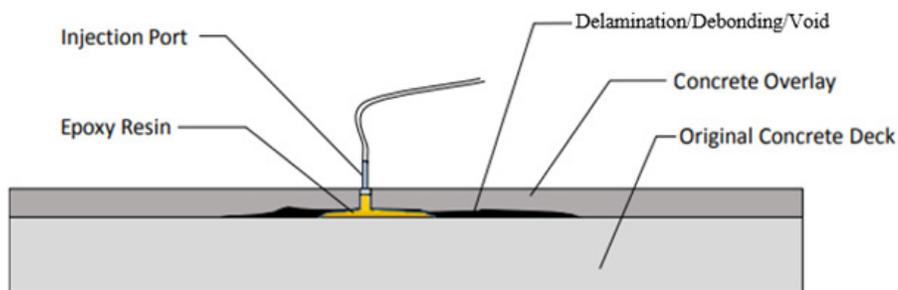
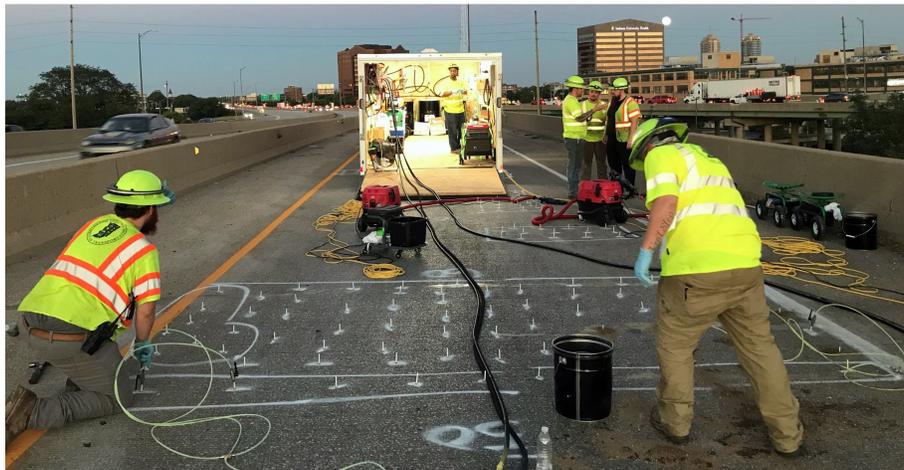


# JOINT TRANSPORTATION RESEARCH PROGRAM

INDIANA DEPARTMENT OF TRANSPORTATION  
AND PURDUE UNIVERSITY



## Implementing Epoxy Injection in Concrete Overlaid Bridge Decks



Prince Baah

## RECOMMENDED CITATION

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## JOINT TRANSPORTATION RESEARCH PROGRAM

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<b>16. Abstract</b> Concrete overlays have proven to be an effective maintenance treatment as they slow de-icing chemical and water penetration into the original deck surface. Typically, due to vibration, structural flexibility, and a weak bond between the concrete overlay and deck concrete (potentially because of poor construction), de-bonding develops at the boundary between the original deck and the overlay. This de-bonding creates voids, providing a reservoir for chloride-laden water to fill after it penetrates cracks in the surface. Displacing this liquid solution and filling these cracks with epoxy helps reduce freeze/thaw cycling and reduces spalling. The epoxy material protects the bridge deck from moisture and helps support the overlay and prevent it from failing under traffic loads. This leads to an extension of the asset life span and life cycle cost benefit increase. Overall, the bridge infrastructure performance improves significantly with greater mobility and less traffic interruptions due to bridge repairs on roadway infrastructures. Epoxy injections helps extend the service life of bridge decks and reduces the need for emergency bridge deck patching and thus improves the safety of road users. Epoxy injection has been added to INDOT's <i>Maintenance Work Performance Standards</i> during the course of this study.			
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## EXECUTIVE SUMMARY

### Introduction

Concrete overlays have proven to be an effective maintenance treatment as they slow the penetration of de-icing chemical and water into the original deck surface. Typically, due to vibration, structural flexibility, and weak bond between the concrete overlay and deck concrete (potentially from poor construction), de-bonding develops at the boundary between the original deck and overlay. This de-bonding creates voids, providing a reservoir for chloride-laden water to fill after it penetrates cracks in the surface. Displacing this liquid solution and filling these cracks with epoxy helps reduce freeze/thaw cycling and spalling.

The epoxy material protects the bridge deck from moisture and helps support the overlay and prevents it from failing under traffic loads. This leads to an extension of the asset life span and an increase in the life cycle cost benefit. Overall, the bridge infrastructure performance improves significantly because of greater mobility and fewer traffic interruptions from repairs to bridges on roadway infrastructures. Epoxy injections help extend the service life of bridge decks and reduce the need for emergency bridge deck patching and, as a result, improve the safety of road users.

### Motivation

Out of the approximately 6,000 state-owned/maintained bridges, 1,575 bridges currently have latex modified concrete (LMC) overlays, and 770 of those overlays have a condition rating of 5 or 6, which may make them good candidates for epoxy injection. These numbers support epoxy injecting for a minimum of ten (10) concrete overlaid bridge decks per district per year in perpetuity.

### Benefits

Displacing water and filling voids at the interface of concrete overlays and concrete decks with epoxy reduces emergency bridge deck patching and extends the service life of bridge decks.

### INDOT Strategic Goals

Epoxy injection of bridge decks impacts the agency in the following strategic areas.

- *Safety*: ensures the road safety for motorists, contractors and INDOT personnel.
- *Asset sustainability*: enhances ability to manage and maintain assets throughout their life cycle.

- *Innovation and technology*: harnesses technology and innovation to develop more effective transportation solutions.

The following are keys to successful epoxy injection of bridge decks:

- selecting the ideal bridge deck candidates,
- personnel with proper training,
- proper materials,
- proper equipment, and
- proper procedures.

The following are ideal bridge deck candidate selection criteria for epoxy injection:

- debonded rigid concrete overlay,
- tight surface cracks,
- light to no cracking on soffit,
- very little to no spalls,
- delamination/debonding not exceeding 30% of the deck area,
- deck rating greater than or equal to 5, and
- wearing surface condition rating greater than or equal to 4.

### Implementation

Based on the findings of this research, guidelines have been provided for a step-by-step injection operation (see Chapter 7). Bridge asset engineers for each district have already started incorporating epoxy injection activity into their maintenance work plans. We have a quantity purchase award agreement (QPA) in place for districts to order epoxy material. Bridge maintenance crews in all six districts have been trained to epoxy inject bridges effectively. Currently, we have two fully equipped epoxy trailers stored in a central equipment yard. All districts have the ability to reserve these trailers for use. It is recommended that each district epoxy injects a minimum of five (5) bridge decks each fiscal year. Epoxy injection work should be added to the annual Maintenance Work Plan by the bridge asset engineers. The proposed maintenance life cycle for a typical bridge deck, which incorporates epoxy injection, is as follows.

- Year 0: new bridge.
- Year 3: maintenance silane spray and crack filling.
- Year 6: maintenance silane spray and crack filling.
- Year 10: thin deck overlay #1.
- Year 20 to 25: thin deck overlay #2.
- Year 30 to 40: LMC overlay #1.
- Year 45 to 55: epoxy injection.
- Year 50 to 60: potential LMC overlay #2.
- Year 60 to 70: potential epoxy injection.
- Year 50 to 75: deck replacement.
- Repeat deck cycle treatments.

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# 1. INTRODUCTION

## 1.1 Motivation and Benefits

It is noteworthy to mention the impact of this epoxy injection technology is incremental. Iowa Department of Transportation (DOT) started injecting their bridge decks in 1970s and later the Michigan Department of Transportation (MDOT) embraced this viable technology. INDOT has adopted this mitigation strategy currently in use by IOWA and Michigan DOTs. Bridge decks are components which do not only support traffic but also protect the other bridge components. Bridge decks are susceptible to the effects of mechanical wear and weather conditions. These factors necessitate that bridge decks require more maintenance and repair than other bridge structure components. Repair of deteriorated decks requires choosing the most cost-effective treatment considering budget constraints, work force, traffic control, and weather.

The use of concrete overlays on bridge decks is the usual practice of INDOT for maintenance purposes. Concrete overlay has proven to be effective maintenance treatment as it prevents de-icing chemicals and water penetration into the original deck surface. Typically, over time, delamination/de-bonding develops at the boundary between the original deck and overlay due to

bond failure induced by vibration and structural flexure, which creates a void layer. The epoxy injection process is used to repair cracks and voids developed as a result of the overlay de-bonding (Figure 1.1). Displacing water (Figure 1.2) and filling these cracks with epoxy helps reduce freeze/thaw damage and extends the asset life span. This also reduces spalling and deterioration requiring emergency patching. Generally, the epoxy injection process could extend the useful asset life approximately 5 to 10 years (Wipf et al., 2019).

Out of the approximately 6,000 state-owned/maintained bridges, 1,575 bridges currently have latex modified concrete (LMC) overlays, and 770 of those overlays have a condition rating of 5 or 6 which may be good candidates for epoxy injection. These numbers support epoxy injecting a minimum of ten (10) concrete overlaid bridge decks per district per year in perpetuity.

## 1.2 Objectives

The objectives of this research project include the following.

- Examine the effectiveness of epoxy injection of bridge decks.
- Develop a state-wide epoxy injection program.
- Develop guidelines for effective epoxy injection.

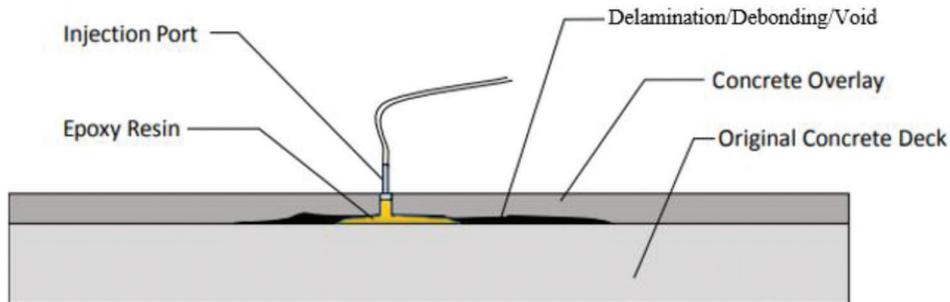


Figure 1.1 Epoxy injection of overlaid concrete bridge deck.



Figure 1.2 Water displacement from bridge deck voids.

## 2. LITERATURE REVIEW

Currently, the Michigan Department of Transportation and Iowa Department of Transportation repair cracks and voids developed as a result overlay debonding by injecting epoxy as part of their regular maintenance activities. The first known patent on epoxy was issued and several basic epoxy systems explored and developed in the 1930s (ACI Committee 503, 1993). According to ACI Committee 503 (1993), several field tests were completed in the late 1940s and early 1950s, including the use of epoxy as an adhesive to bond two pieces of hardened concrete, as a bonding agent for raised traffic line markers on concrete highways, and as surfacing materials on highways.

According to Wipf et al. (2019), Iowa DOT has been using concrete overlays on bridge decks since the

1970s to restore the concrete deck surface and lengthen the service life of the bridge deck. IOWA DOT has identified a need to perform an epoxy injection treatment on 120 to 180 structures annually. When the study was performed, IOWA DOT Districts' bridge crews were performing the epoxy injection. Wipf et al. (2019) developed epoxy injection specifications to place in IOWA DOT contract documents to employ contractors to perform some of the epoxy injection. This reduces the amount of epoxy injection their districts' bridge crews had to perform. Wipf et al. (2019) also conducted a nationwide survey to document the state-of-the-practice for epoxy injection. See Figure 2.1 for their national survey questions and Figure 2.2 for the responses received from the various states who participated.

Question #	Question
Question 1	If epoxy injection is a maintenance method used in your state, please list typical applications and for how long each has been used as a maintenance method.
Question 2	Please identify the epoxy typically used for the injection process. <input type="checkbox"/> ASTM C881 Type __ Grade __ Class __ <input type="checkbox"/> Other
Question 3	Please list the equipment typically involved in the epoxy injection process.
Question 4	Is the epoxy injection limited by conditions unrelated to the actual process? <input type="checkbox"/> Weather <input type="checkbox"/> Temperature <input type="checkbox"/> Maintaining Traffic Flow <input type="checkbox"/> Other (please specify)
Question 5	Who typically completes the epoxy injection process? <input type="checkbox"/> DOT Maintenance Staff <input type="checkbox"/> Hired Contractor <input type="checkbox"/> Other (please specify)
Question 6	Has an instruction manual or specification been developed that outlines the process the injector should use? <input type="checkbox"/> Yes, Contact the individual below to obtain copy of manual/specification (optional). <input type="checkbox"/> No, A manual/specification has not been developed.
Question 7	Please describe the most common method of epoxy injection used in your area.
Question 8	Please rate the effectiveness of the epoxy injection maintenance method. <input type="checkbox"/> Not Effective <input type="checkbox"/> Slightly Effective <input type="checkbox"/> Moderately Effective <input type="checkbox"/> Very Effective
Question 9	How long is the typical service life of the epoxy injection? <input type="checkbox"/> 0 to 5 Years <input type="checkbox"/> 5 to 10 Years <input type="checkbox"/> 10 to 15 Years <input type="checkbox"/> 15 to 20 Years <input type="checkbox"/> More than 20 Years
Question 10	Please indicate the state for which you are completing this survey and provide any additional information that you feel may be pertinent to this review.

**Figure 2.1** National survey questions (adopted from Wipf et al., 2019).

State	Application	State	Application	State	Application
Arizona	Crack repair in decks, girder fascias, and substructure	Maryland (1 of 2)	Not used	Oregon (1 of 2)	Crack repair
Arkansas	Not used	Maryland (2 of 2)	Substructure units	Oregon (2 of 2)	Crack repair of structural members with shear issues
California	Crack repair in concrete girders, abutment walls, and columns	Michigan	Crack repair for concrete piers, segmental concrete structures, and prestressed beams	Pennsylvania	Not used
Delaware	Not used	Minnesota	Not used	South Dakota	Crack repair in prestressed girders, columns, caps, and abutments.
District of Columbia	Not used	Missouri	Surface crack repair	Tennessee	Crack repair in substructures
Florida	Repair of beams, piles, pile caps, barrier walls, and seawalls	Montana	Not used	Texas	Crack repair
Georgia	Repair of columns and bents	Nevada	Crack repair of new and existing concrete elements, including bridge decks	Utah	Thin bonded epoxy overlays
Hawaii	Not used	New Hampshire	Not used	Virginia	Crack repair in substructure units
Idaho	Crack repair for columns, substructures, and girders	New Mexico (1 of 2)	Thin bonded epoxy overlays	West Virginia	Crack sealing bridge decks and void fill
Illinois	Crack repair in substructure units	New Mexico (2 of 2)	Not used	Wyoming	Crack sealing for abutment and bent caps and columns
Kansas	Bridge deck delamination repair and crack repair of substructure members	North Carolina	Crack repair for pier caps and columns		

Figure 2.2 Applications of epoxy injection by state (adopted from Wipf et al., 2019).

### 3. TRAINING AND SELECTION CRITERIA FOR IDEAL BRIDGE CANDIDATES

#### 3.1 Introduction and Number of Bridges Injected

It has been an effective collaboration between INDOT Research and Development, bridge asset engineers, maintenance engineers, and districts bridge crews in implementing epoxy injection of bridge decks. Irrespective of the numerous challenges encountered as part of this research project including COVID 19, each district has performed field epoxy injection. A total of 38 bridges have been injected since 2019. The breakdown is as follows.

- 2019: 7 bridges in the Crawfordsville District.
- 2020: 6 bridges in the Crawfordsville District.
- 2021: 15 bridges in all six districts.
- 2022: 9 bridges in the Crawfordsville District and 1 bridge in Greenfield.

#### 3.2 Training

Lessons learned by MDOT, and IOWA DOT epoxy injection operations clearly have benefitted INDOT. IOWA DOT even though they are the pioneers of bridge deck epoxy injection in the USA have had their fair share of failures. Recent reports published by

IOWA DOT found the following challenges amongst their districts epoxy injection operations:

- inconsistent procedures,
- inconsistent epoxy materials,
- different injection equipment,
- lack of training, and
- inconsistent results.

Various steps were taken as part of this study to overcome these challenges. A typical example is using a two-part epoxy material mix with one-part colored blue and one-part colored yellow so when they are mixed together green material is produced. Some districts of IOWA DOT were using clear parts of epoxy mix producing a clear final product which made it difficult to determine if the mix proportion was right.

We employed webinars, workshops, classroom, and field training with experts from MDOT and Lily Corporation to prepare ourselves to perform effective epoxy injection (see Figures 3.1, 3.2, and 3.3).

#### 3.3 Selection Criteria for Ideal Bridge Deck Candidates

Based on literature review, field observations, and deliberations with the project Study Advisory Committee, the criteria for selection of ideal bridge



**Figure 3.1** Training sessions for epoxy injection.



**Figure 3.2** Training session with Innovation and Process Improvements Director Todd May.



**Figure 3.3** Epoxy injection trailer demonstrated at a strategic planning workshop.

candidates for epoxy injection was determined and is listed as follows:

- debonded rigid concrete overlay,
- tight surface cracks,
- light to no cracking on soffit,
- very little to no spalls,
- delamination/debonding not exceeding 30% of the deck area,
- deck condition rating greater than or equal to 5, and
- wearing surface condition rating greater than or equal to 4.

#### 4. USING IMPACT ECHO NDT IN SCREENING DECK CANDIDATES FOR EPOXY INJECTION

Results from Impact Echo Nondestructive Testing (NDT) was used to help screen bridge decks for the selection of ideal bridge candidates for epoxy injection. Impact Echo Sonic Surface Scanner (see Figure 4.1), S3 manufactured by Olson Engineering was used for the testing. The impact echo scanner method is based on Olson’s technology of a rolling transducer and automated impactor for Impact Echo based thickness and flaw scanning of structural concrete. The scanner system allows the user to collect data along two lines with the test points spaced at 0.5 feet increments along the test lines. A scan rate of around 1 foot per second for best quality results (Olson Instruments, Inc., 2017) was employed. INDOT currently has two of these scanners and has scanned over 300 bridges. INDOT feels these scanners have provided an accurate assessment of the bridges they have scanned. These scanners

can be used for various applications. For this research, they were used to determine delaminated/debonded areas between LMC overlays and the original concrete bridge decks.

