

# **Pavement Management within an Effective Asset Management Program**

**National Conference on Pavement Management**

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Ministry of Transportation Ontario

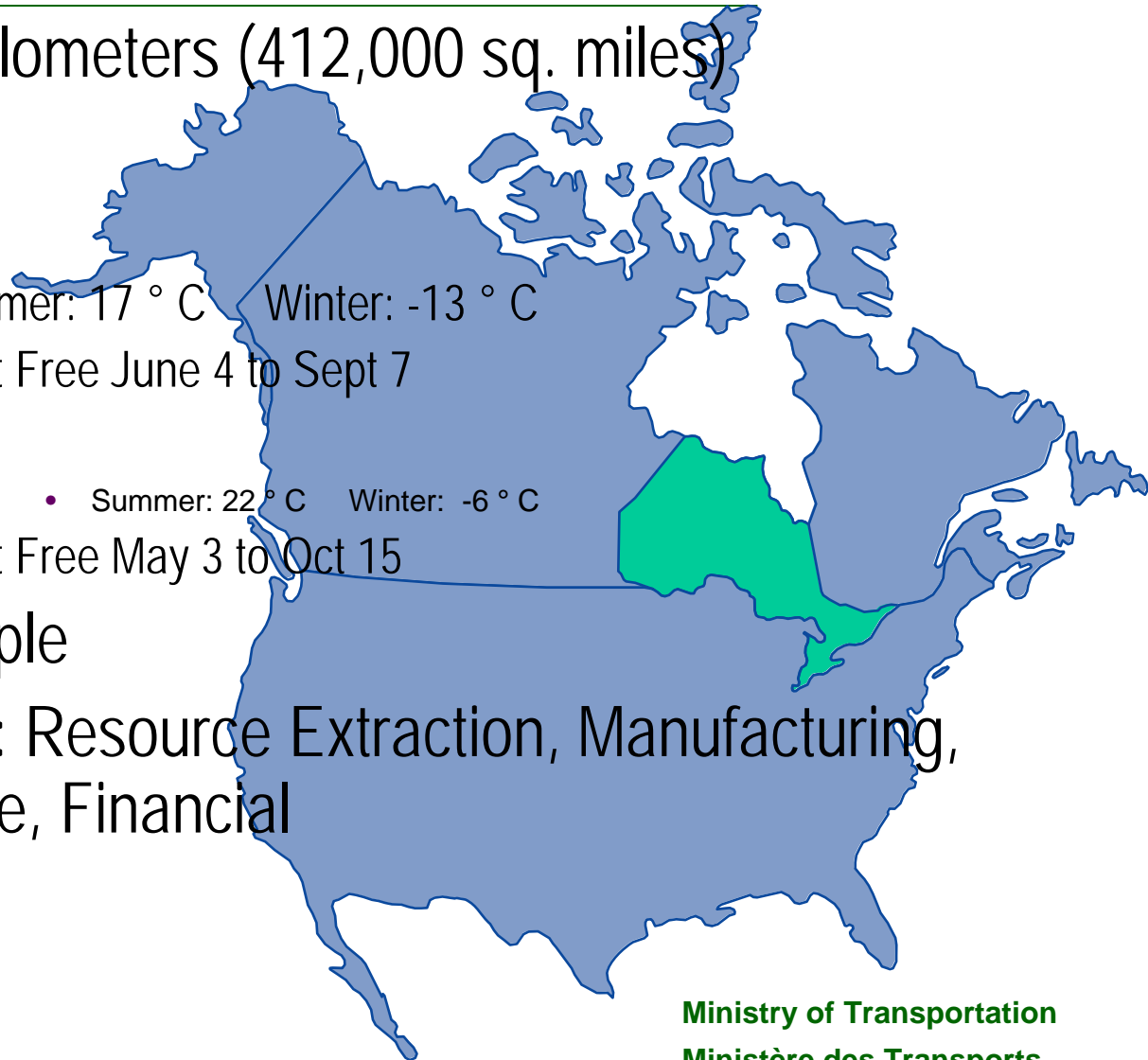
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# Outline

- Ontario Transportation Network
- Asset Management (AM) Overview
  - Definitions, Objectives, and Characteristics of AM
  - Corridor Investment Planning (CIP) in Ontario
- Samples PM Analysis within an AM Program
- Pavement Management (PM) Concepts
  - Pavement Preservation Strategies
- Sustainability Concepts within AM Program

# Ontario

- 1 m sq. kilometers (412,000 sq. miles)
- Climate
  - North
    - Summer: 17 ° C Winter: -13 ° C
    - Frost Free June 4 to Sept 7
  - South
    - Summer: 22 ° C Winter: -6 ° C
    - Frost Free May 3 to Oct 15
- 12 m people
- Economy: Resource Extraction, Manufacturing, Agriculture, Financial

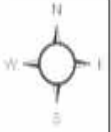




# 39,000 Lane-km of Highway & 2800 Bridges

**Northern Ontario: 22,700 lane-km (58%)  
800 bridges (29%)**

**Southern Ontario: 16,300 lane-km (42%)  
2,000 bridges (71%)**



## Ontario Roads Budget (Capital)

- Province-wide: \$2.7B
- Provincial Highways \$1.2B
  - 540M Highway Rehab/Renewal
  - 340M Expansion
  - 320 M Other Capital

**Total Asset Replacement Value in 2006 = \$39B**

# Types of Capital Investments

- Rehabilitation/Preservation
  - Pavements, Bridges, and other roadside assets
- Safety and Operational Improvements
  - Safety – passing lanes, interchange improvements, paved shoulders
  - Operational – Illumination, Noise Barriers, Signs, Advanced Traffic Management Systems (ATMS)
- Expansion
  - Widening of existing highways
  - Highway occupancy vehicle (HOV) lanes
  - New highway corridors
- Other Investments (ferries, truck inspection stations, rest areas, etc.)

