



# IMPLEMENTATION OF RELATIVE PERFORMANCE TARGETS IN A NEW STATE PMS USING DEIGHTON'S DTIMS PLATFORM

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**RPUG**  
Road Profile Users' Group

# Project Overview


- ❖ Original PCI Developed in CT was based on manual distress collection methodologies
- ❖ Since then many technological leaps caused adjustments/offsets in year-over-year distress data
- ❖ Rating system was proving to be insensitive to 'current day' issues, especially IRI
- ❖ dTIMS Framework built by legacy staff with limited knowledge transfer



# Project Overview

## The Need:

A multi-year effort has been undertaken to develop a new, temporally-resilient PMS



Condition Rating  
System

Condition Triggers

Resets

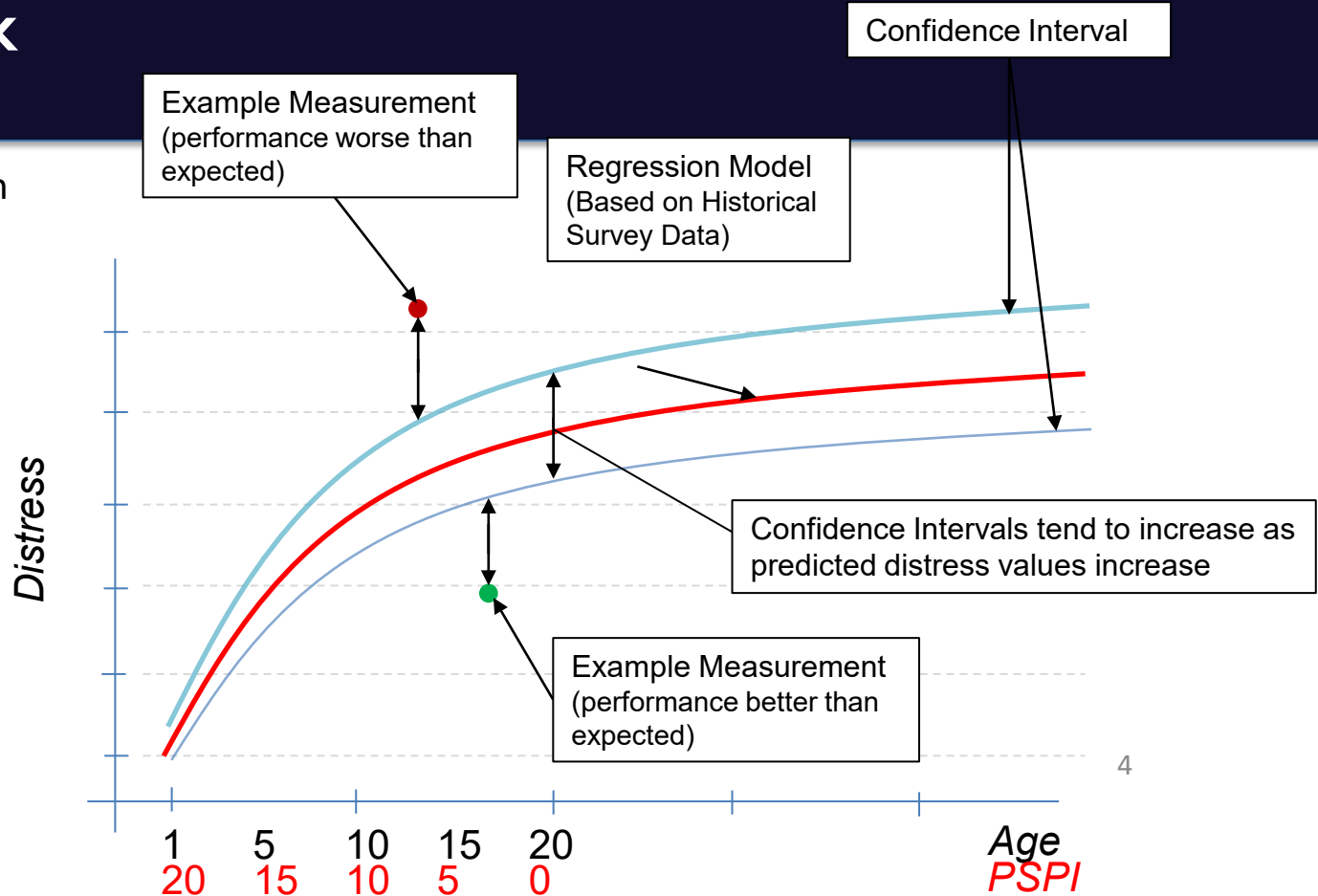
Evaluate  
Treatments and  
Budgets for  
Efficacy

# Previous Work

Presented at RPUG 2020 on the New Rating System:

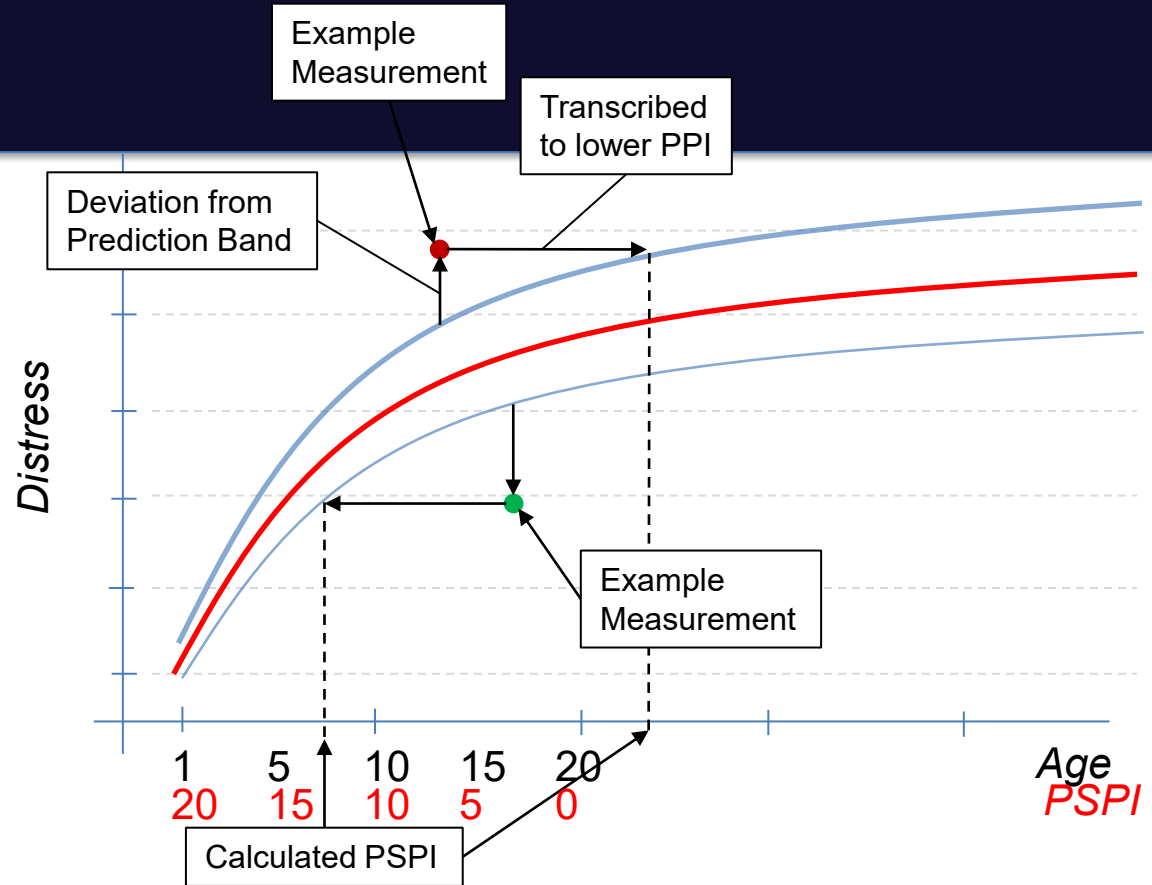
The Pavement Surface Performance Index (PSPI)

The 'decision analysis' occurs in the first 10 to 20 years for a given pavement structure (at least in the Northeast) so why not hone-in to this part of the performance curve only.

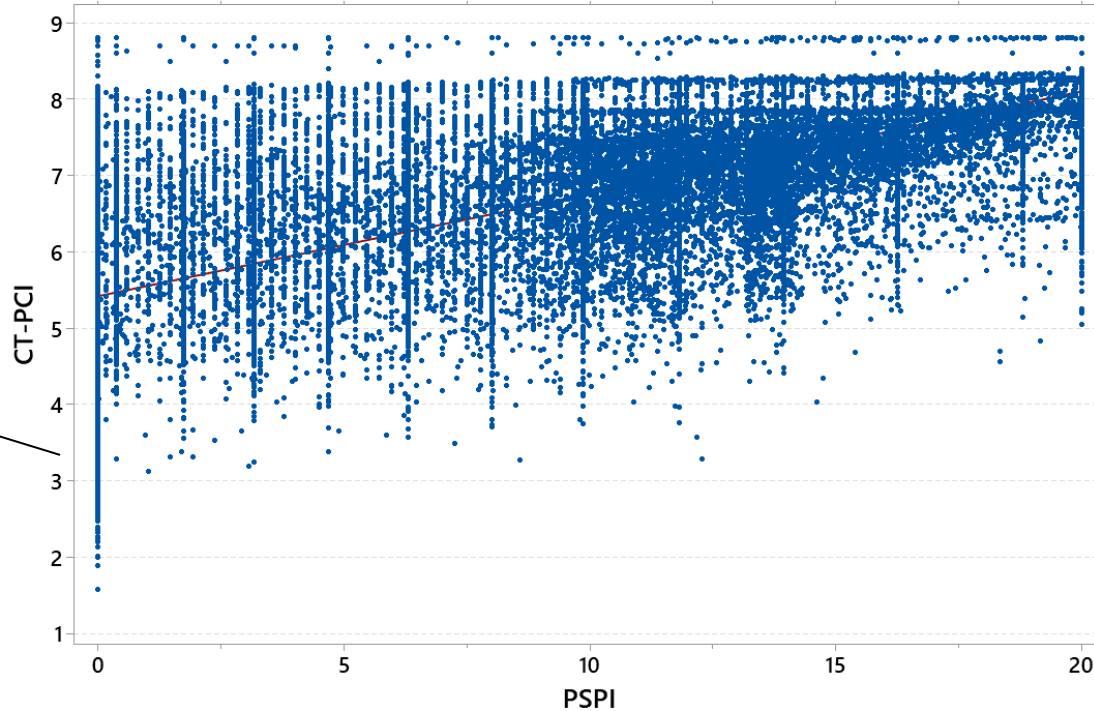


# Previous Work

- ❖ A band of expected values is forecast for each distress of 4 distresses.
- ❖ IRI curves exist for FC1 & 2 and then FC 3, 4, and 5.
- ❖ WP and NWP Cracking curves exist for Composite and Flexible Pavements Separately



