Pavement Management Implementation: Success Stories for Maryland Counties

September 25, 2015

Aaron D. Gerber, P.E.

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How Does Your Organization Manage Pavement Assets?

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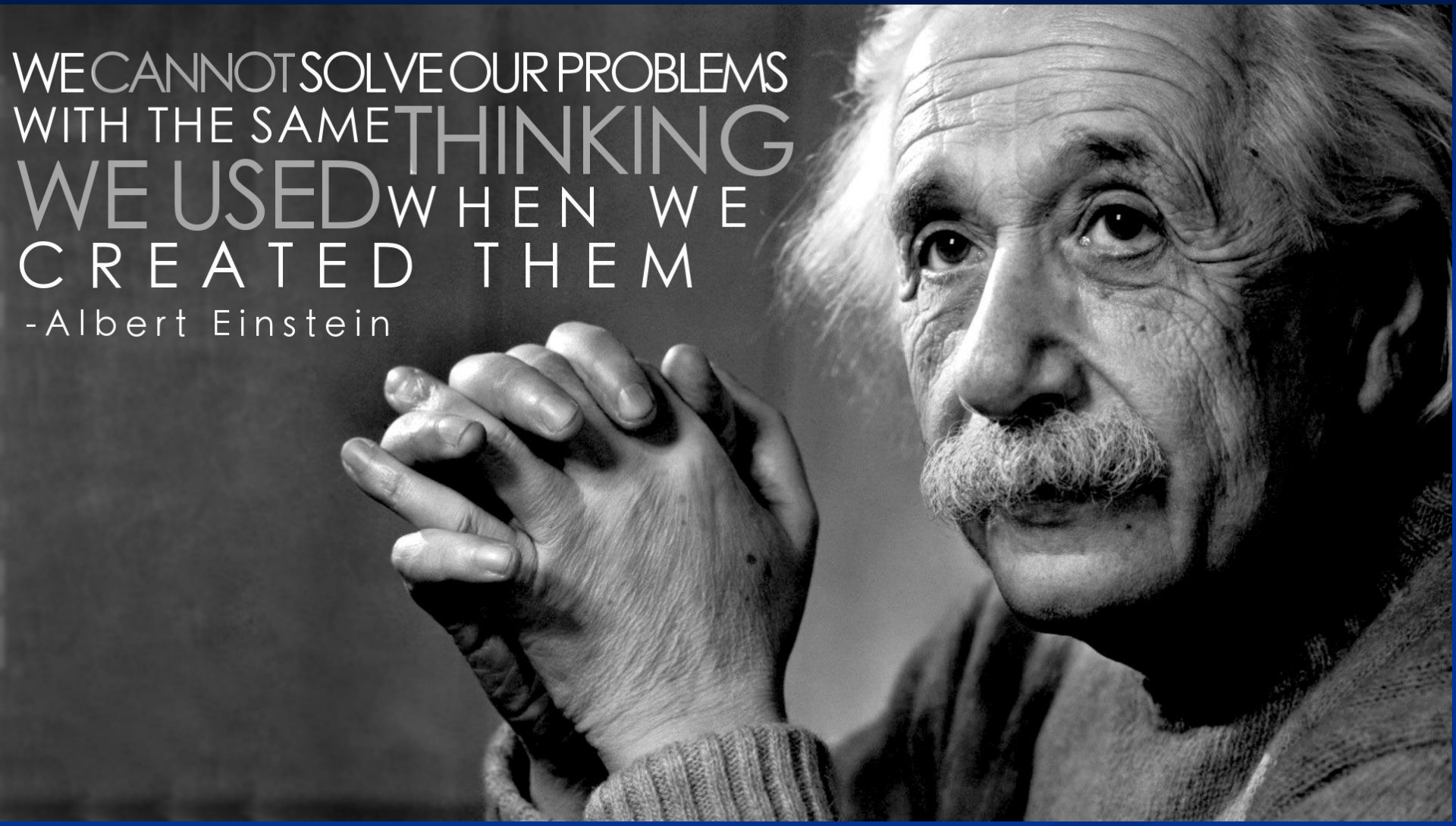
By Experience/Past Practice?



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By Customer Complaint?

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Do You Know What You Own?

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Do You Know the Network Condition?

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What Defines a “Good” vs. a “Bad” Road?

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Do You Know the Current Network Budget Need?

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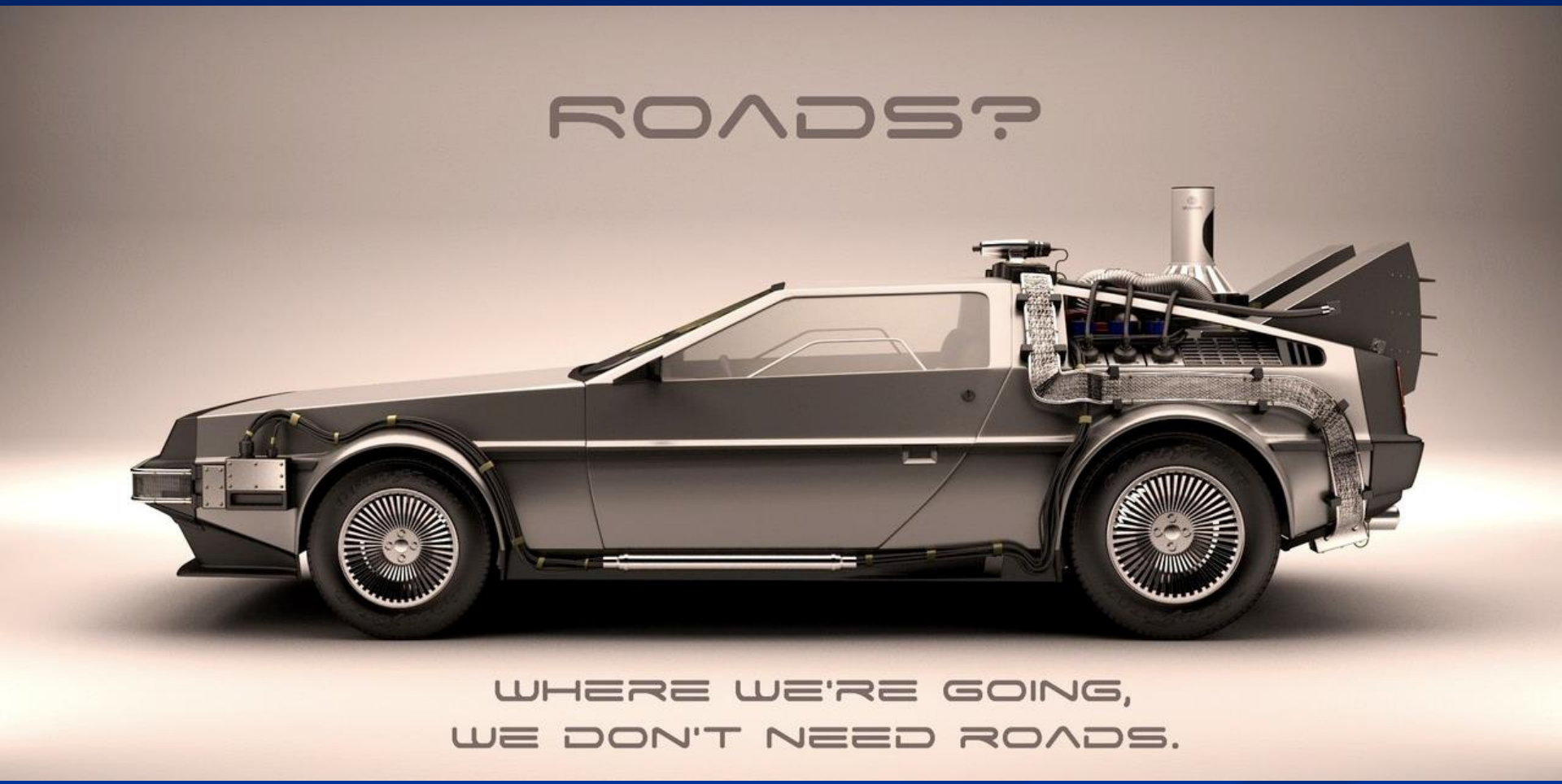
Can You Reasonably Predict the Future Network Condition and Budgetary Needs?



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In Determining Projects, Do You Apply the 3R's?

- Right Treatment
- Right Place
- Right Time

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In Determining Paving Projects, Are You Proactive or Reactive?

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Why Implement Pavement Management?

Identify the Long-Term Consequences of Today's Funding Decisions

Show the Best Use of Limited Tax Dollars for Maintaining County Road Infrastructure

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Why Implement Pavement Management?

Preserve Today That Which Will Cost More to Rehabilitate Tomorrow

Maximize User Benefit and Level of Service

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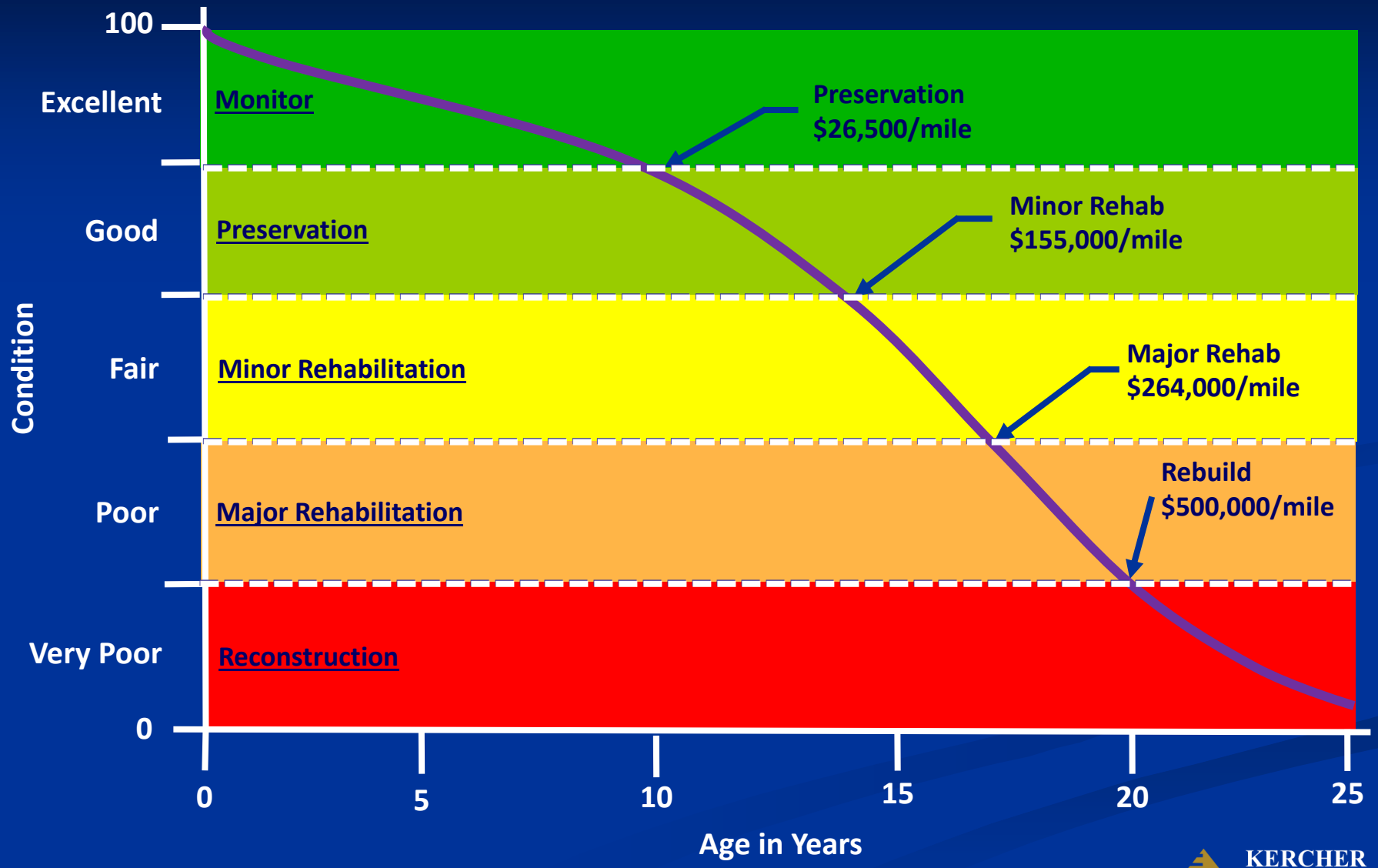
Cost of Delaying Pavement Repairs



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Types of Management Methods

- Worst First – Sort the Network from worst condition to best condition, and start picking off the top of the list
- Prioritization – Develop a weighting scheme to take into consideration additional elements into treatment selection. Create a list and start picking from the highest weighted road to the lowest
- Optimization – Achieve an objective (maximize condition) given a set of constraints (budgets) to make best/optimal use of funds

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Power of Pavement Preservation Comparisons of Optimization vs. Worst First Analysis Results

- Scenario: $10 Million/Year for 10 Years
- Data Source: Carroll County
- Metric 1: Average Network Condition (PCI)
- Metric 2: % of Network Treated
- Metric 3: Backlog Cost of Untreated Network

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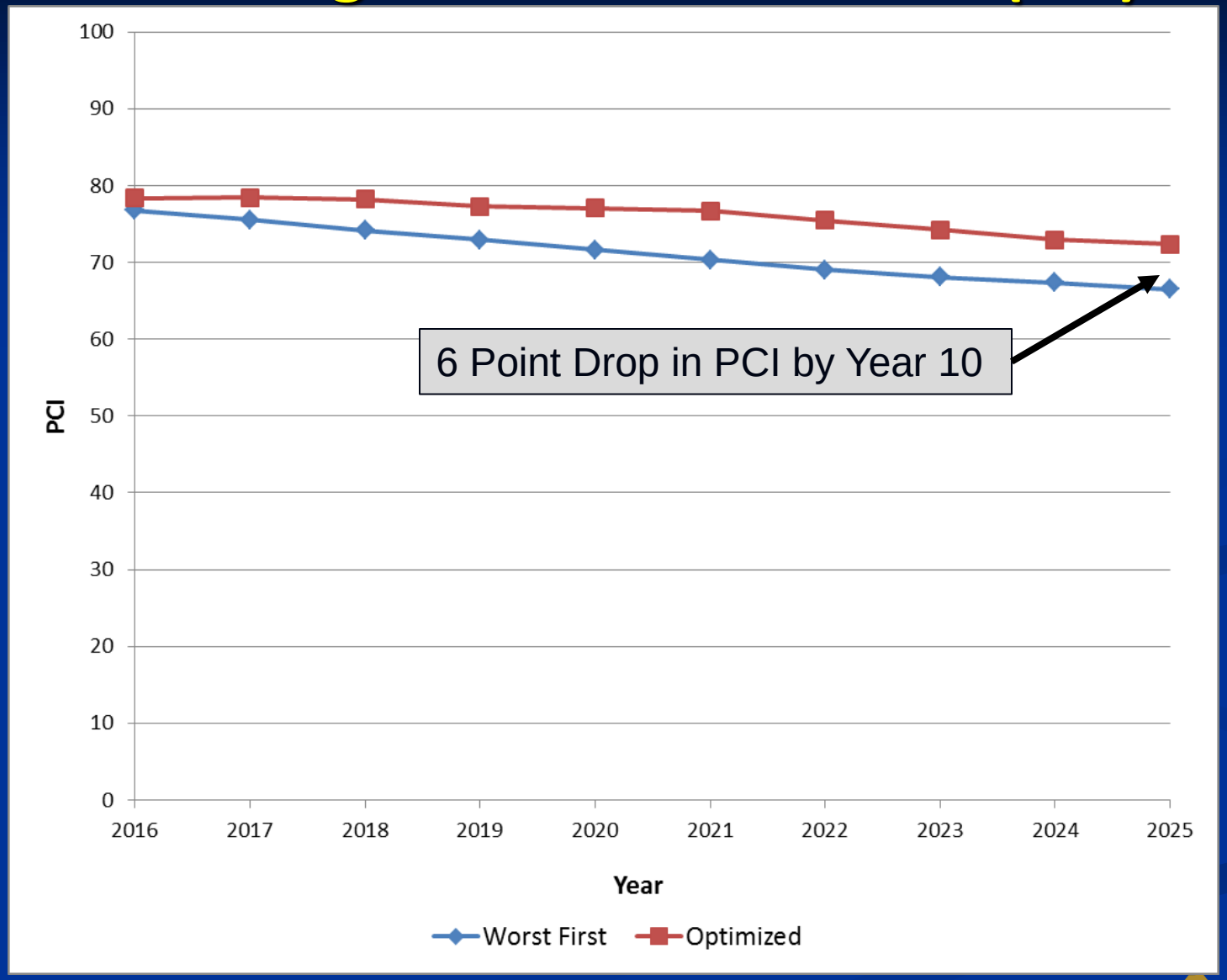
Average Network Condition (PCI)



