

LRRB INV 828

Local Road Material Properties and Calibration for MnPAVE

TAP Meeting #4
Final Summary

May 27, 2008

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Minnesota Department of Transportation

<http://www.dot.state.mn.us/app/MnPAVE/LRRB828.html>



Tasks

1. Survey of Local Road Officials
2. Model Selection
3. MnPAVE Programming
4. Calibration
5. Expand MnPAVE Help Files
6. Summary Report, User's Guide and MnPAVE CD



Task 1:

Survey of Local Road Officials

- 1998 Statewide Survey
 - [Minnesota Low Volume Road Design 1998](#)
 - 2006 Follow-up e-mail survey
 - Limited Response
 - PMS Data – incomplete, difficult to access



Task 1:

Survey of Local Road Officials

(continued)

- 2006 Mn/DOT FWD, GPR & PMS Data
 - Contractor collected FWD, GPR, structural and traffic data
 - Mn/DOT collected PMS data
 - 29 CSAH Routes with useable data
 - Insufficient fatigue data
 - Enough rutting data for calibration



Task 2: Model Selection

- Analysis of 421,000 FWD deflections
- Calculate composite modulus (Hogg Model – LTPP method)
- Spatial query in ArcMap
 - Textural soil map from U of MN
 - Sort modulus values by soil class
 - Calculate statistics
- Clay & Silt model