# Previous Work



Wide spread of pavements rated 'bad' by PSPI are good and bad from CT-PCI

Better agreement as to what is considered "good"

# Previous Work

## Models broken out by Functional Class + Pavement Type per PSPI Initial Sensitivity Analysis

- Roughness/MRI – FC1 & 2 | FC 3, 4, & 5 FC 6 & 7
- Cracking (Both Wheelpath + Non-wheelpath) – Flexible | Composite
- Rutting – no need for different models
- Equations to predict PSPI from age are Exponential with 2 input variables
- Original PSPI Equations were updated using 2021 Condition Current Survey
  - Only sections that degraded (to omit treatments)
  - No Concrete Sections

# Where does this leave us?

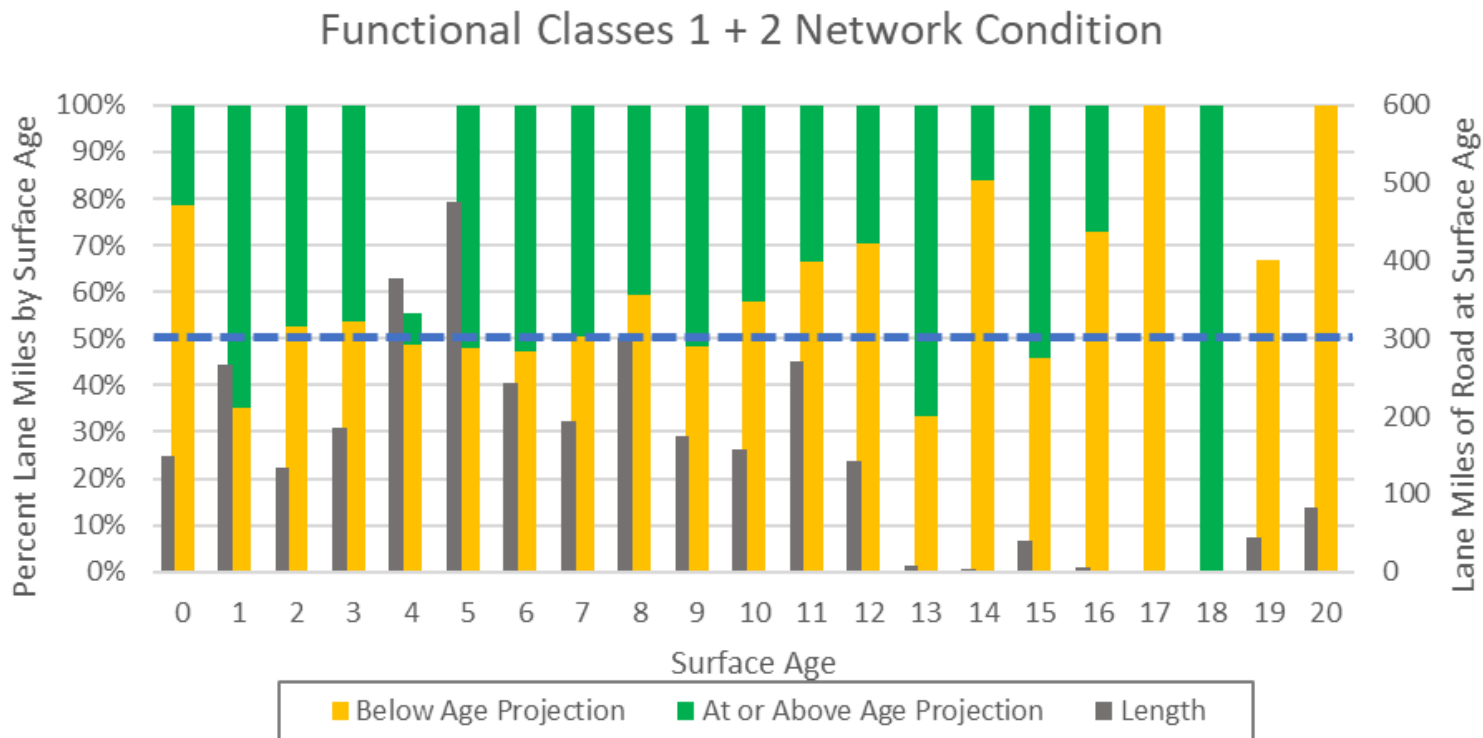
What is good?

...and what do we call the in-between?

What is bad?