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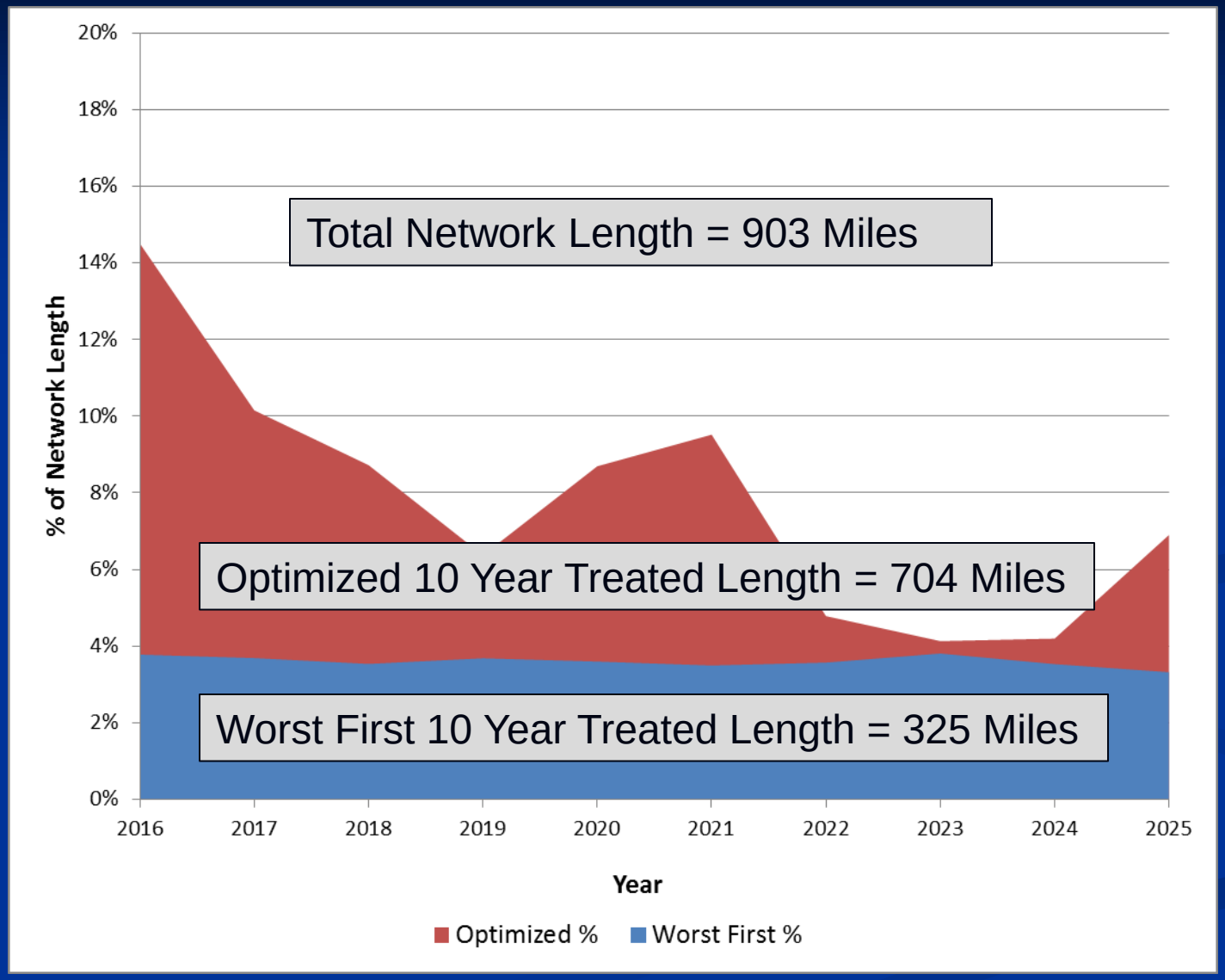
User Benefit – % of Network Treated



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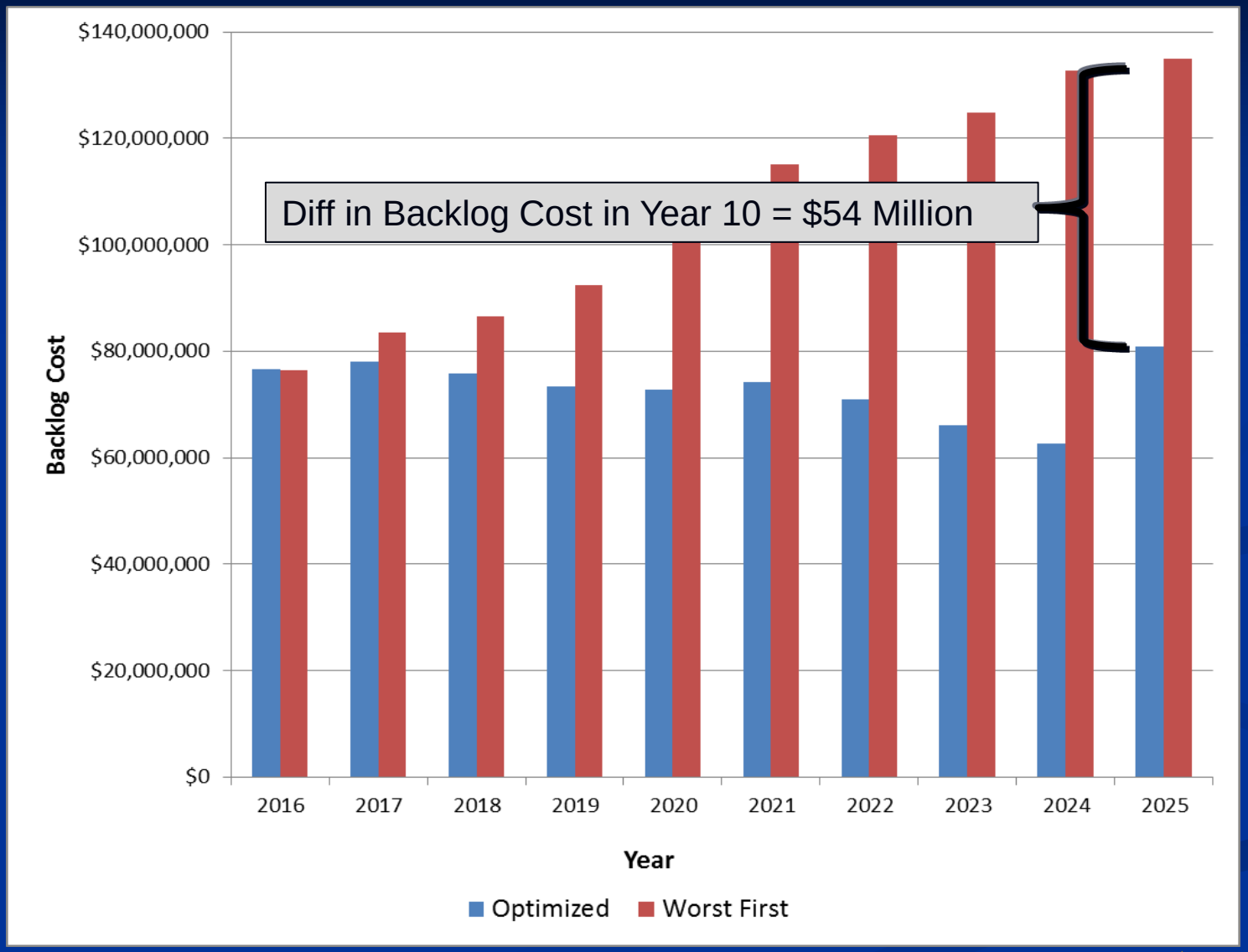
Backlog Cost of Untreated Network



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Maryland Counties Who Can Answer These Questions Effectively

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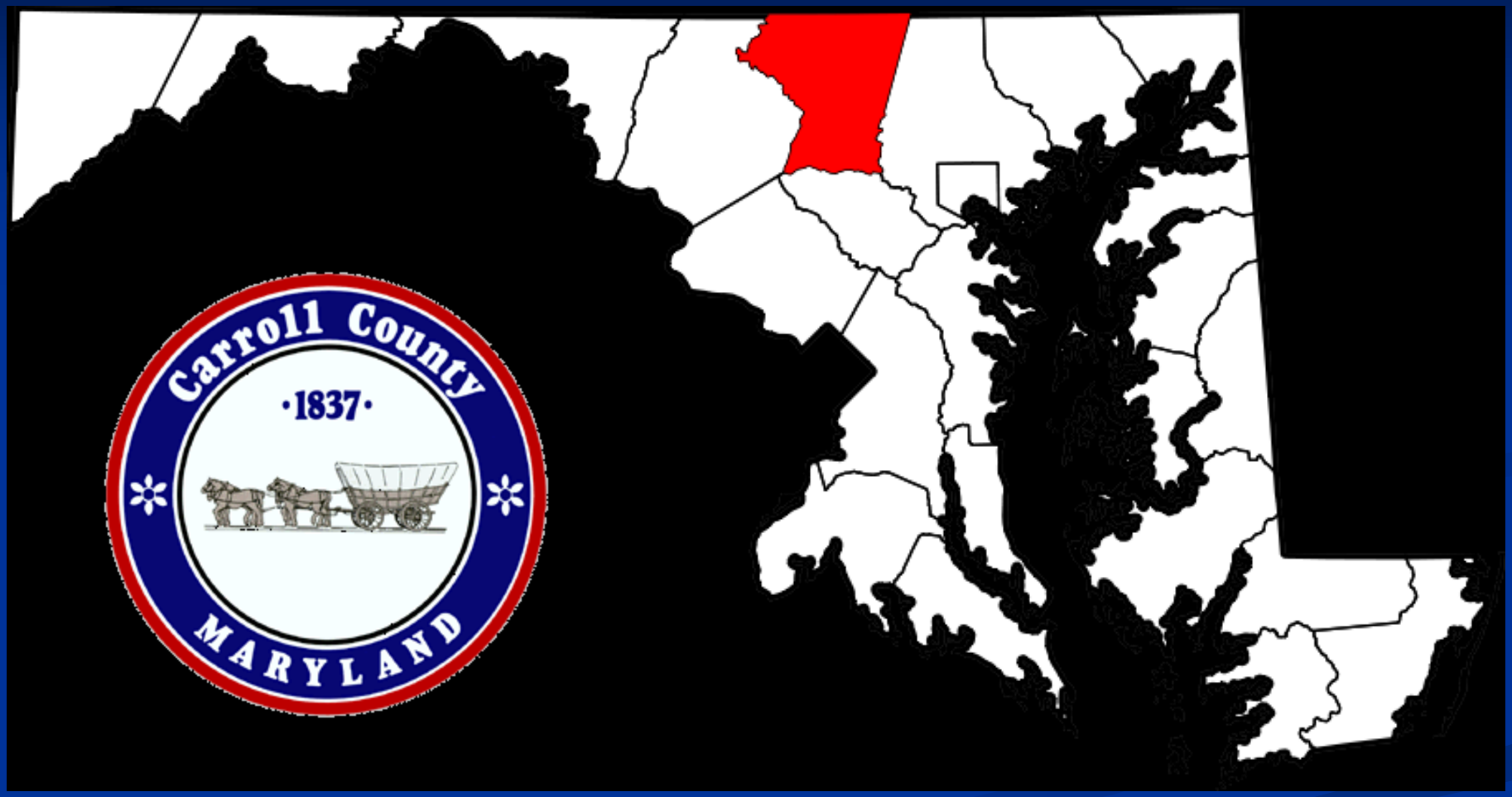
Carroll County



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Background

- County has implemented Pavement Management since mid-90's
- Utilized a simplified Pavement Management System (PMS) to track pavement condition and repair costs
- Limited Functionality
  - No Predictive Modeling
  - No Budget Analysis Capability
  - Not Customizable to County needs

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Background

- In 2011, County acquired state-of-the-art PMS software and consulting services through competitive bid
- Provides budget optimization capabilities and pavement performance prediction
- Provides vastly improved decision making capabilities within the department

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Inventory Management

- County Maintains a Pavement Inventory Database
  - Network Mileage: Approx. 903 Centerline Miles of Paved Roads
- Many Attributes are stored:
  - Road Name
  - Geometric Info: Length, Width, etc.
  - Commissioner District
  - Maintenance District
  - Subdivision

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Pavement Condition Surveys

- Windshield Survey – County Has Performed Pavement Condition Surveys Since the mid-90's
- Improved Processes adopted in 2012
- Collecting Pavement Surface Distresses on Each Road in the Network
  - Distress Severity (How Bad)
  - Distress Extent (How Much)
  - Structural Distresses – Cracking, Rutting, Patches/Potholes
  - Functional Distresses – Cracking, Raveling, Weathering

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Pavement Condition Index

- Pavement Condition Index (PCI) Calculated from Distresses
- 0 to 100 Scale
  - 100 = Perfect/New Condition
  - 71-85 = Satisfactory Condition Range
  - 0 = Not Passable
- Used for Performance Modeling
- Used for Repair Decision Making
- Used for Reporting Network Condition

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Treatments

- Preservation
  - Micro-Surfacing
  - Ultra-Thin Overlay (Subdivision Streets)
- Rehabilitation
  - Thin Overlays: Mill & Fill, Patching & Overlay (< 2”)
  - Thick Overlays: Deep Patching & Thick Overlays (>2”)
- Reconstruction
  - Full Depth Reclamation
  - Remove & Replace

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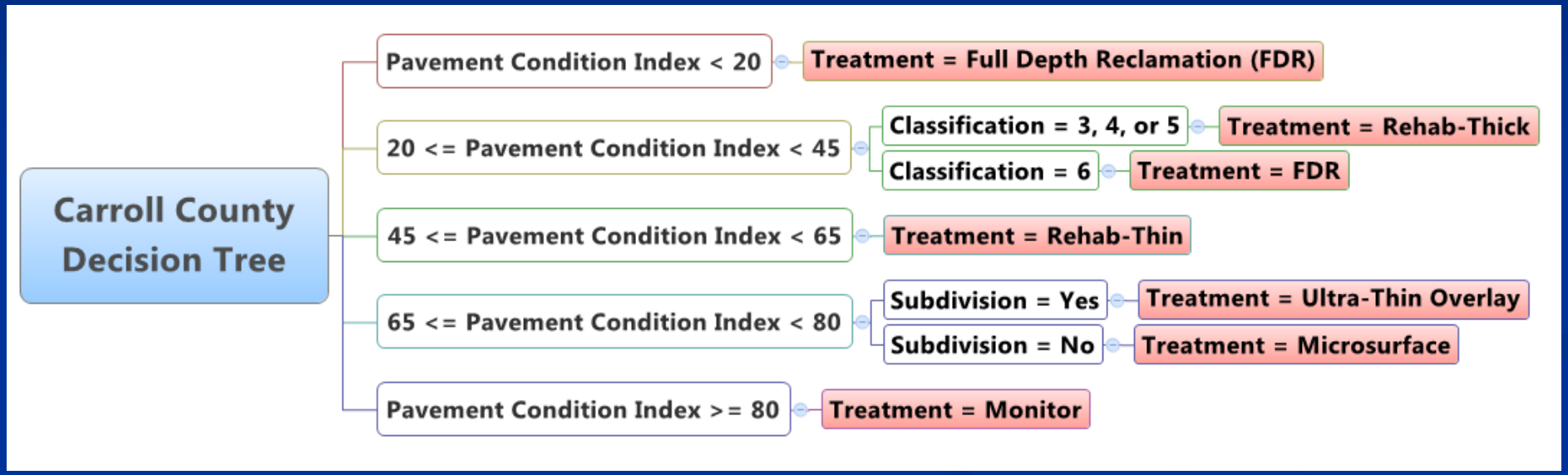
Decision Trees



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Pavement Performance Concept

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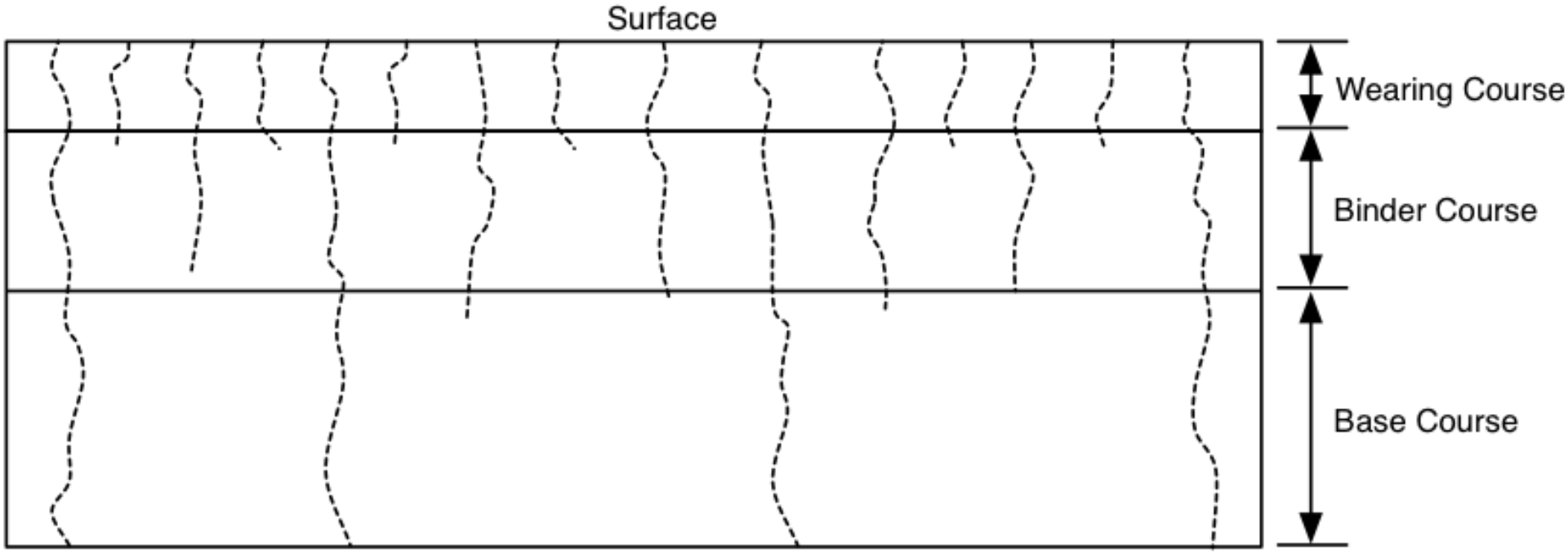
Pavement Structure Review
Distressed Pavement Section