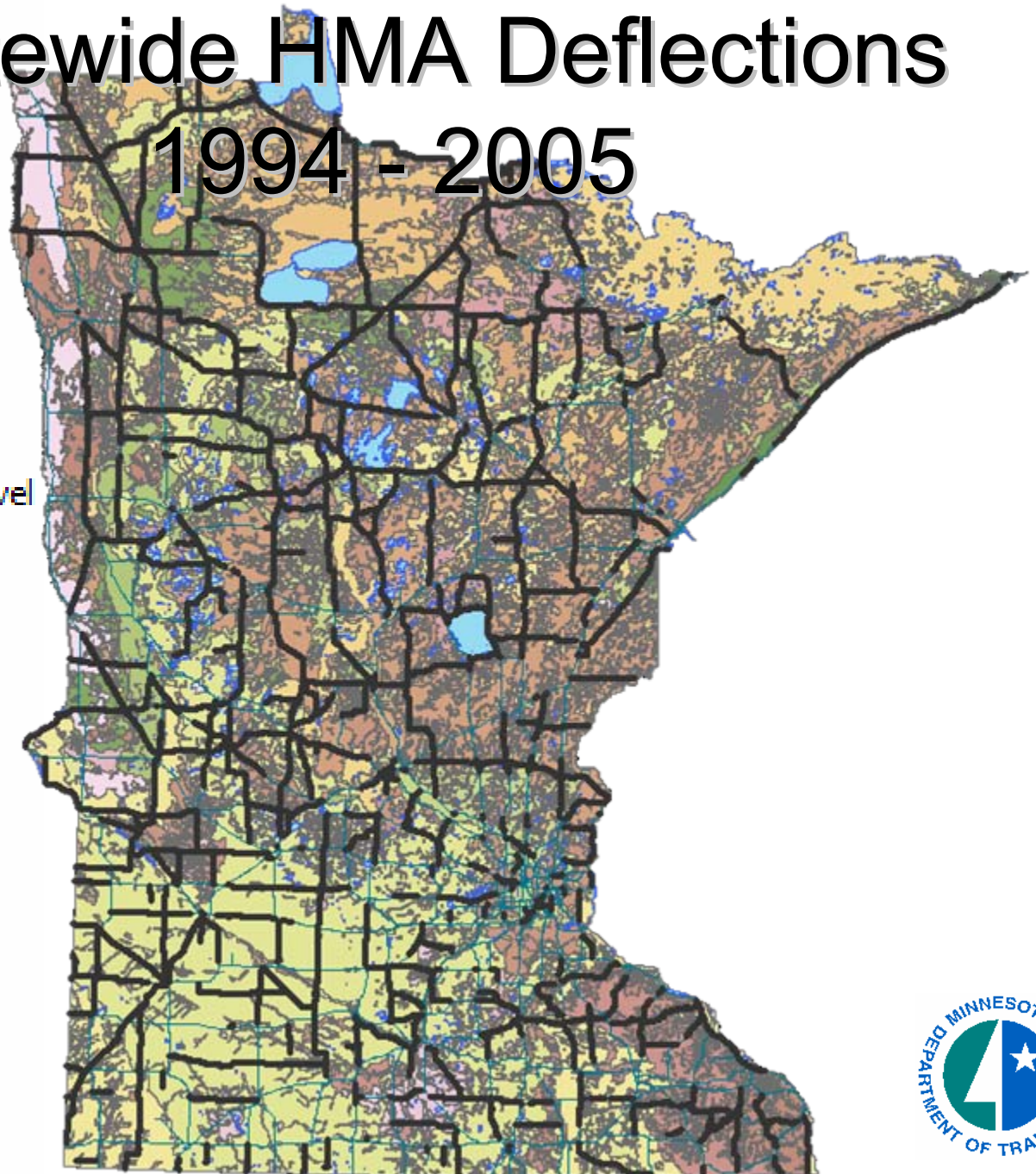


Soil Class

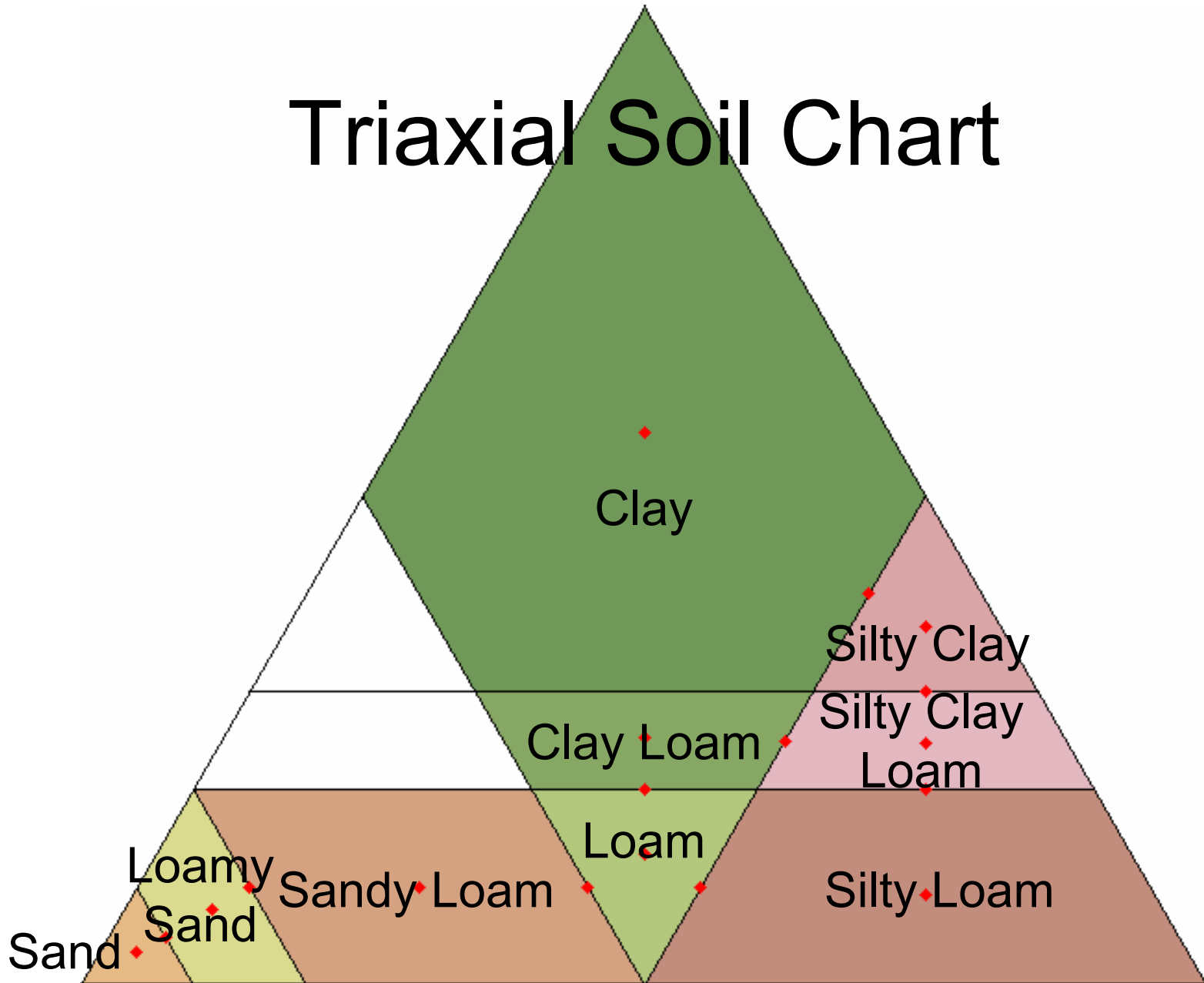
LEGEND

- Clay
- Clay Loam
- Clay Loam to Silty Clay Loam
- Loam
- Loam Sand
- Loam to Clay Loam
- Loam to Sand and Gravel
- Loam to Silt Loam
- Loam to Silty Clay
- Loam, Clay Loam, Sand and Gravel
- Loamy Sand to Sandy Loam
- Mine Dumps
- Peat
- Sand
- Sand to Loamy Sand
- Sandy Loam
- Sandy Loam to Loam
- Silt Loam
- Silt Loam to Silty Clay Loam
- Silty Clay
- Silty Clay Loam
- Silty Clay Loam to Silty Clay
- Silty Clay to Clay
- Water

