Effective Use of Pavement Management Programs

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Pavement Management Is

A Decision Making Process

Effective Pavement Management

- Based on finding cost-effective treatments
- At given time
- To provide desired level of service

StreetSaver Preservation Approach
Good Roads Cost Less than Bad Roads

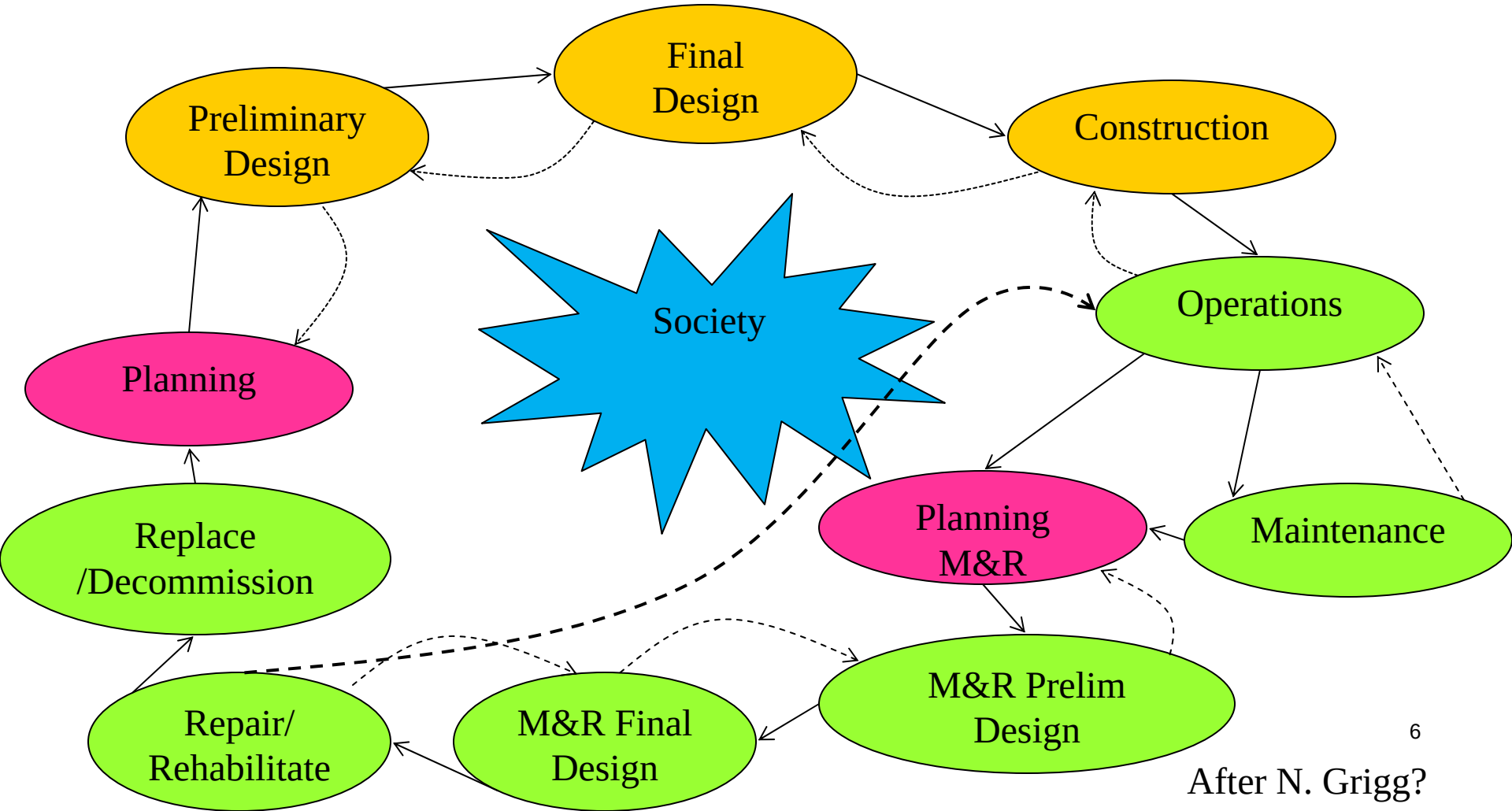
- Over the long term
- If any reasonable level of service is provided
- If the pavement will respond to PM

- Pavement preservation approach provides best roads for the least money

Pavement Management Management Software

- Decision support tool
- Used to help make cost-effective decisions

Infrastructure Life Cycle



After N. Grigg?

Pavement Management is One Component of Infrastructure Asset Management

Pavement & Infrastructure Asset Management Levels

- Strategic – the entire public works or infrastructure system
- Network - the entire street/road network
- Project-Selection – select segments to be worked on in current or next funding cycle
- Project – design and construct a specific pavement section

Strategic – Level

- Related to Investment Analysis & Fund Allocation
  - Total Funds Needed and Allocation of Funds for Each Type Facility to Meet Established Goals
  - Show Impact of Funding Options
  - Justification of Funds
- Communicate with Funding Authorities
  - Level of service desired (Goals & Policies)
  - Investment needed to provide that service
- Previously Considered Planning Activities

Network-Level

- Related to the Budget Process
  - Identify Maintenance and Rehabilitation Needs
  - Funds Needed to Complete M&R
  - Prioritized Listings of Segments Needing Work
- Allocation to
  - Sub-organizations
  - Funding Categories
- Show Impact of Funding Options
  - Preservation vs New Construction
  - Distribution Among Sub-organizations
- Communicate Within Agency

Input from Strategic-level

Project-Selection-Level

- Identify Constraints not Previously Considered
  - Physical
  - Financial
- Refine Alternative Treatments
- Improve Cost Estimates
- Select Segments for Funding & Project-Level Analysis, Design & Construction
- Show Impact of Deviation from Network-Level

Input from Network-level

Project-Level

- Develop Cost-effective Strategy for:
  - Original Construction
  - Maintenance
  - Rehabilitation
  - Reconstruction
- Within Imposed Constraints
- Complete Design
- Construct Project

Input from Project Selection-level

Differences in Data Summary

- Project-level
  - Detailed data needed to complete design
  - For very small % of network
- Project selection-level
  - Enough data to select projects to be funded
  - For small % of network
- Network-level
  - Enough data to identify candidates & support allocation
  - For entire network
- Strategic-level
  - Data from network-level (entire network)
  - Data that funding authorities can use
  - Indicators of work performed and results achieved

Differences in Those Responsible

- Project-level
  - Engineers/Technical Staff
- Project-selection Level
  - Senior Management and/or Department/District Managers
  - Department/District Staff
- Network-level
  - Senior Management
  - District/Department Managers
- Strategic-level
  - Funding authorities
  - Senior management

Elected Funding Authorities

- Elected for generally for two to four years
- Often more interested in less expensive short-term solutions
- Need justification to approve funding for expensive long-term solutions
- Typically are not engineers

Pavement Management Actions in Support of Infrastructure Asset Management

Big Pavement Management Questions

- What level of service should be set as the desirable level?
- Having set a desired service level, how much funding do we need & how should it be spent?
- Given a fixed budget, which pavements should we work on first to get the best return?

Pavement Management Software

- Primarily supports network-level analysis
- Can assist with some project selection-level analysis
- Provides input for strategic level analysis
- Does not design pavements
- Does not identify segments needing emergency or routine maintenance

Network-Level Elements

- Inventory
- Condition assessment
- Determination of fund needs
- Identification of candidate projects for funding
- Determine impact of funding decisions on future condition and fund needs
- Feedback process

Inventory

- What the agency is responsible for
- Where it is located
- Basic information needed to support network-level decisions

StreetSaver Data Collection Principles

- Absolute minimum data collected at the network-level
- More complete data collected for project-selection & project-design level analyses
- Collect only the data needed only when it is needed
- History begins now

StreetSaver Data Approach

- Absolute minimum data required at the network-level
- More complete data can be collected and stored but is not used directly in network level analysis
- More complete data can be used by agency in project selection and project design levels
- Over time, more complete data developed

Condition Assessment

- Defines the health of individual sections
- Collectively defines the health of the network

Condition Data Collection

- Support for network-level decision support
  - Which segments need work
  - About how much $ needed
  - Over some analysis period
- Additional data can be collected for project-selection on candidate segements
- Project-level data collected for those segments being designed that year

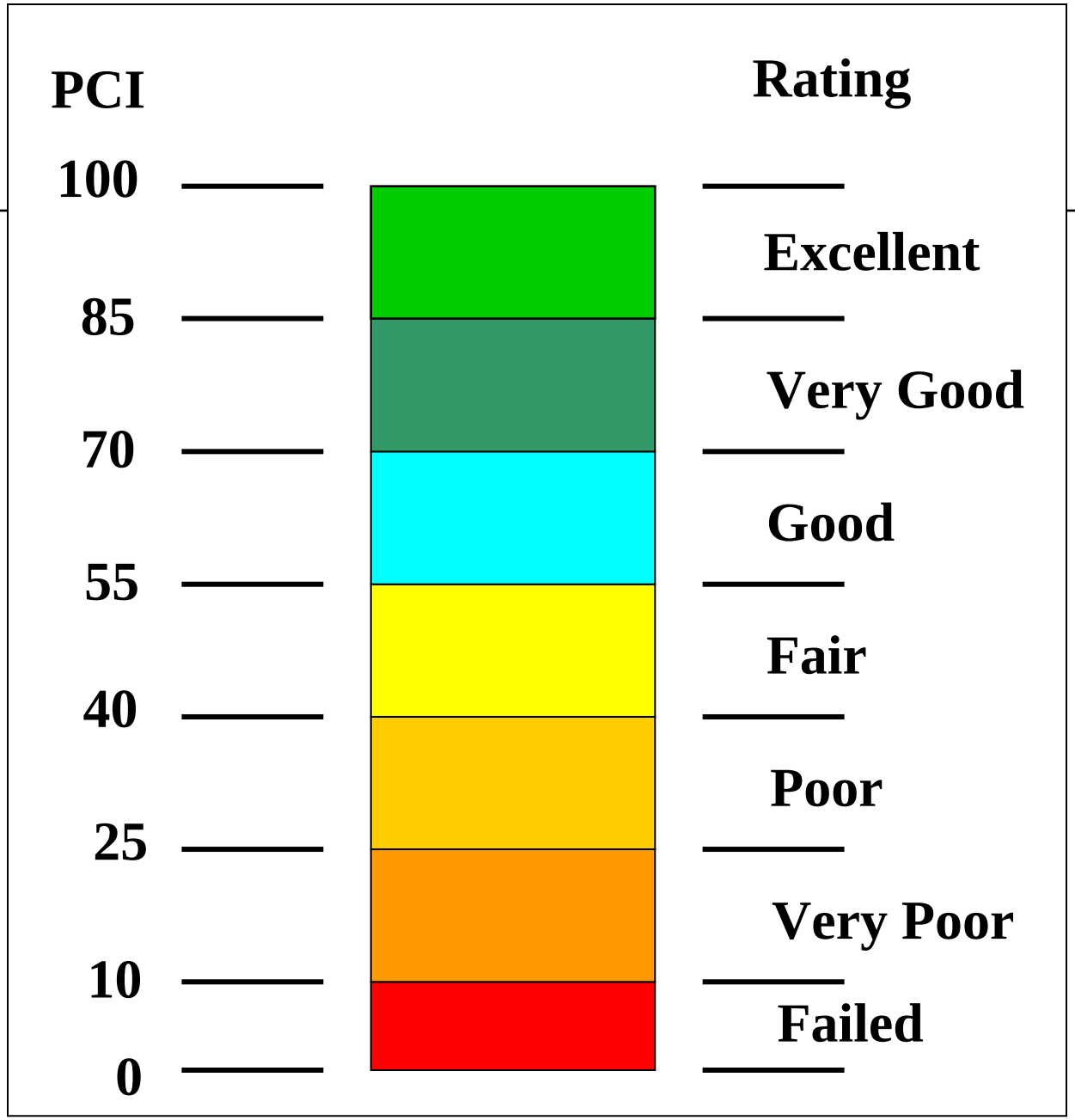
At Local Agency Network-Level

- Distress most important

- Condition indices help in decision support systems, especially at network and strategic levels