Hwy 401, Toronto

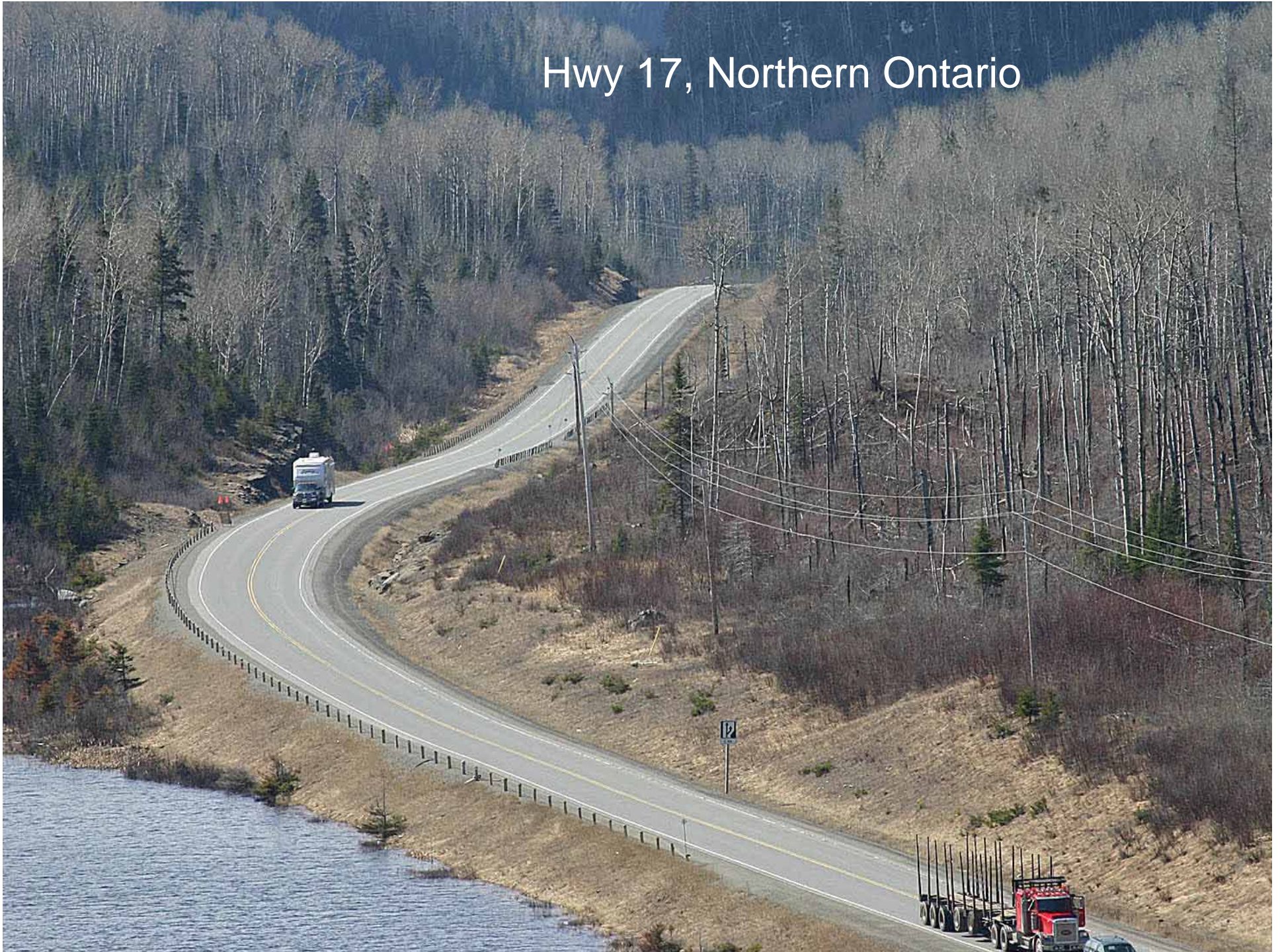








# Hwy 17, Northern Ontario







**Deteriorated Barrier Wall**

County Road No. 3 Overpass, Site No. 27-212 Hwy 417



# Asset Management Definition

- Asset Management is a systematic process of maintaining, upgrading, and operating physical assets cost effectively.
- It combines engineering principles with sound business practices and economic theory, and it provides tools to facilitate a more organized and logical approach to infrastructure investment.

# Key AM Objectives

- Maximize the performance of highway assets over the long-term
- Minimize the cost of both road user and ownership of those assets (life-cycle costs)
- Analyze and justify road investments for within constrained budgets
- Challenge of AM: Developing and delivering affordable investment plans that delivery maximum benefits to the user for lowest LCC

# Key Characteristics of AM in Ontario

- Spans all major investment activities:
  - Planning, Design, Programming, Construction, Contract Administration, and Maintenance
- Calculates and tracks financial and asset deterioration
  - Show impacts of deferred or reduced investment
- Quantifies relationship between performance targets, funding levels and debt (backlog)
- Supports justification for funding new and existing assets
- Enables trade-off analysis and decisions



# Key Features of AM in Ontario

- Long-term investment plans (25-years)
  - Covers all major investment activities
- Performance measures tracked and managed
  - Technical & corporate measures
  - Performance prediction
- Current Tools: Life-cycle costing, PMS/2, BMS
- Tools under development: Trade-off Analysis framework
- Keeping AM practical and not overly theoretical
- Organization by "Corridor" segments

# Corridor Investment Plans (CIP)

- Corridors are usually origin-destination oriented – easy to understand
  - Senior Management, Central funding agencies, and the public
- Enables comparison of highways with similar role and function
- Move away from “traditional” pots of money for expansion, rehabilitation, maintenance towards more integrated corridor-based allocations
- Implementation of AM is being achieved over a 5-year period
  - Corridors enable a phased-in approach
  - Allows introduction of new components over 5-years

# Corridor Investment Plans (cont.)

- Illustrate investments required for individual highway corridors over 25 years.
- Include all Capital and Operating needs outlined with strategies to address needs and backlog over time.
- Asset performance and condition tracked based on proposed investment level
  - Consequences of under-investment demonstrated

# Key Performance Indicators

- Performance Measures
- Performance Targets
- Performance Prediction
- Performance Outcome

