

PILOT PROJECT REPORT

**EVALUATING
THE
URETEK DEEP INJECTION (UDI) PROCESS
TO
IMPROVE LOAD TRANSFER EFFICIENCY (LTE)**

URETEK PROJECT NUMBER 12PA26004

**I-80 Test Site (Mercer County Segment 100, offset 0450-0700)
Mercer County, Pennsylvania**

Prepared By

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*A COOPERATIVE EFFORT EXECUTED BY THE PENNSYLVANIA DEPARTMENT OF
TRANSPORTATION (PennDOT) AND URETEK USA, INC.*

PUBLIC RELEASE VERSION

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INTRODUCTION

Pursuant to meetings between URETEK USA and PennDOT, a cooperative pilot project was developed and executed in 2012. The purpose of the pilot project was to assess the improvement of transverse joint performance in composite pavements following injection of high-density polyurethane. Expansive, high-density, two-component, water-resistant polyurethane was injected into the foundation soils of the pavement system using the URETEK Deep Injection (UDI) process.

This report examines the effectiveness of the UDI process to reduce voids and improve Load Transfer Efficiency (LTE) based on Falling Weight Deflectometer (FWD) testing and analysis. The following activities were the essence of the pilot project:

- PennDOT performed pre-injection FWD testing on transverse joints at the I-80 test site
- URETEK USA executed a specialized application of the UDI process known as Joint Vicinity Injection (JVI) on select joints (7 successive transverse joints in a segment of the Eastbound travel lane) at the I-80 test site
- PennDOT performed post-injection FWD testing on the treated joints
- PennDOT compared pre-injection void conditions and LTE to post-injection void conditions and LTE for the treated joints

In an effort to make the large volume and variety of data palatable and useful to the reader, this report employs a format of a concise summary backed by exhibits.

REPORT ORGANIZATION

- Exhibit A – Project Location Photos
- Exhibit B – Pavement Profile
- Exhibit C – Falling Weight Deflectometer (FWD) Data Table (from PennDOT)
- Exhibit D – Void Analysis (from PennDOT)
- Exhibit E – LTE Analysis (from PennDOT)

PROJECT TIMETABLE

- 28 May 12 PennDOT executes pre-injection FWD testing at a location that becomes the I-80 test site
- 13-14 Sep 12 Pilot project discussions between URETEK USA and PennDOT
- 17 Sep 12 URETEK USA delivers Pilot Project Plan (P3) to PennDOT
- 25 Sep 12 URETEK USA performs polymer injection at the I-80 test site
- 6 Nov 12 PennDOT executes post-injection FWD testing at I-80 test site
- 29 Nov 12 PennDOT releases data and analysis of post-injection FWD results
- 30 Nov 12 URETEK USA compiles and inventories project information
- 8 May 14 URETEK USA releases a Case Study for the I-80 test site
- 16 May 14 URETEK USA releases Pilot Project Report for the I-80 test site

PROJECT SUMMARY

- Project Location/Designation
 - I-80 (Mercer County Segment 100, offset 0450-0700), Mercer County PA
 - URETEK USA Job Number: 12PA26004
- PennDOT Contact
 - Jeffrey L. Oswalt, PE – District Pavement Management Engineer, Engineer District 1-0, Phone 814-678-7109, JOSWALT@pa.gov
- URETEK USA Contacts
 - Michael R. Vinton, Vice President – Sales, Phone 281-351-7800, CELL 281-841-6555, mike.vinton@uretekusa.com
 - Les Simon, Regional Representative – Sales, CELL 717-856-1600, les.simon@uretekusa.com
 - Randall W. Brown, PhD, PE, Vice President – Engineering, CELL 281-415-4760, DrRWBrown@uretekusa.com
 - Stephen S. Reed, Engineering Assistant – Engineering, Phone 281-351-7800, CELL 281-705-6399, sreed@uretekusa.com
- I-80 Site Description
 - Pavement Cross-Section (provided by PennDOT)
 - 3.5" AC (constructed 1992-94)
 - 13.0" PCC (constructed early 1980's)
 - 4.0" Open-Graded Subbase (OGS)
 - 8.0" A-2 Subbase
 - Subgrade = Mixed Materials (Exact Composition Unknown)

