



SHRP2 R06A Implementation Assistance Program Update on Nondestructive Testing for Concrete Bridge Decks

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SHRP2 R06A IAP Project of FHWA/AASHTO/CH2M



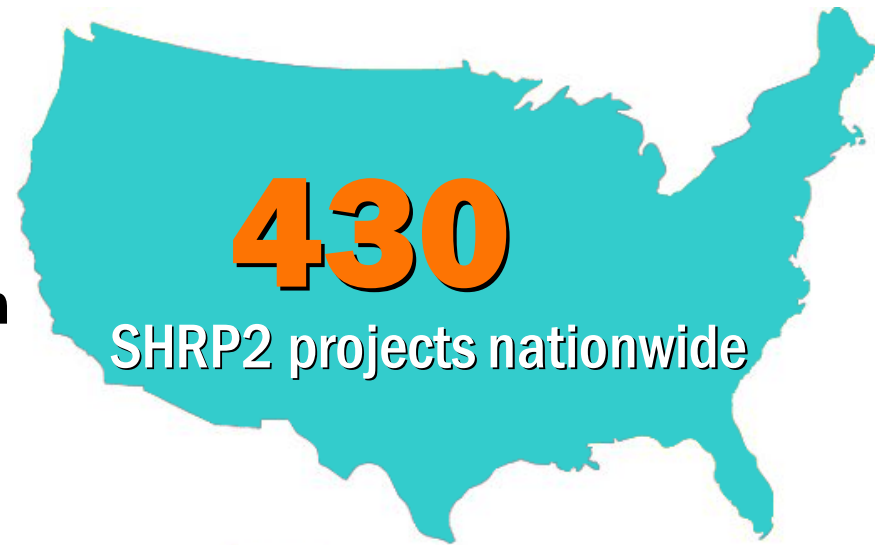
U.S. Department of Transportation
Federal Highway Administration

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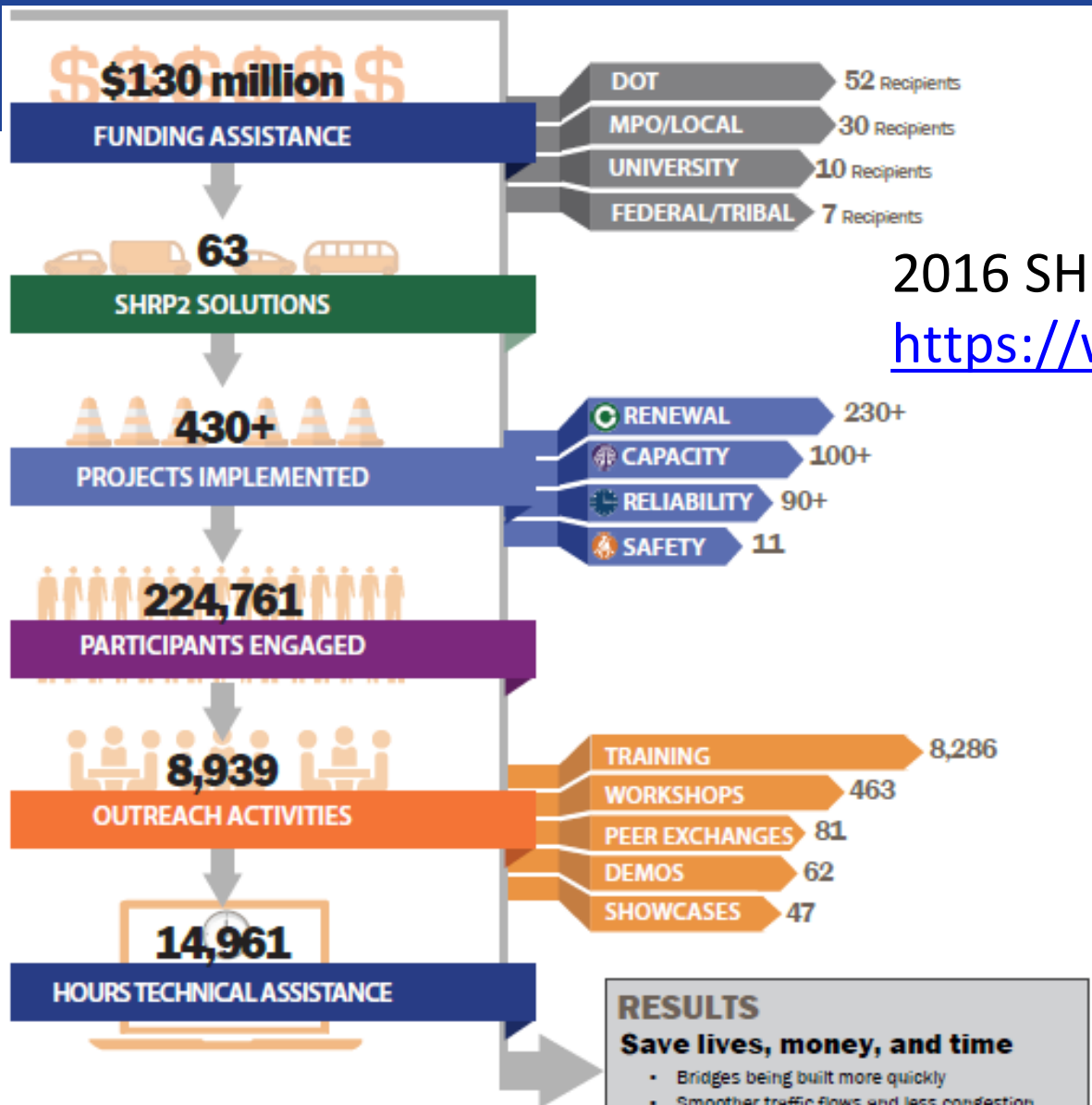
AASHTO

