



Qualification and Testing of NDT and Mechanics-Based Approaches for Evaluating Flexible Base Construction

Product 0-6874-P2

Cooperative Research Program

TEXAS A&M TRANSPORTATION INSTITUTE
COLLEGE STATION, TEXAS

in cooperation with the
Federal Highway Administration and the
Texas Department of Transportation
<http://tti.tamu.edu/documents/0-6874-P2.pdf>

Qualification and Testing of NDT and Mechanics- Based Approaches for Evaluating Flexible Base Construction

*TxDOT Project 0-6874 Develop Nondestructive Rapid Pavement Quality
Assurance/Quality Control Evaluation Test Methods and Supporting Technology
August 19, 2019*

*Robert Lytton, PhD, P.E., Arvind Devadas, Yong Deng, Fan Gu, PhD, Alireza
Joshaghani, Xue Luo, PhD, Sajib Saha*

Goals

- Identify GPR systems that can perform rapid, non-invasive inspection of pavement layer(s) – focusing on base course
- Develop field methods
- Identify and develop lab methods to provide material properties needed to systematically analyze GPR data into useful engineering and construction information
- Develop analytical methods to convert raw GPR data into material properties – focusing on modulus and volumetrics

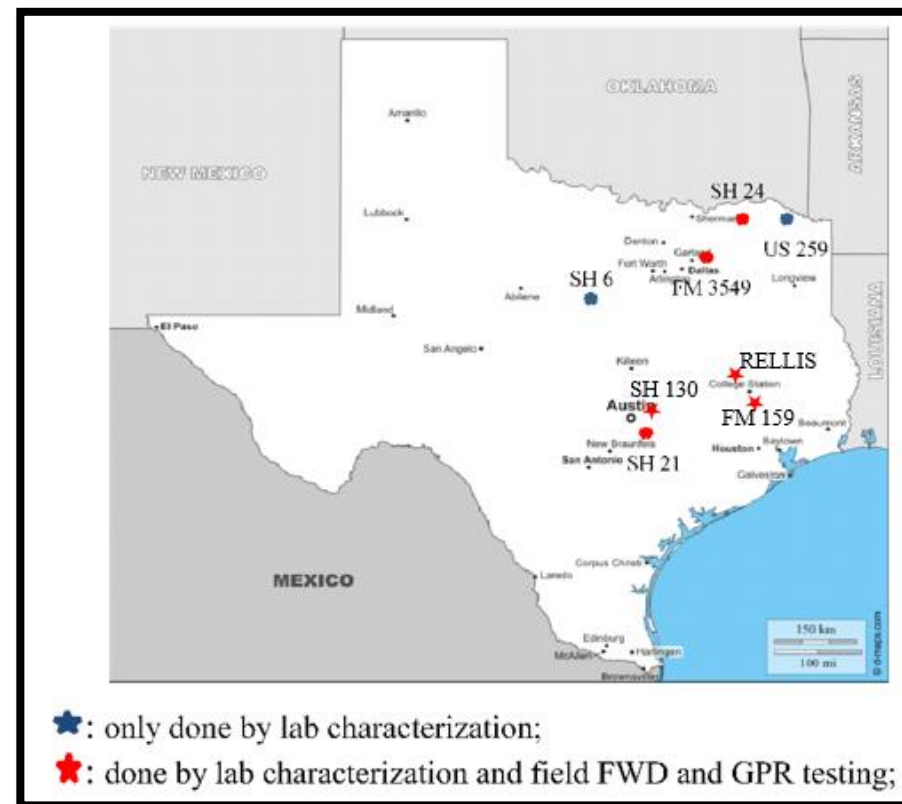
Key Activities Completed

- Resilient Modulus & Volumetrics
 - Developed algorithms to calculate the modulus and volumetrics using ground penetrating radar
 - Completed analysis on GPR scans on several test sites
- Testing of commercial GPR Systems
 - Identified suitable systems
 - 2 GHz Horn Antenna System
 - 2.5 GHz RDM System
- Exploratory work on stabilized materials