- **Problems Cited by PennDOT**
 - **Curling due to loss of fines at joints**
 - **Excess water in subgrade**

- **Results of Pre-injection FWD Testing (performed by PennDOT)**
 - **Load Transfer Efficiencies (LTEs) at the joints were generally low (some states use 80% as the trigger for maintenance/repair action)**
 - **Deflections directly under the load plate (D1 values) were generally high indicating weakness in the shallow layers of the pavement system**
 - **Deflections associated with the subgrade (D7 values) were high in some locations indicating subgrade weakness in those locations**
 - **Intercept values in the “Void Detection Output Section” of the PennDOT pre-injection FWD data report were high in many locations indicating lack of support or voids in those locations**

- **I-80 Test Site Treatment Summary**
 - **URETEK USA executed a specialized application of the UDI process known as Joint Vicinity Injection (JVI) on 7 successive transverse joints in an eastbound (EB) travel lane segment of I-80 identified by PennDOT**
 - **Details of the JVI injection pattern and depth(s) were specified in the Pilot Project Plan (P3) submitted to PennDOT on 17 Sep 2012**
 - **Polymer Information**
 - **URETEK 486 STAR (4-pcf free-rise density, Regular formulation)**

- **I-80 Test Site Data Collection Summary**
 - **PennDOT performed pre-injection and post-injection Falling Weight Deflectometer (FWD) testing on a sampling of the joints at the I-80 test site. The purpose of this investigation was to evaluate improvement in void conditions and Load Transfer Efficiency (LTE) attributable to UDI/JVI polyurethane treatment.**
 - **Exhibit C presents PennDOT-provided data (pre-injection and post-injection) summarizing void conditions and LTEs for treated joints**
 - **Exhibit D presents additional PennDOT analysis on void conditions (pre-injection and post-injection) for treated joints**
 - **Exhibit E presents additional PennDOT analysis on LTEs (pre-injection and post-injection) for treated joints**

FINDINGS

After injecting the selected transverse joints in the test area using the Joint Vicinity Injection (JVI) application of the URETEK Deep Injection (UDI) process, post-injection FWD testing and data analysis by PennDOT revealed:

- Significant reduction in the size of voids in the vicinity of the joints
- Dramatic improvement in the LTEs for the transverse joints

EXHIBIT A-1

**PENNDOT PILOT PROJECT (I-80 Test Site)
Drilling Holes to Prepare for Polymer Injection**



EXHIBIT A-2

PENNDOT PILOT PROJECT (I-80 Test Site)

