



Penetrating Concrete Sealer in Nebraska

National Pavement Preservation Conference 2023

Indianapolis, Indiana

NEBRASKA

Good Life. Great Journey.

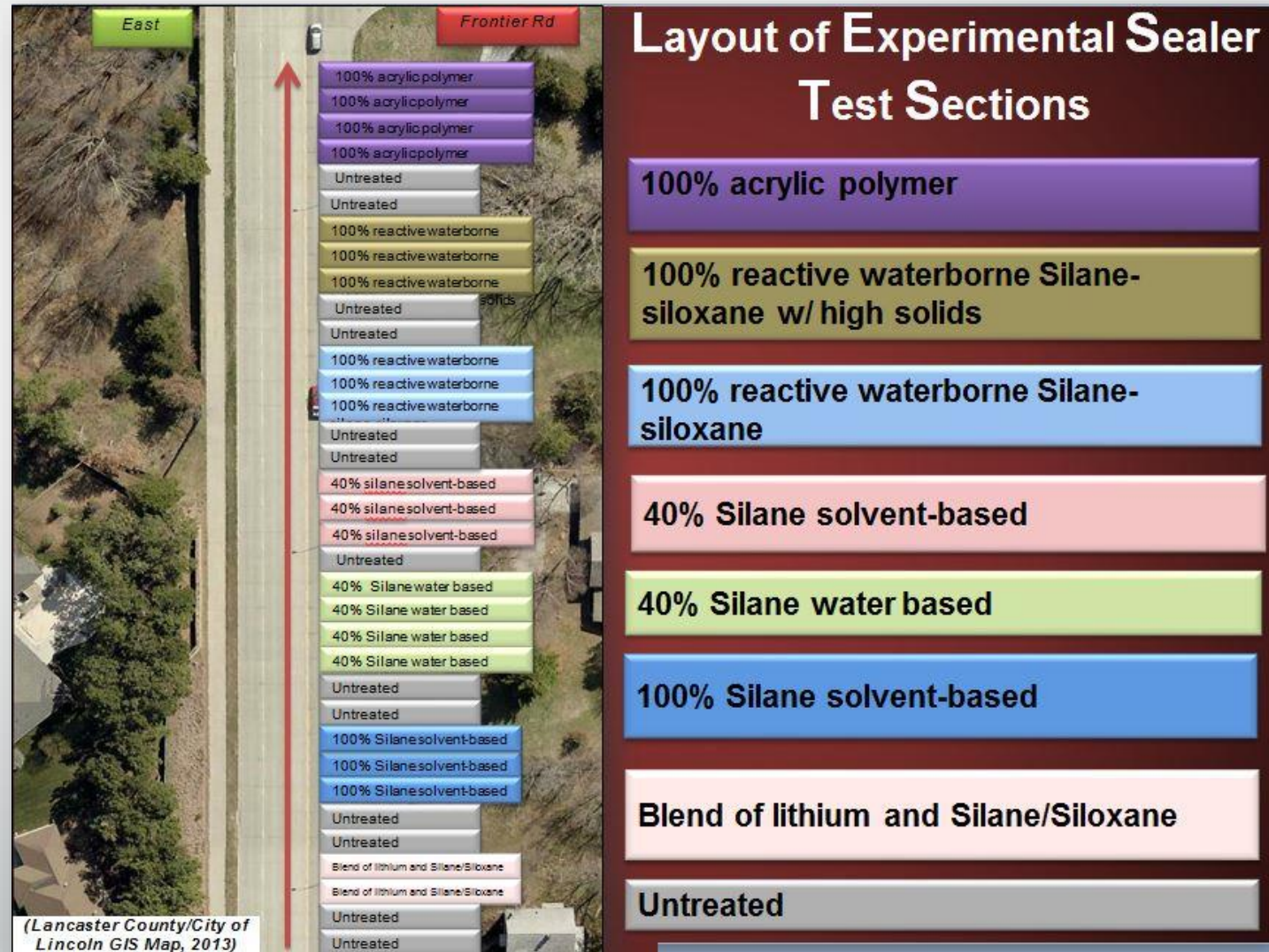
DEPARTMENT OF TRANSPORTATION

Overview

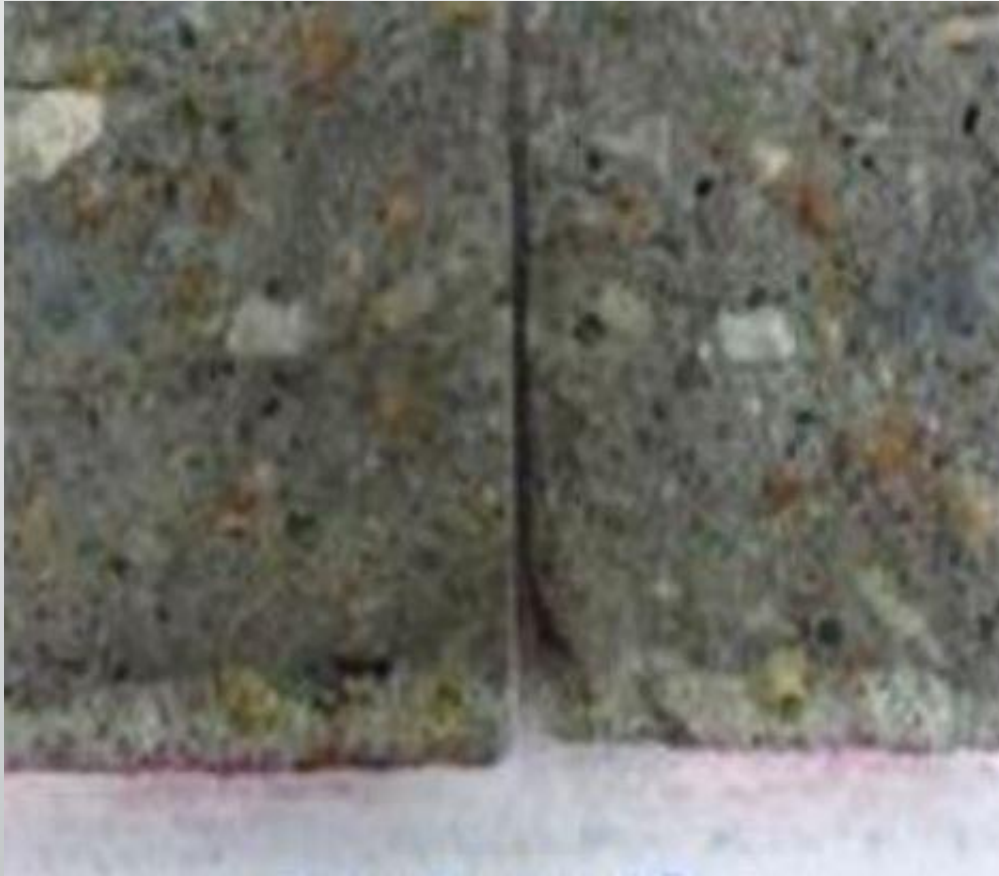
- Evaluating Penetrating Sealers in Nebraska
 - 2010 Phase 1 Evaluations
 - 2016 Phase 2 Evaluations
 - 2018 Phase 3 Evaluations
- Penetrating Sealer Applications
- Build America, Buy America Act
- Current Penetrating Concrete Sealer in Nebraska

