

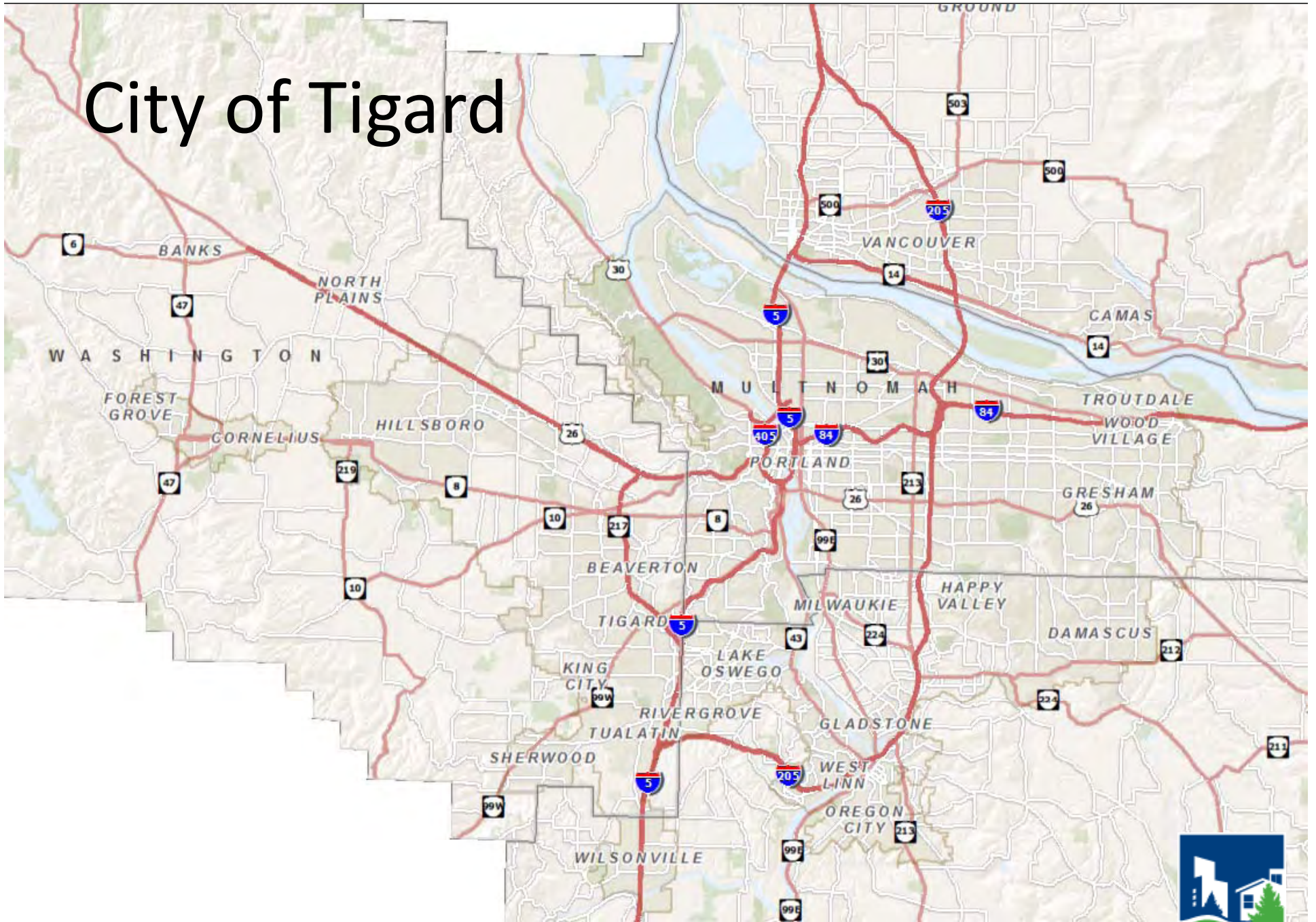


Managing Risks on Your Pavement Preservation Project

Discussion Outline

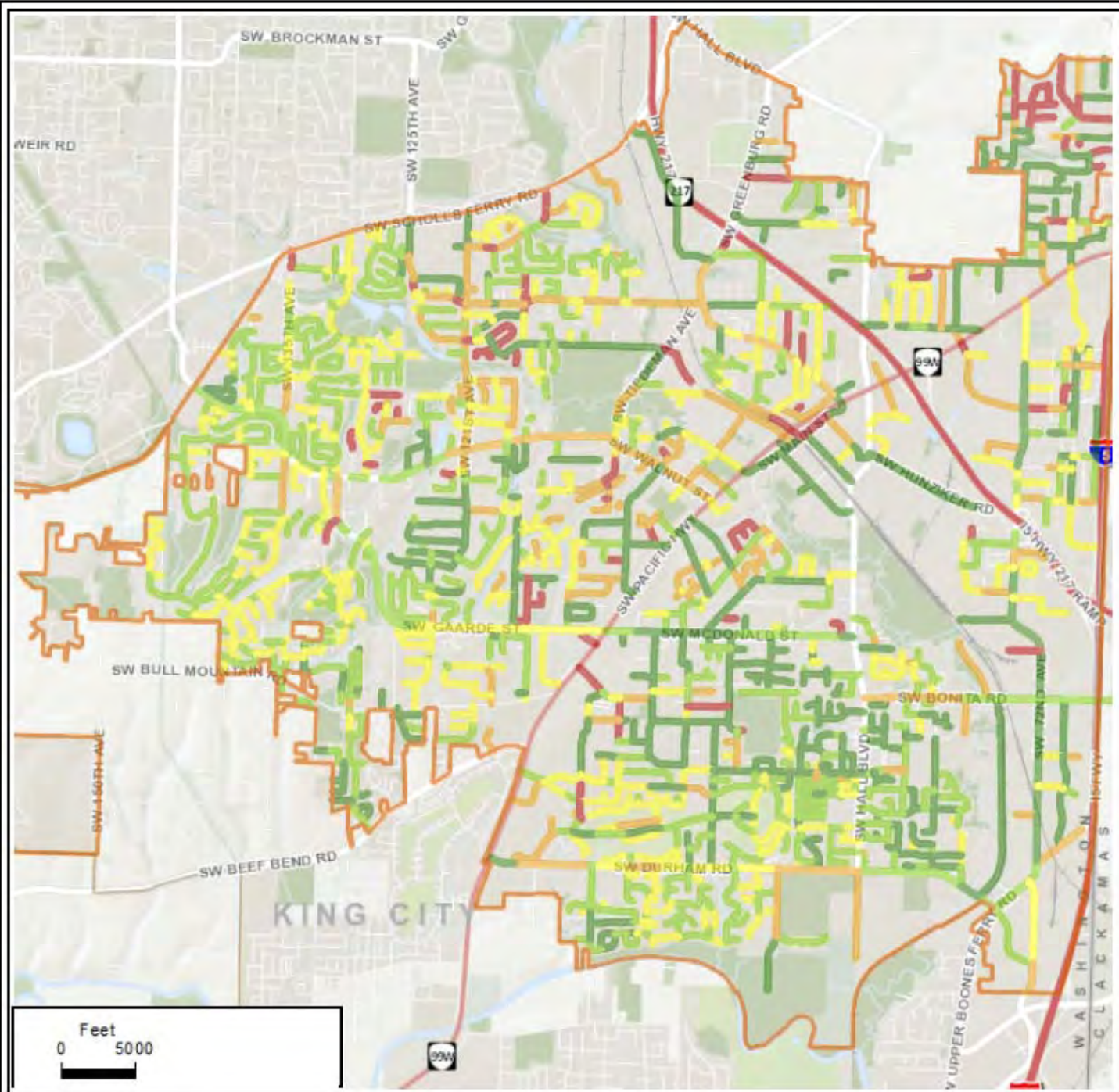
- City of Tigard PMP Overview
- Pavement Construction Cost Risks
- Project-Level Investigation Tools
- Tigard Case Study

City of Tigard



Tigard Basic Facts

- Population 50,444
- Incorporated 1961
- 152 centerline miles
- Many streets built in 60s, 70, and 90s
- PCI 70
- 22 mile backlog



Pavement Condition Index

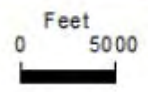
- Pavement Condition
- █ Very Good
 - █ Good
 - █ Fair
 - █ Poor
 - █ Very Poor
 - No Data

PCI: 71

Backlog:
22 Miles

Approx. Scale 1:40,000 - 1 in = 3,333 ft
Map printed at 06:05 PM on 12-Oct-10

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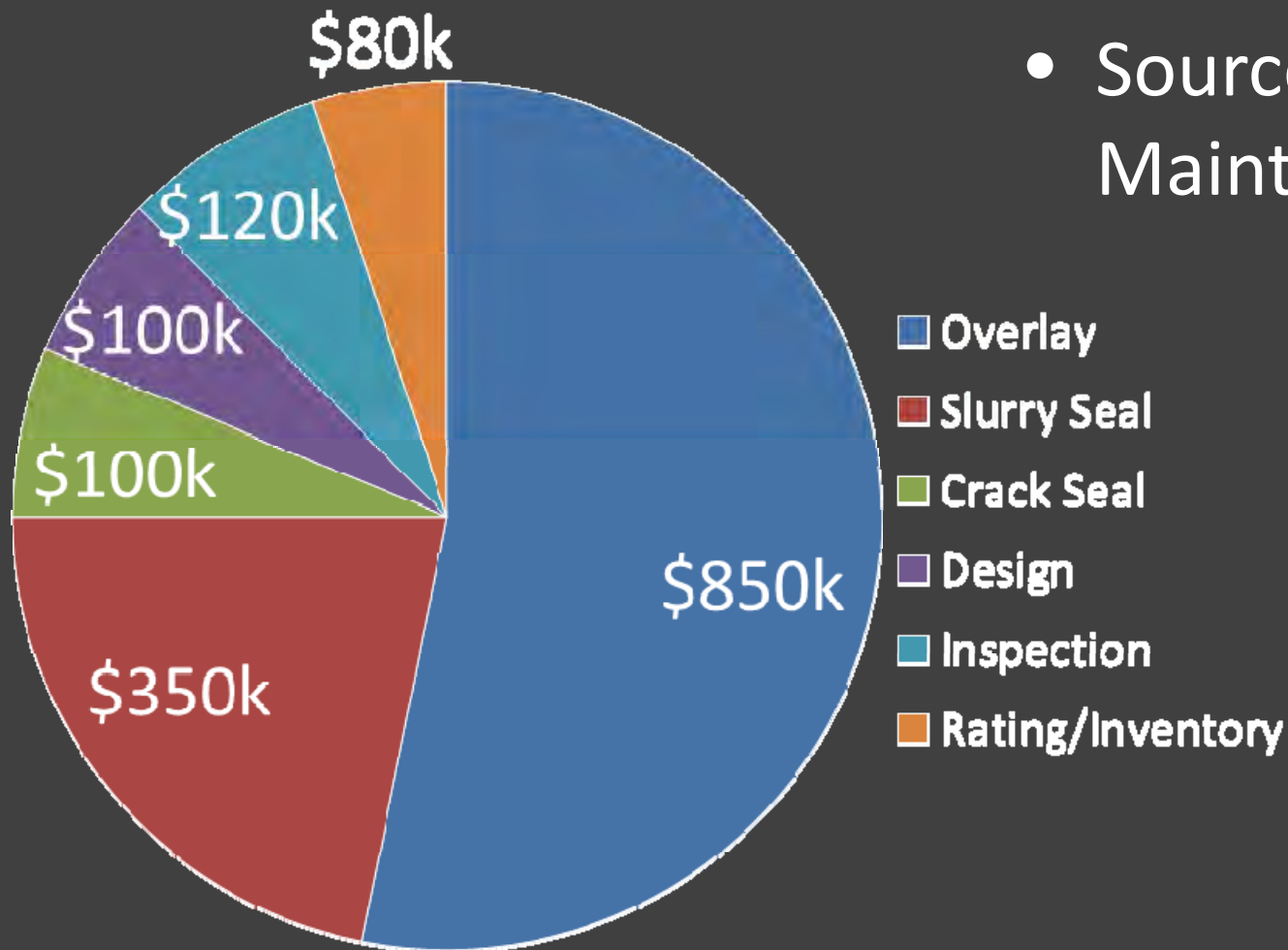