Impact echo method is a seismic or stress-wave based method used in the detection of defects in concrete, primarily delaminations (Sansalone & Carino, 1989). As the technician moves the Impact Echo scanner forward on the bridge deck and the two sensor wheels turn, the automatic solenoids on the side of the sensor wheels impact the deck surface. The compressional waves generated by the impacts travel through the deck concrete and are reflected from the bottom of the deck concrete, or from any flaw or hidden discontinuity such as delamination or debonding. The reflected wave energy is identified by the displacement transducers on the bottoms of the sensor wheels and the data is transmitted, in real-time, to Olson’s WinSSS-IE Software (real-time, interactive 3-D condition mapping) on the provided laptop. If there are multiple delaminations at one location, e.g., it there is a lower-level delamination with overlapping top delamination at the same location, both delaminations are not noted. Sensor wheels spacing of 1 ft was used for the data collection. Impact echo test can be performed at any time of day. The normal test thickness range for the unit is approximately 3 to 20 inches, although tests can be done on thicker concrete with some success if the surface is smoothed enough (Olson Instruments, Inc., 2017). A map (see Figure 4.2) is created from the Impact Echo data, showing both sound concrete and delamination/debonded areas and percentage of each.



**Figure 4.1** Impact Echo Sonic Surface Scanner, S3 manufactured by Olson Engineering.

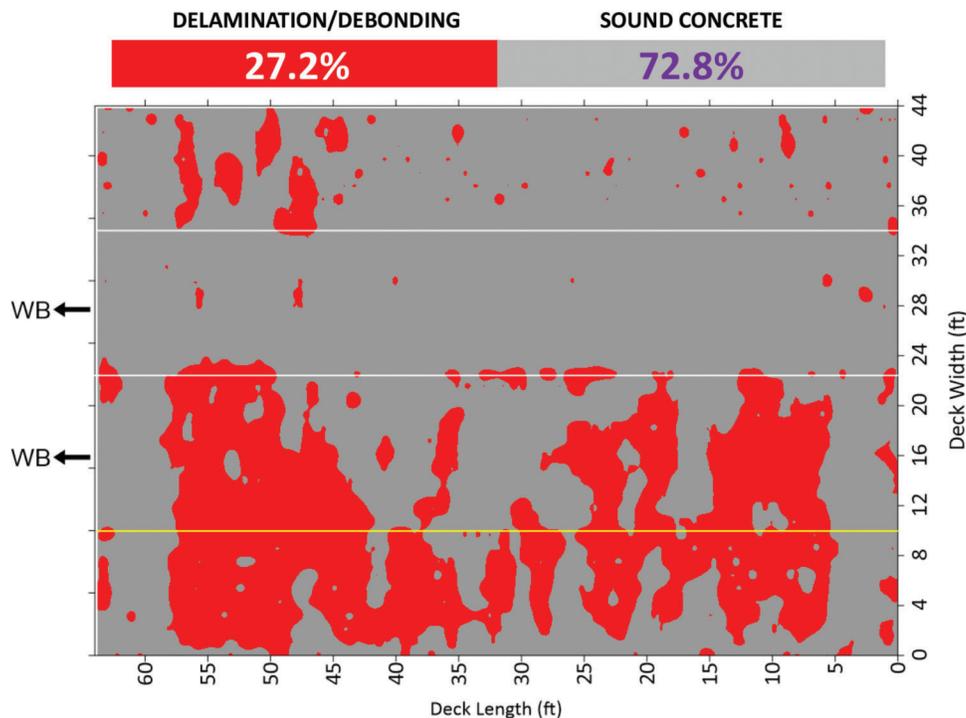


Figure 4.2 Impact Echo damage map.

## 5. FIELD EPOXY INJECTION OPERATION

The keys to effective field epoxy injections include the following:

- selecting the ideal bridge deck candidates,
- personnel with proper training,
- proper materials,
- proper equipment, and
- proper procedures.

Detailed guidelines for the epoxy injection procedure are shown in Chapter 7. Figure 5.1 shows the step-by-step epoxy injection procedure. INDOT currently has two fully equipped trailers (see Figure 5.2) for statewide epoxy injection operations. Figures 5.3, 5.4, 5.5, 5.6, 5.7, and 5.8 show typical epoxy injection procedures.

The epoxy injection procedure includes the following general steps.

- Step 1:** Selection of ideal bridge candidates for epoxy injection.
- Step 2:** Materials, equipment, accessories, and storage conditions.
- Step 3:** Pre-injection procedure, crack sealing, and traffic control.
- Step 4:** Start-up procedure.
- Step 5:** Injection procedure.
- Step 6:** Regular monthly maintenance of equipment.
- Step 7:** End of season shut down of equipment.

### 5.1 Epoxy Injection of Bridge NBI 36660 in Greenfield (Monster Bridge)

Bridge NBI 36660 (I-65 over 7 STS Access Road, Monorail) is located in downtown Indianapolis with heavy traffic daily volume (see Figures 5.9 and 5.10). Bridge was built in 1972 with LMC overlay rehab in 1989. All three lanes of SB 65 from the west end to Illinois Street and most of the MLK on ramp bridge were injected. Epoxy injecting the SB bridge required 2 weeks. Prior to the field injection, training was provided to the bridge crews. Also, prior to performing the injection, Impact Echo NDT was performed on sections of the bridge (Figure 5.11) to determine the delaminated areas. On NB 65 we injected all of lanes 1 and 2 from Illinois Street to the west end of the structure and the entire MLK off ramp. A total of 30 drums out of the 60 drums epoxy material ordered were used covering an area less than half of the overall bridge area. The plan is to use the remaining 30 drums of epoxy material on the remaining half of the bridge next year. The epoxy injection procedure is saving future patching needs for the district and hence enhancing mobility and safety of motorists. Figures 5.12 and 5.13 shows epoxy procedures on bridge NBI 36660.

#### Summary of Work Activities

- Location: I-65 downtown, MM 113.1 to 113.4, and MLK on/off ramps. Epoxy injection west end of bridge to

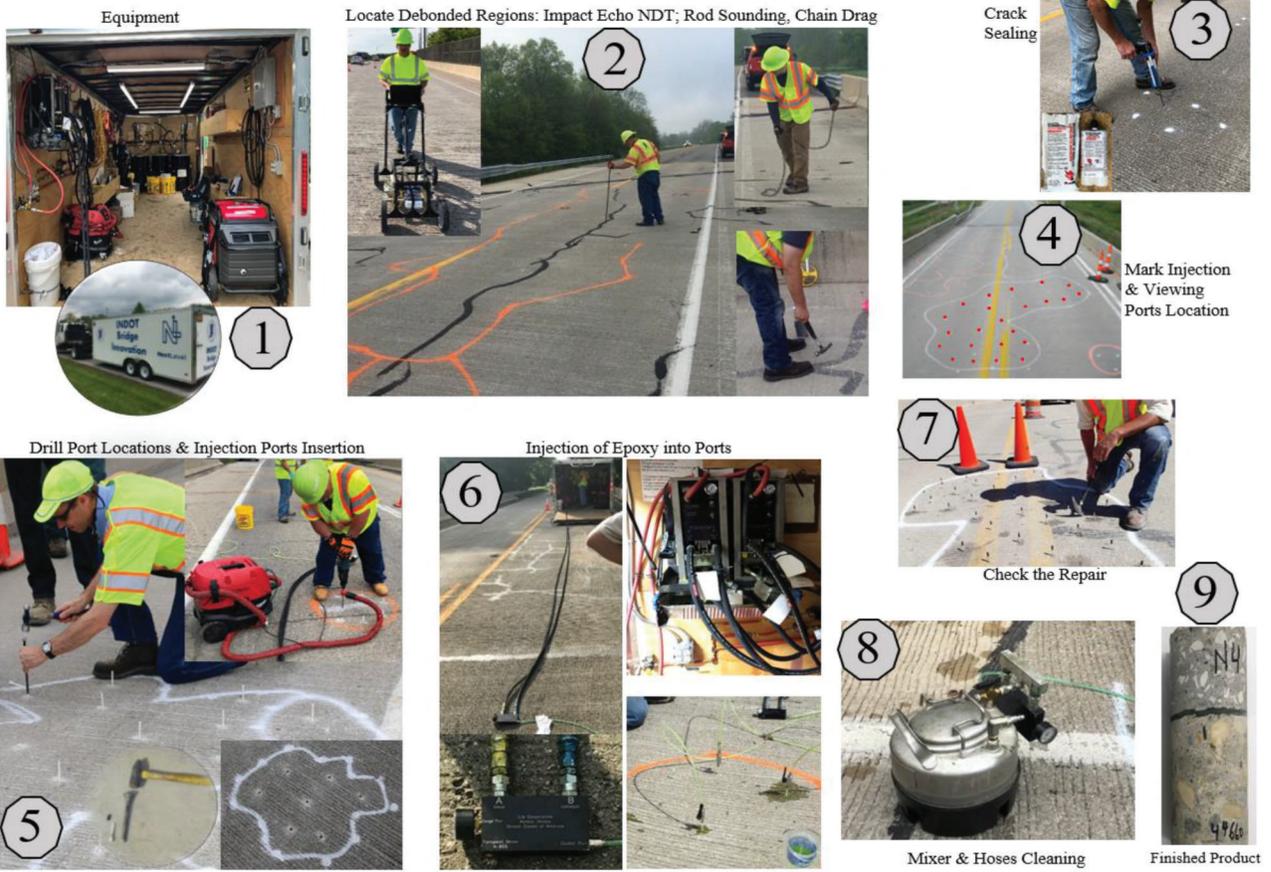


Figure 5.1 Step-by-step field epoxy injection procedure.



Figure 5.2 Epoxy injection trailer.



**Figure 5.3** Using chain drag NDT to mark perimeter of debonded overlay.



**Figure 5.4** Drilling of injection port holes.

Illinois St. including MLK ramps. SB injection lanes 1, 2, and 3. NB injection lanes 1 and 2.

- Timeline: 2 weeks of NDT, crack sealing, and deck patching. 3 weeks of epoxy injection. July 25 to August 25, 7:00 p.m. to 6:00 a.m. lane closures.
- MOT: Closing 2 of 3 lanes nightly and necessary on/off ramps.
- Materials: 30 drums of Akabond 818 (1,500 gal) used on the project. 240 cartridges of 10 minute mender to seal cracks. 50 5' x 5' x 2" deck areas were patched using Kwikbond PPC 1121.
- Crew: 2 separate crews of 7 people with 2 epoxy trailers, working about 500' apart, 12-hour shifts. 8 hours of injection time, 2 hours for MOT setup/teardown, and 2 hours of drum change/cleaning.

- Equipment: Each crew, dump truck pulling the epoxy trailer and filled with sand for epoxy blowouts, MOT cone truck, and foreman truck with light plant.
- Training: Demo with Crawfordsville crew and research hands-on training for the first week on site.
- NDT: Impact Echo NDT determined locations and provided a delamination map. A hammer or chain was used to sound and determine exact limits of delamination. Drilling holes were then marked. Delamination map was especially effective in finding smaller delaminations. Majority of delaminations were extremely large, there were 50-ft long sections of entire lane widths that were delaminated and had to be filled. Production: ~50 gallons per crew per shift, 14 shifts, and 1,300' 12' 6 lanes = 93,600 ft<sup>2</sup> total bridge area. Bridge crew moved about 550 ft in one lane per night.



**Figure 5.5** Epoxy injection through ports.



**Figure 5.6** Fort Wayne District epoxy injection crew.

**5.2 Before and After Epoxy Injection of Bridge NBI 21925**

Bridge NBI 21925 is located in Vincennes District. Bridge was originally built in 1967. Bridge had LMC overlay rehabilitation in 2004. A total of 108 gallons of epoxy were injected into the bridge deck. Figures 5.14, 5.15, and 5.16 shows the before and after epoxy injection Impact Echo NDT delamination maps and cores taken.

**5.3 Before and After Epoxy Injection of Bridge NBI 44460**

Bridge NBI 44460 is located in Crawfordsville District. Bridge was originally built in 1959. Bridge had LMC overlay rehabilitation in 1986. Figures 5.17 and 5.18 shows the before and after epoxy injection Impact Echo NDT delamination maps and cores taken.



**Figure 5.7** Greenfield District epoxy injection crew.



**Figure 5.8** LaPorte District epoxy injection crew.



**Figure 5.9** Bridge NBI 36660 in downtown Indianapolis.



Figure 5.10 Bridge NBI 36660 layout.

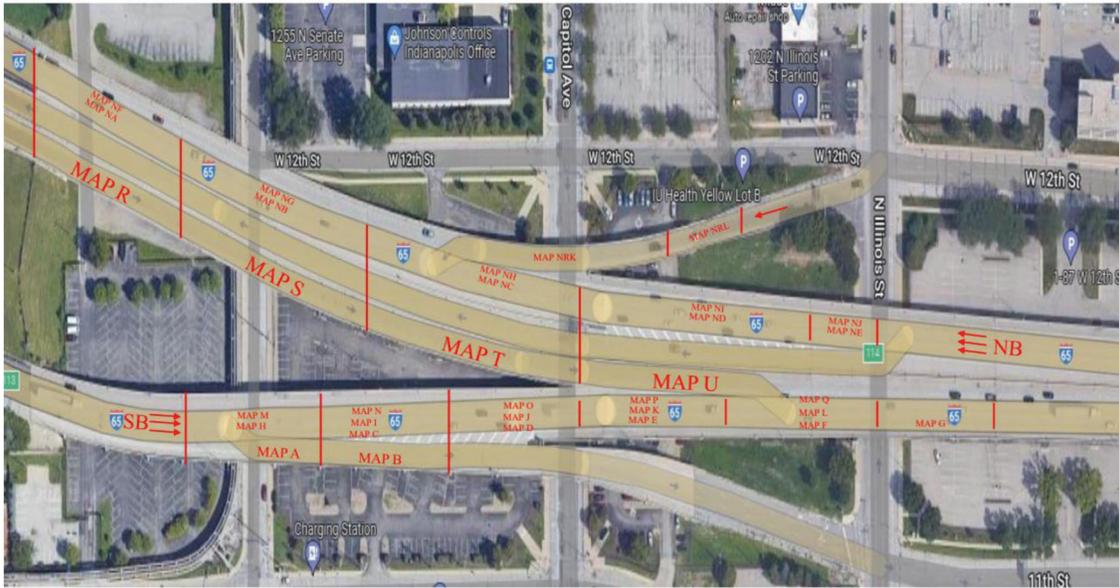


Figure 5.11 Bridge NBI 36660 Impact Echo NDT locations.



Figure 5.12 Bridge NBI 36660 epoxy injection works.



Figure 5.13 Bridge NBI 36660 epoxy injection showing port locations.

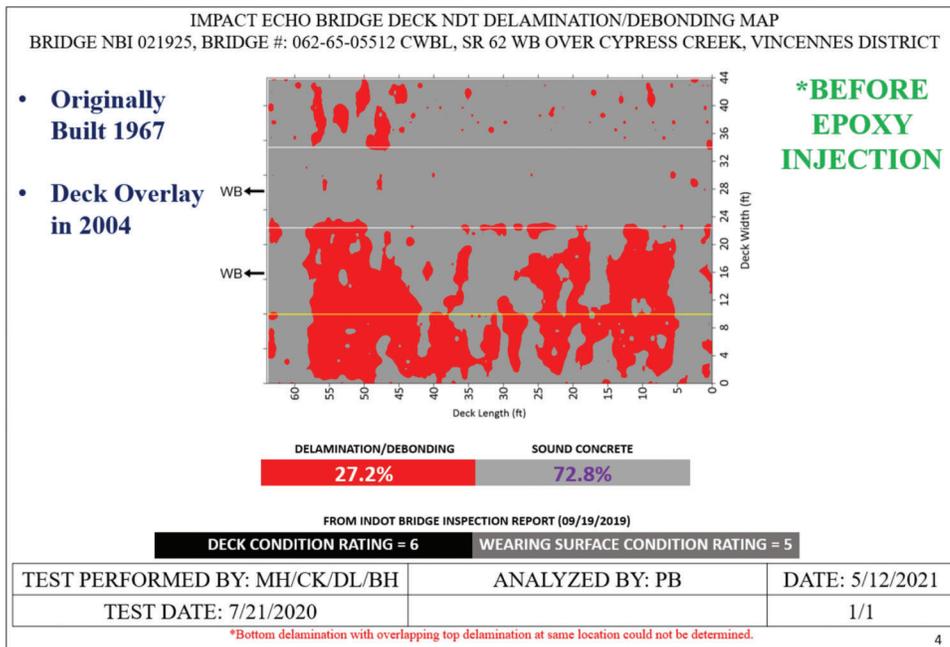
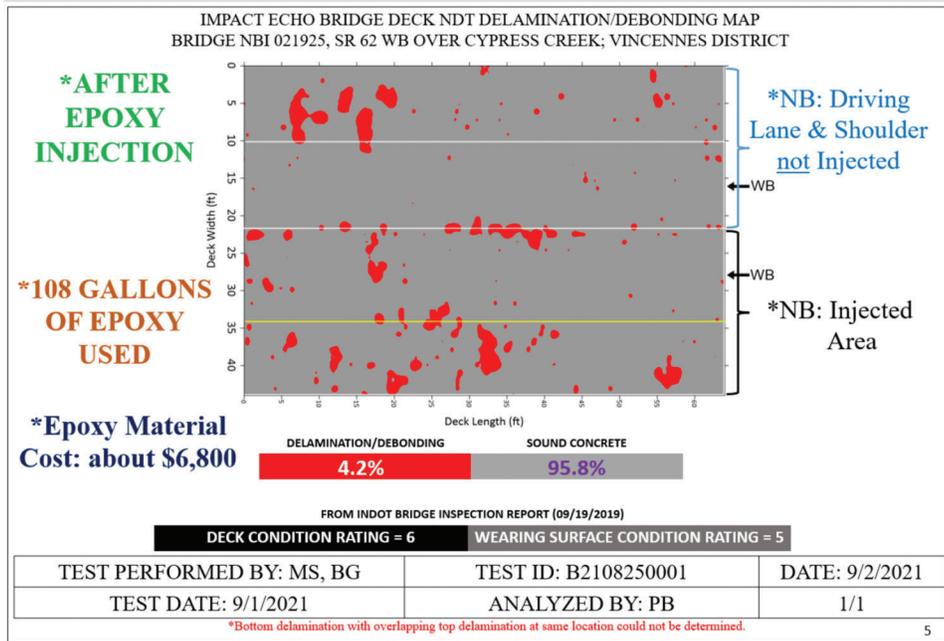
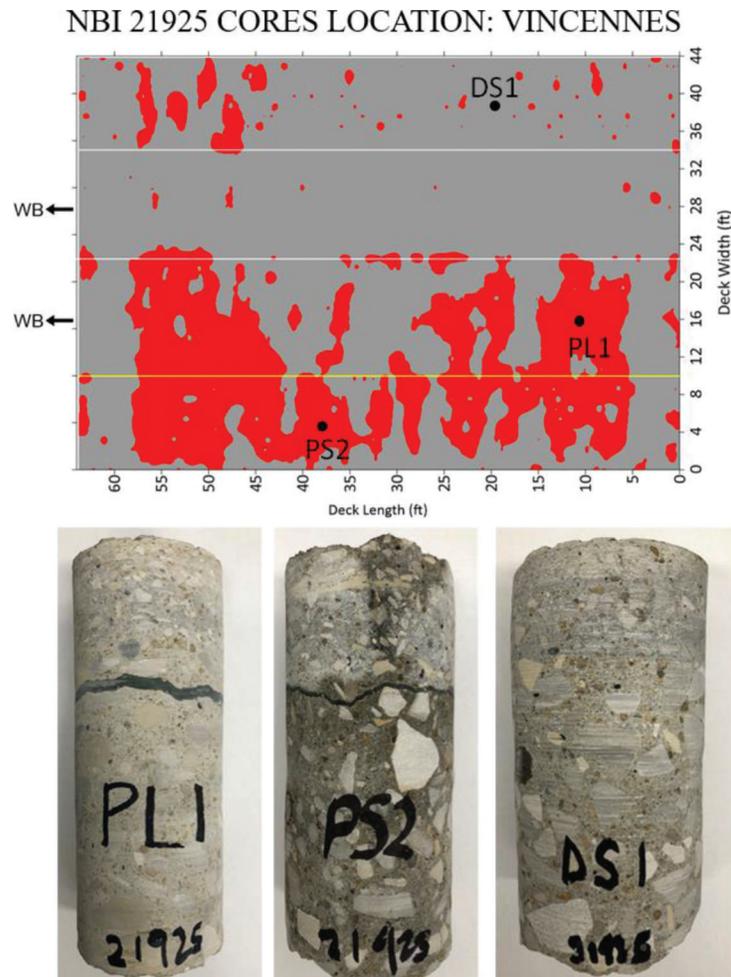


Figure 5.14 Bridge NBI 21925 Impact Echo NDT delamination map before epoxy injection.



