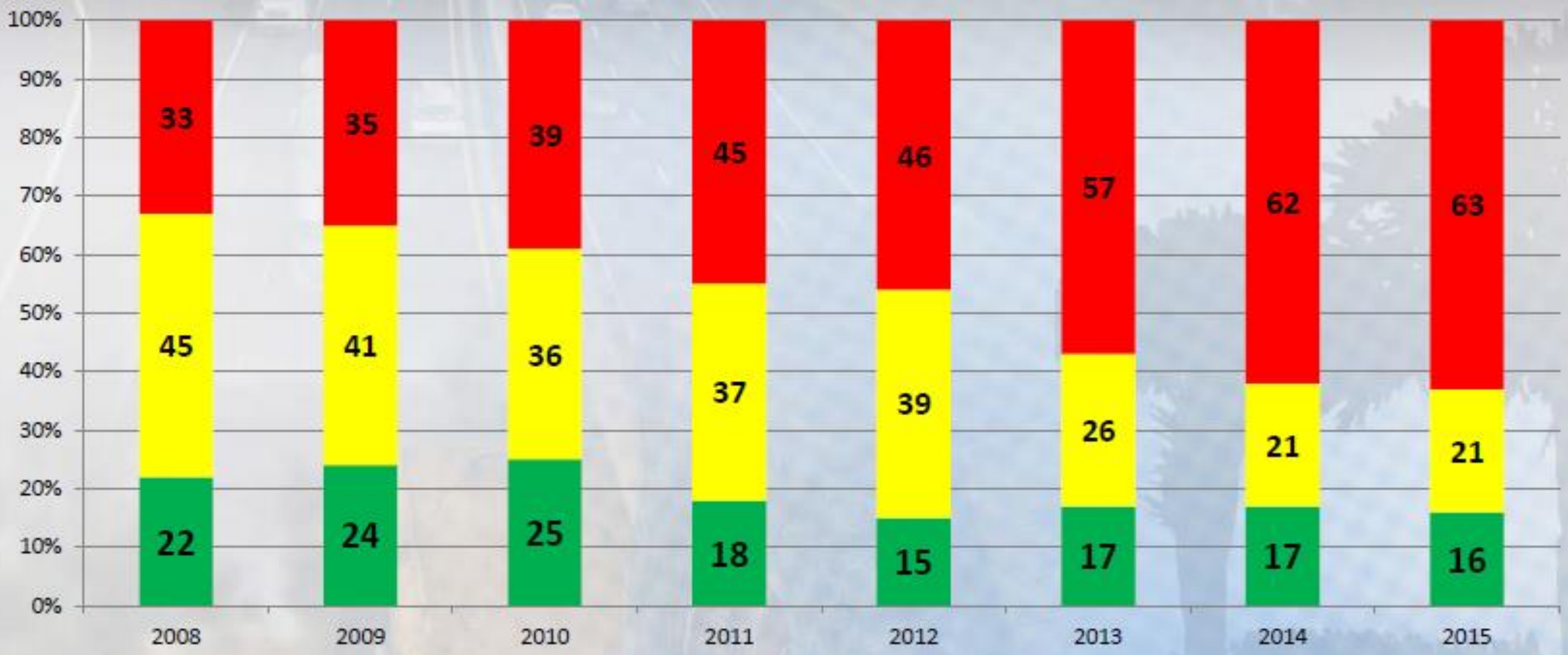
Driving Factors: Initial Construction and Funding for Rehabilitation