City of Tigard
13125 SW Hall Blvd
Tigard, OR 97223
503 639-4171
www.tigard-or.gov



Funding & Expense

- Budget: \$1.6M
- Source: Street Maintenance Fee



Project Selection Process

StreetSaver
+
Spreadsheet

Slurry Seal

- ✓ 122nd Avenue
- ✓ Errol Street
- ✓ Carmen Street
- ✓ Alberta Street
- ✓ 113th Place
- ✓ Etc.

Residential Streets

Overlay Candidates

- ✓ Walnut Street
- ✓ Grant Street
- ✓ North Dakota Street
- ✓ Springwood Drive
- ✓ 92nd Avenue
- ✓ Etc.

Arterials/Collectors

Overlay Candidates

- Triggered by network-level analysis (Traffic Volume, PCI, StreetSaver)
- List modified by project-level considerations

Project-Level Considerations

- Factors not considered at network level:
 - Other planned activities in ROW (Pipes, etc.)
 - Commercial/residential developments
 - Potential discrepancy in traffic conditions
 - Findings from a project-level evaluation
 - Combination with other paving streets
 - Others
- Considering these requires human intervention

What we want to know:

- Does the street really need paving?
- Will an overlay do? Or does it need more?
- What's under the pavement?
 - Pavement thickness
 - Pavement integrity
 - Top-down vs. bottom-up cracking
 - Base thickness and integrity
 - Subgrade support
 - Others
- Goal: build the right project on the right street at the right time

Potential Cost-Increase Risks

- Agencies incur greater risk without conducting project-level evaluations
- Common cost overrun situations:
 - Moisture Damage
 - Delamination
 - Variable Pavement Conditions
 - Inadequate Pavement Capacity

Moisture Damage

- Not readily visible from surface
- Milling into or above moisture-damaged pavement causes a gravelly mess
- Detection
 - Core
 - Ground penetrating radar
- Risks:
 - Deeper grind
 - More AC



Delamination



- Commonly not visible from surface
- Detection and repair same as for moisture damage
- Risks:
 - Deeper grind
 - Increased AC

Variable Pavement Conditions

- Widened roads
- Overlain trench patches
- Thickness variation
- Composite pavement
- Detection:
 - As-built drawings
 - Cores
 - Ground penetrating radar
- Risks:
 - Accelerated distresses
 - Extra work at time of construction
 - Reflective cracking
 - Variable life of treatment



Inadequate Pavement Capacity

- Pavement has experienced more/higher loads than originally anticipated
- Common causes:
 - New developments
 - New bus line
 - Rapid growth
 - Redirected traffic
- Risks:
 - PM software typically does not take into account pavement capacity
 - Rehabilitation not always the best strategy
 - Limited funds may not be wisely spent

Project-Level Evaluation Tools

Page 1 of 3

DATE: 7-30-14
 LOGGER: JGH

Length (ft)	Width (ft)	Type of Distress (Fat., Trans., Long.)	Degree of Distress (High, Medium, Low)	Comments
25	3	Fat	Med. High	Poss trans Pt. N end
22	4	Fat	Med	Pt. N end



GEO DESIGN INC

Distress Survey/Mapping

- Agency benefits:
 - Cracking patterns
 - Identify subgrade problems
 - Suggestions as to depth of distress
 - Total amount of distress
 - Rehabilitation options, localized repair
- Drawbacks:
 - Depth of distress unknown
 - Misses subsurface conditions (e.g., moisture damage)
 - Rehabilitation through grinding can be risky

Cores

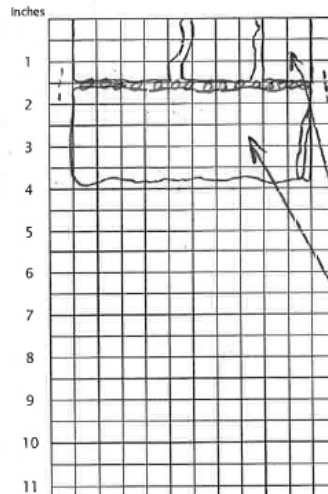
- Agency benefit:
 - Pavement thickness data
 - Cracking depth
 - Moisture damage measurement
 - Aggregate base condition

- Drawbacks:
 - Destructive test
 - Point data
 - Requires traffic control

GEODESIGN^{INC}

PAVEMENT CORE LOG

Core Length: 3 3/4"	Aggregate Depth:	GDI Project: Tigard -23	Core Number: C-3
Core Size: 5"	Final Depth:	Project Name:	Page: 1 of 1
		Street Name / Direction / Travel Lane: N Dakota St WB OWT	Core Date: 1-22-15
		Drilling Contractor: Dan F Dan	Start Time:
		Coring and Sampling Methods:	Station:
			Sampled By: JGH



Cored Through Patch: Yes No
 Cored On Crack: Yes No
 Comments for PM: **Mod Fat**
NB & SB OWT Mod Fat intermittent
min low Block cracking in center
Raveling low-mod

	TYPE						CONDITION		
	Dense AC	Open AC	PCC	CTB	Oil Mat	Other	Good	Fair	Poor
Layer 1 Description:	X						X	X	
Layer 2 Description:	X						X		
Layer 3 Description:									
Layer 4 Description:									
Layer 5 Description:									
Layer 6 Description:									



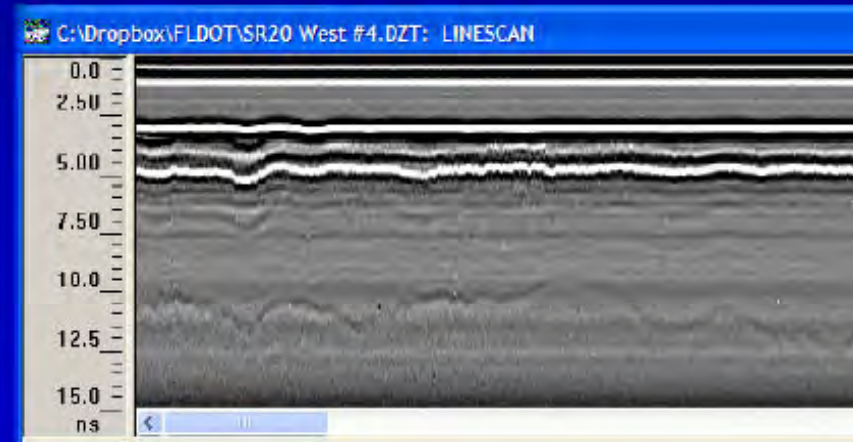
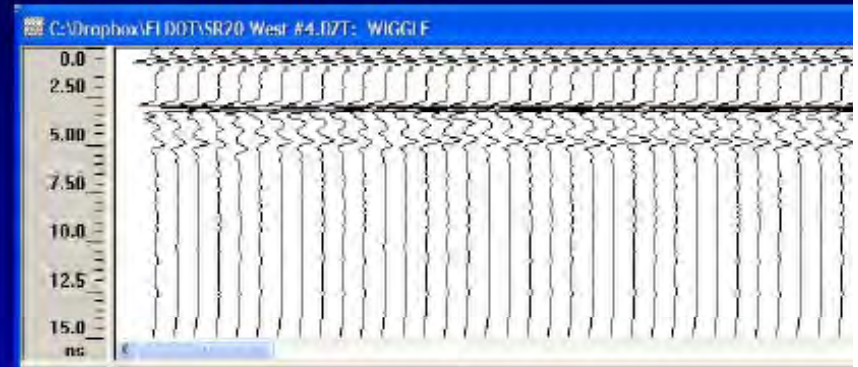
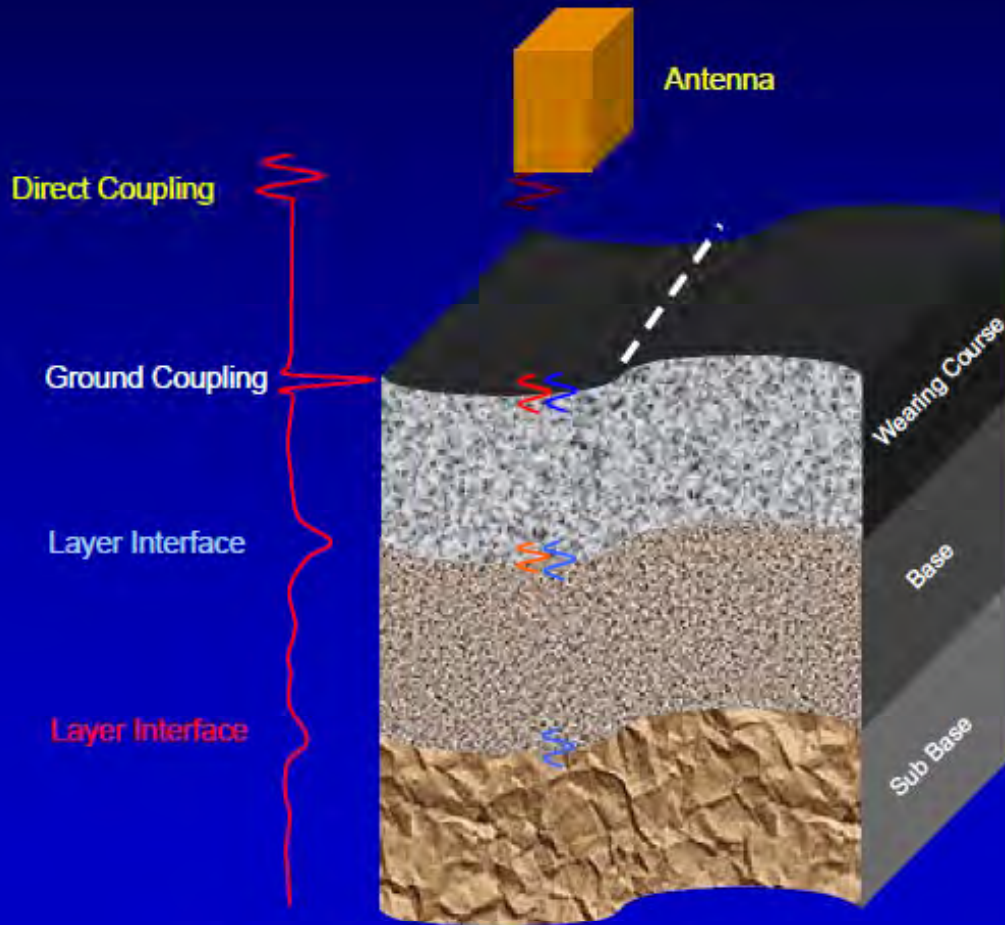
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Ground Penetrating Radar (GPR)

