

The Use of Highly Polymer Modified Emulsion in Slurry and Micro Surfacing Case Study

New Advancements in Polymer Modified Asphalt Binders and Emulsions can Increase Performance of Pavement Preservation Products.

Scott Metcalf
VP Pavement
Preservation Western
Region Ergon A&E

&

R. Gary Hicks PhD, P.E.
Program Manager,
CP2 Center, CSU Chico





Topics Covered

- NCAT Pavement Test Track
- Benefits of Preservation
- Slurry Surfacing
- HiMod Microsurfacing
- HiMod Microsurfacing in Cold Regions
- Final Thoughts

NCAT Pavement Test Track



National Center for
Asphalt Technology
NCAT
at AUBURN UNIVERSITY



Track Research Goals

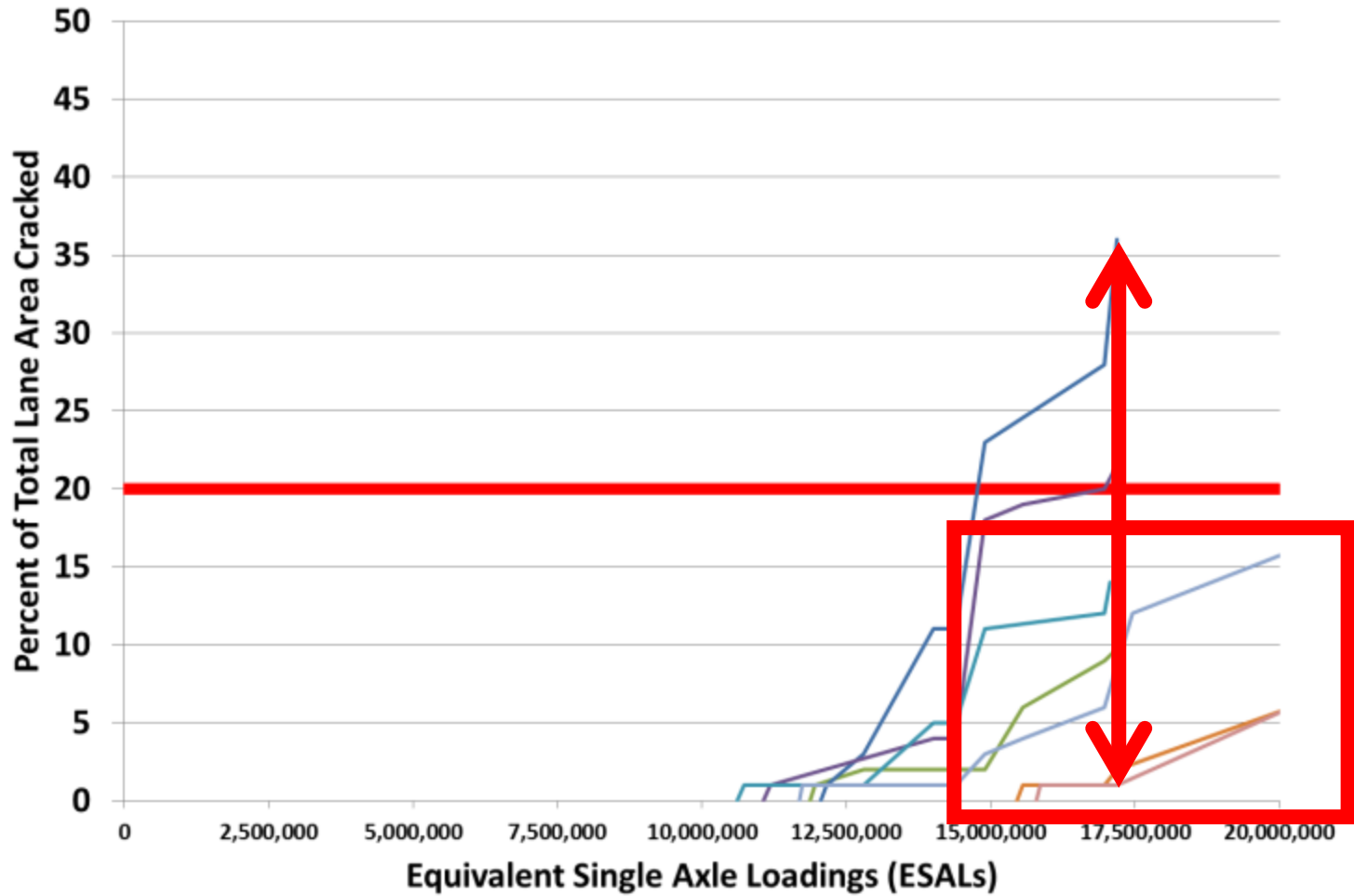
- Help state DOTs implement positive change
- Track Research overview
- Track preservation (APT)
- Lee Road 159 (low ADT)
- 2015 research cycle (high ADT)