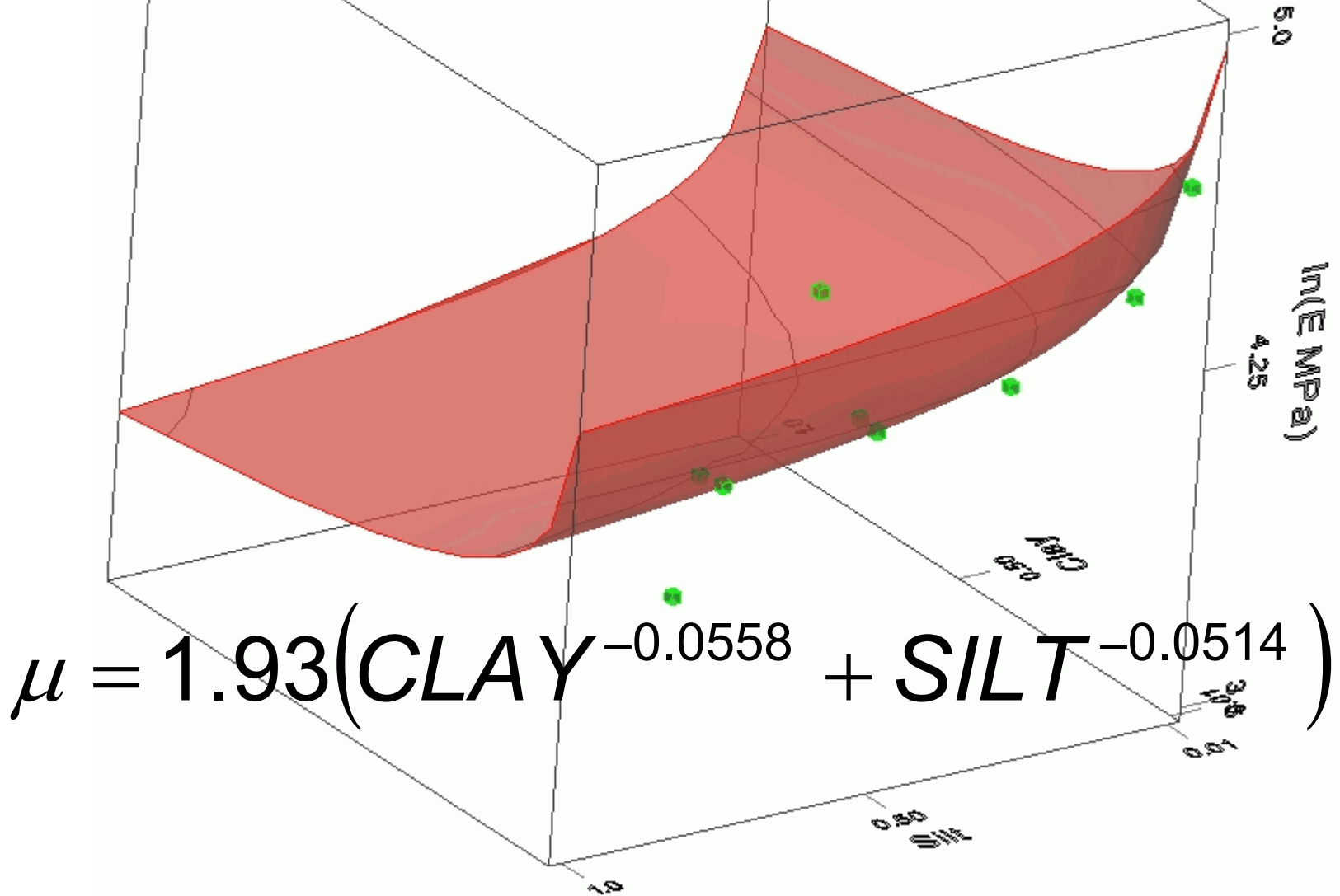
Statewide HMA Deflections 1994 - 2005



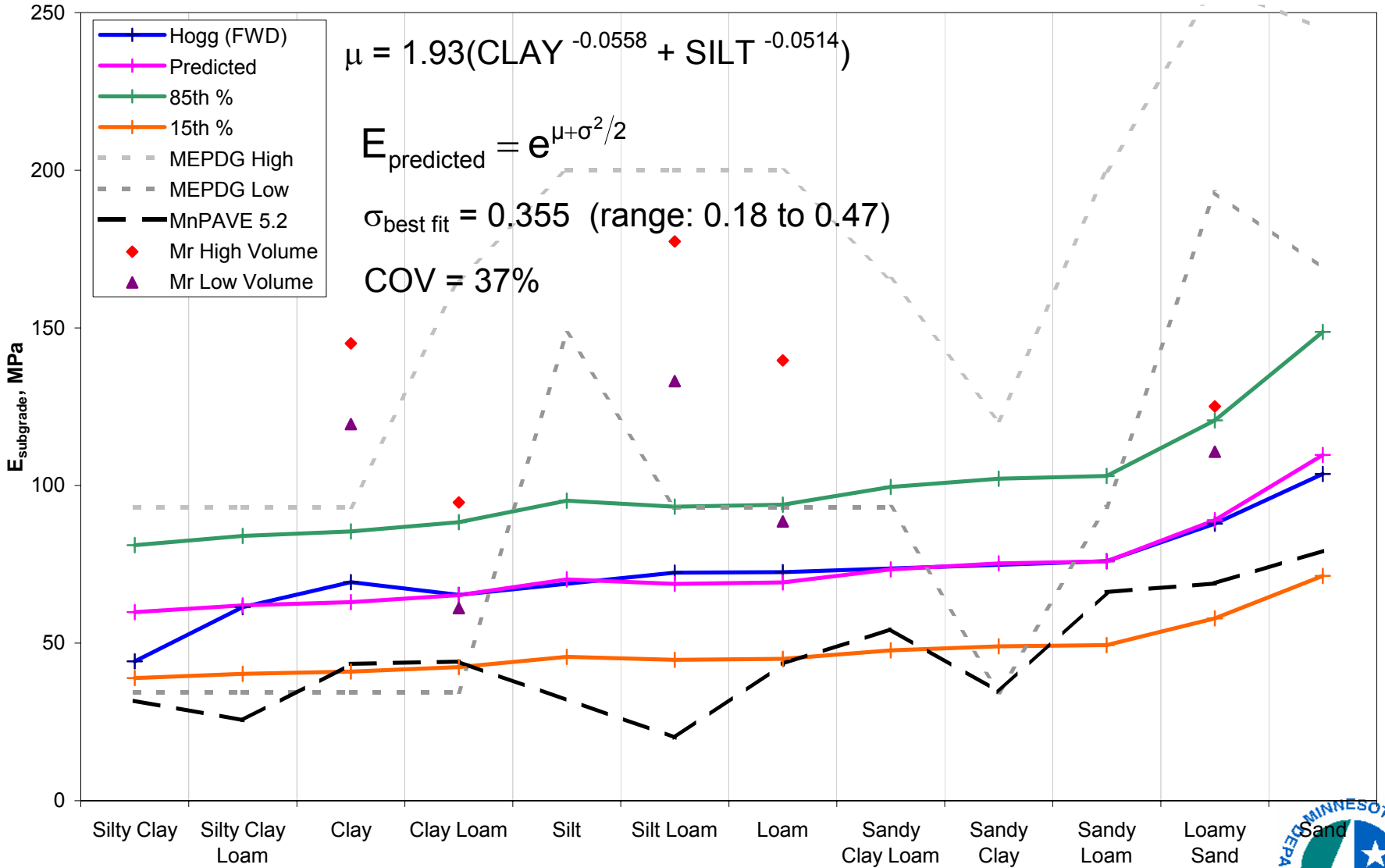
Triaxial Soil Chart



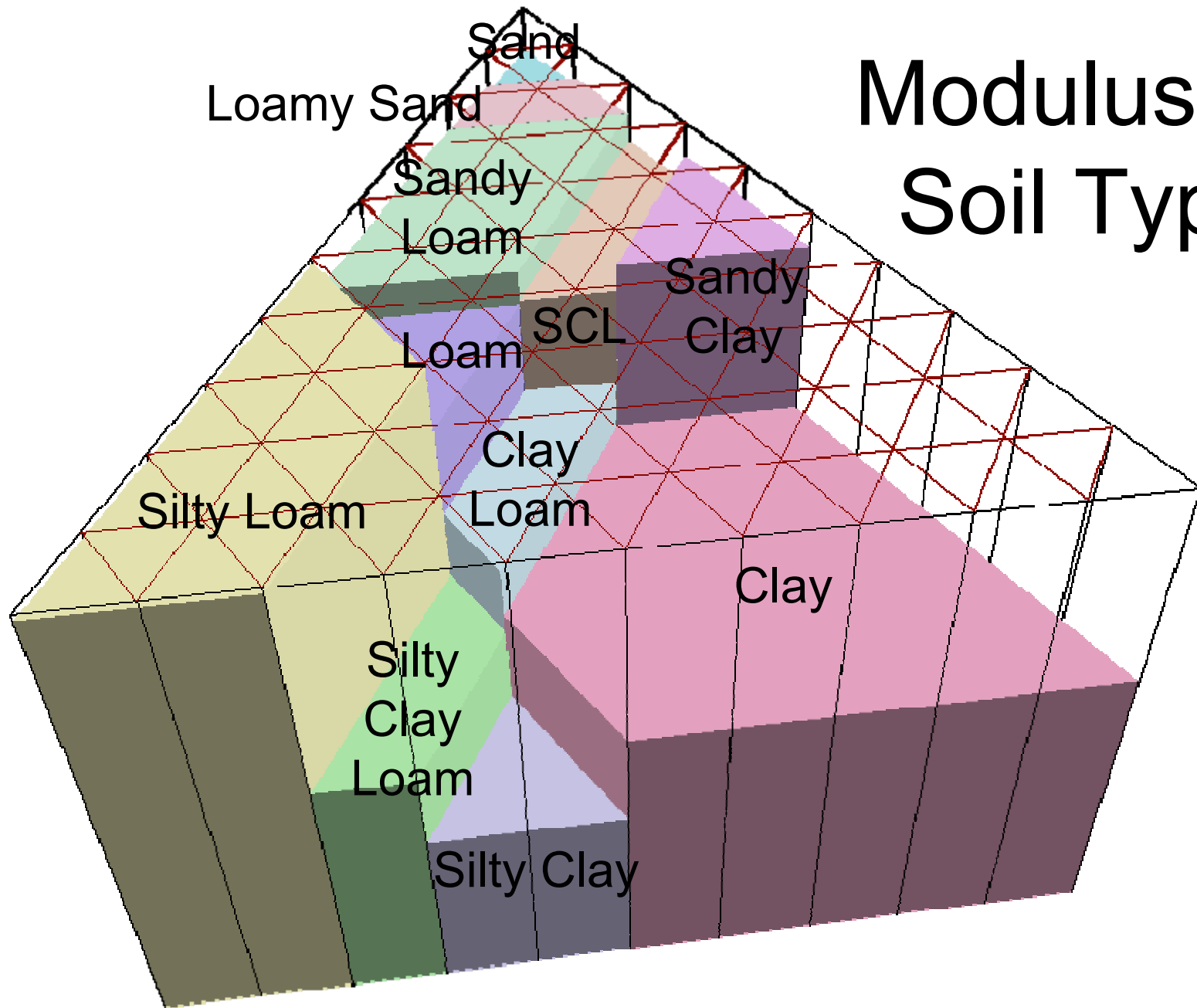
Minnesota Statewide Subgrade Composite Moduli