- Agency benefits:
 - Layer thickness data
 - Some distress information
 - Data at highway speeds
 - Quick and efficient
 - Traffic control normally not required
- Drawbacks:
 - Data in a straight line
 - Need multiple runs to get cross section data

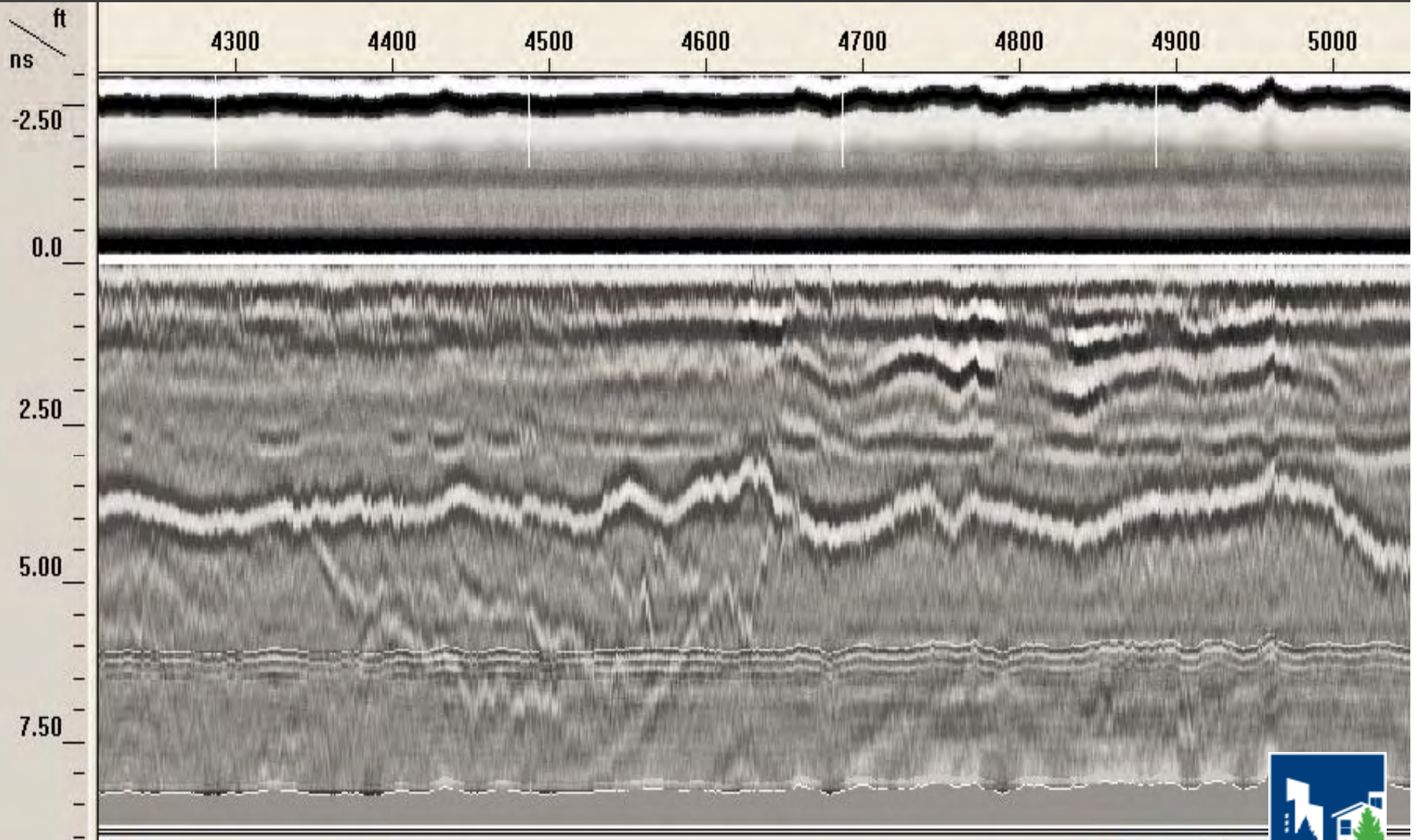
Understanding GPR



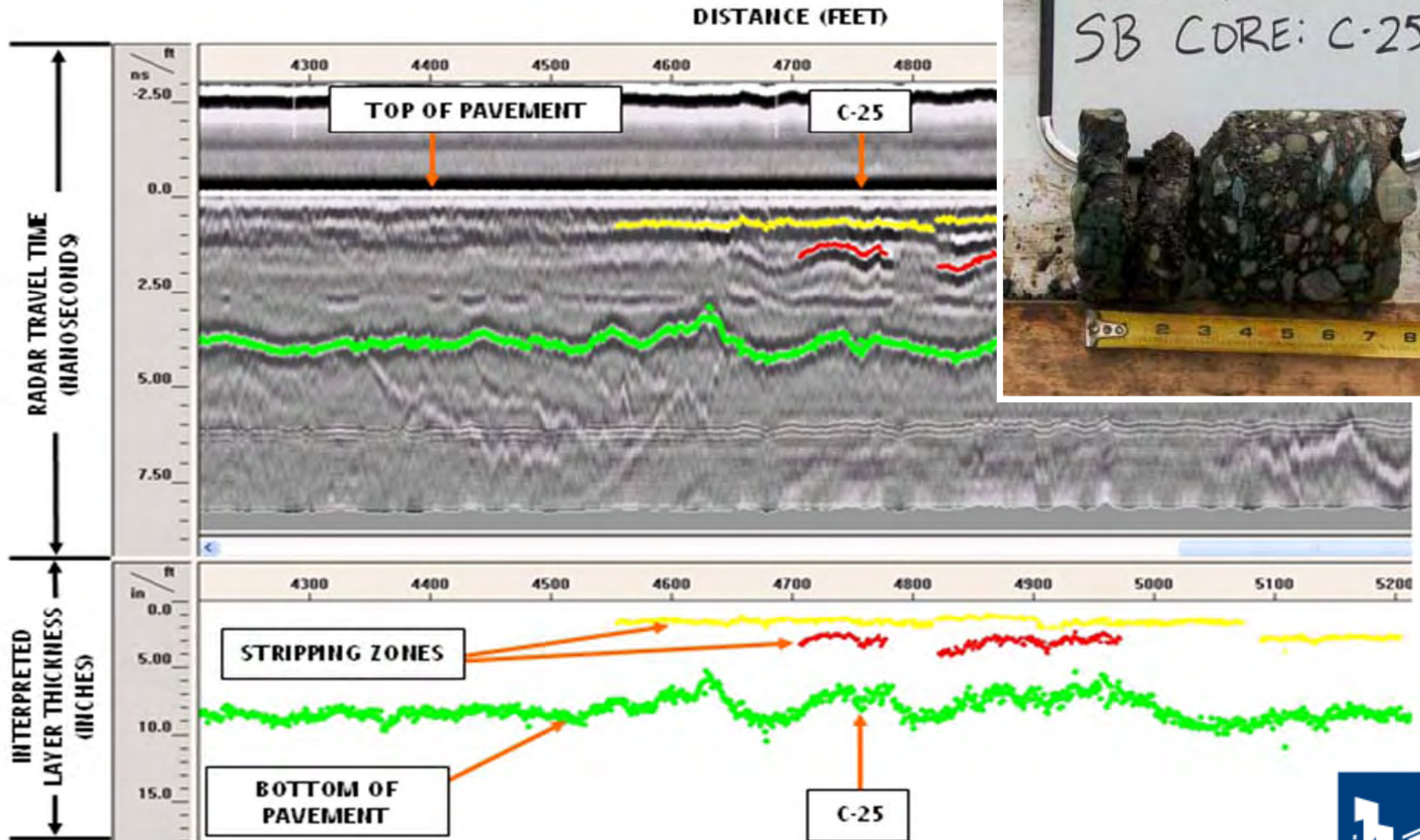
Reflections are produced when the pulse encounters a material with different dielectric constant