Evaluating Penetrating Sealers in Nebraska

- In 2010, Nebraska began experimenting with Penetrating Sealers.
- Phase 1 – Old Cheney Road in Lincoln, NE.
- Evaluated 7 Penetrating Sealers in PCC Pavement.
- The objective was to evaluate the performance of sealers in preventing moisture penetration into concrete pavements as a preventative maintenance tool to mitigate concrete expansion due to ASR.



Phase 1 Evaluations



Penetrating Sealer Visible



Penetrating Sealer Not Visible

Phase 1 Evaluations

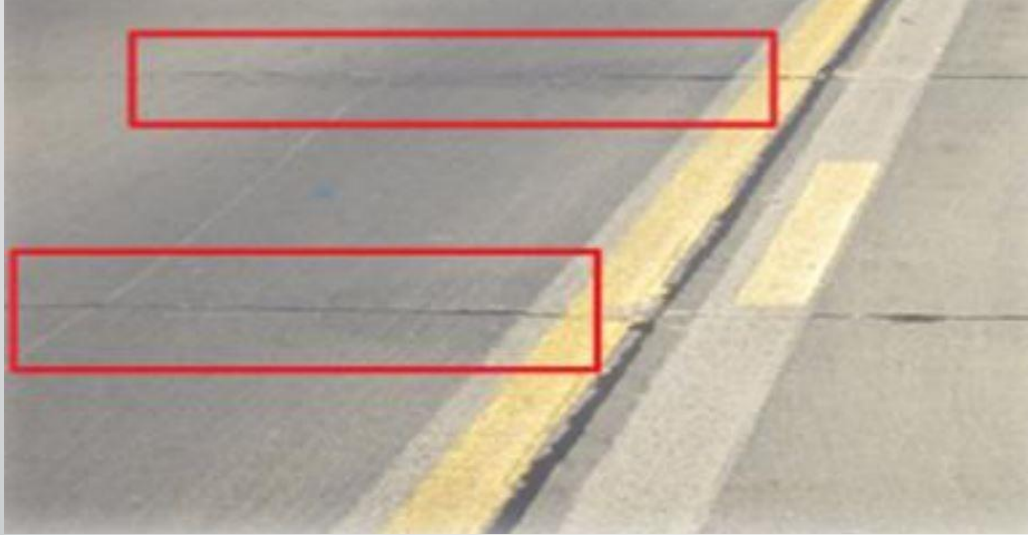


Drilling for Chloride Ion Sample



Chloride Ion Tester

Phase 1 Evaluations



Shading Visible



Shading Not Visible

Phase 1 Evaluations







No Meniscus

Weak Meniscus

Strong Meniscus

Hydrophobia Was Observed

Phase 1 Results

Sealer Section	Sealer Penetration 	Surface Bead Test 	Visual Shading 	Chloride Ion Results 0-1/2" depth 	Average
Lithium & Silane/Siloxane blend	0	2	2	1	1.3
100% Silane Solvent-based	2	2	2	2	2.0
40% Silane Water-based	0	2	2	2	1.5
40% Silane Solvent-based	2	1	2	2	1.8
100% Waterborne Silane/Siloxane	0	2	0	0	0.5
100% Waterborne Silane/Siloxane	0	2	0	0	0.5
100% Acrylic Polymer	0	1	0	0	0.3
Untreated	0	0	0	0	0

The 100% and 40% Silane Solvent-based sealers performed the best.

Evaluating Penetrating Sealers in Nebraska

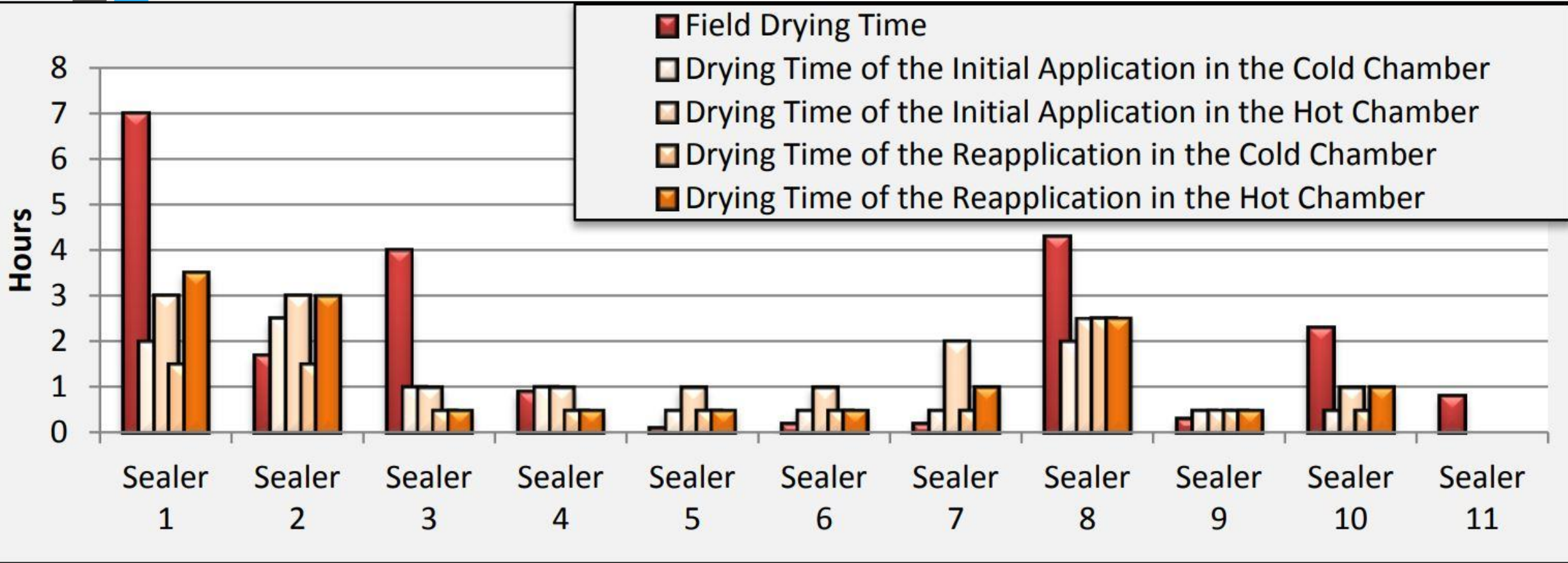
- In 2016, Nebraska conducted another experiment.
- Phase 2 – Wahoo Bypass, Hwy 77
- Evaluated 11 Penetrating Sealers.
- The objective was to evaluate the effects of humidity, temperature, and supplemental cementitious materials on the drying time of penetrating sealers for pavements, evaluate the effects sealer application has on skid resistance, and to re-evaluate sealer acceptability for the APL.