StreetSaver Uses PCI

- Pavement Condition Index Basic Measure of Condition
- Method to Uniformly Characterize Condition of Paved Surface
  - Along Road/street
  - Over Time
  - Among Raters


PCI
Rating
100
85
70
55
40
25
10
0
Excellent
Very Good
Good
Fair
Poor
Very Poor
Failed

PCI Values

- Based on Distress Surveys
  - Type - What Is Wrong?
  - Severity - How Bad Is It?
  - Density - How Much Present?

StreetSaver Distress Definitions

- 7 Types Each for Asphalt Surfaced & PCC
  - Alig Crk, Blk Crk, Dist, L&T Crk, Patch, Rut, W&R
  - Cor Brk, Div Slab, Fault, L&T Crk, Patch, Scale, Spall
- Three Severities - L, M, & H
- Quantity

PAVER/ASTM D 6433-11

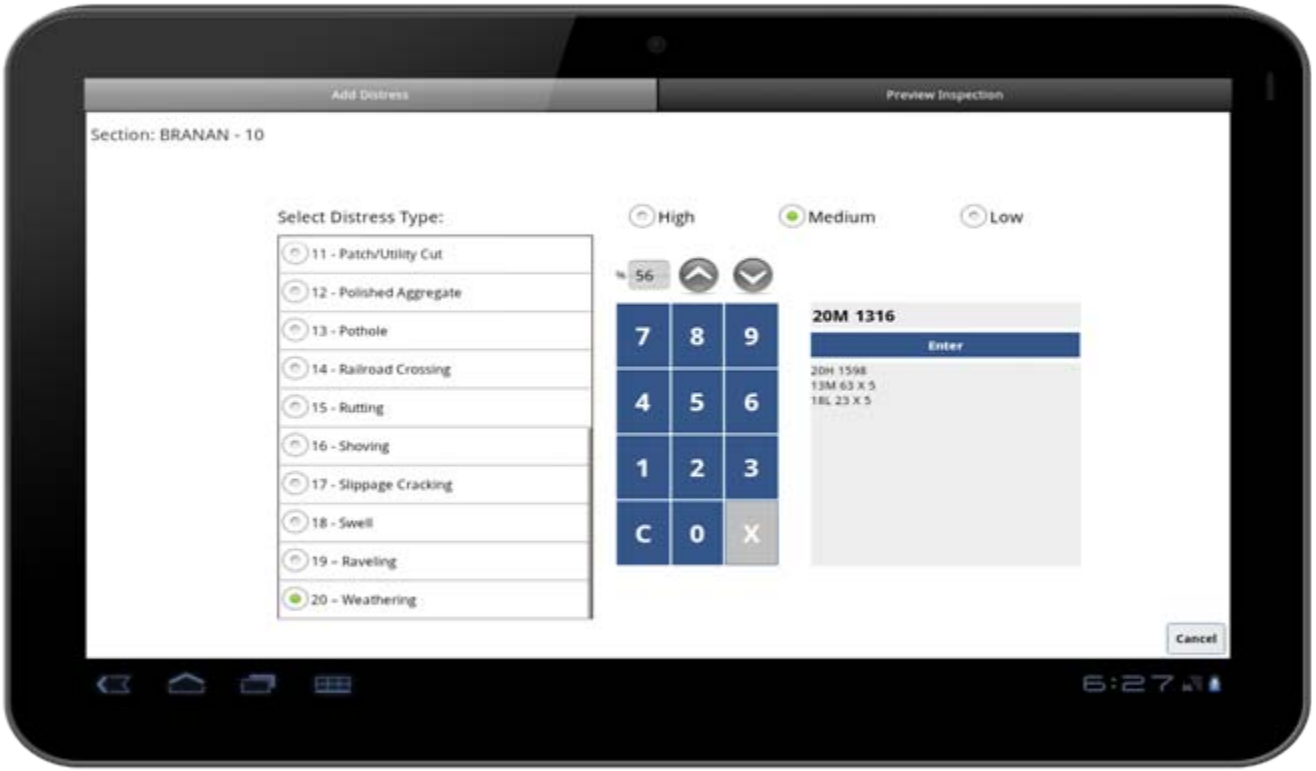
- 20 AC Distress Types
- 19 PCC Distress Types
- Three Severities - L, M, & H
- Quantity

- Must select when setting up database

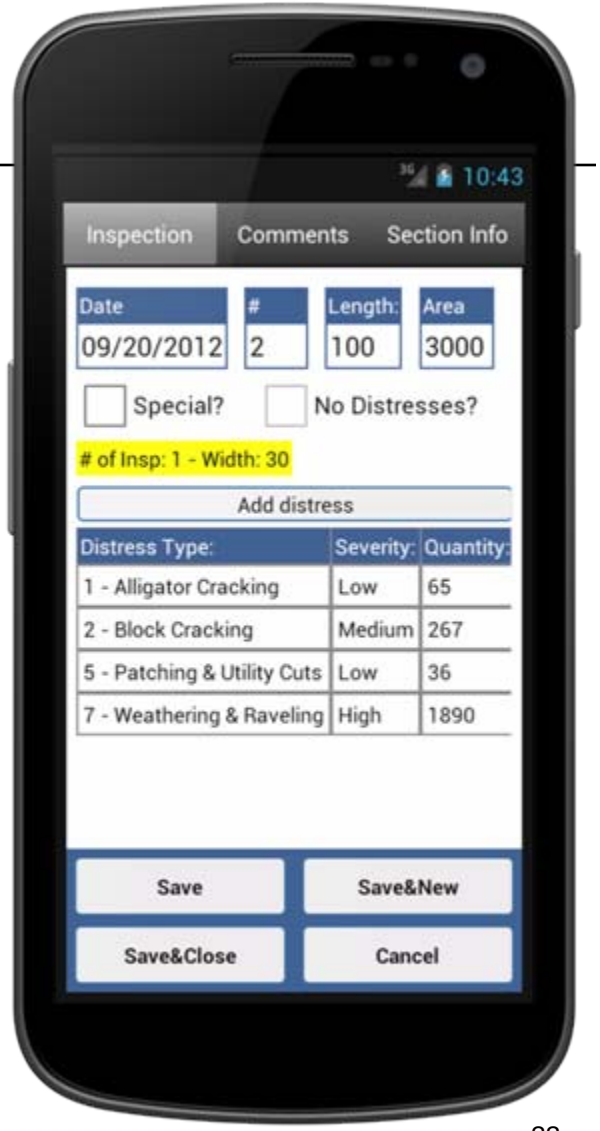
Distress Data Collection

- Training provided
- Automated allowed
- Data quality plan important

Mobile Rater – Android Tablet



Mobile Rater – Android Smart Phone



Other Types of Condition Info

- Collect at project-selection or project design levels
  - Structural – deflection
  - Roughness - IRI
  - Safety - surface friction

