#### FEATURE CORE INNOVATION AREA (CIA) TEAM PRESENTATION:

### CIA TEAM INFRASTRUCTURE PRESERVATION

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# PAVEMENT PRESERVATION ON HIGH TRAFFIC VOLUME ROADWAYS – WHEN, WHERE & HOW?

NJ State Transportation Innovation Council (STIC) Summer Meeting, June13, 2018

### ACKNOWLEDGEMENTS

- Susan Gresavage, Executive Manager, NJDOT PDM&T
- Pavement & Drainage Management & Technology

#### PAVEMENT PRESERVATION ON HIGH TRAFFIC VOLUME ROADWAYS – WHEN, WHERE & HOW?

#### Combination of STIC Innovations

- Pavement Preservation (When and Where)
- Pavement Preservation (How)
- Guidelines for the Preservation of High-Traffic-Volume Roadways (R26)
- Small "Pieces" to larger "Puzzle" at NJDOT
  - Asset Management
  - Pavement Preservation Program
  - 2004 present



### PAVEMENT PRESERVATION PROGRAM

#### 2000 - 2004

- "Worst First" Resurfacing Approach
- Used a hammer for most jobs
- Mill 2" Asphalt and Pave 2" Asphalt
- Not many "tools in the toolbox"
- No dedicated funding for "pavement preservation"

#### Where we started...



### NJDOT PAVEMENT PRESERVATION PROGRAM

2018 NJDOT TAMP submitted to FHWA

2017 USDOT Finalized TAMP & PM Rules

- 2015 USDOT Refined AM (FAST) & NJDOT Increased Pavement Preservation Funding
- 2012 USDOT Initiated AM (MAP-21)(NHS)

 2007 NJDOT Adopted AM (SHS) & Line Item for Pavement Preservation in STIP

2005 NCPP/FHWA Preservation Technical Appraisal

2004 NJDOT Merged Pavement Management with Pavement Design

#### PAVEMENT PRESERVATION ON HIGH-TRAFFIC-VOLUME ROADWAYS – WHEN, WHERE & HOW?



- NJDOT is headed in the right direction
  - Pavement Preservation Program is very robust!!
  - The 3 STIC initiatives assist with
    - Documentation
    - Benchmarking
    - Evaluation/Analysis
    - Making some improvements
    - Training
    - Validation

### NJDOT PAVEMENT PRESERVATION AND ASSET MANAGEMENT

#### • Economy of Pavement Preservation

Condition	Treatment	Treatment Life	Cost
Good-Fair	Pavement Preservation	5-10+ years	\$75-250K/LM
Fair-Poor	Minor Rehab & Resurfacing	10+ years	\$300-350K/LM
Poor	Major Rehab & Reconstruction	10+ years	\$750K-1M+/LM

 Pavement management system recommends \$100M+ annual preservation program





Good = |R| < 95 and  $SD| \ge 3.5$ 

 $Poor = |R| > 170 \text{ or } SD| \le 2.4$ 

Fair = Everything in between

### PRESERVATION PROJECT SELECTION

- Time based (4-8 year window)
- Assess condition and performance
- Select specific preservation treatment based on
  - Road type
  - Condition
  - Traffic volumes
  - Other unique project characteristics



#### NJ State Highway System Annual Preventive Maintenance Pavement Investment



Millions

#### NJ State Highway System Lane Miles of Major Pavement Work Completed (Total System Mainline Lane Miles = 8542)







### HIGH PERFORMANCE THIN OVERLAY (HPTO)



- "Work Horse" of preservation program
- Applicable for NJ highest ADT roadways
- 1 inch thick Surface Course
  - High quality 4.75mm NM Aggregate
  - Polymer modified asphalt binder PG 64-22E or better
  - Can be used for leveling when required in lifts 0.5 inch to 1.5 inch thick

### WHAT IS HPTO?

- HPTO must meet mixture performance requirements
  - Texas Overlay Crack
     Tester
    - Cycles > 600 in OT
  - Asphalt Pavement Analyzer Rut Tester
    - Rut < 4mm in APA



2,800 Cycles

### HPTO PAY ADJUSTMENT

Table 902.08.03-1 Performance Testing Pay Adjustments for HPTO				
Test	Requirement	Test Result	PPA	
APA @ 8,000 loading cycles, mm (AASHTO T 340)	5.0 maximum	t ≤ 5.0 5.0 < t ≤ 12.0 t > 12.0	0 -50(t-5)/7 -100 or Remove & Replace	
Overlay Tester, cycles (NJDOT B-10)	600 minimum	t ≥ 600 600 > t ≥ 400 t < 400	0 -(600-t)/4 -100 or Remove & Replace	





## HPTO ADVANTAGES



- Can improve ride quality (IRI) **significantly**
- Seals out water
- Renew road surface
- Quick open to traffic
- Minimal to zero RAP