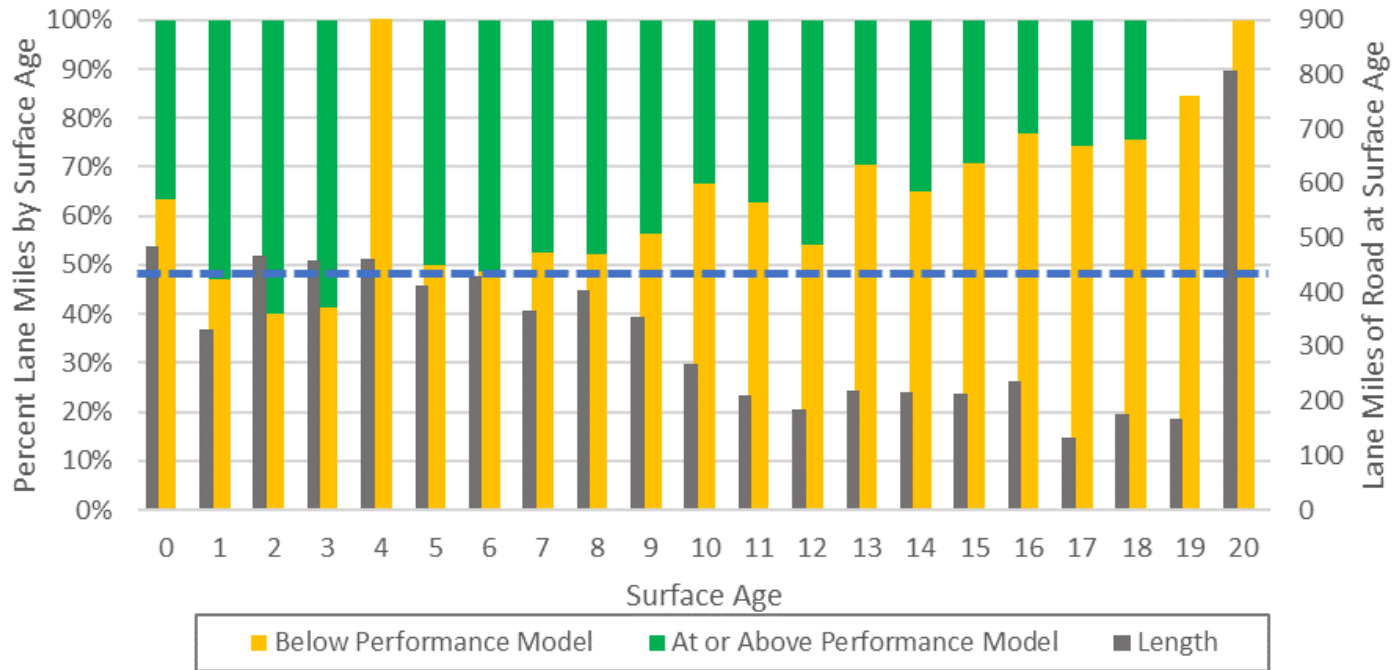


# Where does this leave us?



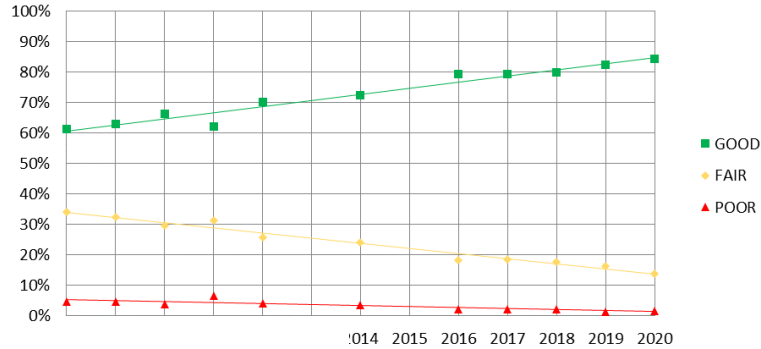
# Where does this leave us?