Subgrade Modulus Predictions



Modulus by Soil Type



Moisture Effects

Unsaturated Soil Technology

Roberson, Siekmeier and Apul, 2005

Season	Multiplier
Fall	1.00 (Optimum)
Winter	10.0 (Frozen)
Spring Thaw	10.0 (Frozen soil, Thawed Base)
Spring Recovery	0.70 (Thawed)
Summer	0.85 (Recovering)



Task 3: MnPAVE Programming

- New subgrade modulus model
- New default modulus values
- Prototype soil class map
- Two reliability methods
 - Layer thickness and modulus adjustment
 - Monte Carlo simulation





Climate

Seasons
Ramsey County

	<input checked="" type="radio"/> Days	Pavement Temp. (°F)
Fall (Standard)	<input type="radio"/> Weeks	
	91	48
Winter (Frozen)	99	22
Early Spring (Base Thaw)	14	38
Late Spring (Soil Thaw)	58	58
Summer (High Temp.)	103	82

Units

English

SI

Finished Climate
Go to Control Panel

Map | Details

Selected County
Ramsey
Metro District

Click map or enter coordinates.

Latitude
45 ° 12 '

Longitude
93 ° 4 '

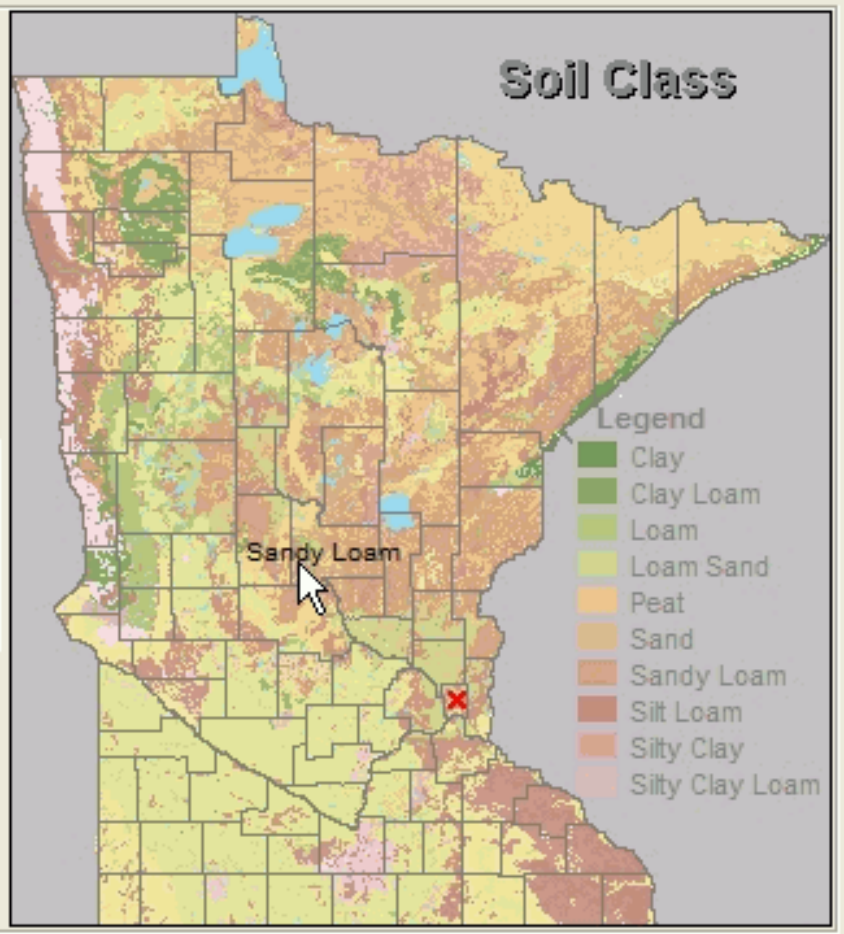
