GPR Applications-Florida Practices

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Non-Destructive Evaluation (NDE) Technologies for Evaluating Asphalt Pavement-Virtual User-Group Peer Exchange

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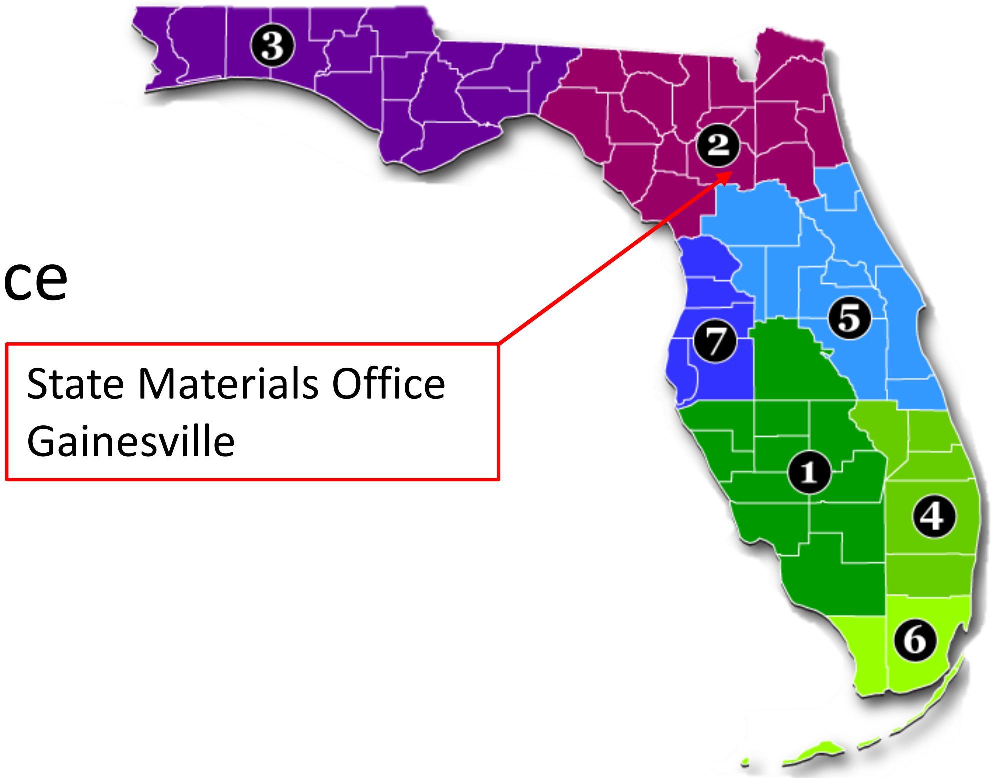
Overview

✓ GPR Applications

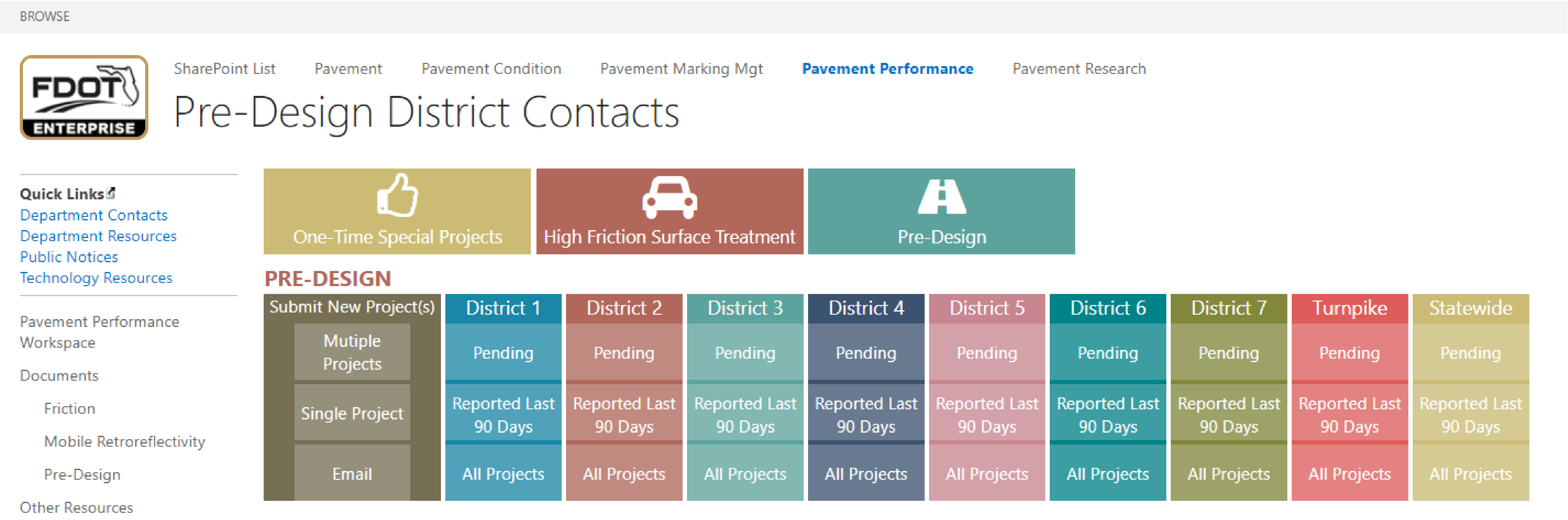
- ➢ Air-Launched GPR
- ➢ Ground-Coupled GPR
- ➢ PaveScan
- ➢ Mini XT

FDOT GPR Program

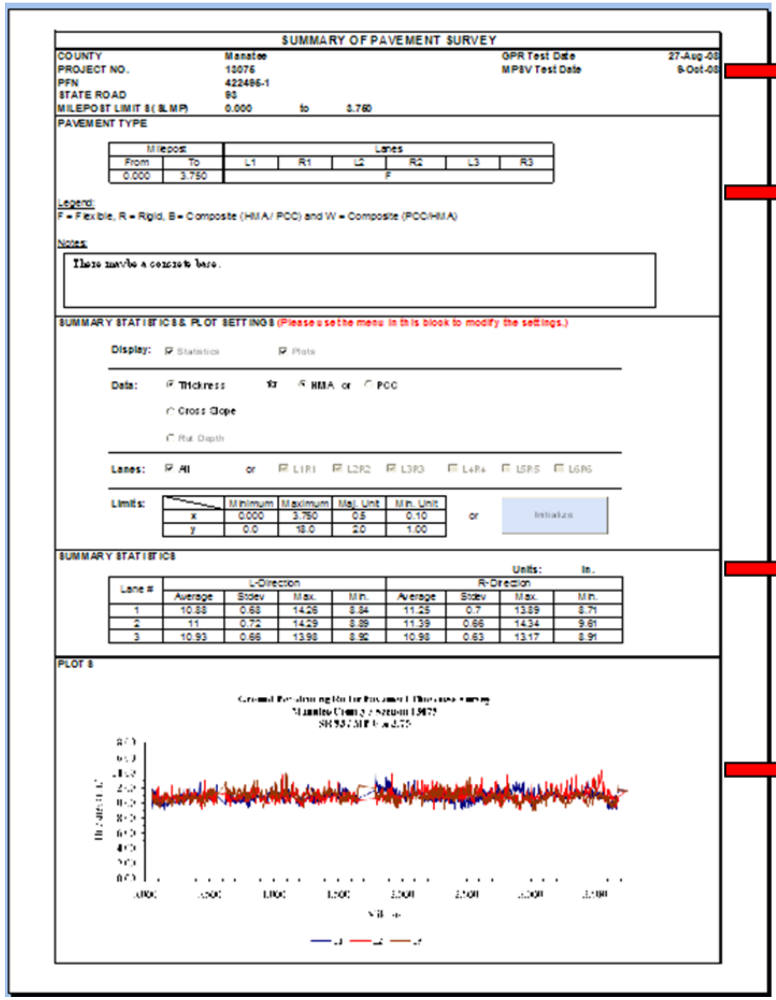
- 30 Years in Production
  - 26,000 Lane Miles
  - 2,000 Projects
- Statewide Predesign Evaluation of In-Service Roadways
  - Thickness of Pavement Layers
- Pavement Forensic Investigations
  - Premature Failure / Distress
  - Sink holes / Voids



SharePoint Pre-Design Request



Example of Pre-Design Thickness Report



SUMMARY OF PAVEMENT SURVEY

COUNTY	Manatee			GPR Test Date	27-Aug-08
PROJECT NO.	13076			MPSV Test Date	9-Oct-08
PFN	422496-1				
STATE ROAD	93				
MILEPOST LIMITS (SLMP)	0.000	to	3.750		

PAVEMENT TYPE

Milepost		Lanes					
From	To	L1	R1	L2	R2	L3	R3
0.000	3.750			F			

Legend:
F = Flexible, R = Rigid, B = Composite (HMA / PCC) and W = Composite (PCC/HMA)

Notes:
There may be a concrete base.

SUMMARY STATISTICS & PLOT SETTINGS (Please use the menu in this block to modify the settings.)

Display: Statistics Plots

Data: Thickness for HMA or PCC
Cross Slope
Rut Depth

Lanes: All or L1R1 L2R2 L3R3 L4R4 L5R5 L6R6

Limits:

	Minimum	Maximum	Maj. Unit	Min. Unit
x	0.000	3.750	0.5	0.10
y	0.0	18.0	2.0	1.00

or Initialize

SUMMARY STATISTICS

Units: in.

Lane #	L-Direction				R-Direction			
	Average	Stdev	Max.	Min.	Average	Stdev	Max.	Min.
1	10.88	0.68	14.26	8.84	11.25	0.7	13.89	8.71
2	11	0.72	14.29	8.89	11.39	0.66	14.34	9.61
3	10.93	0.66	13.98	8.92	10.98	0.63	13.17	8.91

PLOTS

- Project information
- Pavement Types
- Basic Statistics for Thickness
- Plots of Thickness,

Air Launched GPR

- High frequency (1GHz or 2GHz) antennas for pavement surveys
- Operate at highway speed, no traffic restrictions required
- Estimate existing pavement thickness “continuously” and non-destructively
- “Engineered Coring Plan
  - Minimize coring to reduce costs
  - Core verification
  - Isolate areas

GPR vs Coring

	GPR	Coring
Operating speed	Highway speed	Stationary
Traffic restrictions	None	Lane closure
Thickness accuracy	Approximation	Exact
Number of thickness data per lane per mile	52 to 5280	1 to 3