**Figure 5.15** Bridge NBI 21925 Impact Echo NDT delamination map after epoxy injection.



**Figure 5.16** Bridge NBI 21925 cores taken to verify Impact Echo NDT and epoxy injection.

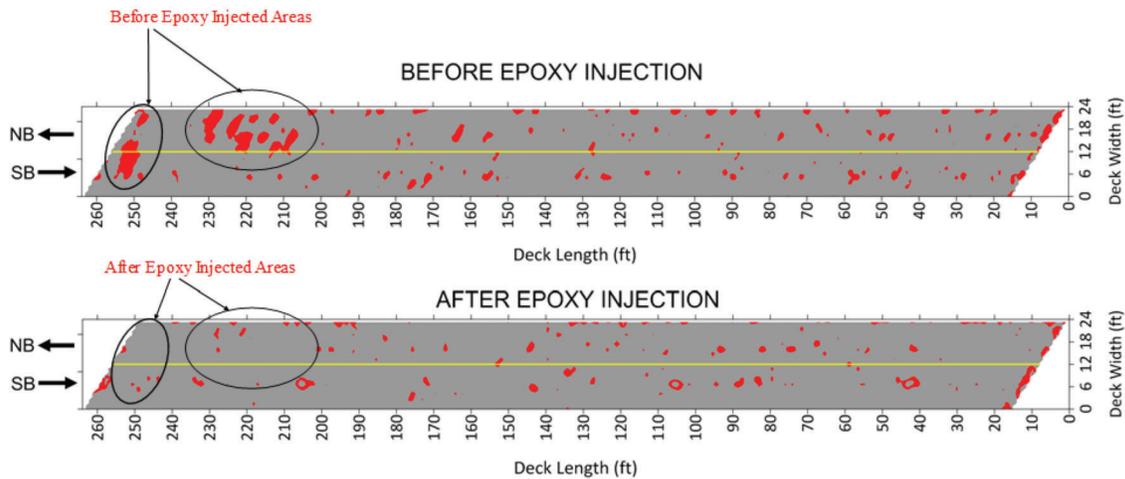


Figure 5.17 Bridge NBI 21925 Impact Echo NDT delamination map before and after epoxy injection.



Figure 5.18 Bridge NBI 44460 cores taken to verify Impact Echo NDT and epoxy injection.

## 6. STATE SURVEY ON EPOXY INJECTION

### 6.1 Methodology

Online questionnaires were sent to 24 bridge/maintenance crew members who participated in their district's field epoxy injection procedure. The intent of the survey was to document the experiences, concerns, and thoughts the crew members had while performing epoxy injection considering procedures, materials, equipment, personnel availability, interest, and workload. A total of 18 out of the 24 crew members responded. Responses were received from all six districts. Appendix C lists all the questions and responses received.

### 6.2 Response Summary

- It was a very easy process to learn and use, seems to be much more efficient and less strain on your body doing the work.

- It is low-cost bridge maintenance activity.
- It uses less destructive method to repair bridge decks.
- Leads to bridge longevity.
- Proactive epoxy injection maintenance is far better than traditional deck patching.

## 7. DEVELOPMENT OF GUIDELINES FOR STEP-BY-STEP EPOXY INJECTION

Based on the results from this research effort, guidelines for epoxy injection of bridge deck were developed. These guidelines provide step by step instructions to be followed for effective epoxy injection. In developing these guidelines, we considered input from the study advisory committee, maintenance engineers, districts bridge asset engineer, the districts, bridge crew workers and technicians as well as field first-hand observations of the injection procedure. The guidelines are included here.

## 7.1 Epoxy Injection Instructions for Work Performance Standards

### 7.1.1 Purpose

- The purpose of the epoxy injection process is to fill areas where a rigid bridge deck overlay has debonded from the bridge deck. The epoxy material protects the bridge deck from moisture and can help support the overlay and prevent it from failing under traffic loads. The epoxy injection process can help to extend the service life of the overlay and prevent the need for future expensive repairs to the bridge deck overlay.
- Epoxy injection work should be included in the annual Maintenance Work Plan by Technical Services.

### 7.1.2 Overview

- An overview video detailing the equipment and procedures used with the epoxy injection trailer can be found here: <https://web.microsoftstream.com/video/39b373d7-a0b2-487f-afb0-2f7f19796992>.

### 7.1.3 Setup and Pre-Injection Procedures

- Reserve epoxy injection trailer on the Central Equipment Yard website prior to the scheduled time of use of the trailer.
  - The Central Equipment Yard website can be found at the following link: <https://centralequipmentyard.myturn.com/library/inventory/browse?requestedFormat=&offset=0&max=15>.
- Set up traffic control according to the traffic control plan.
  - Epoxy injection process may be performed on one lane of bridge at a time, so it is not necessary to close all lanes on a bridge.
  - Epoxy injection process may be performed at night-time, performing work at night should be considered for busy routes.
- Ensure that weather conditions are appropriate.
  - Epoxy injection cannot be performed in the rainwater can infiltrate the port holes and become trapped within the delaminated portions of the deck. The vacuum bit on the hammer drill can also easily become clogged.
  - The bridge deck temperature must be above 65 degrees Fahrenheit to perform epoxy injection procedure. The temperature can be checked using the laser thermometer that is stored on the epoxy trailer (see Figure 7.1).
- Identify locations that require epoxy injection.
  - Identify the extents of overlay delaminated areas using Impact Echo NDT Scanner or chain drag.
  - Use rod/hammer sounding to locate the exact perimeters of overlay delaminated areas and mark the perimeters with spray paint.
- Seal cracks over and adjacent to the delaminated areas. Use bridge deck crack filling material.

- Ensure all air and resin lines are connected and tightened down.
- Connect dispenser lines, shut-off valves, and connect-its (connect-its are small gold connectors that are used to attach the injection nozzles to the end of the hoses—see Figure 7.2).
- Record the amount of epoxy material used to help keep track of epoxy material usage.
- Wear proper clothing, eyewear, gloves, and other appropriate equipment, along with PPE, to ensure protection from epoxy resin and associated materials.

### 7.1.4 Start-Up Procedures

- Start generator—check oil and gas prior to beginning operation.



Figure 7.1 Laser thermometer.



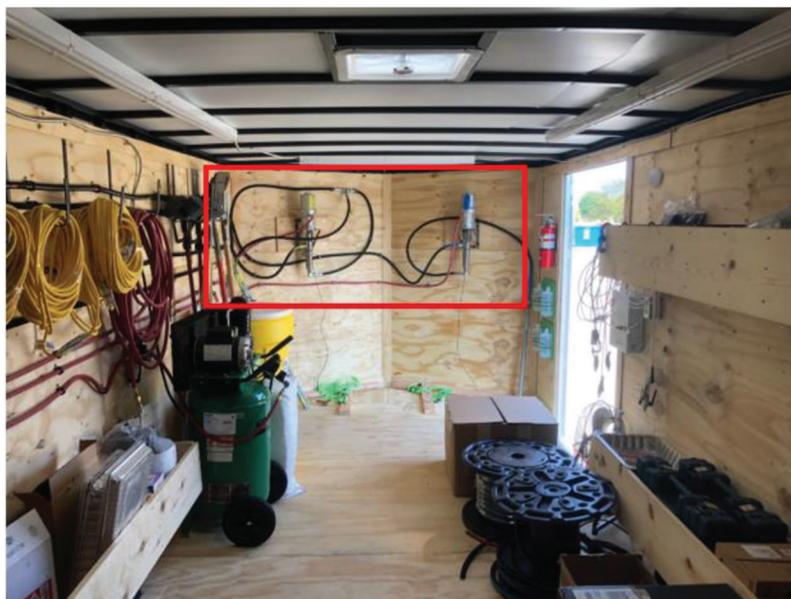
Figure 7.2 Connect-its.

- Connect only one extension cord to each outlet on generator shop vacuum should be run off one outlet and drill should be run off the other outlet.
- Mark injection and viewing port locations.
  - Using the hammer, one should identify the areas within the voided region that have an apparent higher degree of delamination—areas that have the most distinct hollow sound. These areas should be marked as injection port locations. Additional ports should be marked approximately 8"–12" apart depending on the size of the delaminated area. Ensure outer holes remain 6" from the perimeter of delaminated areas.
- Drill the port locations.
  - Using a 1/2" vacuum concrete drill bit, hammer drill, and shop vacuum, drill at each port location until the void is penetrated. It may be obvious when the drill bit reaches the void at some locations as there could be a noticeable and immediate drop of the drill into the voided area. At other locations, the penetration might not be as obvious. Generally, drill 4" down as guide. It is helpful to measure and mark the drill bit at the 4" depth. Do not exceed 6" in drilling depth.
  - Ensure the shop vacuum is connected to the drill bit to collect cement/concrete fine particles.
  - Place crimps on the ports before the ports are inserted in the drilled holes, but do not tighten crimps.
- Check oil level in the lift pumps.
  - The lift pumps are located on the back wall of the trailer (to the right as you enter the side door of the trailer). There are two lift pumps, one for the A side which is yellow and one for the B side which is blue (see red box in Figure 7.3).
  - There are two locations that need to be checked for oil levels, the pump oil containers, and the seal lubricant containers.
  - The oil containers for the pumps are on the wall opposite the side door to the trailer (see red box in

Figure 7.4). There are two identical oil containers here, one for each pump.

The oil level for the pumps can be checked by looking at the viewing windows on either side of the oil containers. The oil level should be above the silver midpoint line on the viewing window (see red arrow in Figure 7.5).

- If the oil level is low (below the silver midpoint line) in either or both pumps, add the Napa 756-1400 Air Tool Lubricant oil (see Figure 7.6) that is stored in the trailer to the oil container(s) until the oil level is near the top of the viewing window.
  - The seal lubricant containers are located on the pumps themselves. The containers are small open cups located directly below the main body of each pump (see red arrows in Figure 7.7).
  - The seal lubricant is poured directly into the cup; the level of lubricant in the cup should be just slightly below the top of the cup. Check the lubricant levels on both pumps. If the level of lubricant is low, pour the Graco Throat Seal Liquid that is stored in the trailer directly into the cup until the level of lubricant is slightly below the top of the cup (see Figure 7.8).
- Turn on both ball valves on the lift rods inserted in the yellow epoxy barrels (see yellow box in Figure 7.9).
  - Turn on ball valve on the lift rod inserted in the blue epoxy barrel.
  - Turn on main valves (see Figure 7.9). Note, the valves to be turned on will be based on whether you are using only one Lily dispenser or both dispensers. The use of one or two of the dispensers depends on the area of bridge deck being injected and the number of laborers on hand. The use of two dispensers will allow for there to be two sets of injection nozzles in use (two sets of three nozzles for six total), while using one dispenser will allow for only one set of three injection nozzles to be in use.



**Figure 7.3** Location of lift pumps and oil containers.



Figure 7.4 Lift pump oil containers.



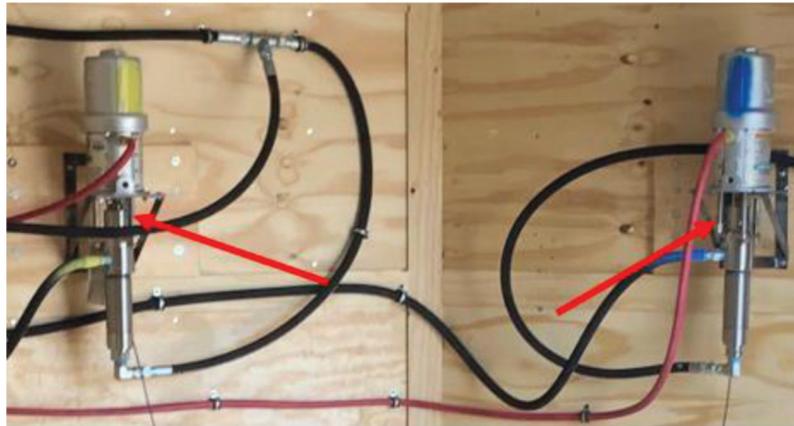
Figure 7.5 Oil level in lift pump container.

- Turn on Lily dispenser pumps for both yellow and blue resin lines. The dispenser pumps are located near the rear door of the trailer on the wall opposite the side door (see red arrow in Figure 7.10). See the yellow arrows in Figure 7.11 for the location of the on/off switches on the two pumps.
- Turn on air compressor. The air compressor is electric and should be plugged into one of the wall sockets located in the trailer.
- Reset Lily dispenser to help record the number of cycles. This can be done by pressing the small gray button on the cycle counter on each of the two dispensers; see the red arrow in Figure 7.12 for the location of the reset button. This is needed to calculate the volume of epoxy used at the end of the injection process.



Figure 7.6 Napa 756-1400 Air Tool Lubricant oil for lift pumps.

- Pull hoses for both A and B side materials out to the bridge deck. Make sure to pull the full length of each hose out on to the deck and to straighten the hoses out to their full length to avoid kinks or tangles.
- Use only metal 5-gallon buckets to purge air from the material lines (one bucket for yellow line and another bucket for blue line). Metal buckets must be used due to the heat of the epoxy material that will be dispensed from the hose.
- Uncap hoses and bleed hoses for 20–30 seconds into metal buckets?
- Connect A and B hoses to the Tempest mixing block (yellow line inside A and blue line inside B; see yellow box in Figure 7.13). Connect 1/4" outlet hose to the outlet port of the mixing block (see blue arrow in Figure 7.13).



**Figure 7.7** Location of seal lubricant containers.



**Figure 7.8** Filling of seal lubricant cap with Graco Throat Seal.

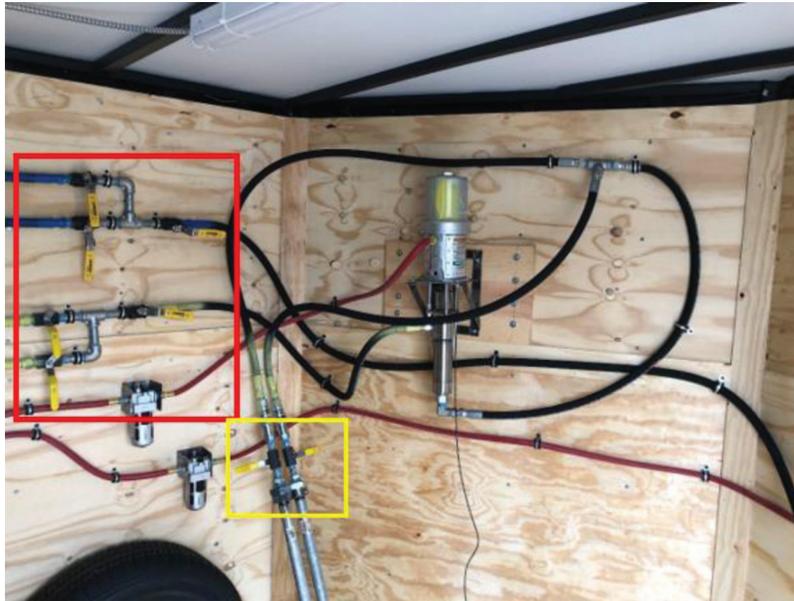
Install the gauge to the mixing block after installing the A and B side hoses and the 1/4" outlet hose (see red arrow in Figure 7.13). If using both dispensers, two mixing blocks will be used.

- Connect the four-way manifold connector (Figure 7.14) to the end of the outlet hose. Connect the three 1/4" hoses with nozzles on the ends to the other three ports of the manifold connector.
- Put all three nozzles into a metal bucket and open the valves on the nozzles. Turn on the dispenser pump and pump epoxy into the bucket until the epoxy output is a consistent green color. This should be done by turning on the pump and then watching the epoxy coming out of the nozzles to view its color.
- Shut off Lily dispenser and connect the three nozzles to the port locations furthest from the trailer.
- Turn on Lily dispenser to pressure close to but not exceeding 20 psi. The pressure can be read on the cylinder pressure gauge on the dispenser pump (see red arrow in Figure 7.15) and can be adjusted by turning the Regulator knob on the dispenser pump (see yellow arrow in Figure 7.15).