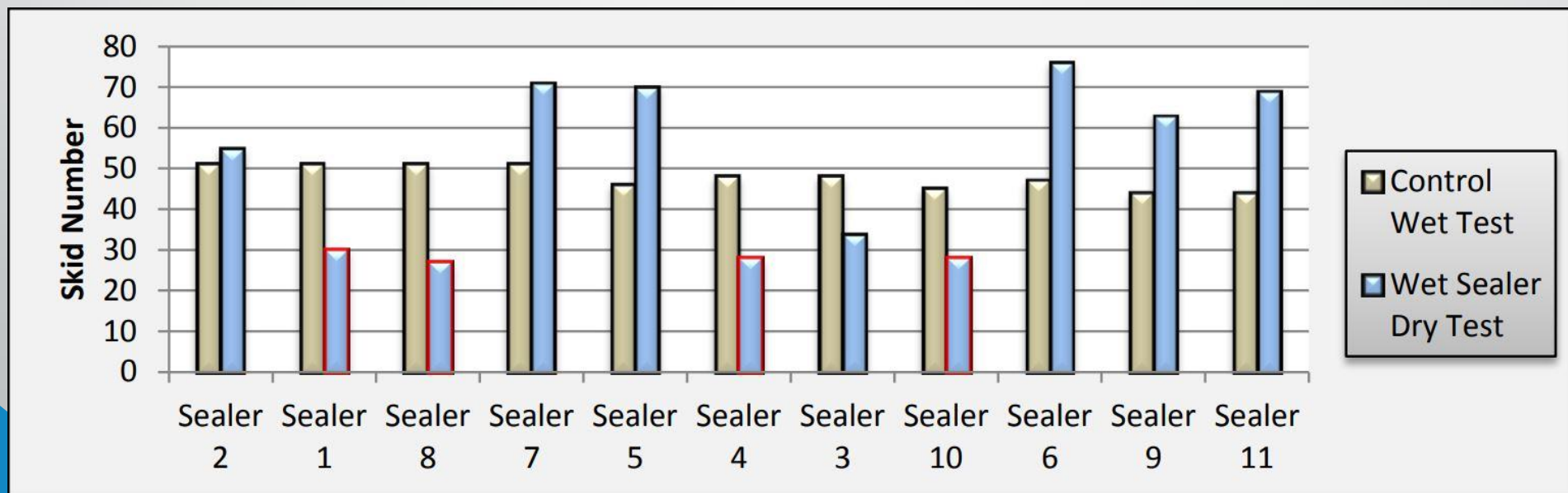
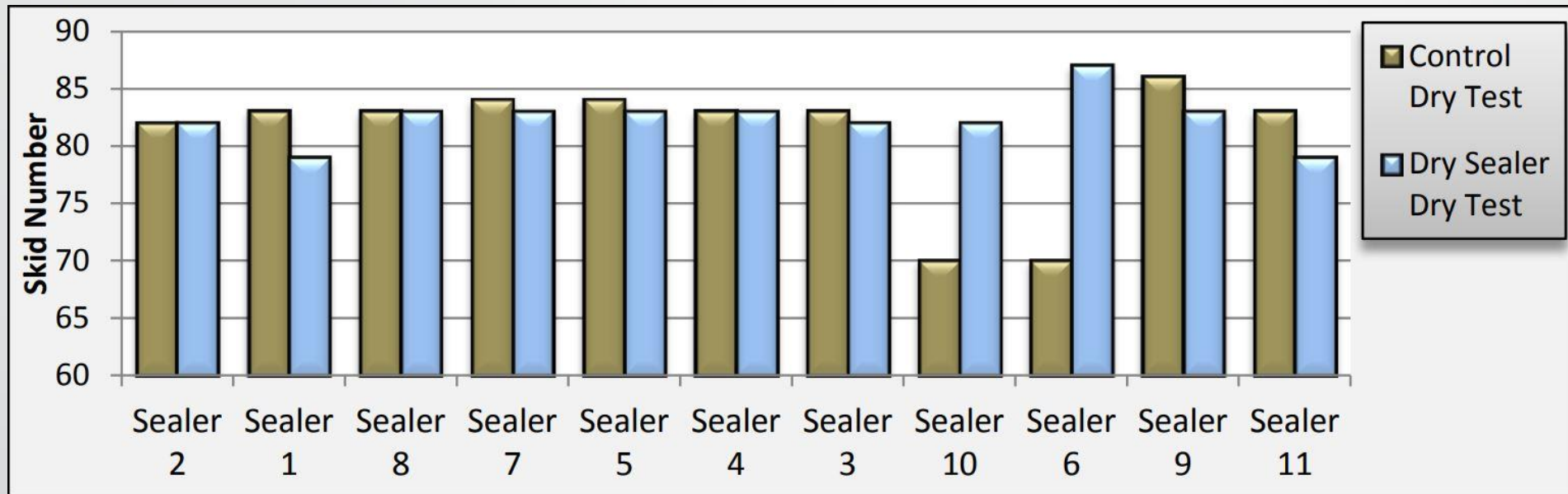
Performance Criteria

- **Drying Time Measurement**
 - The dry time for the Penetrating Sealers were measured and recorded. Dryness was assessed by pressing a white matte printer paper and finding no moisture on the paper.
- **Skid Resistance Test**
 - Skid resistance was measured in accordance with ASTM E 274 and ASTM E 501.
- **Depth of Penetration**
 - Cores were collected 7 days after the sealer application in accordance to ASTM C 42. Cores were split vertically in accordance to ASTM C 496. The depth of penetration was visually observed and measured in inches from the split area of the core. The acceptable depth of penetration shall be greater than or equal to 3/8 of an inch.
- **NDOR Wet and Dry Testing - Cores or Cylinders**
 - At the end of the 280-day period, the cores/cylinders were removed from the chamber and examined for cracks. An acceptable test will show little or no cracks.