GPR Precision Study

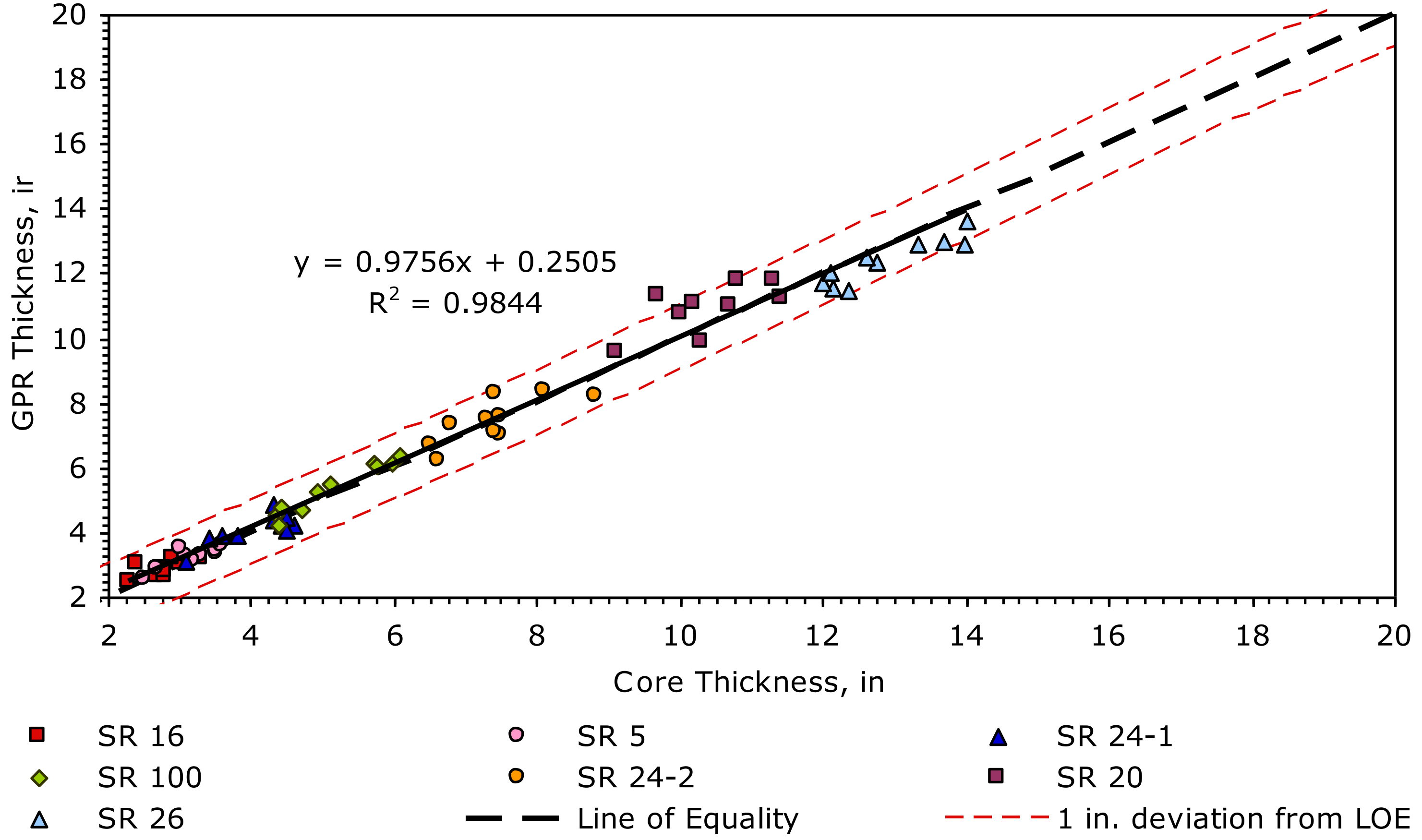
- Seven sites selected for pavement thickness accuracy and repeatability studies
- Four different pavement types used:
  - Flexible (HMA)
  - Rigid (PCC)
  - HMA overlaid PCC
  - PCC overlaid HMA
- Varying pavement thickness

Data Collection (GPR/Core)

Stationary GPR data collected and locations marked for coring

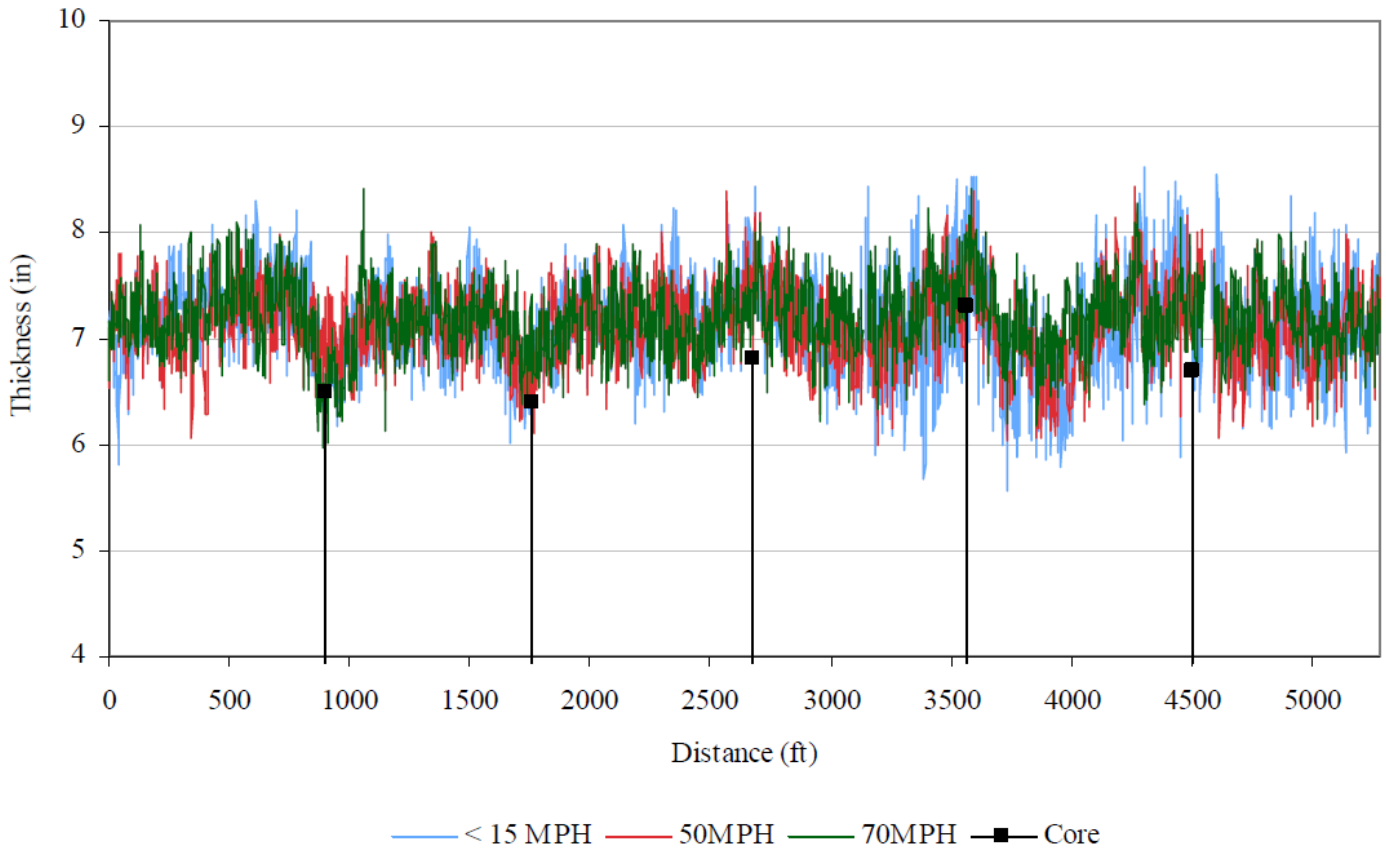
Accuracy of Air Launched GPR

- Thickness error approximately ±5%



Repeatability of Air Launched GPR

- Repeatability in terms of COV within 10 %

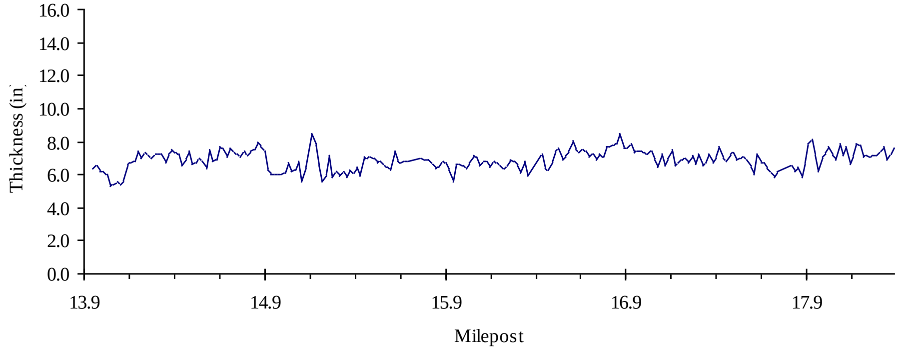


Case-I-75 in Marion County

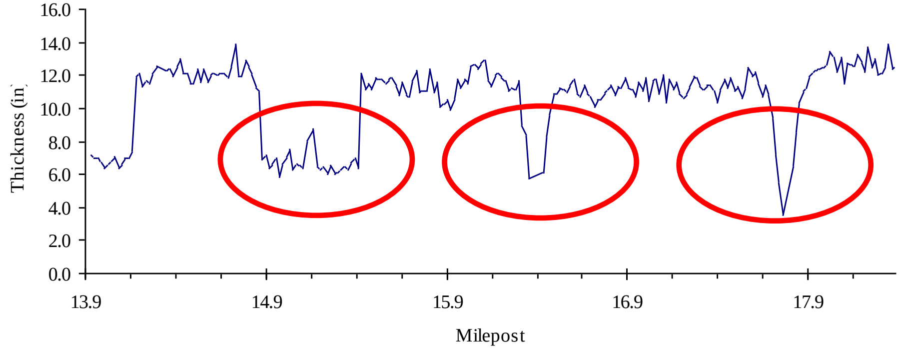
- 6 lane resurfacing
- Lanes L1 and R1 were constructed at different dates
- GPR survey requested to assist in the engineering coring plan
- Safety issue to core in middle passing lane