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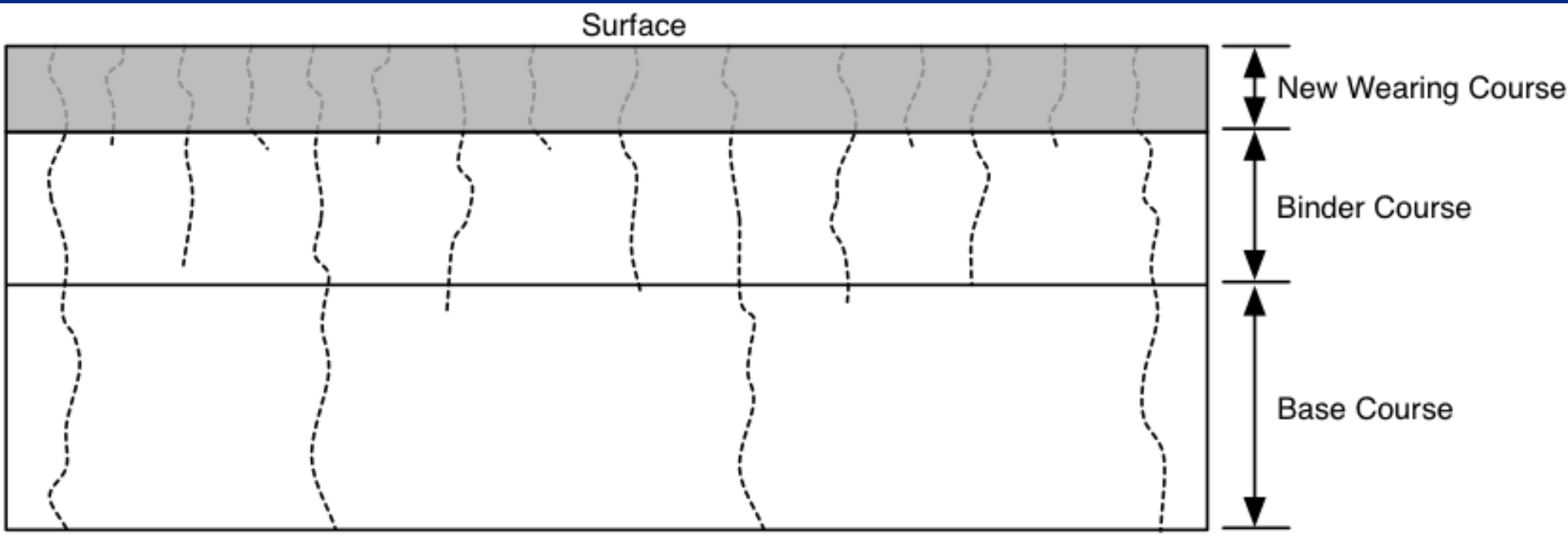
Pavement Structure Review
Treatment: Rehab-Thin



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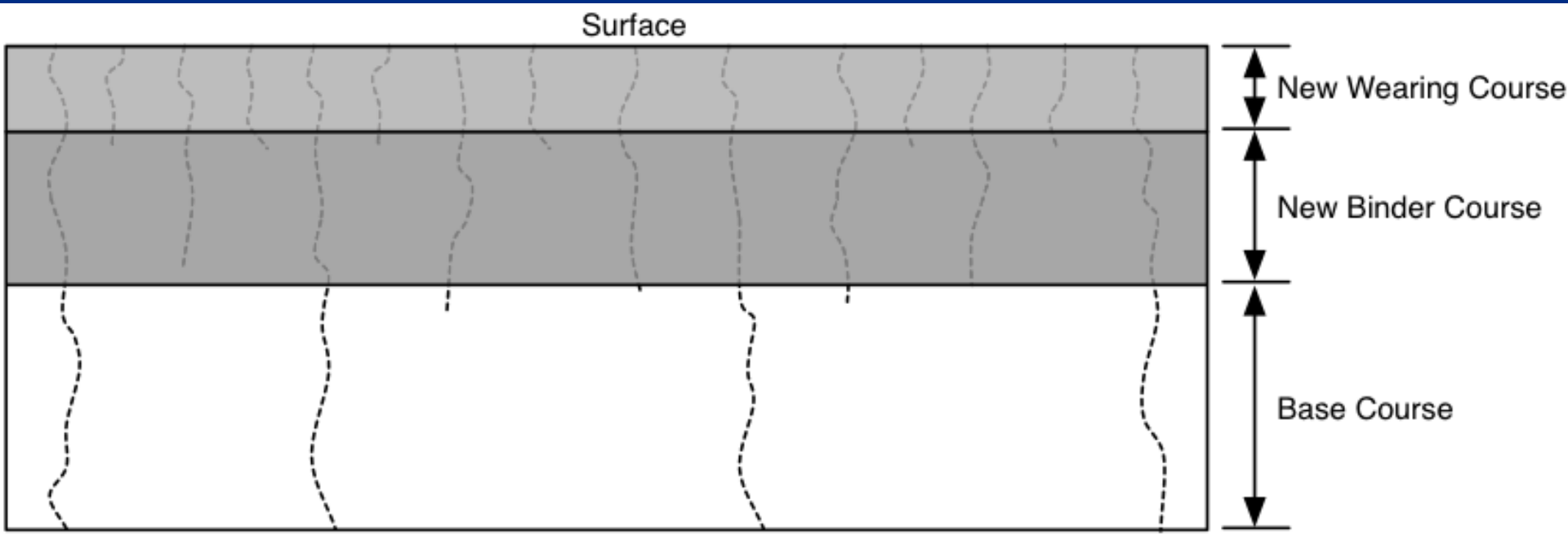
Pavement Structure Review
Treatment: Rehab-Thick



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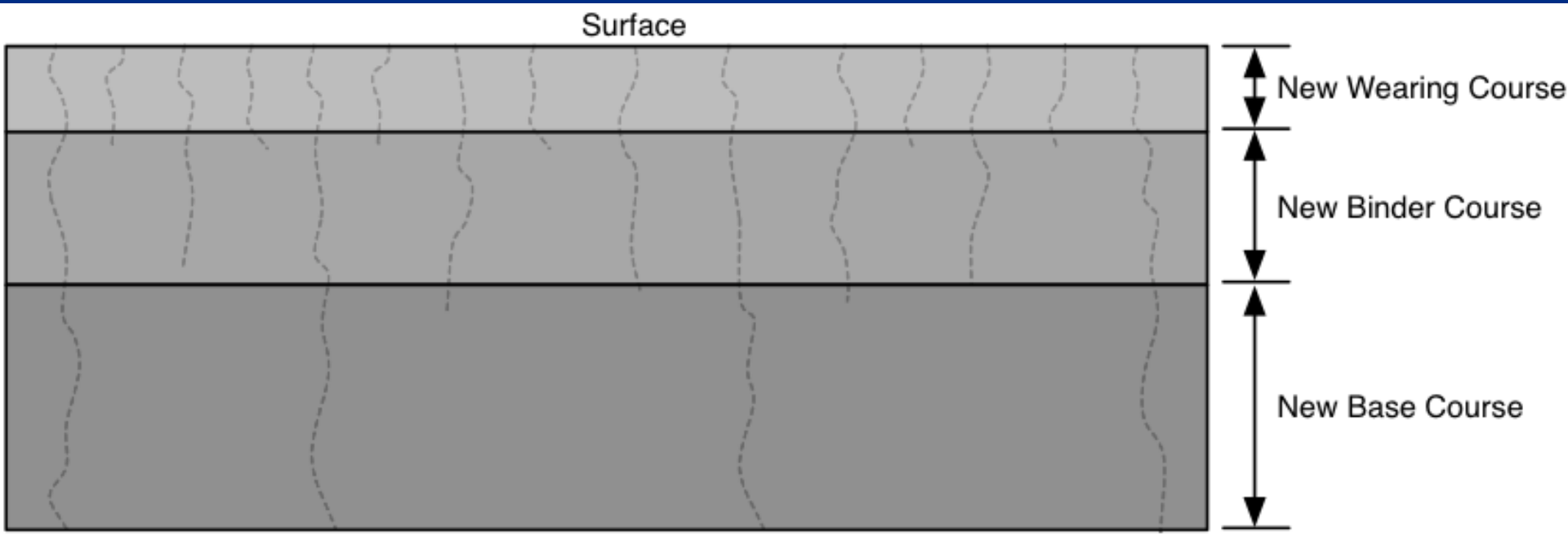
Pavement Structure Review
Treatment: Removal and Replacement / FDR



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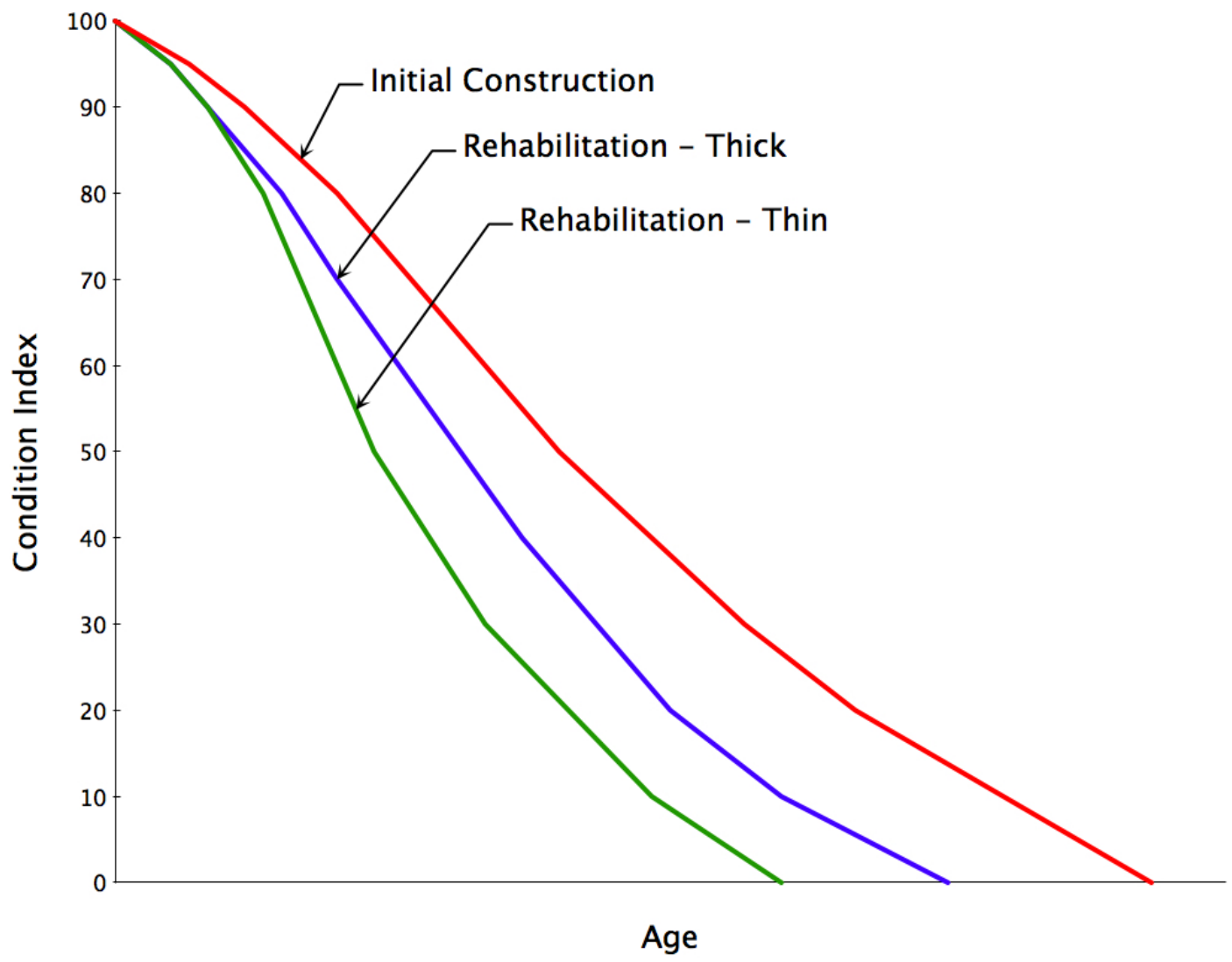
Treatment Performance Relationship



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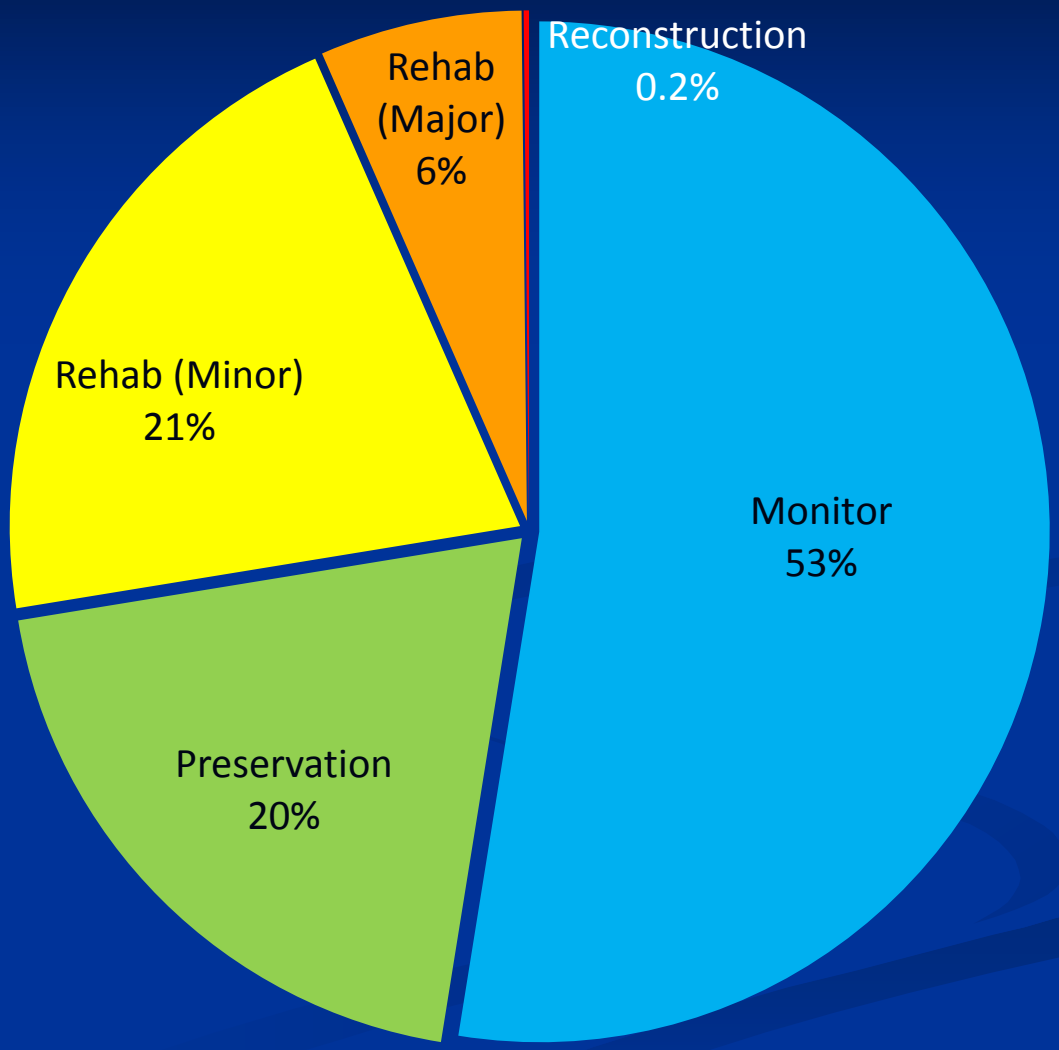
2014 Network Statistics

- Total Network Length = 903 Miles
- Average Network PCI = 76.5
- Approx. Network Cost Backlog = $60 Million
- $/Mile = $67,000/mi



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Multi-Constraint Optimization Analysis

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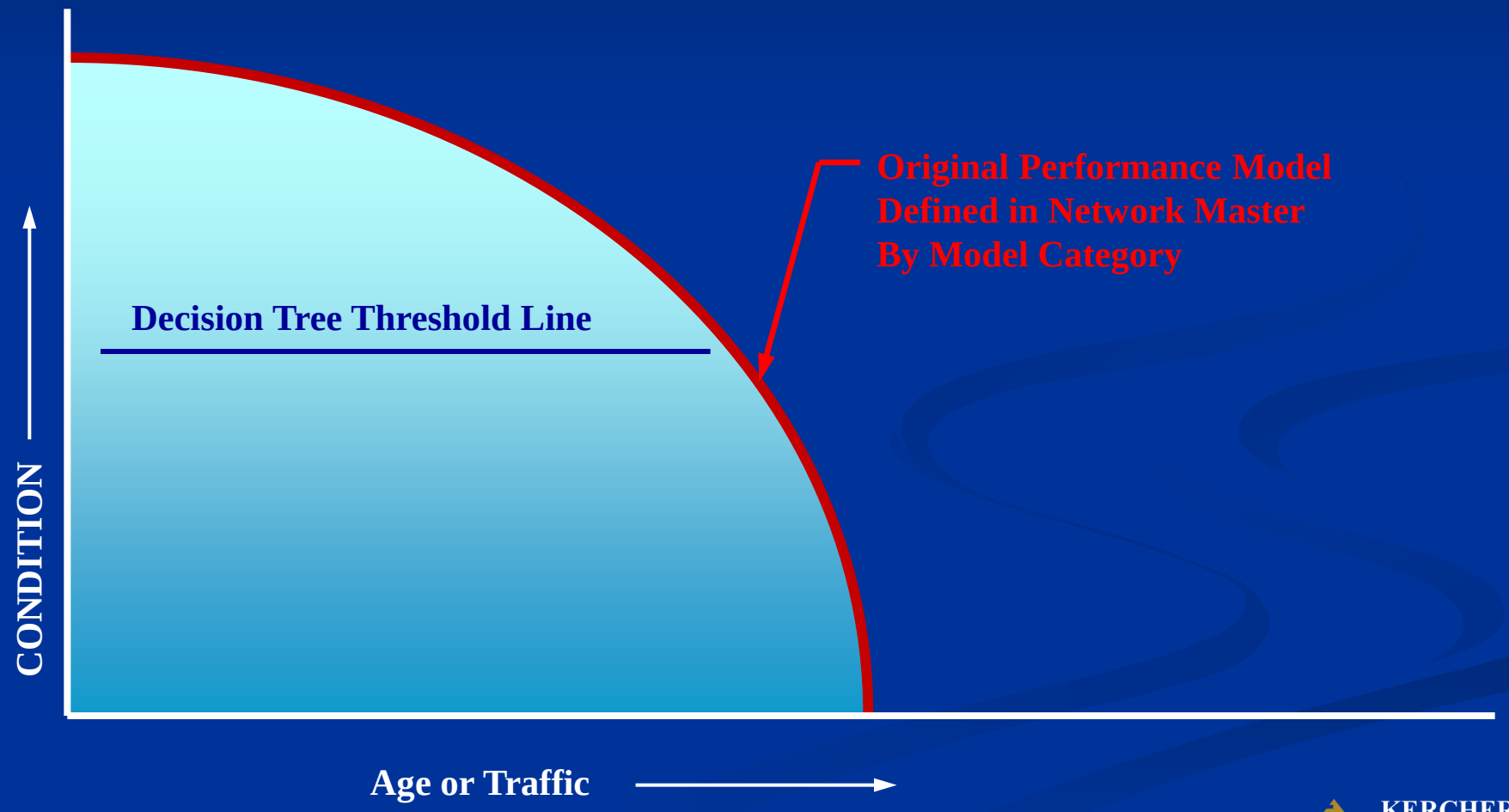
Performance Model – Benefit Concept