Dielectric Constant: Air = 1 Asphalt = 3-5 Concrete = 6-8

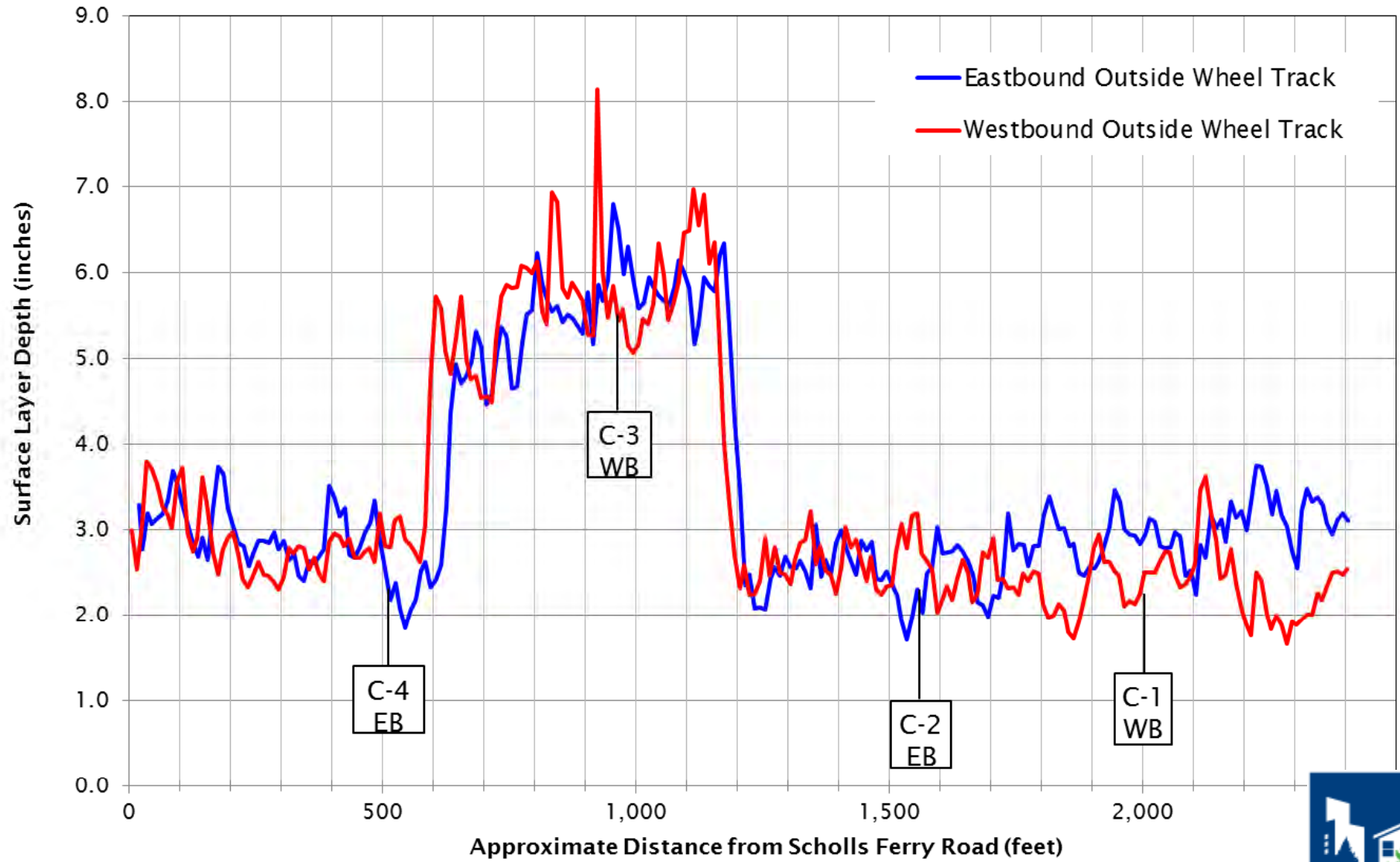
GPR Raw Data



GPR Data Interpretation



GPR Results

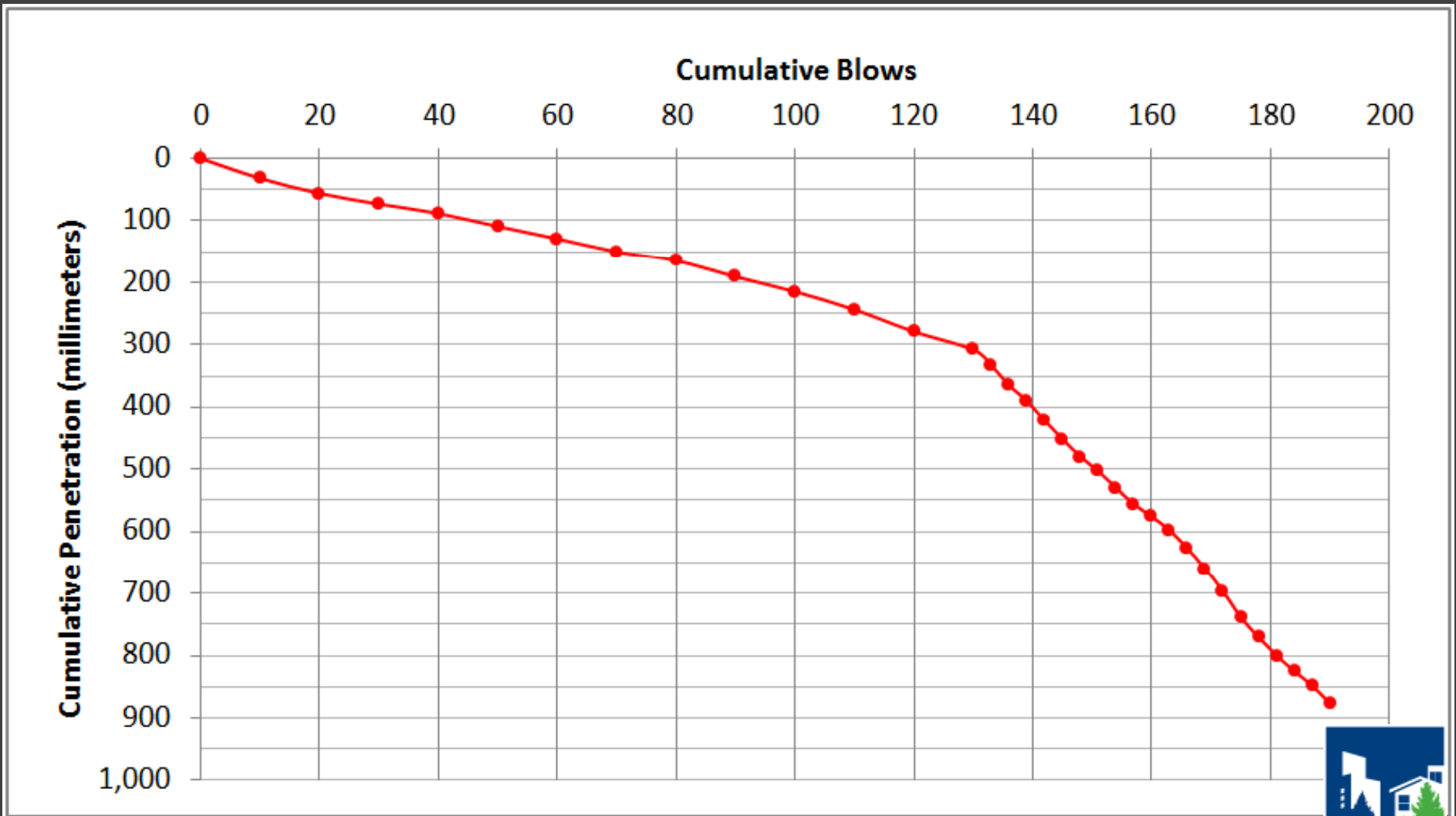


Dynamic Cone Penetrometer (DCP)

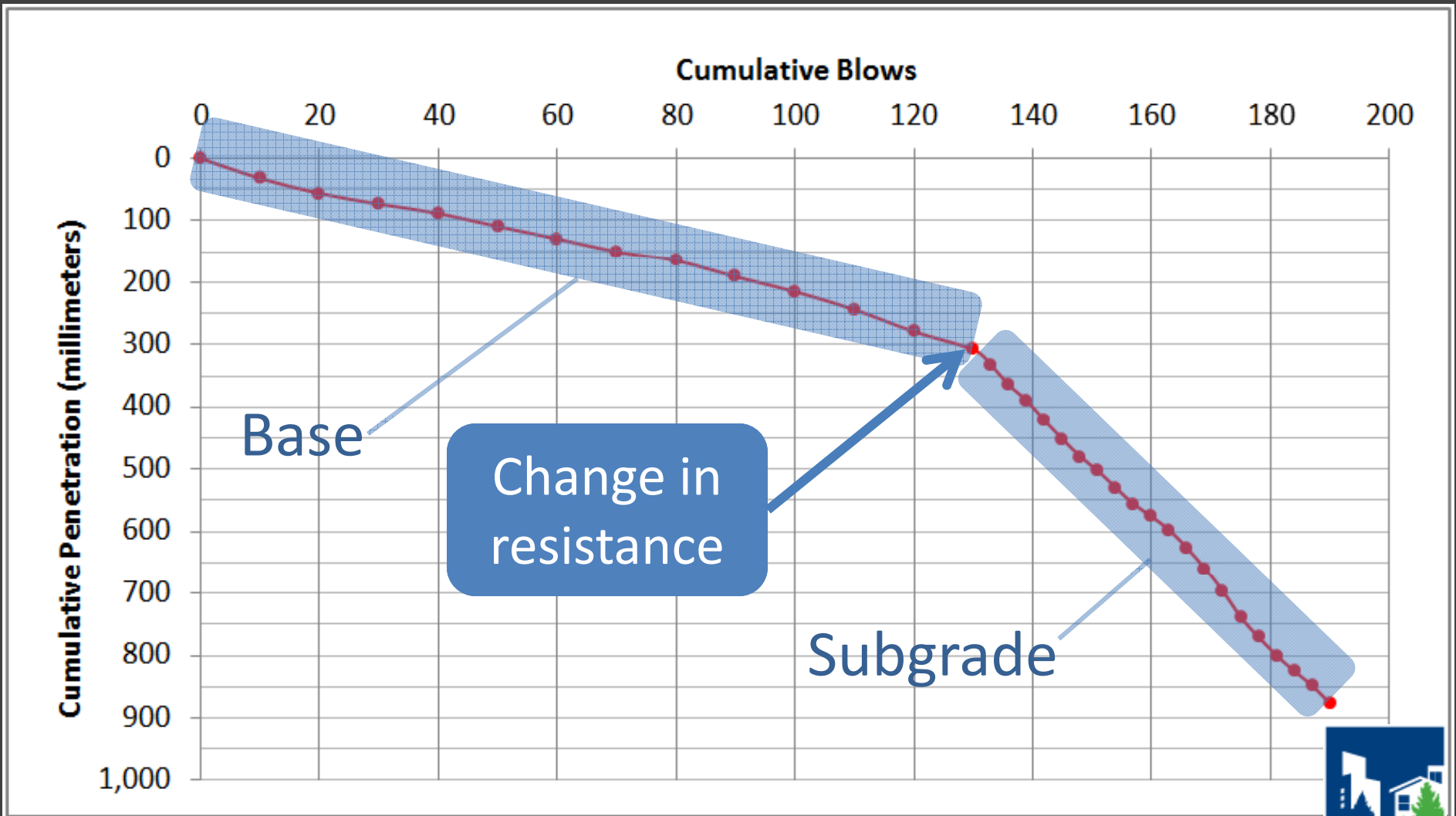
- Agency benefits:
 - Inexpensive
 - Assessment of layer properties beneath surface layer
 - Accurate rehabilitation design
- Drawbacks:
 - Requires access to base layer
 - Limited evaluation locations