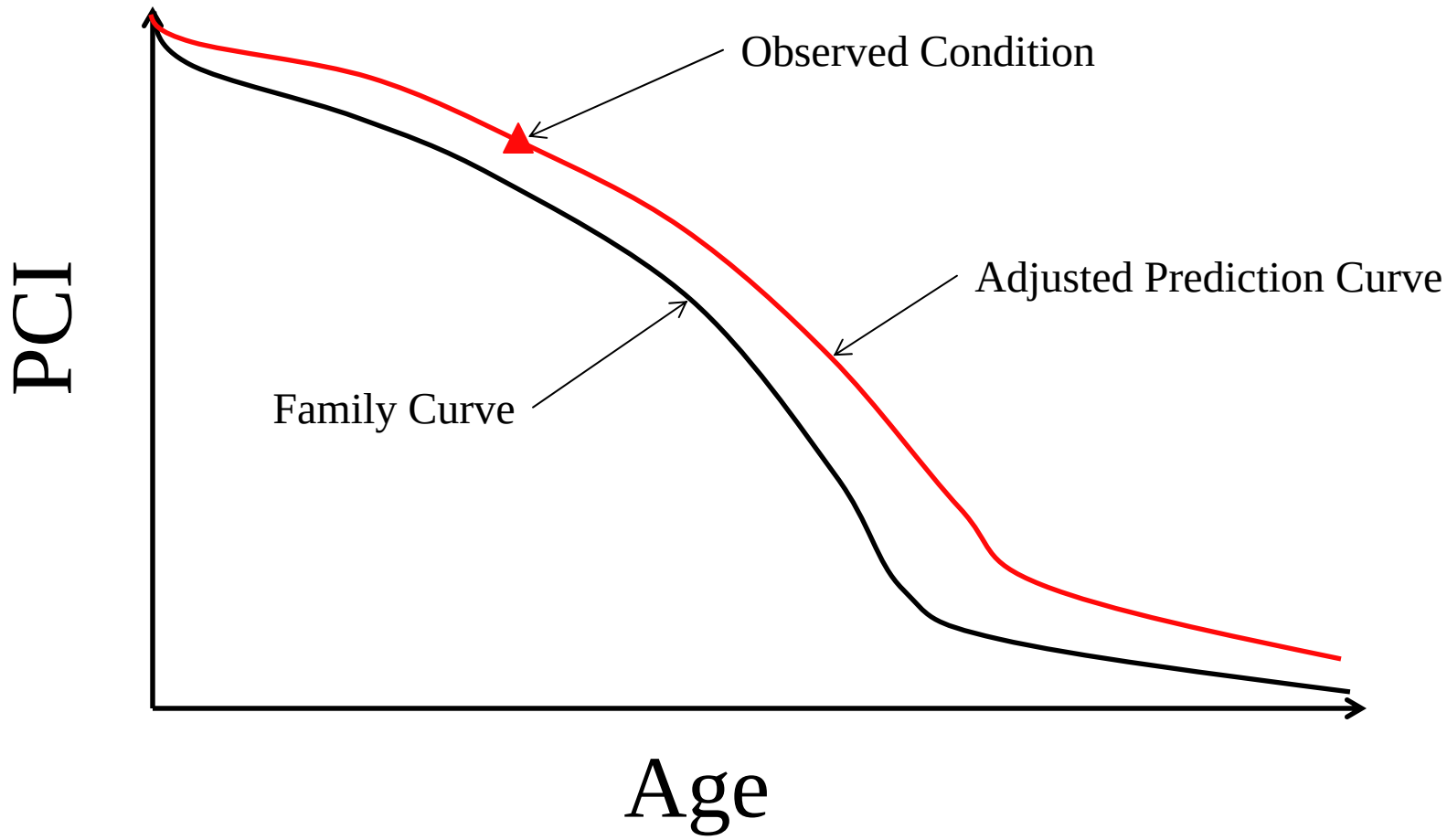
Determination of Fund and Work Needs

- Identifies sections needing work
- Determines funds needed to complete work

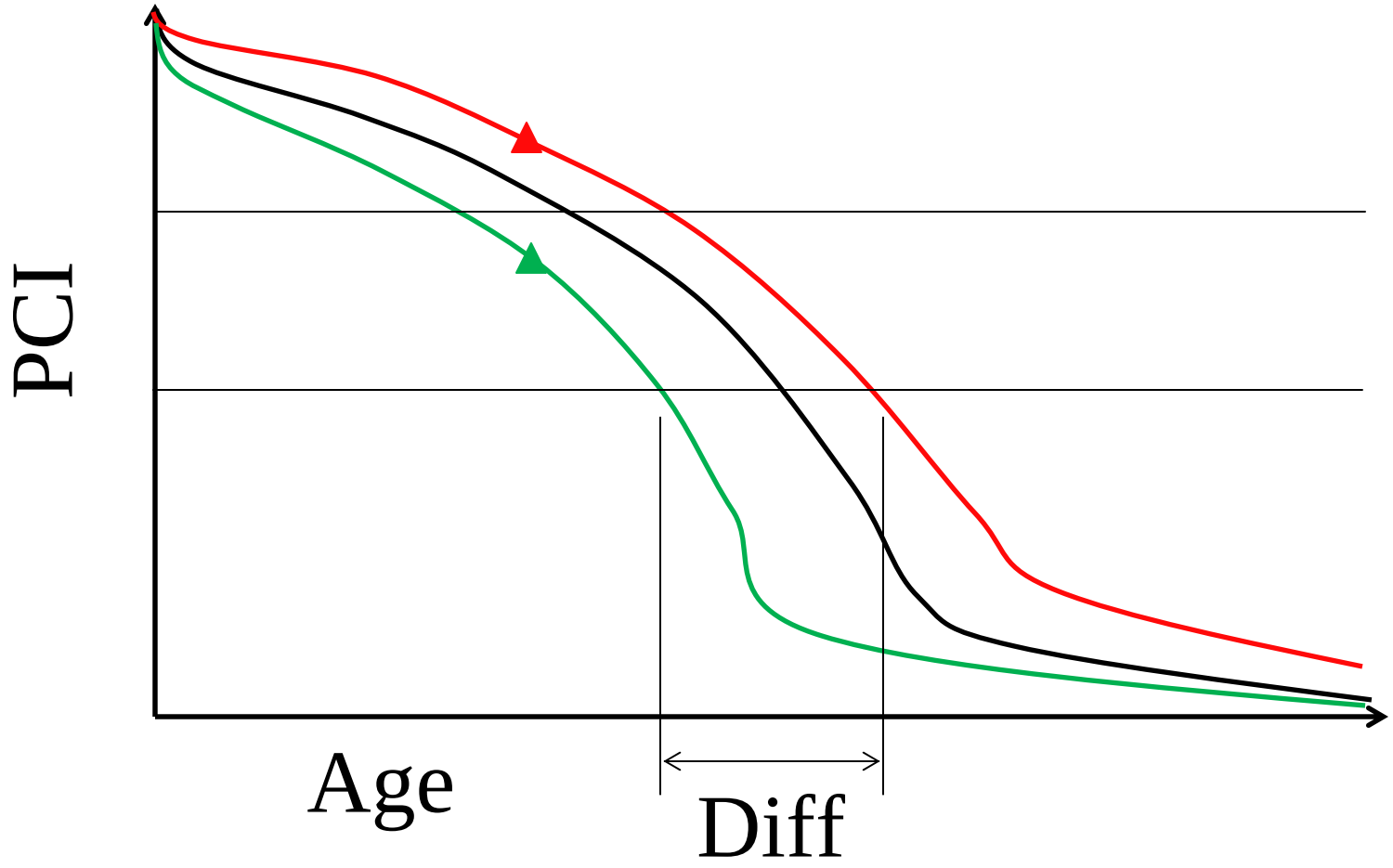
Needs Analysis

- Identify Sections Needing Work
- Estimate Funds Needed
- Rehabilitation - Condition Driven
- Preventive Maintenance
  - Minimum Condition &
  - Time Interval

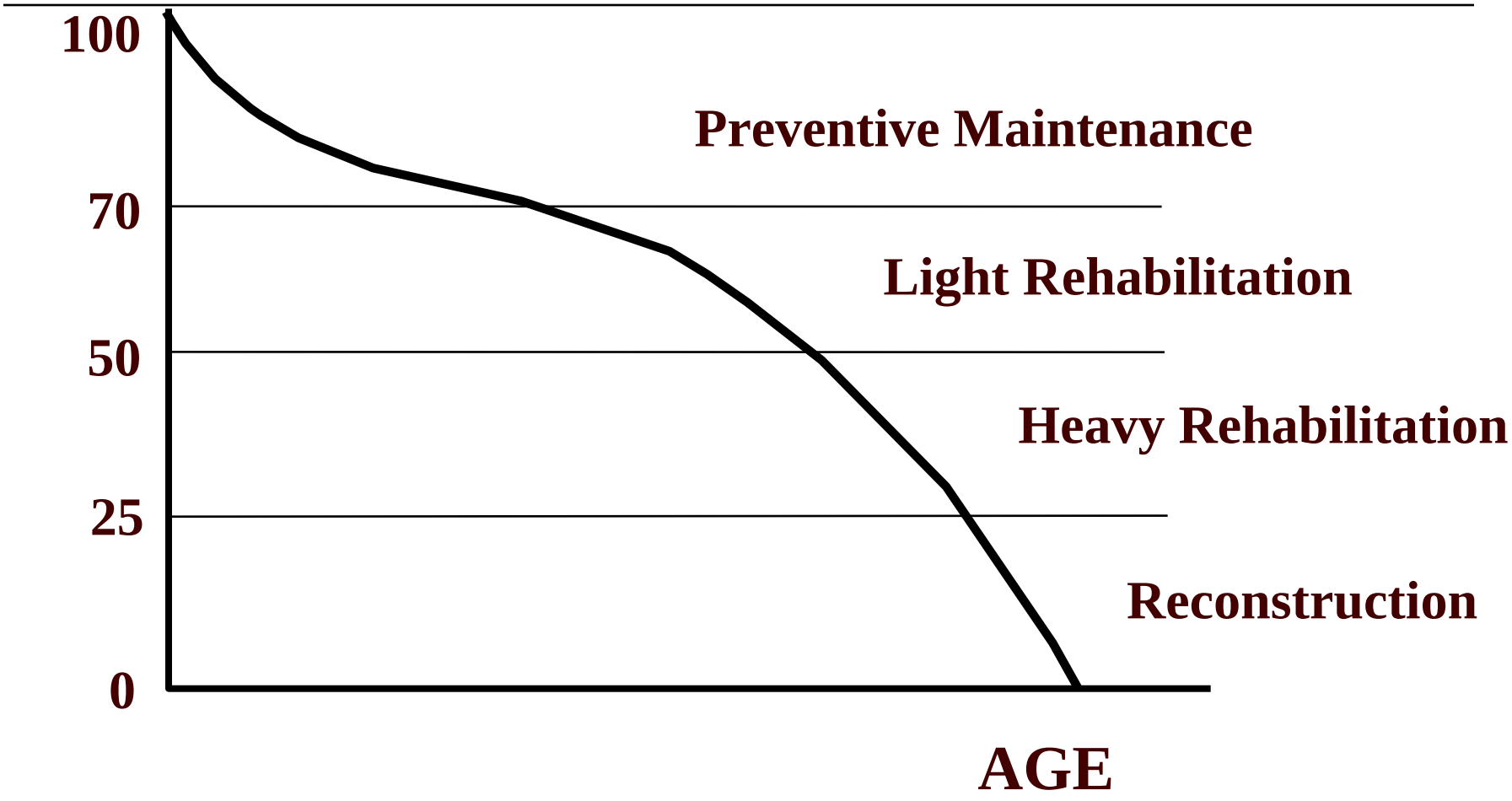
Predicted Condition



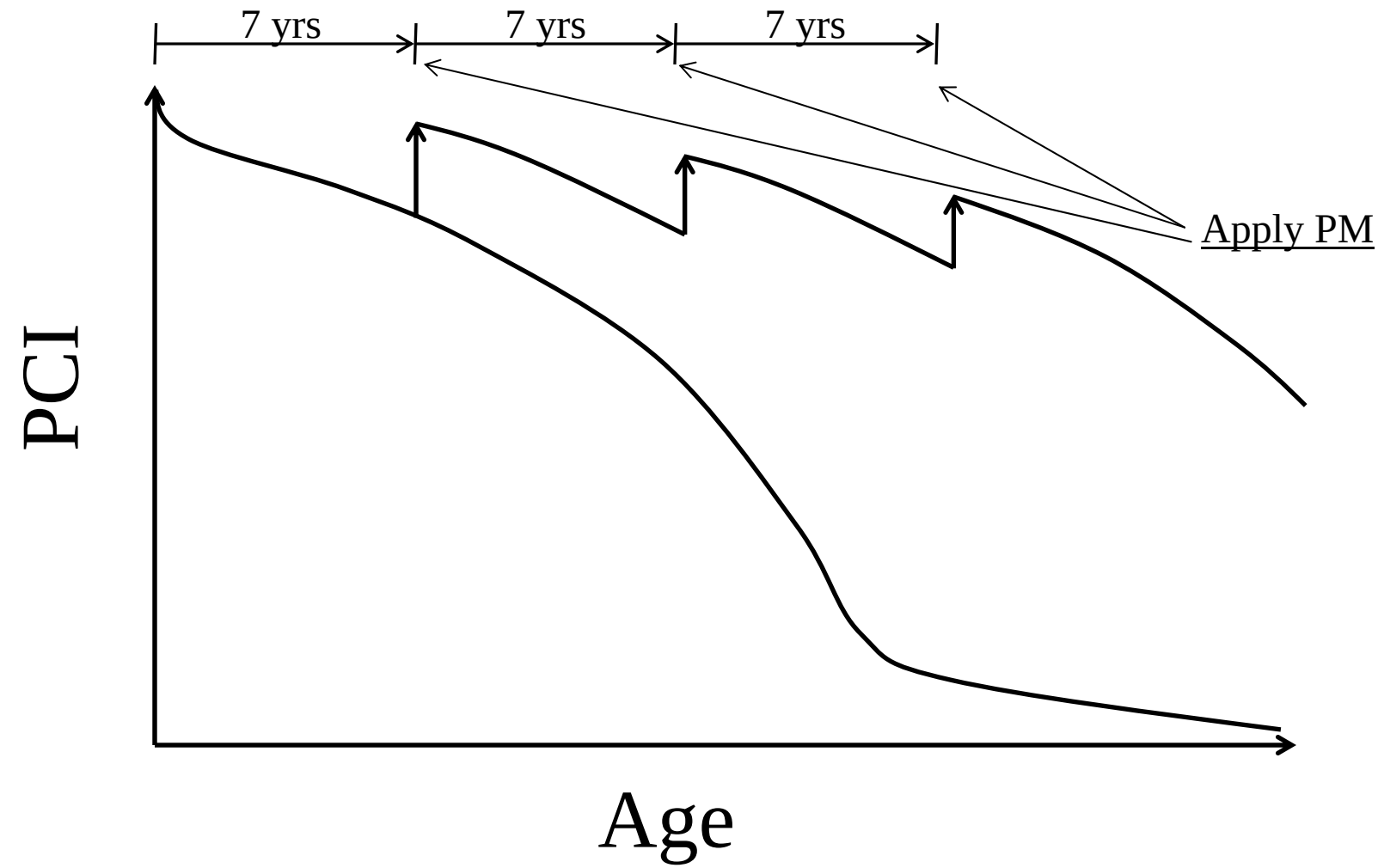
Predicted Condition with High or Low PCI