December 31, 2015 Data

Primary System: % Pavement in Good, Fair & Poor Condition



Non-NHS Primary: % Pavement in Good, Fair & Poor Condition

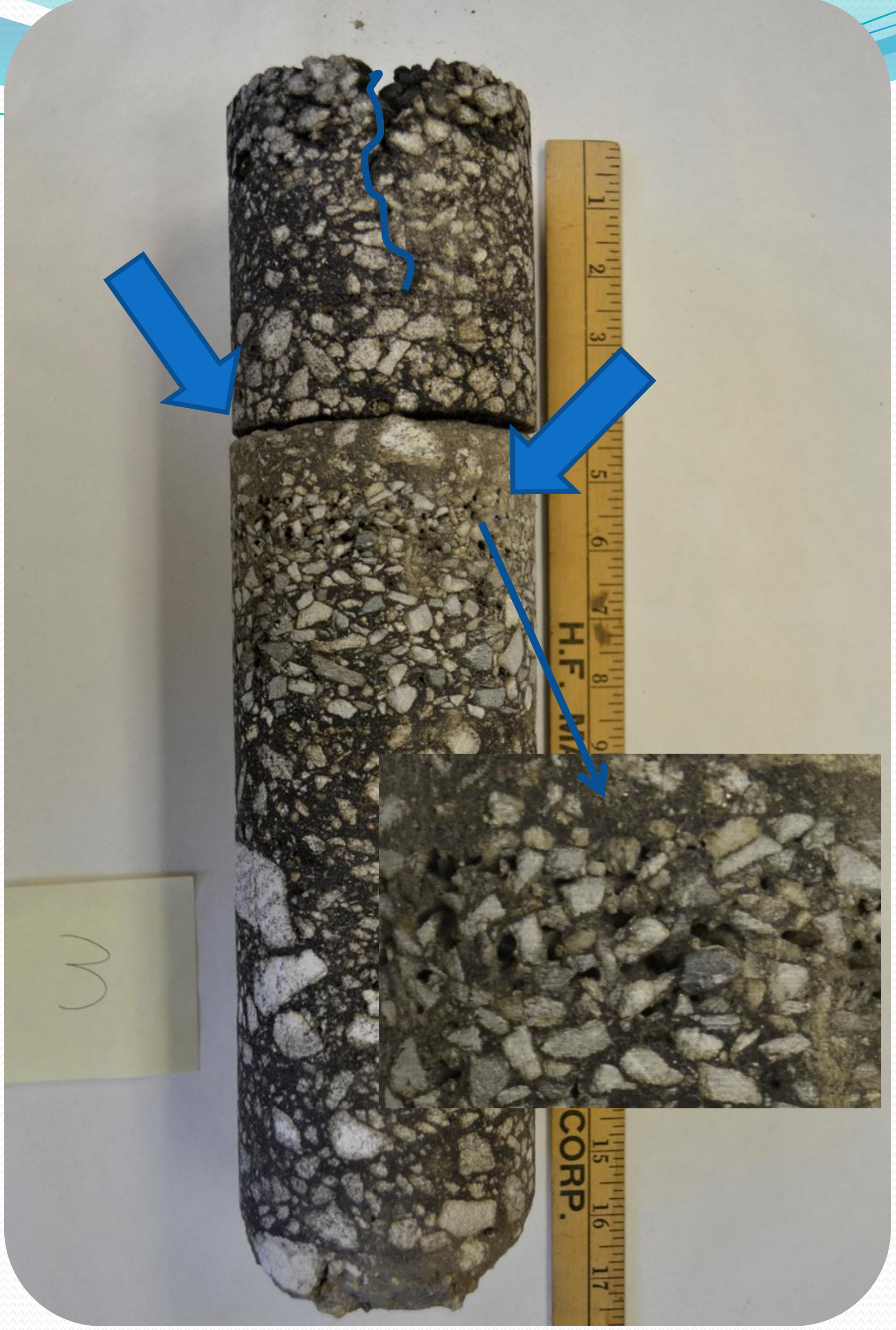


How Did We Get Here?

- Designs never intended to carry this much traffic
- Age of system
- Design life and vertical build up limitations
- Prolonged maintenance cycles, not always fully addressing distress
- Lack of funding
- Repairs last shorter periods

How Do We Fix It?

- Identify the type and extent of distress
- Fix the distress by selecting appropriate rehabilitation strategy
- Investigate and develop new rehabilitation strategies



Optimizing Design

- Simple math vs. incorporation of fixing distress
- Move towards mechanistic design
- Reduce critical stresses in bottom of pavement
- Improve material durability and proper pavement layer selection
- Improve preservation program to keep the good roads good

SCDOT CMRB Usage Began 1994

SC Route 97 (1994)

SC Route 97 (2013)

9 Inches CMRB, 225 psy Intermediate, 175 psy surface

Growth and Current CMRB Program

Growth of CMRB Over 20 Years

- Modest Beginnings
- Within in the first 10 years FDR became recognized across the state but was still less than 100 lane miles per year.
- By the year 2011 the use of FDR was accelerating beyond 100 lane miles per year.
- Due to Funding and Program needs this fluctuated between 100 and 200 lane miles per year until 2015 when the program grew by more than 3x to 600 lane miles per year.

CMRB – Current Program

- During 2015 and 2016 the program has remained relatively constant at more than 600 lane miles
- **4,494,223 square yards let in 2015**
- Our cost is approximately **$5 per square yard**
- **Overall the program has been very successful**
- Some issues with quality as new competition has entered the market and application of FDR has significantly increased

Moving Forward-Improving CMRB and Exploring Other Tools

Moving Forward - CMRB

- Contract Development
  - Projects moving into PreConstruction from Maintenance
  - Increased efforts during investigation and candidate selection
  - Coring, DCP and hand auger borings to be provided in contract documents

- Pavement and Mixture Designs
  - Utilize lessons learned from mechanistic design studies to optimize cement usage
    - Increase mixing depths and reduce cement content (effective 2016)

Moving Forward – Pavement Rehabilitation Tools

- Growth
  - Education of SCDOT construction personnel, contractors, consultants
- Optimization
  - Investigate procedures and specifications to allow for increased use of CMRB on higher volume roadways
  - Start trial projects utilizing alternative stabilizing agents and procedures (CIP & CCPR)

Moving Forward – Pavement Rehabilitation Tools

- Research
  - MEPDG Phase II
  - MEPDG Bound and Unbound Bases
  - Rehabilitation Strategies for Non-Interstate Routes
  - In House CMRB Research
    - Field Performance Evaluation
    - Gradation – Compaction – Moisture – Cement Content - Compressive Strength - Durability
  - Update SCDOT Pavement Design Guide
- End Result
  - Keep things reasonable for technicians and contractors. Find key factors to focus on.
  - Maintain a good cost benefit ratio for SCDOT
  - **<u>Set up projects for preservation</u>**