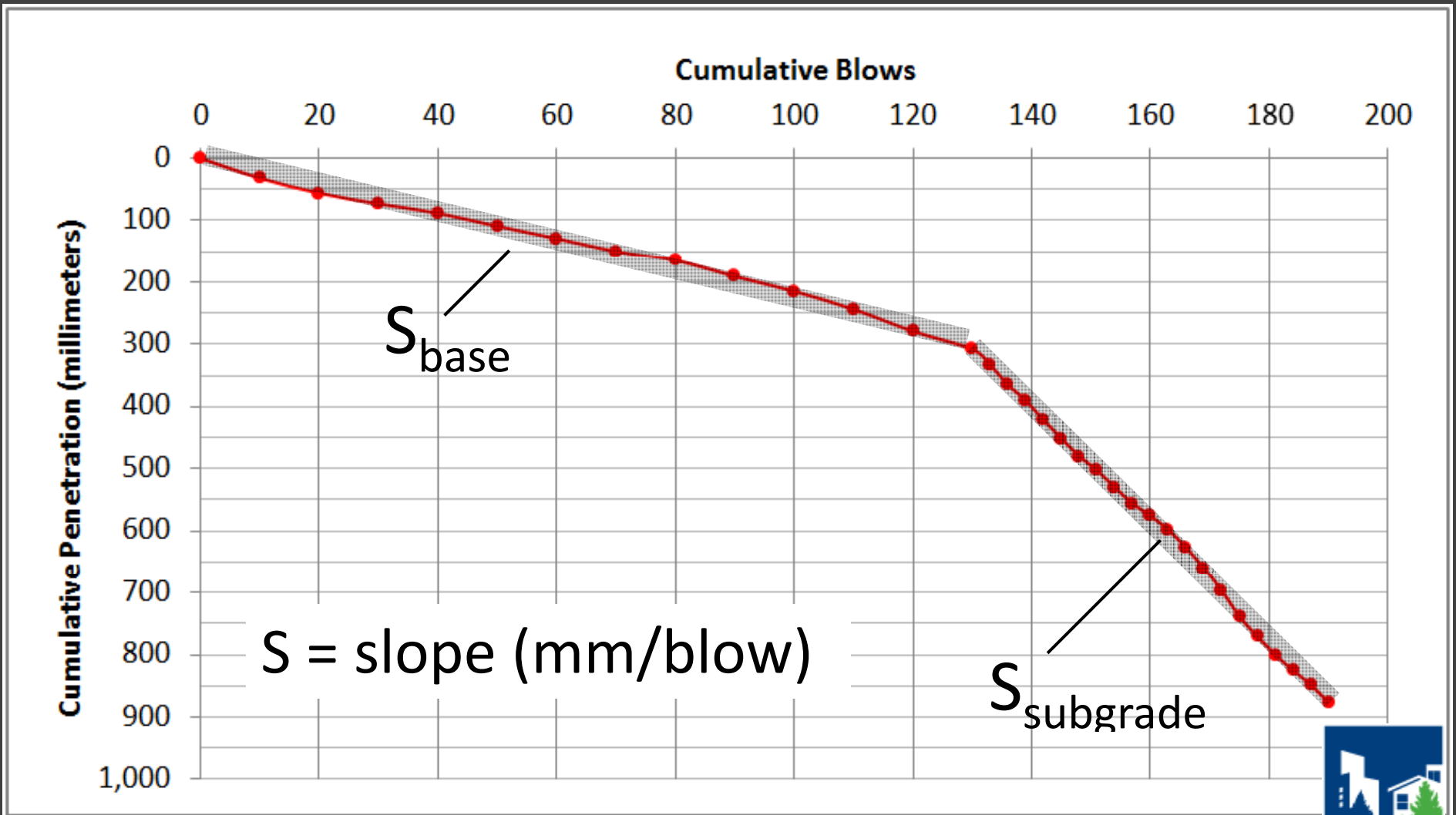
DCP Data Interpretation



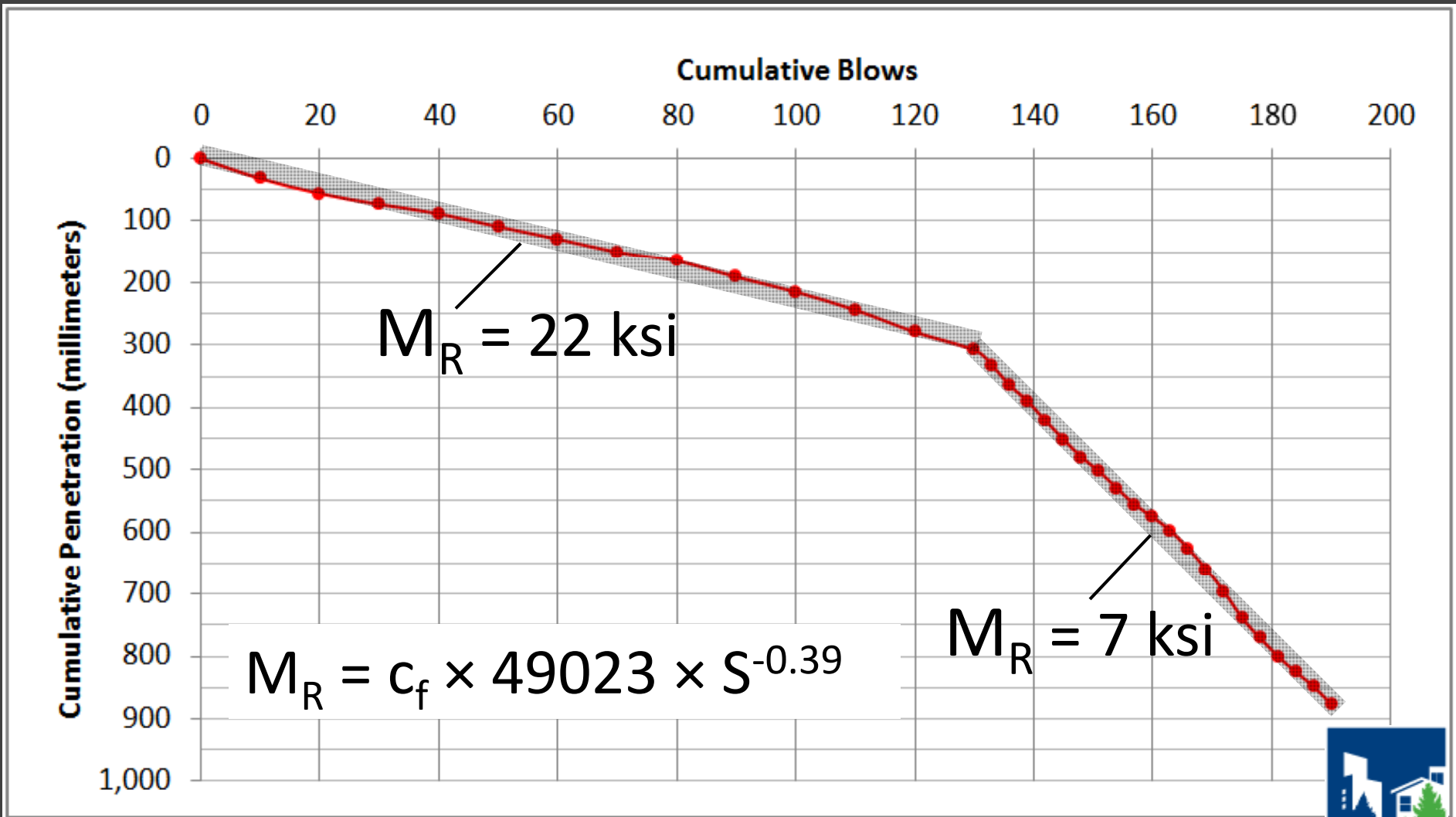
DCP Data Interpretation



DCP Data Interpretation



DCP Data Interpretation

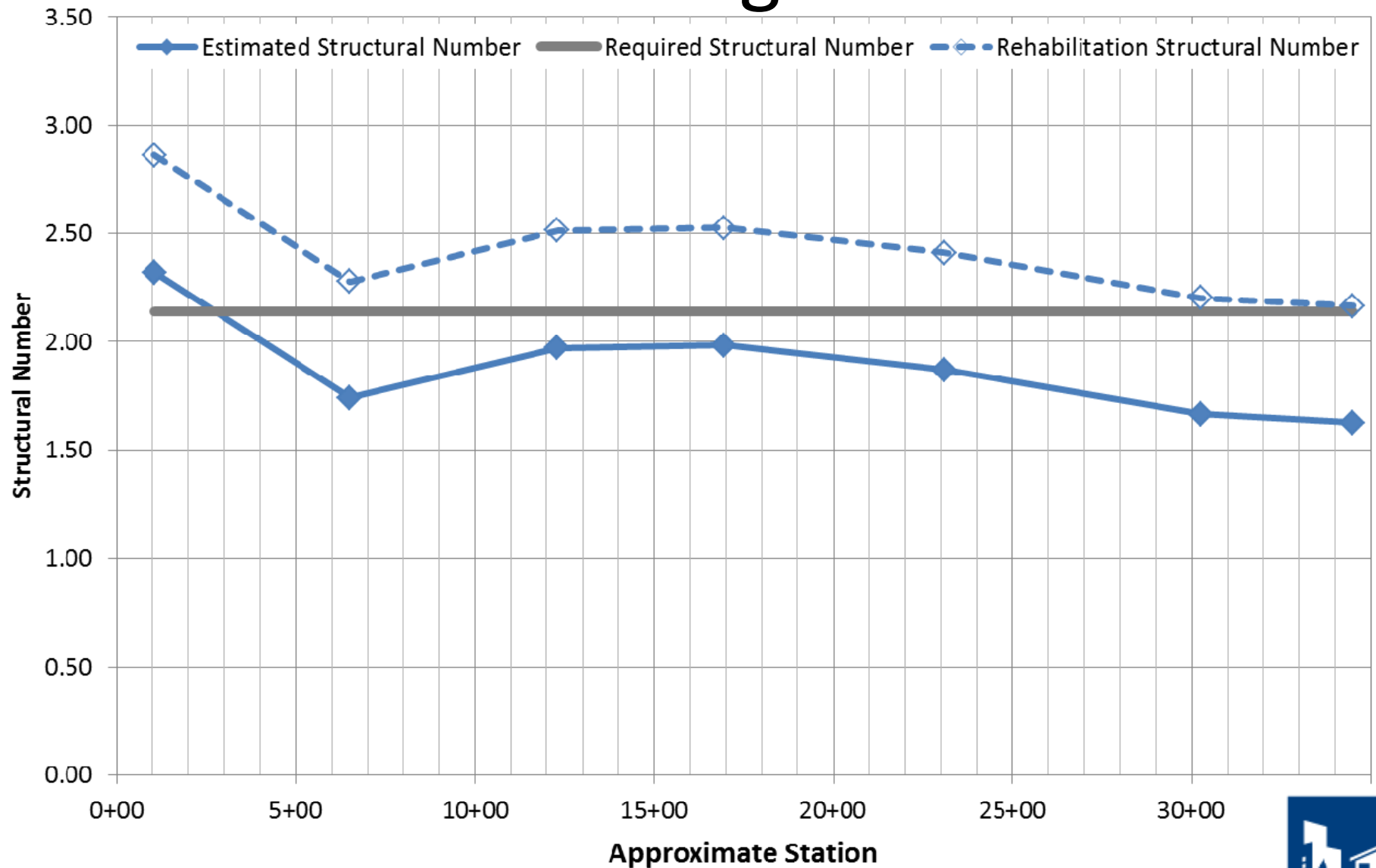


DCP Results

Table 4. Base Thickness, Base Modulus, and Subgrade Modulus
Estimated from DCP Testing

Core Number	Street	Direction	Estimated Base Thickness ¹ (inches)	Estimated Resilient Modulus (psi)	
				Base	Subgrade
C-1	North Dakota	Westbound	19.7	19,300	6,000
C-2	North Dakota	Eastbound	13.0	18,900	6,700
C-3	North Dakota	Westbound	14.6	19,500	8,100
C-4	North Dakota	Eastbound	16.1	20,700	6,300
C-5	North Dakota	Eastbound	9.1	36,100	5,200
C-6	North Dakota	Eastbound	6.3	21,000	6,200
C-7	North Dakota	Westbound	11.8	18,400	4,800
C-1	115 th	Northbound	12.2	11,900	3,600
C-2	115 th	Southbound	6.3	21,900	4,700
C-1	92 nd	Northbound	5.5	17,200	4,700
C-2	92 nd	Northbound	6.7	18,800	4,500
C-3	92 nd	Southbound	5.9	19,100	5,100
C-4	92 nd	Northbound	9.4	19,600	3,900
C-1	Nimbus	Southbound	11.4	25,300	6,100

Rehabilitation Design



Falling Weight Deflectometer (FWD)

- Agency benefits:
 - Non-destructive
 - Direct pavement capacity assessment
 - Accurate rehabilitation design
- Drawbacks
 - More expensive
 - Calculation intensive