SHRP2 at a Glance

- **SHRP2 Solutions** – 63 products
- **Solution Development** – processes, software, testing procedures, and specifications
- **Field Testing** – refined in the field
- **Implementation Assistance Program**
430 IAP transportation projects; adopt as standard practice
- **SHRP2 Education Connection** – connecting next-generation professionals with next-generation innovations



SHRP2 Implementation: Moving Us Forward



- DOT 52 Recipients
- MPO/LOCAL 30 Recipients
- UNIVERSITY 10 Recipients
- FEDERAL/TRIBAL 7 Recipients

- RENEWAL 230+
- CAPACITY 100+
- RELIABILITY 90+
- SAFETY 11

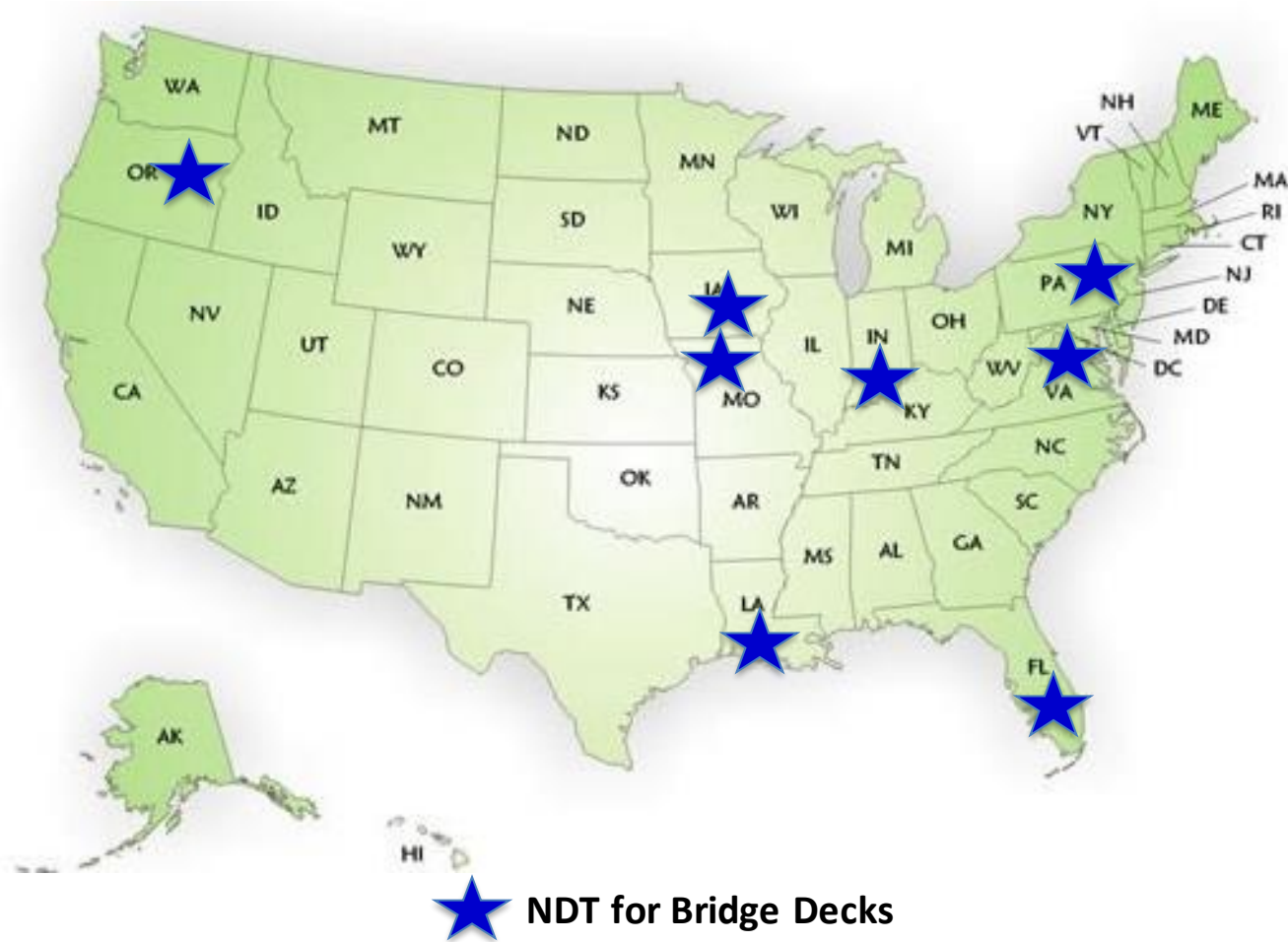