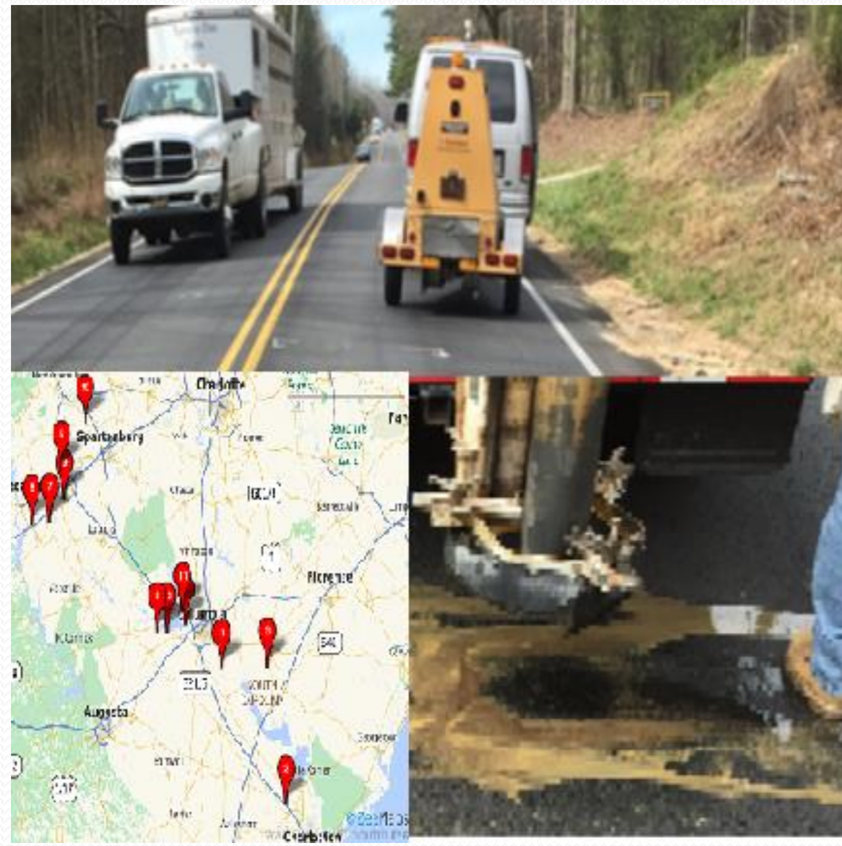
Improving Cement Modified Recycled Base

CMRB

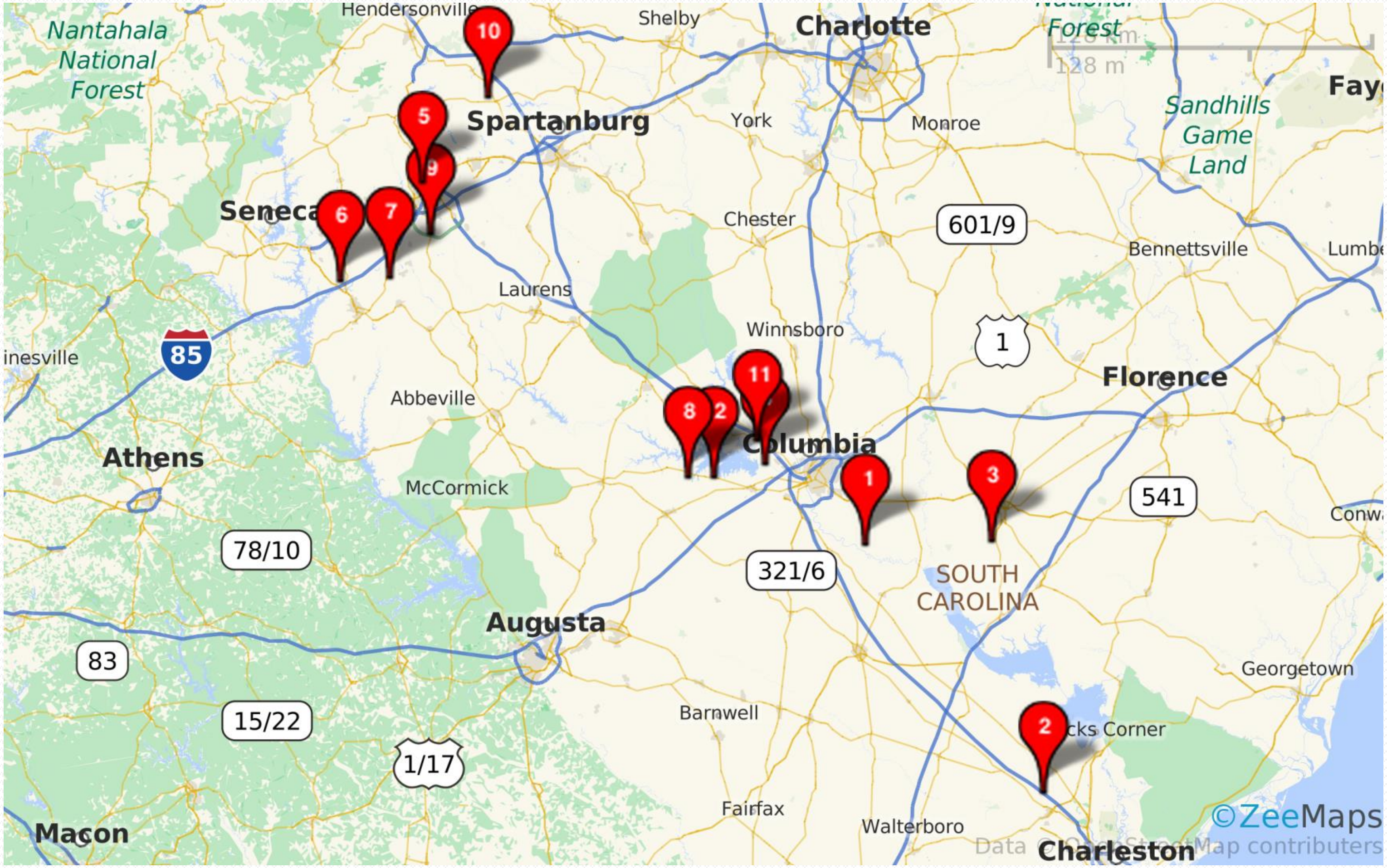
- Field Performance Review
  - FWD Testing
  - Cores
    - Depth Checks
    - Compressive Strength Determination
- Field Observations
- Lab Study
  - Compressive Strength
  - Durability
  - Compressive Strength
- CMRB Changes