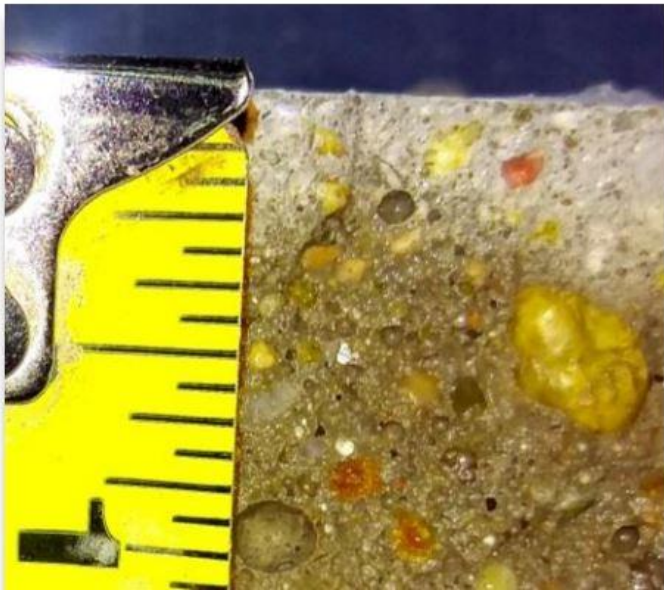
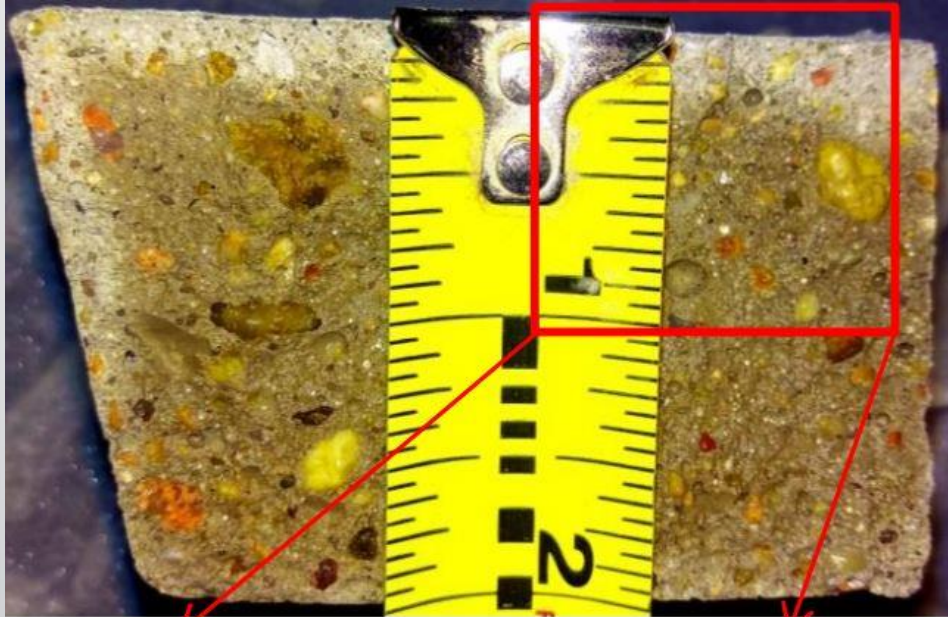
Phase 2 Evaluation