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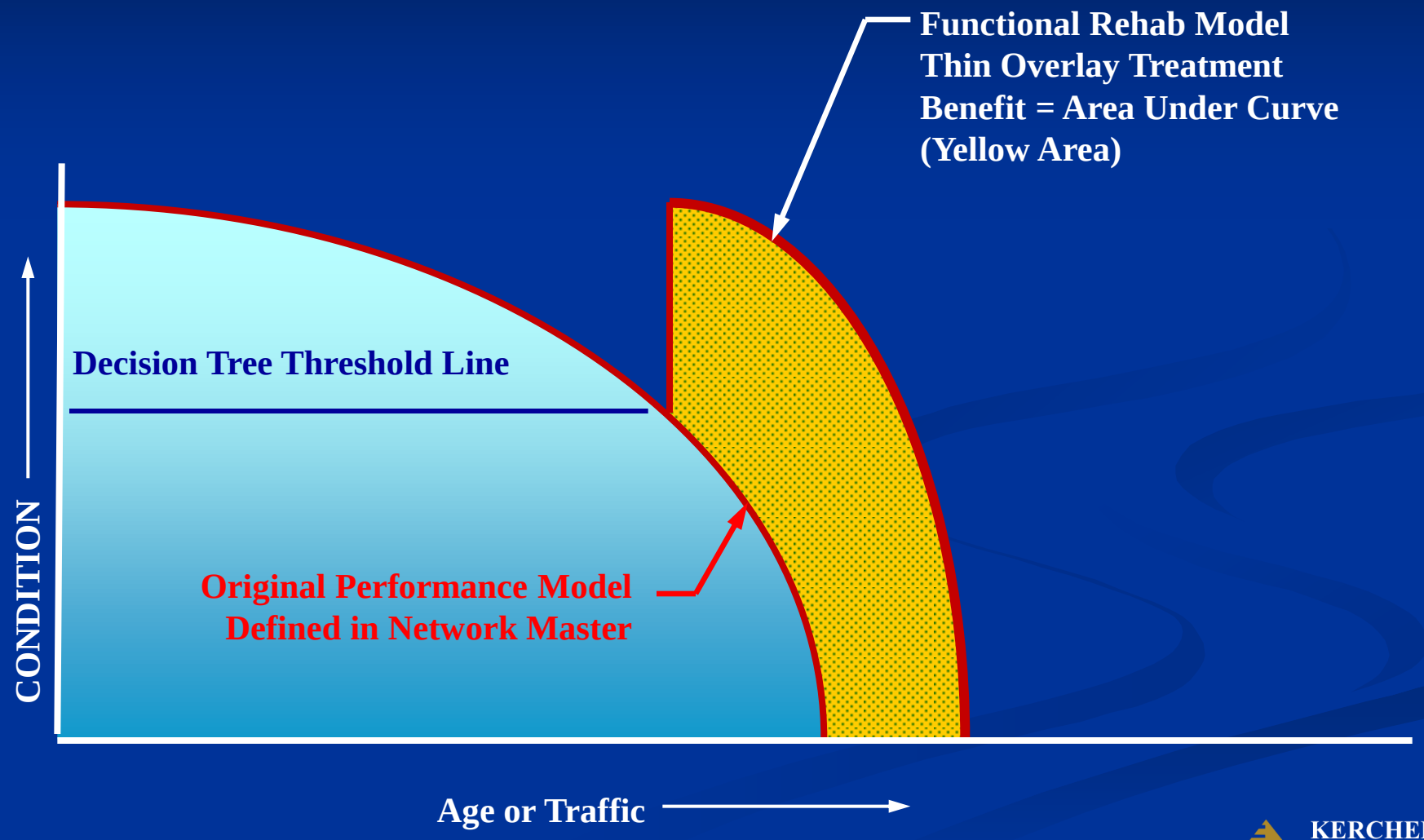
Performance Model – Benefit Concept



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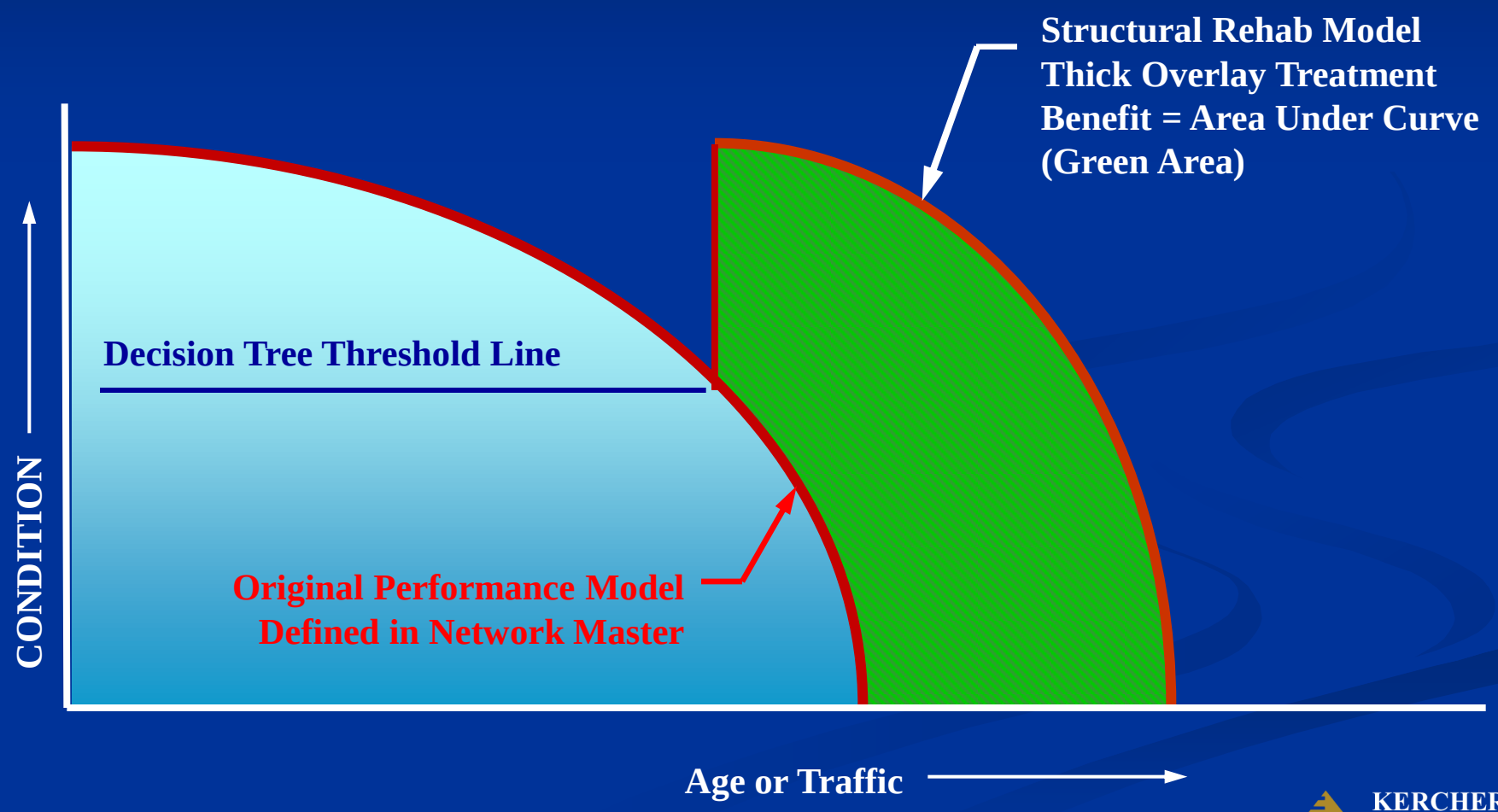
Performance Model – Benefit Concept



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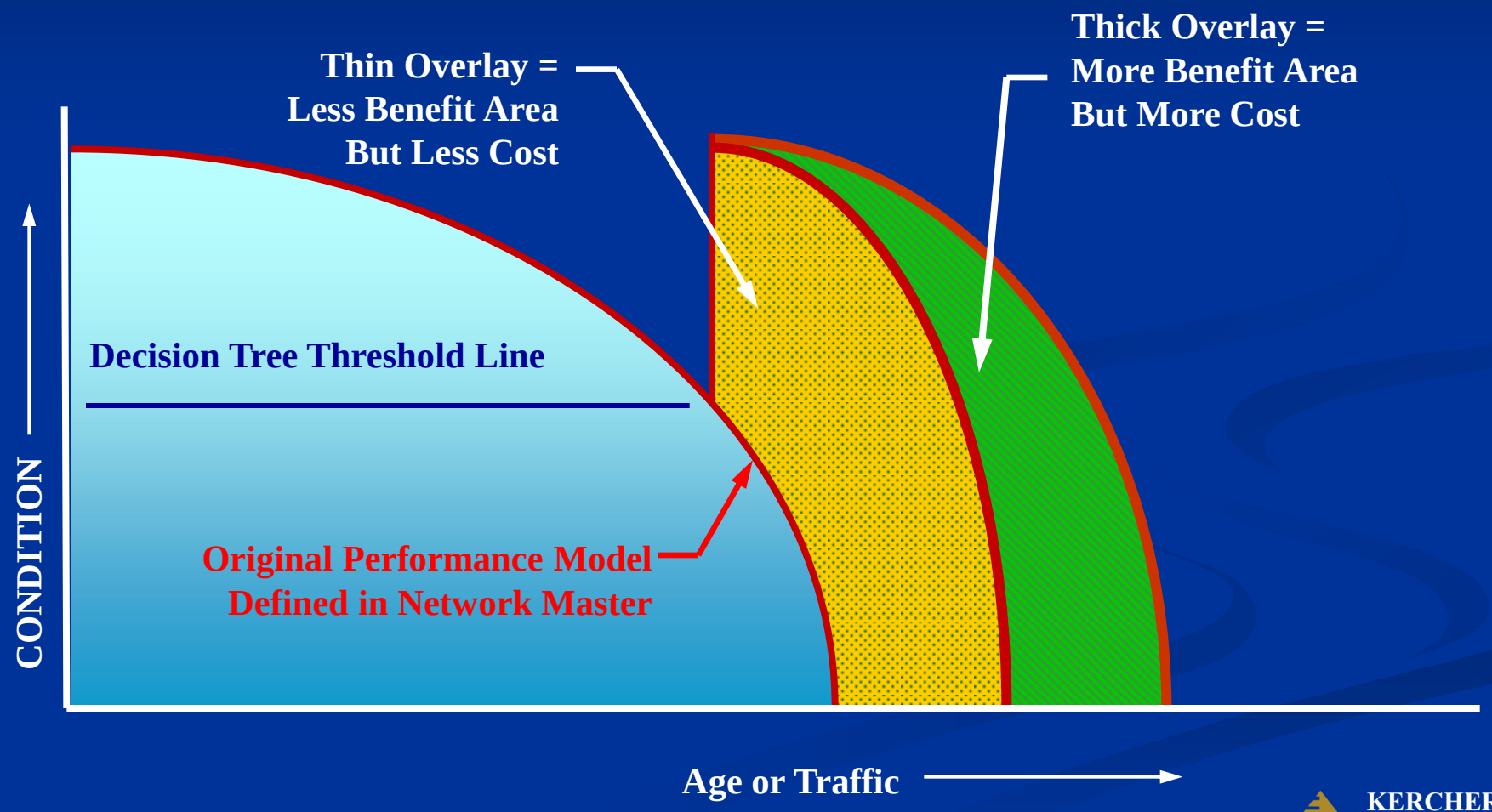
Performance Model – Benefit Concept



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Optimization Goals

- Obtain the Best Set of Projects
  - The projects meet a set of constraints
  - Maximizes or minimizes an Objective (maximize condition, minimize budget, etc.)
- The desired OUTPUT of the analysis is a WORKPLAN, that is:
  - Which sections to fix (WHERE)
  - Using which treatments (WHAT)
  - In which year (WHEN)

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Performance Monitoring Process

- DPW Goal – Maintain Network Average PCI between 71 and 85 (Satisfactory Level)
- Run Various Optimization Analyses to Test Funding Needs to Meet Goal
- Compare to CIP Budgeting Scenario to determine Funding Needs
- Determine the Best Funding Scenario to Minimize Backlog Cost while Maintaining PCI Goal

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Performance Monitoring Process

- Specific Requests from Budget Office
  - What happens to the network if we cut your budget in half?
  - What happens to the network if we give you additional $2 Million?
  - How much money would you need to achieve a PCI of 80 during the CIP period?

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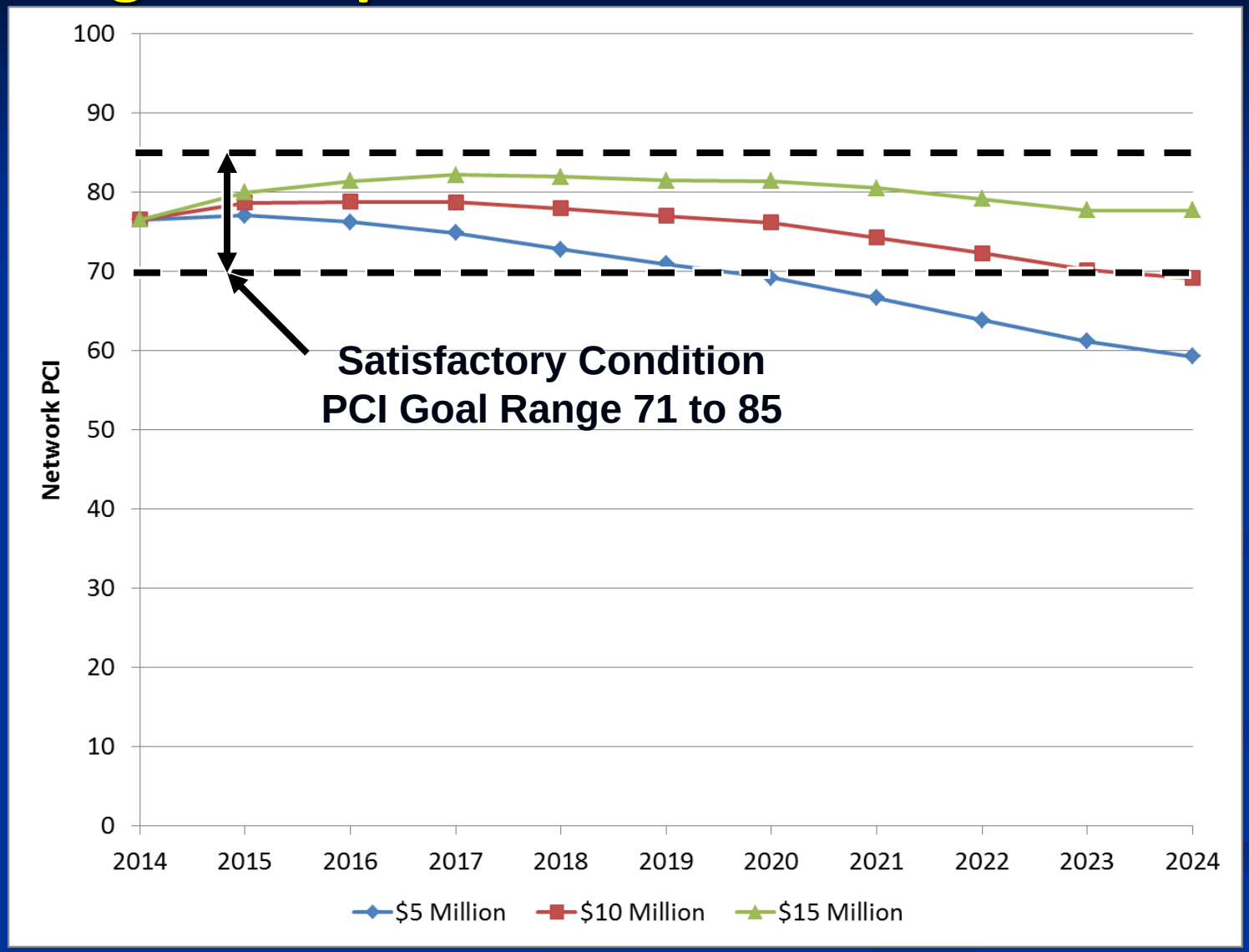
Budget Comparisons – Network Condition