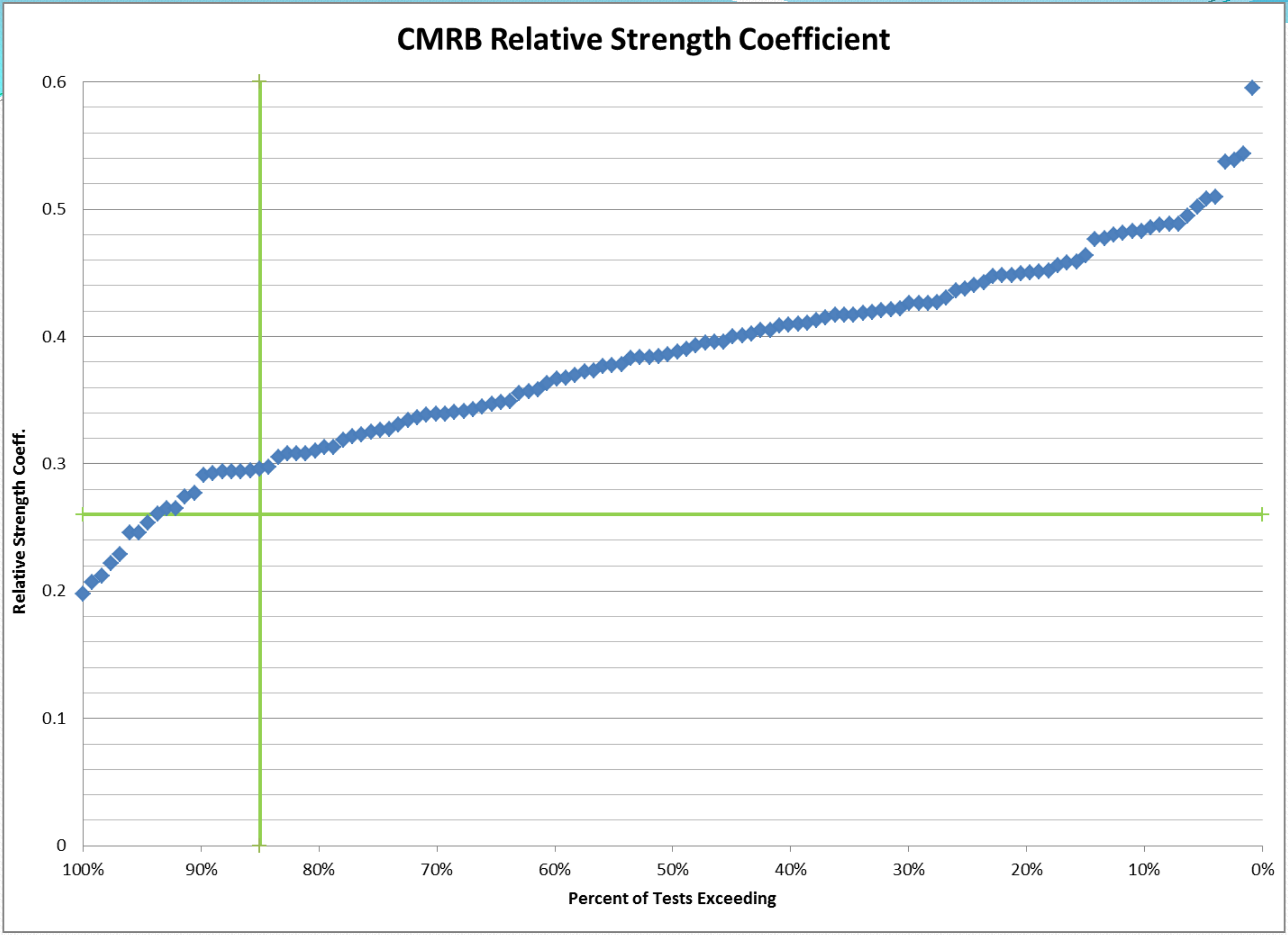
CMRB Field Performance Review

- Contractors
  - 8 contractors
- Locations
  - 11 completed
  - 5 ongoing
- Depth
  - 8-11 inches
- Cement Percentages
  - 3.5% - 9%
- Design Strengths
  - 250 - 610 psi