Service Life in Years Until 20% Cracking for Preservation Treatments

Treatment	Poor	Fair	Good
Rej. Fog seal	2.4	4.1	6.0
Single chip seal	4.3	8.5	7.9
Single chip seal + crack seal	7.3	7.4	10+
Double chip seal	6.8	10+	10+
Triple chip seal	10+	10+	10+
Fibermat chip seal	7.1	8.8	10+
Scrub seal	10+	10+	10+

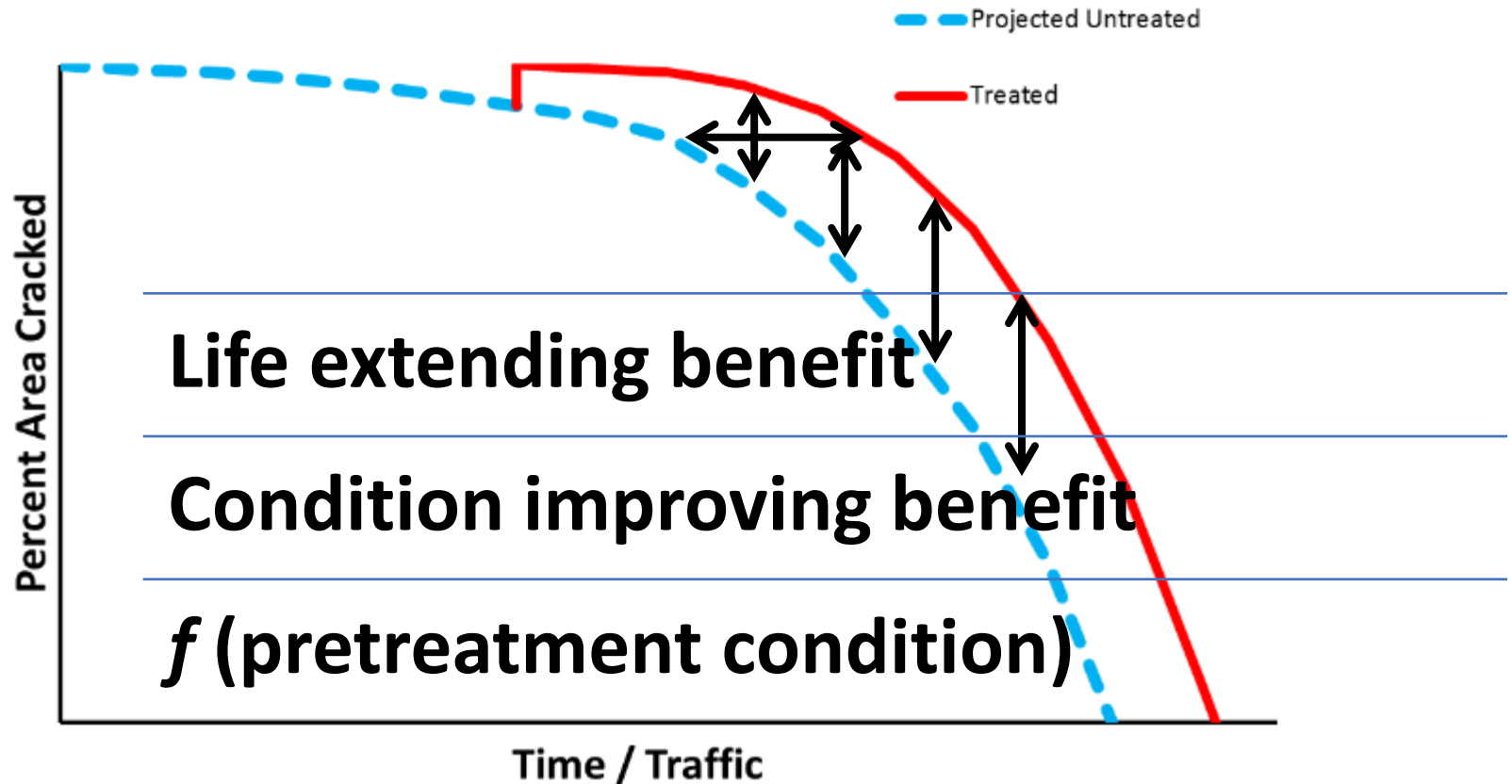
Service Life Until 20 % Cracking for Other Mixes