GPR Profiles per Lane

L1: Newer pavement

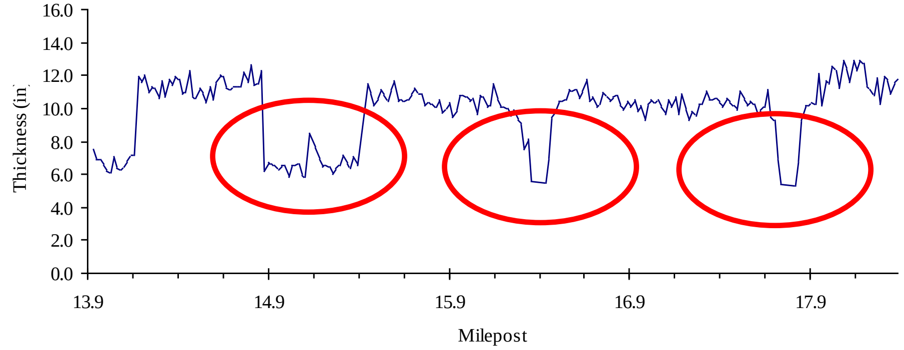


L2: Original pavement



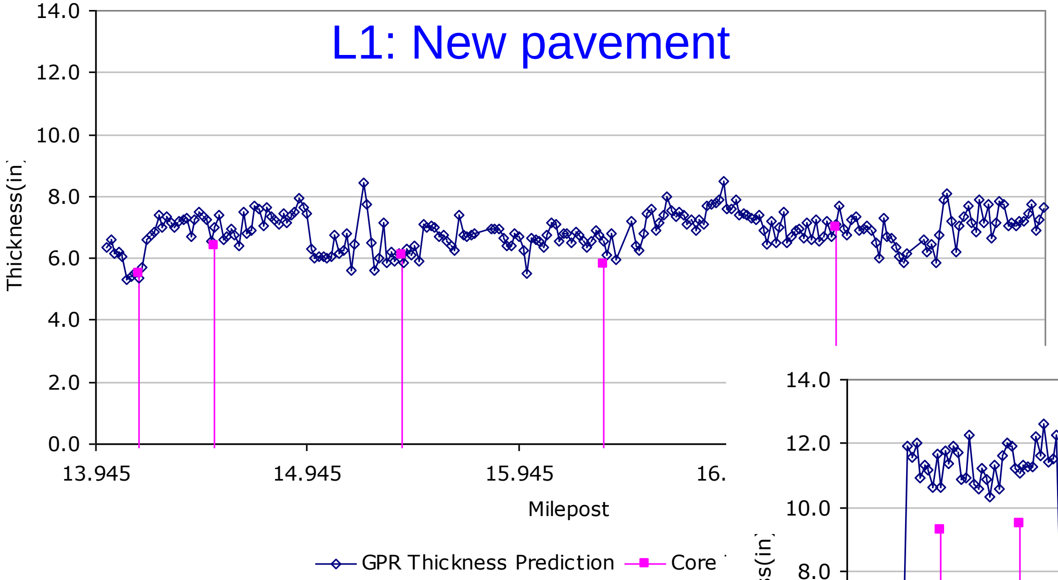
Thickness Variability

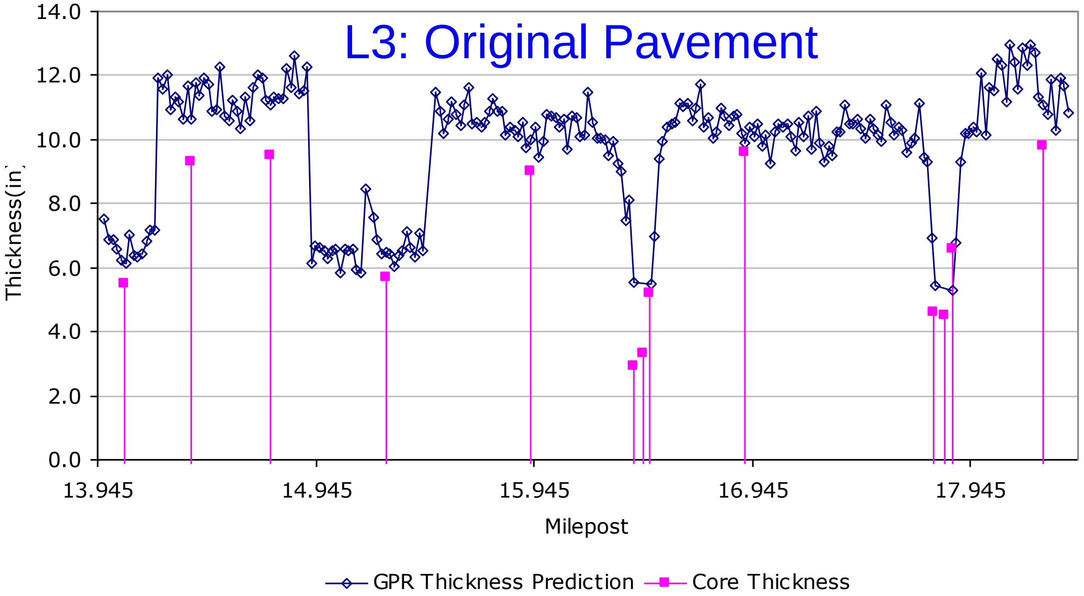
L3: Original pavement



- **Similar thickness profiles between L2, R2 and L3, R3**
- **Thickness Variability**
- **District decided NOT to core lanes L2 and R2**
- **Reduced MOT and Total savings = $ 4,000**

Follow Up, GPR vs Cores



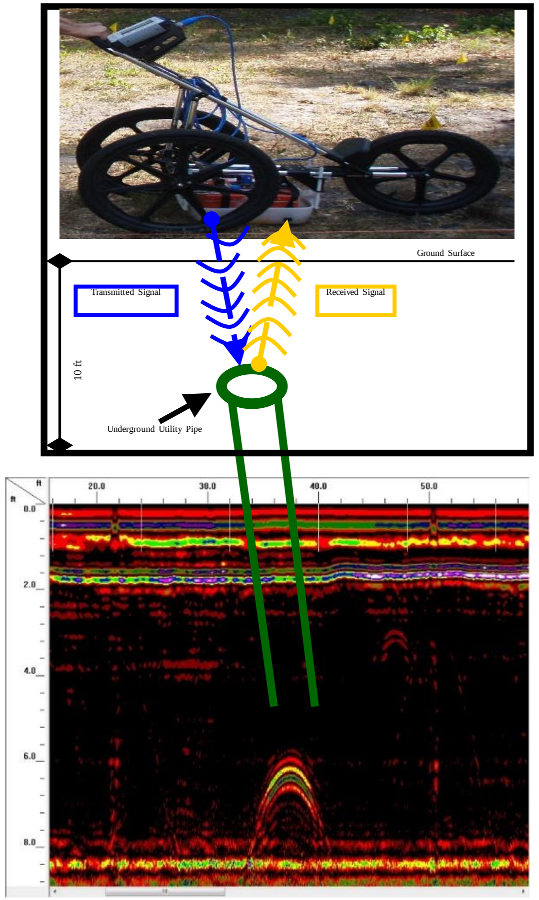


Ground-Coupled GPR

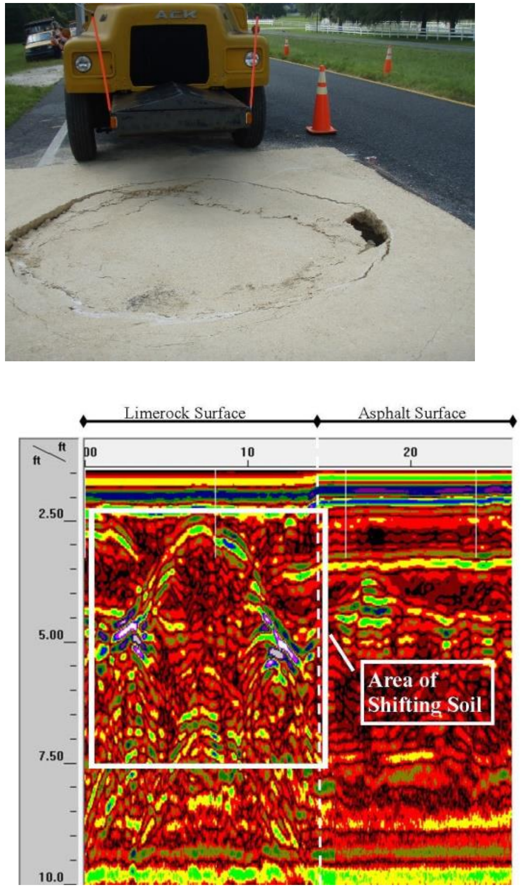
- Antennas of various frequencies (100 MHz to 900 MHz)
- Used for pavement surveys and forensics
- Handheld, requires traffic restrictions
- Lower frequency antennas offer greater penetration depths but lower resolution
- Higher frequency antennas offer greater resolution but lower penetration depths