Field Performance Review Locations



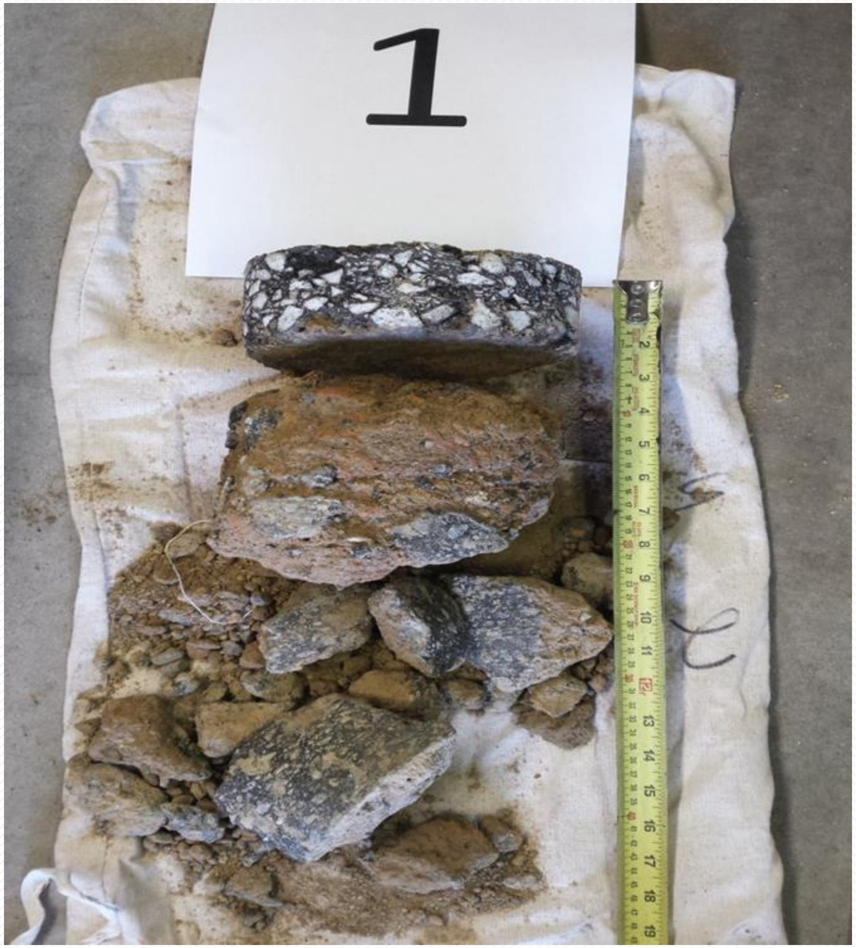

CMRB Relative Strength Coefficient
Relative Strength Coeff.
0.6
0.5
0.4
0.3
0.2
0.1
0
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
0%
Percent of Tests Exceeding

CMRB Field Performance

- Project Test Results
  - FWD Testing
    - 9 Meet or exceeded expectations
    - 2 Below expectations
    - Ranges (0.23 to 0.43)
  - Cores
    - Qualitative Observations
    - Compressive Strengths
      - Ranges (0% to 160% of design strength)

CMRB Field OBSERVATIONS

Pulverization

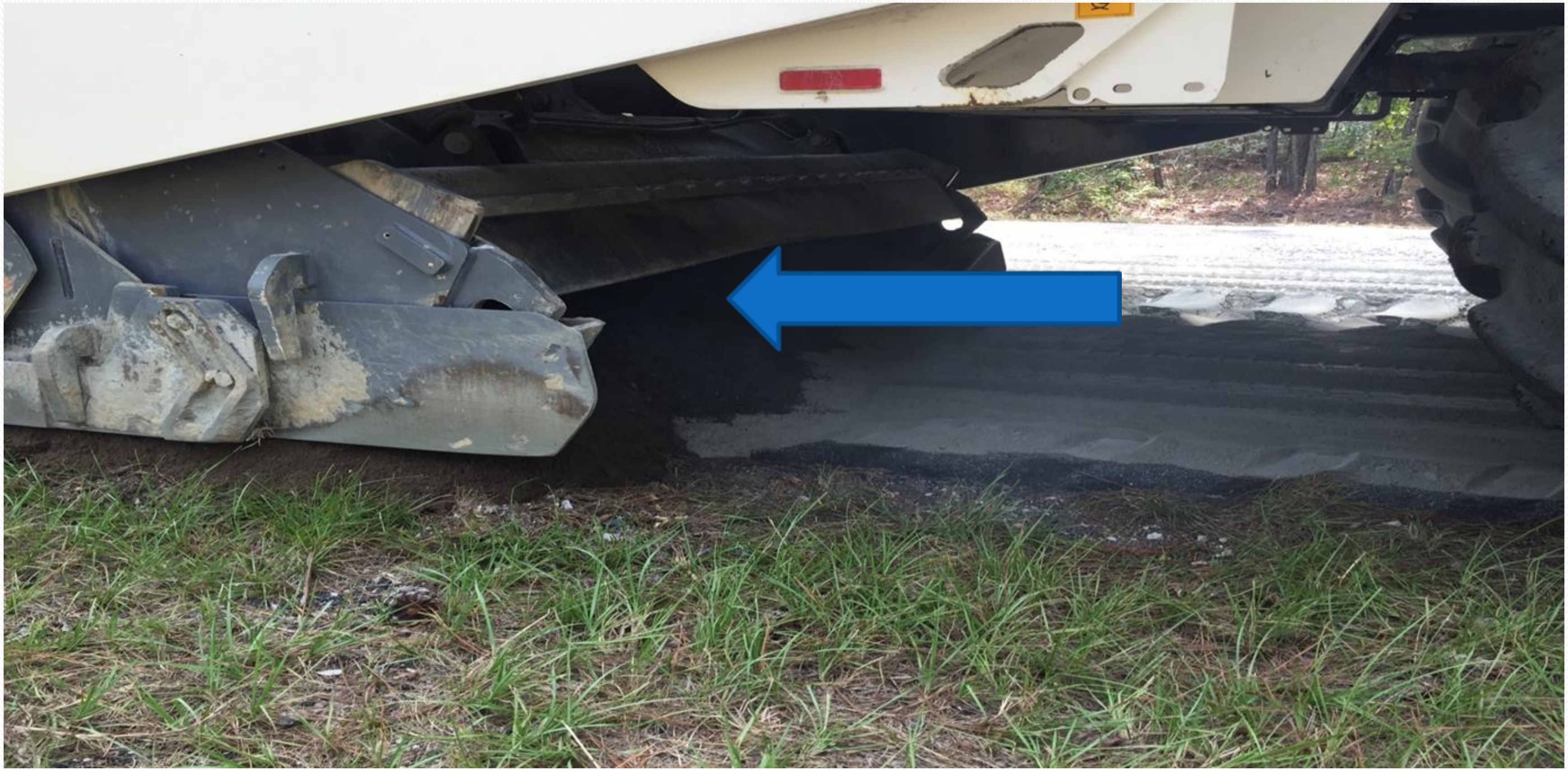


Pulverization

The front rotor plate opens wide and is equipped with a crusher bar ...