## Functional Classes 3, 4, & 5 Network Condition

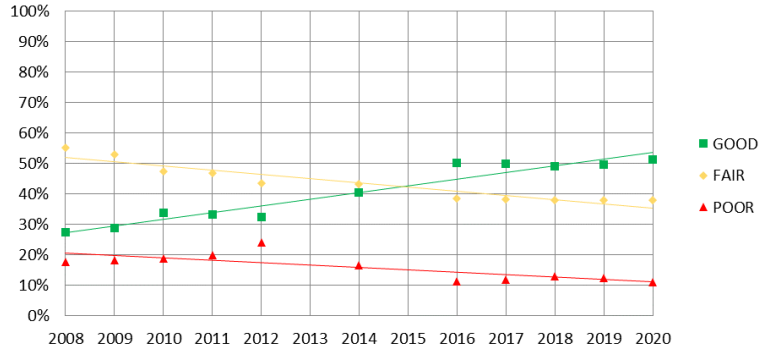


# Where does this leave us?

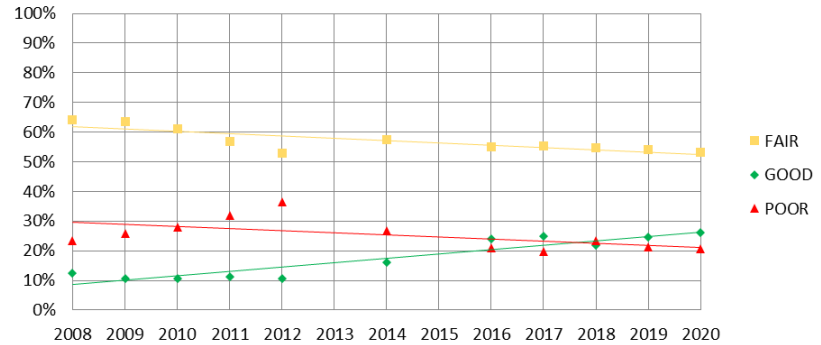
## Class 1 IRI



## Class 2&3 IRI



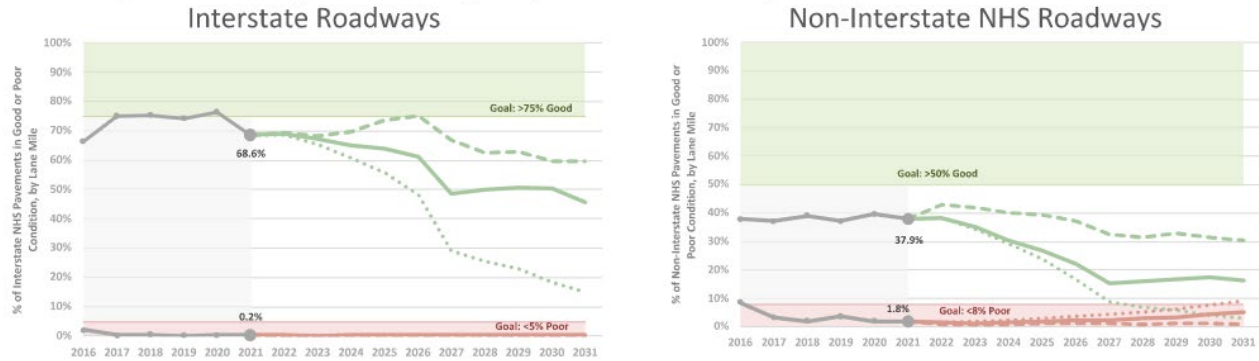
## Class 4,5&6 IRI



# Where does this leave us?

## NHS Pavement Performance Projections

Federal Requirements by lane miles for 4,917 lane miles of NHS pavement



### % Good (by lane miles)

--- Preferred Funding (\$350M)    — Current Funding (\$157M)    ..... No Funding (\$0M)    ● Actual Conditions

### % Poor (by lane miles)

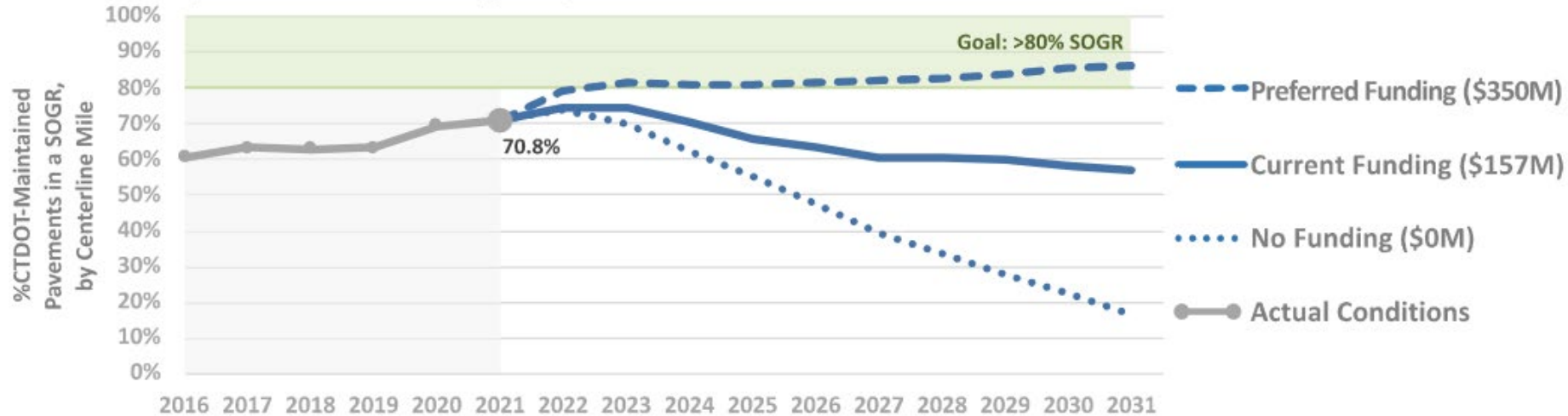
--- Preferred Funding (\$350M)    — Current Funding (\$157M)    ..... No Funding (\$0M)    ● Actual Conditions

Based on funding as of 12/31/22

# Where does this leave us?

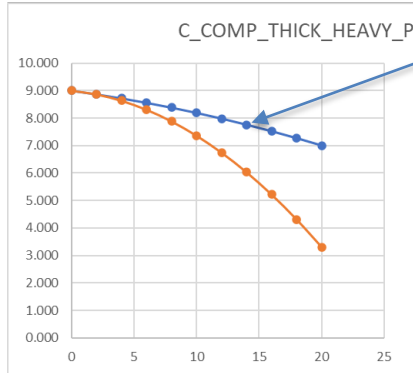
## CTDOT-Maintained Pavement Performance Projections

State Goals by centerline miles for 3,715 centerline miles

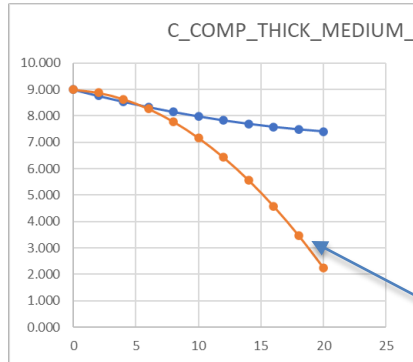


Based on funding as of 12/31/22

# Existing Performance Curves



2019 Condition Data (Typ)

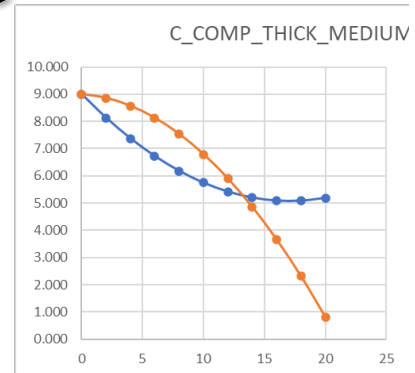
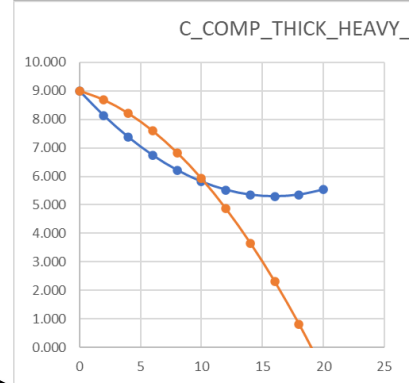