- Note: a 20-psi pressure on the Lily dispenser will be equivalent to about 4–5 times the pressure (80–100 psi) recorded at the injection port on the deck.

### 7.1.5 Epoxy Injection Procedures

- One person should remain in the trailer to monitor the cycling rate on the Lily dispenser. The cycling rate can be monitored with the cycling rate gauges that are on the side of the dispensers that faces the back wall of the trailer (see Figure 7.16).
- Begin injection of epoxy at the port of most significant delamination (to be determined by hammer tapping) and cap adjacent ports as epoxy appears. Attach each of the three nozzles to three of ports in a delaminated region. Initially, turn of valves for each of the three nozzles. Turn on one nozzle at a time to check that the epoxy is flowing into a void. The cycling rate on the dispenser will indicate how quickly the deck is receiving the epoxy, and if there is a void being filled at the location of the port being injected. The speed of the up and down motion of the cycling rate gauge indicates the speed at which the epoxy is being dispensed. Where the cycling is relative steady and quick the injection can simply be monitored periodically to ensure the injection is progressing. When the cycling is very slow or not progressing at all, move to adjacent injection port. If epoxy is flowing at a port, leave that nozzle opened. If no epoxy is flowing at a port, close the valve on that particular nozzle and move it to a different port in the same delaminated region. Continue in the same manner until all ports have been occupied and the delamination has been filled in that region. It is important to observe all ports in this injected area. Firstly, cap ports as epoxy comes out and later crimp the ports (click crimps twice, one on each side to prevent epoxy from gushing out when the ports are trimmed). Note that epoxy resin will not always extend to all viewing ports (ports that are not currently having epoxy injected into them) or to the perimeter of the delaminated area. It is up to the judgment of the user to drill additional ports to fill that remaining area. Generally, if the vast majority of the delaminated area has been filled



**Figure 7.9** Main resin lines valves and valves on lift rods going into the resin barrels.

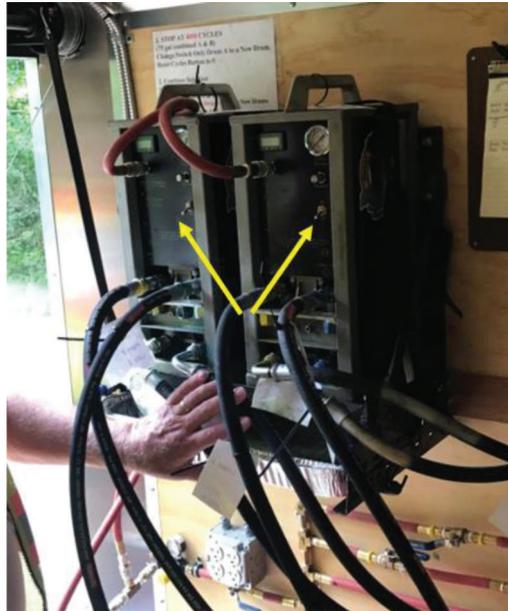


**Figure 7.10** Location of Lily dispensers.

and only a small, voided area is thought to remain, the void can be left without injection.

- Don't rush to cut off ports not taking epoxy early. Leave until all the injection in that region is done.
- In the event that epoxy flows out of the bridge deck at a location that does not have a port inserted (a crack or joint, for example), immediately stop injection at current port. Clear the epoxy that has leaked onto the deck by placing sand on top of the filled epoxy, mixing the sand with the epoxy to absorb it. Let the sand sit on the epoxy for several minutes and then remove the sand with shovels and put it into a metal waste bucket.
- Monitor the bottom of the deck during the injection process to ensure epoxy resin is not leaking through the deck. Leakage must be abated before injection can continue.

- To verify effective injection, re-sound injected areas by broadcasting sand on the area of interest and hammer tapping. An unfilled area will sound hollow. Areas with voids will experience appreciable bouncing of the sand particles. Filled areas will sound solid and experience less movement of the sand particles. A video of the re-sounding procedure can be found here: <https://web.microsoftstream.com/video/762a56c2-ac47-4f85-aa8c-013b4cedae7d>.
- Clean any area where epoxy has leaked onto the deck using sand with the method described above.
- Move to another marked delaminated/debonded region to repeat the process.
- Cut off part of the port's extension beyond the crimps upon completion of the epoxy injection.



**Figure 7.11** Location of the on/off switches on the two Lily dispensers.

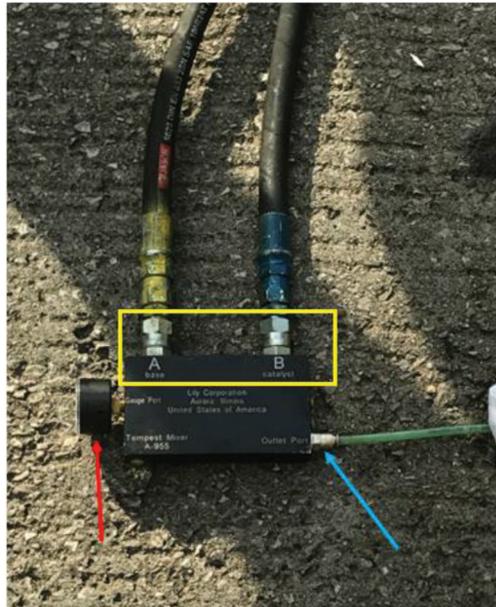


**Figure 7.12** Location of cycle counter reset.

- Cut off all ports at the surface of the bridge deck and make sure that all sand has been removed from the bridge deck by shoveling or sweeping.
- Perform equipment clean-up steps listed below.
- Bridge can be opened to traffic approximately 1 hour after the epoxy injection process is completed.
- Remove all traffic control signs or devices.

#### 7.1.6 Equipment Clean Up

- Disconnect pump hoses from mixer and drain excess epoxy from the hoses into a bucket.
  - Leave thin tubing leading to nozzles attached to mixer.
  - Pour sand into waste epoxy bucket to cool down hot epoxy.



**Figure 7.13** Tempest mixing block connections.



**Figure 7.14** Manifold connections.

- It is very important to clean all hoses and the tempest mixing block that held any mixed epoxy resin after the epoxy injection is completed for the day. This process is easily done using the pressurized purge assembly that accompanies the tempest mixing block. Once pressurized, a solution of acetone is passed through the mixer thereby removing any epoxy remnants. Hand tools and short hoses can be placed directly into the purge assembly for cleaning before storage. A video of this process can be viewed here: <https://web.microsoftstream.com/video/84fc7191-6d5c-4e48-a8fa-a83628a816d0>.
- Neatly wind-up A and B side hoses, and all extension cords and hang them on the hooks on the walls of the epoxy trailer.
- Place generator, shop vac, and air compressor back in trailer and strap down.
- The procedures for cleaning and storing the epoxy injection trailer equipment at the end of the season or before a long period of inactivity (3–4 weeks) are outlined in a video at the following link: <https://web.microsoftstream.com/video/038dfe47-1996-4e42-9e6c-acc6d6223845>.



Figure 7.15 Cylinder gauge and regulator.



Figure 7.16 Cycling rate gauges.

## 8. ANTICIPATED BENEFITS, DELIVERABLES, AND IMPLEMENTATION

### 8.1 Benefits

Epoxy injection is a low-cost maintenance procedure. Displacing water and filling voids at the interface of concrete overlays and concrete deck with epoxy helps reduce emergency bridge deck patching and extend service life of bridge decks. Out of the approximately 6,000 state-owned/maintained bridges, 1,575 bridges currently have LMC overlays, and 770 of those overlays have a condition rating of 5 or 6 which may be good candidates for epoxy injection. These numbers support epoxy injecting a minimum of ten (10) concrete overlaid bridge decks per district per year in perpetuity.

### 8.2 Deliverables and Implementation

#### 8.2.1 INDOT Strategic Goals

Epoxy injection of bridge decks impacts the agency in these strategic areas.

- *Safety*: ensure bridge safety for motorists, contractors, and INDOT personnel.
- *Asset sustainability*: enhance ability to manage and maintain bridge assets throughout their life cycle.
- *Innovation and technology*: harness technology and innovation to develop more effective bridge solutions.

The following are the keys to successful epoxy injection of bridge decks:

- selecting the ideal bridge deck candidates,
- personnel with proper training,
- proper equipment, and
- proper procedures.

The following are the ideal bridge deck candidate selection criteria for epoxy injection:

- debonded rigid concrete overlay,
- tight surface cracks,

- light to no cracking on soffit,
- very little to no spalls,
- delamination/debonding not exceeding 30% of deck area,
- deck rating greater than or equal to 5, and
- wearing surface condition rating greater than or equal to 4.

### 8.3 Implementation

Based on the findings of this research, guidelines have been provided for a step-by-step injection operation (see Chapter 7 of main report). Bridge asset engineers for each district has already started incorporating epoxy injection activity into their maintenance work plans. We have a quantity purchase award agreement (QPA) in place for districts to order epoxy material. Bridge maintenance crews in all six districts have been trained to epoxy inject bridges effectively. Currently, we have two fully equipped epoxy trailers stored in a central equipment yard. All districts have the ability to reserve these trailers for use. It is recommended each district epoxy injects a minimum of five (5) bridge decks each fiscal year. Epoxy injection work should be added to the annual Maintenance Work Plan by the bridge asset engineers.

A proposed maintenance life cycle for a typical bridge deck, which incorporates epoxy injection, is shown as follows.

- Year 0: new bridge.
- Year 3: maintenance silane spray and crack filling.
- Year 6: maintenance silane spray and crack filling.
- Year 10: thin deck overlay #1.
- Year 20 to 25: thin deck overlay #2.
- Year 30 to 40: LMC overlay #1.
- Year 45 to 55: *Epoxy injection*.
- Year 50 to 60: potential LMC overlay #2.
- Year 60 to 70: *potential epoxy injection*.
- Year 50 to 75: deck replacement.
- Repeat deck cycle treatments.

In the current *INDOT Maintenance Work Performance Standards*, epoxy injection is included as sub activity 841 under *Activity 2490-Other Bridge Maintenance*. See Figure 8.1.



INDIANA DEPARTMENT OF TRANSPORTATION  
DIVISION OF MAINTENANCE  
**WORK PERFORMANCE STANDARD**



<b>ACTIVITY</b>		<b>Other Bridge Maintenance</b>		<b>CODE</b>		<b>2490</b>	
<b>Purpose</b>				<b>Category</b>			
Complete other bridge maintenance or repair that is not identified with a separate activity.				Bridge			
				<input type="checkbox"/> PM <input type="checkbox"/> QA <input type="checkbox"/> Plan Location			
<b>Scheduling &amp; Coordination</b>							
Schedule this work throughout the year as needed. Observe weather and temperature limitations for individual activities.							
<b>Reporting</b>		<b>Asset to Report to</b>		<b>Reporting Units</b>		<b>Person Hours</b>	
		Bridge Structures					
<ul style="list-style-type: none"> <li>• Accomplishment is the total person hours worked.</li> <li>• Report to the specific bridge asset each time this activity is performed.</li> </ul>							
<b>Crew Size</b>		<b>Workers</b>		<b>QTY</b>		<b>P.P.E.</b>	
Crew size determined by sub-activity being performed				PPE determined by sub-activity to which will be performed			
				<b>Materials</b>			
				Materials determined by sub-activity to which will be performed			
<b>Job Specific Equipment</b>		<b>QTY</b>		<b>Other References</b>			
Job specific equipment determined by sub-activity being performed				Silica Exposure Plan (WPS Preface)			
<b>Sub Activities</b>							
830 – Scour repair (Rip Rap placement)				837 – Repair of slopewall			
832 – Bearing Assembly / Bridge Seat repair (bearing lubrication, reset bearings, mudwall repair, Seal abutment)				838 - Repair to drainage component (curb and gutter, drains, drain extensions)			
833 - Channel maintenance (log jam removal, debris removal, etc.)				839 -Repair to traffic safety component (handrail, sidewalk, guardrail attachments, bridge barrier)			
834 - Graffiti Removal				840 – Replacing riprap			
835 – Joint replacement				841 – Epoxy Injection			
836 – Repair joint material				840 – Bridge Approach Repair			
<b>Average Daily Production</b>		<b>Person Hours</b>		<b>EFFECTIVE DATE</b>		<b>8/10/2022</b>	

Figure 8.1 INDOT maintenance work performance standard.

## 9. CONCLUSIONS AND RECOMMENDATIONS

### 9.1 Summary and Conclusions

Epoxy injection is a viable and proactive bridge maintenance alternative to traditional deck patching as it requires less manpower, less destructive and low-cost. Concrete overlays have proven to be an effective maintenance treatment as they slow de-icing chemical and water penetration into the original deck surface. Typically, due to vibration, structural flexibility, and weak bond between the concrete overlay and deck concrete potentially due to poor construction, de-bonding develops at the boundary between the original deck and

overlay. This de-bonding creates voids, providing reservoir for chloride laden water to fill after it penetrates cracks in the surface. Displacing this liquid solution and filling these cracks with epoxy helps reduce freeze/thaw cycling and reduces spalling. The epoxy material protects the bridge deck from moisture and helps support the overlay and prevent it from failing under traffic loads. This leads to an extension of the asset life span and life cycle cost benefit increase. Overall, the bridge infrastructure performance improves significantly with greater mobility and less traffic interruptions due to repairs to bridges on our roadway infrastructures. Epoxy injection helps extends the service life of bridge decks and reduces the need for emergency bridge deck patching and as a

result improves safety of road users. Epoxy injection has been added to INDOT's Maintenance Work Performance Standards during the course of this study.

## 9.2 Recommendations

It is recommended each district injects about minimum of five (5) each fiscal year. Epoxy injection work should be included in the annual Maintenance Work Plan by Technical Services. It is imperative to monitor injected bridges in the near future.

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## APPENDICES

**Appendix A. Epoxy Injection Trailer and Accessories**

**Appendix B. Quantity Purchase Award (QPA) for Epoxy Material**

**Appendix C. State Epoxy Injection Survey Results**

**Appendix D. Epoxy Injection on Bridge NBI 36660 (Monster Bridge)**

## APPENDIX A. EPOXY INJECTION TRAILER AND ACCESSORIES

1. Enclosed trailer
2. Lily CD 15 Dispenser (2 Qty.)
3. Lily Tempest Mixer Assembly
4. Lily Purge Assembly
5. Injection Ports
6. Caps for Injection Ports
7. Connect tools
8. Tubing (250' Reel)
9. Shutoff Cock
10. Seal Tool
11. Socket Setting Tool
12. Crimps
13. Manifold (MR-3-4 Way)
14. 7500W Gas Generator
15. Material Transfer Pumps (2 Qty)
16. Air Compressor
17. Electrical system to power trailer lighting and air compressor
18. Hoses (pneumatic and material)
19. Drills and bits for installing epoxy injection ports
20. High efficiency vacuum systems for drill debris pickup
21. Safety equipment for personal protection and spill clean-up
22. 55 gallon drum dolly
23. Temperature Gun
24. Dry Sand
25. Metal 5 Gallon Buckets

Table A.1 Epoxy injection accessories

Lily P/N	Qty	Description
2	CD15	CD15 DISPENSER
1	A-118-2	PURGE ASSY - CD15 1/2 JIC
4	A-955	TEMPEST MIXER ASSY - CD15
40	P-235	P-235 INJECTI-REGULAR PORT (LOT 250)
30	P-226	P-226 CAP-ITS ( 500 LOT)
10	P-228	P-228 CONNECT-IT (LOT 10)
2	P-134	N-4 TUBING (250 ' REEL)
20	P-233	FF-2 SHUTOFF COCK
1	P-493	CAP SEAL TOOL
1	P-317	SOCKET SETTING TOOL
50	P-316	CRIMP-ITS (LOT OF 250)
5	A-270	MANIFOLD - MR-3 - 4 WAY

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 Fax # 765-362-7841  
 800-382-0972

[www.indianarubber.com](http://www.indianarubber.com)

# QUOTATION

Date	Quote #
3/14/2022	12638

Name / Address
Indiana Dept. of Transportation RESEARCH & DEVELOPMENT 1205 N. MONTGOMERY ST. WEST LAFAYETTE, IN 47996 PO BOX 2279

Proposed Shipping Date	Terms	Sales Rep
	Net 30 Days	

Description	Qty	Units	Price	Total
3/8" I.D. 200 PSI A/W HOSE	120	FT	1.06	127.20
2FM2-B Q-D COUPLER	8	EA	6.40	51.20
2FS3-B Q-D COUPLER	8	EA	8.52	68.16
D2M2 Q-D PLUG	8	EA	1.61	12.88
209P-12-4 BRASS BUSHING	8	EA	4.33	34.64
102-0606C BRASS HOSE BARB	16	EA	2.32	37.12
215PN-4-20 BRASS NIPPLE	6	EA	2.18	13.08
2203P-4 BRASS TEE	8	EA	4.99	39.92
14R113FC REGULATOR	4	EA	35.16	140.64
3/8" BRASS BALL VALVE	6	EA	6.93	41.58
LS4312-6-6B PUSH LOK FITTING	10	EA	5.30	53.00
4312-6-6B PUSH LOK FITTING	10	EA	1.68	16.80
BFM687 BRASS COLLOR	60	EA	0.60	36.00
GH781-08 HYD HOSE	500	FT	5.60	2,800.00
1AA8FJC8 HYD FITTING	12	EA	27.41	328.92
1AA8PS8 HYD FITTING	30	EA	12.34	370.20
1/2" C/S BALL VLAVE	10	EA	40.44	404.40
2081-32-16S BUSHING	6	EA	28.93	173.58
2081-16-08S BUSHING	8	EA	6.42	51.36
HT4F4 HYD PLUG	8	EA	39.09	312.72
4HTF4 HYD COUPLER	8	EA	69.50	556.00