- TRAINING 8,286
- WORKSHOPS 463
- PEER EXCHANGES 81
- DEMOS 62
- SHOWCASES 47

2016 SHRP2 Highlights Report at <https://www.fhwa.dot.gov/goshrp2>

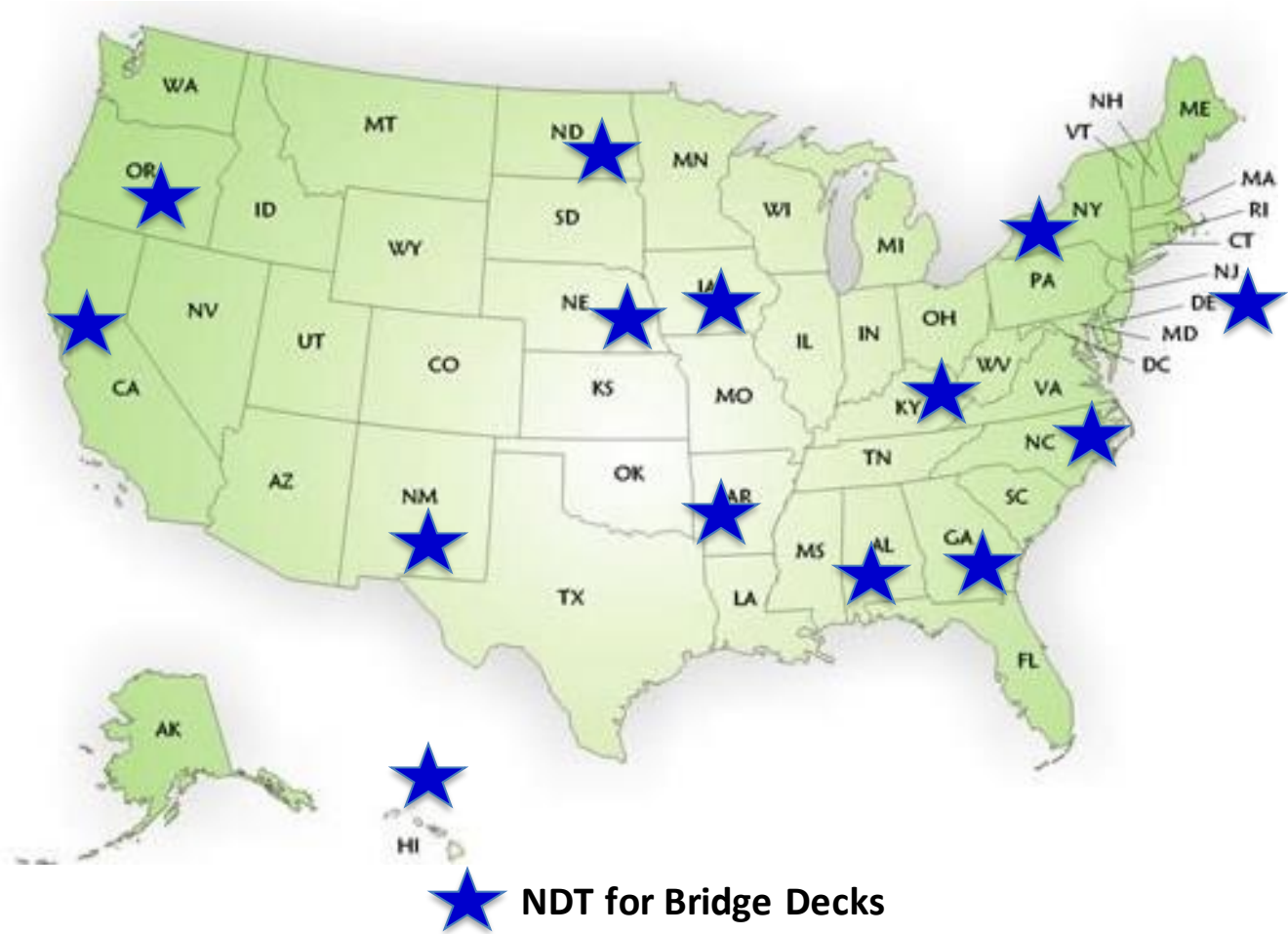
RESULTS
Save lives, money, and time

- Bridges being built more quickly
- Smoother traffic flows and less congestion
- Reduced construction costs
- Safer roadways
- Smarter environmental reviews

SHRP 2 R06A Round 4 – 8 IAP State DOTs 2015-2017



SHRP 2 R06A Round 7 – 14 IAP State DOT's 2016-2018



NDT Techniques studied in SHRP2 R06A Research by Dr. Nenad Gucunski, Rutgers University and 9 university/research/company organizations