— Trigger — HMA — OGFC — WMA-F — WMA-A — HRAP — WRAP — HiMA



Benefits of Preservation





Slurry Surfacing


- Slurry Seals are applied at one stone thickness. Typically, 12-16 lbs. per yd²
- Micro-Surfacing can be applied at multi-stone thickness. Typically, 25-30 lbs. per yd²





A Picture is Worth a Thousand Words

- Let's set the stage, imagine a road 4 years old in good shape with no cracks.
- It only has slight to moderate chain wear, snow tire wear, rutting in wheel paths, no cracks and 7,000 ADT.
- Now imagine that one lane is Slurry Sealed, the other lane is Micro-Surfaced and a control section untouched.
- What does it look like 6 years later?



Slurry Seal

Micro-Surfacing

**No maintenance for
6 years**



Conventional MSE vs HiMod- Emulsions at Lake Tahoe



HiMod Microsurfacing Granite Bay, Placer County

What is new in Polymer Modification in Asphalt Emulsions?

- Typically, anything over 4% polymer is very sticky and hard to work with.
- Hard to emulsify SBS, and with SBR latex the chemistry of the latex starts to override set and break times of the emulsion.
- Performance from lab to field is very different.



Specification	Property Test Procedure (AASHTO)	Specification	
		Min	Max
Hi- Mod Emulsion			
Asphalt Base Properties			
Original DSR, kPa ($G^*/\sin \delta$, 10 rad./sec) @ 76°C	T315	1.00	
Emulsion Properties			
Viscosity, Saybolt-Furol, @ 122°F, SFS	T59	15	150
Sieve Test, % T59 0.1	T59		0.1
Residue by Evaporation, % T59 62	T59	62	
Residue Properties From Low Temperature Evaporation	PP72-11, Procedure B		
MSCR @ 64°C, Recovery @ 3.2 kPa, %	TP70	75	
Inr @ 3.2/kPa	TP70		0.50



The MSCR TEST is critical to early performance in power steering burns and long-term durability from snow-plows as seen in the next slides.

Comparison of Conventional vs HiMod Emulsions in a Cul-du Sac after the same trash Truck

**LMCQS-
1H 3%**



High Mod



Less Early Damage



Photo taken Spring 2022
Same contractor different emulsion spec. Same Agg
Hi Mod Emulsion Vs LMQCS-1H

2015 work

2014 work



Hi-Mod Emulsion for Micro- Surfacing and Slurry Seals

- An innovative Asphalt Emulsion product (high polymer content up to 6%) which is much tougher than its conventional counterparts
 - Higher temperature tolerant to reduce scuffing and tearing
 - More damage resistant to resist snow-plow situations.