## HPTO ADVANTAGES

- Placed with a conventional paver or <u>ultra-thin paver</u>
- Excellent life extension (12+ years) = durability
  - Mill 2" pave 2" w/ HMA = 8 years average life
- Low tire noise
- Improves skid resistance (SN = 50)
- Applicable to all roadways





# ULTRA-THIN FRICTION COURSE (UTFC)

- ¾ inch thick Thin Bonded Hot Mix Asphalt (HMA) Overlay
  - Like Novachip (but not proprietary)
- 4.9 6.0 % polymer modified (PG 64E-22) asphalt binder
- Volumetric Mix Design Requirements
- 9.5 mm nominal maximum size high quality aggregate
  - Gap/open graded HMA
  - Flakiness Index (cubicle aggregate)

### WHAT IS UTFC?



- Spray paver
- Self priming paver
- Polymer Modified
   Emulsified Asphalt Tack
   Coat
  - CRS 1P



### ULTRA-THIN FRICTION COURSE VIDEO

Link for video

## ULTRA-THIN FRICTION COURSE

- Benefits:
  - Improvement in ride quality
  - Improves wet weather skid resistance/spray
  - Seals out water
  - Renew road surface
  - Quick open to traffic (300 feet!!)



## ULTRA-THIN FRICTION COURSE



- Benefits:
  - Minimal milling = minimal to zero rap
  - Placed with spray paver
    - Ensures <u>superior bond</u> with existing pavement
    - No tracking tack coat by HMA trucks!!
  - Great performance when designed and constructed properly (Rt.195 WB, 2000)

#### Cold applied mixture of:

- Polymer modified asphalt emulsion (CQS-1hP)
  - SB, SBS, SBR or natural latex
- High quality aggregate
- Mineral filler
- Water
- Additives





- Capable of being spread in variable cross-sections:
  - Wedges
  - Ruts
  - Longitudinal joints micropaving joints
  - Scratch or intermediate layer
  - Surface treatment
- Typically applied at 20 lbs/SY aggregate + 0.35 gallons/SY asphalt emulsion

- A System high quality aggregate and emulsion compatibility and consistency is vital
- Should maintain a skid-resistant surface (high wet friction coefficient)
- Type 2 (ISSA)
  - ¼" nominal maximum aggregate size



### MICRO-SURFACING/SLURRY EQUIPMENT

- Types:
  - Truck mounted
  - Continuous paver
- Mixing Equipment
- Proportioning Devices
- Spreading Equipment
- Support equipment





Figure 6.3 Flow Diagram of a Typical Slurry Seal Mixer





### MICROPAVING LONGITUDINAL JOINTS





#### MICRO-SURFACING / SLURRY SEAL VIDEO

# Link for video

- Benefits:
  - Maintains existing ride quality
  - Improves skid resistance
  - Seals out water
  - Renew road surface
  - Quick open to traffic
  - Minimal to zero rap
  - 25-40% of the cost to mill and pave



### CHIP SEAL

#### Asphalt binder application

- 0.40 0.65 gallons/SY
- Polymer modified asphalt emulsion
- Crumb rubber modified
- High quality aggregate application immediately following the asphalt binder
  - 6.25 9.5 mm (1/4 3/8 inch) aggregate size
  - Clean and cubicle



### CHIP SEAL

#### Asphalt "Glue" + Stone "Chip"



#### Compaction "Seating"



### CHIP SEAL – VACUUM SWEEPING

![](_page_34_Picture_1.jpeg)

### CHIP SEAL

- Benefits:
  - Maintains ride quality but no improvement
  - Seals out water
  - Durable
  - Fast renewal road surface
  - Quick open to traffic

![](_page_35_Picture_7.jpeg)

### CHIP SEAL

![](_page_36_Picture_1.jpeg)

- Benefits:
  - Improves skid resistance
  - Minimal to zero rap
  - Ease of construction
  - Historically the **most** cost effective thin overlay treatment

### FOG SEAL

- Mixture of asphalt emulsion and water
  - SS-1h, CSS-1h, or CQS-1h
  - Other proprietary products available
- Applied with asphalt distributor (0.06-0.10 gallons/SY)
  - Higher application rates with light sand
- Light sand application (0.25 to 0.5 lbs./sy)
  - Skid resistance

![](_page_37_Picture_8.jpeg)

### FOG SEAL

![](_page_38_Picture_1.jpeg)

### FOG SEAL WITH LIGHT SANDING

![](_page_39_Picture_1.jpeg)

- RE should base acceptance on visual inspection
  - Proper coverage
    - Fog seal emulsion
    - Sand
  - Random sampling and testing of emulsion

### FOG SEAL

- Benefits:
  - Maintains ride quality but no improvement
  - Seals out water
  - Preserves surface
  - Quick open to traffic
  - Zero RAP
  - Pennies on the dollar

![](_page_40_Picture_8.jpeg)