Ground-Coupled GPR Applications

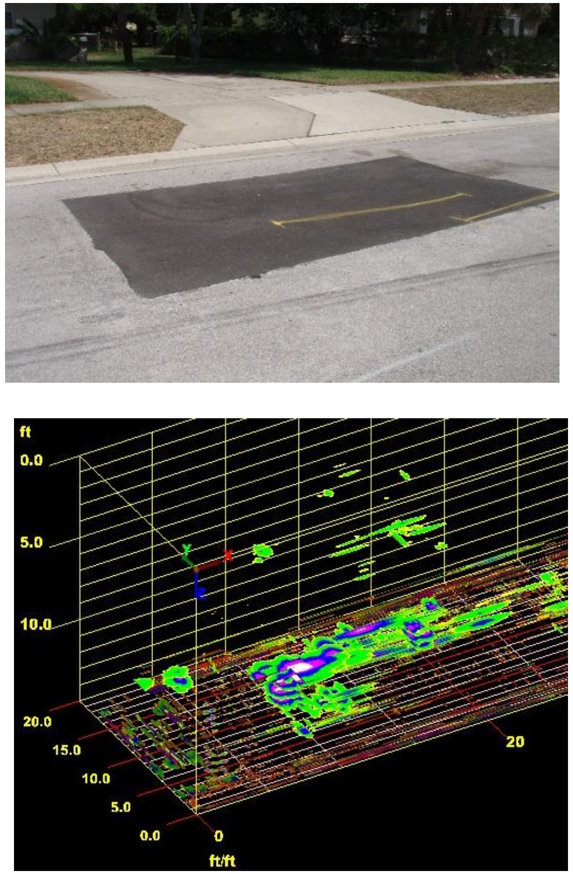
Underground Utilities



Sinkhole Investigations



Pavement Depressions/High Moisture

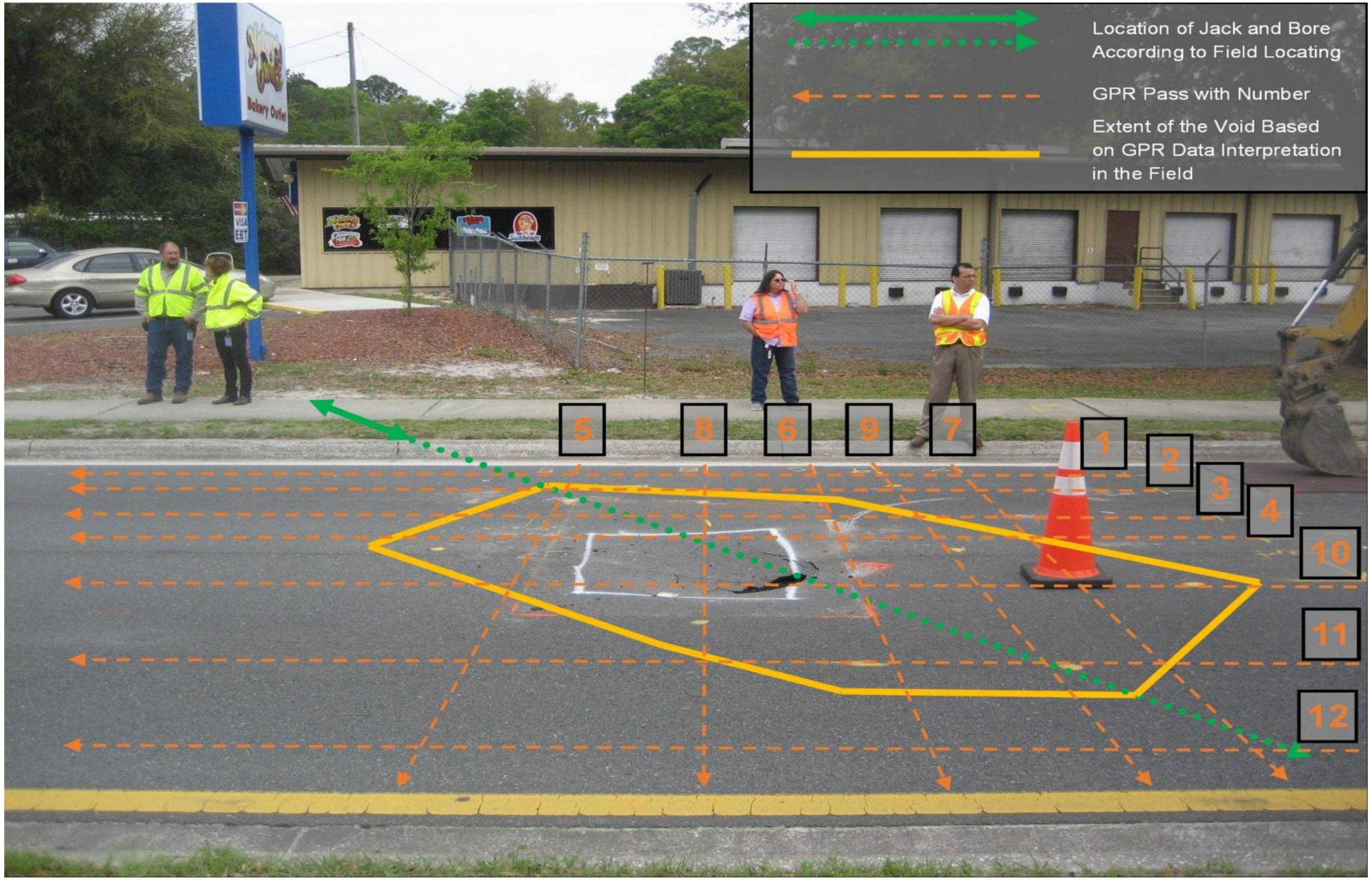


SR 24/Waldo Road, Alachua County, FL

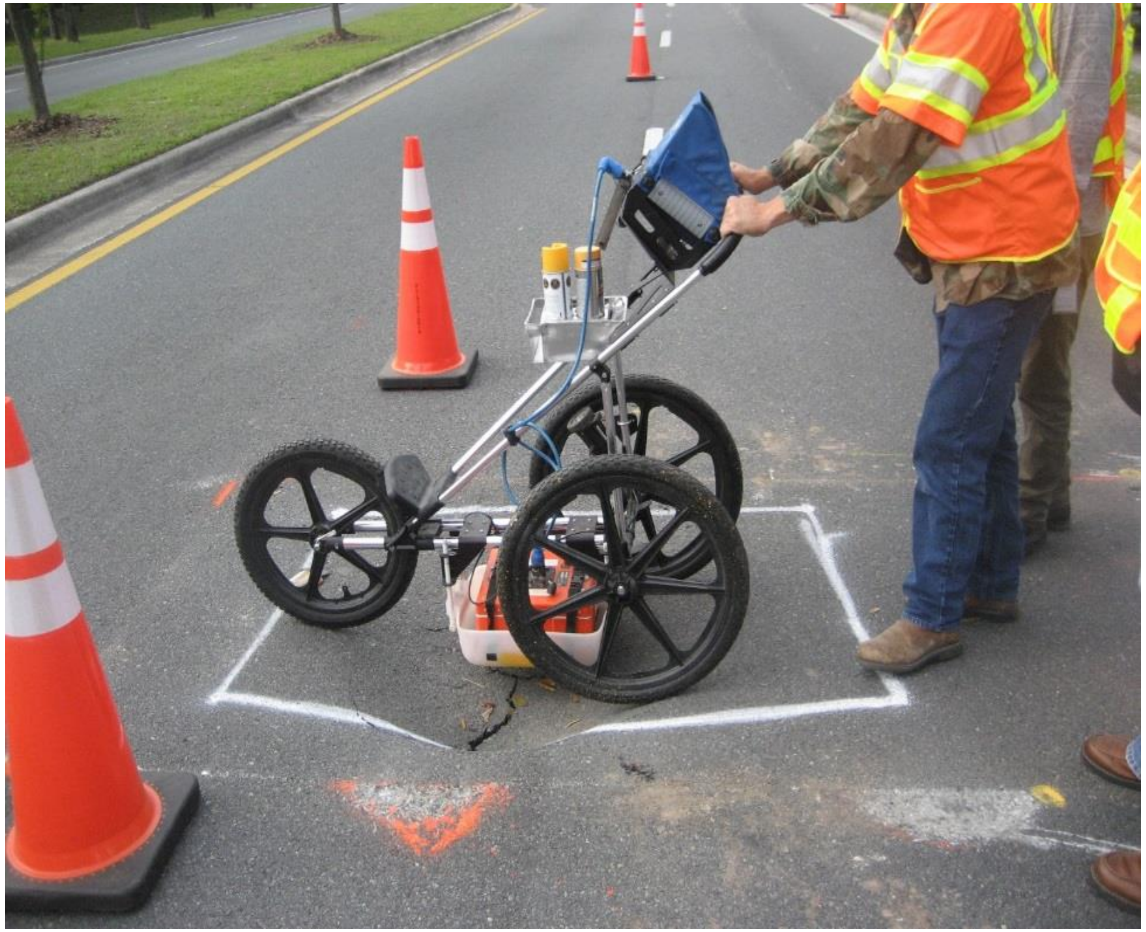
Removing steel plate over pavement depression

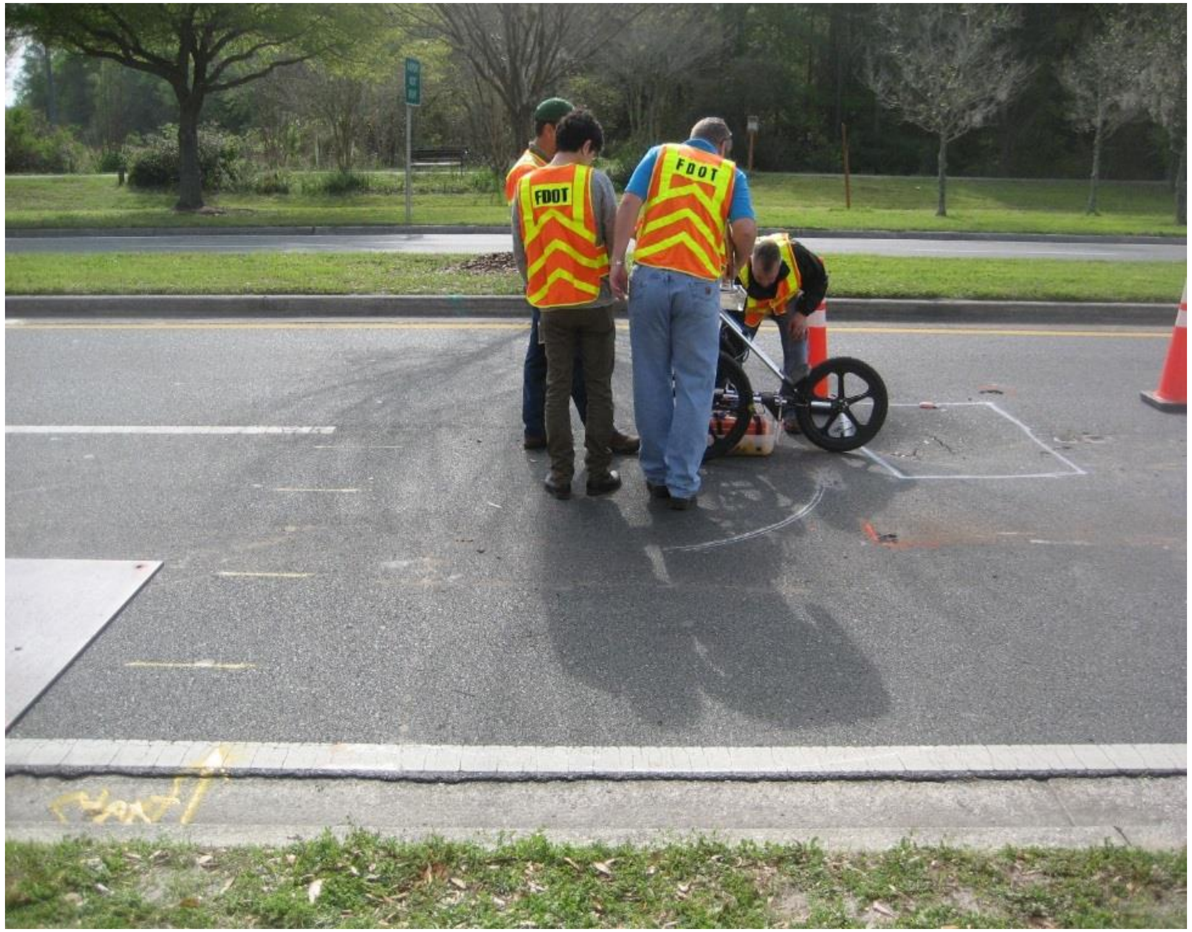
Pavement depression after steel plate was removed

GPR Test Layout



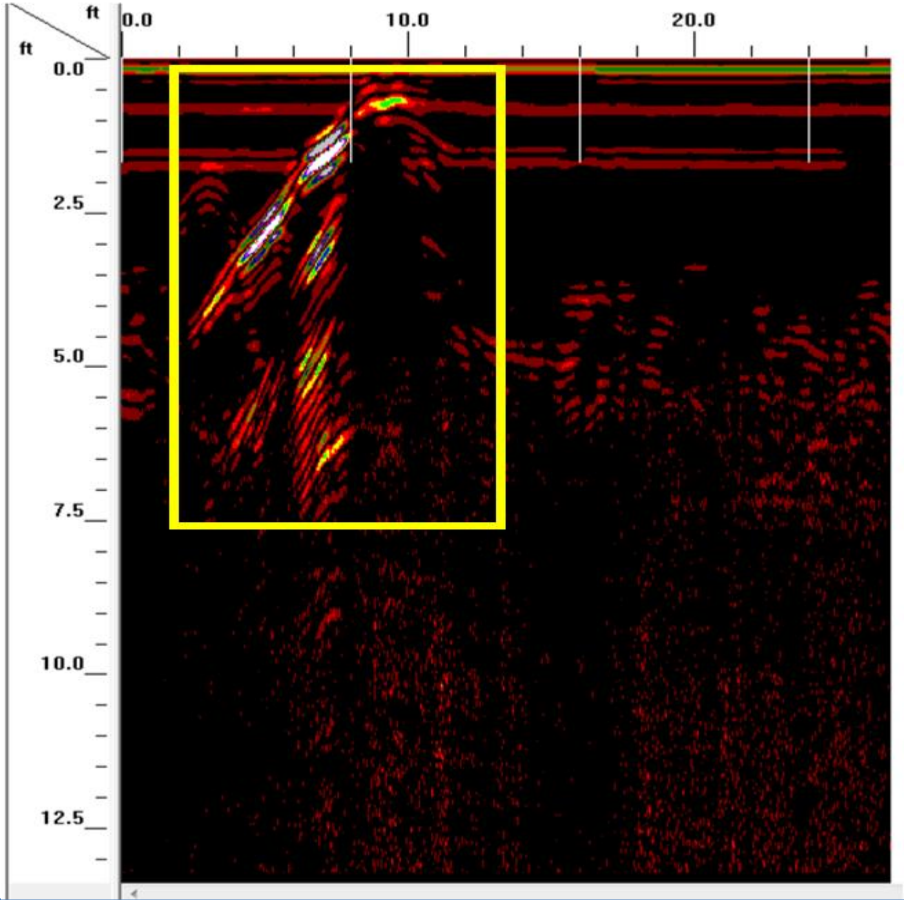
GPR testing directly over the Pavement Depression