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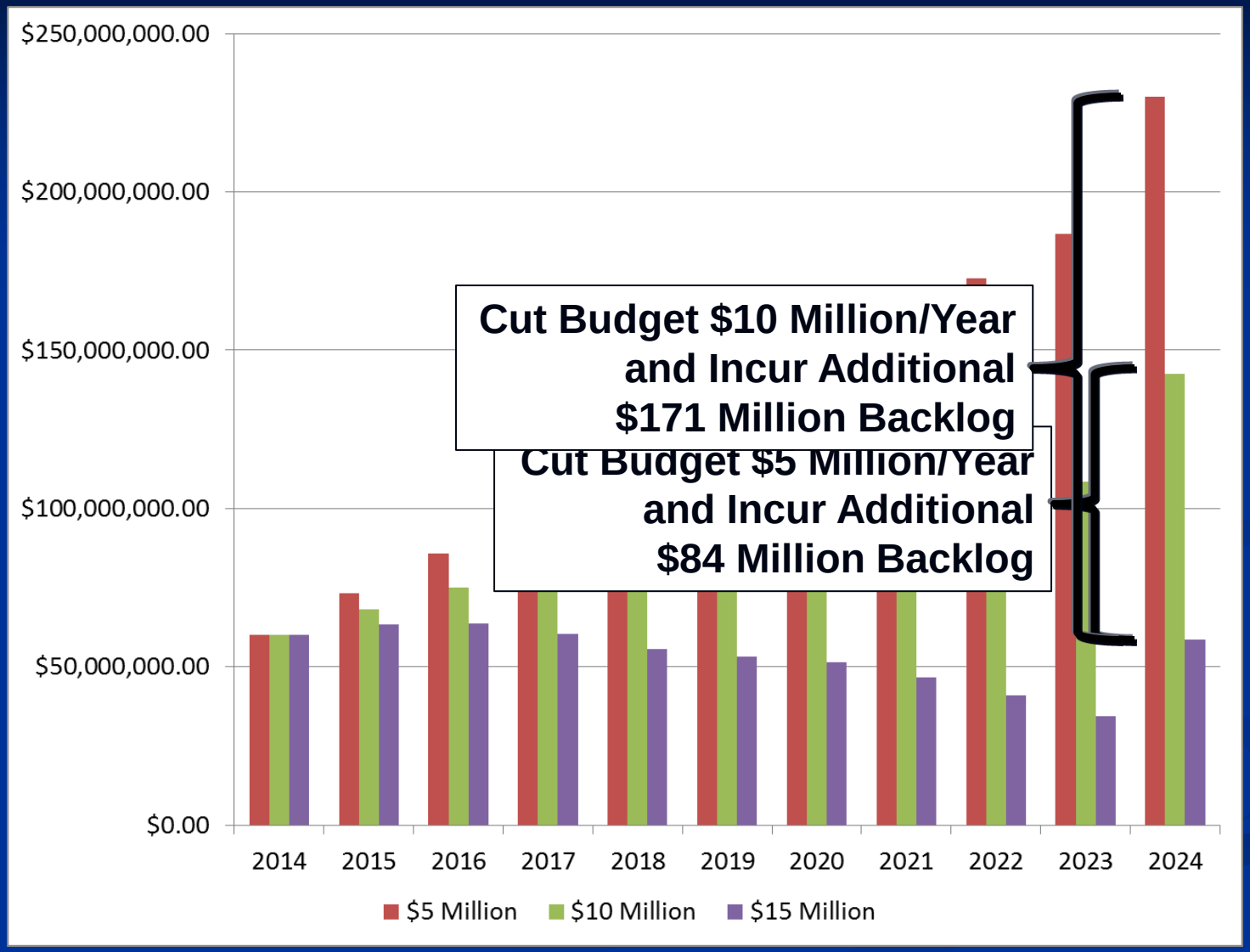
Budget Comparisons – Network Cost Backlog



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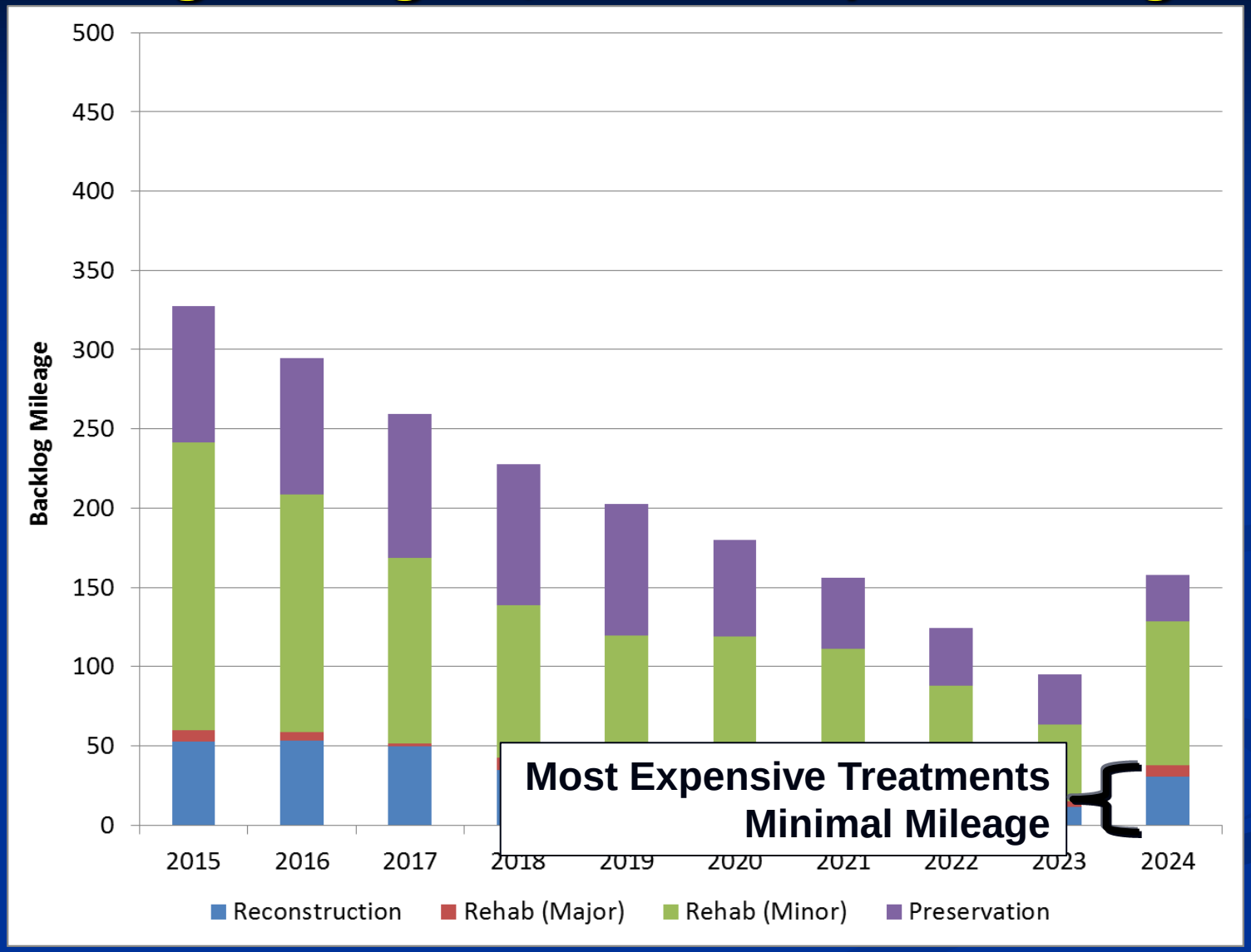
Backlog Mileage - $15 Million/Year Budget



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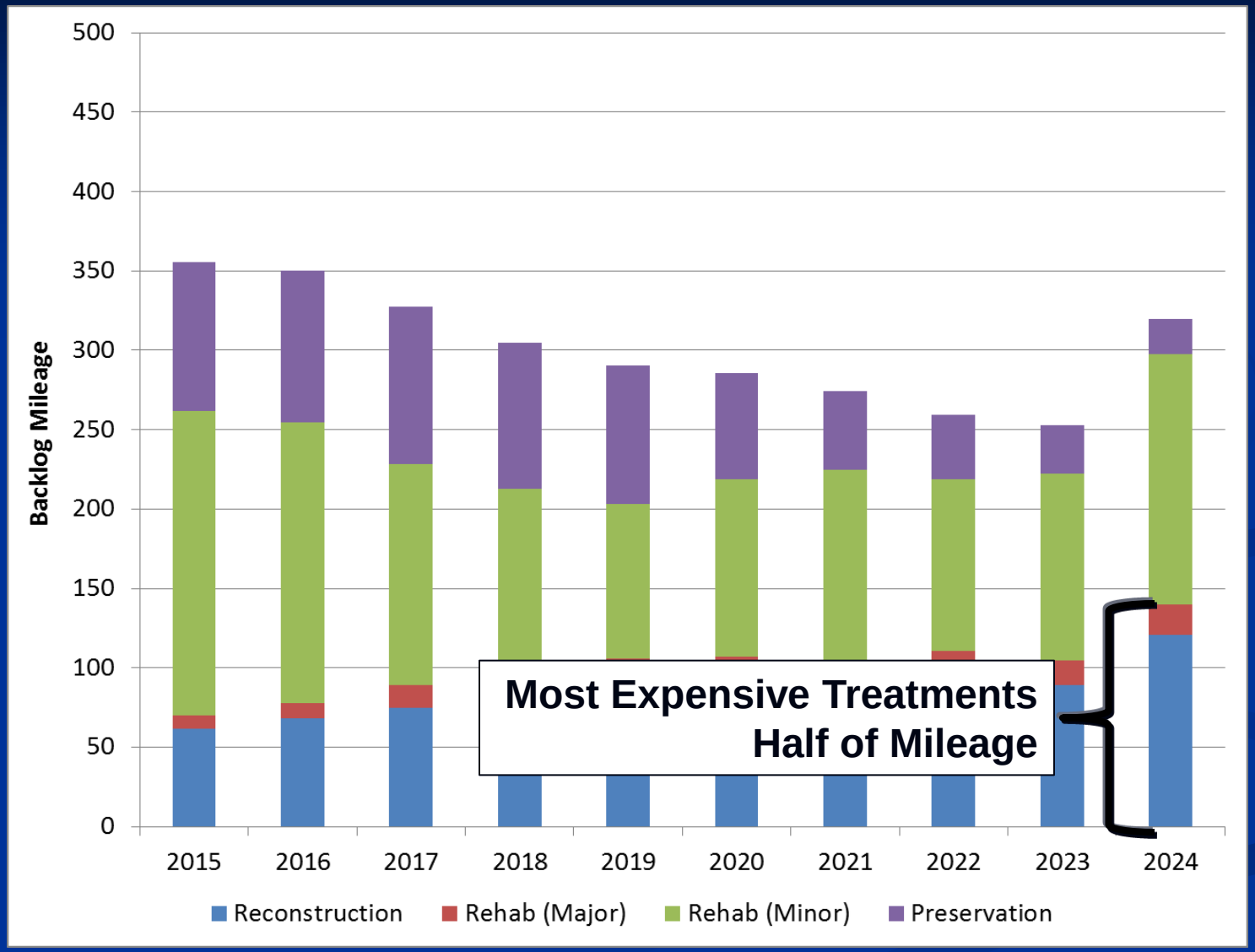
Backlog Mileage - $10 Million/Year Budget



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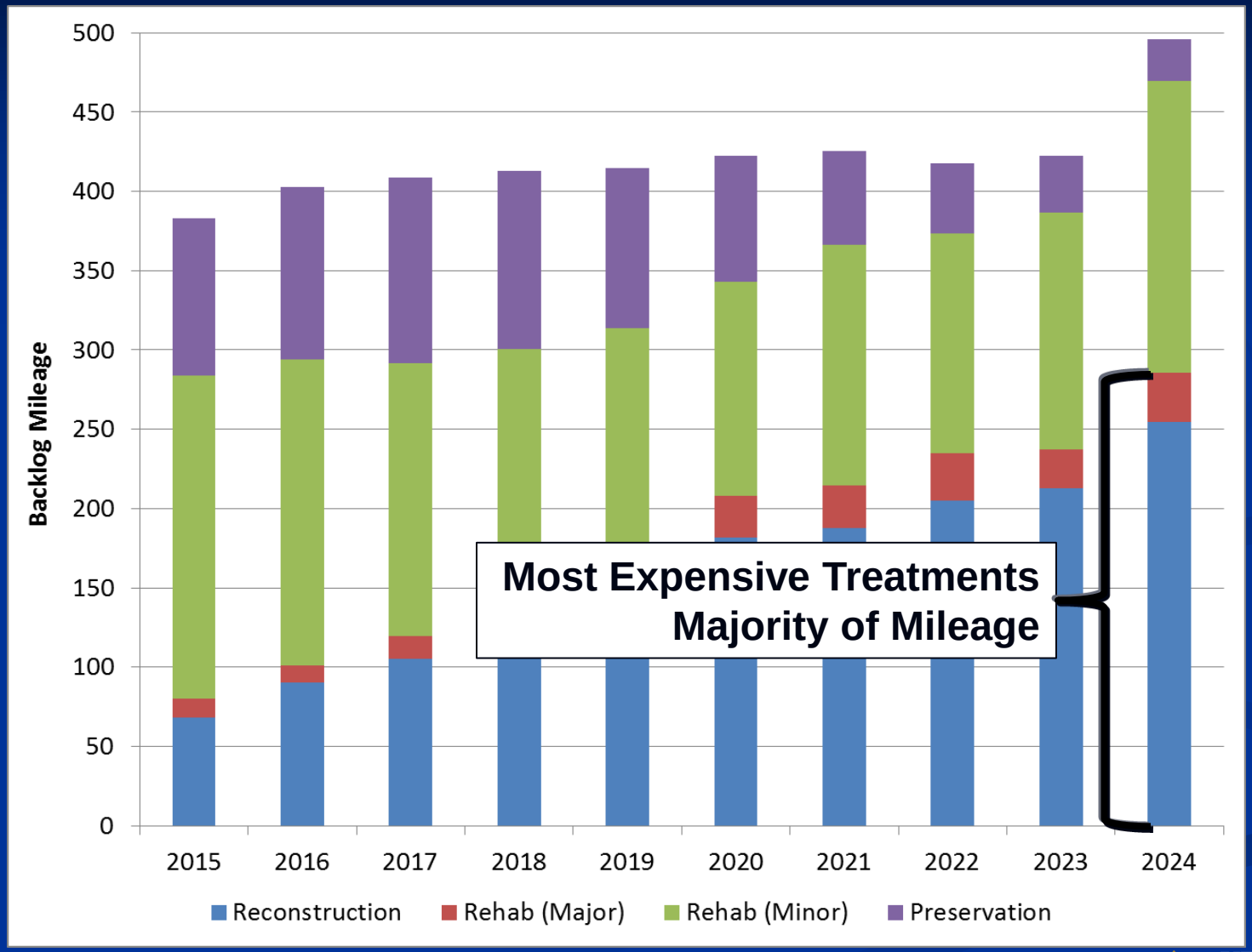
Backlog Mileage - $5 Million/Year Budget



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Carroll County Summary

- Making good treatment choices – Using the 3Rs
- Justifying and maintaining appropriate funding levels
- Educating public officials on processes
- Staff dedicated to the success of the program

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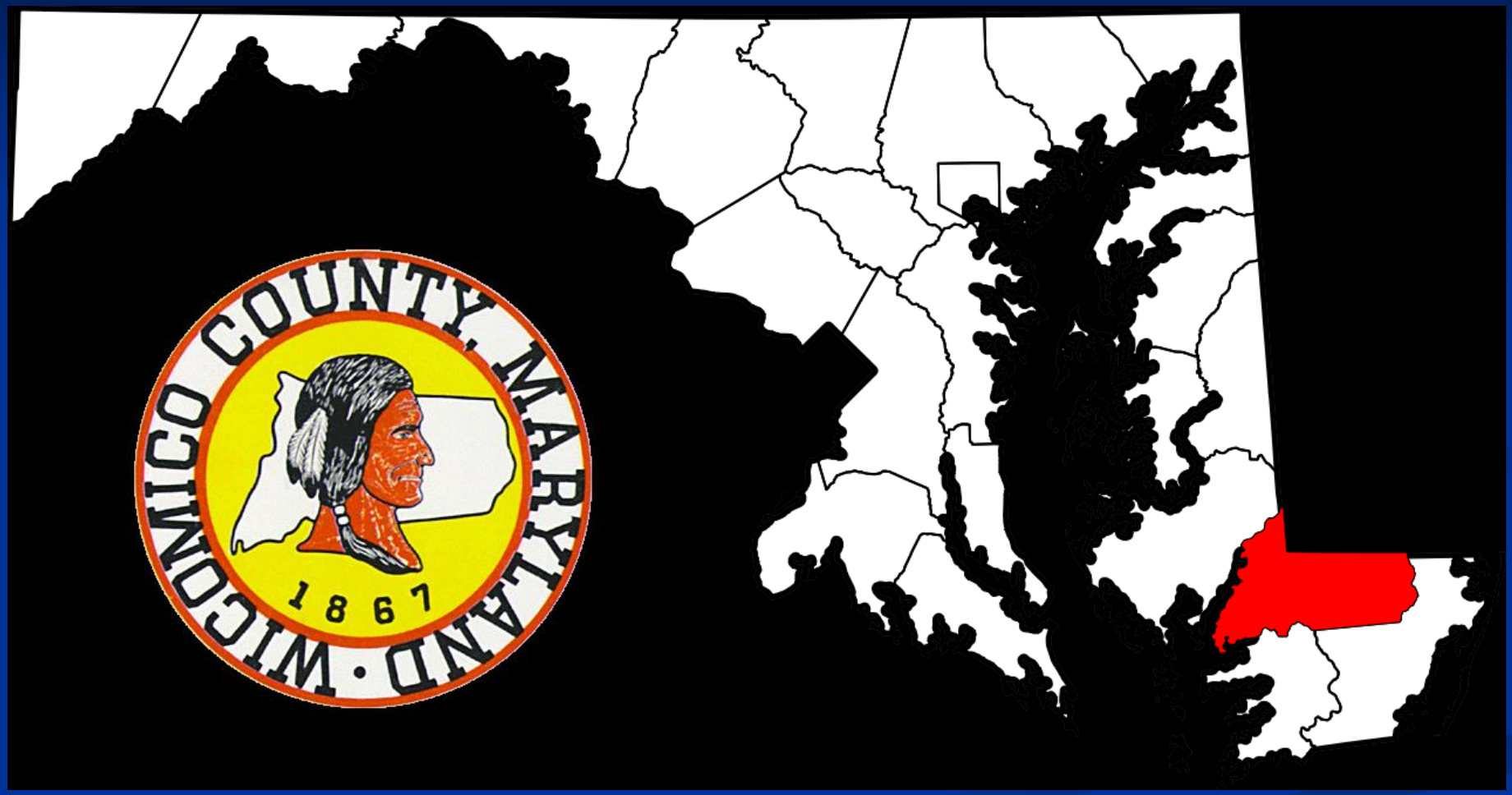
Wicomico County