Testing Summary



GPR testing on Completed Base Course



Participating Test Site Locations

Example Results – SH 21 Actual Field Condition

Fatigue cracking
in wheel paths
generally
throughout
extents



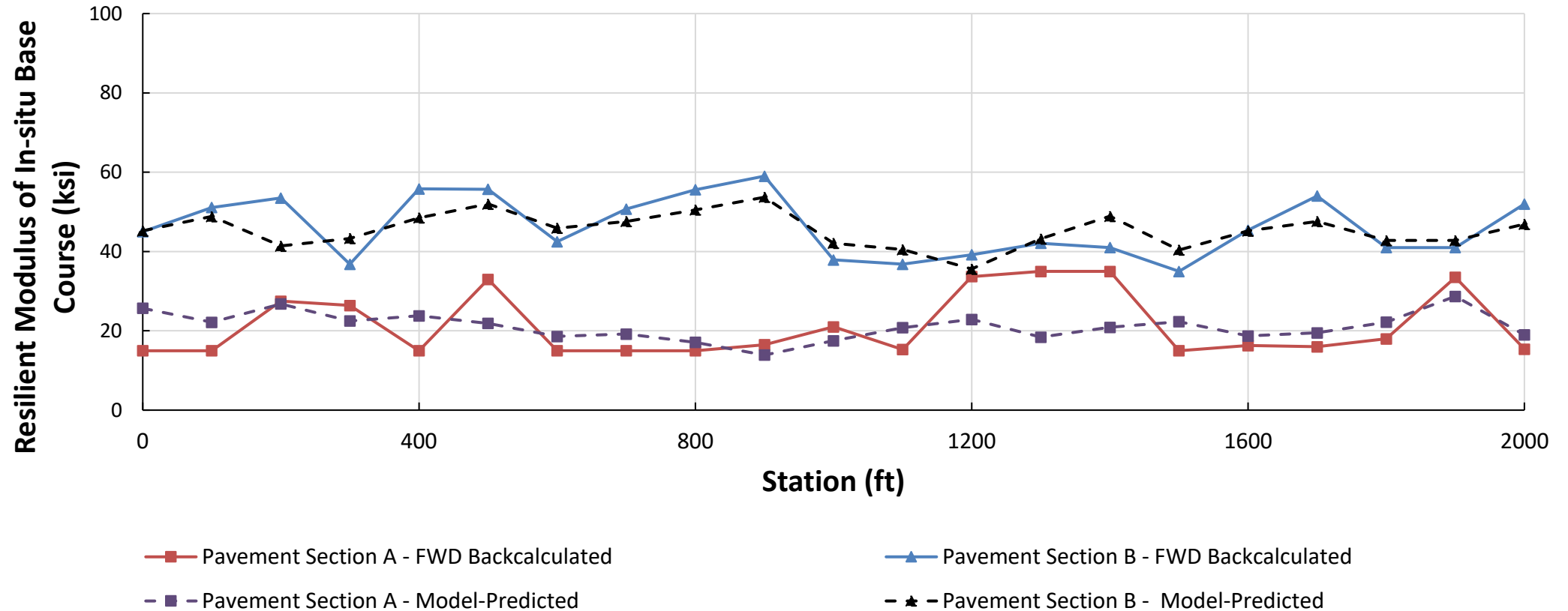
Section "A"