Current Prediction Models in CT dTIMs Framework (Typ)

Existing CT-PCI RIDE Models



Existing CT-PCI Env. Cracking Models



# NEW Performance Curves

$$\text{Predicted IRI or RUT} = a \times e^{(b \times \text{AGE})}$$

$$\text{Predicted Cracking} = a \times \text{AGE} + b$$

$$\text{Predicted PSPI} = c \times e^{(d \times \text{AGE})}$$

$$\text{Predicted PSPI} = 20 - \frac{\ln(\text{DISTRESS}/a)}{b}$$

# Statistics

# New PMS Development in dTIMS

- Web-based
- Multi-User/Simultaneous User
- Has been used by CTDOT for many years

The screenshot displays the dTIMS BA Home web application interface. The top navigation bar includes the dTIMS logo, a user profile icon for 'deighton', and links for 'Support', 'Settings', and 'Help'. The main content area is divided into several sections:

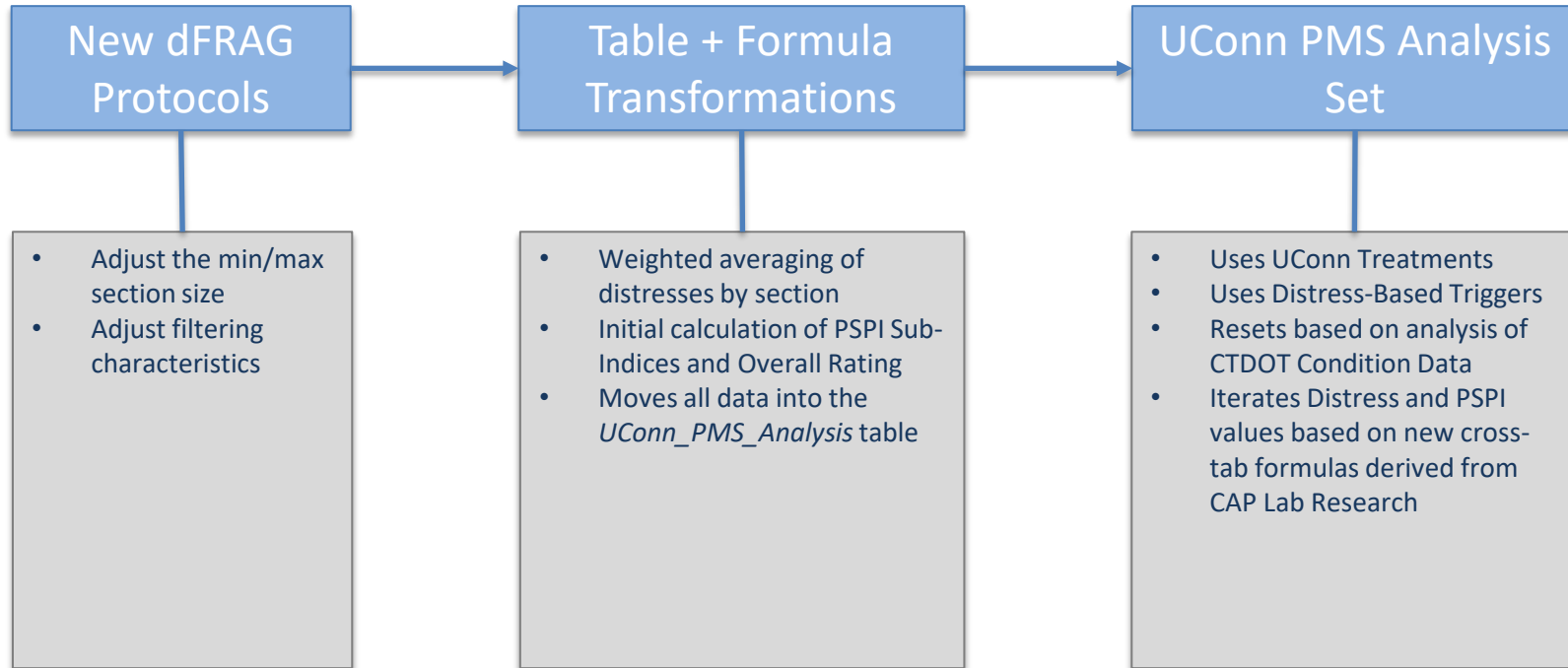
- Getting Started:** A list of links including 'Getting Started with dTIMS BA', 'Deighton University', 'Related Products', and 'Upcoming Web Events'.
- Recent Activity:** A table showing recent actions and their dates. The table has two columns: 'Action' and 'Activity Date'.

Action	Activity Date
Budget Scenario UConn_MAP2L_Project_Length_Analysis ...	Mon Apr 22 2024 12:32:18 GMT-0400 (Eastern Daylight Time)
Budget Scenario UConn_MAP2L_Project_Length_Analysis ...	Mon Apr 22 2024 08:32:24 GMT-0400 (Eastern Daylight T...
Analysis Set UConn_Base_Analysis was executed by alex.b...	Mon Apr 22 2024 08:31:36 GMT-0400 (Eastern Daylight Tim...
- Base Network Map:** A map showing a geographical area with various locations and roads. The map is titled 'Base Network Map' and includes a search bar and navigation controls.