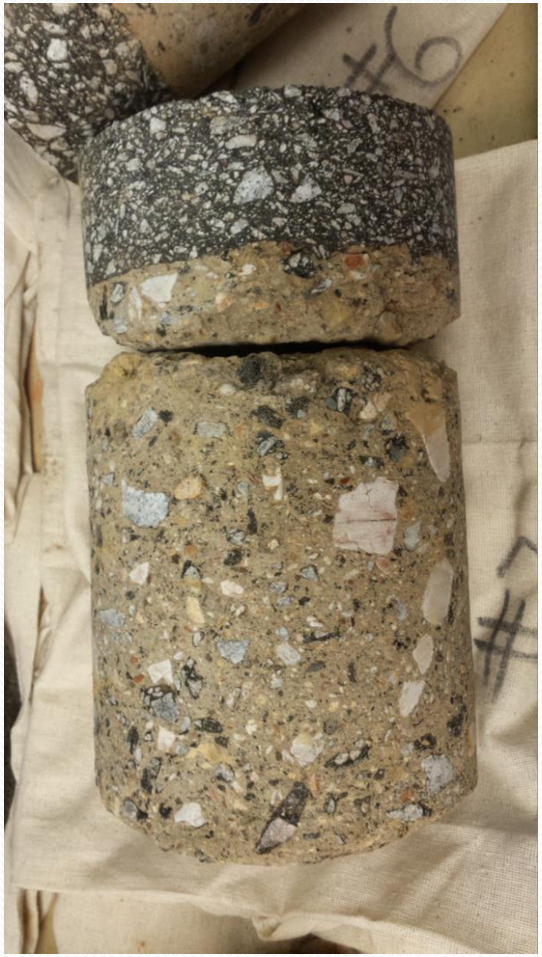
... which can be adjusted to produce the specified particle size

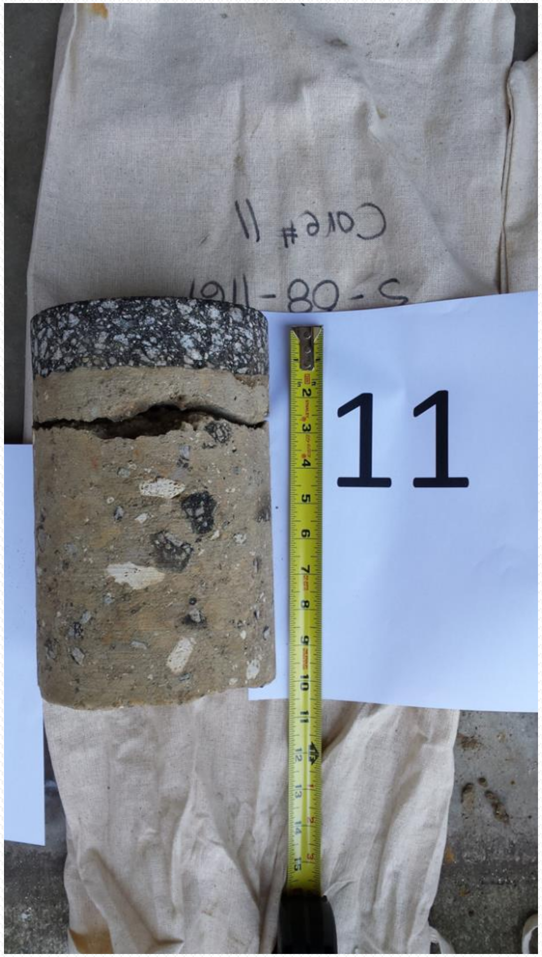
Pulverization



Surface Moisture

Delamination / Final Grading





Surface Chatter

Surface Chatter

Surface Chatter

CMRB LAB Study

CMRB Lab Study

- Variables
  - Compactive Effort
  - Subgrade Type
  - Rap Percentages
  - Cement Percentages
- Properties
  - Compressive Strength
  - Durability

CMRB Changes

CMRB Operational / Specification Changes

- Preliminary Investigation
- Contractor Quality Control Plan
- Project Test Strip
- Tighter Moisture Tolerance
  - Optimum to +2 %

Cement Stabilized Aggregate Base UPdate

CSAB Study Implementation

- New Specification
  - SC-M-308
  - Released in 10/2015.
  - Main Changes
    - New Mix Design
    - Contractor Required QC Plan
    - Test Strip
    - Trial Batch
    - Tighter Moisture Tolerance
    - Required Cylinders
    - Depth Checks – Core holes

Developing New Recycling Tools

Table 15-1: Stabilizing Agent[1] Selection Guide for FDR Mixtures Including RAP

Material Type - Including RAP	Well Graded Gravel	Poorly Graded Gravel	Silty Gravel	Clayey Gravel	Well Graded Sand	Poorly Graded Sand	Silty Sand	Clayey Sand	Silt, Silt with Sand	Lean Clay	Organic Silt/Organic Lean Clay	Elastic Silt	Fat Clay, Fat Clay with Sand
USCS[2]	**GW**	**GP**	**GM**	**GC**	**SW**	**SP**	**SM**	**SC**	**ML**	**CL**	**OL**	**MH**	**CH**
AASHTO[3]	**A-1-a**	**A-1-a**	**A-1-b**	**A-1-b A-2-6**	**A-1-b**	**A-3 or A-1-b**	**A-2-4 or A-2-5**	**A-2-6 or A-2-7**	**A-4 or A-5**	**A-6**	**A-4**	**A-5 or A-7-5**	**A-7-6**
Emulsified Asphalt SE > 30 or PI < 6 and P_{200} < 20%	X	X	X	X	X	X	X						
Foamed Asphalt PI < 10 and P_{200} 5 to 20%	X		X	X	X		X						
Cement, CKD or Self-Cementing Class C Fly Ash PI < 20 SO_4 < 3000 ppm	X	X	X	X	X	X	X	X	X	X			
Lime/LKD PI > 20 and P_{200} > 25% SO_4 < 3000 ppm								X		X		X	X

Cold In-Place Recycling

CIR

- Utilizes equipment train that converts a distressed pavement into a rehabilitated pavement ready for surface treatment.