Generally
good
performance
with minimal
distress
throughout
extents

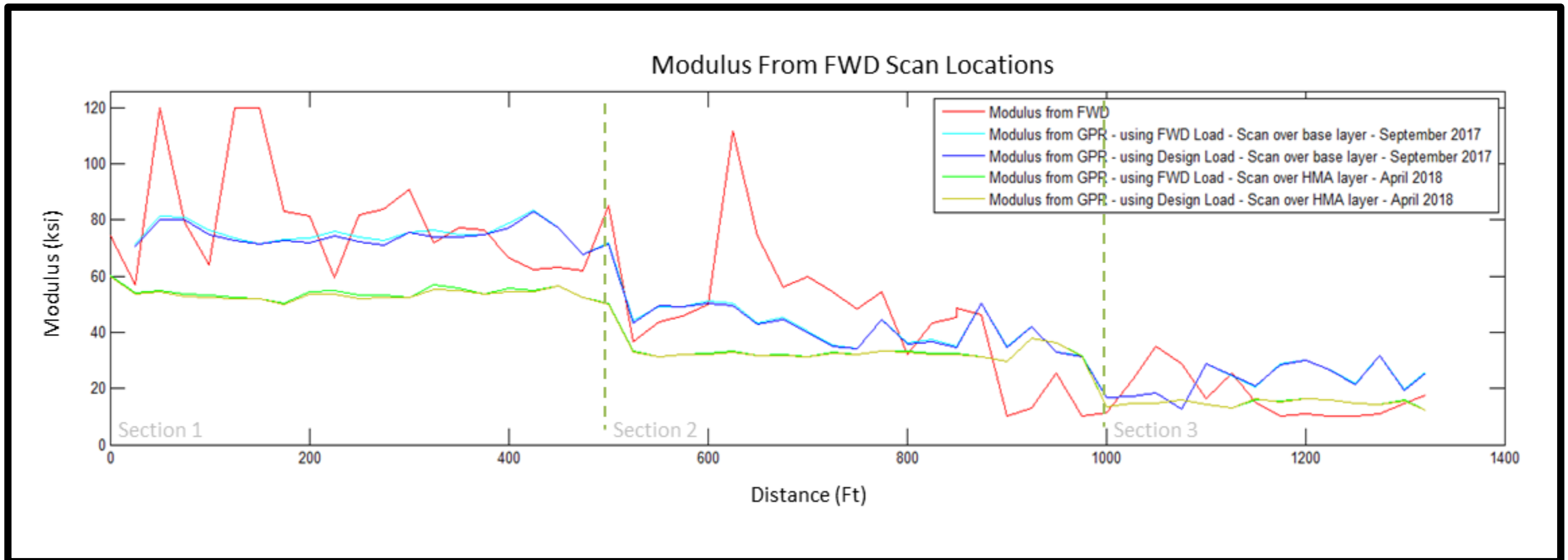


Section "B"