The left sidebar contains a navigation menu with the following items: Analysis Results, Map, Asset Data, Reports, Database Configuration, Analysis Configuration, Transformation Configuration, Query Configuration, Action Requests, and Workflows.

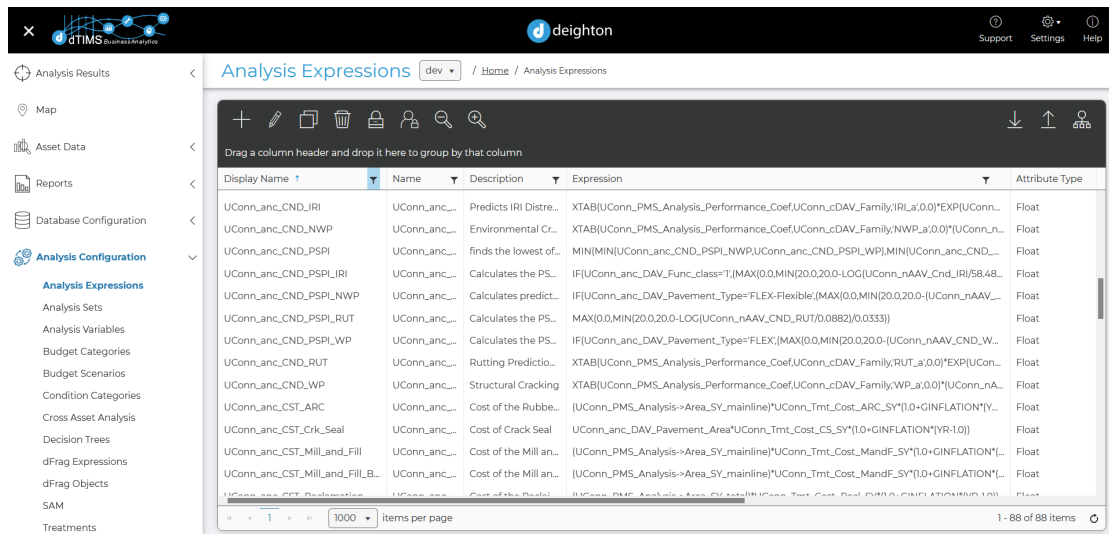


# New PMS Development in dTIMS



# New PMS Development in dTIMS

- Iterates data from tables by
  - Ingesting them using 'analysis variables'
  - Manipulating them using analysis expressions
  - time increments annually
  - different treatment scenarios are explored
  - each pavement segment comes from a base table



# New PMS Development in dTIMS

## Goals of a New System:

1. More responsive to distresses than old CTDOT PCI
2. Easier to maintain and update
  1. Update distress curves as technology advances
  2. Able to Modify resets and triggers
  3. Easy to trouble-shoot if issues arise

# New PMS Development in dTIMS

## Preserved Naming Criteria

- cDAV
- nAAV
- nCAV

## Cross-Tabs

- Distress curves are age-based
- Projections and ratings are based on the same models
- Cross-Tab is also used for resets to simplify modification process

## Expressions

- System is distress-based
- PSPI calculated at the end of treatment assignment

# Treatments

Budget Category

- ARC
- Ultra Thin Bonded Overlay (Ultra\_Thin\_Overlay)
- Thin Friction Wearing Course
- Mill and Fill

*System\_Preservation*

- Structural Overlay
- Reconstruction
  - Composite/Flexible
- Reclamation

*Major\_Rehabilitation*

# Triggers

...what is actionable?

Criteria	Factor	Value at PCI $\approx$ 4.0	MAP 21
Index Distortion	Rut Avg	0.47 inches	0.4 inches
Index Ride	IRI Average	262 in/mi	170 in/mi
Index Environmental	NWP Total	120	
Index Structural	WP Total	21 (variable 0 – 253)	20 %

# Triggers

In both cases – very labor intensive and ultimately provided unrealistic outputs

in-depth  
analysis

- Too many factors to determine meaningful triggers

OPTime  
(NCHRP 523)

- Too little data

# Example Treatment Triggers and Resets: Asphalt Rubberized Chip Seals

## EXISTING

(PSR)

### Conditions

*abf\_TRG\_TSA\_Rubb\_Chip\_Seal*  
6 <= Age <= 10  
5 <= Index\_Env Cracking <=8.5  
5 <= Index\_Str Cracking <=8.0

### Site Factors

PType: Flex  
ADT <=10,000

Life Expectancy: 5 years (Interval)  
Cost: \$10.01 / sy  
Subsequent Treatments:

- ARC
- Reclaim
- Reconstruct

## PROPOSED

(Distress Values)

### Conditions

Age >= 2  
NWP Cracking >= 2.15  
WP Cracking >= 2.05  
RUT <=0.4

### Site Factors









PType: Flex  
ADT <=10,000

Life Expectancy: 7 years (Interval)  
Cost: \$10.01 / sy  
Subsequent Treatments:

- Crack Seal
- ARC
- Mill & Fill
- Reclamation
- Reconstruction

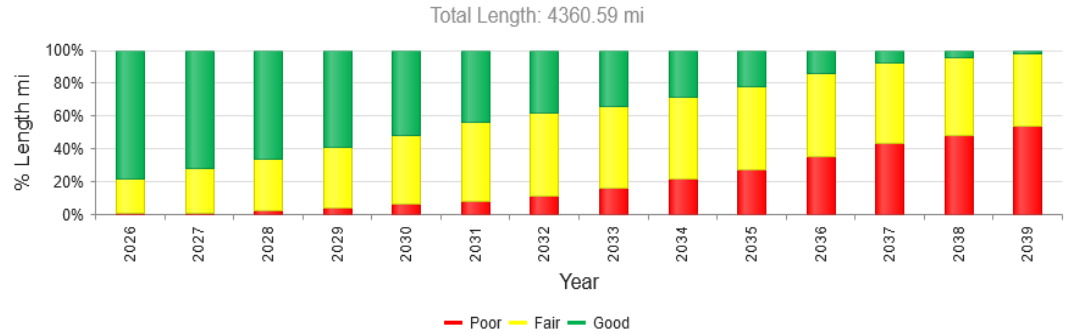


# Challenges / Lessons Learned: Transformation Class

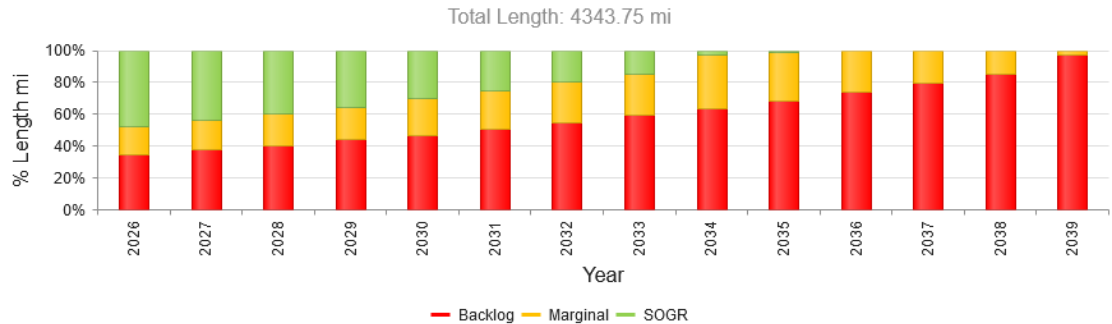
Name:	<input type="text" value="PMS_Family_Soils"/>
Description:	<input type="text" value="Transform Soils to PMS Analysis"/> 
<b>Specific</b>	
Execute Workflow:	(None) 
Target Attribute:	PMS_Analysis->Family_Soils  
Transformation Class:	MostLength 
Source Attribute:	Soils->Rating  
Network Filter:	(None) 
<b>Logging</b>	
Created By:	<input type="text" value="testDTIMS"/>
Created On:	<input type="text" value="5/20/2015 11:45:41 AM -04:00"/>
Modified By:	<input type="text" value="testDTIMS"/>
Modified On:	<input type="text" value="5/20/2015 11:45:41 AM -04:00"/>

# Comparison to Original System

Original CT-PCI | Do-Nothing

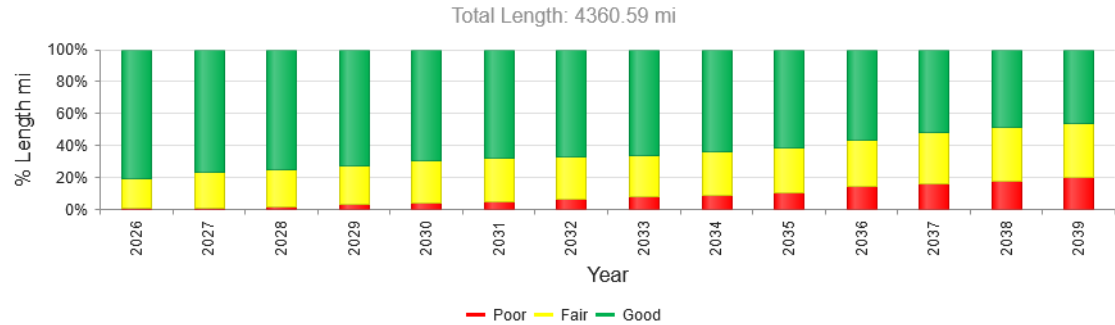


New PSPI | Do-Nothing

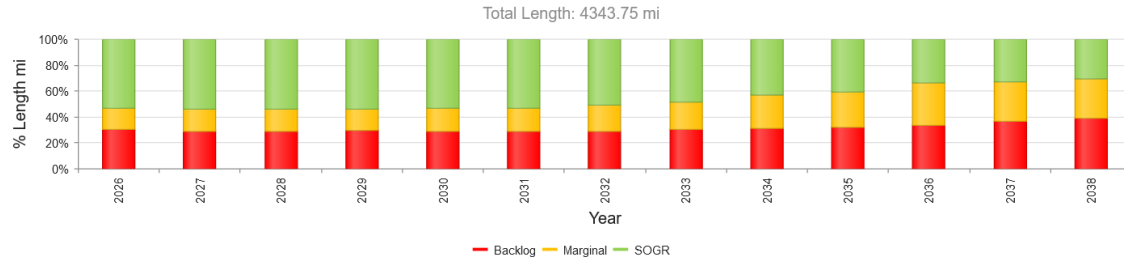


# Comparison to Original System


Original CT-PCI | \$240M Annually



New PSPI | \$240M Annually



# Implementation Strategy

- ~~• Build the new PMS~~
  - ~~• Test the new PMS~~
  - Develop Construction Programs for CTDOT Review
  - Work with Central DOT + Districts to see if the suggested treatments fit the program
  - Maintain degradation models and treatment trigger/reset criteria over time
- We are here!
- 

# Future Updates/Improvements

- Explore the addition of risk, traffic, and equity factors for treatment selection
- Add automatic updating for condition-based segmentation
- Explore the impact of averaging versus max/min distress use in dTIMS



**Thank you!**

# QUESTIONS

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