Rehab – Condition Driven



PM – Time Sequenced



Decision Tree Approach

- Network-level planning treatment
  - Assigned each section needing work
  - During analysis period (5 to 30 yrs)
- Factors considered:
  - Condition – PCI & % load related distress
  - Usage & importance – Functional Class
  - Surface type – AC, AC/AC, AC/PCC, PCC, & ST

Decision Trees

- This is where you put in your treatments
- Selecting the treatment for each condition category sets up your strategy
- Selecting the right treatment for the right condition sets up a pavement preservation strategy

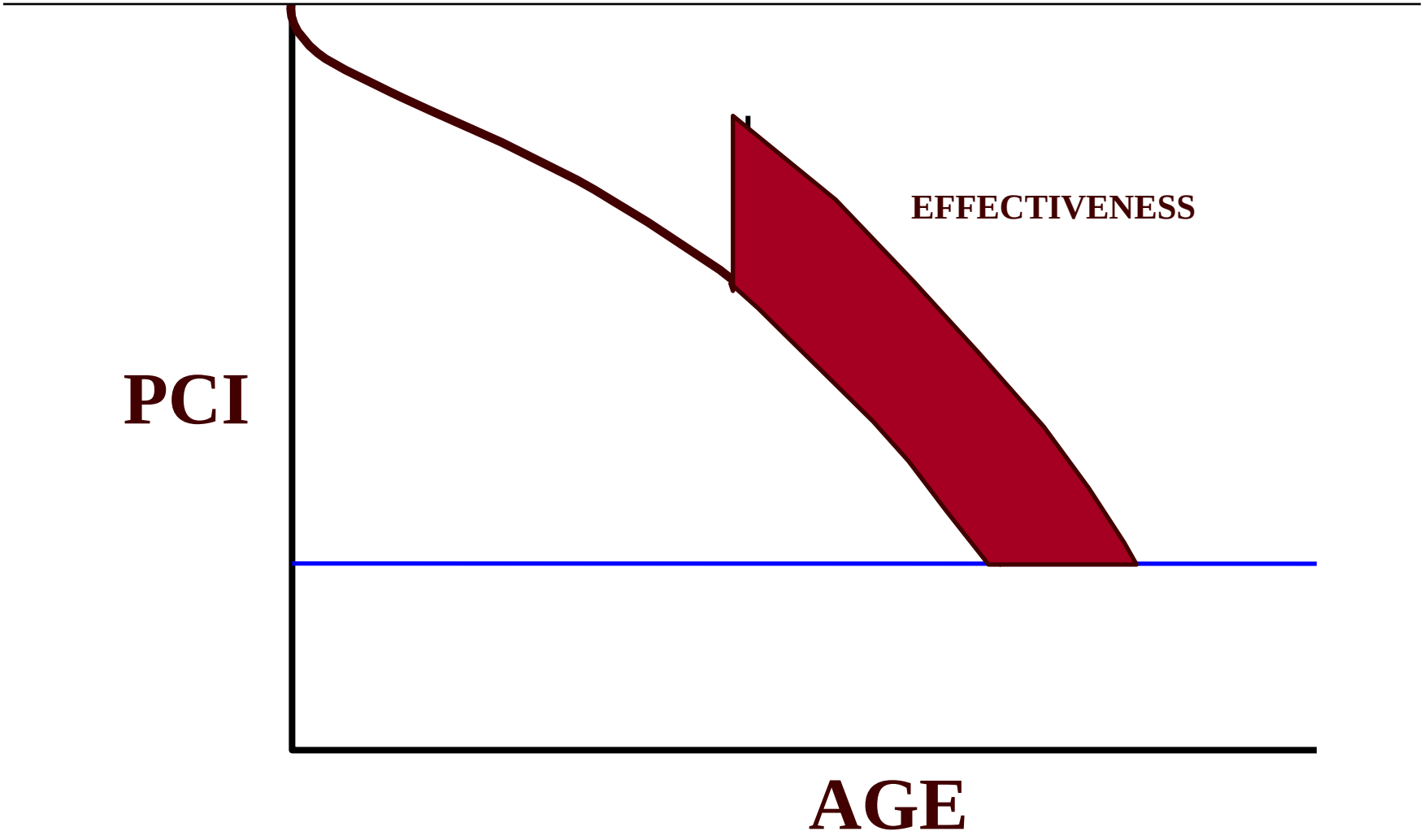
Prioritizing Candidate Sections

- Rank order sections needing work
- Goal –
  - Provide best possible pavement network for available funds
  - Identify funds needed to provide desired level of service

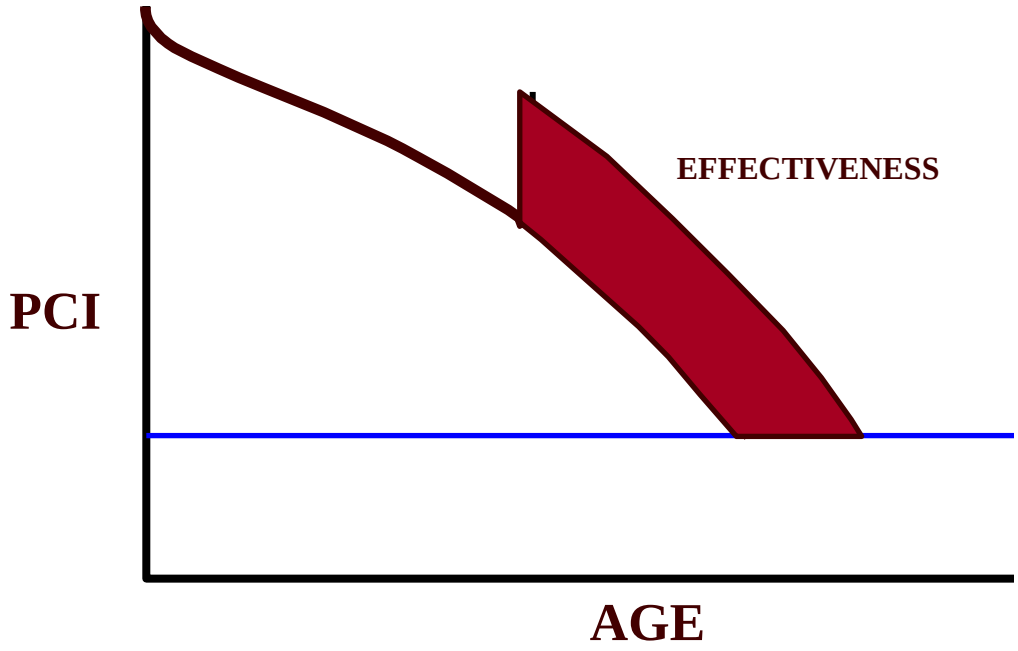
Possible Prioritization Concepts

- Worst First - Weighted for Traffic
- Least Life-cycle Costs
- Best Benefit-cost Ratio
- Best Effectiveness-cost Ratio

Prioritization Based on Cost-Effectiveness



Cost-Effectiveness Ratio



$$\text{Cost-Effectiveness Ratio} = \frac{\text{Effectiveness}}{\text{Cost}}$$

Cost-Effectiveness Candidates

- Sections
  - That will be in the best condition for the longest time for least cost
  - Give best return on funds &
  - Should be repaired first

- StreetSaver – Near optimization selection with PM controlled to enhance preservation

Funds Needed to Meet Desired Levels of Service

Desired Objectives	Desired Levels
Average Network PCI	$\geq$ 75
Average Network Remaining Life	> 15 yrs
% Network in Very Good Condition	$\geq$ 30%
% Network in Poor Conditoin	$\leq$ 10%

StreetSaver Approach

- Near optimal approach
- Incremental Cost-Effectiveness Approach
- Multiple Objectives Considered