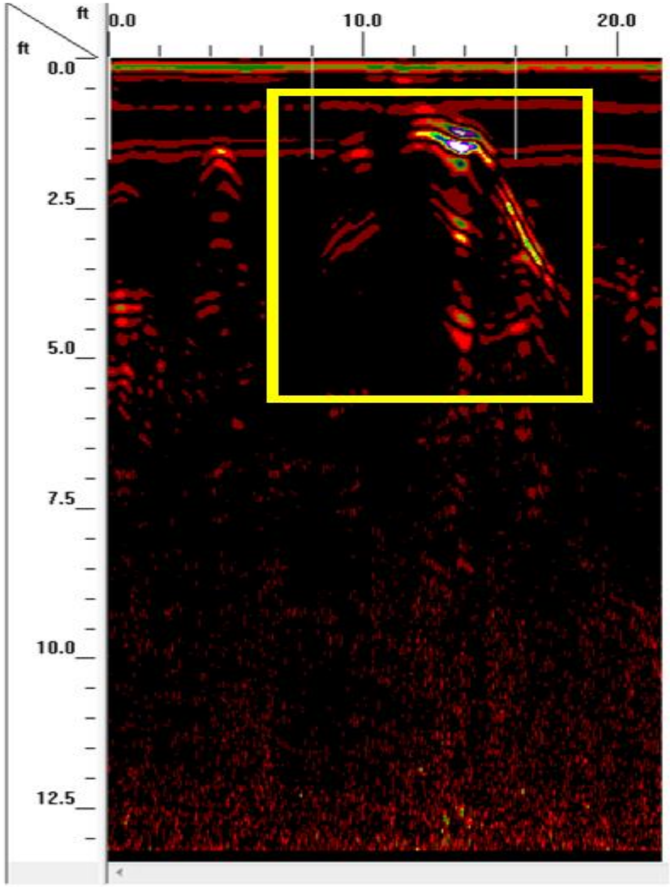


GPR Results

Longitudinal GPR pass 10 indicate potential shifting soils and void around pavement depression



Transverse GPR pass 6 indicate potential shifting soils and void around pavement depression



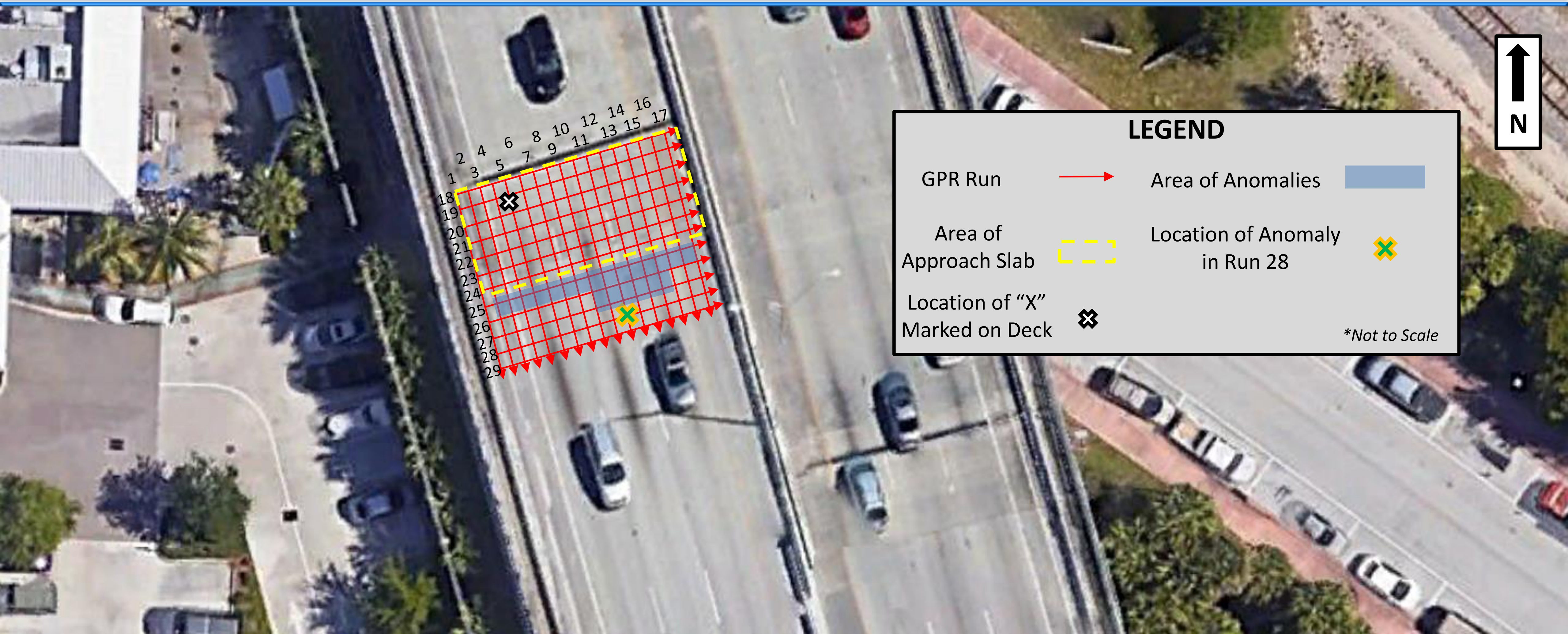
On-Site Voids Confirmation

- Maintenance breaking out center of Pavement Depression for visual access

- Void revealed when pavement was removed

South Bound Roosevelt Bridge Approach Slab in Stuart, Florida

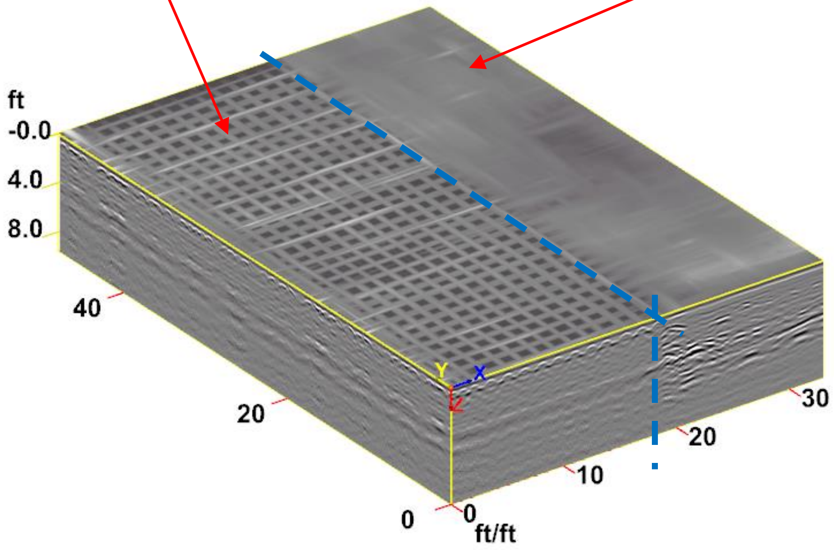
Testing Schematic



Bridge Approach Slap Voids-3D Rendering

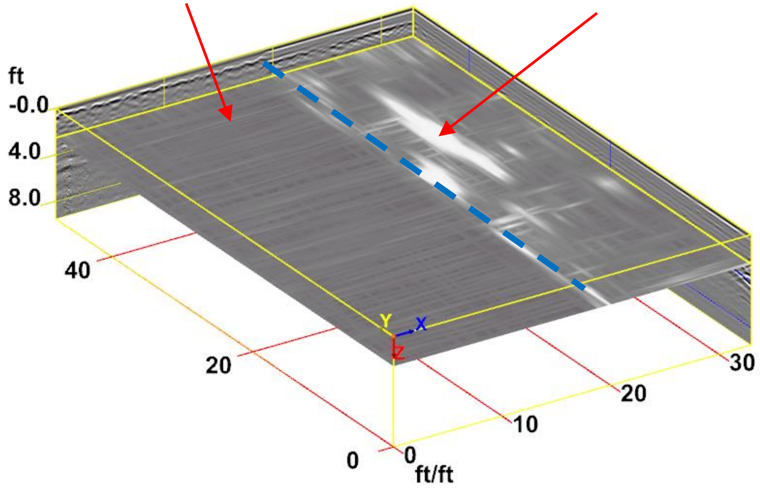
Approach Slab

Asphalt Surface



Beneath the Approach Slab

Beneath the Asphalt Surface



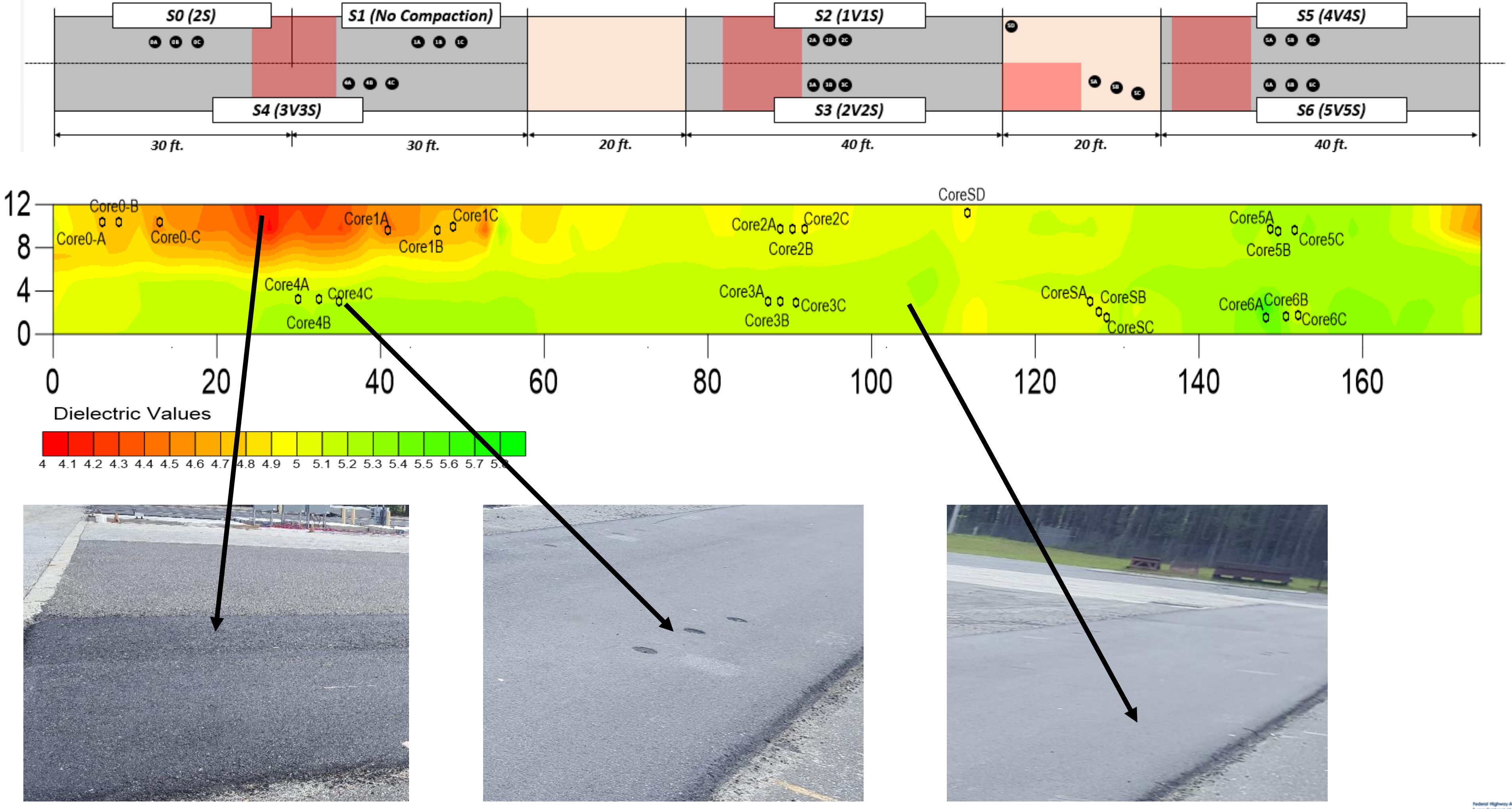
PaveScan Applications

- PaveScan device used to determine relative density of asphaltic layer
- Quality assurance/quality control of new pavements
- Real-time dielectric measurements that correlate to density
- Allows for on-site continuous evaluation of relative compaction effectiveness