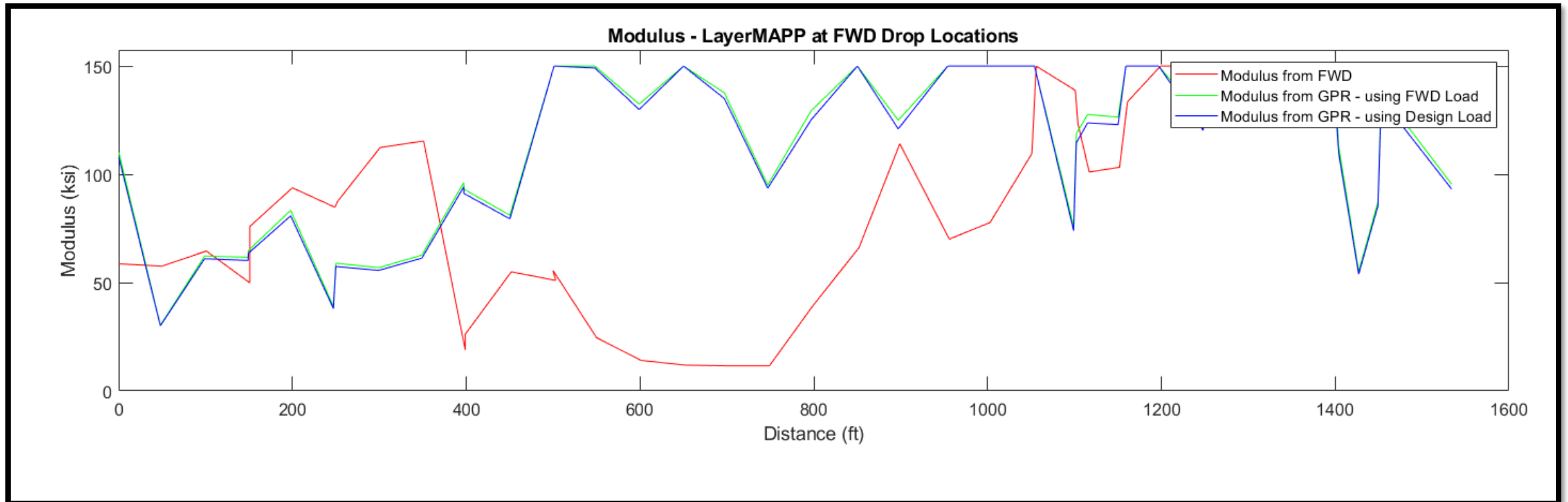
Example Modulus Result – SH21



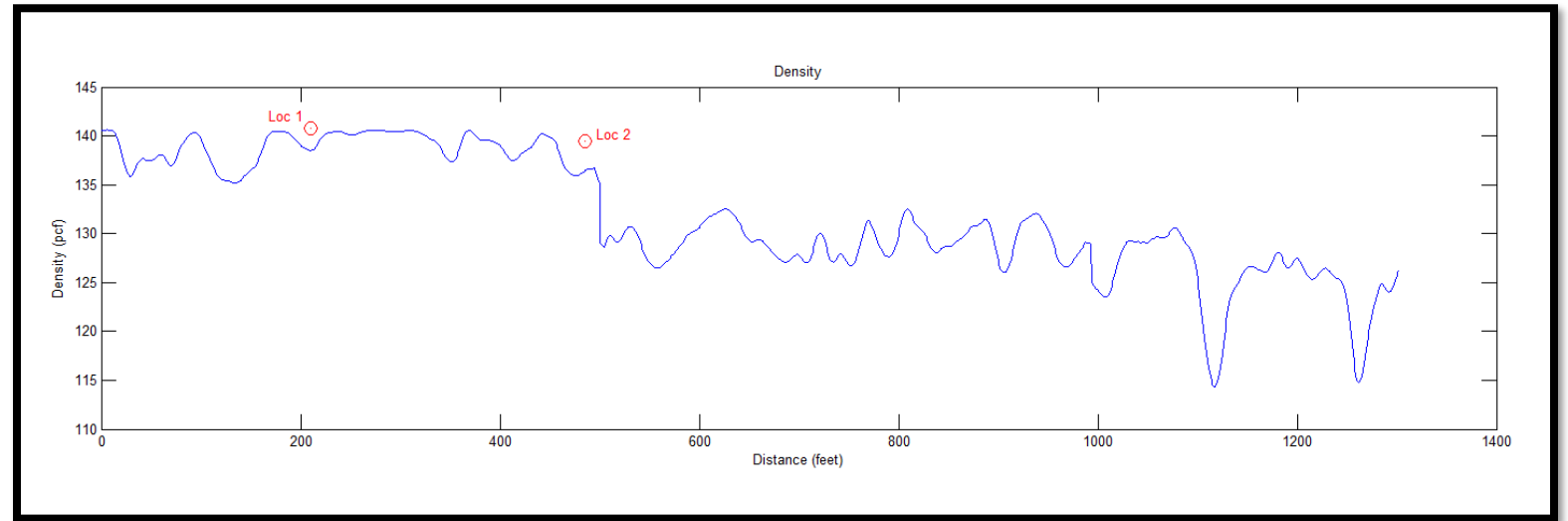
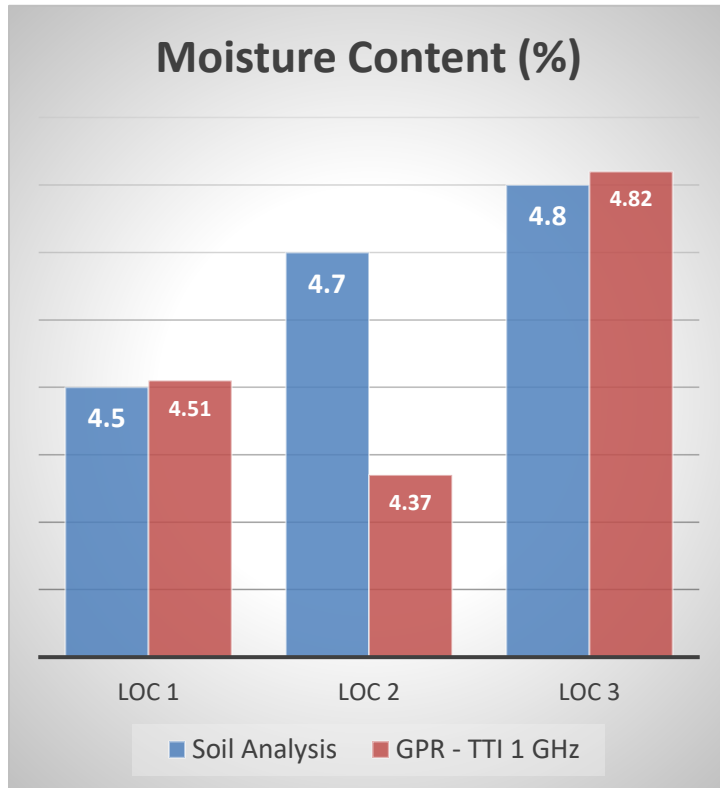
Example Modulus Result – RELLIS Site