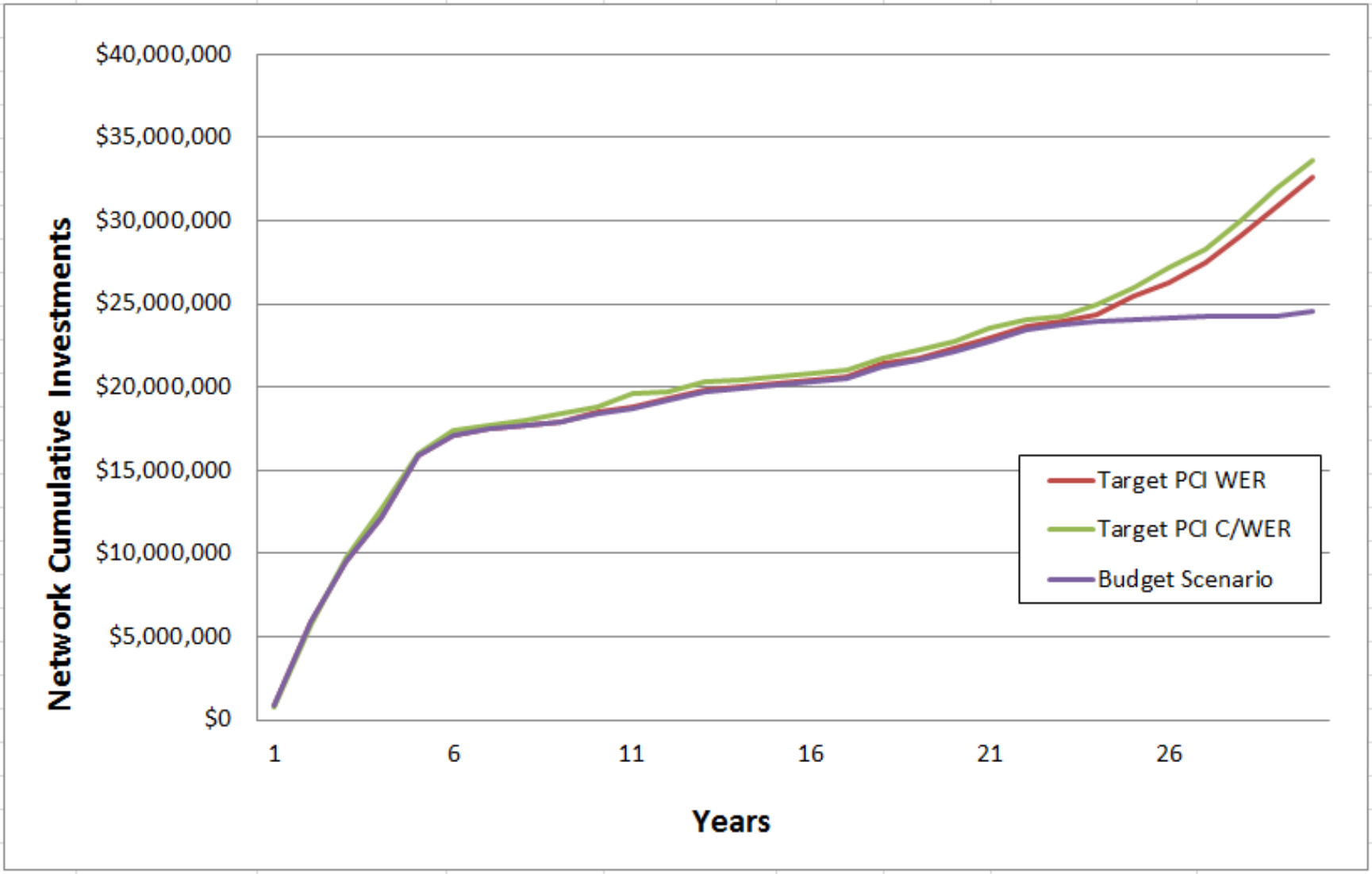
Current Pavement Network Parameters

Functional Class	Average Pavement Condition Index (PCI)	Average Remaining Life (years)	Percent of the Pavement Network Group in Very Good Condition (%)	Percent of the Pavement Network Group in Poor and Very Poor Condition (%)
Entire Network	59	19	50	35

PCI Target Objectives

	Current (PCI)	Target Average Pavement Condition Index (PCI)				
		Year 1	Year 2	Year 3	Year 4	Year 5
Entire Network	59	62	69	74	77	81

Cumulative Funds Needed



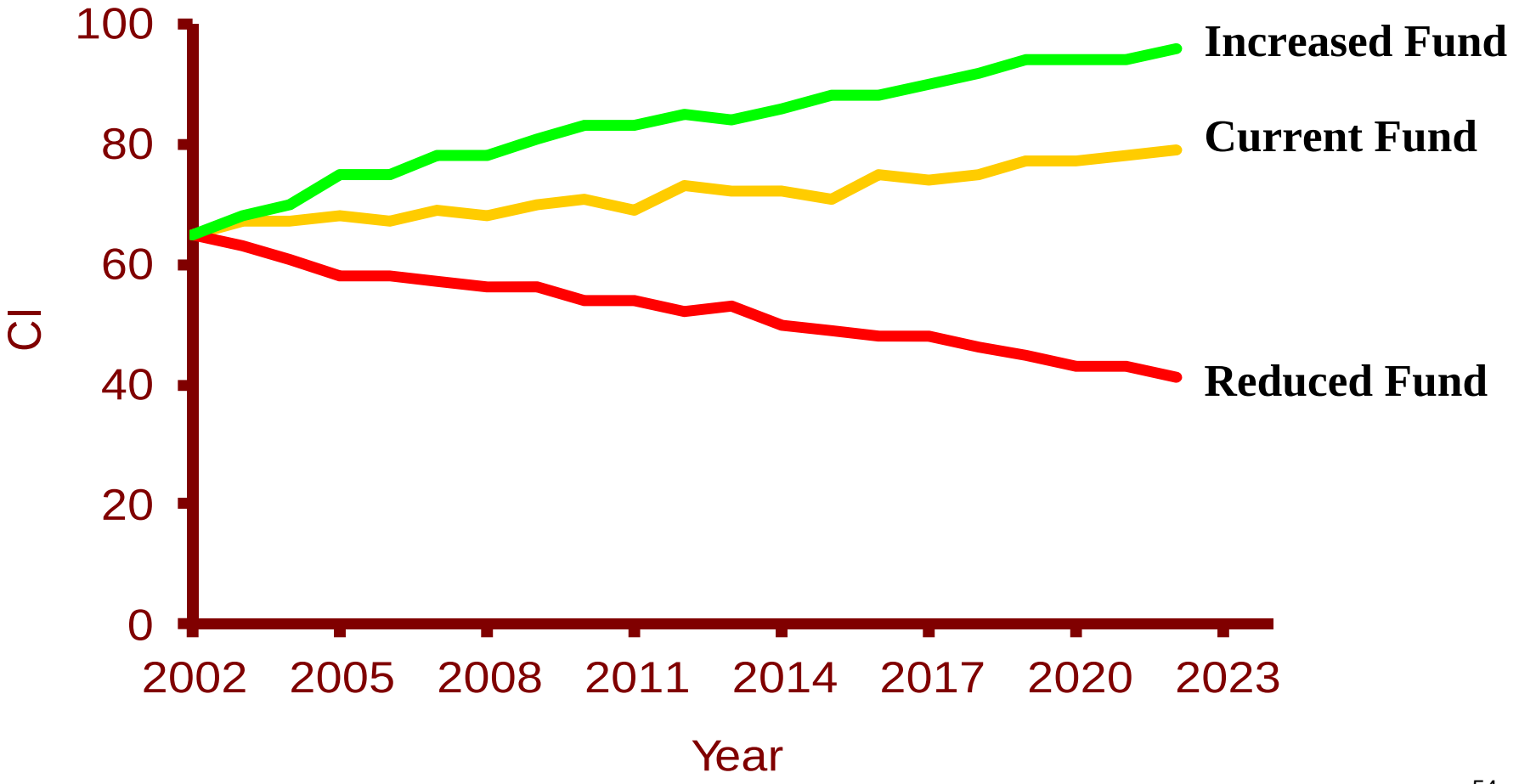
Cost-Effective Candidates

- Funds needed to provide desired level of service
- Also lists sections
  - Give best return on funds &
  - Should be repaired first

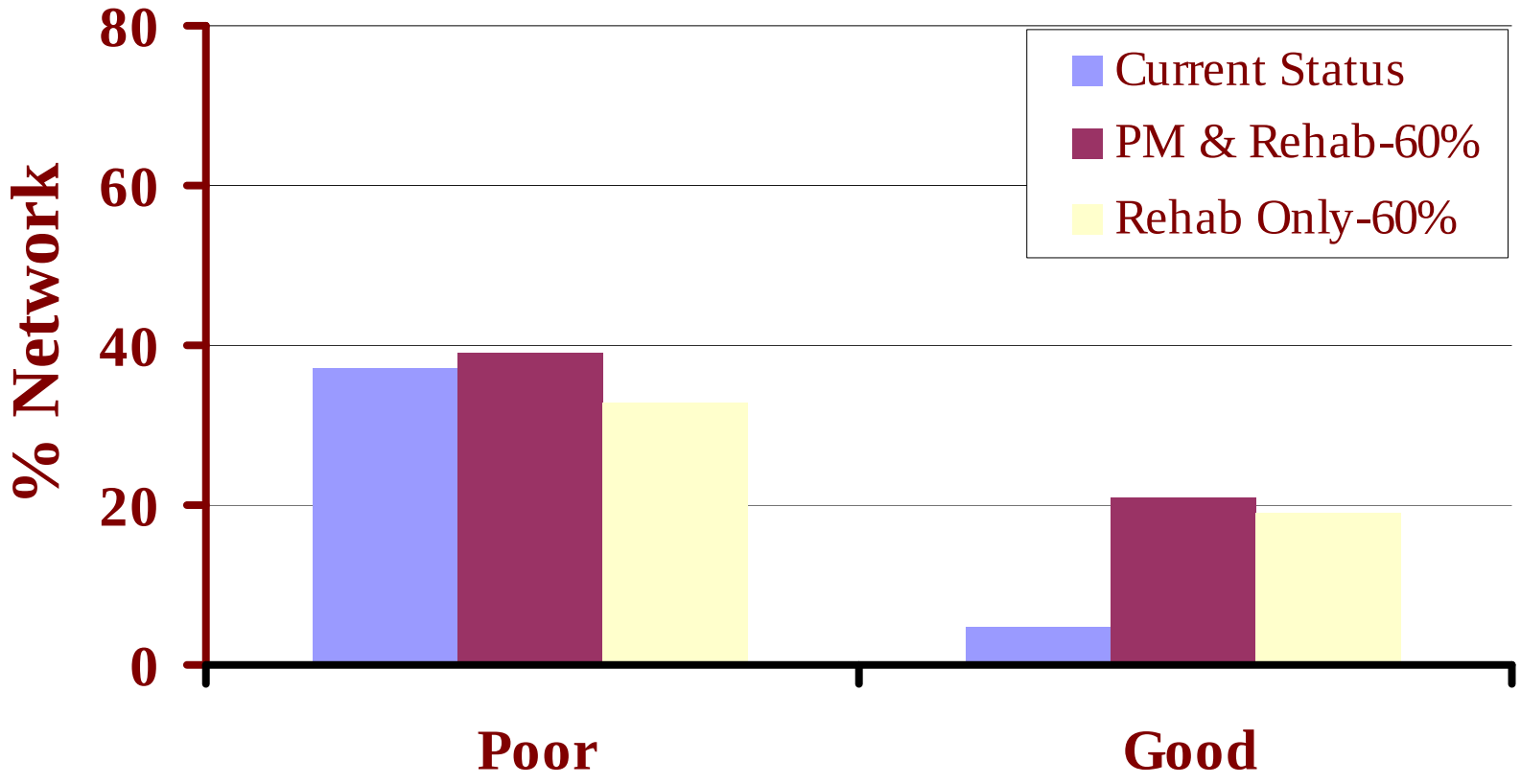
Determine the Impact of Funding

- Connect PMS to funding decisions
- Determine funds needed to provide desired level of service
- Justification for funding requests
- Support for allocation decisions