<b>Subtotal</b>
<b>Sales Tax (7.0%)</b>
<b>Total</b>

**EMAIL:**  
[kent.richmond@indianarubber.com](mailto:kent.richmond@indianarubber.com)

Signature

**Central Indiana Rubber Products, Inc.**

**QUOTATION**

Phone # 765-362-7790  
 Fax # 765-362-7841  
 800-382-0972

Date	Quote #
3/14/2022	12638

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Proposed Shipping Date	Terms	Sales Rep
	Net 30 Days	

Description	Qty	Units	Price	Total
SPN-12 LOOP CLAMP	75	EA	1.44	108.00
SPN-16 LOOP CLAMP	75	EA	1.56	117.00
208P-6-4 BRASS REDUCING COUPLING	10	EA	5.26	52.60
209P-8-6 BRASS BUSHING	12	EA	2.60	31.20
2083-8-8S ADAPTOR	10	EA	2.57	25.70
1/2" S/S TEE	6	EA	5.92	35.52
1/2" X 3.0" S/S NIPPLE	8	EA	4.62	36.96
1/2" S/S 90 DEG ELBOW	6	EA	4.34	26.04
1/2" S/S COUPLING	4	EA	4.97	19.88
2045-8-12S ADAPTOR	4	EA	7.35	29.40
2096-8-8S ADAPTOR	6	EA	6.00	36.00
224-889 KIT CONVERSION PTFE GRACO SORRY FOR THE DELAY	4	EA	264.83	1,059.32
THANKS, MIKE				
PLUS INBOUND FRT				
200P-8-8 1/2" BRASS 90 DEG ELBOW	3	EA	8.56	25.68
208P-8-4 BRASS REDUCING COUPLING	4	EA	5.86	23.44
			<b>Subtotal</b>	
			<b>Sales Tax (7.0%)</b>	
			<b>Total</b>	

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[kent.richmond@indianarubber.com](mailto:kent.richmond@indianarubber.com)

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Indiana Dept. of Transportation RESEARCH & DEVELOPMENT 1205 N. MONTGOMERY ST. WEST LAFAYETTE, IN 47996 PO BOX 2279

Proposed Shipping Date	Terms	Sales Rep
	Net 30 Days	

Description	Qty	Units	Price	Total
218P-4 1/4" BRASS PLUG	3	EA	1.10	3.30
2021-0808S ADAPTOR	8	EA	2.33	18.64
2047-8-12S ADAPTOR	4	EA	13.84	55.36
1AA8FJ8 HYD FITTING	8	EA	8.25	66.00
REVISED 3-22-22				

	<b>Subtotal</b>	\$7,439.44
<b>Prices firm for 10 days.</b>	<b>Sales Tax (7.0%)</b>	\$0.00
<b>Prices subject to Manufacturers increases.</b>	<b>Total</b>	\$7,439.44

**EMAIL:**  
[kent.richmond@indianarubber.com](mailto:kent.richmond@indianarubber.com)

Signature \_\_\_\_\_







# APPENDIX B. QUANTITY PURCHASE AWARD (QPA) FOR EPOXY MATERIAL

## ATTACHMENT B

### INDIANA DEPARTMENT OF TRANSPORTATION (INDOT) QUANTITY PURCHASE AWARD (QPA) AGREEMENT MINIMUM SPECIFICATIONS FOR EPOXY MATERIALS FOR BRIDGE DECKS

#### 1. General

Item	Item Description	Compliance																																								
1.	<p>Axson Technologies Akabond 818 or INDOT approved alternate.</p> <p>Epoxy material shall be 100% solids, low viscosity epoxy adhesive that is suitable for pressure injection.</p> <p>Manufacturer: <u>Axson Technologies</u></p> <p>Product Name: <u>Akabond 818</u></p>	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no																																								
2.	All material supplied shall have a shelf life of 12 months when stored in original, unopened containers between 55 and 77 degrees Fahrenheit.	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no																																								
3.	The liquid epoxy components shall be packaged in 55-gallon drums and delivered on wooden pallets.	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no																																								
4.	The material shall be certified to meet ASTM C-881: Types I, II, IV and V. Grade 1, Classes B and C.	<input checked="" type="checkbox"/> yes <input type="checkbox"/> no																																								
5.	<p>The liquid epoxy components supplied shall meet the following physical properties:</p> <table border="1"> <thead> <tr> <th>Property</th> <th>Applicable Standard</th> <th>Akabond 818 Resin Part A, or INDOT Approved Equal</th> <th>Akabond 818 Hardener Part B, or INDOT Approved Equal</th> <th>Part A and Part B Mixed</th> </tr> </thead> <tbody> <tr> <td>Composition</td> <td></td> <td>Epoxy</td> <td>Amine</td> <td></td> </tr> <tr> <td>Mix Ratio By Weight:</td> <td></td> <td>100</td> <td>43</td> <td></td> </tr> <tr> <td>By Volume:</td> <td></td> <td>100</td> <td>50</td> <td>2/1</td> </tr> <tr> <td>Appearance</td> <td></td> <td>Liquid</td> <td>Liquid</td> <td>Liquid</td> </tr> <tr> <td>Color</td> <td></td> <td>Yellow</td> <td>Blue</td> <td>Green</td> </tr> <tr> <td>Viscosity @ 77° (25° C) cPs</td> <td>ASTM D 2393</td> <td>700</td> <td>35</td> <td>200</td> </tr> <tr> <td>Density @ 77° (25° C) g/cc</td> <td>ASTM D 792</td> <td>1.13</td> <td>0.96</td> <td></td> </tr> </tbody> </table>	Property	Applicable Standard	Akabond 818 Resin Part A, or INDOT Approved Equal	Akabond 818 Hardener Part B, or INDOT Approved Equal	Part A and Part B Mixed	Composition		Epoxy	Amine		Mix Ratio By Weight:		100	43		By Volume:		100	50	2/1	Appearance		Liquid	Liquid	Liquid	Color		Yellow	Blue	Green	Viscosity @ 77° (25° C) cPs	ASTM D 2393	700	35	200	Density @ 77° (25° C) g/cc	ASTM D 792	1.13	0.96		<input checked="" type="checkbox"/> yes <input type="checkbox"/> no
Property	Applicable Standard	Akabond 818 Resin Part A, or INDOT Approved Equal	Akabond 818 Hardener Part B, or INDOT Approved Equal	Part A and Part B Mixed																																						
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Viscosity @ 77° (25° C) cPs	ASTM D 2393	700	35	200																																						
Density @ 77° (25° C) g/cc	ASTM D 792	1.13	0.96																																							

	(lb/gal)		(9.4)	(8.05)	
	Pot Life @ 77° (25° C) 229 g minutes	ASTM D 2471			20
6.	Epoxy shall meet the following physical properties at 74° F (23° C) when cured:				
	Property	Applicable Standard	Unit	Value	
	Hardness	ASTM D 2240	Shore D	82	
	Tensile Strength	ASTM D 638	psi (MPa)	10,100 (70)	
	Tensile Modulus	ASTM D 790	psi (mPa)	472,000 (3,250)	
	Flexural Strength	ASTM D 790	psi (mPa)	14,500 (100)	
	Flexural Modulus	ASTM D 790	psi (mPa)	511,000 (3,520)	
	Compressive Strength	ASTM D 695	psi (MPa)	14,700 (101)	
	Compressive Modulus	ASTM D 695	psi (MPa)	353,000 (2,430)	
	Glass Transition Temperature (Tg)	DMA	°F (°C)	141 (61)	
	Application Temperature		°F (°C)	>40 (4)	
	Final Cure		days	7	
	Water Absorption	24 Hour Immersion	%	0.27	
					<input checked="" type="checkbox"/> yes <input type="checkbox"/> no

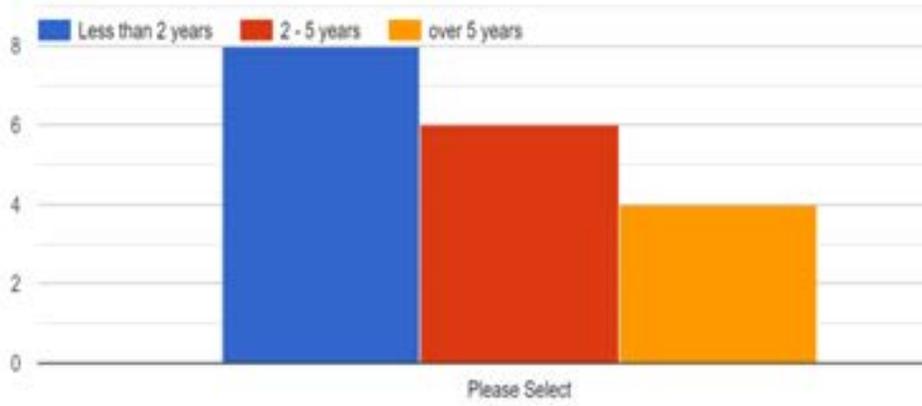
**ATTACHMENT C**

**INDIANA DEPARTMENT OF TRANSPORTATION (INDOT)  
PRICING SHEET FOR EPOXY MATERIALS FOR BRIDGE DECKS**

<b>ITEM #</b>	<b>EST. QTY.</b>	<b>UNIT</b>	<b>ITEM DESCRIPTION</b>	<b>UNIT PRICE (May 1, 2022 thru April 30, 2023)</b>	<b>UNIT PRICE (May 1, 2023 thru April 30, 2024)</b>
1.	24	Drum	Akabond 818 Part A liquid epoxy resin for injection bridge deck patching  <b>Manufacturer: <u>Axson Technologies</u></b>  <b>Part #</b> <u>A</u>	\$3,701.35 PER DRUM  PS: 100409257	\$4,256.55 PER DRUM  PS: 100409259
2.	12	Drum	Akabond 818 Part B liquid hardening agent for injection bridge deck patching  <b>Manufacturer: <u>Axson Technologies</u></b>  <b>Part #</b> <u>B</u>	\$2,599.34 PER DRUM  PS: 100409258	\$2,989.24 PER DRUM  PS: 100409260

## APPENDIX C. STATE EPOXY INJECTION SURVEY RESULTS

1. How long have you been with the bridge/maintenance crew?

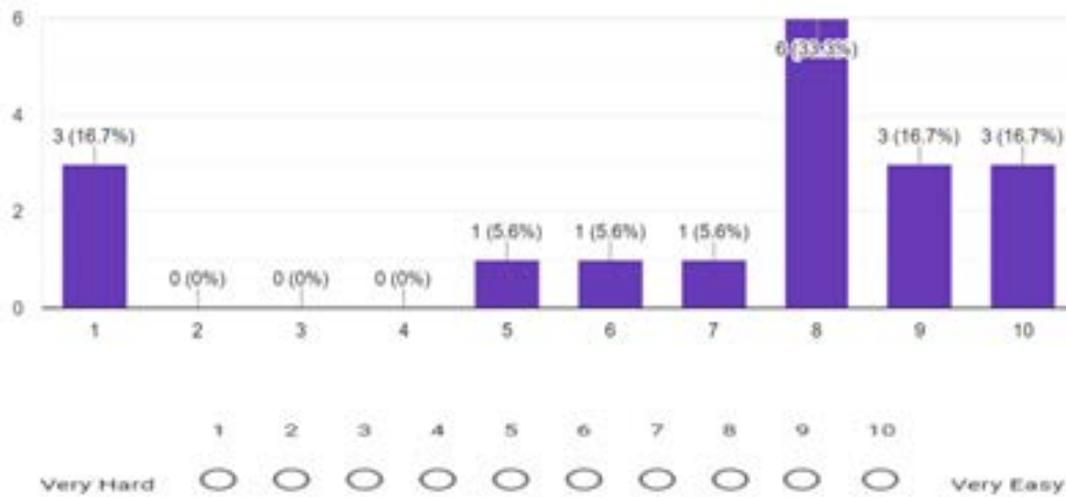


2. Did you have hands on experience with the demo epoxy injection in your District?



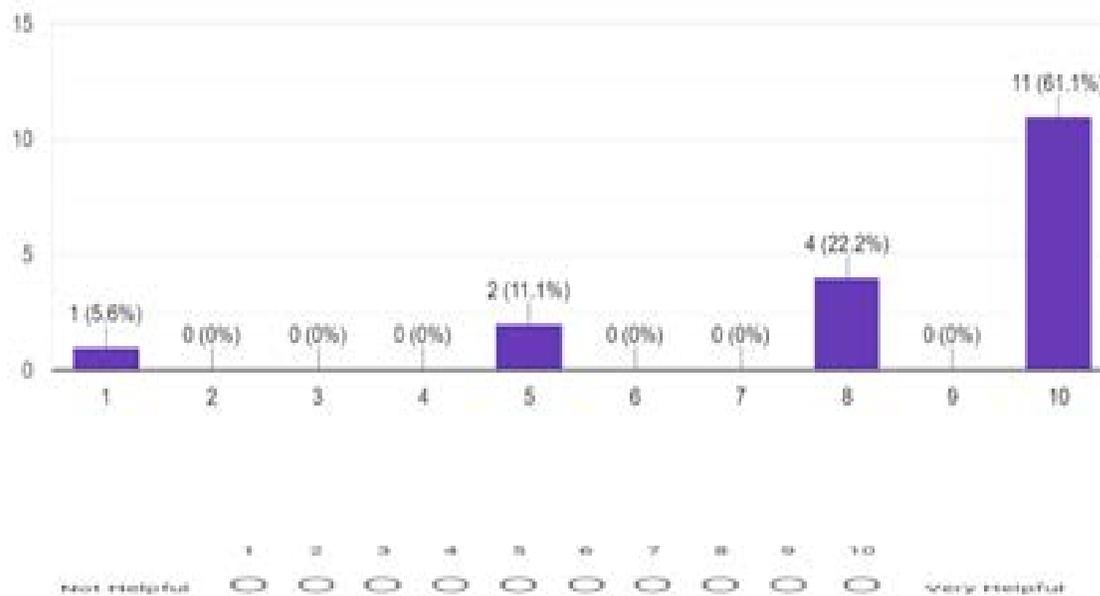
### 3. How difficult was it to learn how to do epoxy injection?

18 responses

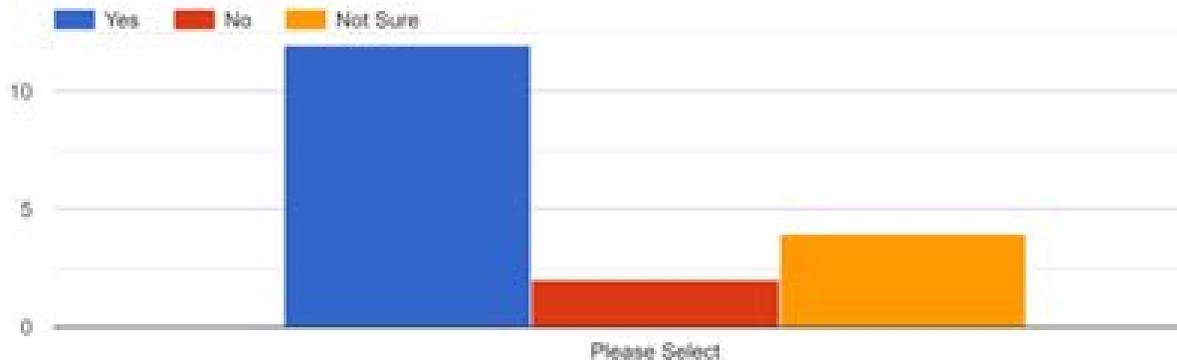


### 4. How beneficial was the field training?

18 responses



5. Was the time spent injecting bridge worth the desired output?



6. What are your perceived benefits for the crew and the bridge concerning this work?

Boring

From my understanding and what was explained to me but it seemed to be a better and more efficient way to fill in voids on bridges

less deck patching

I don't get to use the jack hammer as much.

The bridge can be released to traffic without waiting the length of time as concrete. Less work compared to jackhammers.

I could not see the out come.

No more going back do to jackhammering hopefully.

Not inhaling exposed chemicals and being more efficient

N/A

**Boring and yes it will make the bridge deck last longer by. Filling voids under overlay. But didn't feel it was worth the time and effort it's boring**

Longer bridge life

**This is reduce the needs of permanent deck patching.**

added time before bridge deck has to be patched for spalling

Not having to jack-hammer all the time.

**Helps the bridge deck last longer**

**Repairing deck delamination before it becomes a hole is just good preventative bridge maintenance.**

less jackhammering in the future

It will save a lot of money in material in the long run

7. What were your biggest concerns of the process? 18 responses

None off the top of my head

sounding the deck on a noisy road

When is coming back for me to repair.

Chemical exposure.

Was the trailer going to make all 5 other districts without failure.

Was the trailer going to make all 5 districts.

The slowness of the epoxy that occurred sometimes

Are all the voids being filled?

Making sure the voids are filled

Did not have any.

both lilly pumps working correctly

Making sure no chemicals got into water ways.

None get more people

Making a mess on the bridge with spilled epoxy.

blowouts

Trying to learn something I haven't ever done

8. How can we improve epoxy injection or the training? Please enter any comments or suggestions below: 18 responses

I thought the training was very straightforward and easy to understand  
all was good

If it was going to work throughout the different locations.

We need people to appreciate it, take care of the equipment and understand components to help maintain its effectiveness. Possibly having a person assigned to look after the operation per district and insure accountability.

A/C, stools, extra generator,

A/C, Stools, extra generator,

Nothing I think everything is explained well

The training was well conducted.

do more training or of the actual process more frequently

Training was fine.

Get more people doing hands on during training

Maybe create a visual labeling system and hand signals for the individual injection valves. In order to make the process of elimination of what valves are flowing epoxy and what aren't, easier to communicate between the man in the trailer and the men on the deck.

training on epoxy trailer is hands on. the demo this year had everyone standing watching and three people working

Definitely has to be hands on training.

9. What areas of additional training would be helpful? 18 responses

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Making sure things are strapped down and cleaned.

This process I feel is very hands on, learning this way takes more time. Possibly have a model training plan drawn up for operators to complete.

Cleaning and Strapping things down.

pump tear down

Not sure

None pretty easy even for a rookie. Kind of like reading a kids book in college

Finding voids.

Maybe a list of supplies, as in where and what to purchase.

Breaking down and cleaning of equipment.