PaveScan Applications: Static/Vibratory Compaction Experiment

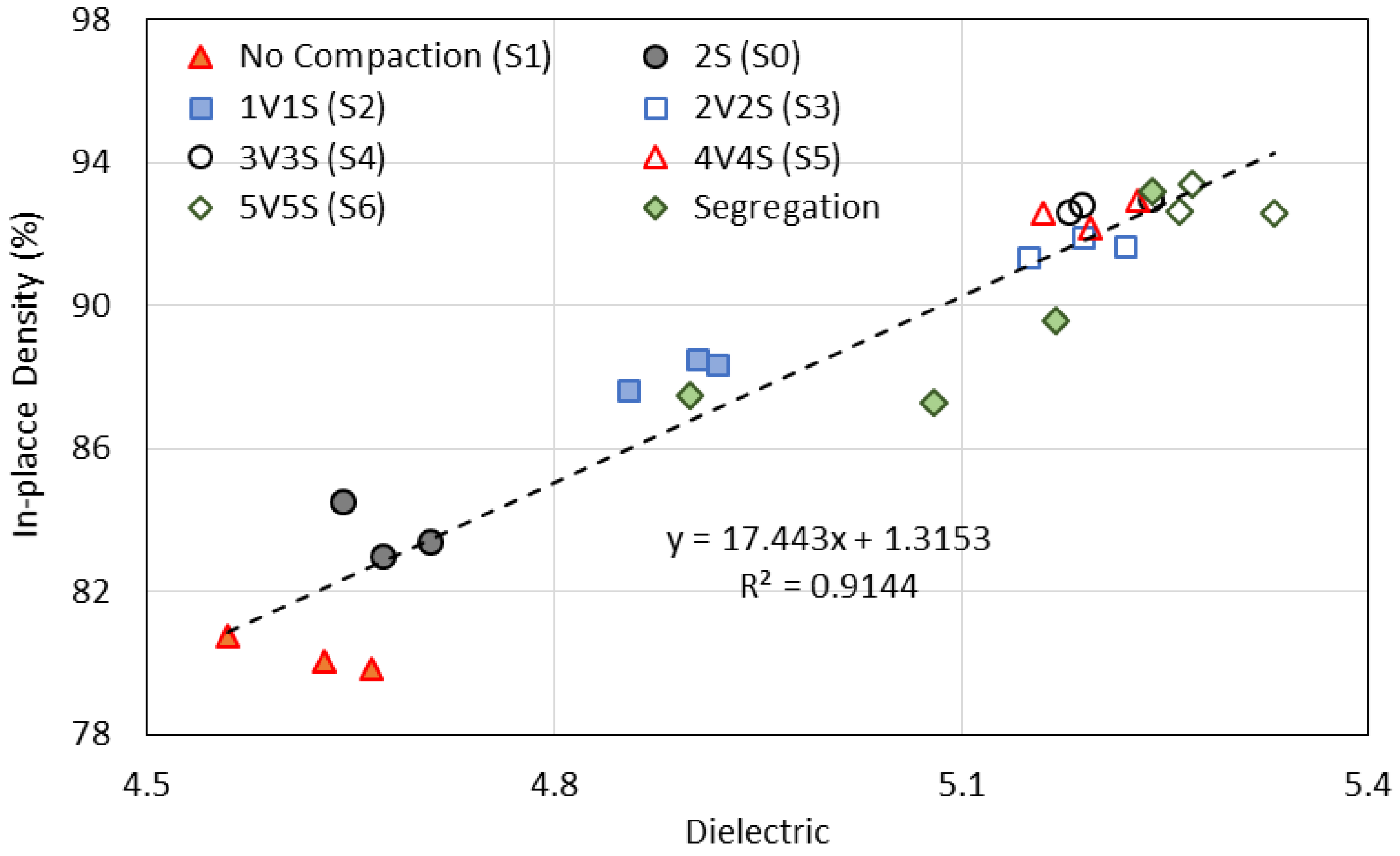
- SMO Test Strip

Static/Vibratory Compaction



Static/Roller Compaction Results

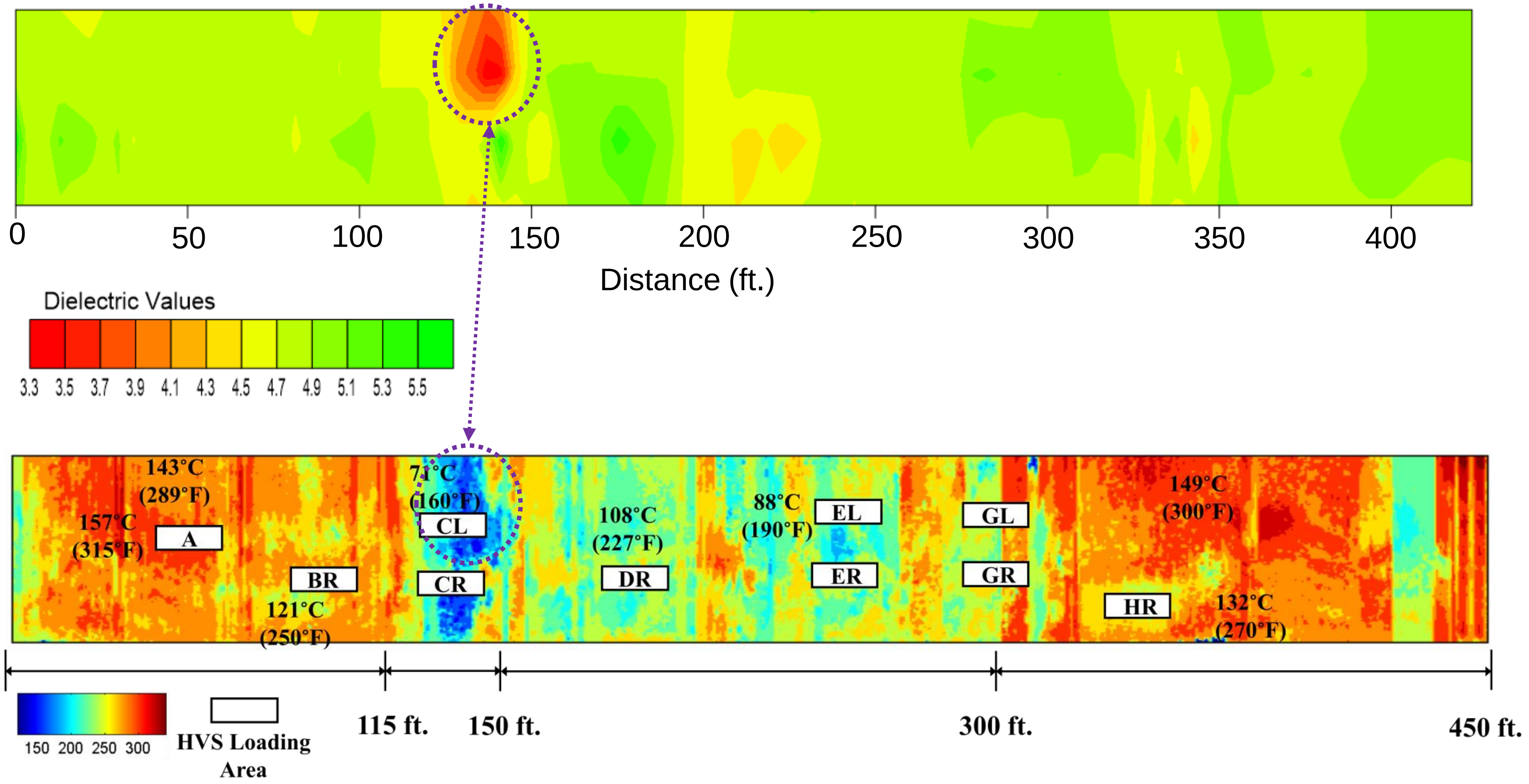
- Plot of % Density (Cores) and GPR Dielectric Values