Load Plate

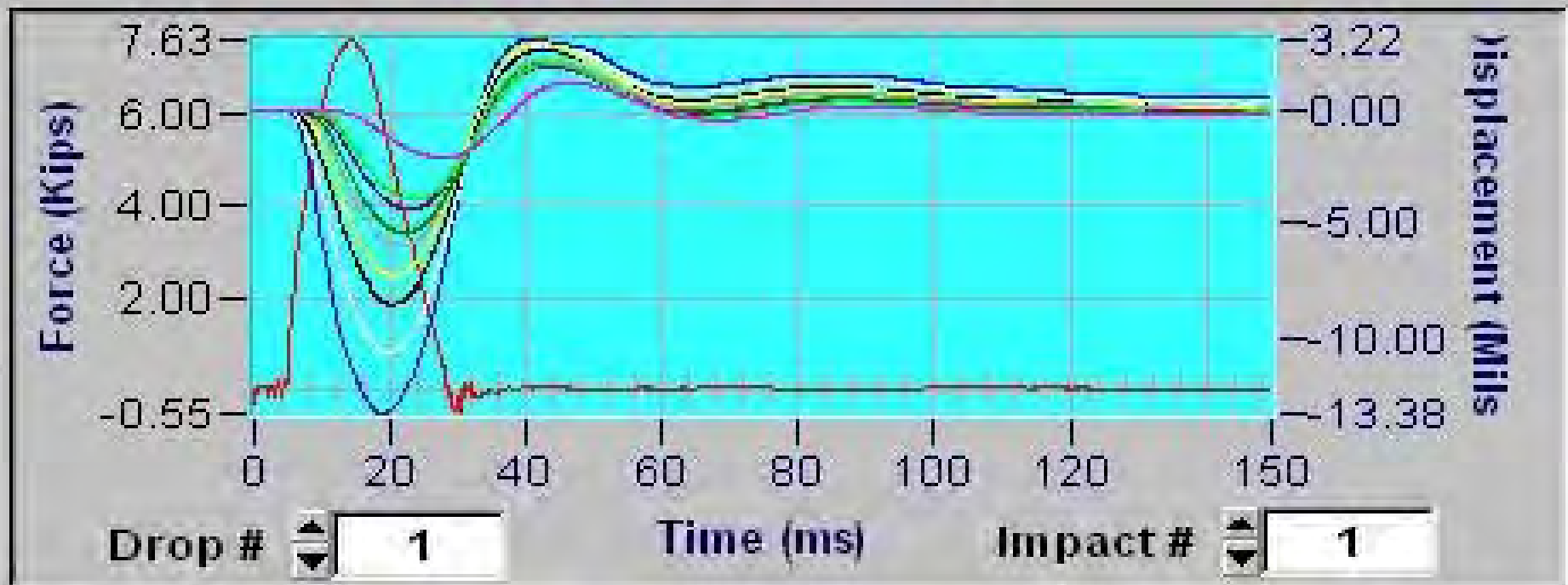


Deflection Sensors



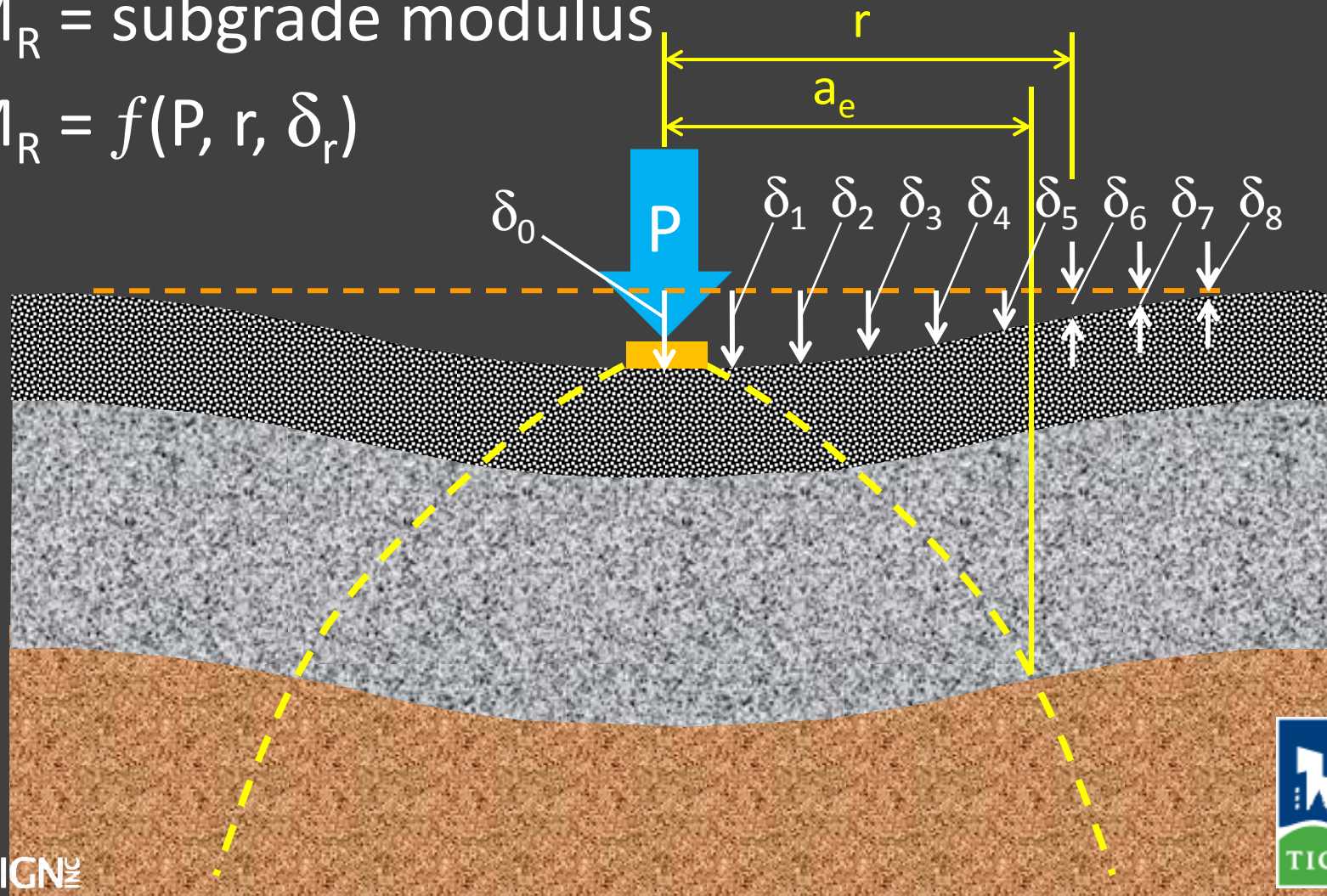
Understanding FWD

Force & Displacements



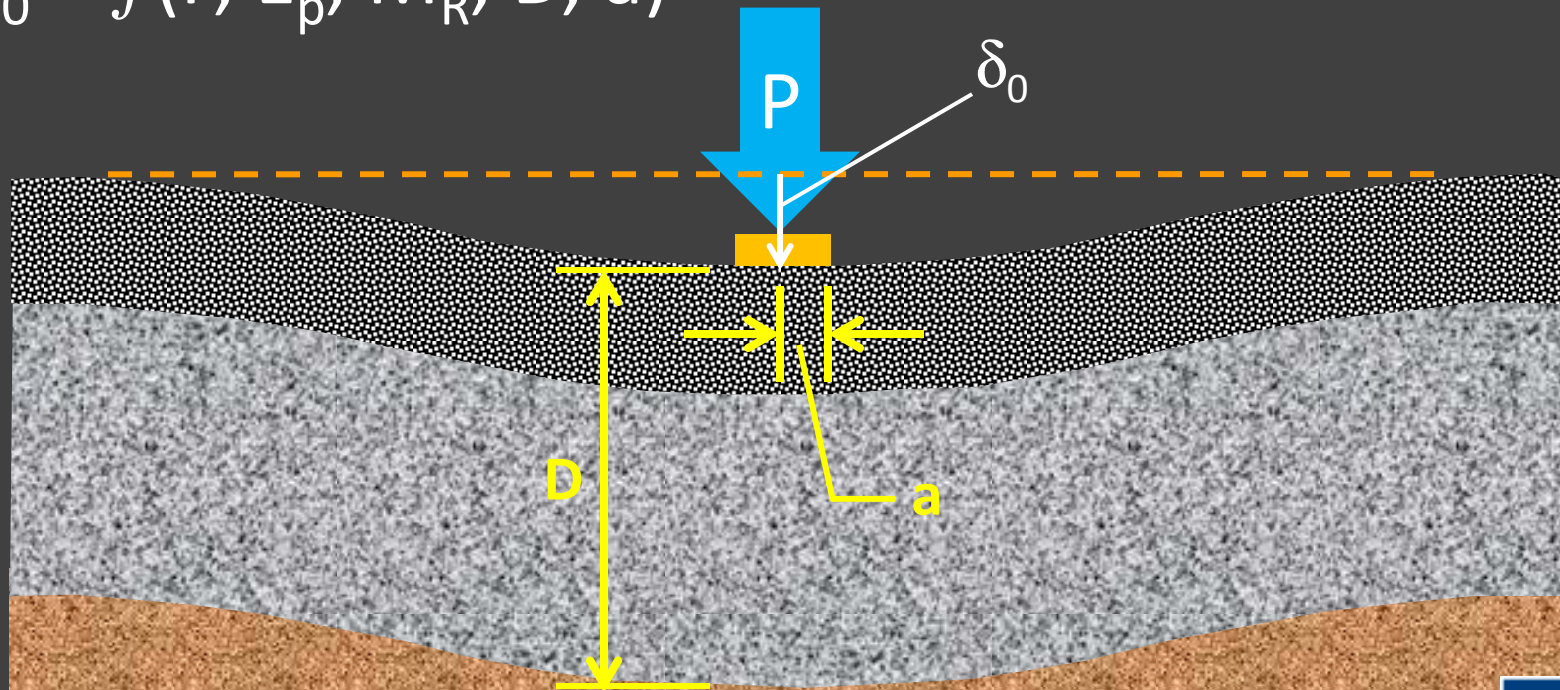
Understanding FWD

- M_R = subgrade modulus
- $M_R = f(P, r, \delta_r)$