Pointer Text

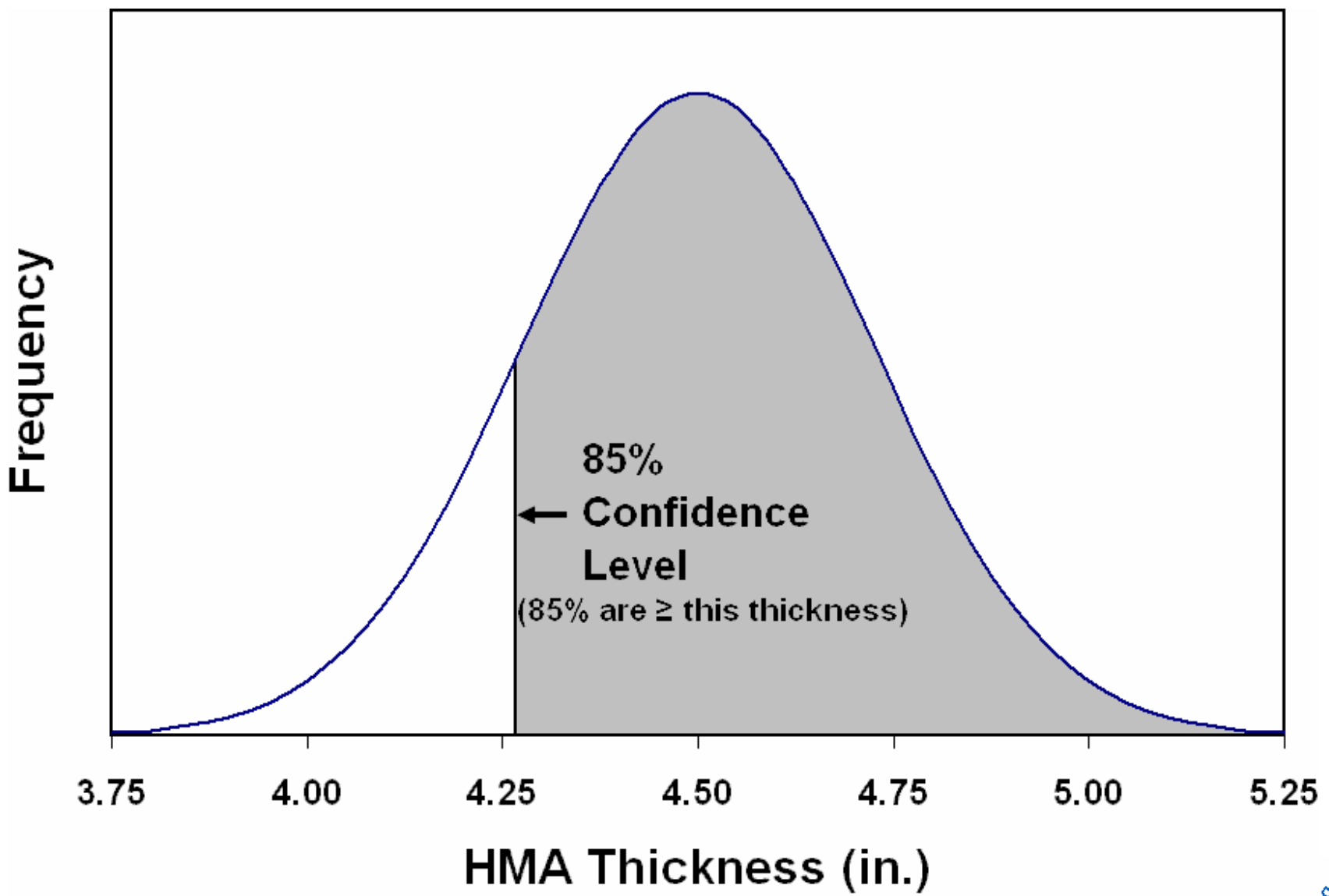
Counties

Coordinates

Soil Class

None





Output

- Life
- Damage

Conf. Level Total Repetitions

Expected Life

Layer 1 2
Years

Fatigue 46
Rutting 20

Adjust Materials

	H (in.)
HMA: PG 58-34	<input type="text" value="4.5"/>
AggBase: C1.5	<input type="text" value="12"/>
EngSoil: CL	<input type="text" value="12"/>
UndSoil: CL	

Units
 English
 SI

Basic Batch Mode Reliability

Monte Carlo Simulation

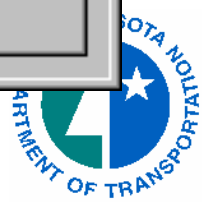
Number of Monte Carlo Cycles

- Automatically Save when finished.
- Include Details from all Cycles (must be selected prior to simulation)

Reliability (probability of non-failure during 20 year design life)

Quick Monte Carlo
 %
 %

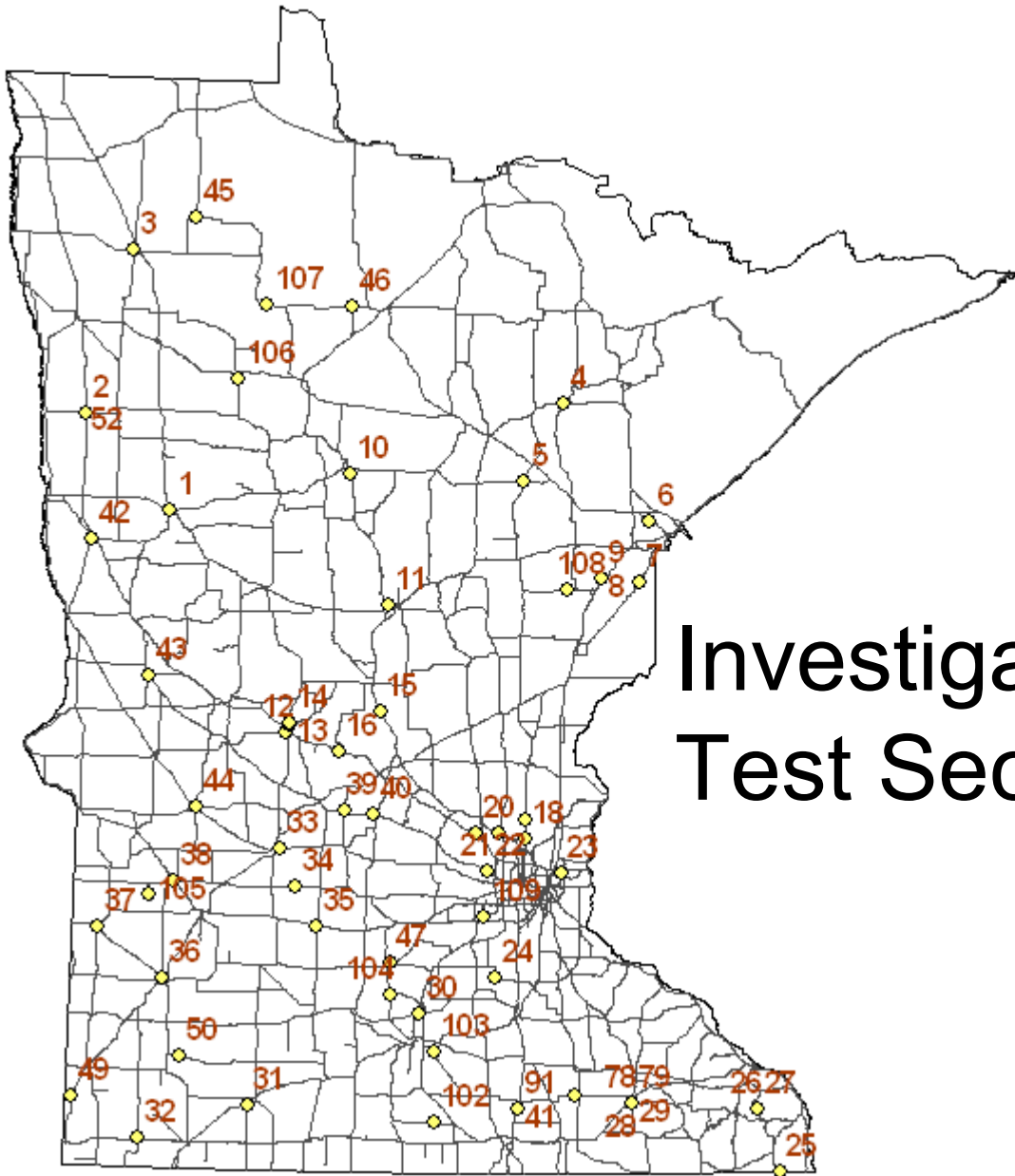
Output was saved as "Example1.xls"



Task 4: Calibration

- Rutting model calibrated
(2006 CSAH data)
- Rutting model validated
(Investigation 183 data)
- 2002 Fatigue model validated
(CSAH & Investigation 183 data)