Example Modulus Result – FM 159



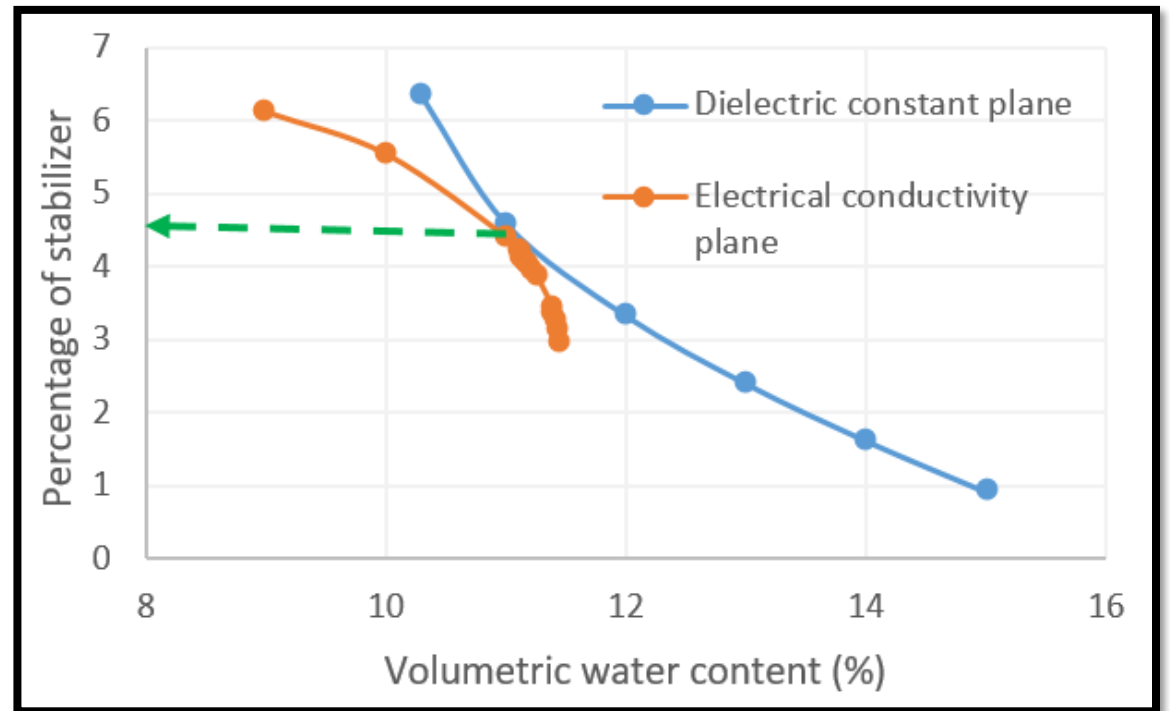
Example Volumetric Result – RELLIS Site



Data from RELLIS test site

Results – US 259 Estimating Stabilizer (cement) Content

- Dielectric and conductivity both increase with increasing water content and increasing amounts of cement
- Intersection of dielectric constant planes and electrical conductivity planes indicates stabilizer content
- GPR can measure the dielectric, and may also be able to measure the conductivity





Summary

- LayerMAPP – generally average predicted modulus value is statistically equivalent to average modulus from FWD
 - Requires supporting lab tests (MBV, AIMS, PFC, M-D curve)
 - Alternate model is needed for non-plastic materials with low percentage of non-plastic fines
 - Need min. $\frac{3}{4}$ " surfacing if pavement already has a surface
- Self-consistent model good promise for estimating density / moisture
- Original vision was construction testing. However, these tools could also apply in forensic or asset mgmt. settings.
 - Identifying how frequently lab index properties or field reference values are needed requires clarification
- Exploratory work for measuring stabilizer content shows promise

Performing Agency Contacts

- Robert Lytton, PhD, PE
979-845-9964
r-Lytton@civil.tamu.edu
- Stephen Sebesta (RS)
979-317-2297
s-sebesta@tti.tamu.edu
- Arvind Devadas
979-845-9964
a-devadas@tti.tamu.edu