Understanding FWD

- E_p = effective pavement modulus
- $\delta_0 = f(P, E_p, M_R, D, a)$

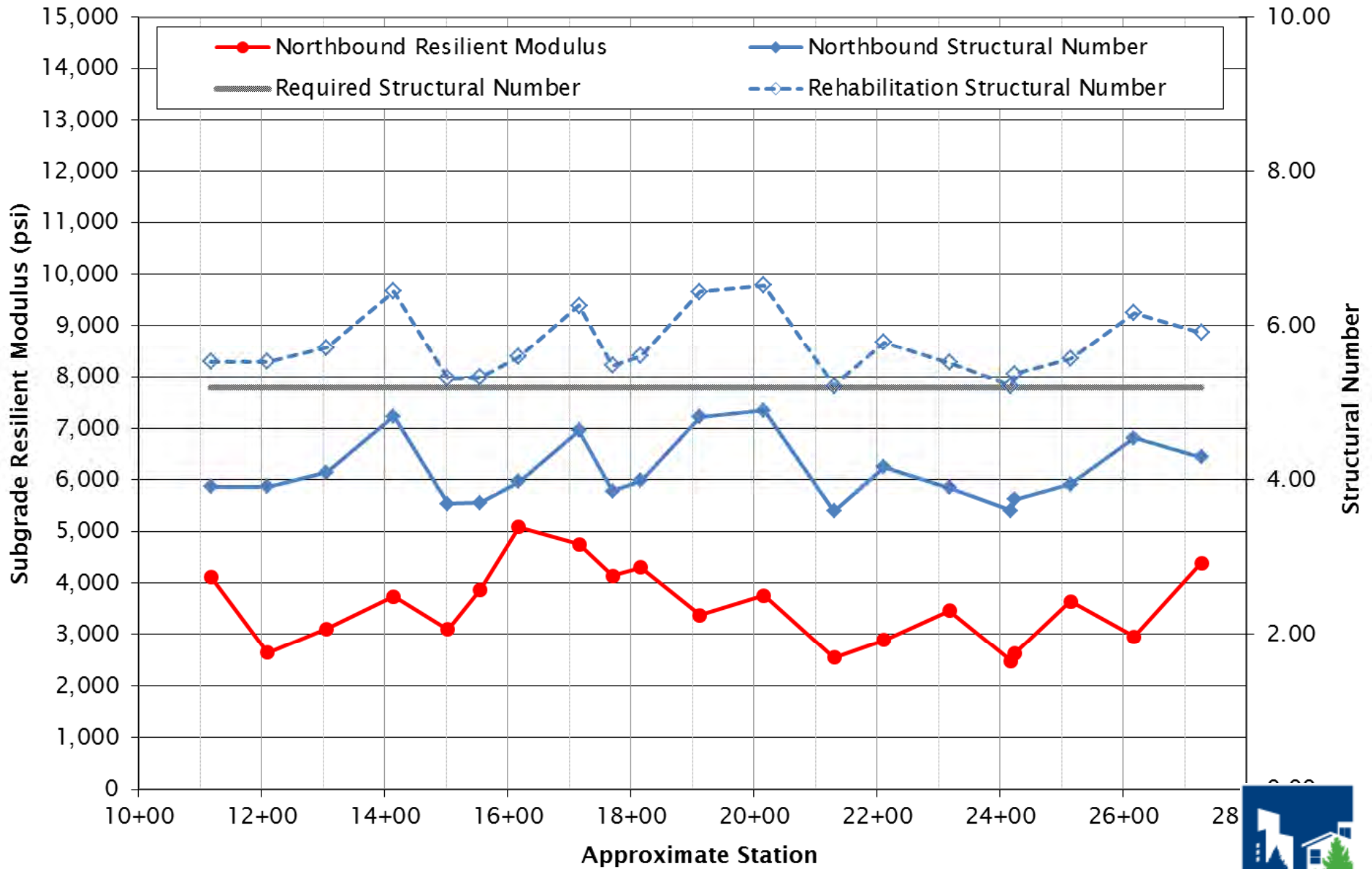


FWD Results

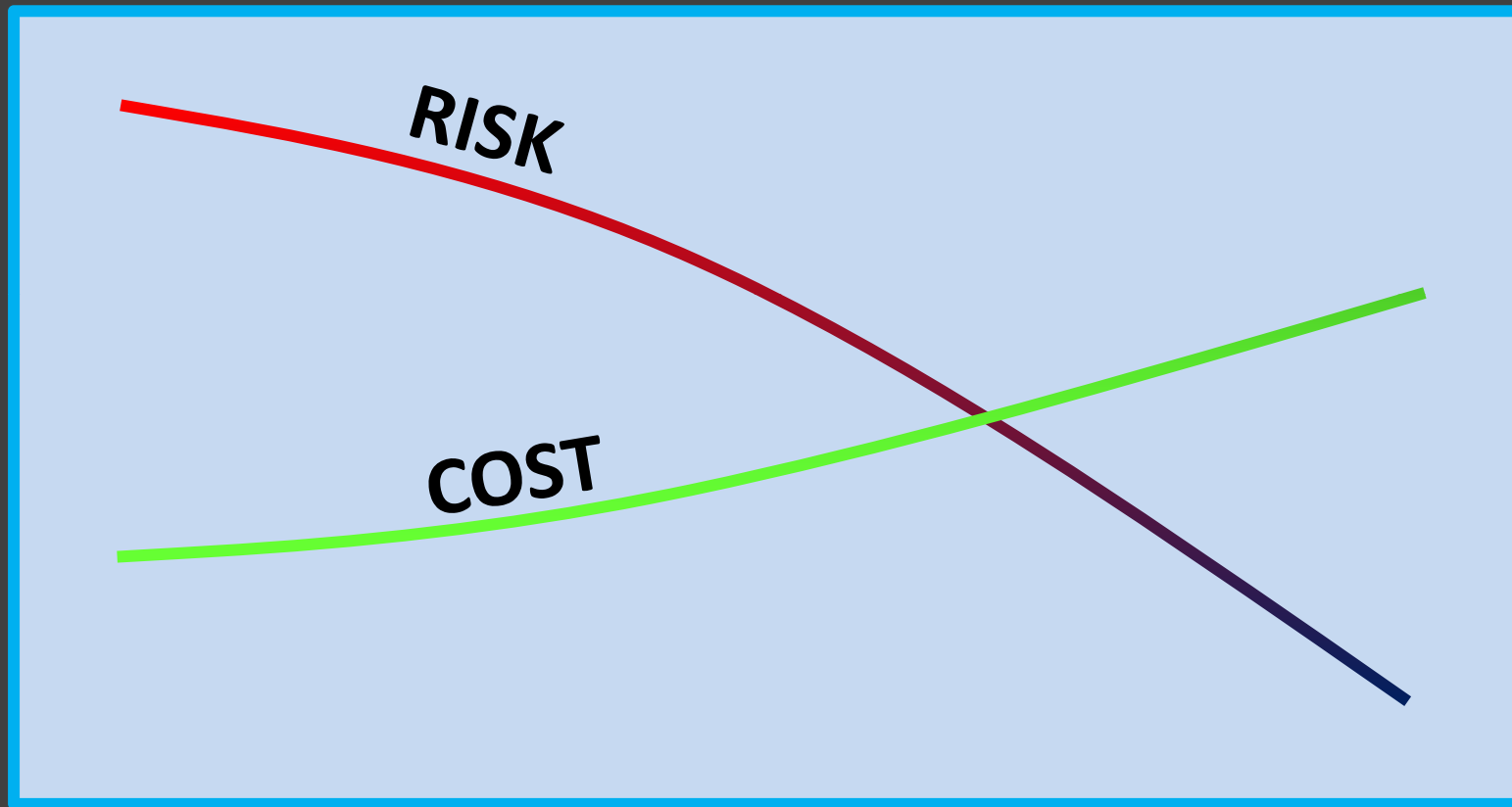
**TABLE B-1
FWD Results
Fairfield Avenue from Highway 99 to Royal Avenue
Eugene, Oregon**