- Impact Echo Ultrasonic Surface Waves (IE)
- Impulse Response (IR)
- Ground-Penetrating Radar (GPR)
- Infrared Thermography (IR)
- Electrical Resistivity (ER)
- Galvanostatic Pulse (GP)
- Half Cell Potential (HP)
- Hammer Sounding/Chain Drag



Nondestructive Testing - Concrete Bridge Deck US Hwy 15 over I-66 in Haymarket, VA Rutgers University SHRP2 R06A Project



R06A Challenge: State of Practice – Acoustic Sounding and Half-Cell Potential



Challenge: Evaluating the Full Range of Deterioration Types



Deterioration of Interest

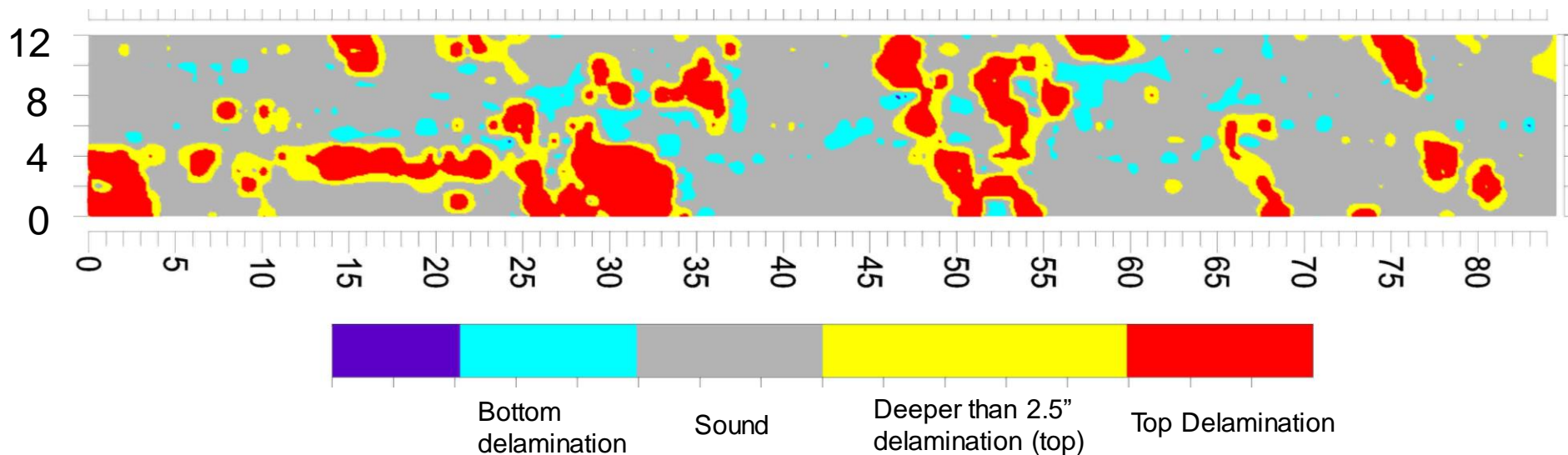
- Delamination
- Corrosion
- Vertical cracking
- Degradation