PaveScan Applications- Temperature Study

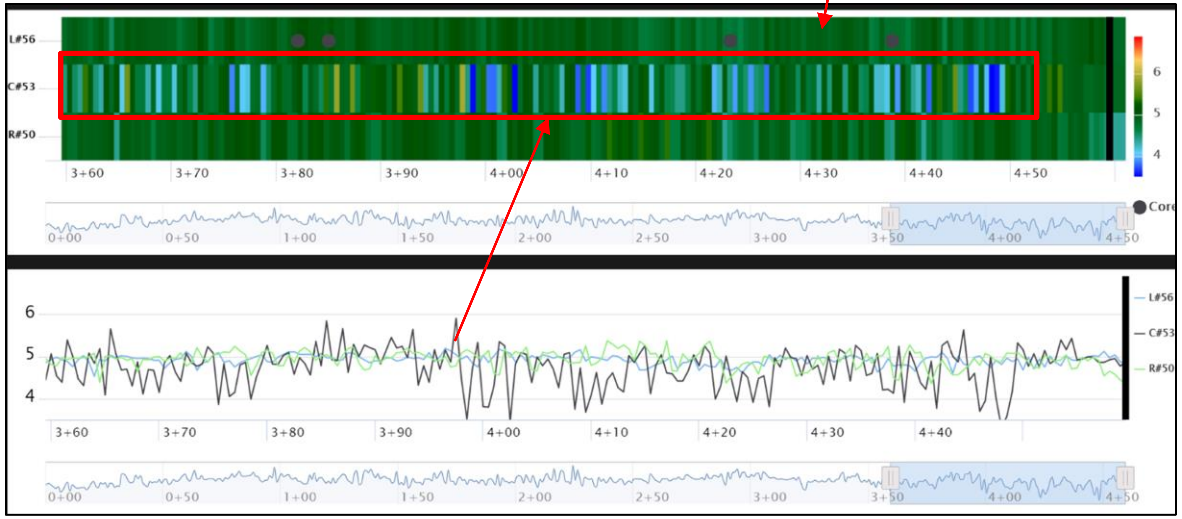
PaveScan Applications-SMO APT Lane 5

GPR Dielectric Values and Thermal Imaging Profile



PaveScan Applications: RoadWorms-SR 26, Alachua, FL

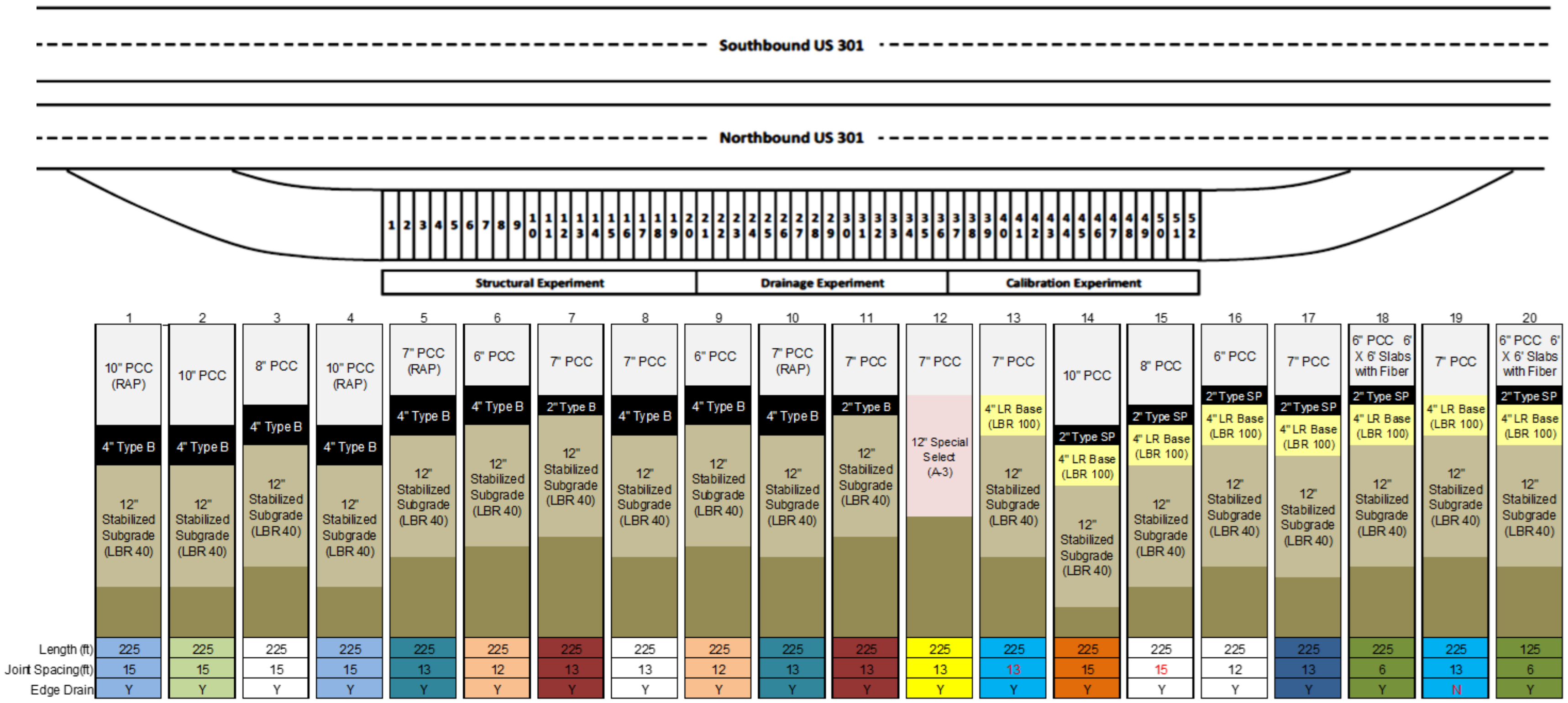
RoadWorm



PaveScan Applications-Florida Concrete Test Road-US 301

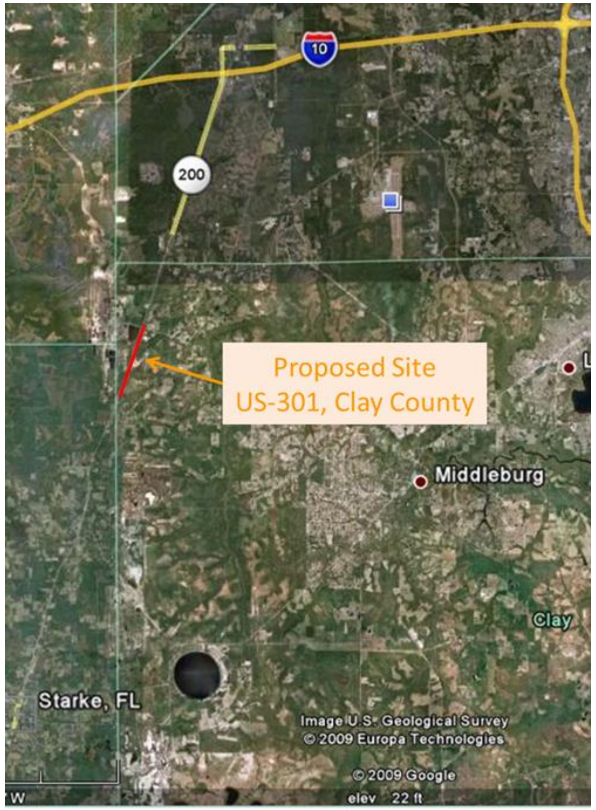
- 52 Test Sections Distributed Into 3 Experimental Groups:

  Structural (20 Test sections), Drainage (16 Test sections), and Calibration (16Test sections),



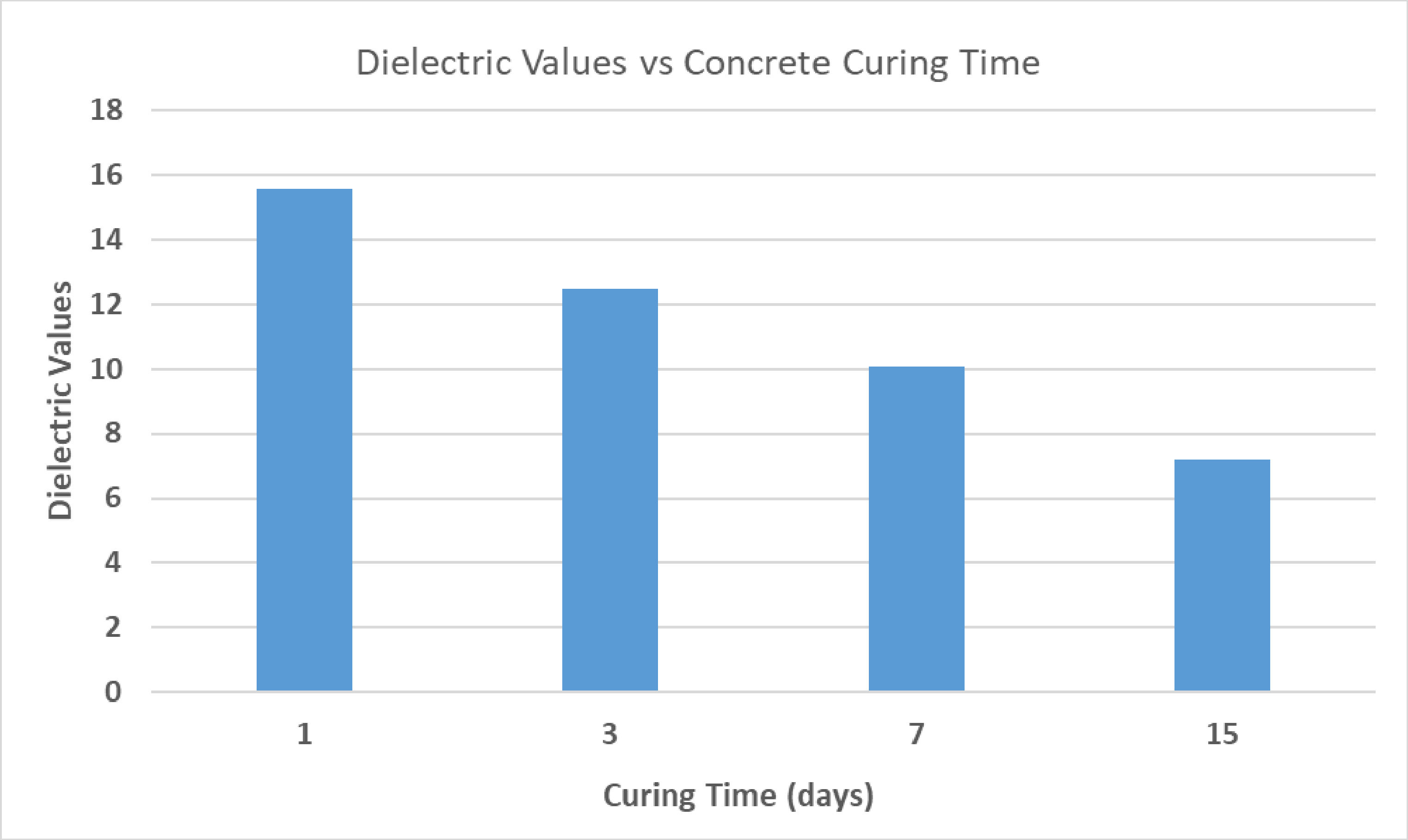
PaveScan Applications-Florida Concrete Test Road-US 301

- Propose Using PaveScan to Measure Concrete Slab Curing Rate



PaveScan Applications-Florida Concrete Test Road-US 301

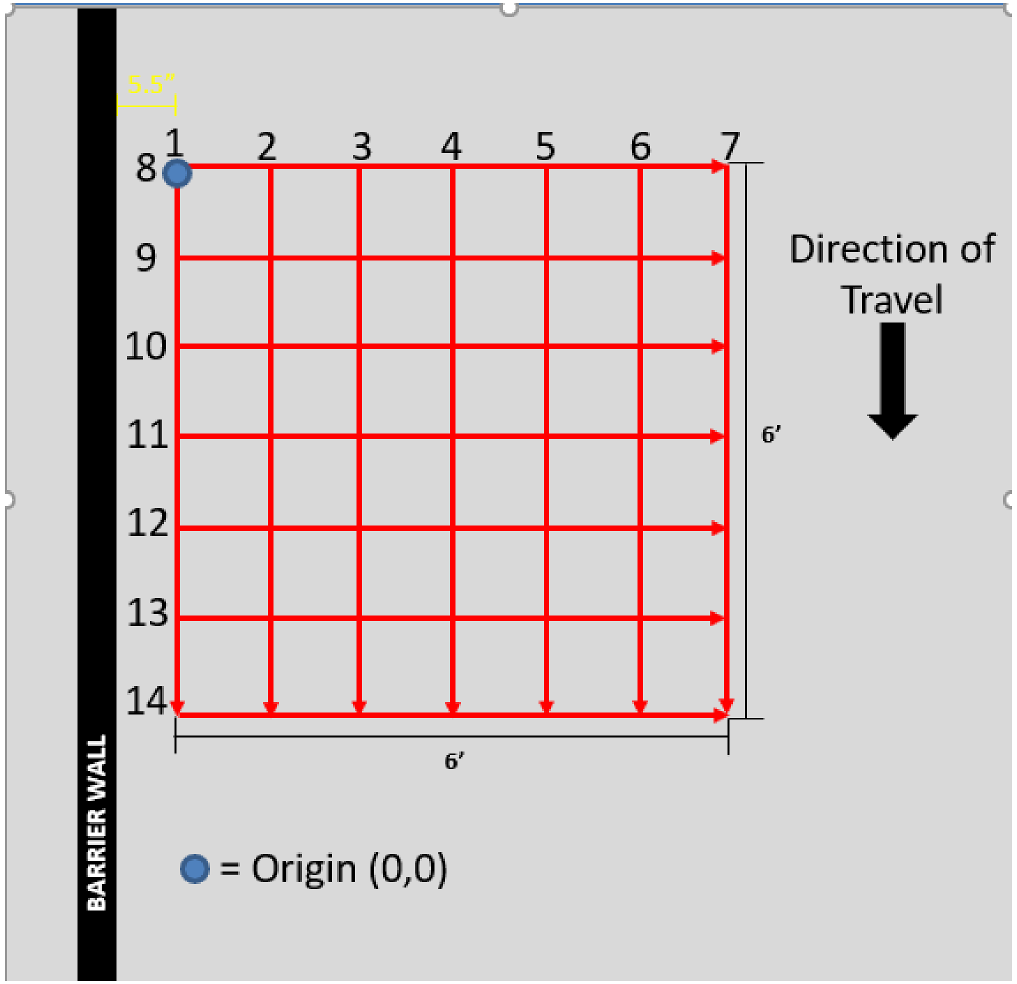
- Dielectric Values vs Concrete Curing Time