CANTABRO LOSS-DURABILITY TEST

Scope

- This test method determines the abrasion loss of compacted slurry, micro, and hi-mod micro samples.
- Measures the breakdown of various emulsion specimens utilizing the Los Angeles Abrasion machine



Calculation

Use the following formula to measure Cantabro Loss:

$$CL = \frac{A - B}{A} \times 100$$

Mass Loss % = 5.21



CQS-1H

Mass Loss % = 2.89



MICRO

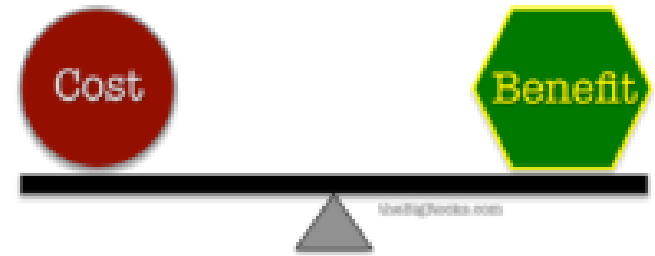
Mass Loss % = 0.04



HI-MOD MICRO

Typical Cost and Performance

- The typical cost increase to use the HI Mod emulsion is .25 to .35 cents more per yd².
- The expected life increase should be 3 or more years longer than your current Slurry and Micro products.
- Many contractors have seen and expect to observe 75% reduction in raveling and post project sweeping.



Projects at Lake Almanor Country Club, Northern California,

Road Network and Climate

Pavement Conditions in 2016

Dates Constructed

- 2016. High Mod Micro
- 2017. High Mod Micro over an AR Chip Seal
- 2019. Regular Micro over an AR Chip seal

Performance Evaluated in 2021

Expected lives of each product



Road Network and Climate

- 25 centerline miles of existing asphalt concrete pavement beginning in the early 50's
- Traffic
 - Mostly passenger cars
 - Some construction traffic
- Climate
 - 120 inches of snow
 - Lots of snow plowing
- Elevation
 - 4500 ft



Pavement Condition in 2016 Prior to Construction

- Overall condition of pavements
 - Fair to good
 - Pavement rating from 4 to 8 using the Paver System
- Major Types of Pavement Distress
 - Edge and thermal cracking
 - Root bumps
 - Some alligator cracking



Typical Edge Cracking of 2016 Projects



Typical Thermal Cracking in 2016

Minor Alligator Cracking in 2016



2016 Construction

HiMod Micro only



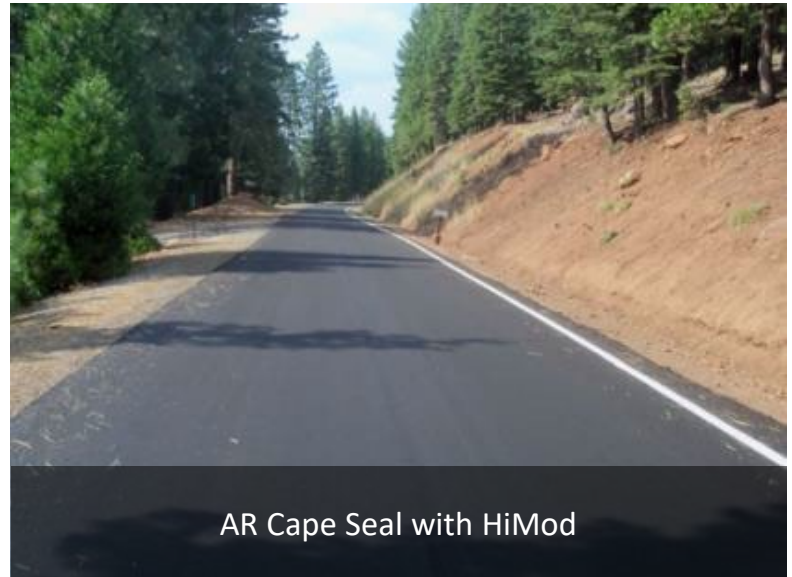


2017 Construction

- AR chip seal followed by HiMod micro
- Existing pavement was micro milled prior to place the Cape Seal



2017 Construction



2019 Construction



- Did not use HiMod Micro even though specified.
- Used standard Caltrans Micro instead
- Application rates and aggregates used were essentially the same
- Did not use a micro mill prior to the AR chip seal however they did use a milling machine.