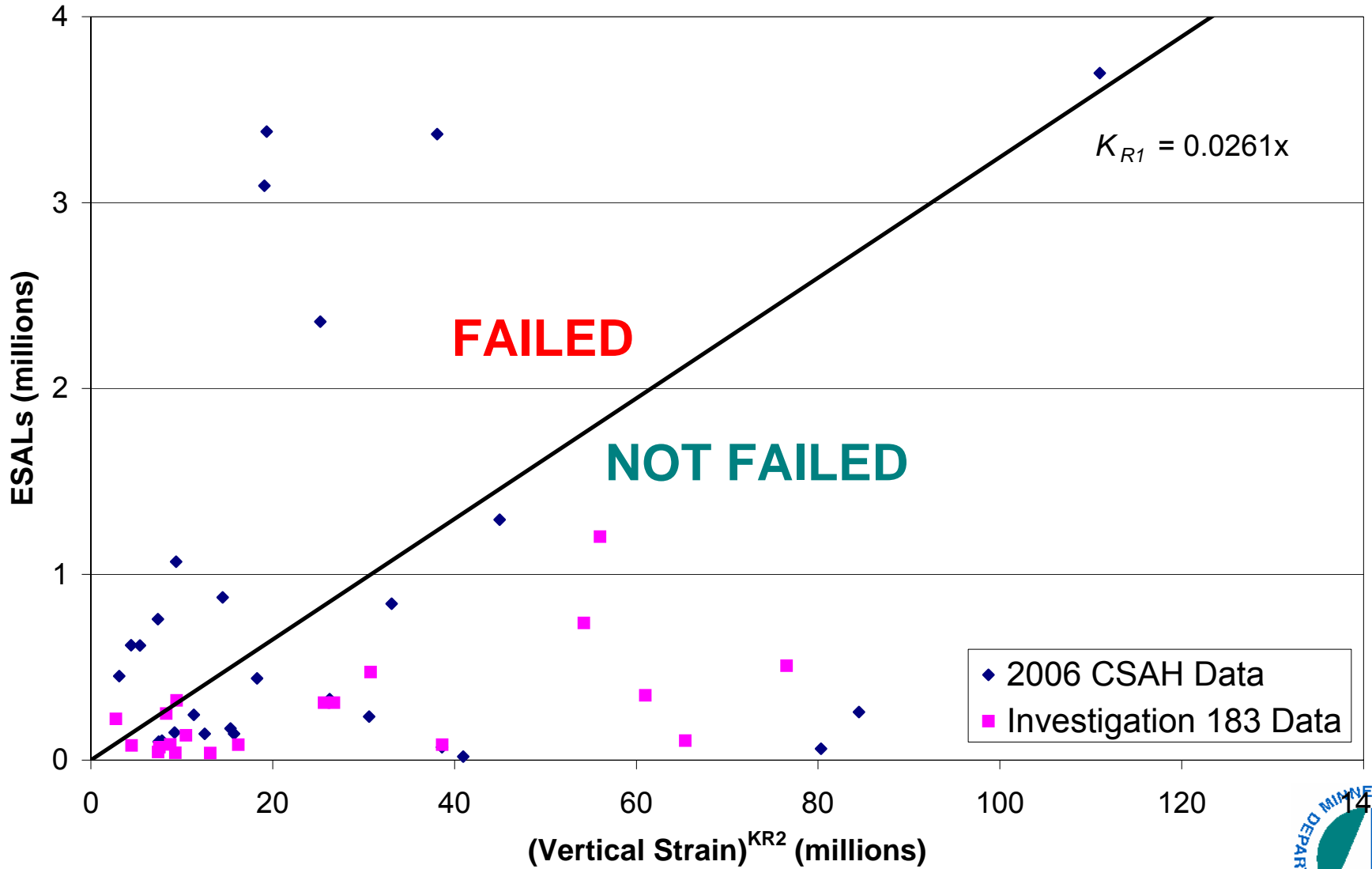




Investigation 183 Test Sections



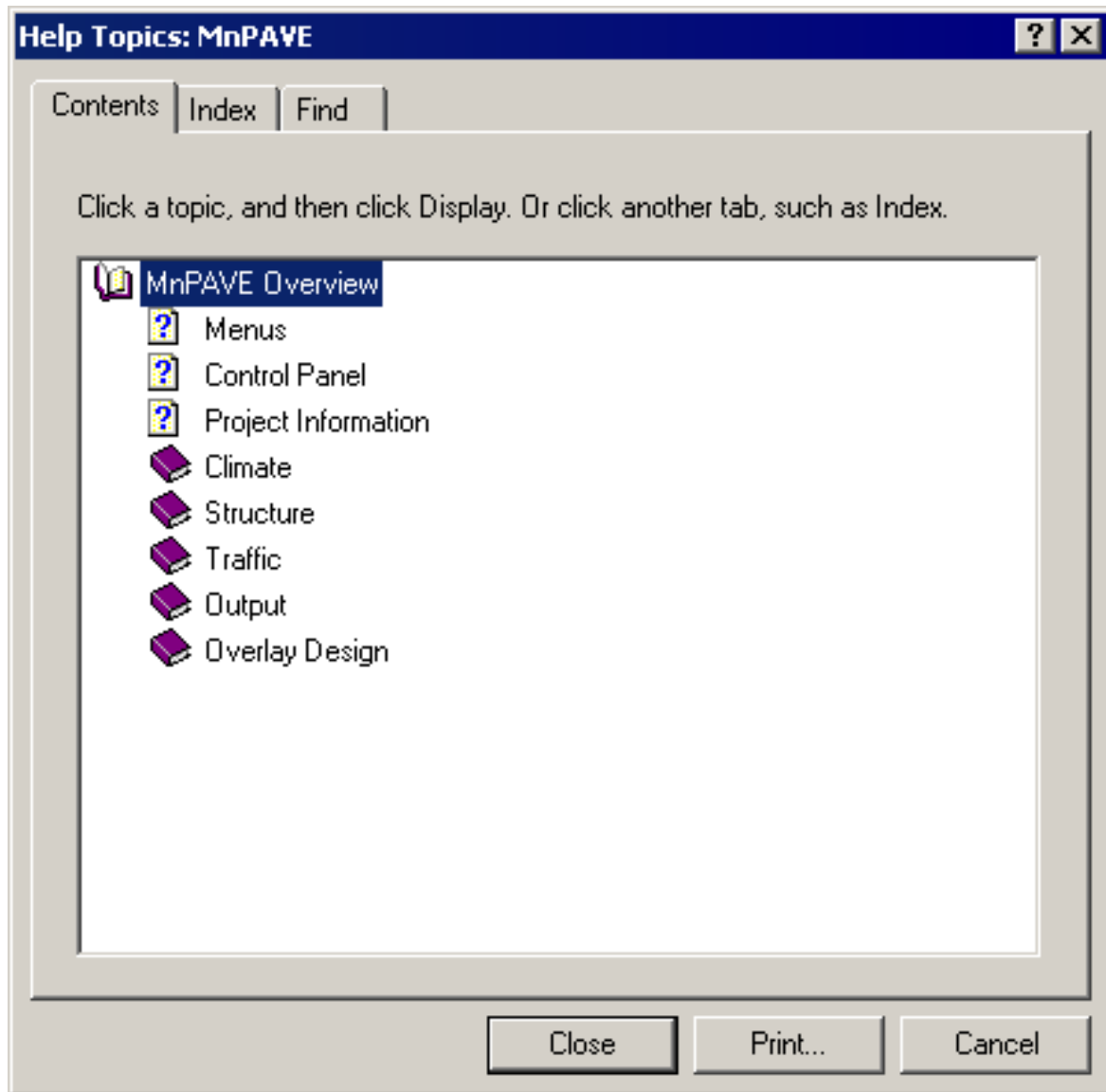
MnPAVE Rutting Calibration (2008)