None

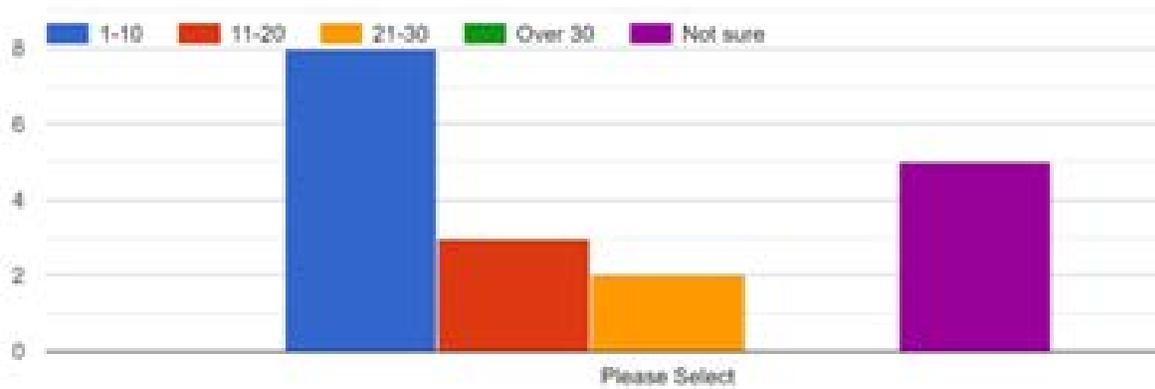
Deck sounding.

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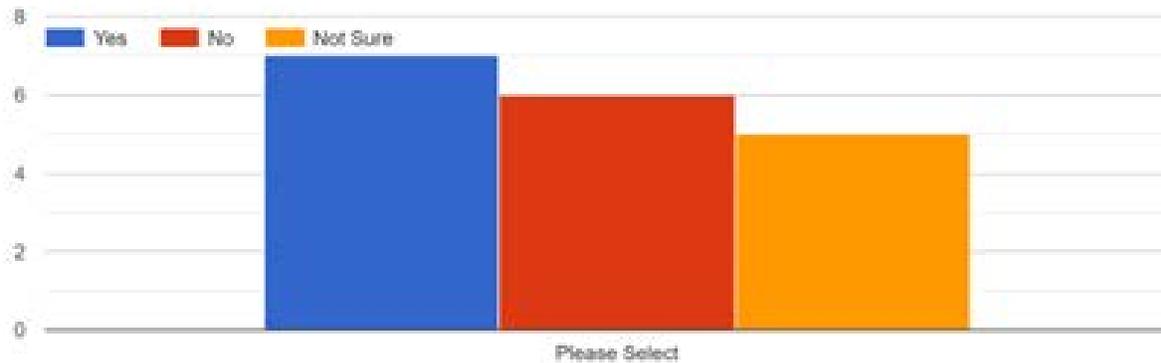
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13. Should each District have its own injection trailer?



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epoxy is better than deck patching

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Less mess, recover time to let traffic flow. Results from Impact Echo show improvement.

Less work in other areas.

Seems to be a lot easier on the body and the bridge deck.

Making time go by fast versus patching

N/A

Long boring days.

Bridge longevity

How much of a time saver and lower cost in the long run it will be over deck patching.

extends the lifespan of the bridge deck before patching has to occur

Using a less destructive method to repairing are bridge decks.

It works

The importance and labor savings of epoxy injection to prevent deterioration of our bridge decks.

I was part of the demo

Easy to learn

15. Any other comments or suggestions

Lots of big labels in the trailer saying where things go

n/a

I think three man crew from 2 districts would be better, team up and knock them out together, so that the remaining crews at there districts can continue to do there regular work activities.

Nope all is covered

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Better than jack hammering .

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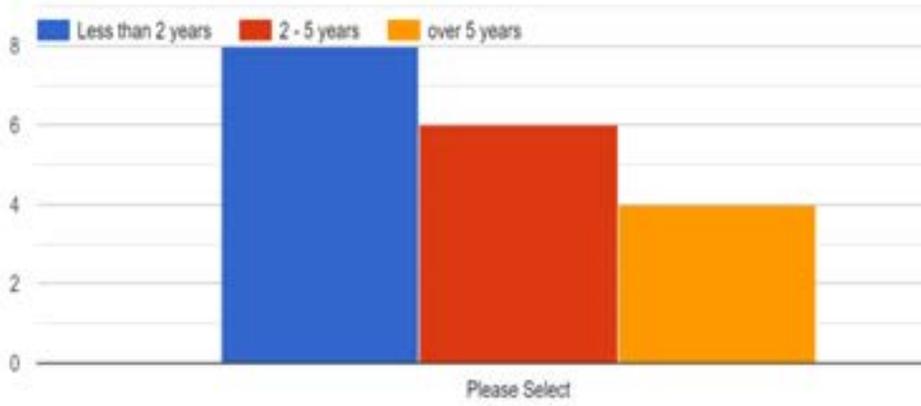
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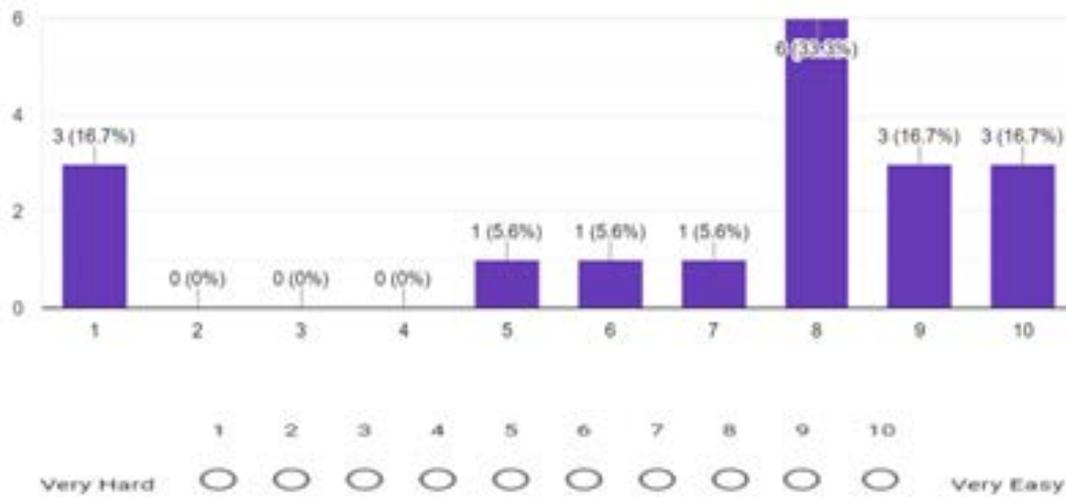


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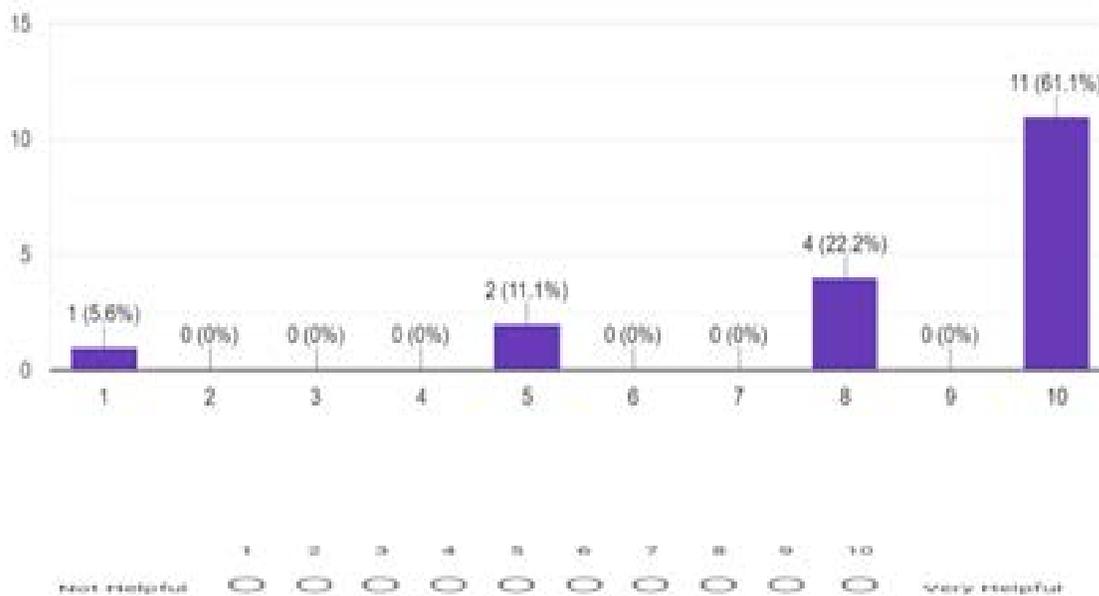
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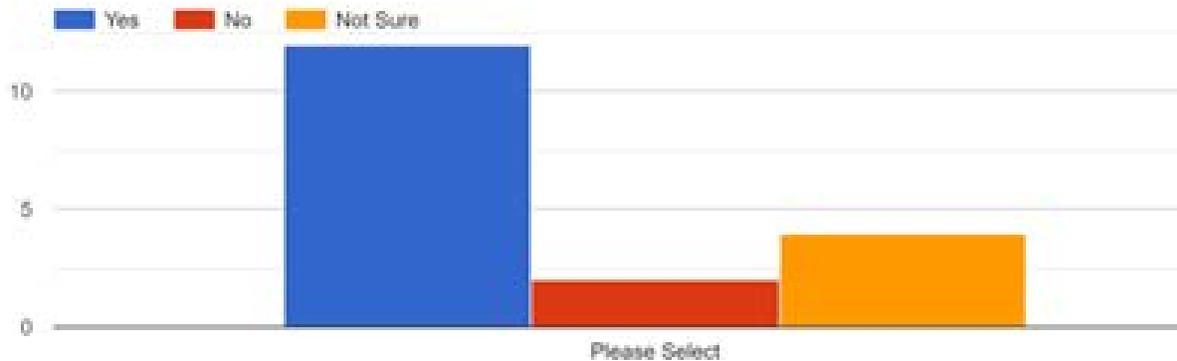


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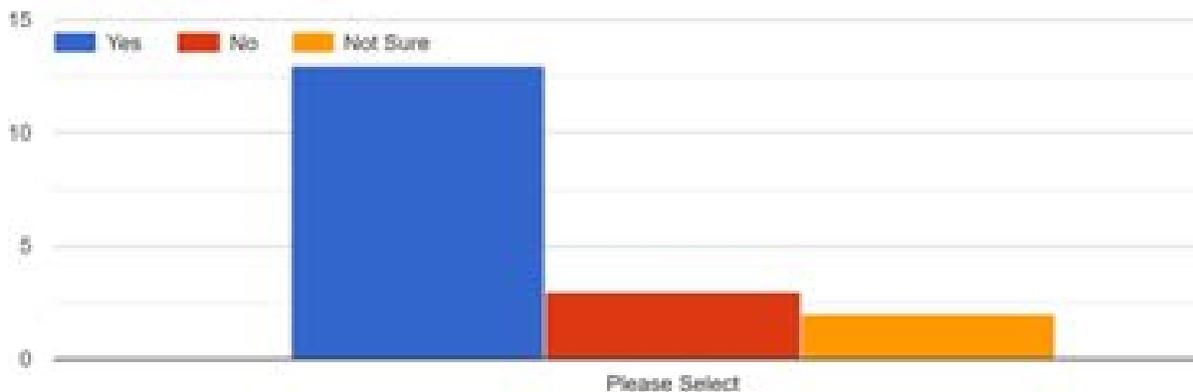
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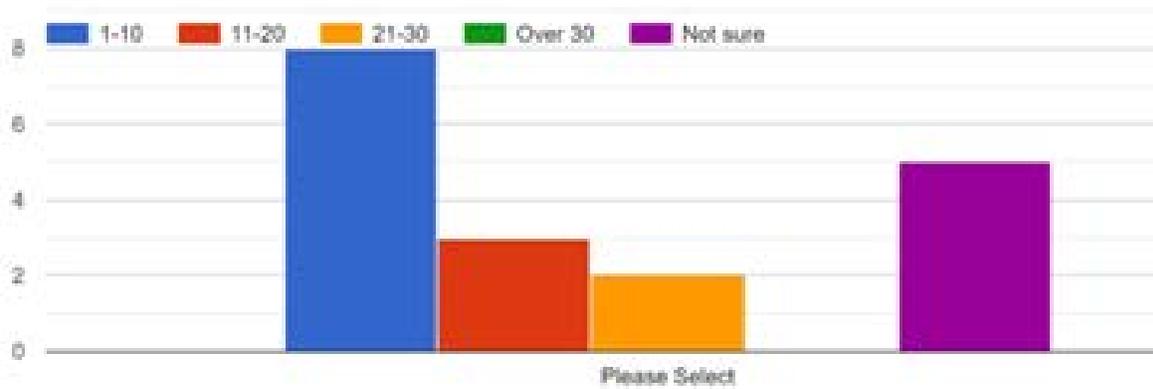
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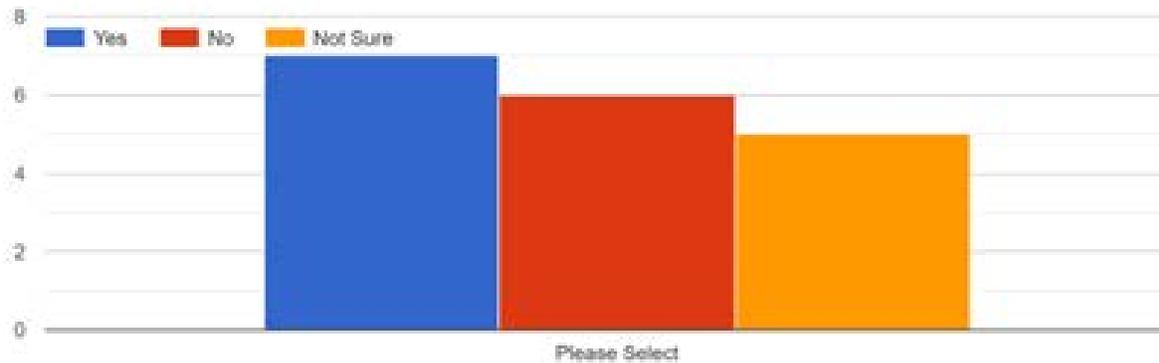
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None

I enjoyed doing the epoxy injection.

we should explore other uses of this material

It's a lot more money but I would suggest maybe 2 3 man crews per district would be more efficient

**APPENDIX D. EPOXY INJECTION ON BRIDGE NBI 36660 (MONSTER BRIDGE)**

Material			
Western	1500 ft	6 lanes	30% delamination
Total	32,400 sq ft		
Rate	0.1 gal/sft		3240 gal
			~60 drums
			40 part A
			20 part B
Price	\$61 per gal		
			\$197,640
Labor			
	1500 sft per shift		
	22		8 hour shifts
Parts			
	Ports, tools, cleaning		\$2,500

Figure D.1 Monster bridge epoxy injection quantities.



Department of Transportation

Supplier: 0000405221
SIKA CORPORATION
201 POLITO AVE
LYNDHURST NJ 07071

Purchase Order

Dispatch via Print

Table with columns: Purchase Order, Date, Revision, Page, Payment Terms, Freight Terms, Ship Via, Buyer, Phone/Email, Currency. Includes values like 00800-0020083966, 04/26/2022, 1, 35 Arrears, FOB DESTINATION, Ship Via VENDOR RESPONSIBL, Erin Hermann-00800, USD.

Ship To: 800IDOT38
Dept Of Transportation
Indianapolis Subdistrict
7105 S BROOKVILLE RD
INDIANAPOLIS IN 46239
United States

Attention: William Andrew Byers - 00800

Bill To: Dept Of Transportation
Greenfield District
32 S BROADWAY
GREENFIELD IN 46140
United States

Tax Exempt? Y Tax Exempt ID: 0004897013

Replenishment Option: Standard

Main line items table with columns: Line-Sch, Item/Description, Mfg ID, Quantity UOM, PO Price, Extended Amt. Includes items for Akabond 818 Part A and Part B liquid epoxy resin.

Please send invoices to greenfieldinvoices@indot.in.gov

In Accordance with the Award of Solicitation #800-22-120, Attachments A & B

Delivery is required within 90 Calendar Days

Vendor Contact: Brandon McNamara
Phone: 201-249-1993
Email: mcnamara.brandon@us.sika.com

INDOT Contact: Mark Anderson
Office: (317) 356-2412 ex. 222
Email: maanderson1@indot.in.gov

Please send invoices to greenfieldinvoices@indot.in.gov

Deliveries acceptable only between 8:00AM and 4:00PM, Monday through Friday, excluding State Holidays

Total PO Amount 200,046.00

Authorized Signature

Erin Hermann 4/26/2022

**CONTRACT #45297**  
**DESCRIPTION Polyurethane PCC Sealers/Healer**  
**BID #800-21-035**

**CONTACT INFORMATION**

Company Name	Northern Crack Repair & Supply
DBA	N/a
<b>Purchase Order</b> Mailing Address	8140 W. 350 N.
City, State and Zip	Angola, IN 46703
Vendor Contact Name	Scott Townsend
Phone Number	260-829-6860
Fax Number	N/a
Email	fixit@northerncrack.com
Federal Identification Number	47-3792282
Website Address	N/a

Extend pricing to other Governmental bodies? Yes.