Approximate Station	Direction	Back-Calculated Resilient Modulus (psi)	Back-Calculated Effective Pavement Modulus (psi)	Back-Calculated Structural Number
26+20	Southbound	2,636	42,503	3.00
25+18	Southbound	2,903	70,645	3.55
24+21	Southbound	2,841	80,316	3.00
23+47	Southbound	2,403	64,660	3.00

Rehabilitation Design



Project-Level Investigation Tools



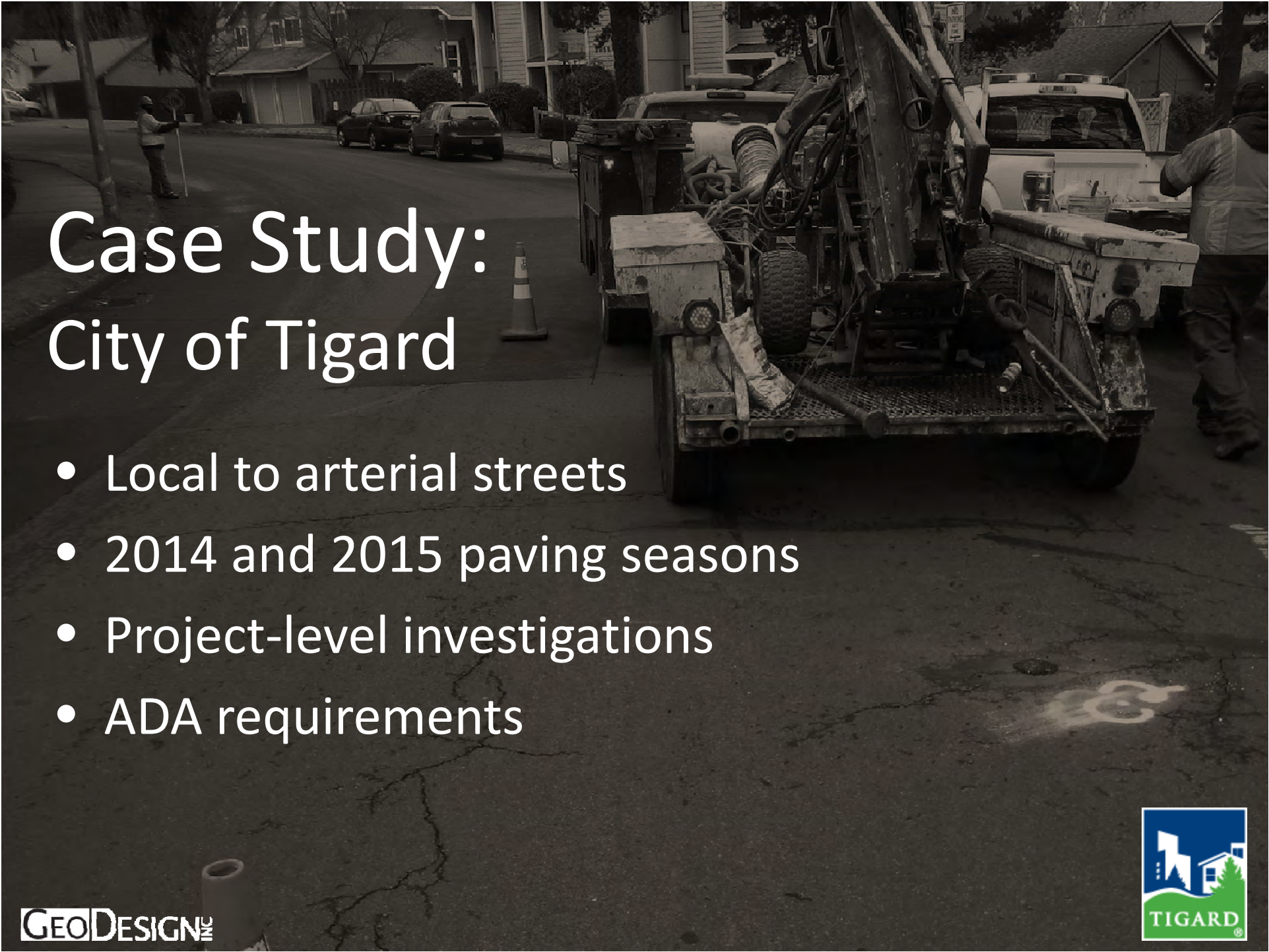
Distress
Survey

Cores

DCP

GPR

FWD



Case Study: City of Tigard

- Local to arterial streets
- 2014 and 2015 paving seasons
- Project-level investigations
- ADA requirements

2014 Overlay Program

- 12 initial candidates
- Project-level investigations:
 - Cores
 - GPR
 - Walk-throughs:
 - Digouts
 - Deeper grinds
 - ADA

Final Project List:

- ✓ Locust Street
- ✓ Spruce Street
- ✓ 71st Avenue
- ✓ 78th Avenue
- ✓ Tigard Street
- ✓ 121st Street

2015 Overlay Program

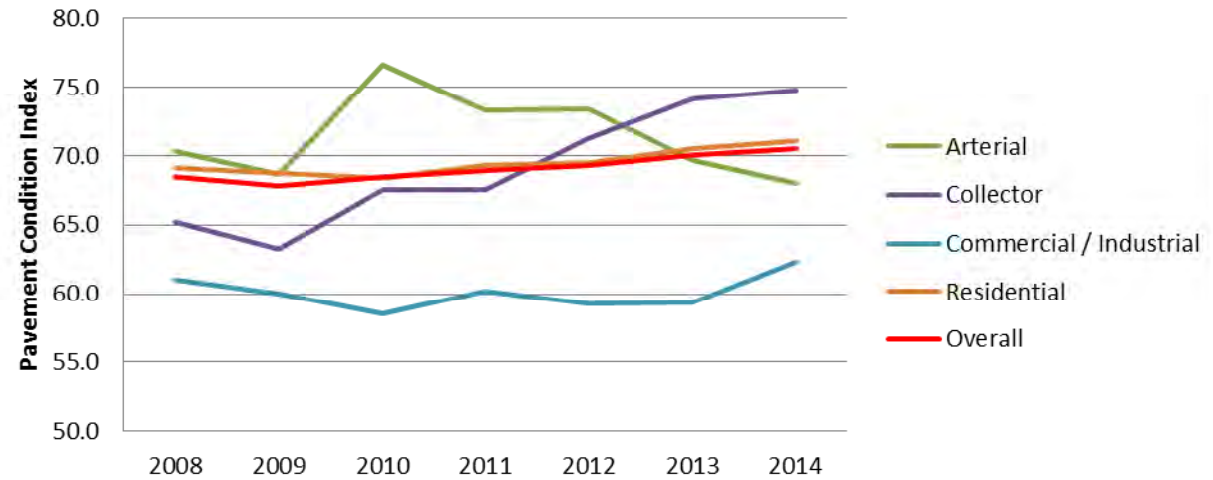
- 16 initial candidates
- Project-level investigations:
 - Cores
 - DCP
 - GPR
 - Pavement designs
 - Walk-throughs

Final Project List:

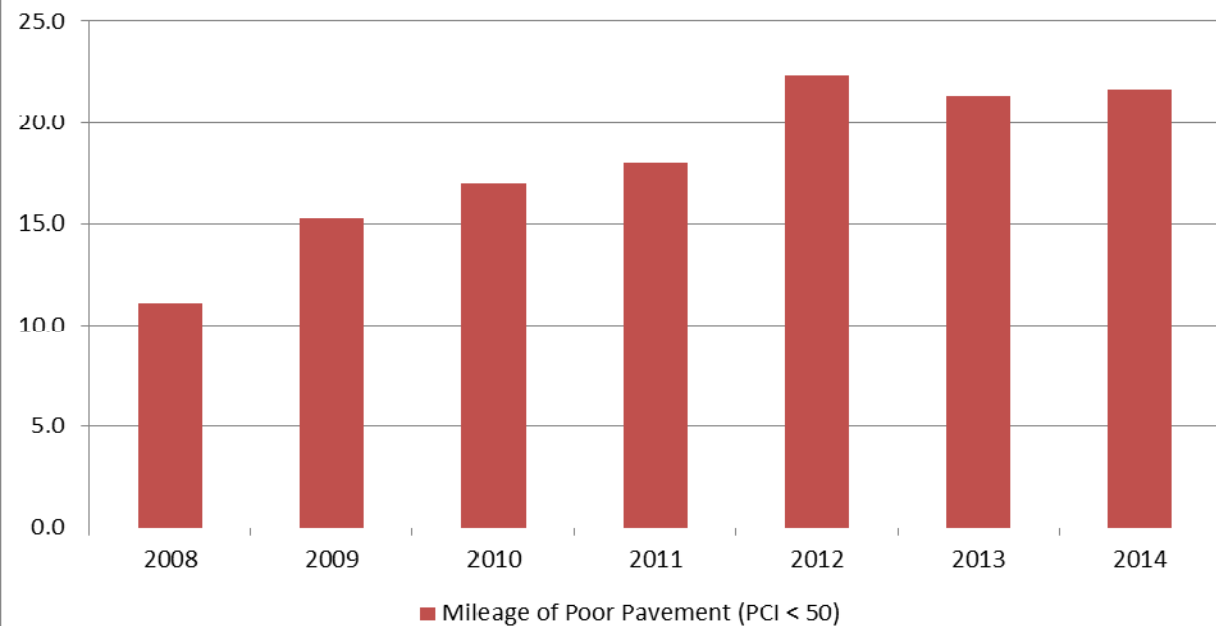
- ✓ Walnut Street
- ✓ Grant Street
- ✓ North Dakota Street
- ✓ Springwood Drive
- ✓ Nimbus Avenue
- ✓ 92nd Street

Results

Pavement Condition Index by Functional Class



Backlog - Mileage of Poor Pavement



Summary and Conclusion

- Limited budgets and resources
- PM software → initial list of rehab candidates
- Project-level investigations → final list
- Reduce construction cost overruns
- Responsible public stewards

- Thank you!