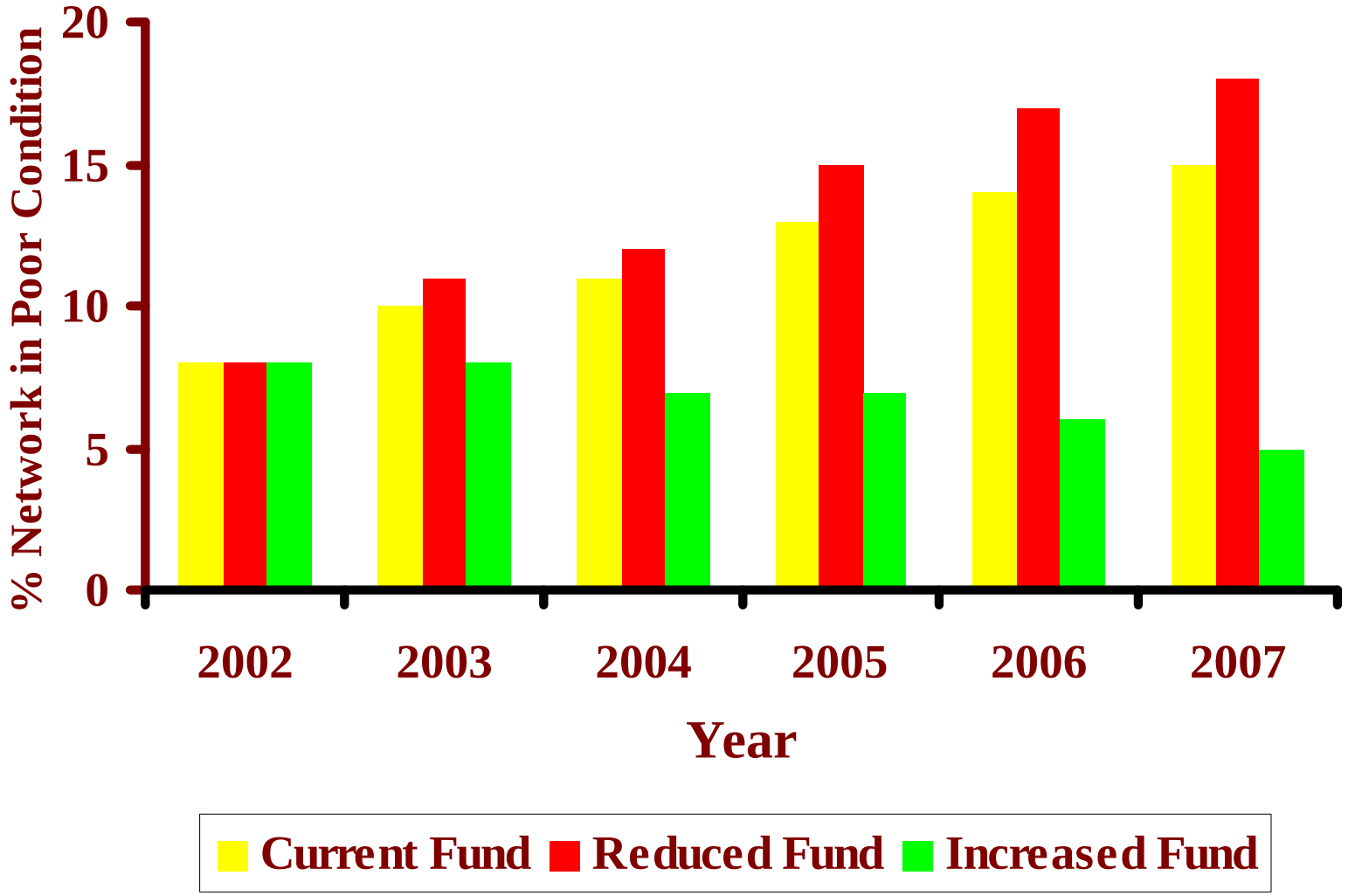
Projected Condition



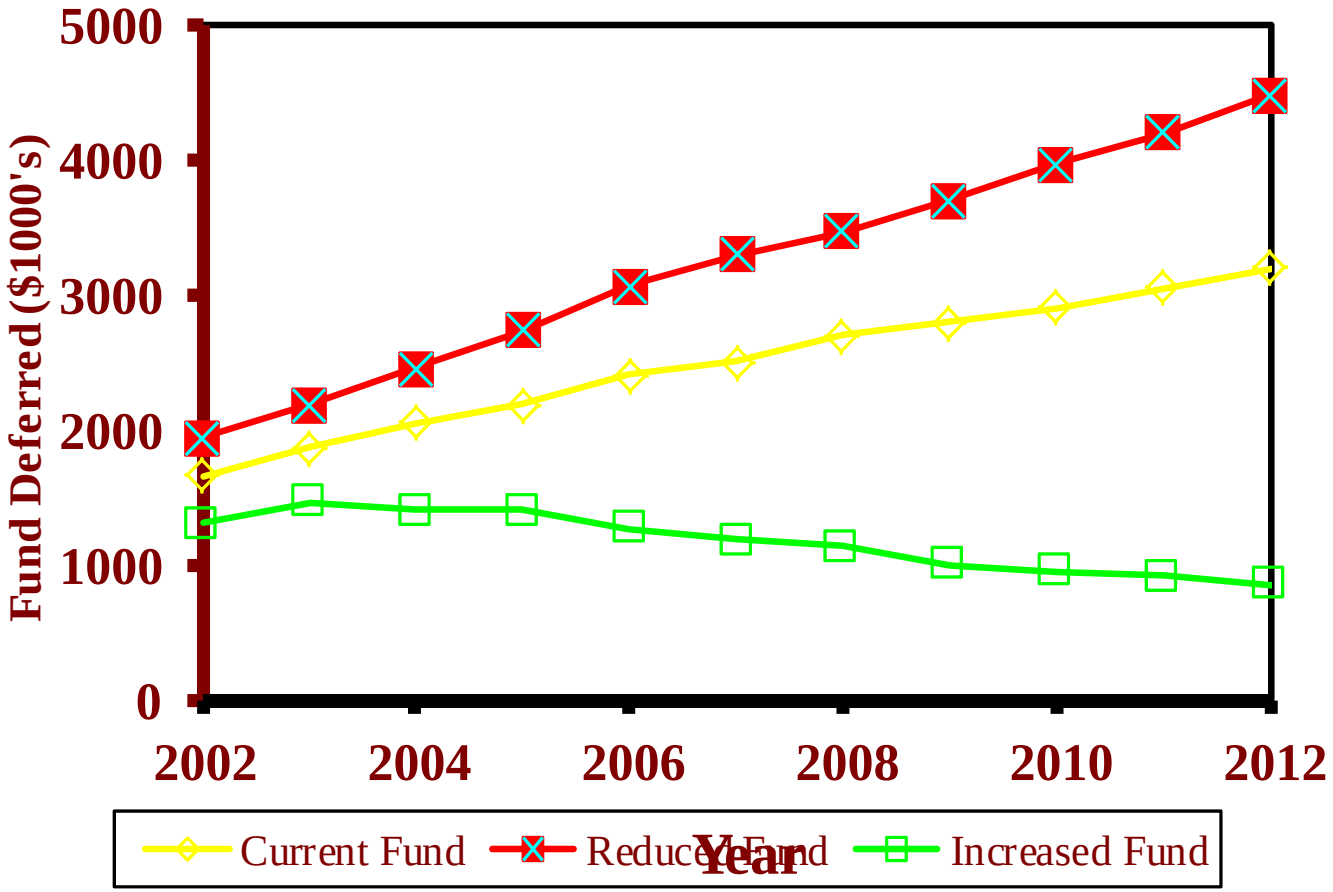
Impact of PM on Average CI



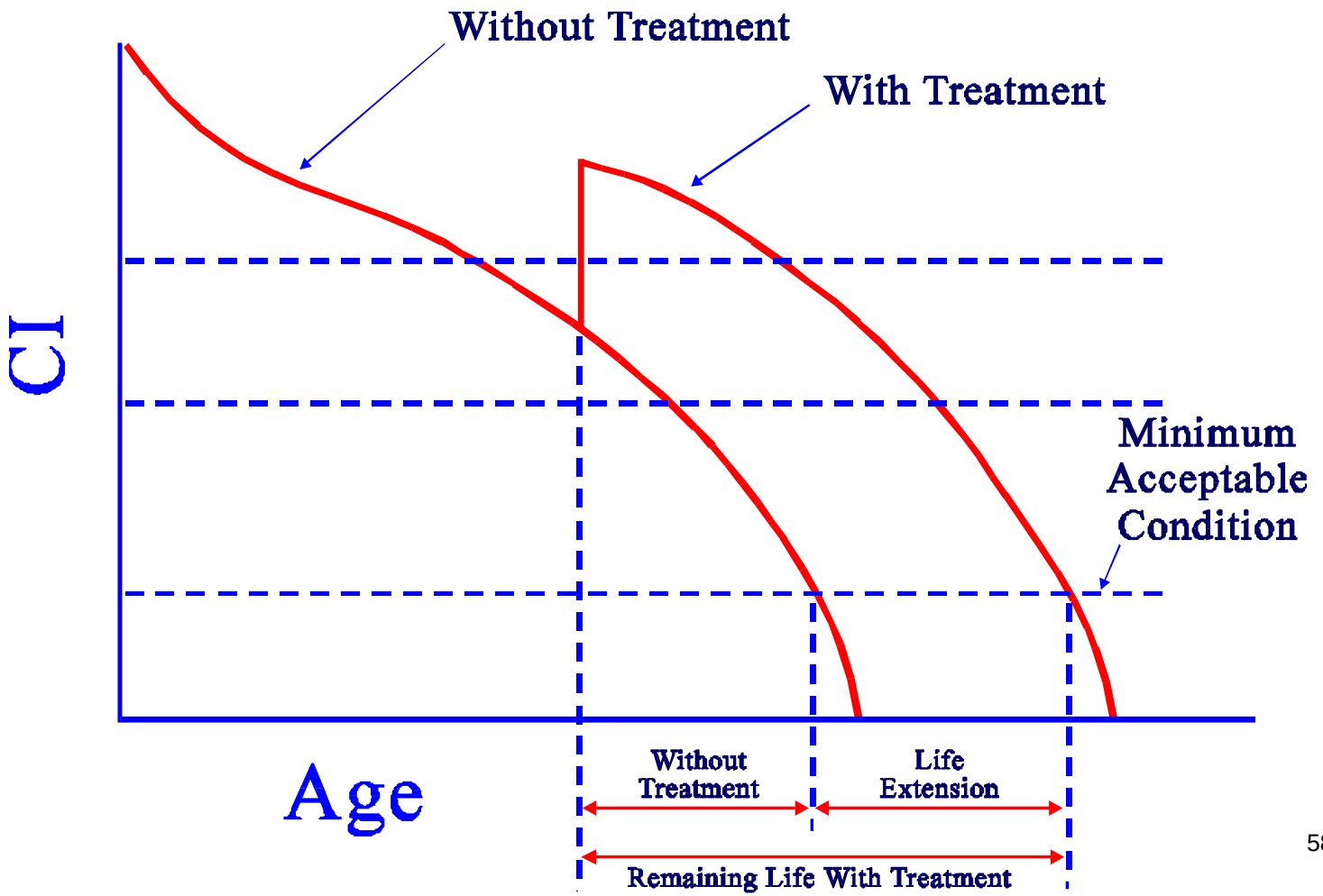
Poor Condition Category



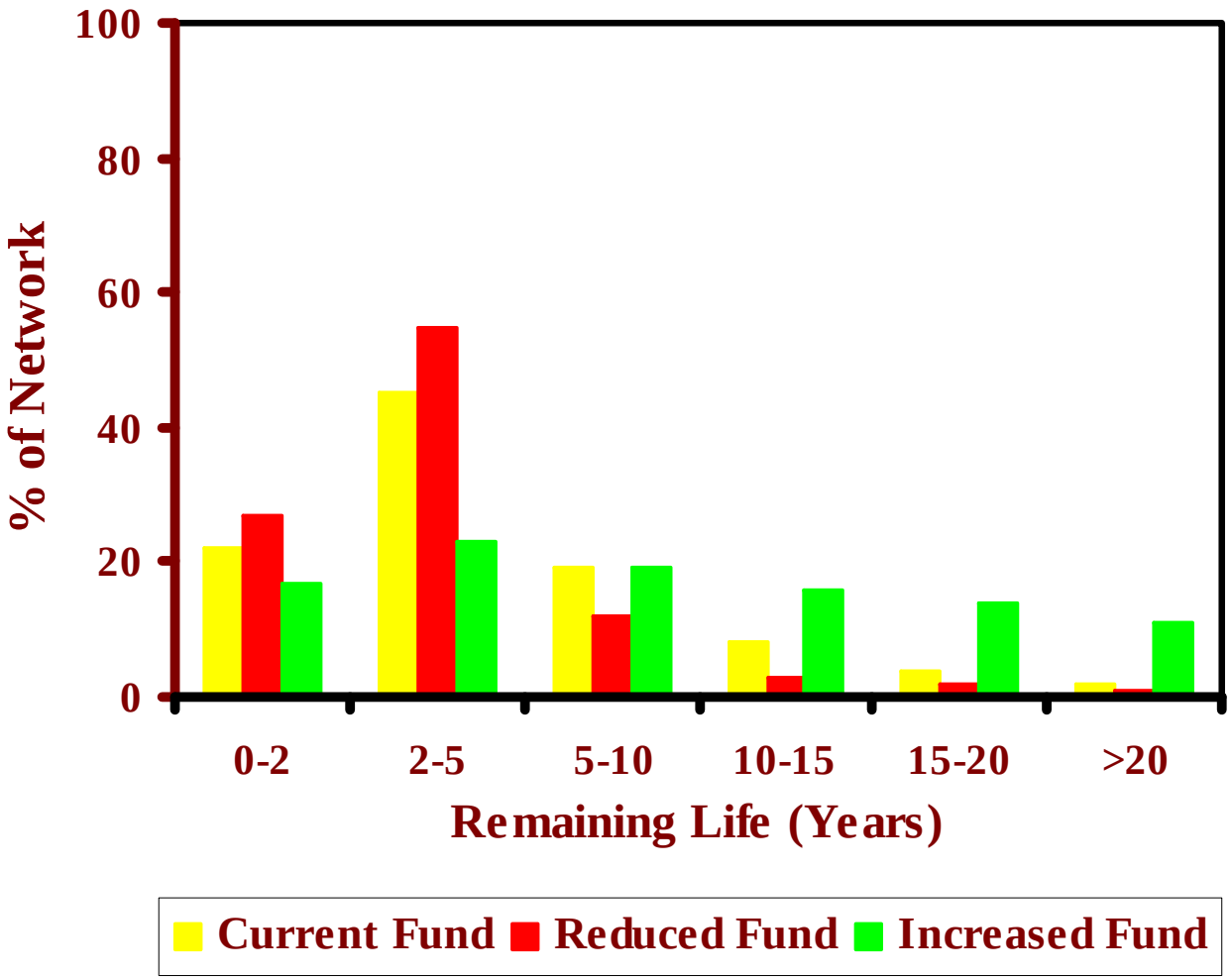
Deferred Fund Needs



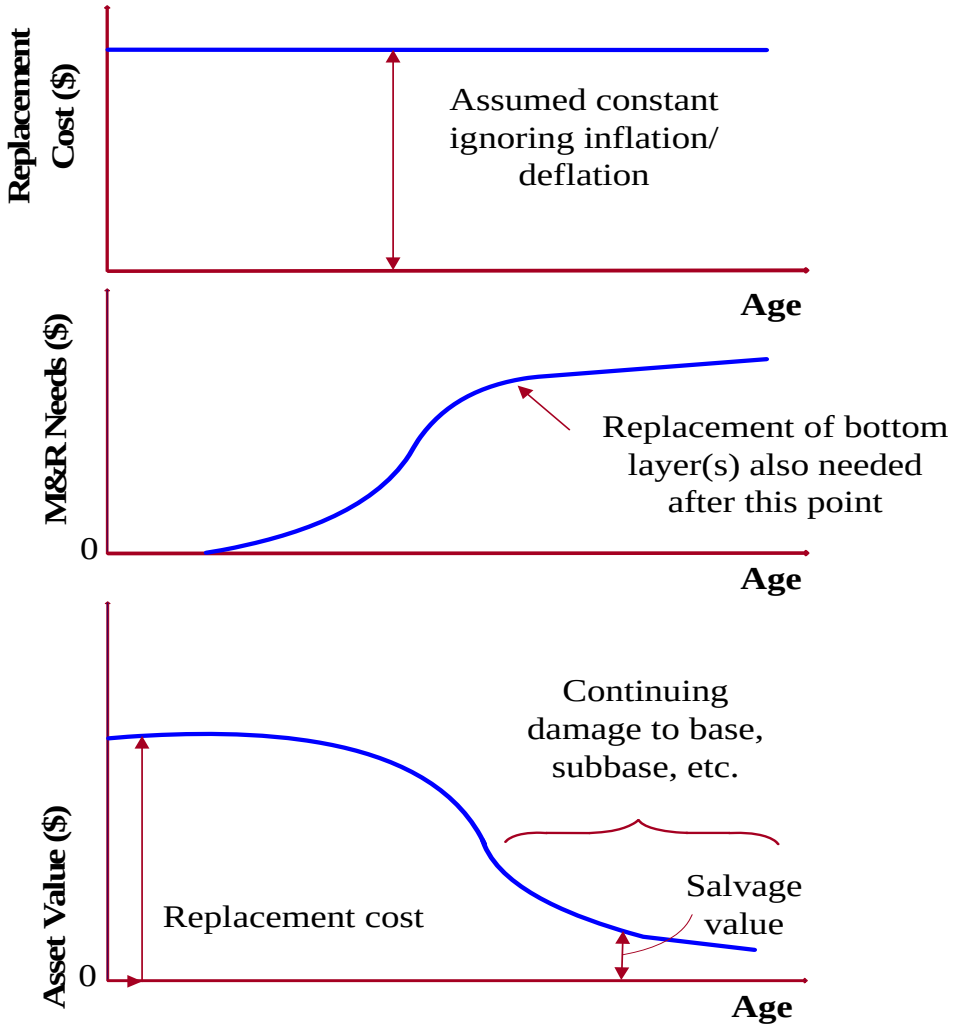
Remaining Life Definition