Performance of 2016 Projects in 2021





Performance of 2017 Projects in 2021



Performance of 2019 Projects in 2021

14lbs at 14% emulsion after 4 years done with 6%
HiMod Emulsion
High Sierras 21 feet of snow



Conventional Micro 2019
VS
Hi Mod eflex Micro 2016
Photo in 2021



Life Expectancy

*Latest HMA overlay was done in 2006

Treatment	Typical Cost (\$ per sq.yd.)	Expected life (years)
Crack filling or sealing	0.60	2-4
Patching	72.0	4-6
AR chip Seal	4.50	5-8
High Mod Microsurfacing	3.00	6-10
AR Cape Seal	6.95	8-10
2 inch HMA	12.75*	8-12

Major findings from LACC project

- Pavement preservation treatments work well in cold climates and for high elevations.
- The treatments have performed well for a period of 4-5 years on the main roads in the LACC. The one exception was the 2019 project where there has been considerable shedding of the Micro Surfacing in two years from plows and chains
- AR Cape seals have proven to work well on more distressed roads. Again, the 2019 project has shown considerable shedding in the Micro surfacing.
- The performance of the treatments is greatly influenced by the Contractor placing the treatment and the level of oversight by the LACC. **Or the owner gets what they inspect!!**



CP2 CENTER NEWS

Newsletter of the California Pavement Preservation Center

No. 65

March 2023



'Hi-mod' Micro Surfacing and Slurry Seal for Harsh Conditions

By Cesar Lara (Unico Engineering) and Gary Hicks (CP2 Center)

The improved properties and performance benefits of highly polymer modified ('hi-mod' - 6% polymer) micro surfacing and slurry seal emulsion, when compared to conventional slurry surfacings (< 4% polymer), have been demonstrated in the laboratory and the field. For several years, hi-mod emulsion has been used in micro surfacing and slurry seal applications on roadways in high-elevation, cold-climate areas throughout California for the usual sealing and smoothing, as well as in warm/hot-climate, and urban areas. But in colder climates, the hi-mod emulsion has also proven to resist thermal cracking, snowplow damage, and other distresses brought on by cold weather conditions. And in the warm/hot weather climates in urban areas, the hi-mod emulsion has provided

improved resistance to scuffing, showing, and pushing at intersections and cul-de-sacs.

Hi-mod Performance in High-Elevation and Snowy Conditions

A series of projects at Lake Tahoe, Big Bear, and Lake Almanor Country Club (LACC) demonstrated the enhanced performance of hi-mod treatments in high-elevation and snowy conditions. The projects at the LACC included a 2015 hi-mod micro surfacing and a 2016 cape seal featuring an asphalt rubber (AR) chip seal and hi-mod micro surfacing. Evaluated in the fall of 2021, findings from these LACC projects showed that the hi-mod project was still performing well with little-to-no snowplow damage, as shown in Figure 1. There was some reflective thermal

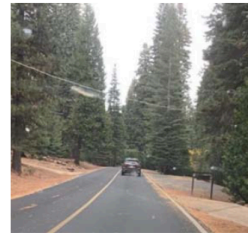


Figure 1. Performance of 2016 projects in 2021



Figure 2. Performance of 2019 Projects in 2021

Continued, next page



CP² CENTER NEWS

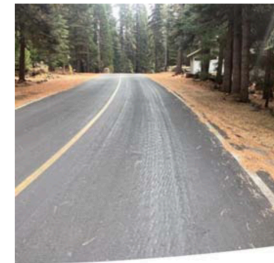
Newsletter of the California Pavement Preservation Center
No. 65 March 2023



cracking, but, as shown in Figure 2, the pavement surface was still in good condition and expected to last up to 10 years. In 2019, another AR cape seal was applied at the LACC, but this time with a conventional micro surfacing emulsion (meeting Caltrans specification) instead of the hi-mod product. The conventional micro surfacing wearing course has already worn off on many project sections and is exhibiting extensive snowplow damage, as shown in Figure 3.