Location Maps

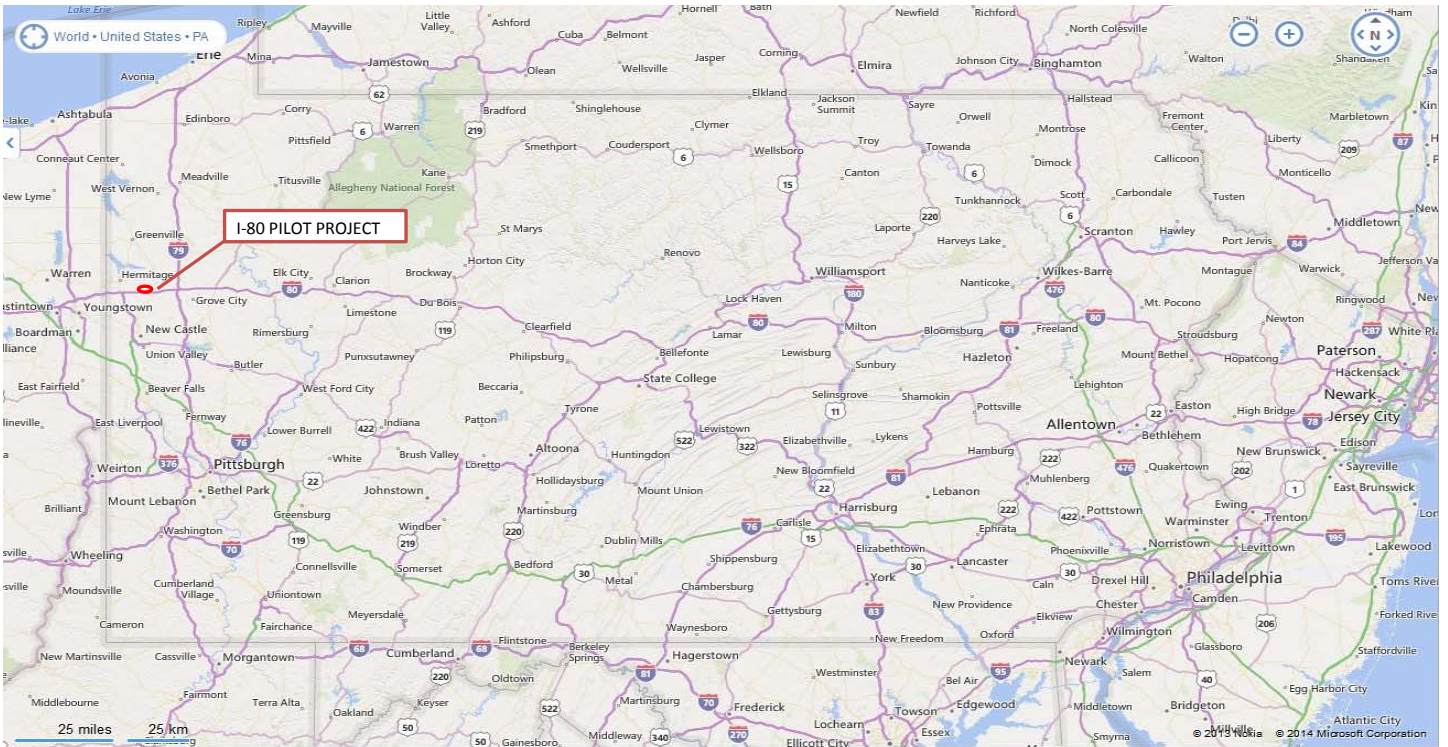


EXHIBIT B

PENNDOT PILOT PROJECT (I-80 Test Site) PAVEMENT PROFILE

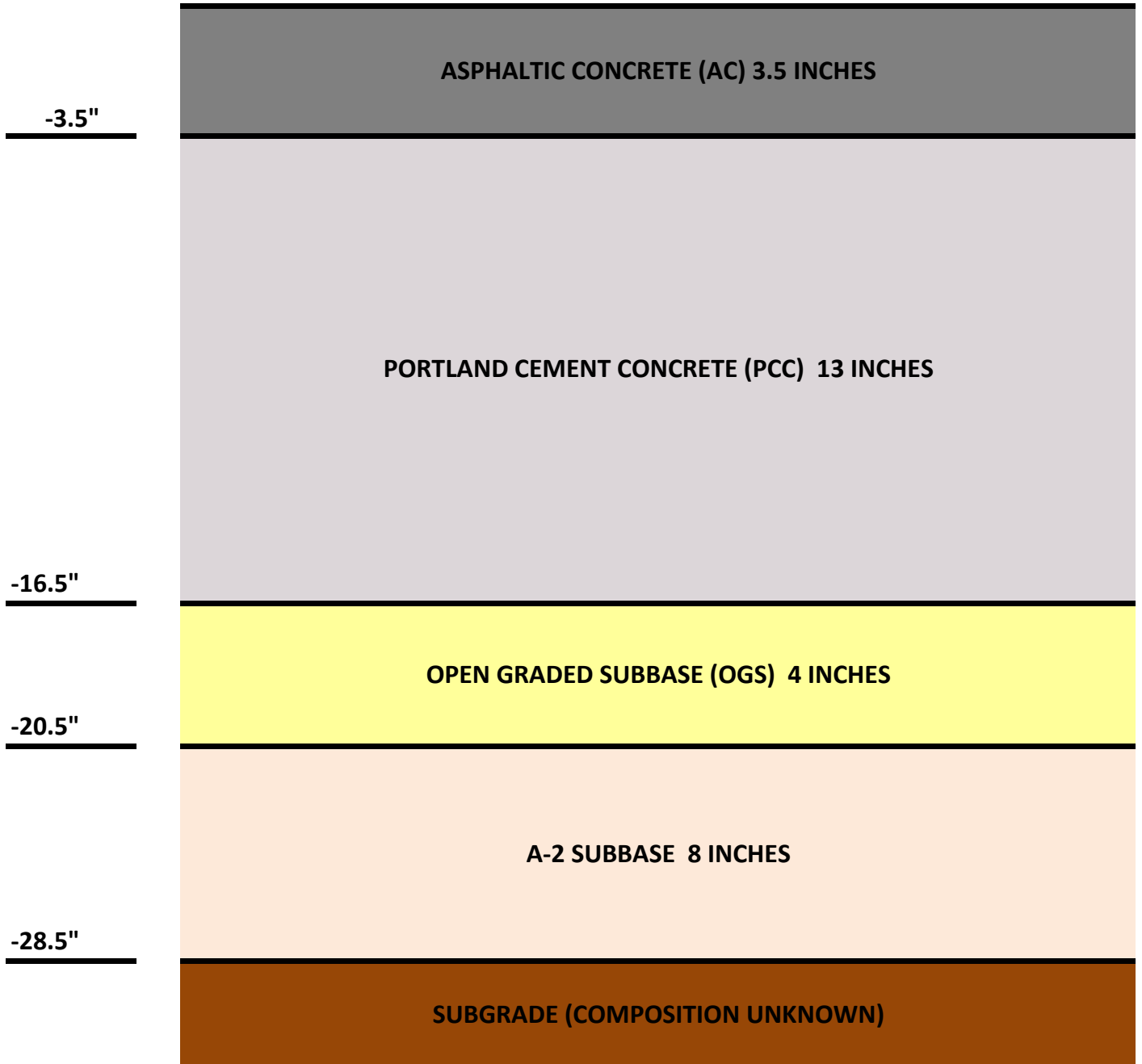


EXHIBIT C

**PENNDOT PILOT PROJECT (I-80 Test Site)
FWD Data Table from PennDOT**

Stabilization Of Transverse Joints Using The URETEK DEEP INJECTION (UDI) Process							
Mercer County Seg. 100 Offset 0450-0700							Average % Improvement LTE
Joint NO.	PRE-INJECTION TESTING			POST-INJECTION TESTING			665
	Load	Voids (mm)	LTE (%)	Load	Voids (mm)	LTE (%)	% Improvement LTE
1	BJ	4.96	79%	BJ	0.45	79%	0
	AJ	4.63	80%	AJ	0.45	83%	4
2	BJ	4.67	64%	BJ	0.21	77%	20
	AJ	2.83	78%	AJ	0.42	79%	1
3	BJ	4.62	67%	BJ	1.04	72%	7
	AJ	4.36	69%	AJ	1.03	80%	16
4	BJ	10.97	14%	BJ	1.15	52%	271
	AJ	16.82	13%	AJ	0.95	62%	377
5	BJ	14.56	4%	BJ	0.71	63%	1475
	AJ	10.93	3%	AJ	0.82	64%	2033
6	BJ	14.62	4%	BJ	2.22	53%	1225
	AJ	15.20	4%	AJ	2.45	48%	1100
7	BJ	10.56	4%	BJ	0.67	59%	1375
	AJ	9.67	5%	AJ	0.63	75%	1400

Calculation Of % Improvement in Load Transfer Efficiency (LTE) =

$$\text{((Post LTE-Pre LTE) / Pre LTE * 100)}$$

NOTES

- 1) FALLING WEIGHT DEFLECTOMETER (FWD) DATA AND ANALYSIS TABLE PROVIDED BY PENNDOT.
- 2) PERCENT IMPROVEMENT IN LTE CALCULATED BY THE URETEK ENGINEERING GROUP (UEG) FROM PENNDOT DATA.
- 3) BJ = BEFORE JOINT
AJ = AFTER JOINT