Phase 2 Evaluation

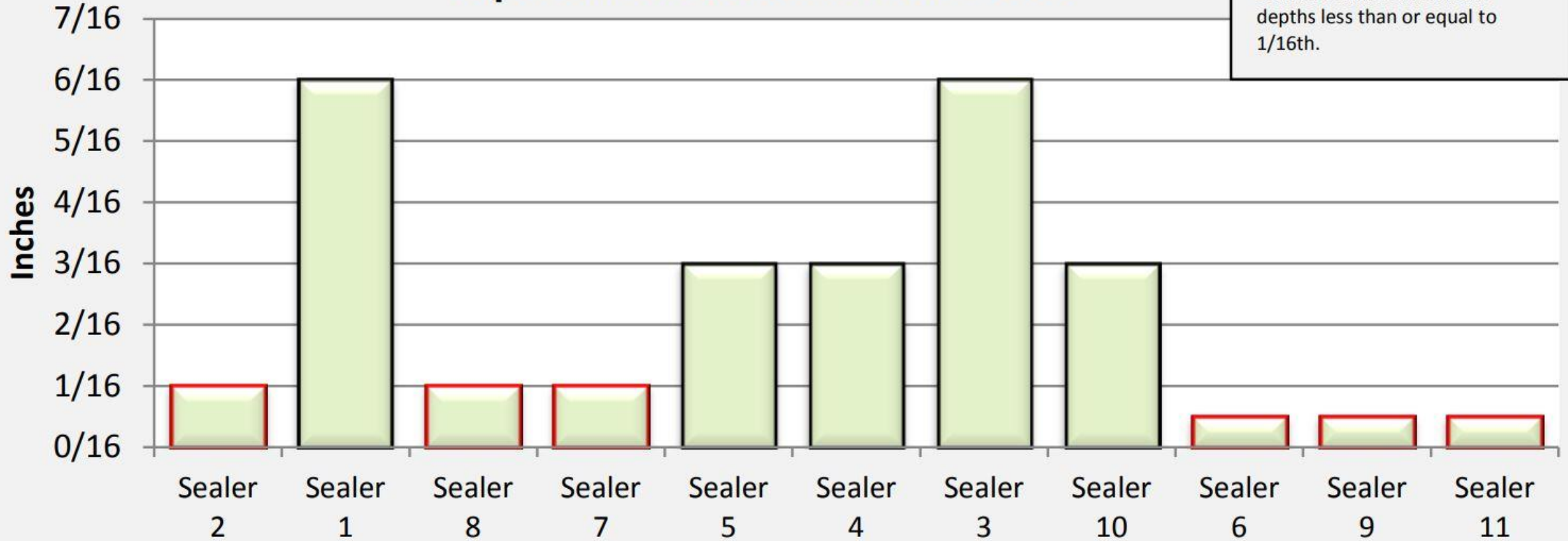


Phase 2 Evaluation

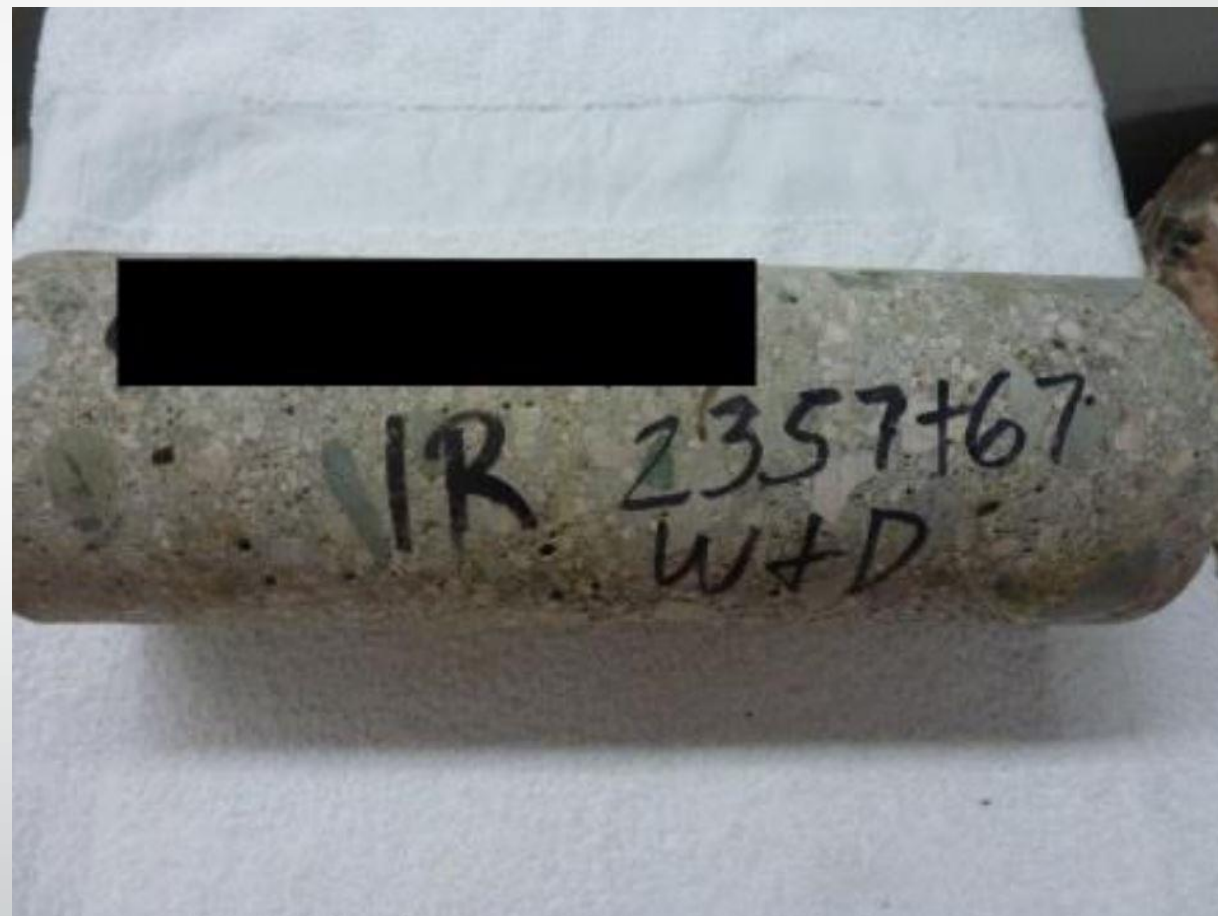
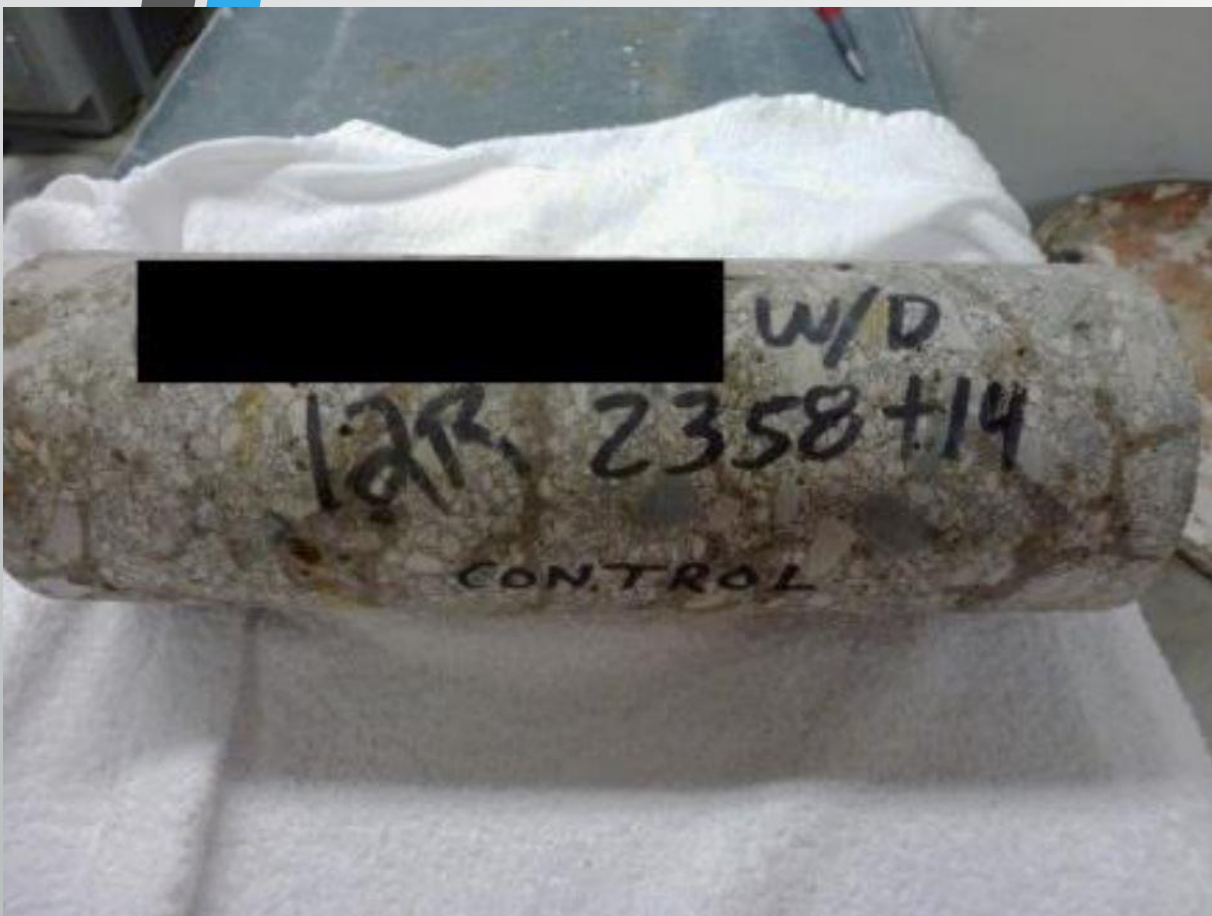