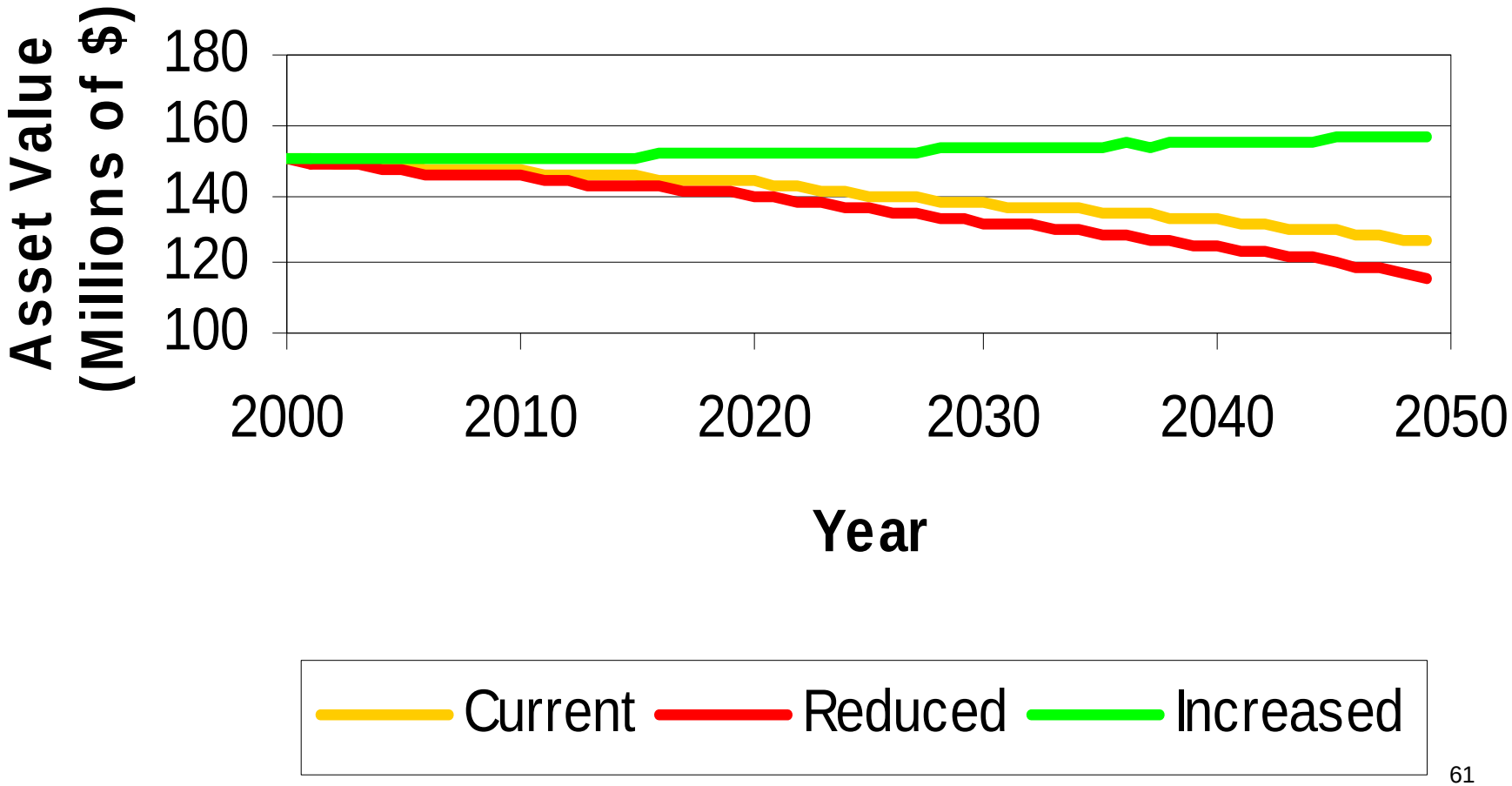
Large Amount of Short Remaining Life



Asset Value Calculation



Projected Change in Asset Value



Results of Impact Analysis

- Ability to Look at Different Funding Scenarios
  - Different Funding Levels
  - Different Allocation Approaches
  - Different Approaches to Treatment
- Answer “What If?”
- Feeds into Strategic Management