EXHIBIT D-1

**PENNDOT PILOT PROJECT (I-80 Test Site)
Void Analysis From PennDOT**

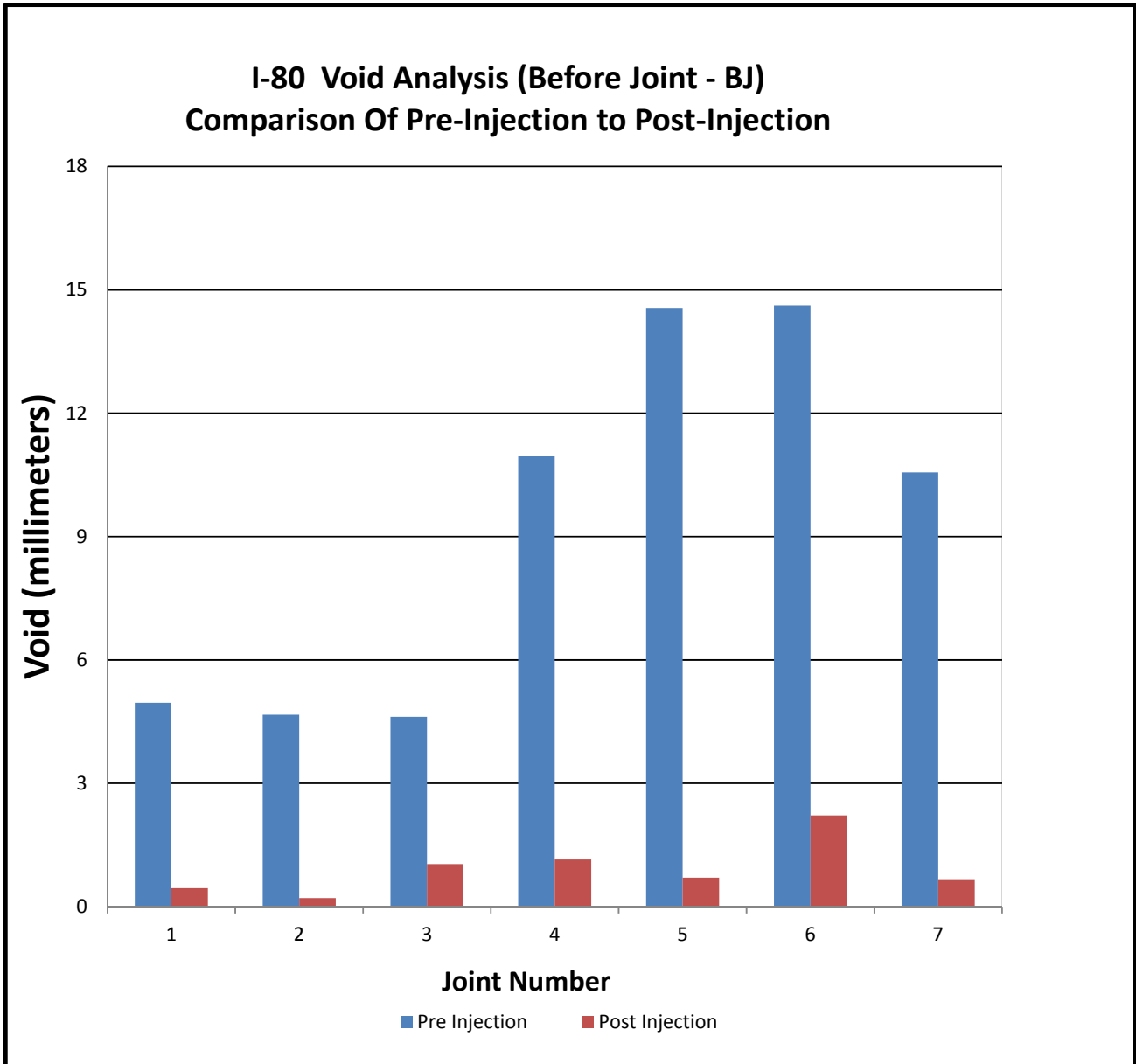


EXHIBIT D-2