Phase 2 Evaluation

Depth of Penetration in Field Cores



Phase 2 Evaluation



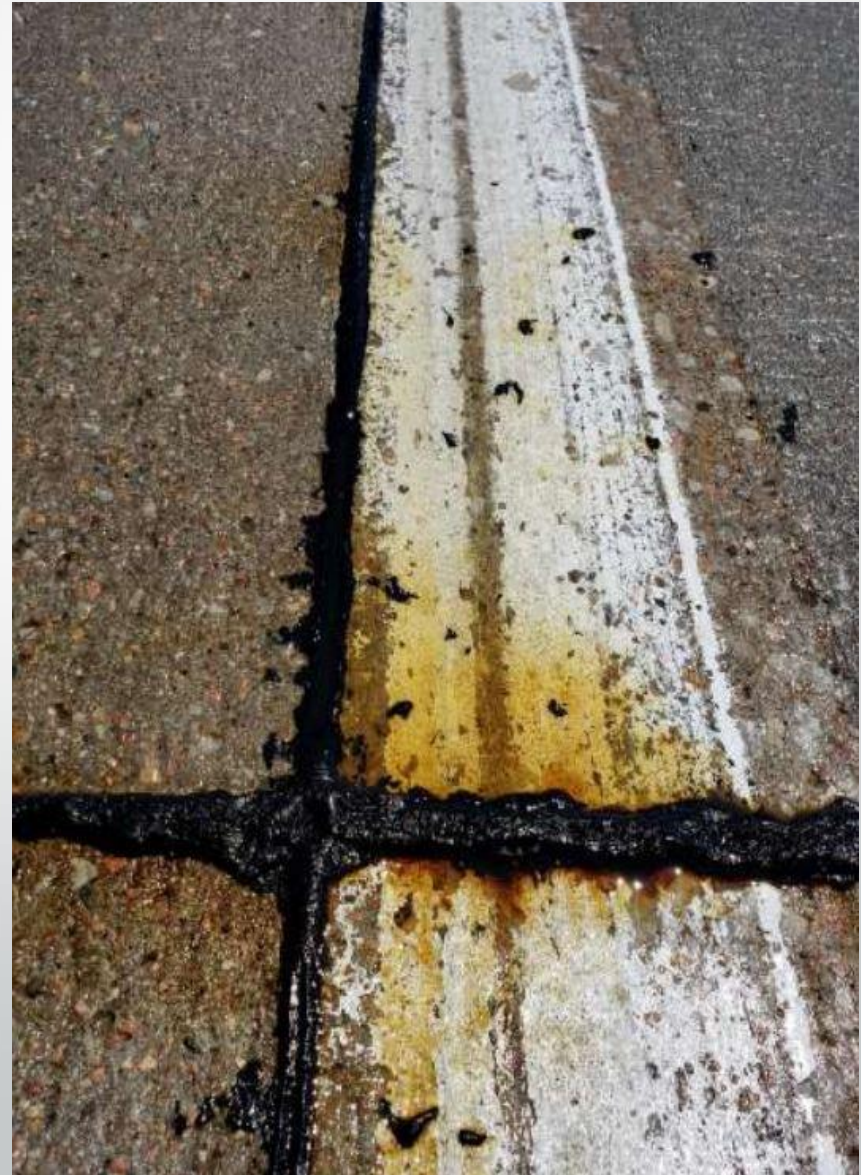
Phase 2 Evaluation

- Results from Phase 2 included the implementation of performance criteria for our Approved Products List.
 - Cores treated with sealers that show no cracking after 3 months in a Wet & Dry chamber will be acceptable for approval.
 - Sealers with a depth of 1/16th of an inch or greater may be acceptable for approval.
 - Skid resistant and drying time measurements will be evaluated to categorize the sealers for the APL. Longer drying times may be acceptable for contract-let projects. Shorter drying times may be acceptable for state forces (maintenance).

Sealer Application Field application Order	Core Observation Cracking Description
Sealer 2	No cracks
Sealer 1	No cracks
Sealer 8	No cracks
Sealer 7	Small cracks
Sealer 5	Small cracks appearing in the middle
Sealer 4	No cracks
Sealer 3	No cracks
Sealer 10	No cracks
Sealer 6	Small cracks
Sealer 9	No cracks
Sealer 11	Small cracks throughout
Control	Lots of small cracks throughout