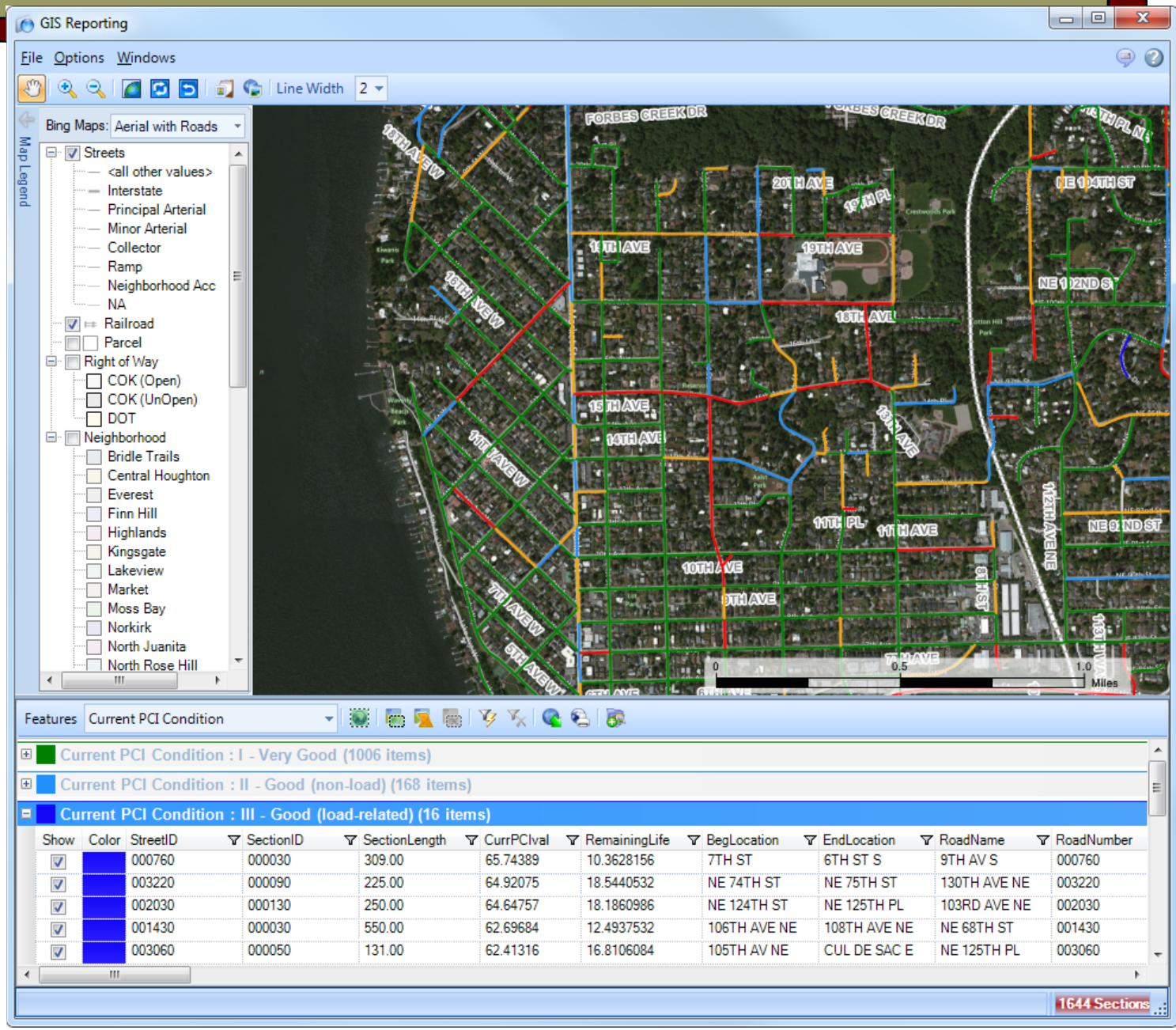
Funding Decisions

- Funding decisions controlled by elected officials
- Public works spends (cost-effectively)
- Public works staff must explain effects of funding recommendations
- Impact analysis is the connection of PMS to the budget process

Elected Funding Authorities

- Elected for generally for two to four years
- Often more interested in less expensive short-term solutions
- Need justification to approve funding for expensive long-term solutions
- Typically are not engineers

GIS Tool Assists in Presenting Information In Visual Format



Feedback System

- Helps system learn from past
- Improves reliability
- Updating costs
- Updating projection procedures

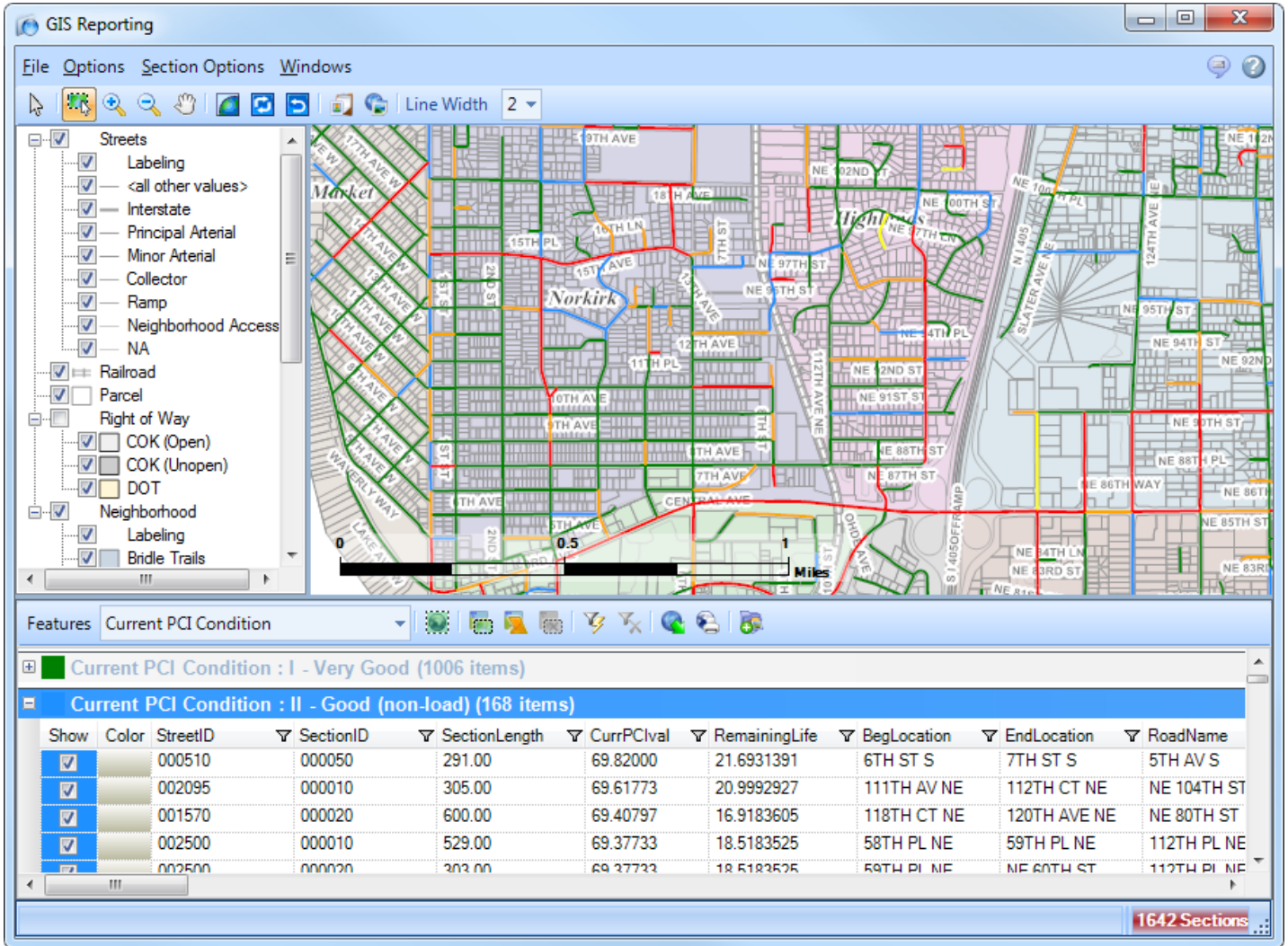
Project Selection-level Analysis

- Used to develop improved cost estimates for each individual segment
- Consider constraints & cost elements not included in network-level analysis
- May require more data and more analysis
- Some help from some PM software
  - Run Analysis with Selected Projects

Contract package

- Set same date and treatment to a group of sections needing similar treatment over some period of time (slurry seal program)
- User must know sections
  - Set sections, treatment type and date
- Sections 001, 006, and 011

GIS Aids in Project-Selection



Construction package

- Set same, or similar, treatment to a group of adjacent sections
- User must know sections
  - Set sections, treatment type and date
- Sections 004, 048, & 060

Treatment over multiple years

- Large segment of street, or group of streets, will have worked sequenced over a number of years
- User must know sections
  - Set sections, treatment type and date
- Sections 028-04, 033-05, & 038-06

Conflict Analysis

- Avoid treatment until after utility work completed

- User must know conflicts
  - 1. Designate date after which work is allowed
    - or
  - 2. Set treatment type and date

- Section 009 – No work until 2014

Delay work

- The section needs reconstruction, but work will be delayed until some future date (parabolic section)

- User must know sections and dates
  - 1. Designate date after which work is allowed
    - or
  - 2. Set treatment type and date

- Section 023 – Delay work until after 2013

Required Section

- Improve street because of agency commitment
- User must know section
  - Set treatment type and date
- Section 026 – Thick overlay 2013

New or Changed Treatments

- Treatment must be designated
  - 1. Only treatments defined in MTC PMS allowed
  - 2. PM must be designated
  - 3. Costs must be entered
  - 4. No treatment allowed during analysis period
    - “Do nothing” set for analysis period

Scenario

- Each year, both selected and non-selected sections are analyzed
- Selected sections are funded first
- Non-selected sections can only be funded if the selected sections are funded
  - Exception, when selected sections cannot be funded with remaining funds and non-selected sections can, they can be funded

User Responsible

- Must have completed appropriate designs
- Must have appropriate costs
- Must make decisions about adjustments

Project-Level

- Used to determine the best treatment and to develop final cost estimates for each individual segment
- Requires more detailed data and more extensive analysis
- Agency must do this with their design process
- Then it gets constructed

Questions