**PENNDOT PILOT PROJECT (I-80 Test Site)
Void Analysis From PennDOT**

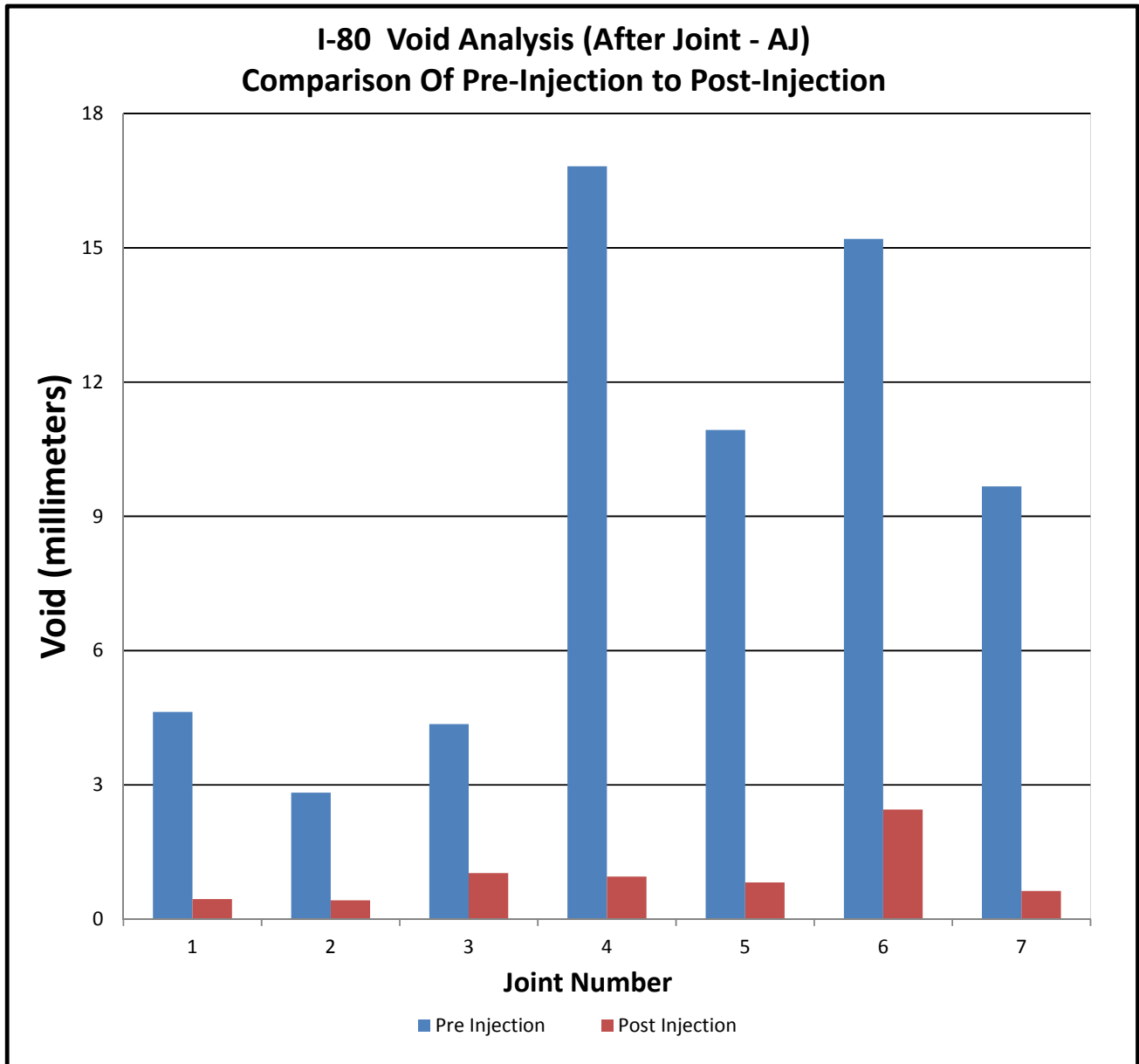


EXHIBIT E-1

**PENNDOT PILOT PROJECT (I-80 Test Site)