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Background

- In the past, the County utilized a spreadsheet to track inventory and construction history of pavement network
- This didn't provide forecasting capability or budget analysis
- In 2013, County acquired software and consulting services through bridge contracting

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Pavement Condition Surveys

- Windshield Survey – Performed Pavement Condition Surveys in 2014
- Collecting Pavement Surface Distresses on Each Road in the Network
  - Distress Severity (How Bad)
  - Distress Extent (How Much)
  - Structural Distresses – Cracking, Rutting, Patches/Potholes
  - Functional Distresses – Cracking, Raveling, Weathering

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Treatments

- Preservation
  - Micro-Surfacing
  - Slurry Seals
  - Chip Seals
  - Cape Seals
- Rehabilitation
  - Thin Overlays: Mill & Fill, Patching & Overlay (< 2”)
  - Thick Overlays: Deep Patching & Thick Overlays (>2”)
- Reconstruction
  - FDR/CIR

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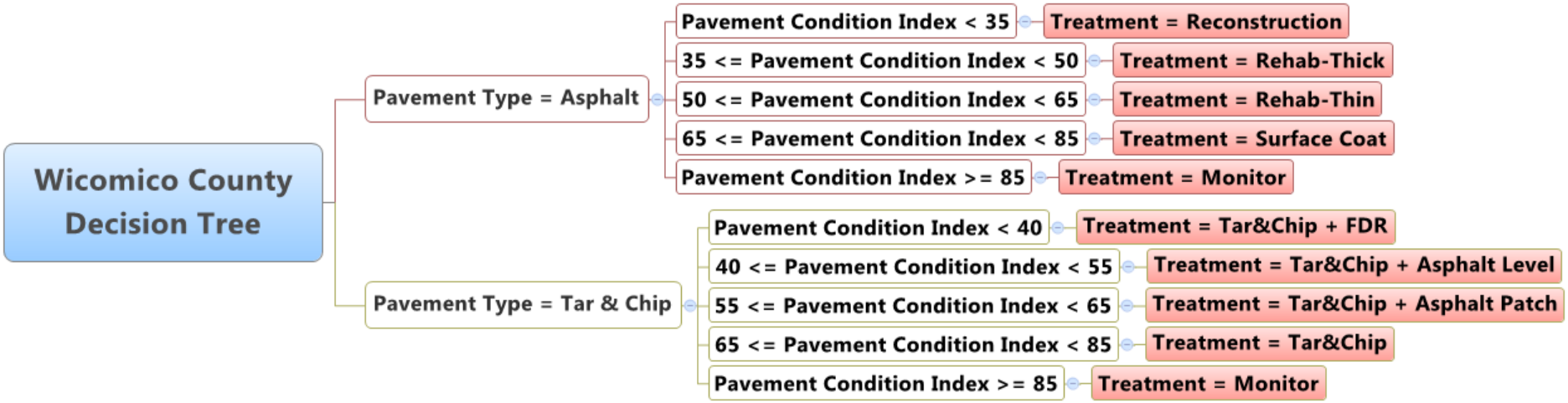
Decision Trees



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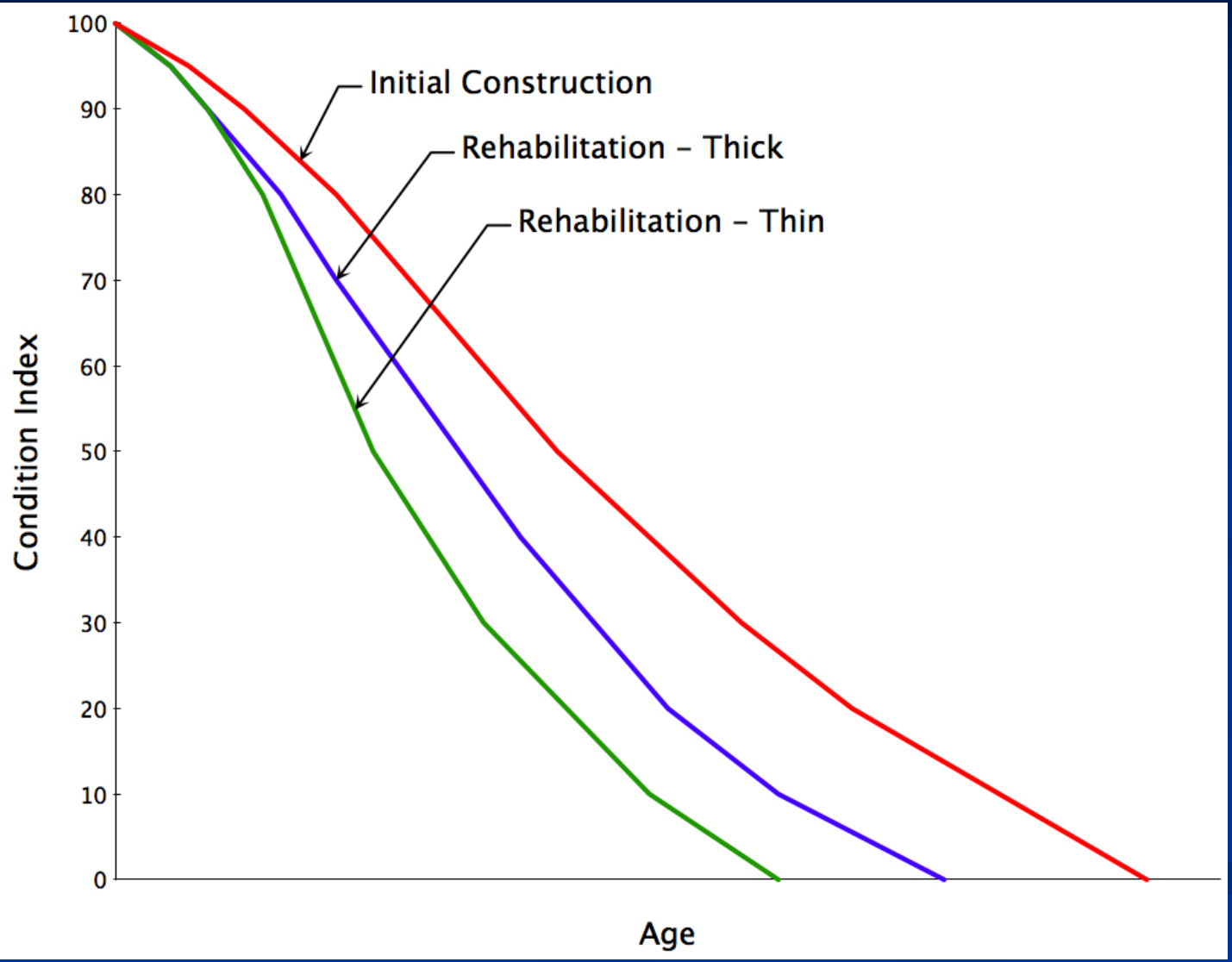
Performance Models



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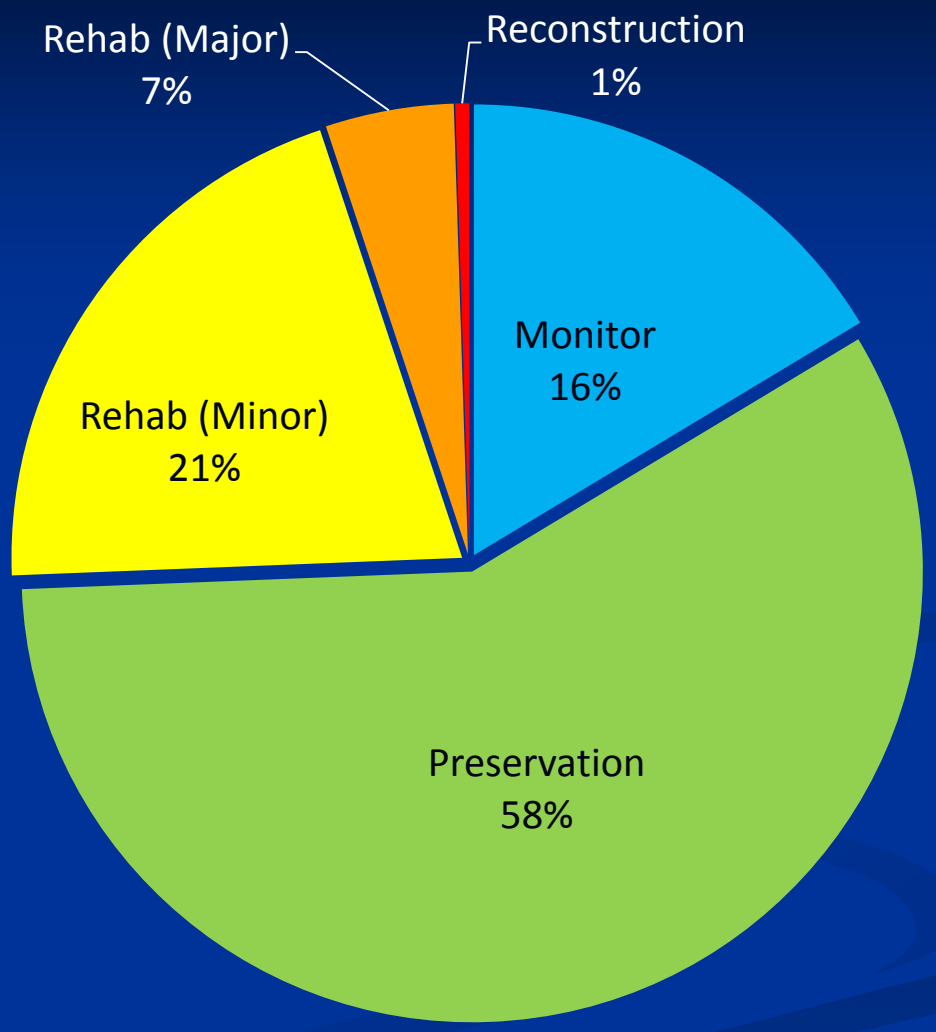
2014 Network Statistics

- Total Network Length = 623 Miles
- Average Network PCI = 72.3
- Approx. Network Cost Backlog = $44 Million
- $/Mile = $71,000/mi



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Performance Monitoring Process

- Compare various Budget Scenario Results
- Plot PCI for analysis period
- Identify Backlog Cost and Length
- Determine Budget Requests Based on Results

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Integration with Local Towns and Cities

- Inventory includes towns and cities within County limits
  - 8 Towns and Cities included
- Allows for collaboration with other local agencies
- Provides agencies with ability to take advantage of powerful analytics
- Reduces local government costs for implementation
  - Potential for cost sharing

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Wicomico County Summary

- Just getting started in the process
- Now has understanding of network condition and budgetary needs
- Ready to move to the next stage of development of the program
- Integrating towns and cities into the County processes a plus

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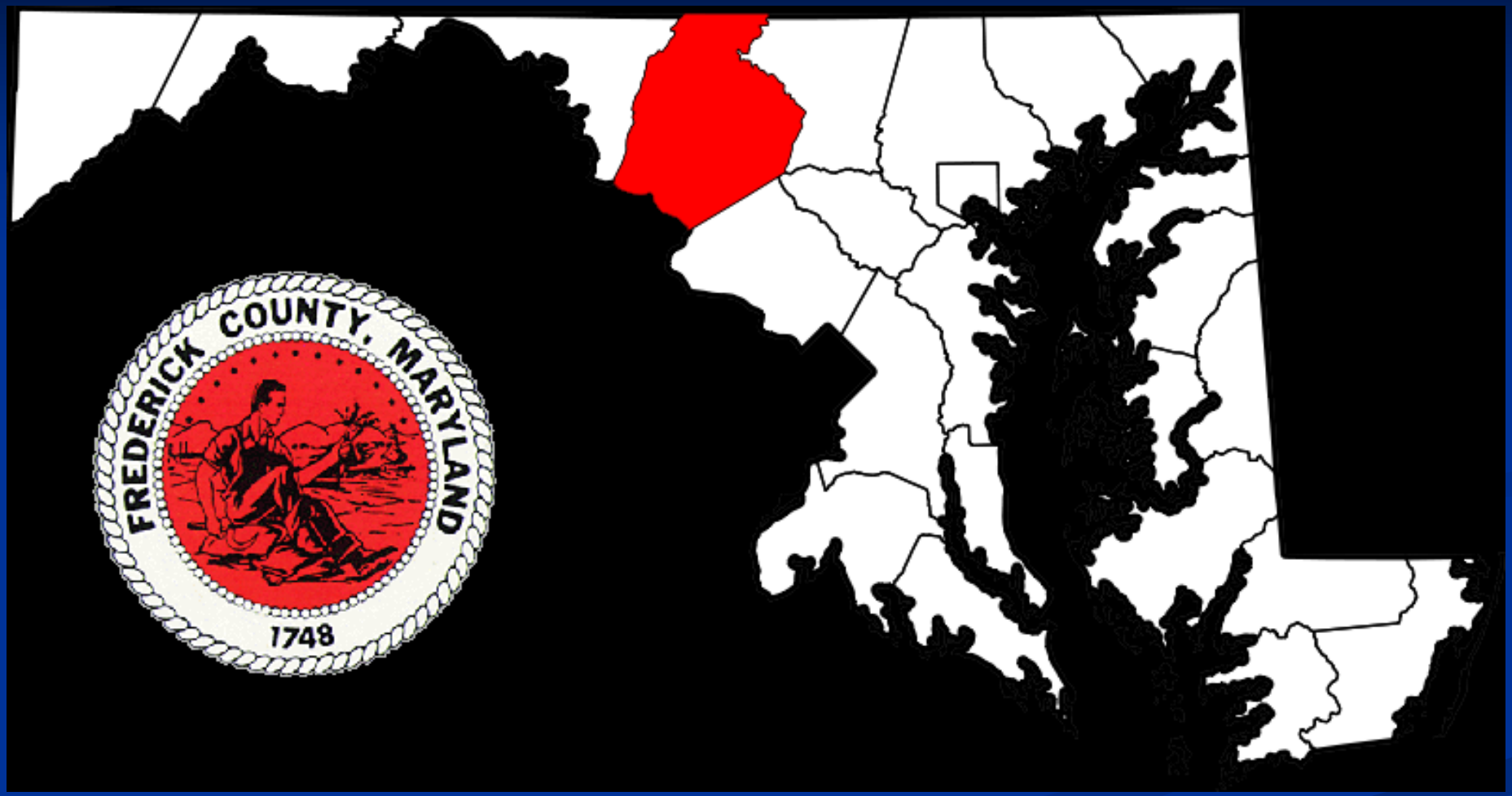
Frederick County



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Background

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- Utilized a simplified Pavement Management System (PMS) to track pavement condition and repair costs
- In 2011, County acquired software and consulting services through bridge contracting

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Inventory Management

- County Maintains a Pavement Inventory Database
  - Network Mileage: Approx. 1,208 Centerline Miles of Paved Roads (Asphalt + Tar & Chip)
- Many Attributes are stored:
  - Geometric Info: Length, Width, Shoulders, etc.
  - Jurisdiction, Functional Classification, AADT
  - Maintenance District, Subdivisions
  - Culverts, Guardrails

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Pavement Condition Surveys

- Windshield Survey – Performed Pavement Condition Surveys Since the mid-90's
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Pavement Condition Index

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  - 100 = Perfect/New Condition
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- Used for Repair Decision Making
- Used for Reporting Network Condition

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Treatments

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  - Slurry Seals
  - Chip Seals
- Rehabilitation
  - Thin Overlays: Mill & Fill, Patching & Overlay (< 2”)
  - Thick Overlays: Deep Patching & Thick Overlays (>2”)
- Reconstruction
  - Full Depth Reclamation
  - Remove & Replace

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Parking Facilities Management

- Integration of parking lots owned and maintained by the County into PMP
- Includes condition assessment of each site
- Specific treatment configurations
- Specific decision trees and models
- Analysis and Reporting for facility managers based facility maintenance budgets