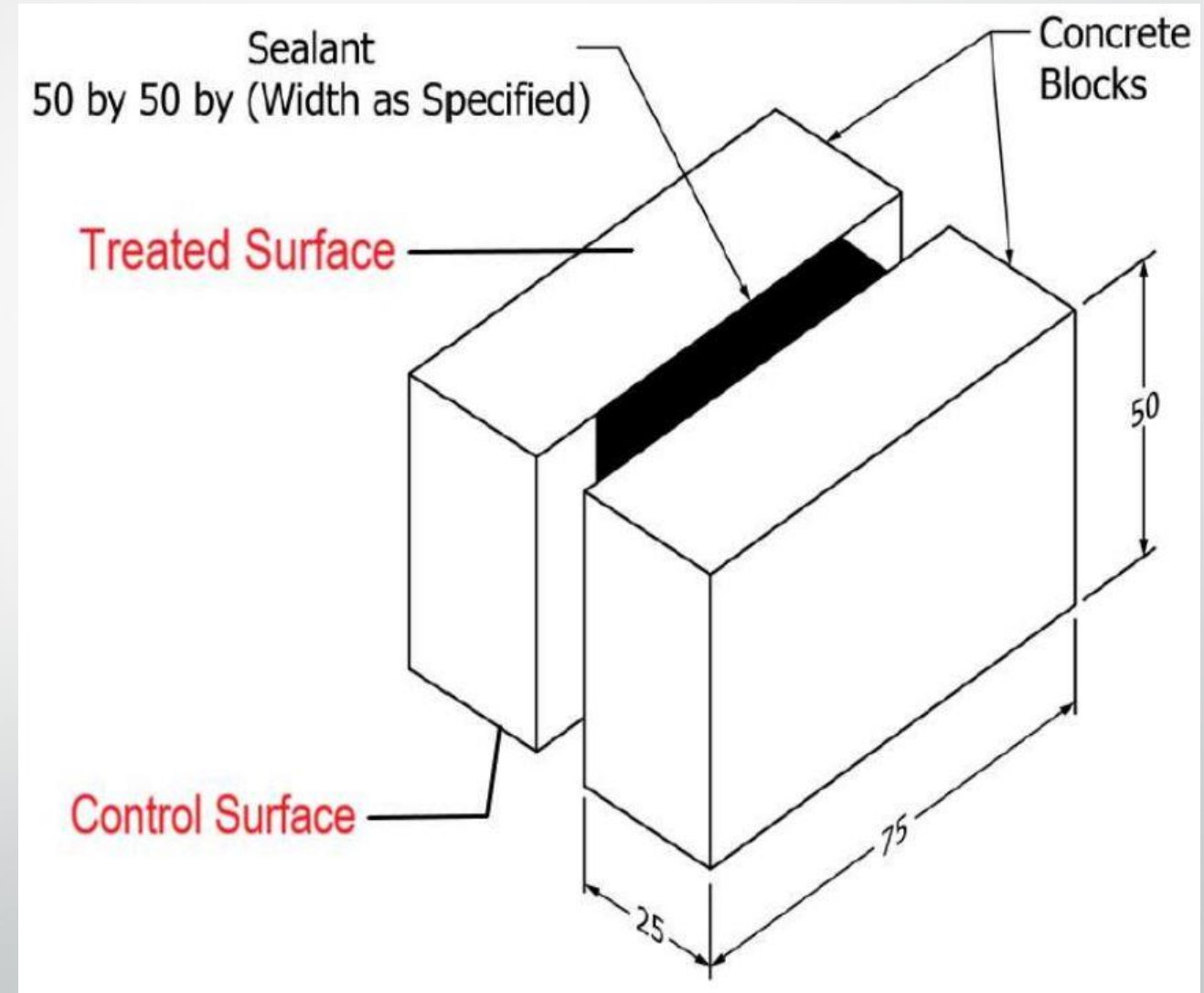
Phase 3

- Based on field observations from previous projects, NDOT conducted another experiment involving the effects to the interfacial bond between the hot-pour sealant and the concrete pavement after applying Department approved Penetrating Concrete Sealer.

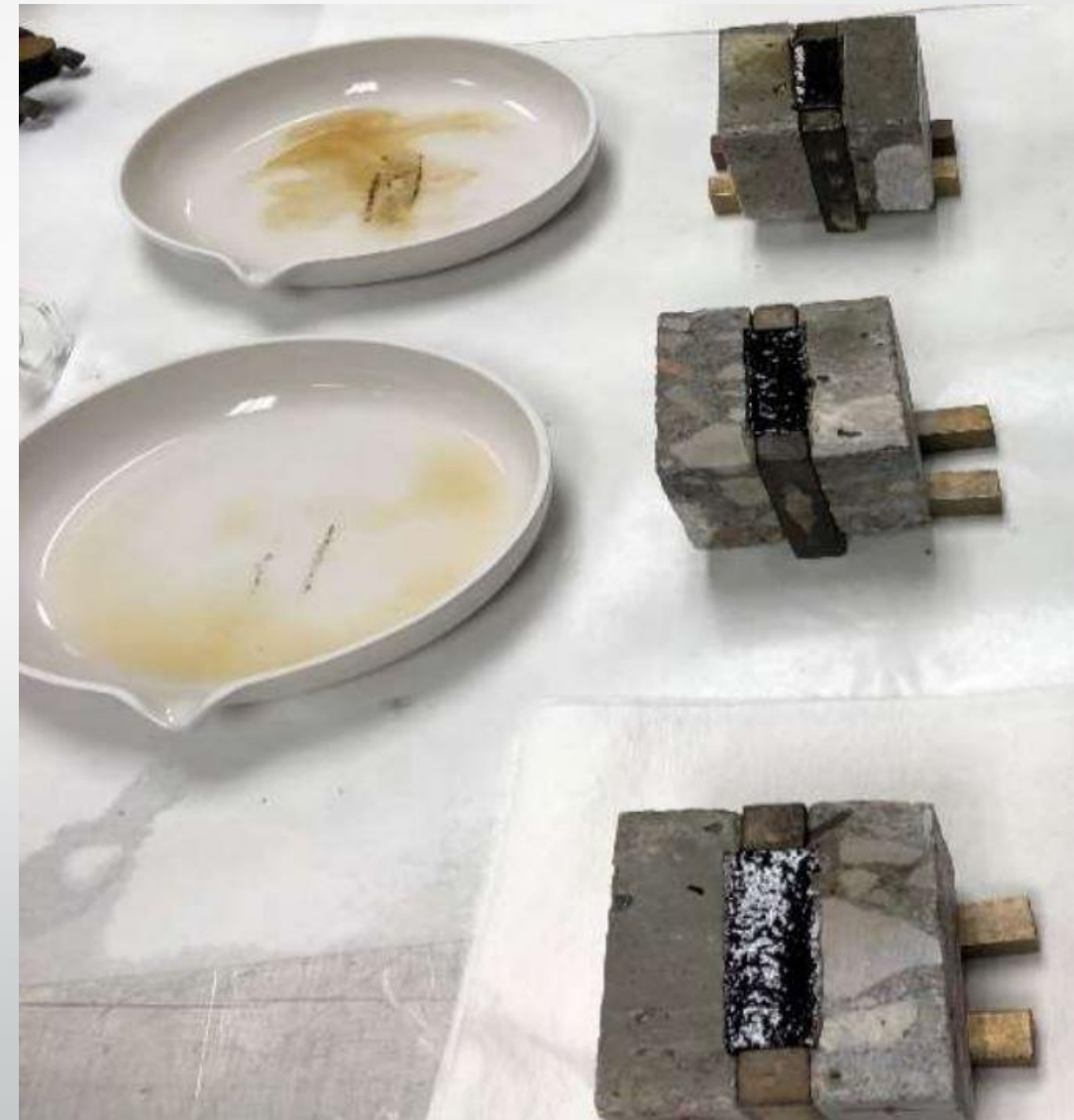
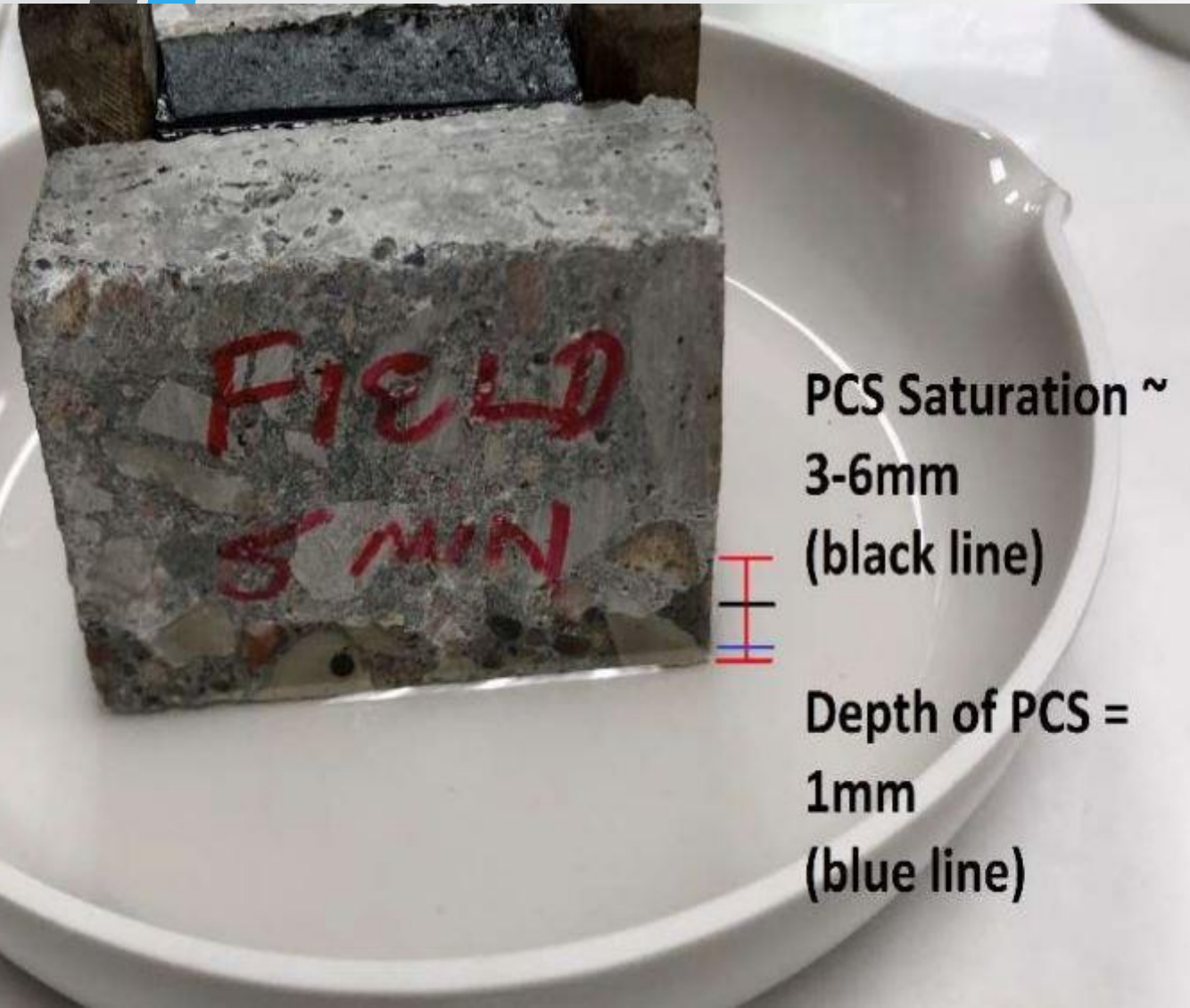