# Performance Measure (Example)

## Technical

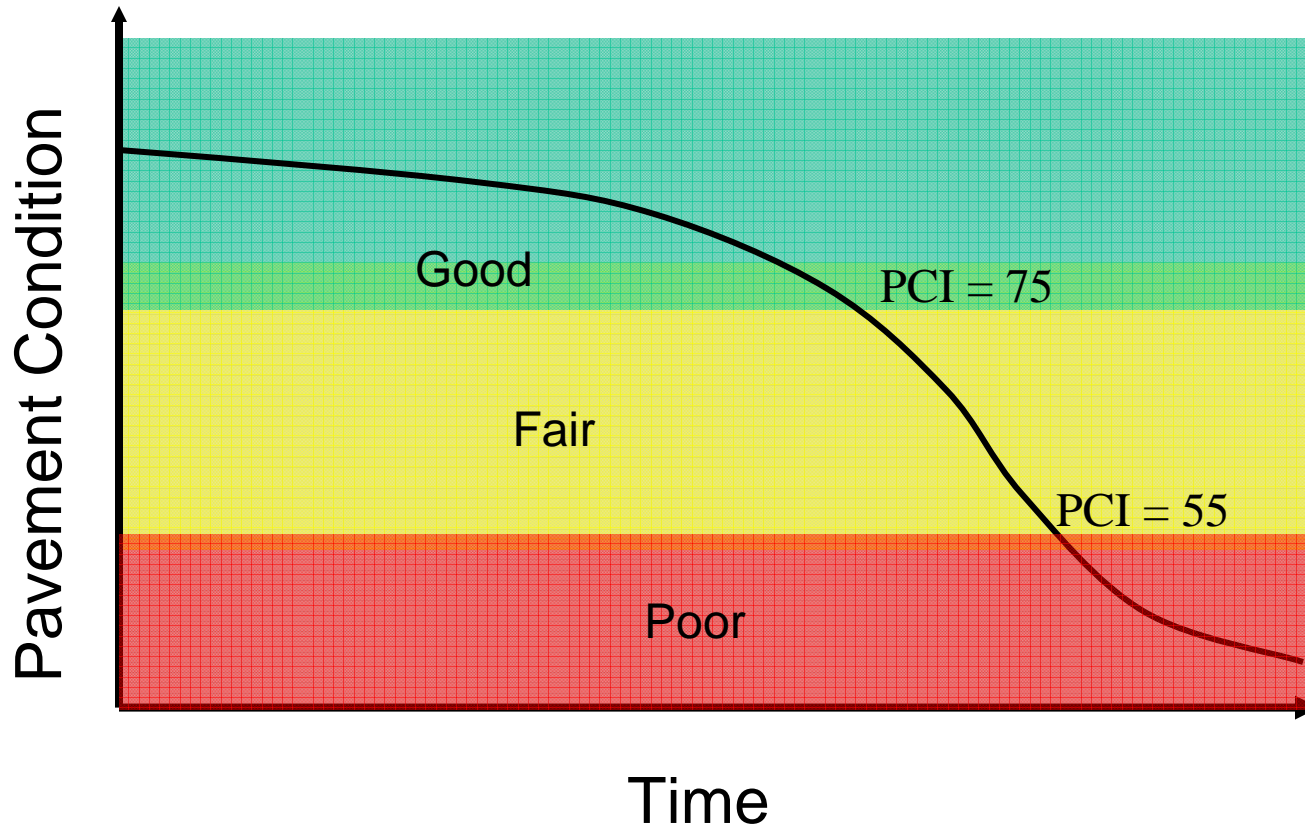
- Pavement condition index (PCI)
- Bridge condition index (BCI)
- Remaining life

## Corporate

- % highways in good, fair & poor condition
- % bridges in good, fair & poor condition
- Remaining life of the assets

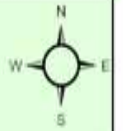
# Pavement Performance Categories

## Arterial Highways



# **Asset Management – Regional Network Example**





EASTERN

3000 2-lane kilometres of Highway  
550 Bridges, 5 Ferries

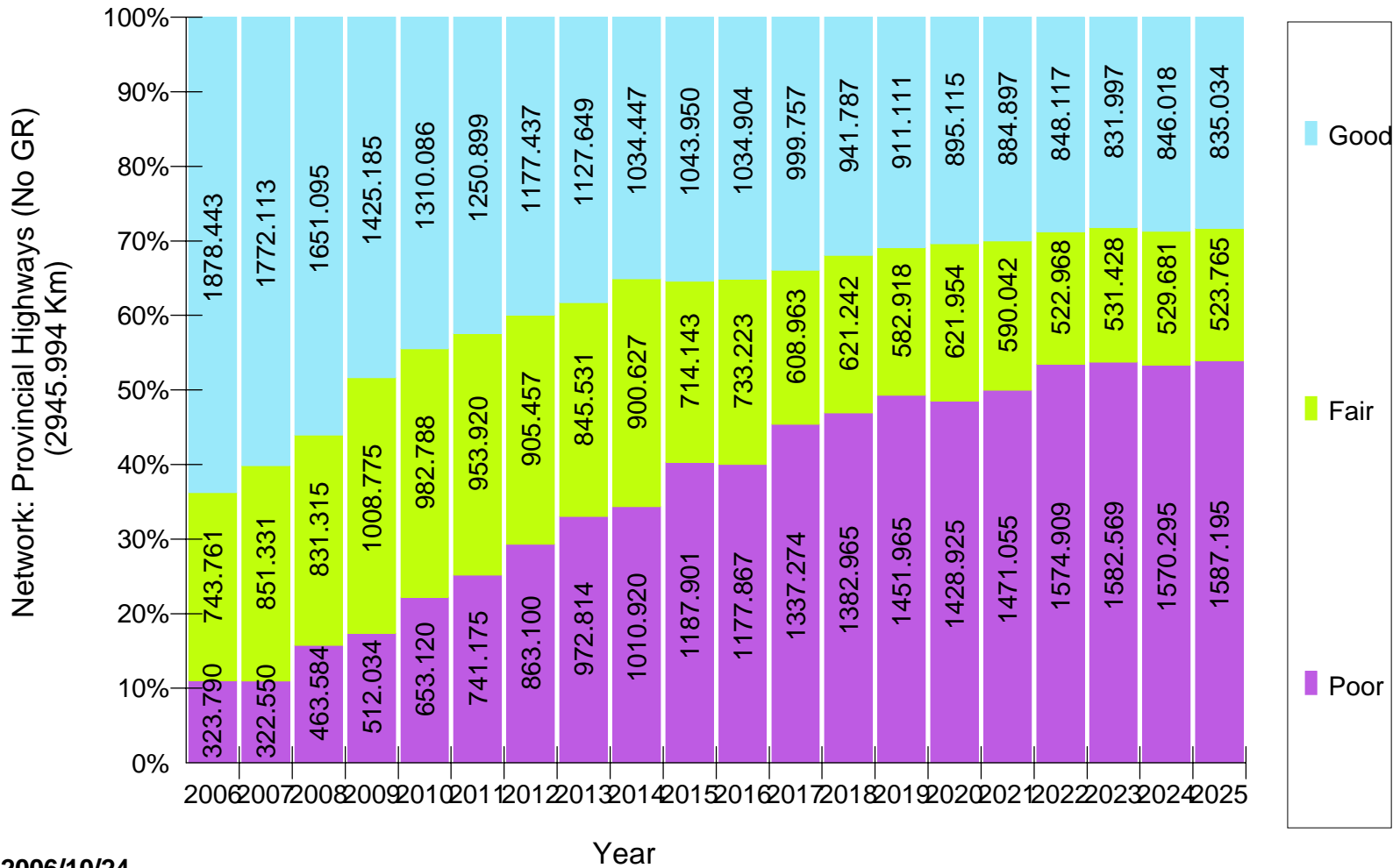


# Rehabilitation Needs & Budget

- Infrastructure Backlog (Debt) - Total 480M
  - Pavements 290M
  - Safety & Operational Improvements 100M
  - Bridges 90M
- Projected (next 10 years)
  - Pavement +20M/year
  - Safety and Operational Improvements + 9M/year
  - Bridges + 13M/year
  - Total + 42M/year
- Annual Rehab Budget ~ \$70M