  - Mills Recycled Pavement
    - 2-5 inches
  - Mixes with Recycling Agent and other additives
    - Foam / Emulsion
    - Cement / Lime
  - Repaves Recycled Mix
  - Compacts to a Specified Density

CIR

CIR

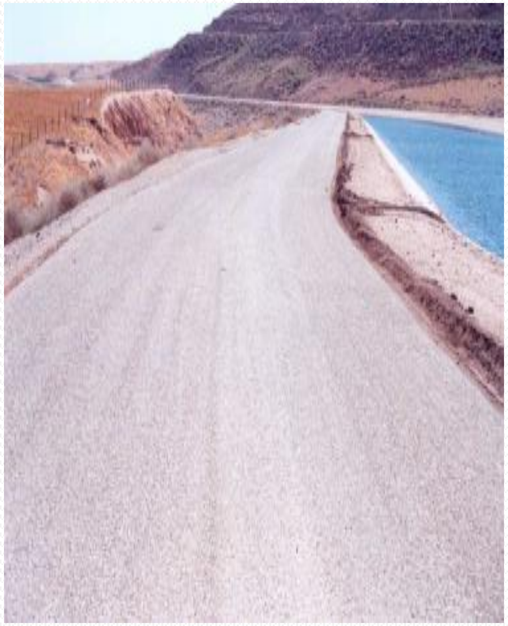
CIR

CIR

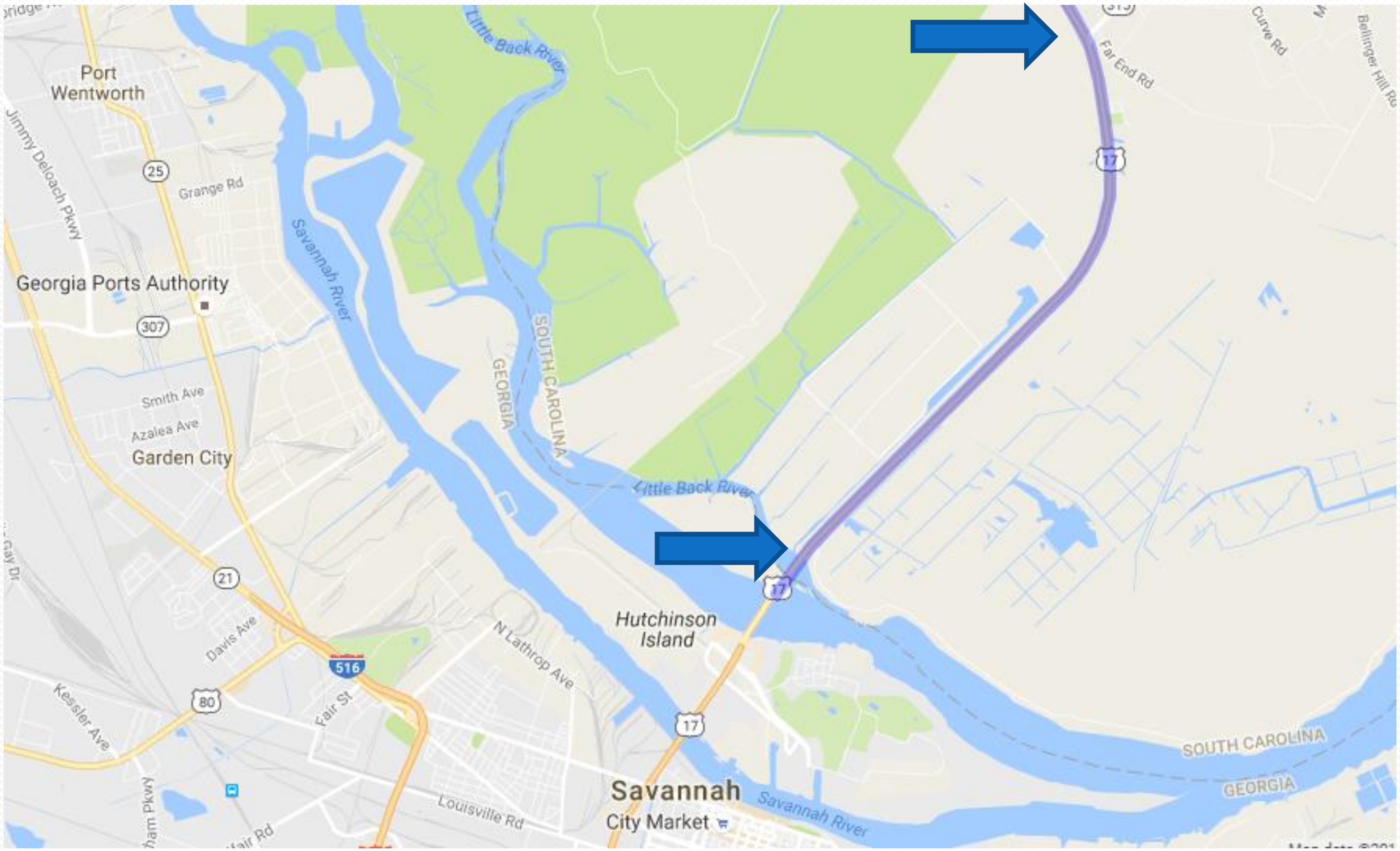
CIR

CIR

Because of higher void ratio's CIR/CCPR surfaces must be sealed.