### MICRO-MILLING

- Finest milling available = Ideal for Thin Preservation Treatments
- Maintain elevations where necessary
  - Transitions for thin overlays beginning and end of treatment
  - Bridge approaches
  - Bridge vertical underclearance
- Ride quality improvement

![](_page_41_Picture_7.jpeg)

![](_page_42_Picture_0.jpeg)

# MICRO-MILLING

- RE acceptance based on
  - Texture depth using sand patch test (ASTM E 965)
    - 4mm maximum allowable
  - Visual inspection
  - Ride quality if micro-milling will be final riding surface

# QUALITY MICRO-MILLING

- Provides better bonding for thin preservation treatments
- Smoothest surface of milling
- Can be used as a final riding surface
- Ideal milling for thin preservation treatments

![](_page_43_Picture_5.jpeg)

### SUCCESSES+CHALLENGES+OPPORTUNITIES = LESSONS

![](_page_45_Picture_0.jpeg)

- Weather Limitations
  - 50-60°F and rising
  - Dry pavement with no precipitation forecasted
- Limitations to some thin surface treatments
  - Slurry seal, micro-surfacing, chip seal, fog seal (cape seal?)
    - May not be suitable for **some high traffic volume**, truck traffic, turning movements
    - Higher tire noise than HMA
    - No ride quality improvement
    - Customer satisfaction??

- Initial appearance may be very "shiny"
  - High asphalt content mixtures = durability
  - Skid resistance may initially be low
  - Will improve after a few months of traffic
  - Light sand application has been used to improve skid

![](_page_46_Picture_6.jpeg)

![](_page_47_Figure_1.jpeg)

- Some treatments may slightly impact roadway geometry
- HPTO, UTFC, Cape Seal require ADA compliance
- Micro-milling required in floodway at affected stream crossings (no fill)
- Resetting, recasting, and reconstructing inlets and manholes, curb and driveways as needed

![](_page_48_Picture_1.jpeg)

• Removal of all unsound material

#### Bond is critical for <u>ALL</u> thin overlays

- tack coat spec. needs updating
- Construction sampling in progress
- Some <u>ultra-thin paver HPTO</u> projects next year
- Trackless tack coat
- Bond/shear/pull test study in progress

![](_page_48_Picture_9.jpeg)

![](_page_49_Picture_0.jpeg)

![](_page_49_Picture_1.jpeg)

- Treatments in combination working very well
  - Thin HMA overlay over slurry seal
    - HPTO over slurry seal
    - UTFC over slurry seal
  - Cape seal = slurry seal over chip seal (SHRP 2 R26 best performance)

- Specifications a work in progress
  - Constantly improving materials specifications
    - HPTO rutting issues
    - UTFC aggregate
  - Constantly improving construction practices
  - Maintenance bond?
    - Considering it

## LESSONS LEARNED - HPTO

- HPTO = Best Performance = Most frequently used preservation treatment
- Performance Rutgers preliminary performance study shows that treatment timing is critical
  - SDI < 2.4 = 5 years service life
  - SDI > 2.4 = 13+ years service life
- Good performance on composite pavements
  - Composite is approx. 60% of network
  - HPTO = Reflective Crack Resistant
- Used in combination with slurry seal scratch course

![](_page_51_Figure_9.jpeg)

![](_page_51_Picture_10.jpeg)

- Aggregate shape and gradation is <u>critical</u> to success
  - Improper aggregate = premature failure
  - Aggregate crushing operation is critical
  - Refined specification to more clearly indicate mix design requirements
- Tack coat bond is critical
  - Under application or poor coverage = premature failure
  - Improper tack coat material = premature failure

# LESSONS LEARNED - UTFC

![](_page_52_Picture_8.jpeg)

- Overall thin overlay treatments are performing as well as or better than mill 2" + pave 2" HMA
- Pavement condition must = <u>FAIR/GOOD</u> condition for preservation

![](_page_53_Picture_3.jpeg)

# CHALLENGES/THREATS

![](_page_54_Picture_1.jpeg)

- Agency
  - Staffing, training/knowledge gap
  - Lack of quality assurance
- Design
  - Retool for quicker delivery
  - Better manage SOW (Environmental, ADA, Safety/Guiderail, ITS)
  - Document/Guidance Right treatment on right road
- Industry
  - Build industry capabilities, comfort, capacity
  - Resistance to change
  - Lack of quality control
- Manage Customer Expectations
  - Public Outreach and Communication
  - Treatment failures

"Right Mix, On the Right Road, At the Right Time, for the Right Cost"

![](_page_55_Picture_2.jpeg)

![](_page_55_Figure_3.jpeg)

Source: NJDOT Pavement Management

### WHY PAVEMENT PRESERVATION?

![](_page_56_Picture_1.jpeg)

![](_page_57_Picture_0.jpeg)

#### NJDOT Pavement & Drainage Management & Technology Team THANK YOU! QUESTIONS? ROBERT BLIGHT, SUPERVISING ENGINEER ROBERT.BLIGHT@DOT.NJ.GOV