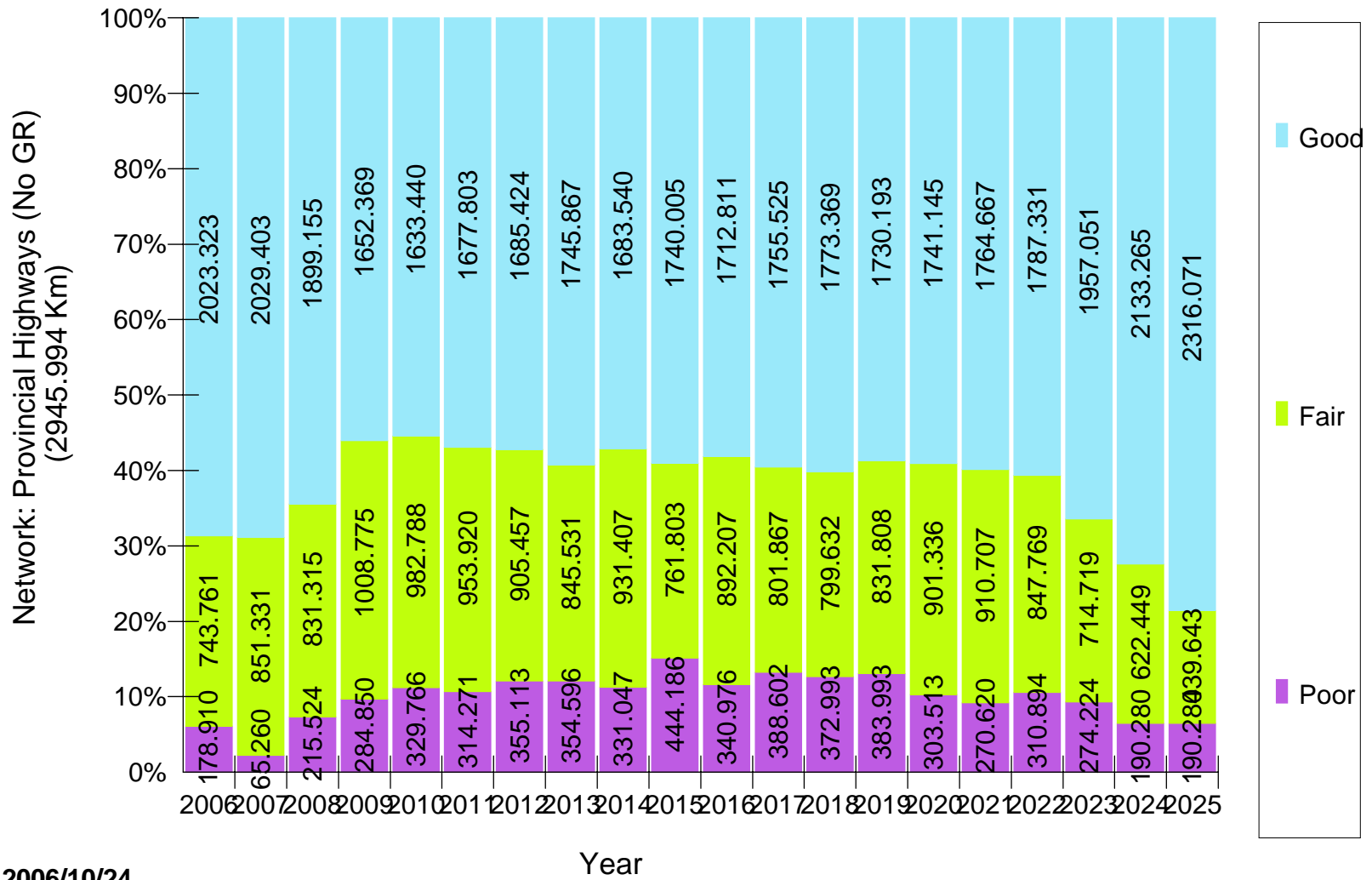
# PMS Network Analysis - \$20M

PCI DISTRIBUTION: 2006 - 2025

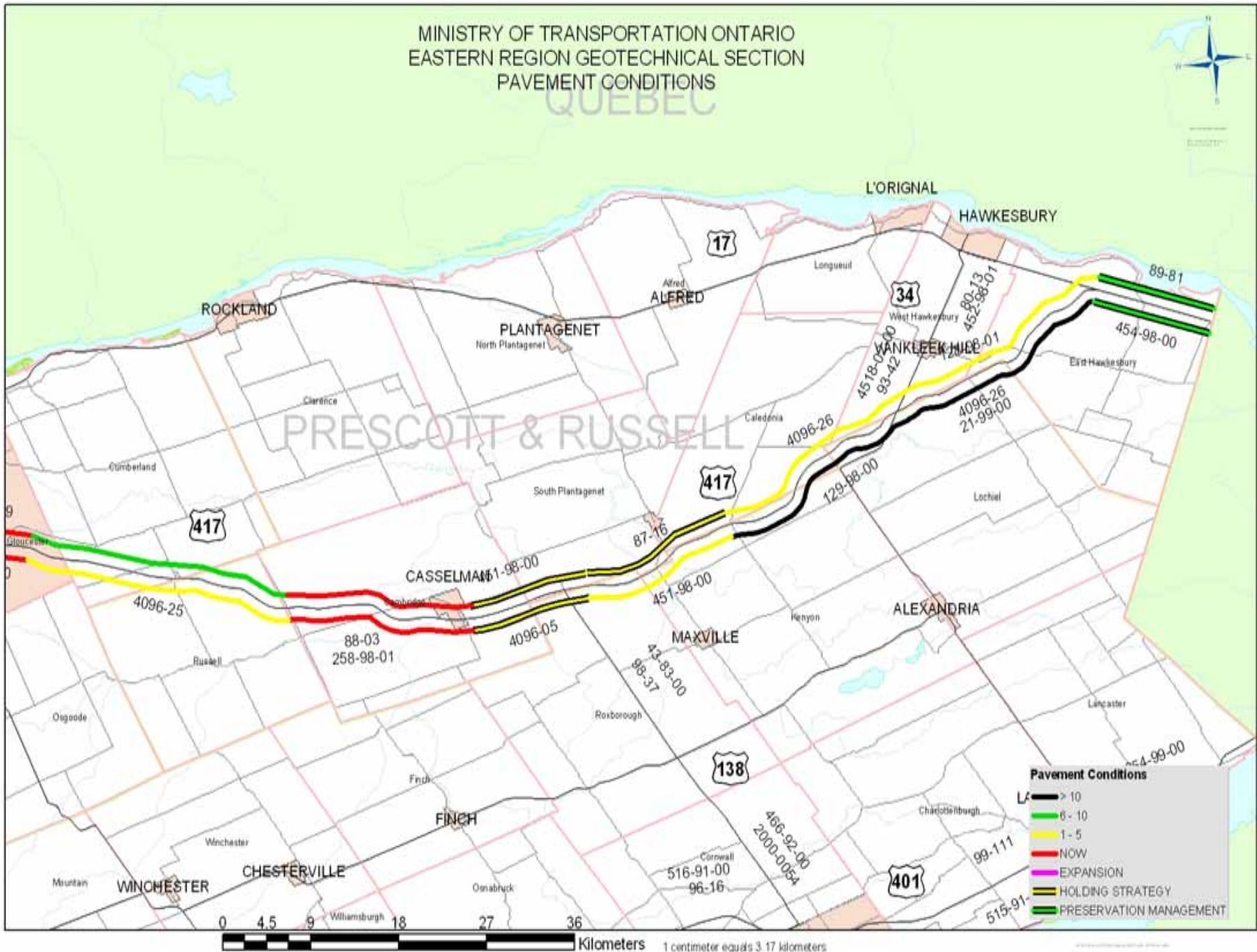


# PMS Network Analysis - \$50M

PCI DISTRIBUTION: 2006 - 2025



MINISTRY OF TRANSPORTATION ONTARIO  
 EASTERN REGION GEOTECHNICAL SECTION  