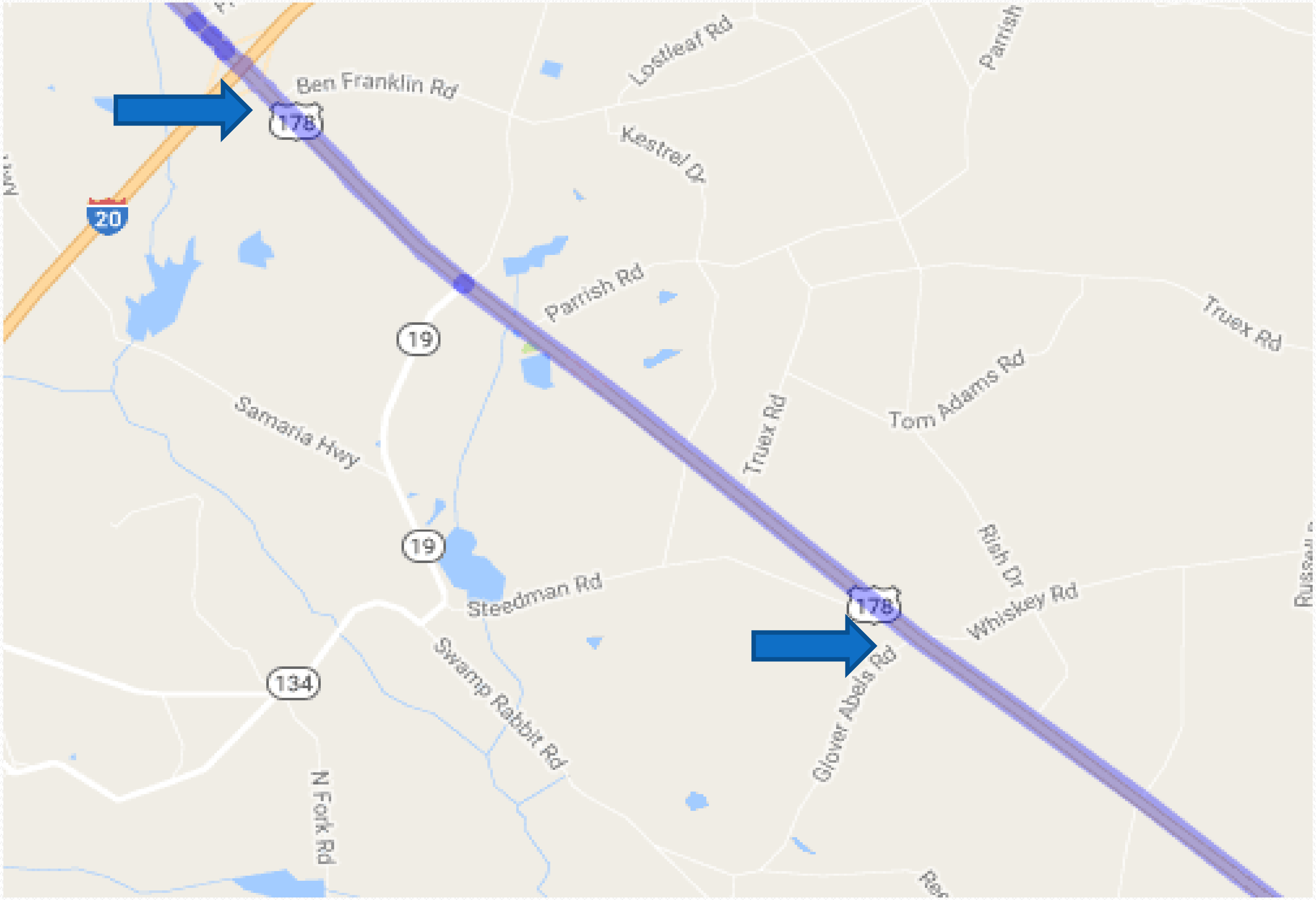
US-17 CIR



Port Wentworth
Jimmy Deloach Pkwy
Grange Rd
Georgia Ports Authority
Smith Ave
Azalea Ave
Garden City
Davis Ave
Kessler Ave
Fair St
Louisville Rd
N Lathrop Ave
Savannah River
Little Back River
GEORGIA
SOUTH CAROLINA
Hutchinson Island
Savannah
City Market
Far End Rd
Curve Rd
Bellinger Hill Rd
25
307
21
516
80
17

US-17 CIR

US 178



Ben Franklin Rd
178
20
Loblolly Rd
Kestrel Dr
Parrish
Parrish Rd
19
Samaria Hwy
Truex Rd
Tom Adams Rd
Truex Rd
19
Steedman Rd
Rish Dr
178
Whiskey Rd
134
Swamp Rabbit Rd
Glover Abels Rd
N Fork Rd

US 178

Cold Central Plant Recycling

CCPR

CCPR

CCPR

CCPR

CCPR

CCPR

Conclusions

- Pick the right fix for the problem
  - System Needs
  - Approach to a Solution
  - Improving Current Products / Procedures
  - Moving Forward

Questions