LTE Analysis From PennDOT**

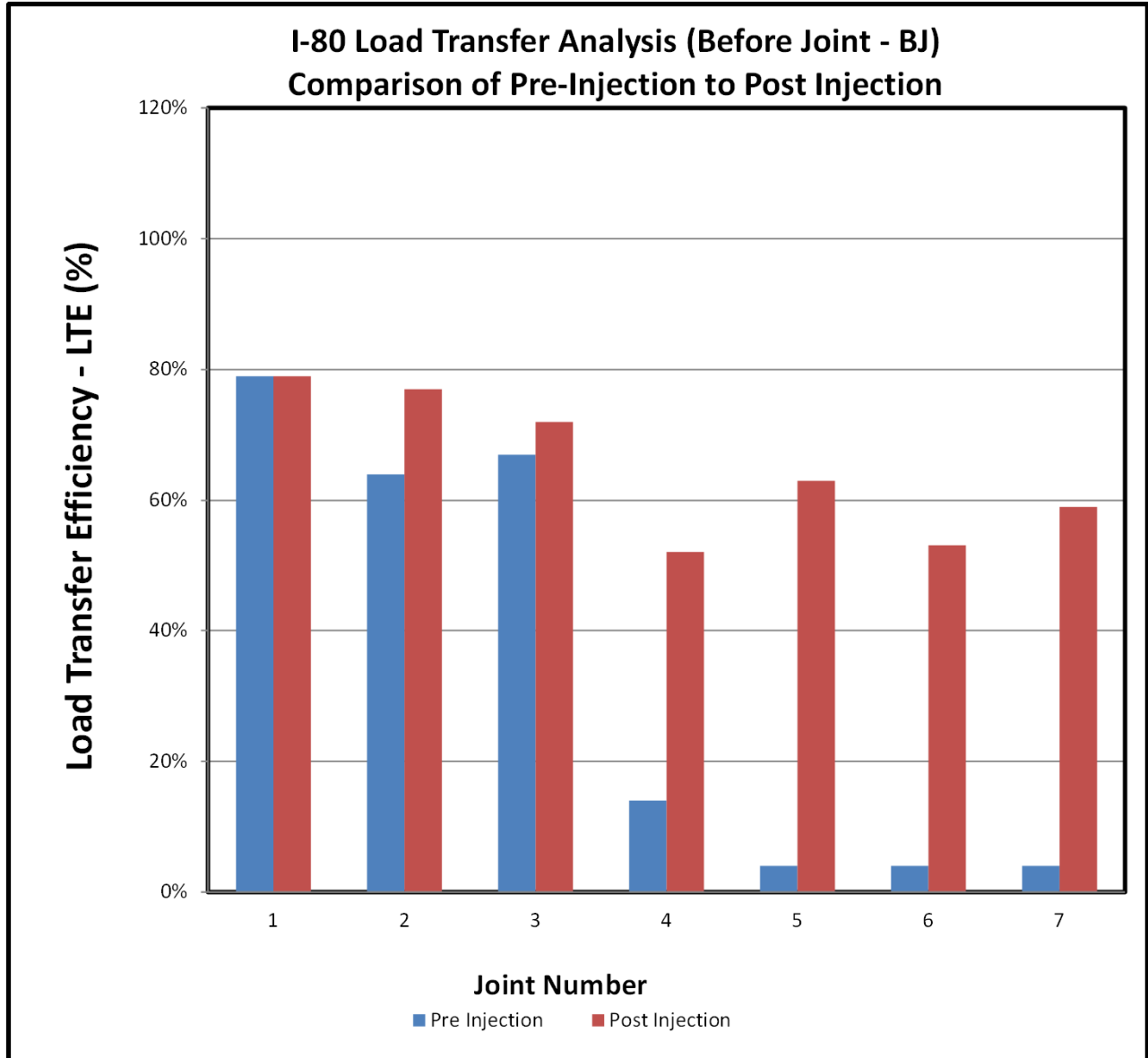


EXHIBIT E-2

**PENNDOT PILOT PROJECT (I-80 Test Site)
LTE Analysis From PennDOT**