 PAVEMENT CONDITIONS



PAVEMENT CONDITIONS HWY 417 QUEBEC TO OTTAWA

0 4.5 9 18 27 36 Kilometers 1 centimeter equals 3.17 kilometers

# Highway 17 Corridor Investment Plan - Eastern Region

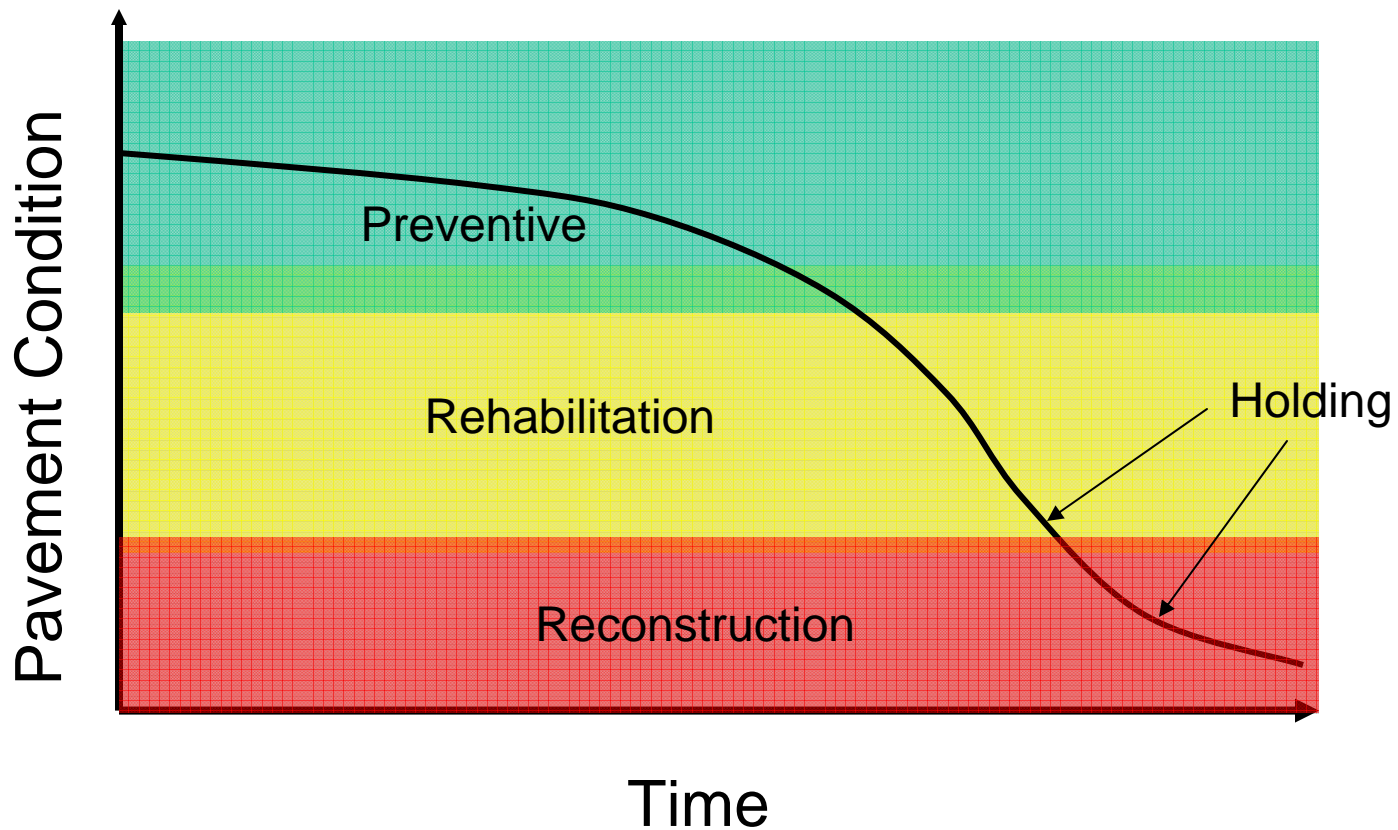
## Current Pavement and Bridge Conditions