Phase 3 Evaluation

- Test concrete blocks were created according to ASTM D5329 and filled with different types of Hot-Pour Sealant.
- A set of three blocks were used for each product.
- One block was sprayed twice with a hand sprayer and set on a table for observation.
- The other two blocks were placed in a ceramic dish with Penetration Sealer. One block sat for 1 minute, the other 5 minutes.



Phase 3 Evaluation



Phase 3 Evaluation



Phase 3 Evaluation

- Phase 3 Experiment showed that all Hot-Pour Sealant experienced discoloration when in contact with Penetrating Concrete Sealer.
- Despite the discoloration, all of the Hot-Pour Sealant passed the extension test and no de-bonding was observed between the concrete blocks and the Hot-Pour Sealant.

Product 5	Discoloration	Extension Test
Sprayed Block	Yes – observed within 5 minutes after spray	Pass
1-minute Block	Yes – observed upon removing block from soak	Pass
5-minute Block	Yes – strong; observed upon removing block from soak	Pass

Product 5	Discoloration	Extension Test
Block 1	Yes – Hot pour sealant flowed from test block	Pass
Block 2	Yes – Hot pour sealant flowed from test block	Pass
Block 3	Yes – Hot pour sealant flowed from test block	Pass



Penetrating Sealer Applications

- Since 2018, Nebraska has been letting projects for sealing applications instead of asphalt overlays.
- Penetrating Sealers are being applied to concrete pavements that are acceptable to ASR.
- Penetrating Sealers are also useful to decrease the permeability of the concrete pavement thus extending the life span of the concrete by keeping water and salt out of the surface.
- Started experimenting with vertical faces in 2022 by applying Penetrating Sealer to Concrete Median Barriers and Bridge Rails.
- Possible future applications include bridge decks and abutments/piers.
- Monitoring of Penetrating Sealer continues.



Build America, Buy America Act (BABAA)

- Part of the Infrastructure Investment and Jobs Act on November 15th, 2021.
- Required all federal agencies to ensure by May 14th, 2022 that no federal financial assistance for infrastructure projects unless all of the iron, steel, manufactured products, and construction materials used in the project are produced in the United States.
- Although silane sealer is a manufactured product, it did not meet the FHWA definition of a manufactured product.
 - Items that consist of two or more of the listed materials that have been combined through a manufacturing process, and all items that include at least one of the listed materials combined with a material that is not listed through a manufacturing process, should be treated as manufactured products, rather than as construction materials.

BABAA in Nebraska Today

- After BABAA took effect on May 14th, Nebraska allowed Penetrating Sealers on State Funded projects only.
- On July 31st, Nebraska decided to move from 100% Silane Sealers to 40% Silane Sealers which would meet the BABAA requirements.
- On August 16th, FHWA agreed that Penetrating Concrete Sealer can qualify for a public's interest waiver with the following restrictions:
 - The total value of the non-compliant products is no more than the lesser of \$1,000,000 or 5% of total applicable costs for the project; or
 - The total amount of Federal financial assistance applied to the project, through awards or subawards, is below \$500,000.

Current Penetrating Concrete Sealer in Nebraska

- Through our internal research evaluations, we found that 40% silane penetrating concrete sealer will provide only 5 years of protection while 100% silane penetrating concrete sealer will provide 10-12 years of protection.
- Still looking for additional Penetrating Concrete Sealer products to add to our Approved Products List. Currently experimenting with Soy Methyl Ester around concrete joints and cracks.

Source Name	Product Name	Effective Date
Sika Corporation	MasterProtect H 440 HZ	8/2/2023
Evonik Industries	Protectosil CHEM-TRETE 40 VOC	8/2/2023



Questions?

NEBRASKA

Good Life. Great Journey.

DEPARTMENT OF TRANSPORTATION