**Work Order**

Actions ▼

<b>WO#</b> 22470908	<b>Labor DC Exists</b> Yes	<b>Equipment DC Exists</b> Yes
<b>Material DC Exists</b> Yes	<b>Cost DC Exists</b> No	<b>Accomplishments DC Exists</b> Yes
<b>PS Cost DC Exists</b> No	<b>Location Exists</b> Yes	<b>Management Unit</b> (3102) - TIBBS UNIT (PS065454)
<b>Category (Project)</b> BRIDGE	<b>Asset Type</b> Bridge Structures	<b>Responsible Crew</b>
<b>Activity</b> 2451 - PERMANENT BRIDGE DECK PATCHING (SQF - S...	<b>Subactivity</b> 00: * NO SUBACTIVITY	<b>Start Date</b> 7/26/2022
<b>Finish Date</b> 7/27/2022	<b>Duration</b> 24	<b>Plan Amount</b> 220
<b>Amount</b> 220	<b>Labor Cost (\$)</b> \$2,453.01	<b>Equipment Cost (\$)</b> \$4,134.12
<b>Material Cost (\$)</b> \$600.83	<b>Other Cost (\$)</b> \$0.00	<b>Status</b> Completed
<b>Work Completed Date</b> 7/27/2022	<b>Start Hour</b> 6	<b>End Hour</b> 6
<b>Calendar</b> Sun-Sat 24hrs	<b>Activity Category</b> BRIDGE	<b>Man Hour Used</b> 109
<b>Comments</b> Crew patched lanes 2 and 3 on monster bridge	<b>Attach.</b>	<b>User Update</b> DBARTLETT
<b>Date Update</b> 8/18/2022 1:40 AM		

Actions ▼		
<b>WO#</b>	<b>Labor DC Exists</b>	<b>Equipment DC Exists</b>
22591732	Yes	Yes
<b>Material DC Exists</b>	<b>Cost DC Exists</b>	<b>Accomplishments DC Exists</b>
Yes	No	Yes
<b>PS Cost DC Exists</b>	<b>Location Exists</b>	<b>Management Unit</b>
No	Yes	(3102) - TIBBS UNIT (PS065454)
<b>Category (Project)</b>	<b>Asset Type</b>	<b>Responsible Crew</b>
BRIDGE	Bridge Structures	
<b>Activity</b>	<b>Subactivity</b>	<b>Start Date</b>
2490 - OTHER BRIDGE MAINTENANCE (MHR - WORK ...	841: EPOXY INJECTION	8/25/2022
<b>Finish Date</b>	<b>Duration</b>	<b>Plan Amount</b>
8/26/2022	11.5	82
<b>Amount</b>	<b>Labor Cost (\$)</b>	<b>Equipment Cost (\$)</b>
82	\$1,904.39	\$2,959.18
<b>Material Cost (\$)</b>	<b>Other Cost (\$)</b>	<b>Status</b>
\$7,462.12	\$0.00	Completed
<b>Work Completed Date</b>	<b>Start Hour</b>	<b>End Hour</b>
8/26/2022	18	5.5
<b>Calendar</b>	<b>Activity Category</b>	<b>Man Hour Used</b>
Sun-Sat 24hrs	BRIDGE	82
<b>Comments</b>	<b>Attach.</b>	<b>User Update</b>
Epoxy injection 65 NB MLK exit ramp		KSEXTON
<b>Date Update</b>		
9/13/2022 8:25 AM		

<< < 1 of 1 total rows > >>

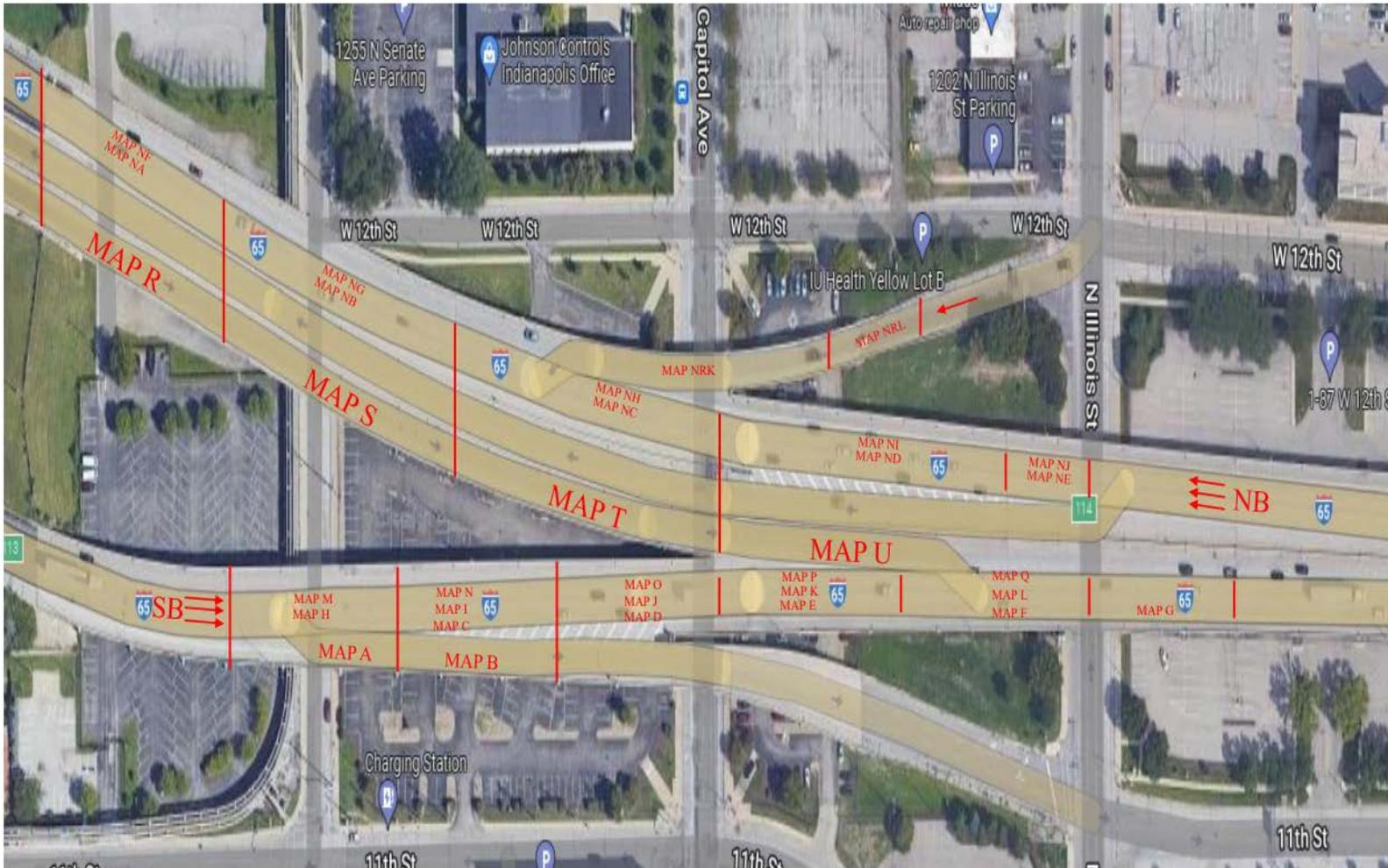
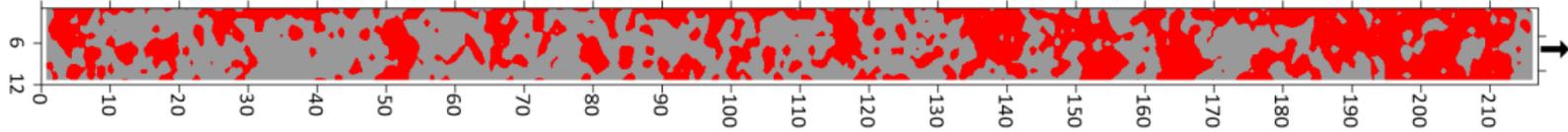


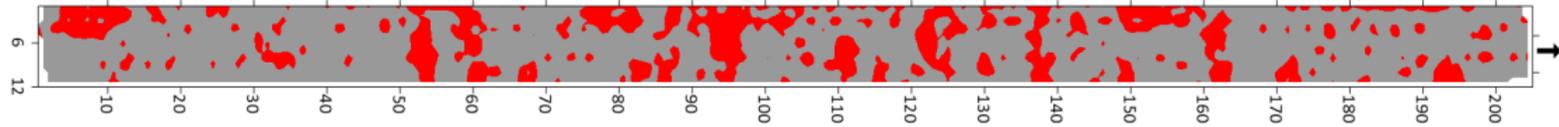
Figure D.1 Bridge NBI 36660 Impact Echo NDT delamination map layout references.

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

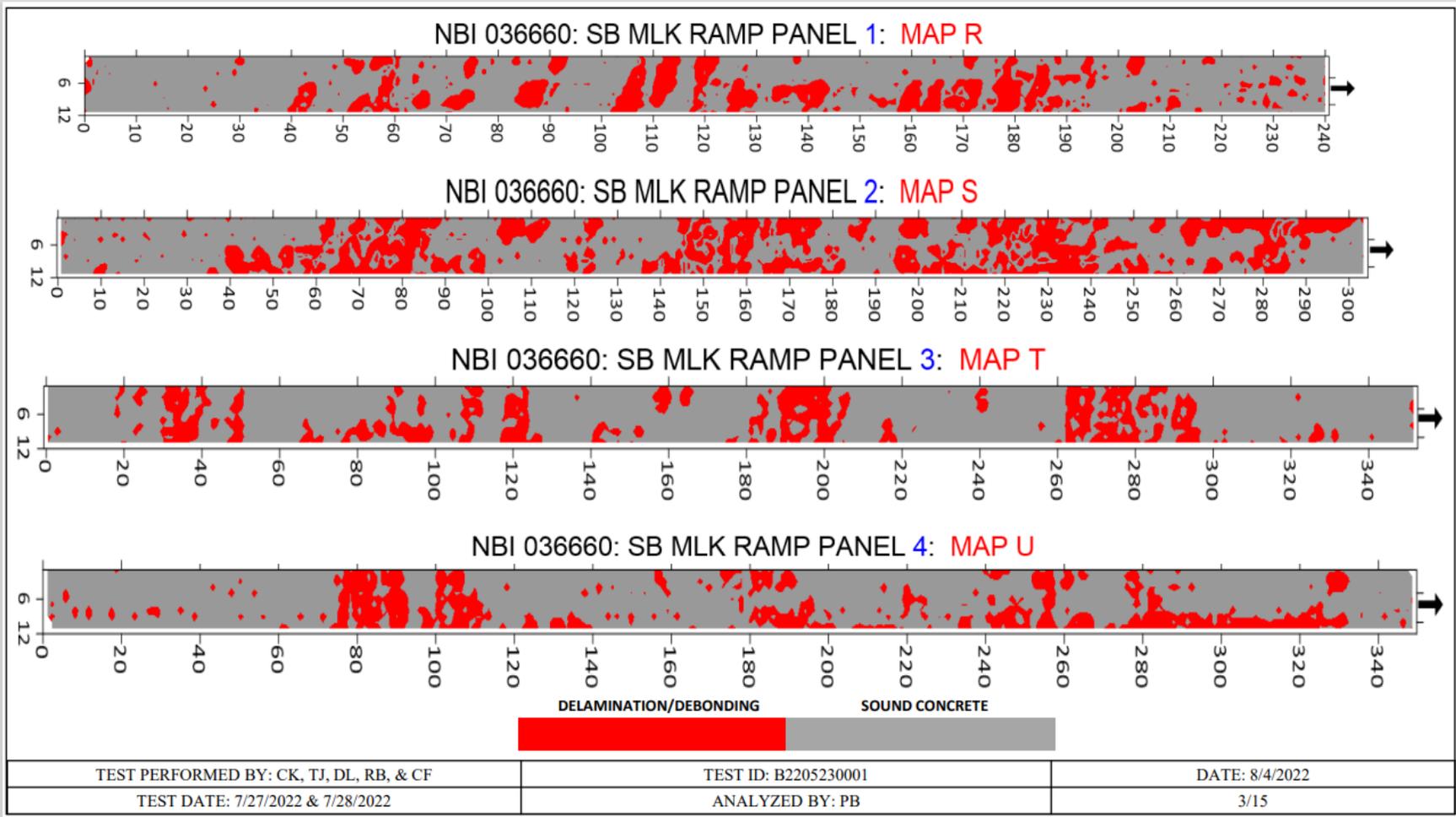
**NBI 036660: SB RAMP PANEL 1: MAP A**



**NBI 036660: SB RAMP PANEL 2: MAP B**

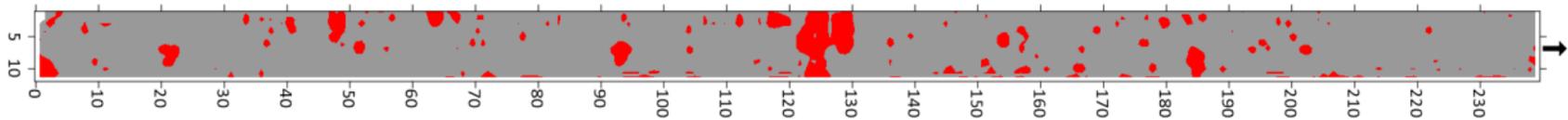


TEST PERFORMED BY: CK, TJ, DL, RB, & CF	TEST ID: B2205230001	DATE: 8/4/2022
TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	2/15

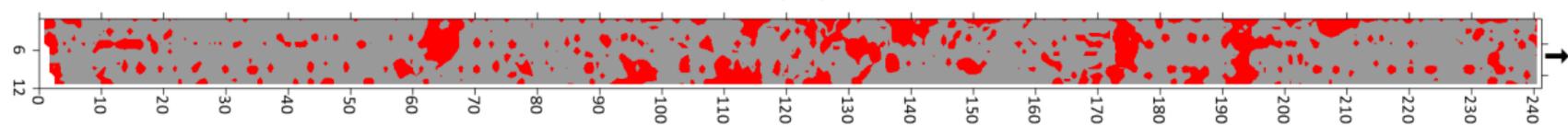


**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: SB PL (L1) PANEL 1: MAP M**



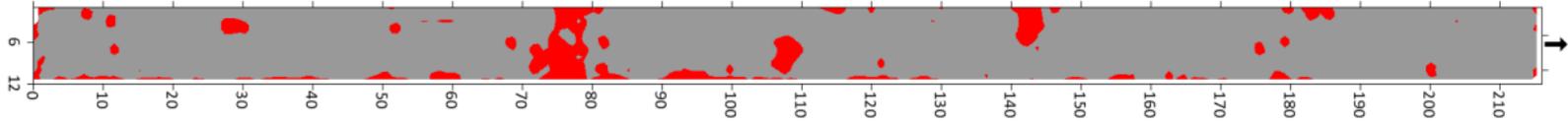
**NBI 036660: SB ML (L2) PANEL 1: MAP H**



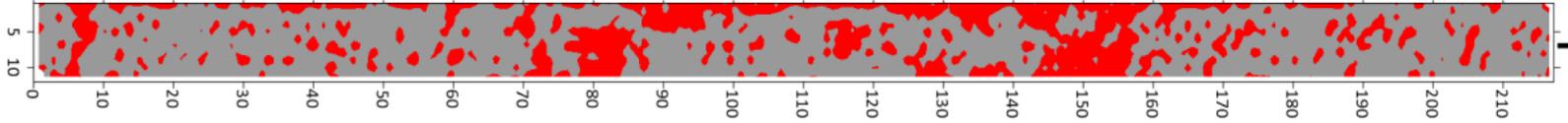
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TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	4/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

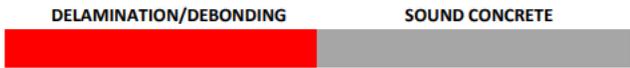
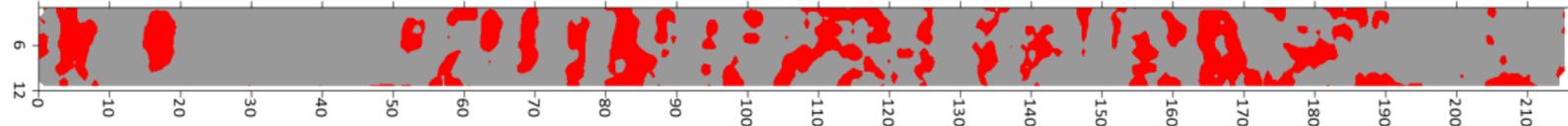
**NBI 036660: SB PL (L1) PANEL 2: MAP N**



**NBI 036660: SB ML (L2) PANEL 2: MAP I**



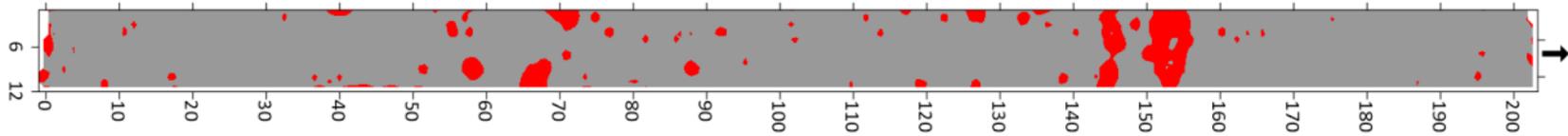
**NBI 036660: SB DL PANEL 2: MAP C**



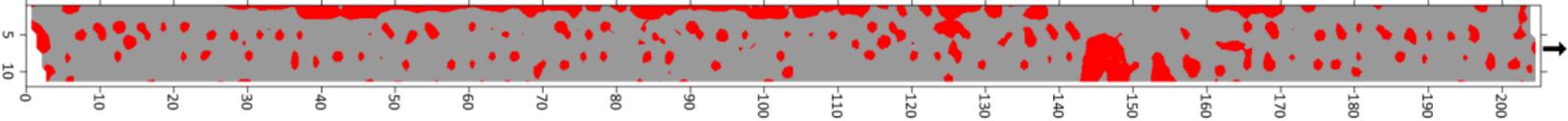
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TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	5/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

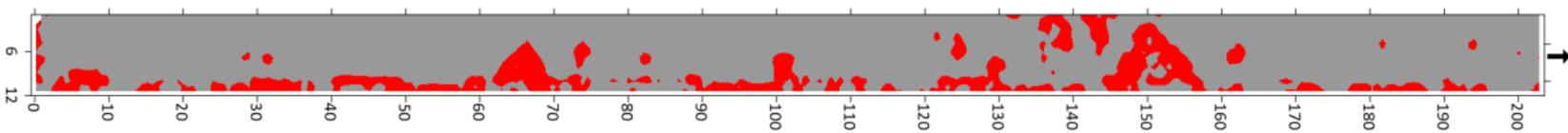
**NBI 036660: SB PL (L1) PANEL 3: MAP O**