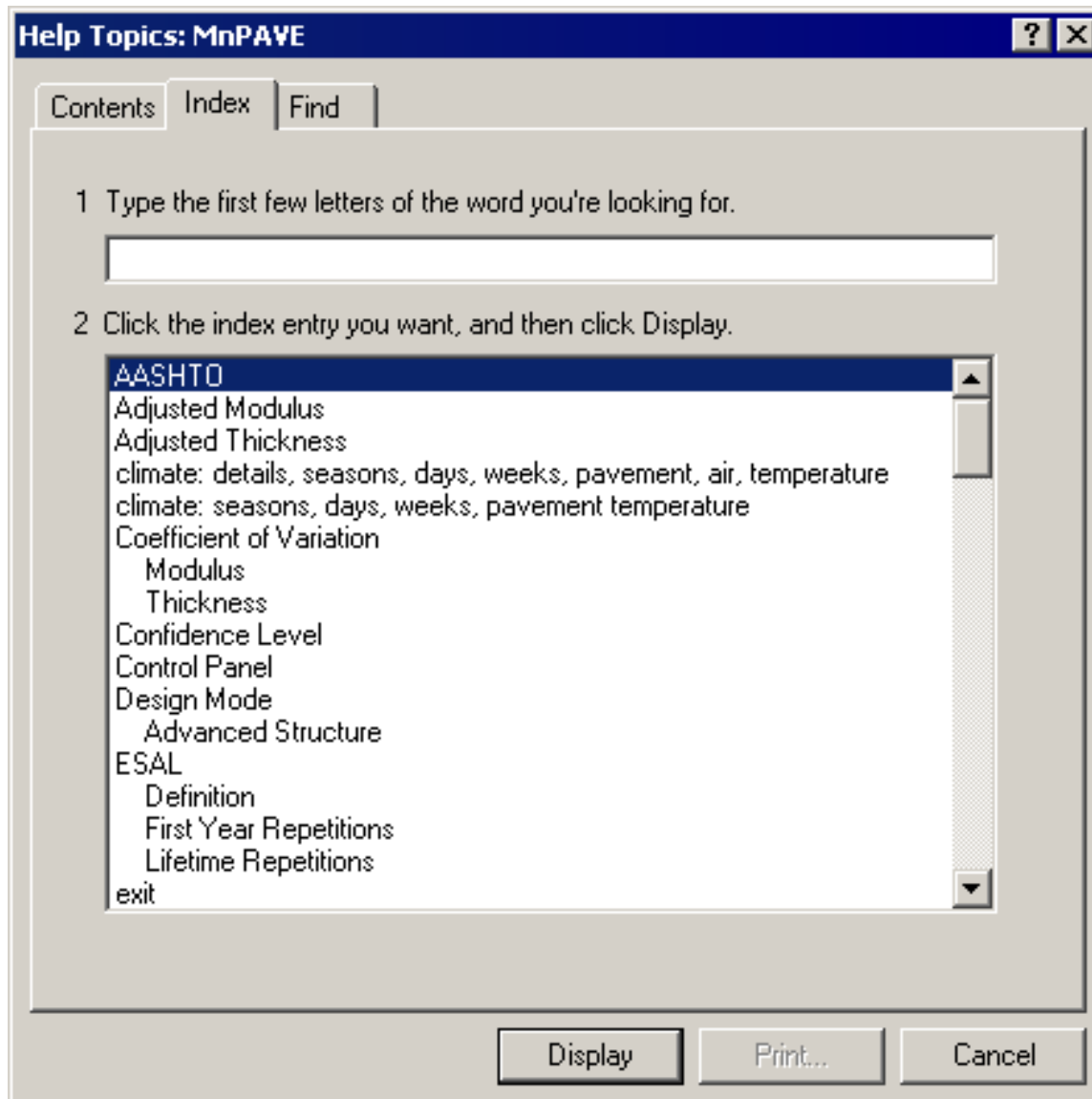


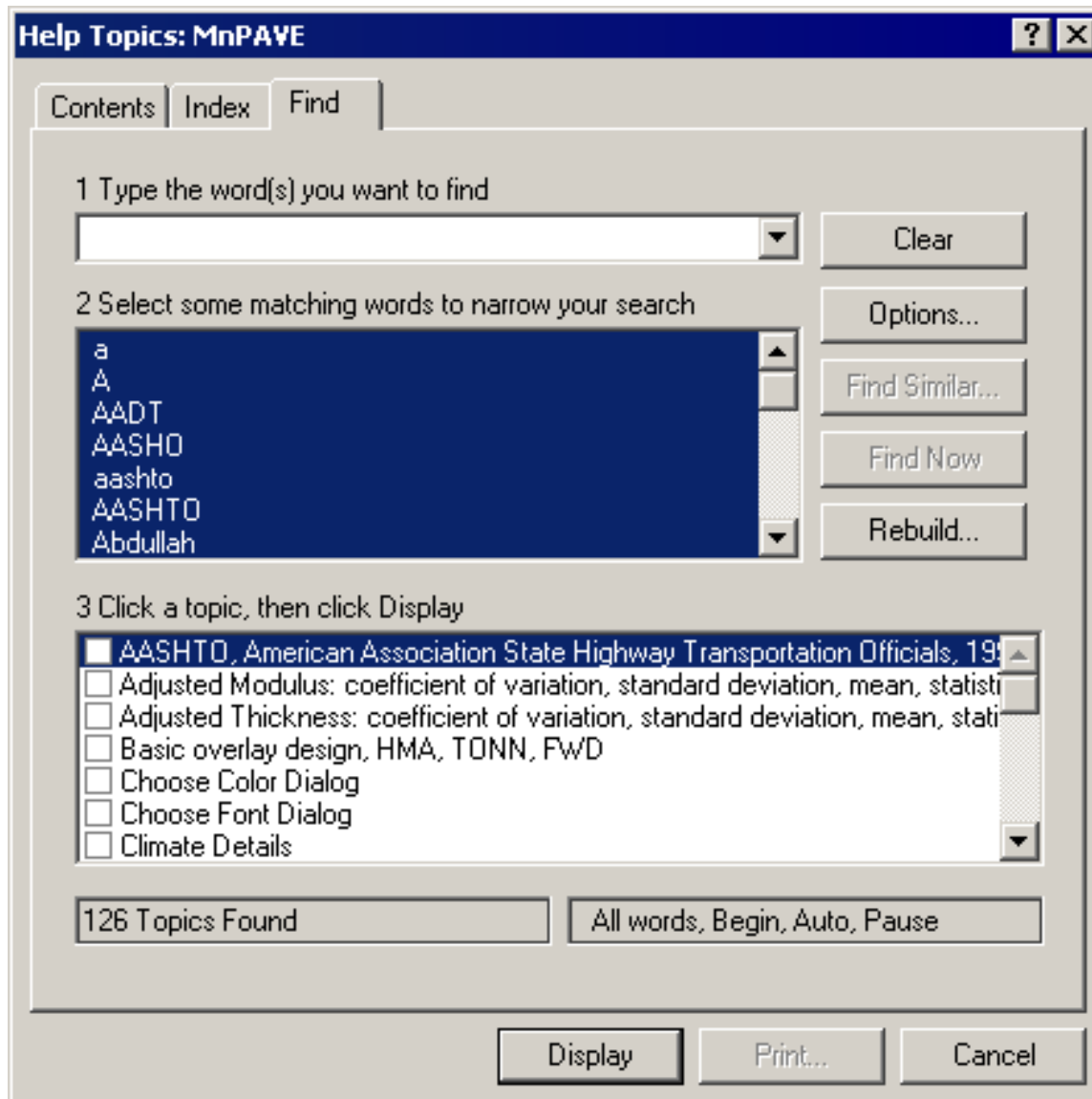
Task 5: Help Files

- Contents
- Index
- Find
- Help topics with links
- Clickable images









Structure

Confidence Level (50 to 99%)

View

- Thickness Values
- Coefficient of Variation
- Adjusted Thickness

Edit Structure

Layers	Material	Thickness (in.)
<input type="radio"/> 1	HMA	4.5
<input type="radio"/> 2	AggBase	12
<input type="radio"/> 3	EngSoil	12
<input checked="" type="radio"/> 4	UndSoil	
<input type="radio"/> 5		

Design Mode:

Units

- English
- SI

Basic | Intermediate | Advanced

Default Structures

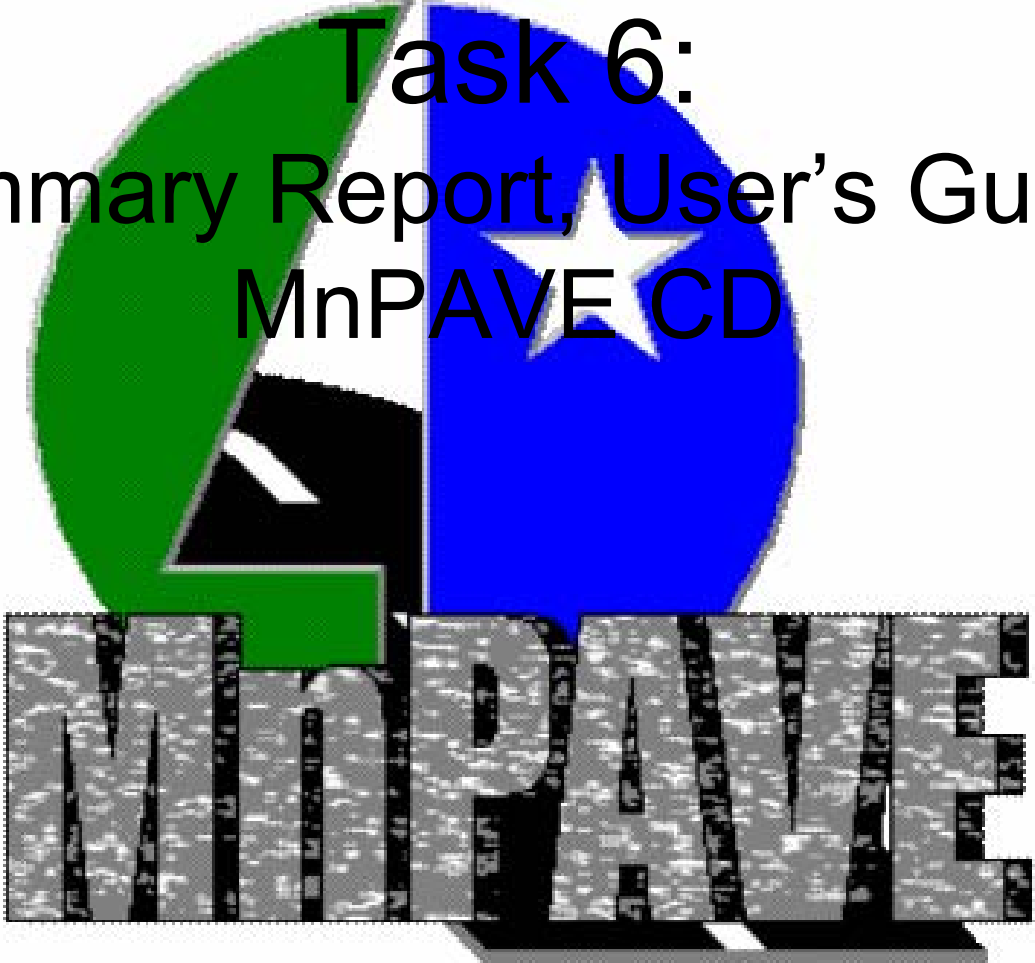
<input checked="" type="radio"/>	HMA Agg. Base Eng. Soil	<input type="radio"/>	HMA 1 HMA 2 Agg. Base Eng. Soil	<input type="radio"/>	HMA Eng. Soil
<input type="radio"/>	HMA Agg. Base Agg. Subbase Eng. Soil	<input type="radio"/>	HMA Overlay Old HMA Agg. Base Eng. Soil	<input type="radio"/>	User Defined

Material Type

- Hot-Mix Asphalt
- Aggregate Base
- Engineered Soil
- Undisturbed Soil

Click to Select Subtype

- PG 58-34
- Mn/DOT Class 5
- Clay Loam
- Clay Loam



Task 6:
Summary Report, User's Guide,
MnPAVE CD

Mn/DOT Flexible Pavement Design
Mechanistic-Empirical Method
Version 5.3

User's Guide





Questions