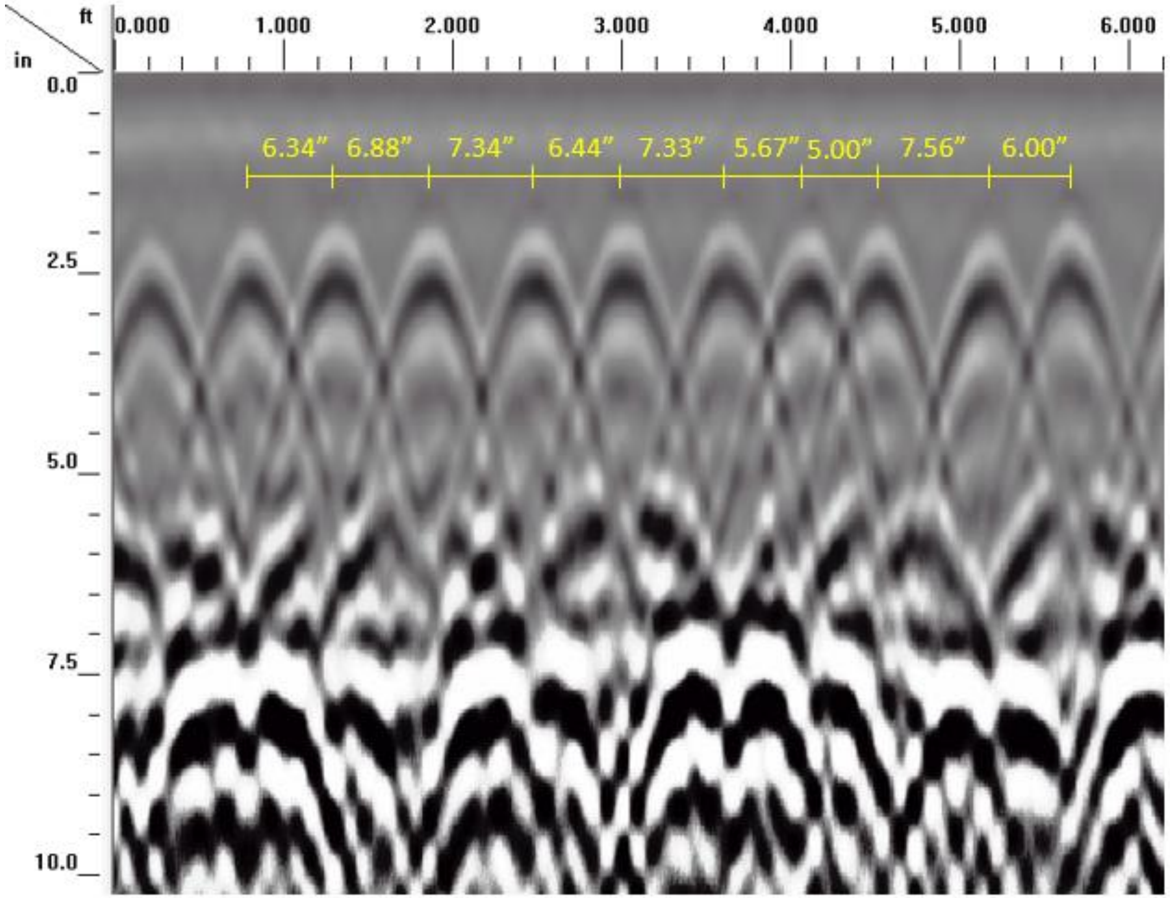
StructureScan Mini XT

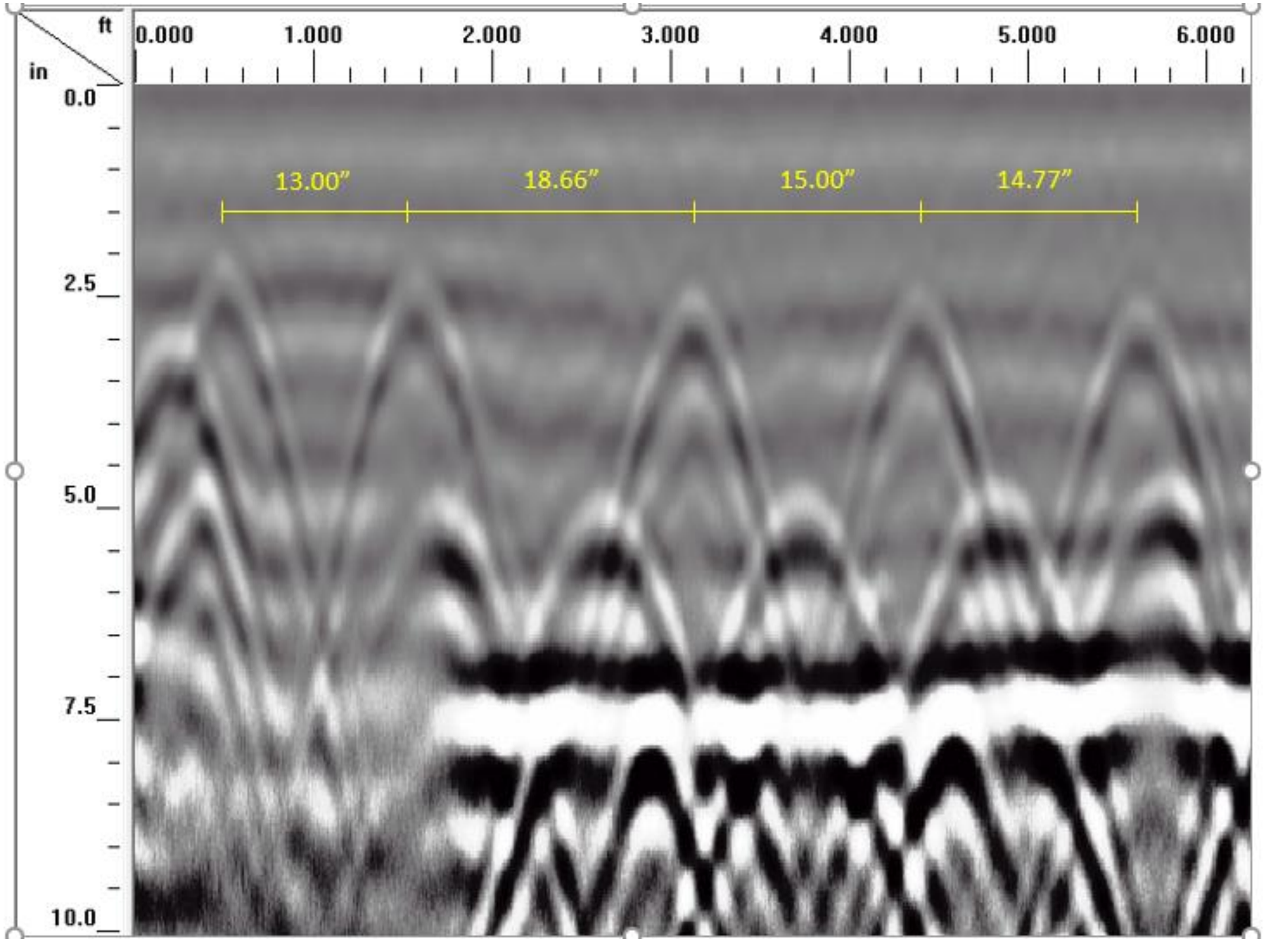
- Antenna Frequency 2.7 GHZ
- Mainly for locating reinforcements in concrete

Transverse and Longitudinal Reinforcement Bar Spacing



Transverse and Longitudinal Reinforcement Bar Spacing



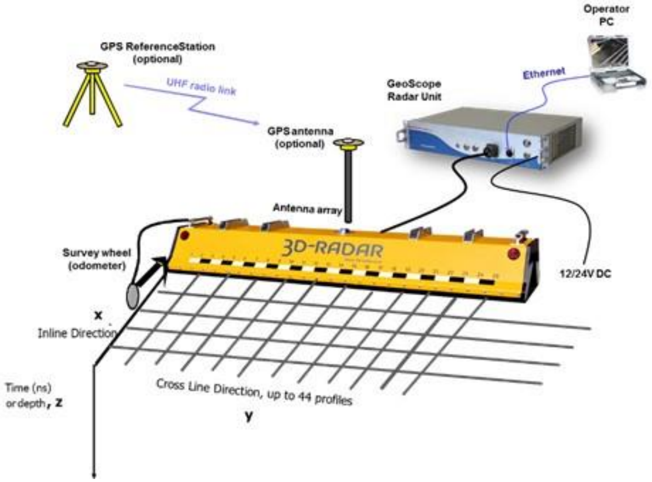


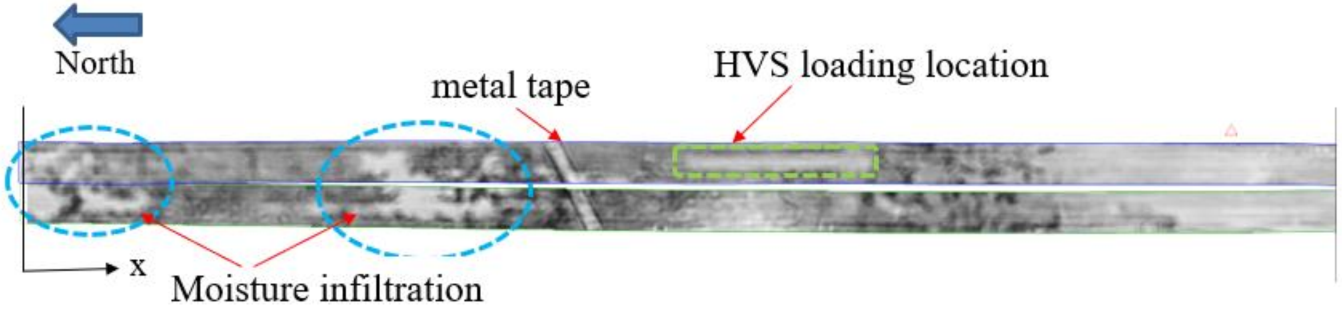
Challenges on GPR Applications

- Bridge Deck Corrosions
- Delamination in Asphalt Layers
- Limited to the Localized Survey
- MOT Support

Moving Forward-New GPR Technology

- 3D Radar
- High Speed Mobile
- 21 Antenna Array/6 ft wide
- Step Frequency
  - ✓100 MHZ to 3 GHz
- Continuous
- Up to 6 ft depth





Questions?