**NBI 036660: SB ML (L2) PANEL 3: MAP J**



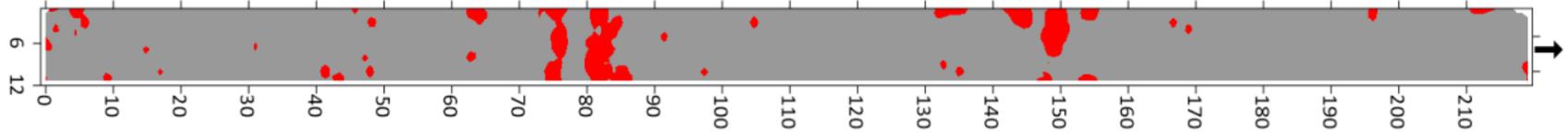
**NBI 036660: SB DL PANEL 3: MAP D**



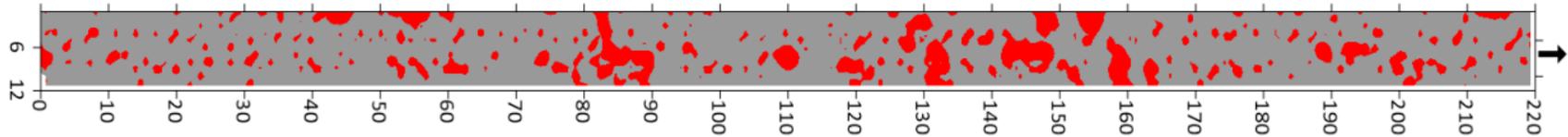
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TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	6/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

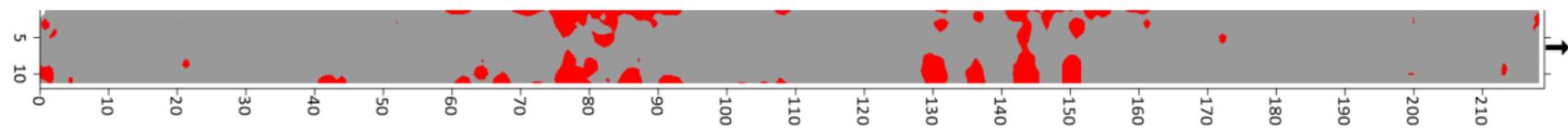
**NBI 036660: SB PL (L1) PANEL 4: MAP P**



**NBI 036660: SB ML (L2) PANEL 4: MAP K**



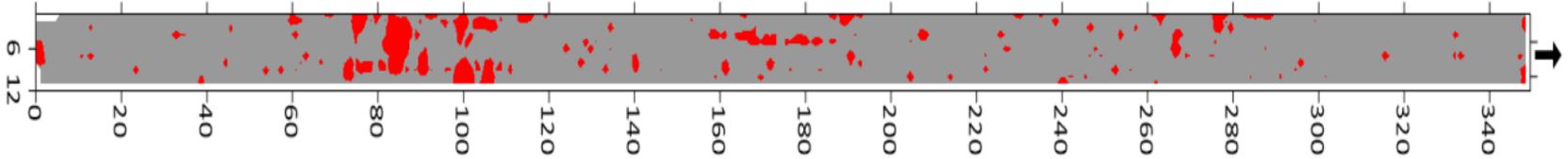
**NBI 036660: SB DL PANEL 4: MAP E**



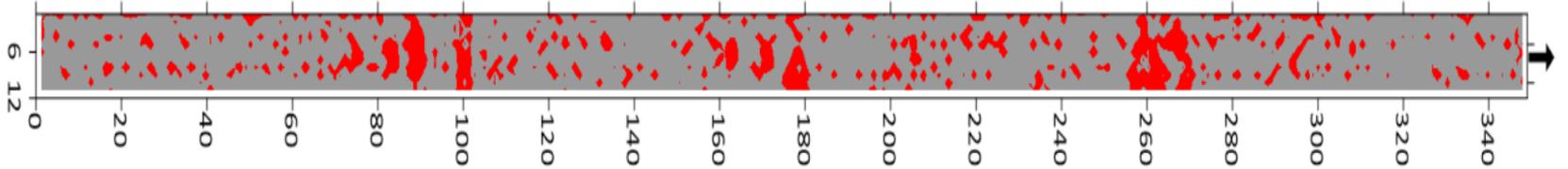
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TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	7/15

IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP  
 BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT

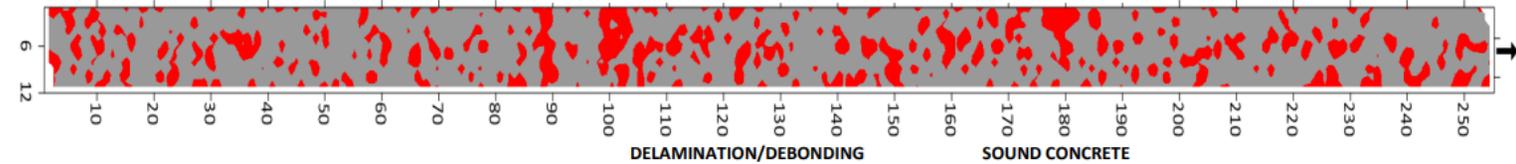
NBI 036660: SB PL (L1) PANEL 5: MAP Q



NBI 036660: SB ML (L2) PANEL 5: MAP L



NBI 036660: SB DL PANEL 5: MAP F



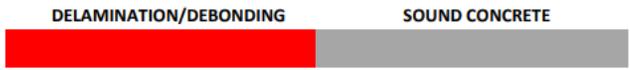
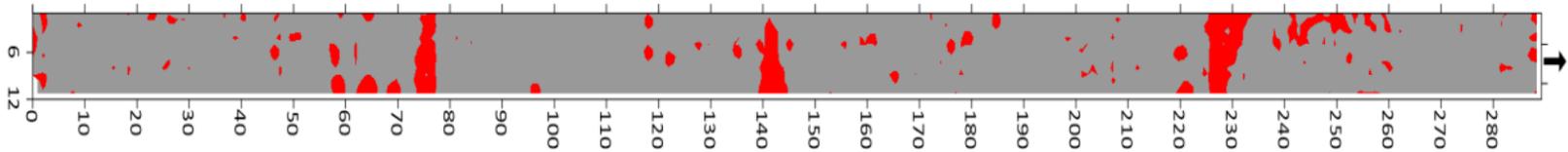
DELAMINATION/DEBONDING      SOUND CONCRETE



TEST PERFORMED BY: CK, TJ, DL, RB, & CF	TEST ID: B2205230001	DATE: 8/4/2022
TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	8/15

IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP  
 BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT

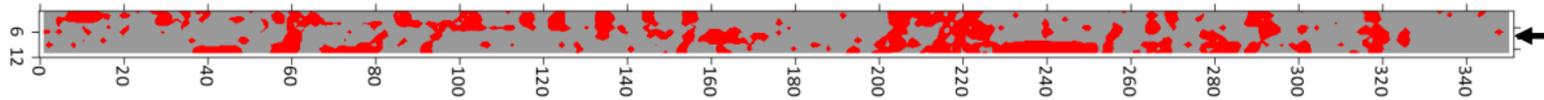
NBI 036660: SB DL PANEL 6: MAP G



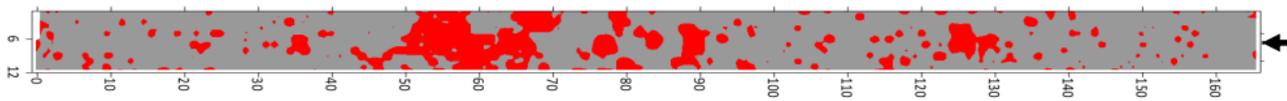
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TEST DATE: 7/27/2022 & 7/28/2022	ANALYZED BY: PB	9/15

IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP  
 BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT

NBI 036660: NB RAMP PANEL RP1: MAP NRK



NBI 036660: NB RAMP PANEL RP2: MAP NRL



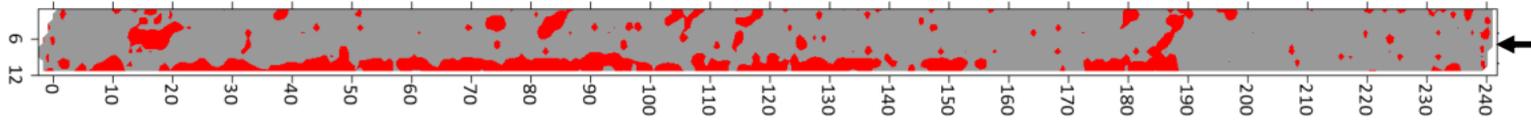
DELAMINATION/DEBONDING      SOUND CONCRETE



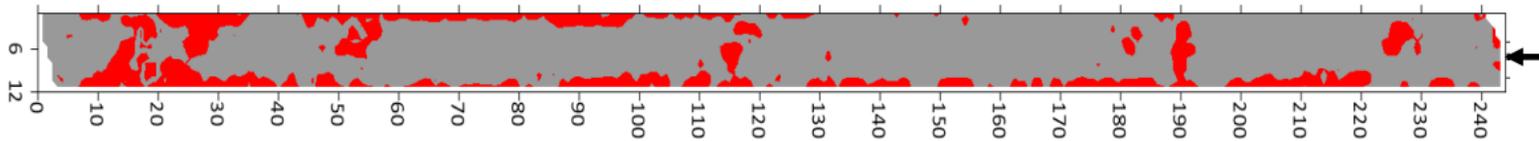
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TEST DATE: 7/26/2022	ANALYZED BY: PB	10/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: NB DL PANEL 1: MAP NF**



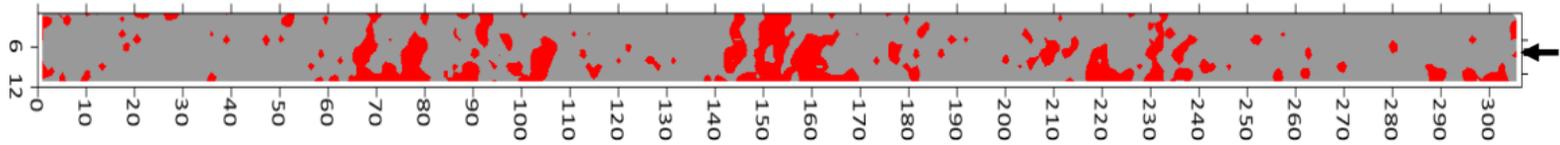
**NBI 036660: NB ML PANEL 1: MAP NA**



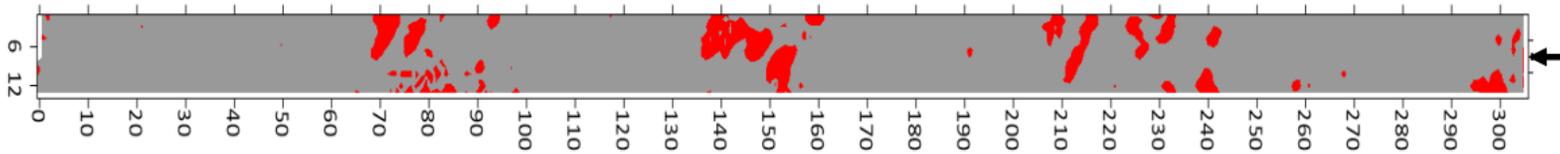
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TEST DATE: 7/26/2022	ANALYZED BY: PB	11/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: NB DL PANEL 2: MAP NG**



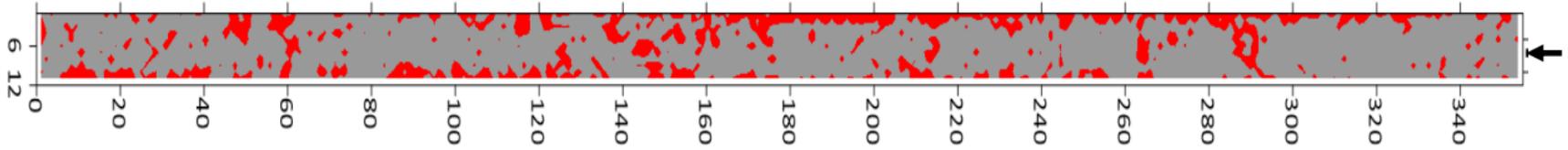
**NBI 036660: NB ML PANEL 2: MAP NB**



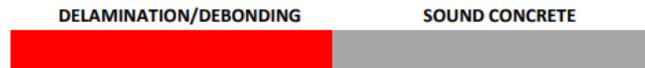
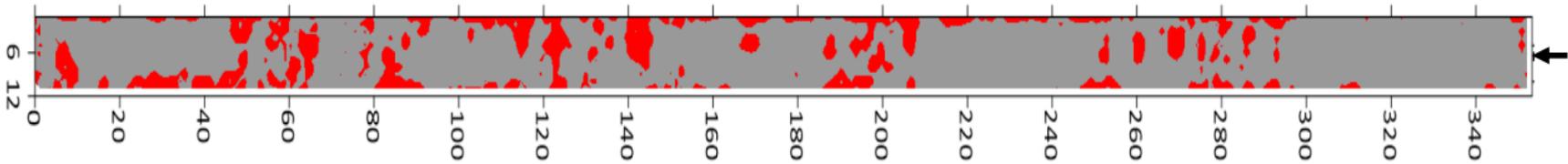
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TEST DATE: 7/26/2022	ANALYZED BY: PB	12/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: NB DL PANEL 3: MAP NH**



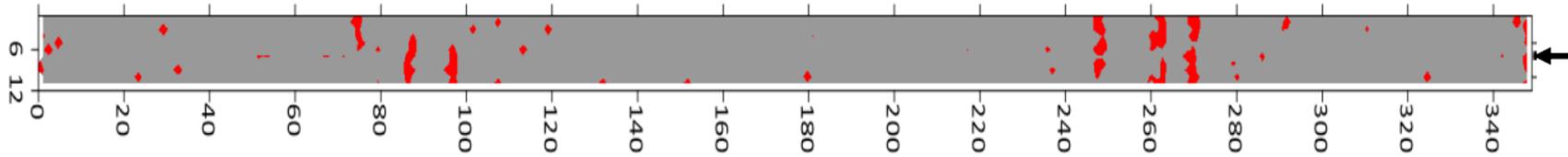
**NBI 036660: NB ML PANEL 3: MAP NC**



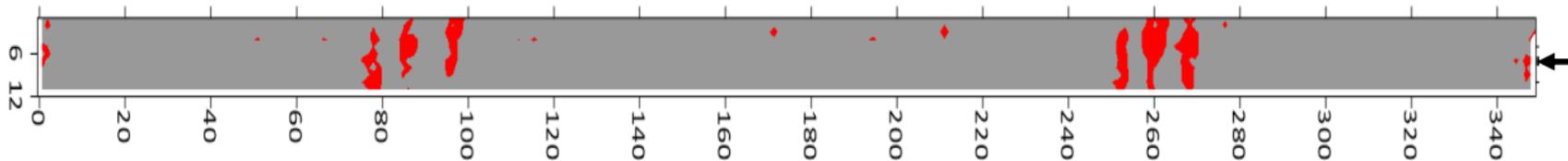
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TEST DATE: 7/26/2022	ANALYZED BY: PB	13/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP**  
**BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: NB DL PANEL 4: MAP NI**



**NBI 036660: NB ML PANEL 4: MAP ND**



**DELAMINATION/DEBONDING**

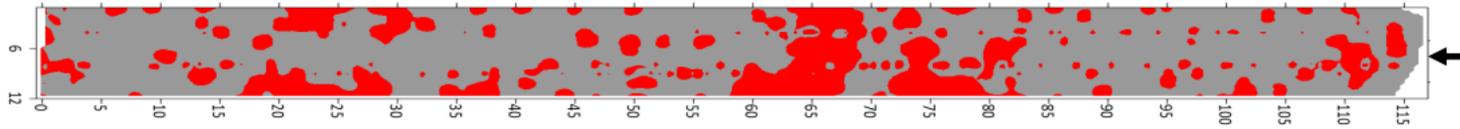
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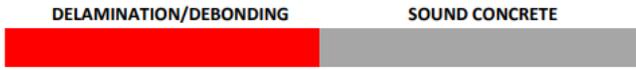
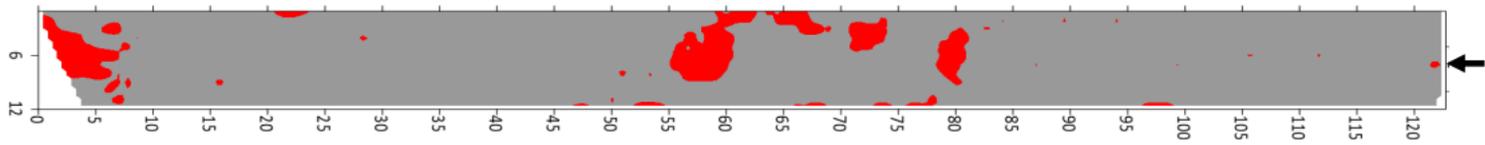
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TEST DATE: 7/26/2022	ANALYZED BY: PB	14/15

**IMPACT ECHO BRIDGE DECK NDT DELAMINATION/DEBONDING MAP  
 BRIDGE NBI 036660, BRIDGE #: I65-112-02419C; I-65 OVER 7 STS ACCESS RD, MONORAIL; GREENFIELD DISTRICT**

**NBI 036660: NB DL PANEL 5: MAP NJ**



**NBI 036660: NB ML PANEL 5: MAP NE**



TEST PERFORMED BY: CK, TJ, DL, RB, & CF	TEST ID: B2205230001	DATE: 8/8/2022
TEST DATE: 7/26/2022	ANALYZED BY: PB	15/15

## About the Joint Transportation Research Program (JTRP)

On March 11, 1937, the Indiana Legislature passed an act which authorized the Indiana State Highway Commission to cooperate with and assist Purdue University in developing the best methods of improving and maintaining the highways of the state and the respective counties thereof. That collaborative effort was called the Joint Highway Research Project (JHRP). In 1997 the collaborative venture was renamed as the Joint Transportation Research Program (JTRP) to reflect the state and national efforts to integrate the management and operation of various transportation modes.

The first studies of JHRP were concerned with Test Road No. 1 — evaluation of the weathering characteristics of stabilized materials. After World War II, the JHRP program grew substantially and was regularly producing technical reports. Over 1,600 technical reports are now available, published as part of the JHRP and subsequently JTRP collaborative venture between Purdue University and what is now the Indiana Department of Transportation.

Free online access to all reports is provided through a unique collaboration between JTRP and Purdue Libraries. These are available at <http://docs.lib.purdue.edu/jtrp>.

Further information about JTRP and its current research program is available at <http://www.purdue.edu/jtrp>.

## About This Report

An open access version of this publication is available online. See the URL in the citation below.

Baah, P. (2023). *Implementing epoxy injection in concrete overlaid bridge decks* (Joint Transportation Research Program Publication No. FHWA/IN/JTRP-2023/03). West Lafayette, IN: Purdue University. <https://doi.org/10.5703/1288284317588>