NDT Technologies of SHRP2 R06A

NDT Technique	Mode of Deterioration Detected	System	Resolution	Lane Closure
IE	1) Deeper cracks - top and bottom rebar mat 2) Shallow delamination 3) Concrete degradation - ASR/DEF - Freeze thaw	1) Scanning	High	Yes
		2) Point by Point	Grid size	Yes
GPR	1) Corrosion 2) Cracks (if filled with deicing salt) 3) Concrete degradation	1) Air coupled	Lower	No
		2) Ground coupled	High	Yes
IR	Shallow delamination - Top and bottom	1) Truck mounted	High	No
		2) Handheld	High	Yes
Resistivity	Corrosion	Point by Point	Grid size	Yes
Half Cell/GP	Corrosion	Point by Point	Grid size	Yes
Slab IR	Cracks	Point by Point	Grid size	Yes
SASW	1) Vertical cracks 2) Concrete degradation	1) Scanning	High	Yes
		2) Point by point	Grid size	Yes
Sounding	Only shallow delamination	Manual		Yes

Vs.

Example Deliverable from NDT – Bridge Deck Scanner Impact Echo Results from SHRP2 R06A Research



Areas with Probable Top Delaminations = 14%

Areas with Probable Incipient (Deeper) Top Delaminations = 13%

Areas with Probable Bottom Delaminations (or Thin Section) = 5.7%

Classroom Training and Field Demo of Airborne GPR and Bridge Deck Scanner Impact Echo in Round 4

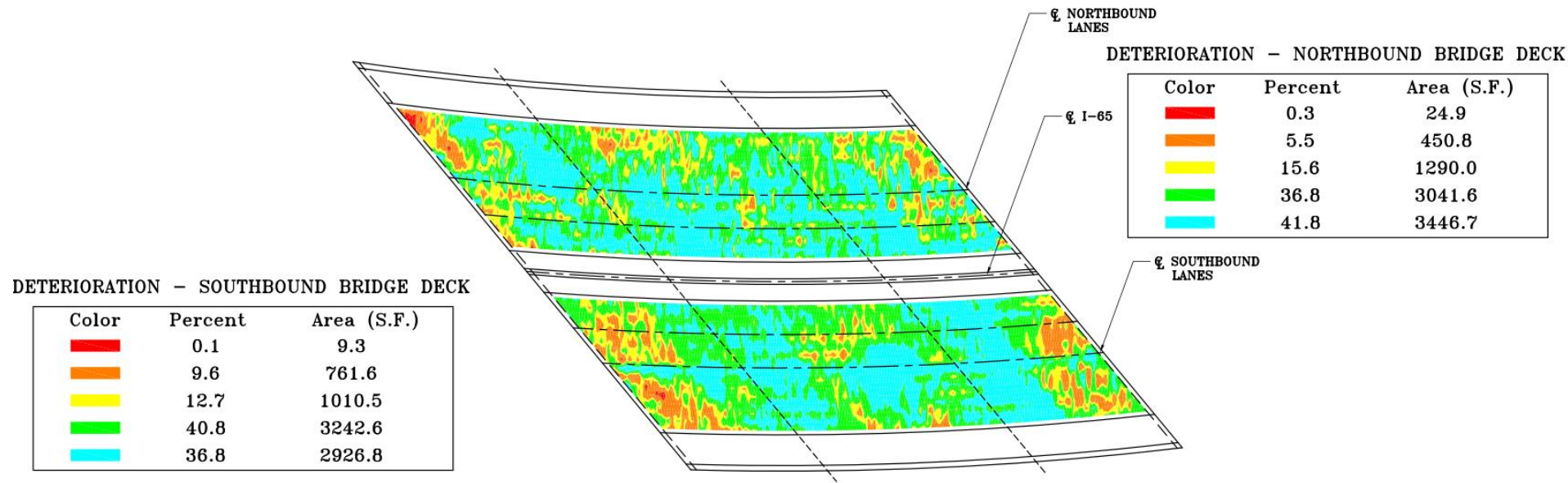


Indiana DOT – Round 4

- Interested in evaluating the higher-volume urban Indianapolis area using high-speed GPR and IR
- Hired 2 consultants (Resource International and AECOM) to evaluate 48 bridge decks.
- Resource International recently completed the GPR testing on 48 bridge decks with a budget of \$52,000