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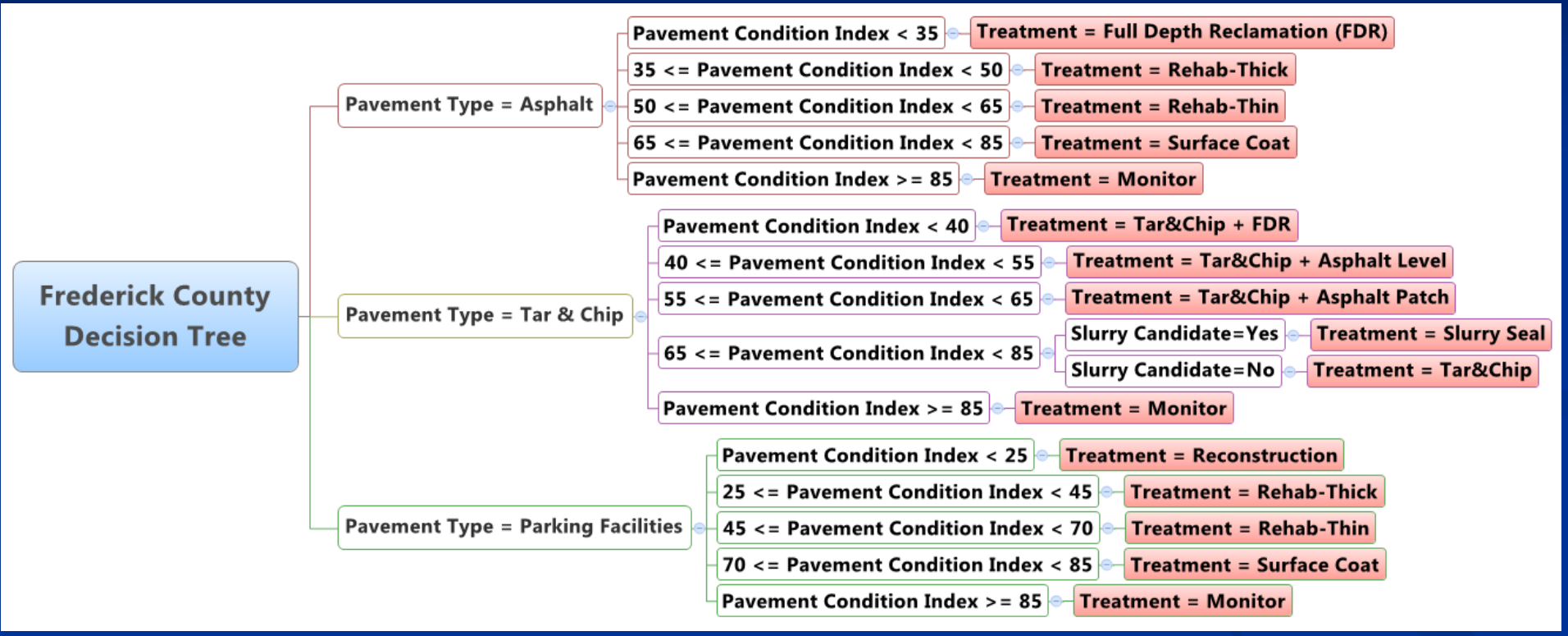
Decision Trees



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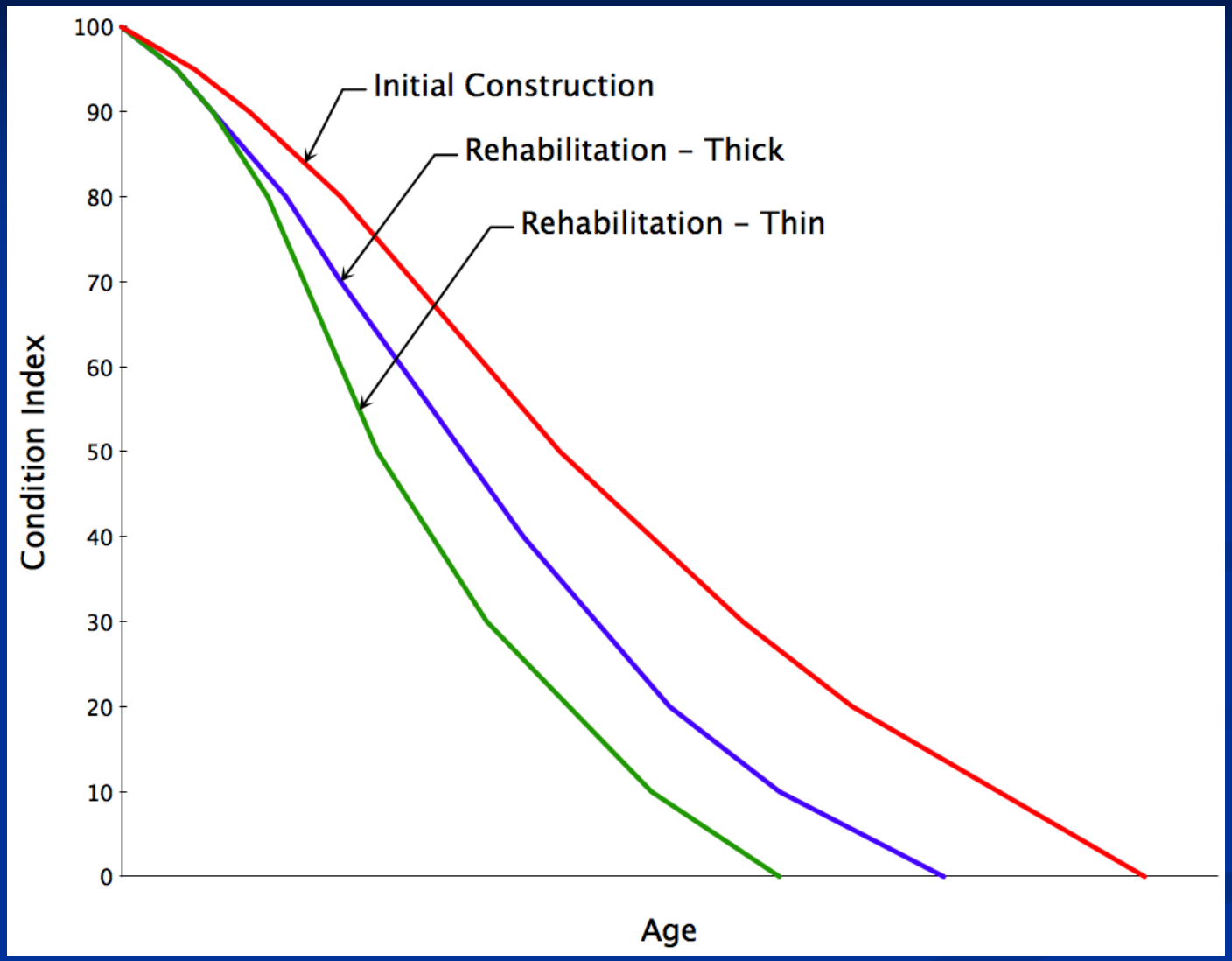
Performance Models



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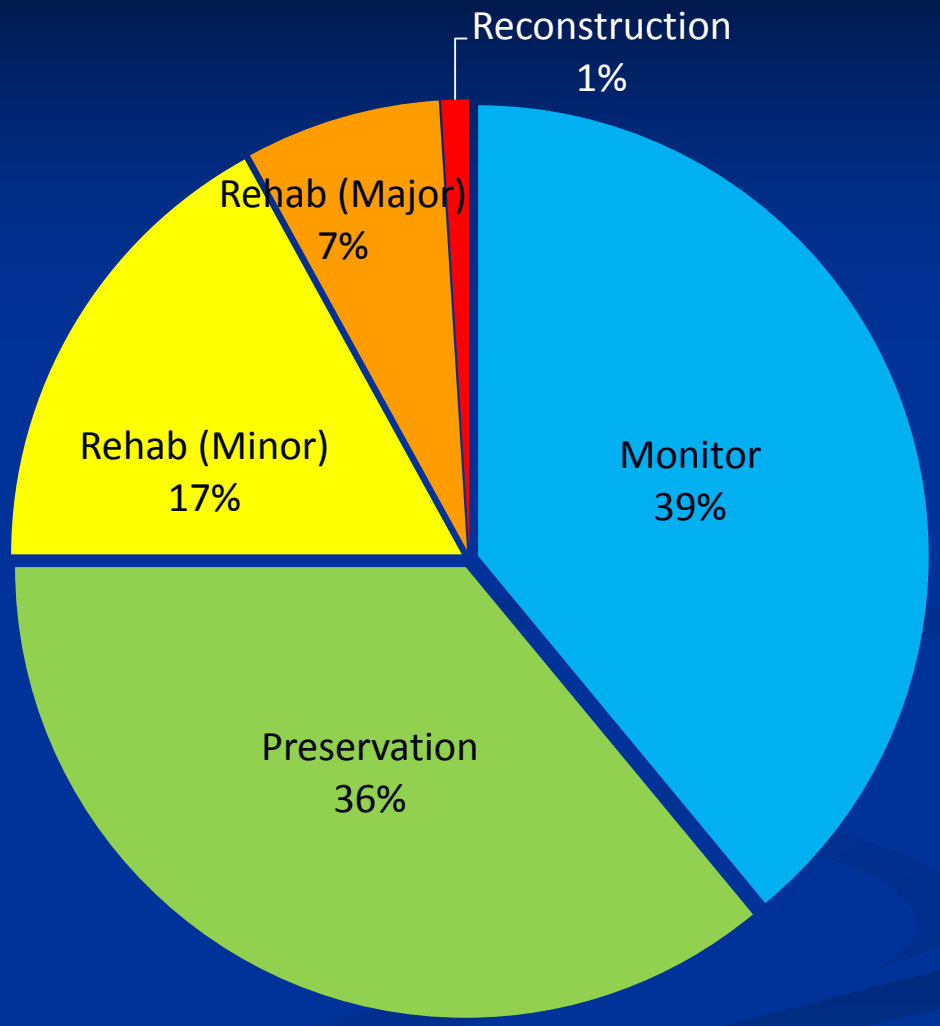
2014-2015 Network Statistics

- Total Network Length = 1,208 Miles
- Average Network PCI = 76.4
- Approx. Network Cost Backlog = $80 Million
- $/Mile = $66,000/mi



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Performance Monitoring Process

- CIP Budgeting Scenario to determine Funding Needs
  - Bond Funds vs. Cash Funds
- Plot PCI condition over CIP Budget Period
  - Asphalt and Tar & Chip are Separate
- Identify Backlog Cost related to CIP Budget
- DPW Goal – Maintain 85% of Network above 70 PCI
- Determine Adjustments to Budget Requests Based on Results

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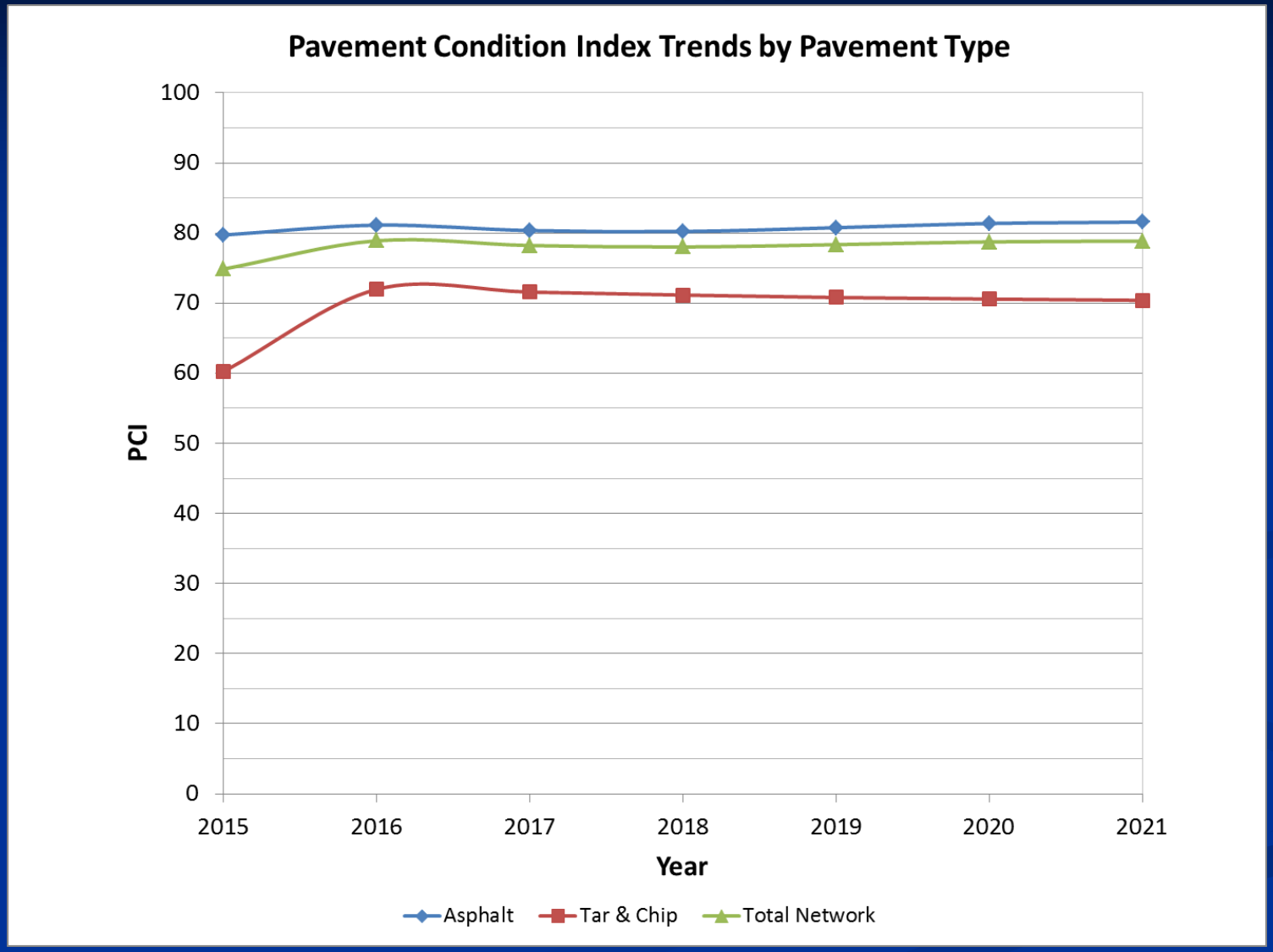
Network Condition – by Pavement Type



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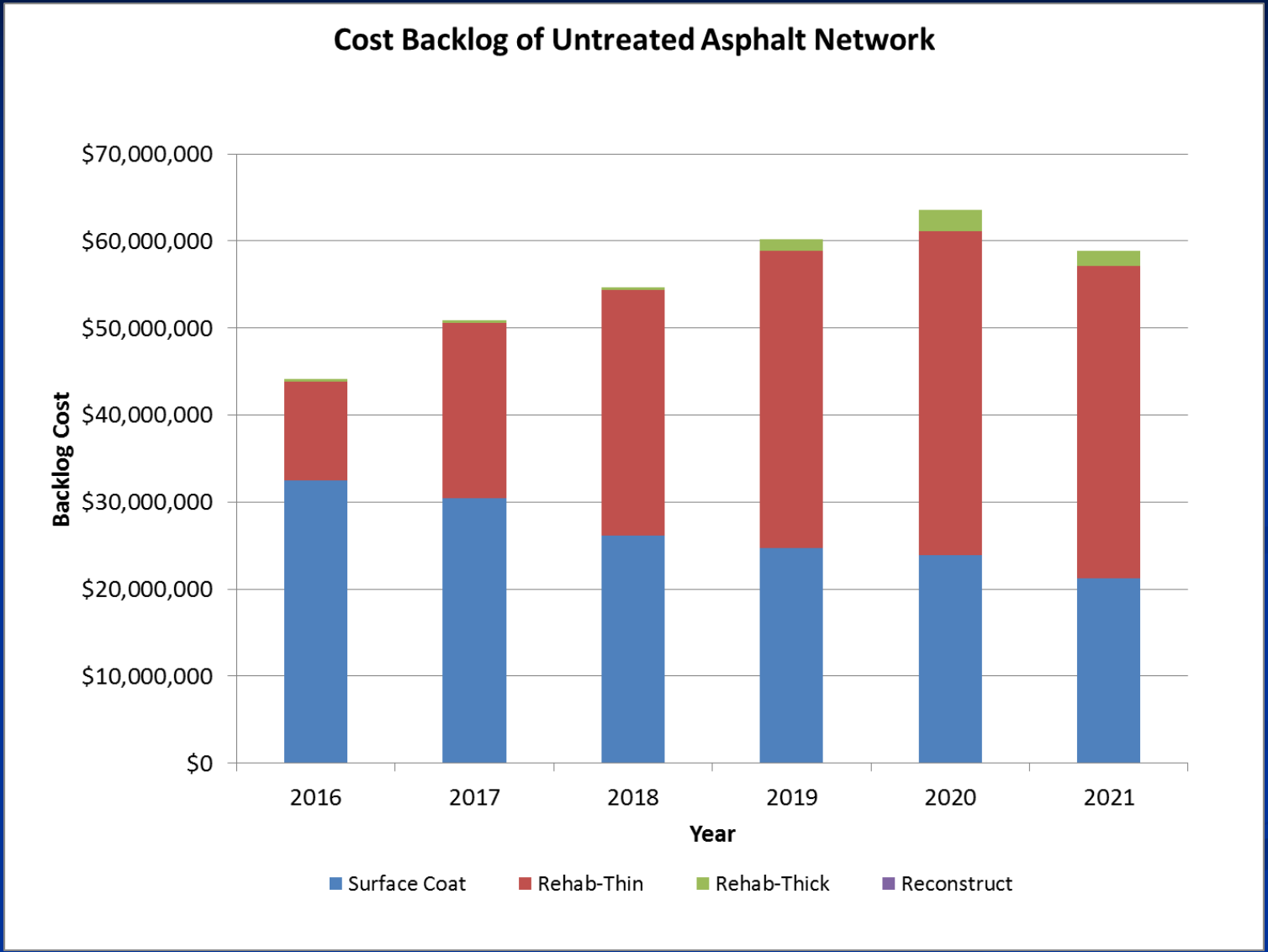
Network Cost Backlog – Asphalt Network