# Pavement Management Strategies



# Pavement Treatment Strategies



# Strategy Definitions

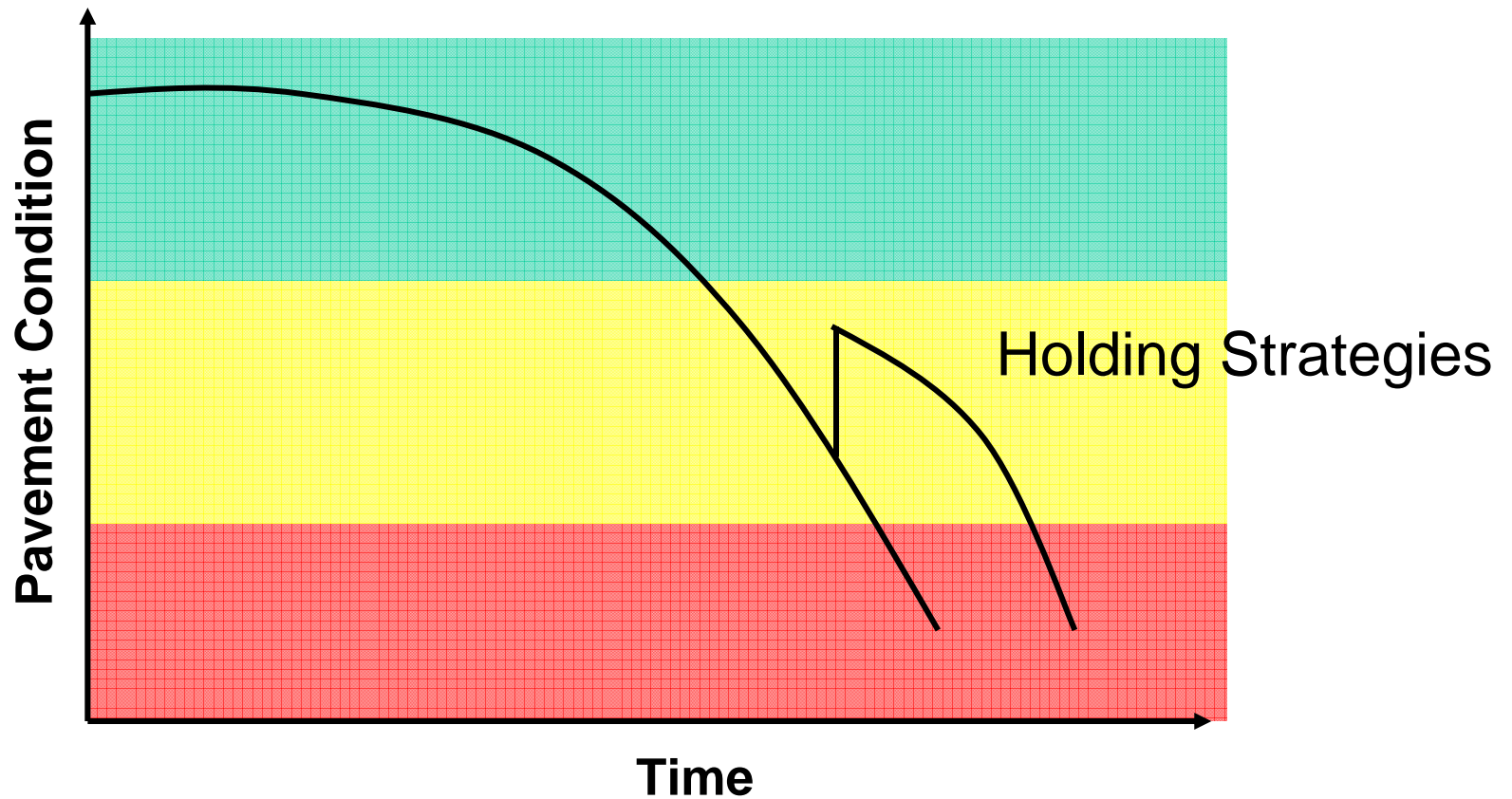
- Preventive
  - planned strategy to extend the life of the pavement
  - preserves the system, retards deterioration, and maintains or improves the functional condition of the system (without increasing structural capacity)
- Rehabilitation
  - renews the life of the pavement
  - work undertaken to restore serviceability and improve an existing pavement to a condition of structural or functional adequacy
- Reconstruction
  - removal and replacement of the existing pavement structure
- Holding
  - strategy that prolongs or extends the life of an asset (for a *planned* period of time). Strategy employed to maintain acceptable levels of functionality or safety until full rehabilitation or reconstruction can be completed.



# “Mix of Fixes”

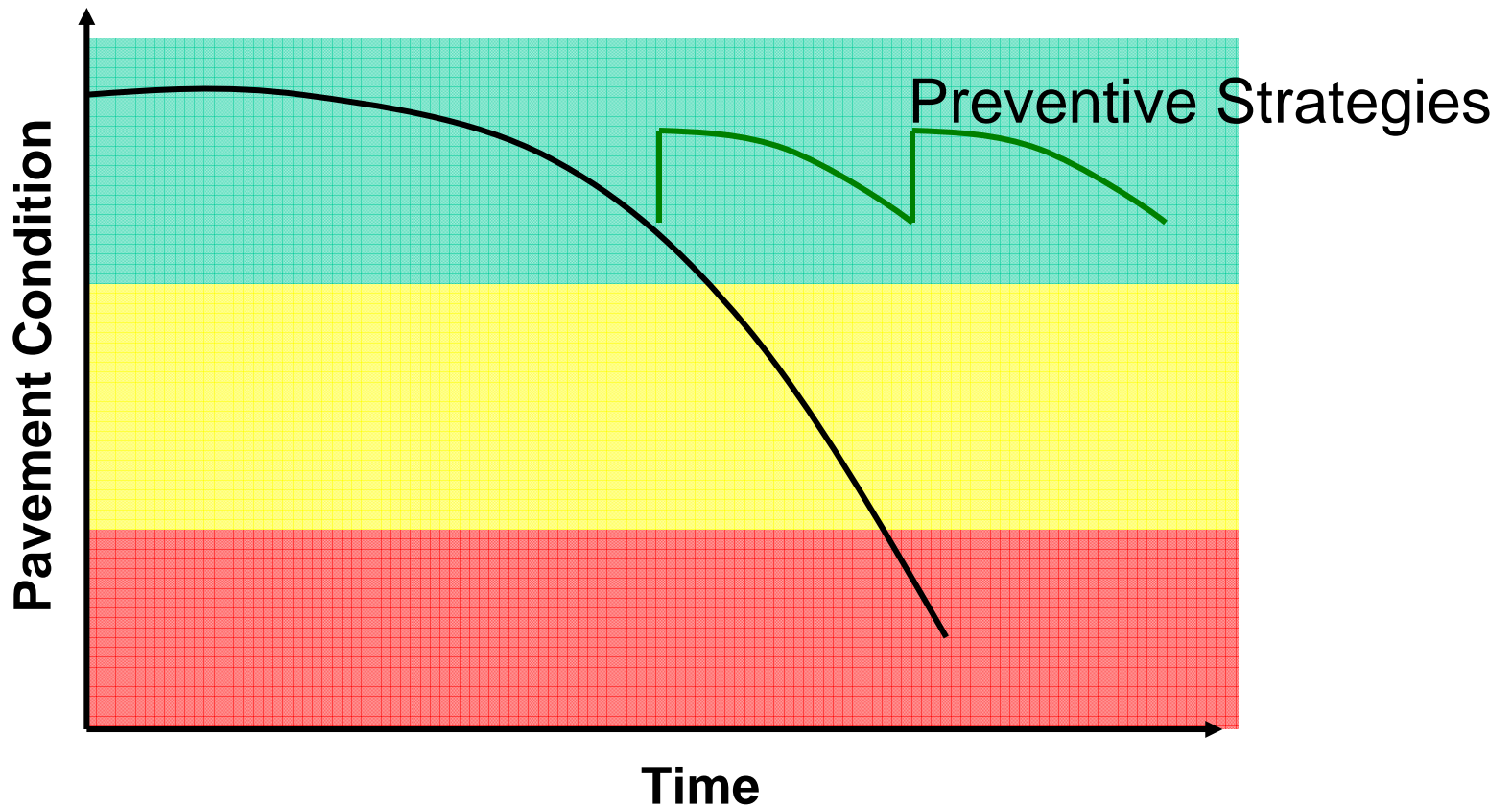
- Preventive
  - Microsurfacing
  - Mill 50 mm, Pave 50 mm (Recycled Hot Mix)
  - Hot In-Place Recycling
- Rehabilitation
  - Mill 50 mm, Pave 90 mm (Recycled Hot Mix)
  - Cold In-Place Recycling and Pave 50 mm
- Reconstruction
  - Rubblize CTB, granular grade raise, and pave asphalt
  - Full depth reclamation (FDR) and HMA paving
  - Full depth removal and replacement with new pavement structure
- Holding
  - Hot Mix Patching
  - Ultra-thin Resurfacing