Indiana DOT - GPR Results



Example Damage Map Provided by the GPR Technique

Florida DOT Round 4

- Interested in the IR, GPR and IE technologies
- Purchased 3 handheld IR cameras and recently have 10 staff trained for Level I – IR Inspection
- Field tested IR cameras on inspected bridges with mixed results. IR imaging appeared to be better when scanning bottom of decks.
- Hires a consultant to evaluate bridge decks exhibiting cracking and rebar corrosion efflorescence using GPR, IR and IE
- Currently assembling a standardized format for field reports to be attached to NBI inspection reports
- SHRP2 IAP Project Report Submitted on Findings

Oregon DOT Round 4

- Interested in high-speed GPR, IR and IE
- Procurement process for NDT services let for consulting project
- Identified 200+ bridges across three geographic regions as candidates for the field evaluation

Virginia DOT Round 4

- VDOT is progressing through a series of pilot contracts to procure NDT services for rapid deck screening using GPR, IR and IE.
- The ultimate goal is to develop statewide task order contracts for NDT services that can be used by each district bridge office to evaluate bridges, with a focus on condition screening (more often using mobile scanning technologies).

Iowa DOT Round 4

- Interested in Impact Echo Scanning for detailed project level assessments of concrete decks with high density concrete overlays
- Iowa DOT purchased a Bridge Deck Scanner cart system using 2 transducer wheels to evaluate bridge decks on a detailed project level and applied it to their decks in August 2016 and reported on this at the AASHTO Bridge Committee Meeting in Portland, Oregon
- Currently estimated repair quantities are up to 100% underestimated. NDT will be used to both better estimate quantities for contracting and to provide contractor control during repair.

Missouri DOT Round 4

- Interested in Resistivity Technique for identifying when silane sealed concrete bridge decks need to be re-sealed
- Began lab testing end of 2015, including some initial trials of Wenner Probe resistivity measurements on concrete slabs at the lab coated with various dilutions of silane sealer.
- Made additional concrete panels in the lab for additional probes testing with sealants.
- Consulting project to be conducted in 2017

Louisiana DOT Round 4

- Interested in high-speed GPR.
- Recently deployed GPR/IR NDT on the LA 1 Port Allen Canal Bridge (two bridges over the intercoastal waterway – non-SHRP2 related project), and next to deploy GPR/IR on the I-20 Mississippi River Bridge near Vicksburg.
- Consultant to evaluate the I-10 Atchafalaya Basin Bridge (two bridges, each 16 miles long), near Baton Rouge.

Pennsylvania DOT Round 4

- Interested in GPR/IR technology
- Purchased a ground contact GPR system that can be attached to a vehicle (speed up to 15 mph) for deck corrosion/delamination condition assessment

Summary of SHRP 2 R06A IAP Projects

- Round 4 project is progressing well with SHRP 2 IAP Project Reports starting to be submitted
- State directions are different depending on their internal resources and type of bridge deck they own.
- Results from the NDT provide a quantitative areas of delaminated decks and will assist with the future planning of asset management for the highway department.
- SHRP2 recently awarded the last round (Round 7) of IAP funding for this project and 13 state DOT's received the user incentive funds with most states planning to complete their studies in 2017.

Resources

- FHWA: Hoda Azari, Ph.D., Turner-Fairbank Highway Research Center, McLean, VA, Hoda.Azari@fhwa.gov
- AASHTO: Patricia Bush, Washington, DC pbush@aaashto.org
- SHRP2 R06A Bridge NDT and R06G Tunnel NDT Subject Matter Experts:
 - Larry Olson, PE, Olson Engineering, Rockville, MD
larry.olson@olsonengineering.com
 - Dennis Sack, PE, Olson Engineering, Wheat Ridge, CO
dennis.sack@olsonengineering.com
- www.fhwa.dot.gov/goshrp2
- SHRP2 R06A Bridge and R06G Tunnel NDT Information and reports
http://shrp2.transportation.org/Pages/R06_NondestructiveTesting.aspx