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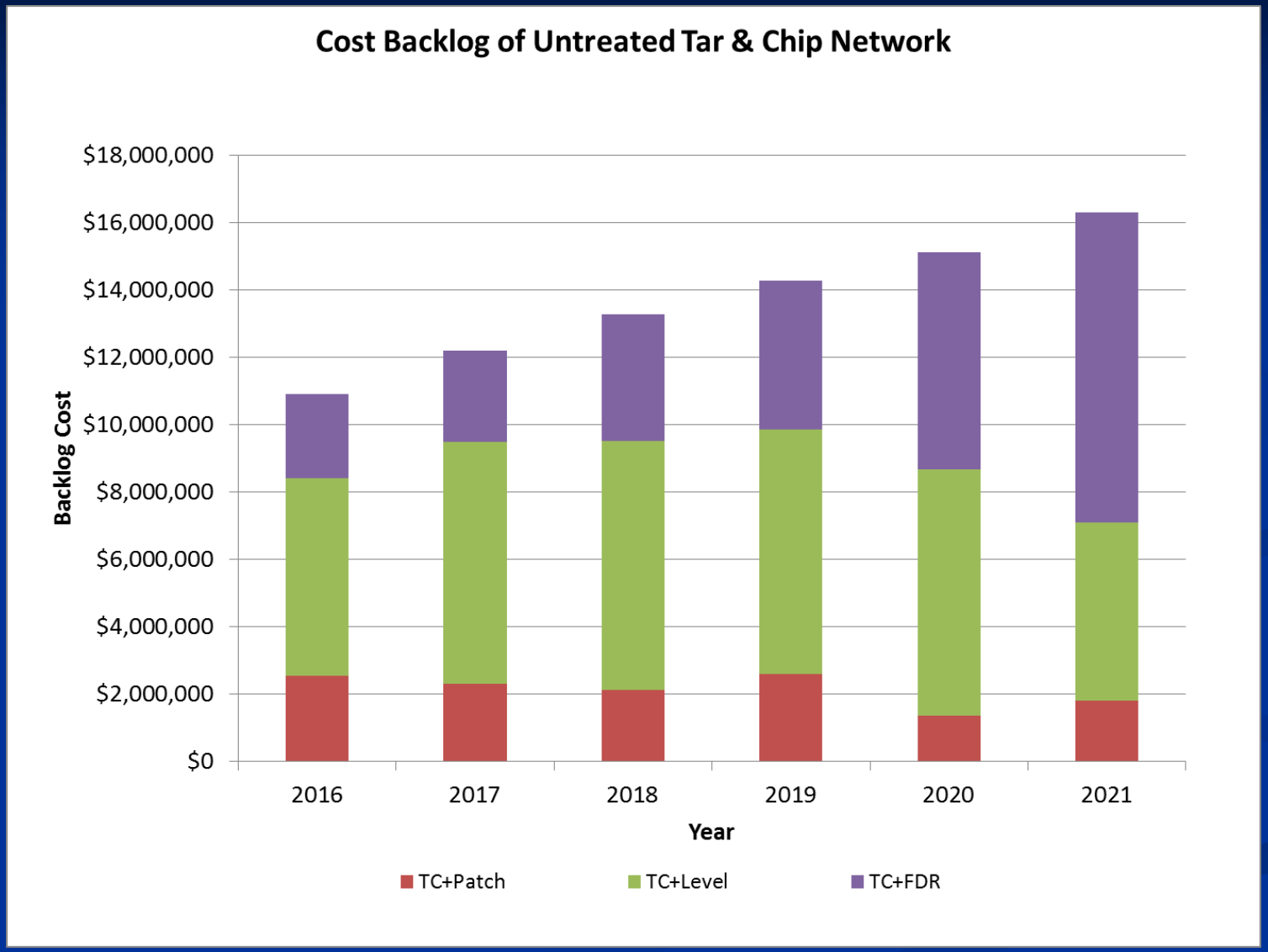
Network Cost Backlog – Tar & Chip Network



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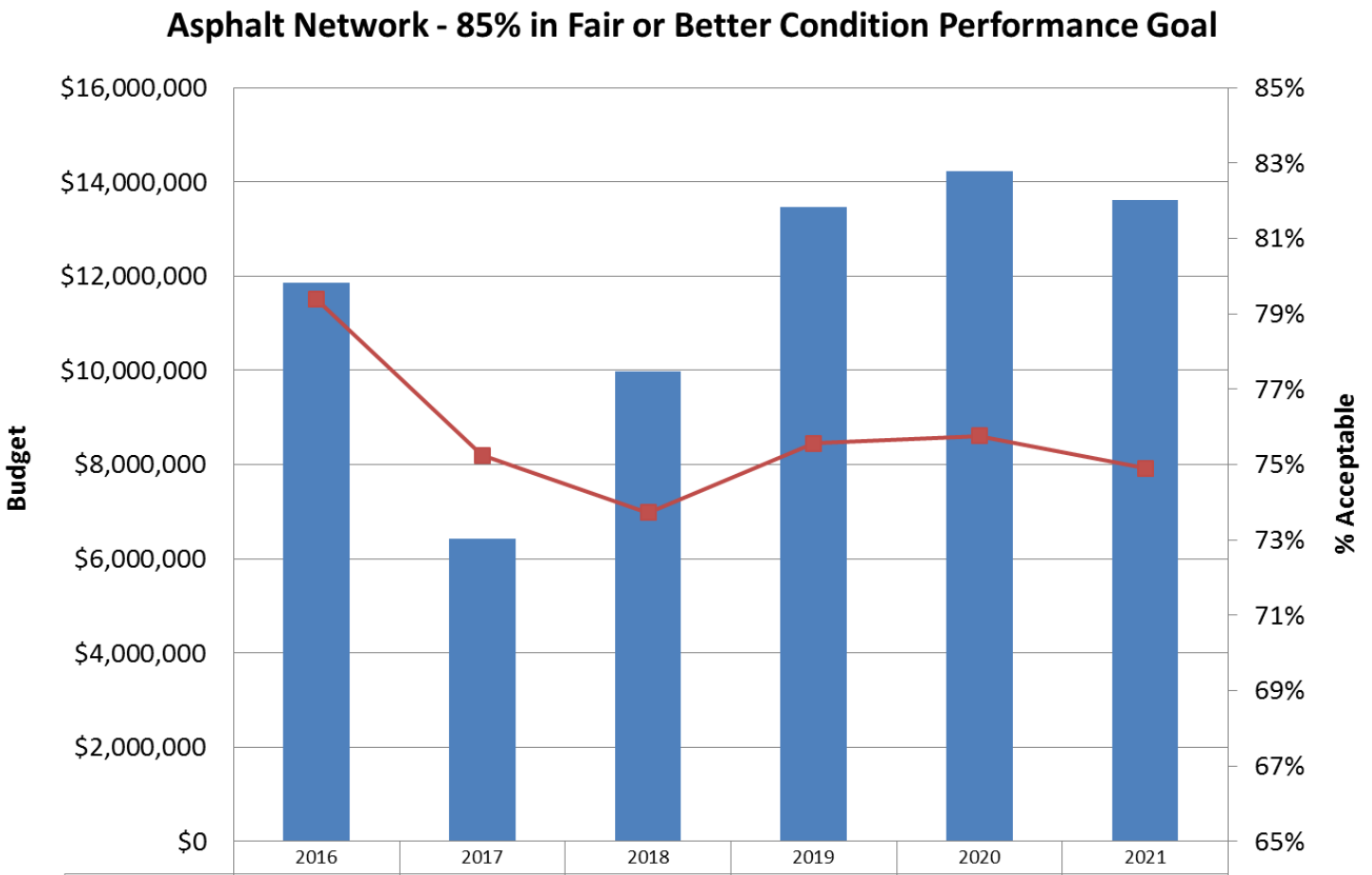
Performance Goal Monitoring



	2016	2017	2018	2019	2020	2021
CIP Budget	$11,862,700	$6,427,700	$9,977,700	$13,455,200	$14,223,600	$13,611,600
% Acceptable	79%	75%	74%	76%	76%	75%

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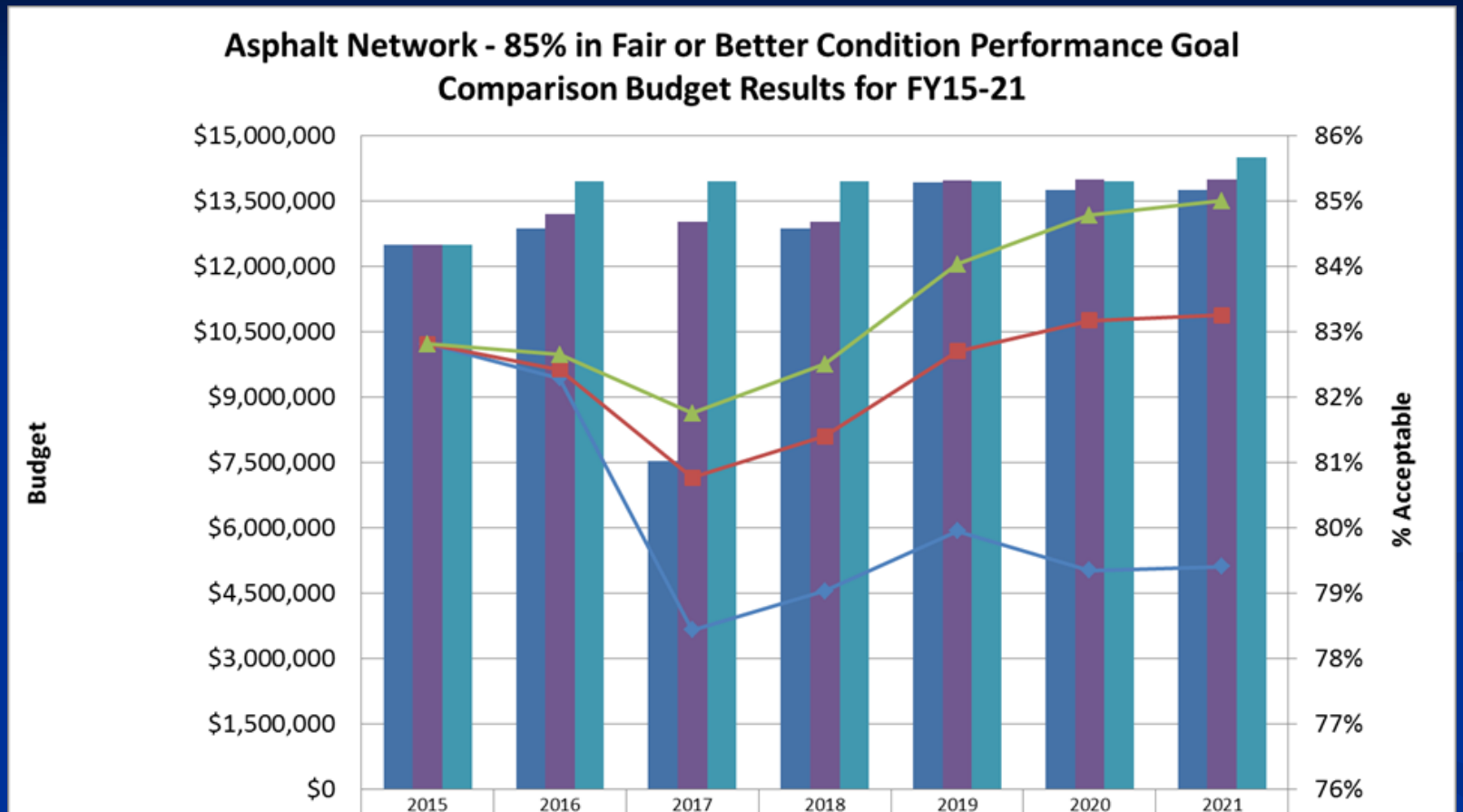
Performance Goal Monitoring



	2015	2016	2017	2018	2019	2020	2021
Accounting Budget	$12,483,726	$12,861,581	$7,529,660	$12,861,581	$13,920,644	$13,745,995	$13,745,995
Requested Budget	$12,483,726.00	$13,205,920.00	$13,018,720.00	$13,018,720.00	$13,972,400.00	$13,982,800.00	$13,982,800.00
Goal Setting Budget	$12,483,726.00	$13,959,938.00	$13,959,938.00	$13,959,938.00	$13,959,938.00	$13,959,938.00	$14,500,000.00
Accounting Budget % Acceptable	83%	82%	78%	79%	80%	79%	79%
Requested Budget % Acceptable	83%	82%	81%	81%	83%	83%	83%
Goal Setting Budget % Acceptable	83%	83%	82%	83%	84%	85%	85%

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Frederick County Summary

- Making good treatment choices – Using the 3Rs
- Justifying and maintaining appropriate funding levels
- Staff dedicated to the success of the program at all levels
- Taking advantage of software flexibility with parking facilities integration

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How Did These Counties Succeed Where Many Fail?

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By Adopting Powerful Software Solutions

- Pavement Management can be a Complex Process
- Maintain quality software to Ease the Burden
- Use the Software to Identify Budgetary Needs and Make Objective Decisions
- Fund the Network Properly to Save Money in the Long Run
- Choose the Treatment 3R approach
- Integrate Other Assets into the PMS Software to Manage Broader Infrastructure Funding Needs

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By Adopting Sound Engineering Processes

- PMS Software is only part of the Process
  - It is a tool to manage DPW's policies and practices
- Comprehensive Pavement Management Program:
  - Field Testing
  - Pavement Design
  - Quality Contract Documents and Administration
  - Quality Construction Specifications
  - Thorough Construction Inspection
  - Continuous Pavement Health Monitoring

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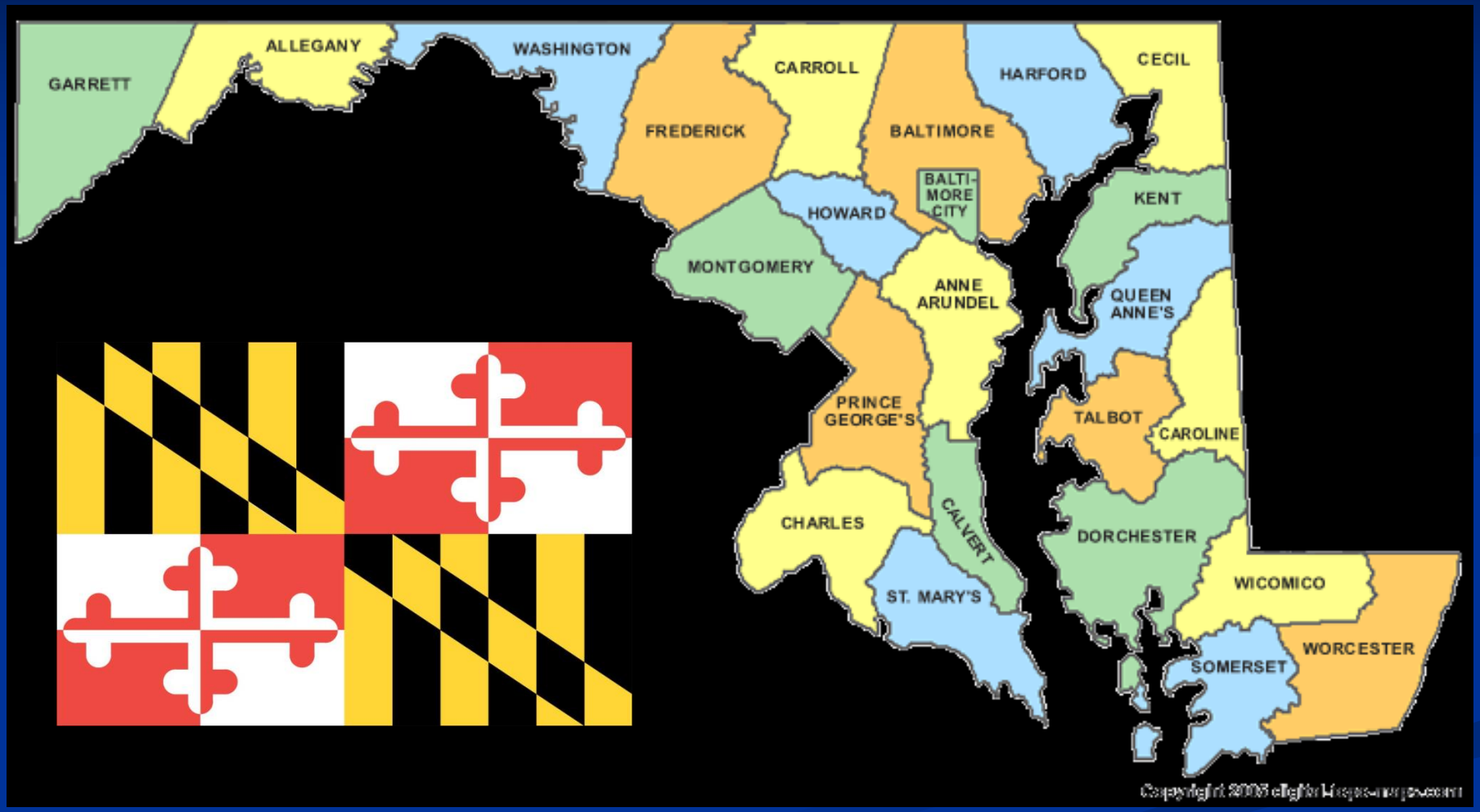
Now We're Waiting on the Rest of You!



KERCHER ENGINEERING INC.

Thank You!

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