a) Loss of Micro



b) Snow Plow Damage

Figure 3. Performance of 2019 projects in 2021

Bob Feeney, a LACC homeowner and one of the team that laid out and inspected the first two projects said, "The 2015 and 2016 projects went well. There was good communication between the contractor and the LACC staff. Also, the project had some daily inspections. For the 2019 project, the hi-mod was not used. Also,

the communication and expectations between the contractor was not good, there were some workmanship issues, and the work was done in the late season where temperatures dropped below freezing at night. The material placed in 2019 did not perform as well as the 2016 and 2017 projects".

Other projects in high-elevation situations have yielded comparable results as these hi-mod projects at the LACC. Recent results from a 2013 demo project at Big Bear evaluating the benefits of hi-mod versus conventional slurry seal revealed minimal snowplow damage on the hi-mod section compared to the section that received the conventional slurry seal, which is now mostly worn. Results were similar on a Lake Tahoe application where hi-mod micro surfacing was compared to conventional micro surfacing. These projects have proven that hi-mod emulsion does make a difference in long-term performance.

Increased Durability in Urban Areas

Hi-mod's improved performance has also been demonstrated in hotter urban areas on projects in Victorville, Ontario, LaQuinta, and more sites. Hi-mod micro surfacing applications on roadways at these sites resulted in resistance to scuffing due to hot temperatures as well as resistance to surface abrasions due to power steering in cul-de-sacs, as shown in Figure 4.



a) Conventional Emulsion



b) Hi-Mod Emulsion

Figure 4. Comparison of the Conventional emulsion with a hi-mod emulsion at a cul-de-sac after the same trash truck

The hi-mod applications also reduced the risk of instability (pushing)

Continued, next page



CP² CENTER NEWS

Newsletter of the California Pavement Preservation Center

No. 65

March 2023

at intersections.

Hi-mod in High Demand

Many agencies and taxpayers are demanding better performing, more sustainable, and resilient products. Hi-mod emulsion checks all of these boxes. With increased durability, a wider temperature band, and increased flexibility, hi-mod emulsions have increased the life-extending benefits of micro surfacing and slurry seal projects in comparison to its conventional counterparts.

The specific emulsion utilized for these California

hi-mod projects was supplied by Ergon Asphalt & Emulsions.

"Hi-mod emulsion allows for the possibility of up to 10 years of service life, which is a game changer," said Ergon Asphalt & Emulsions' Scott Metcalf. "Agencies that have used hi-mod have all noted that it's just tougher and more durable."

For more information on hi-mod micro emulsion, contact Gary Hicks at rgicks40@outlook.com or Scott Metcalf at Scott.Metcalf@ergon.com.



California State
University **Chico**

Big Bear, California Sugarloaf Neighborhood

ADT: Less Than 600,
1% Box Trucks





2014

2023

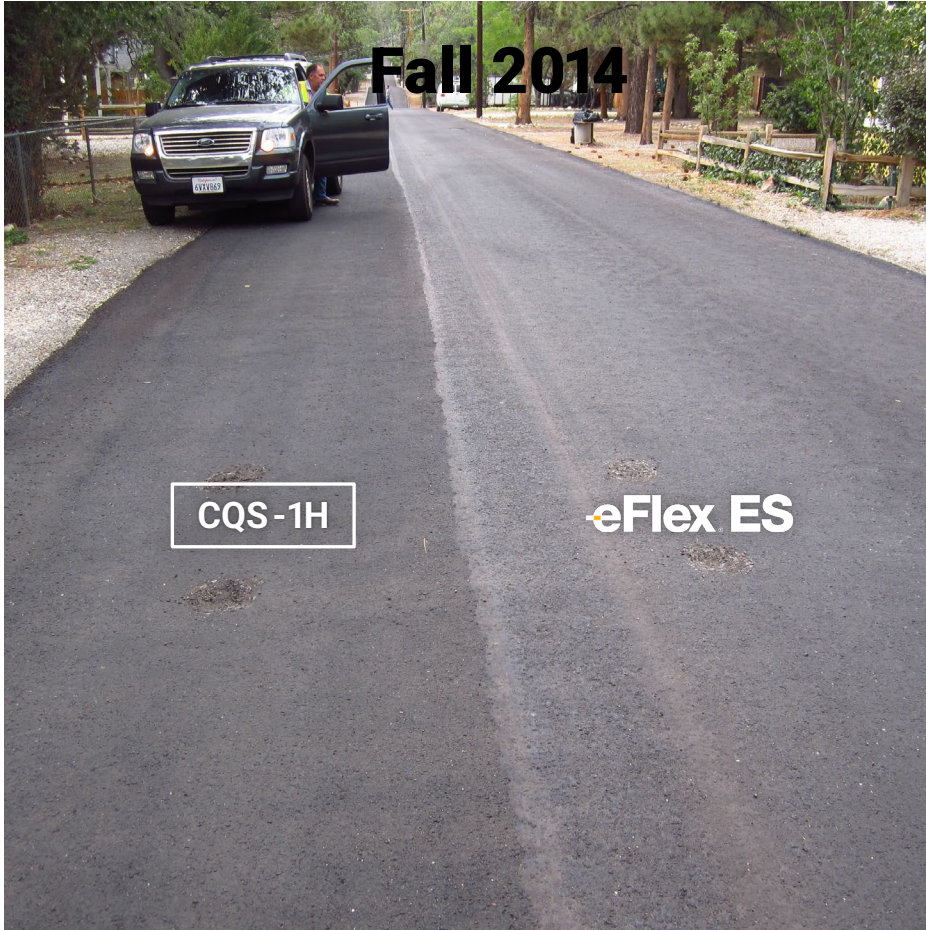


2014



2023

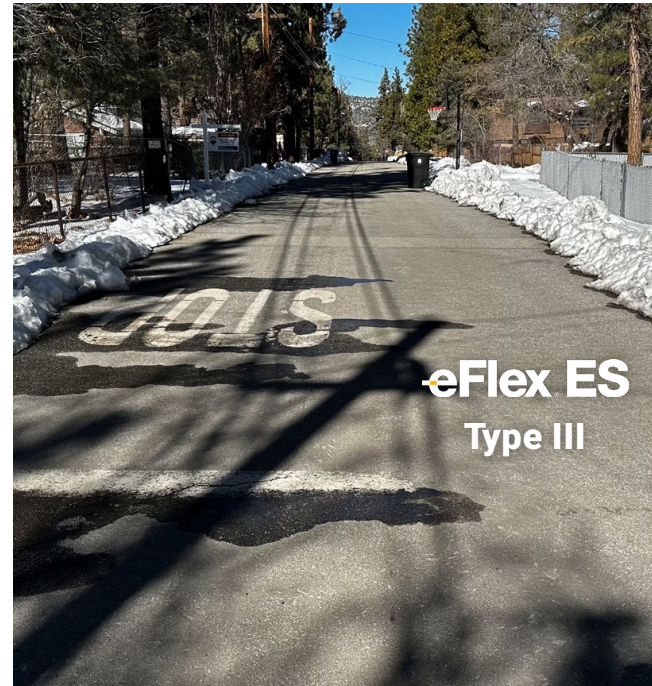




January 2023



Plowed-Through Stop Bar



Power Steering Burn

eFlex ES
Type III

CQS-1H
Type III Slurry









Questions??

NWPMA PRESENTS

Scott Metcalf

VP Pavement Preservation

Scott.Metcalf@Ergon.com

909-228-2159

2023

NORTHWEST PAVEMENT

R. Gary Hicks, P.E.

Program Manager, CP2
Center

rghicks40@outlook.com

530-588-4446

MANAGEMENT CONFERENCE

October 24th - 27th