# Holding Strategies





# Preventive Strategies





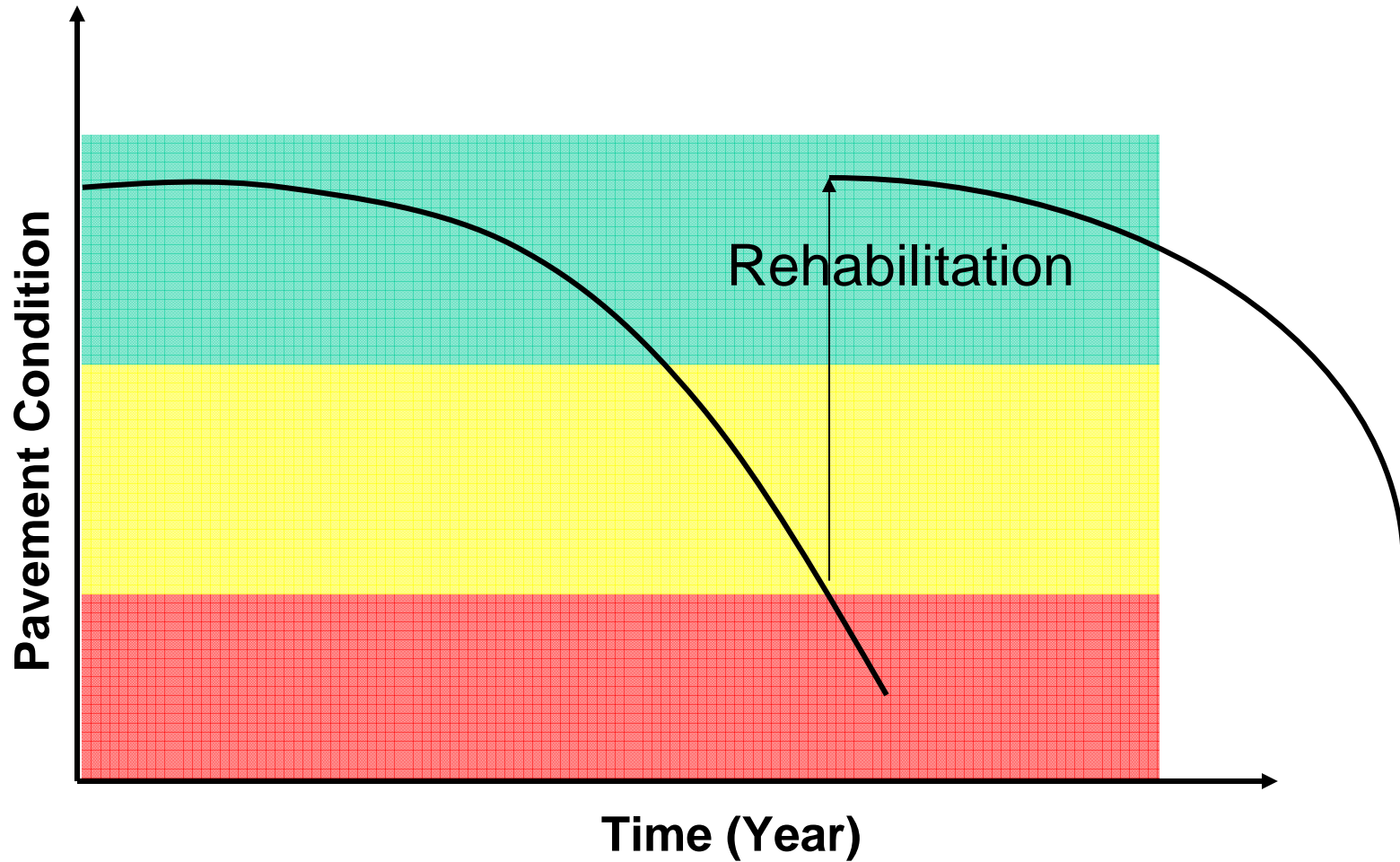


# Hot In-Place Recycling - HIR





# Rehabilitation Strategies





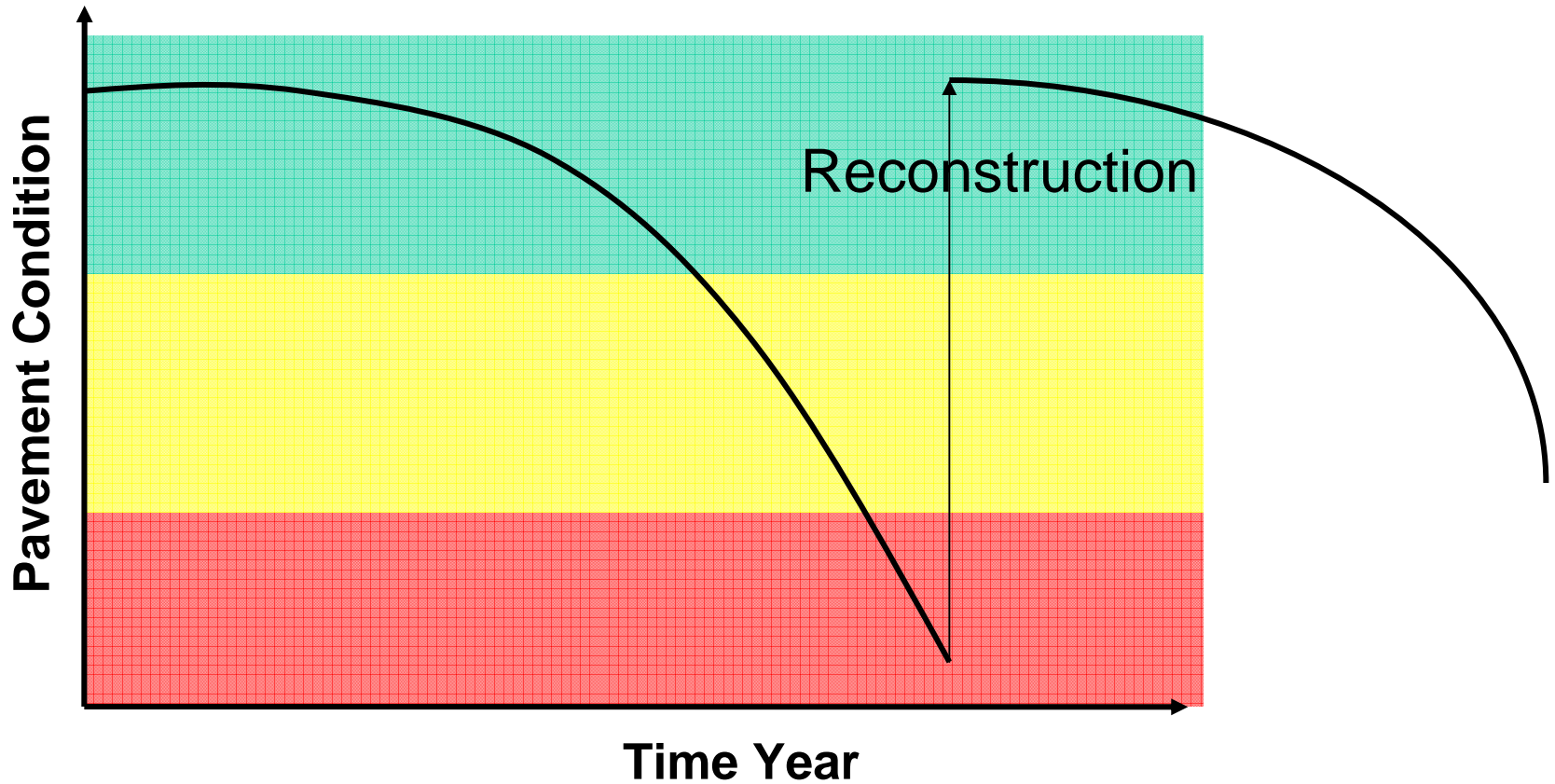
# Cold In-Place Recycling -CIR



# CIR with Expanded Asphalt



# Reconstruction Strategies





# Full Depth Reclamation - FDR

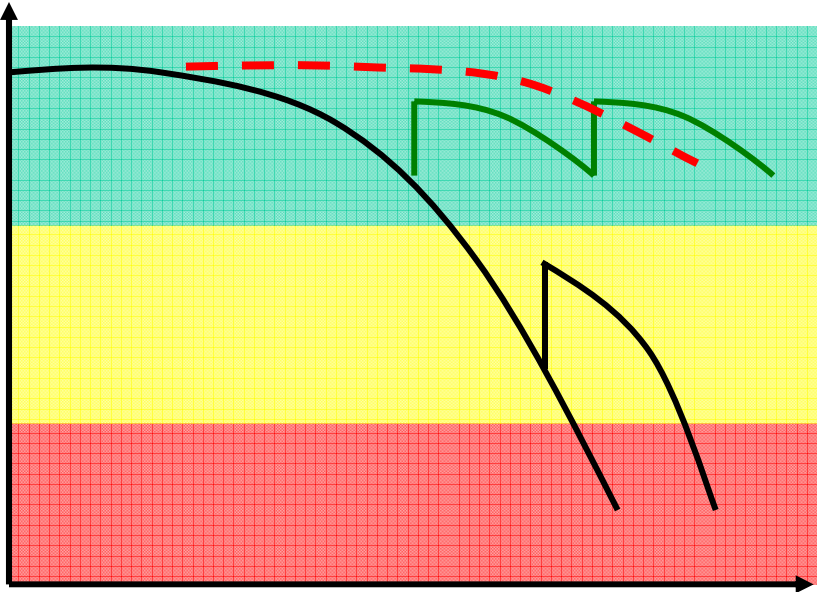




# FDR with Expanded Asphalt Stabilization

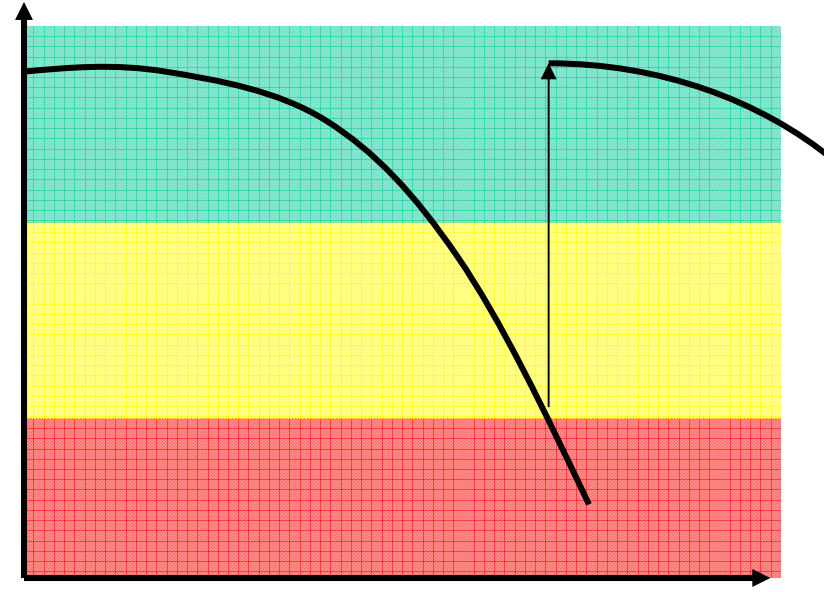


# Coordinated Approach to Investment



Preventive or Holding

+



Rehabilitation

= Optimized Asset Performance

# **Sustainability Concepts within an Asset Management Program**



# Towards a Sustainable Future

## What is Sustainable Development?

".... Development that meets the needs of the present without compromising the ability of future generations to meet their own needs."

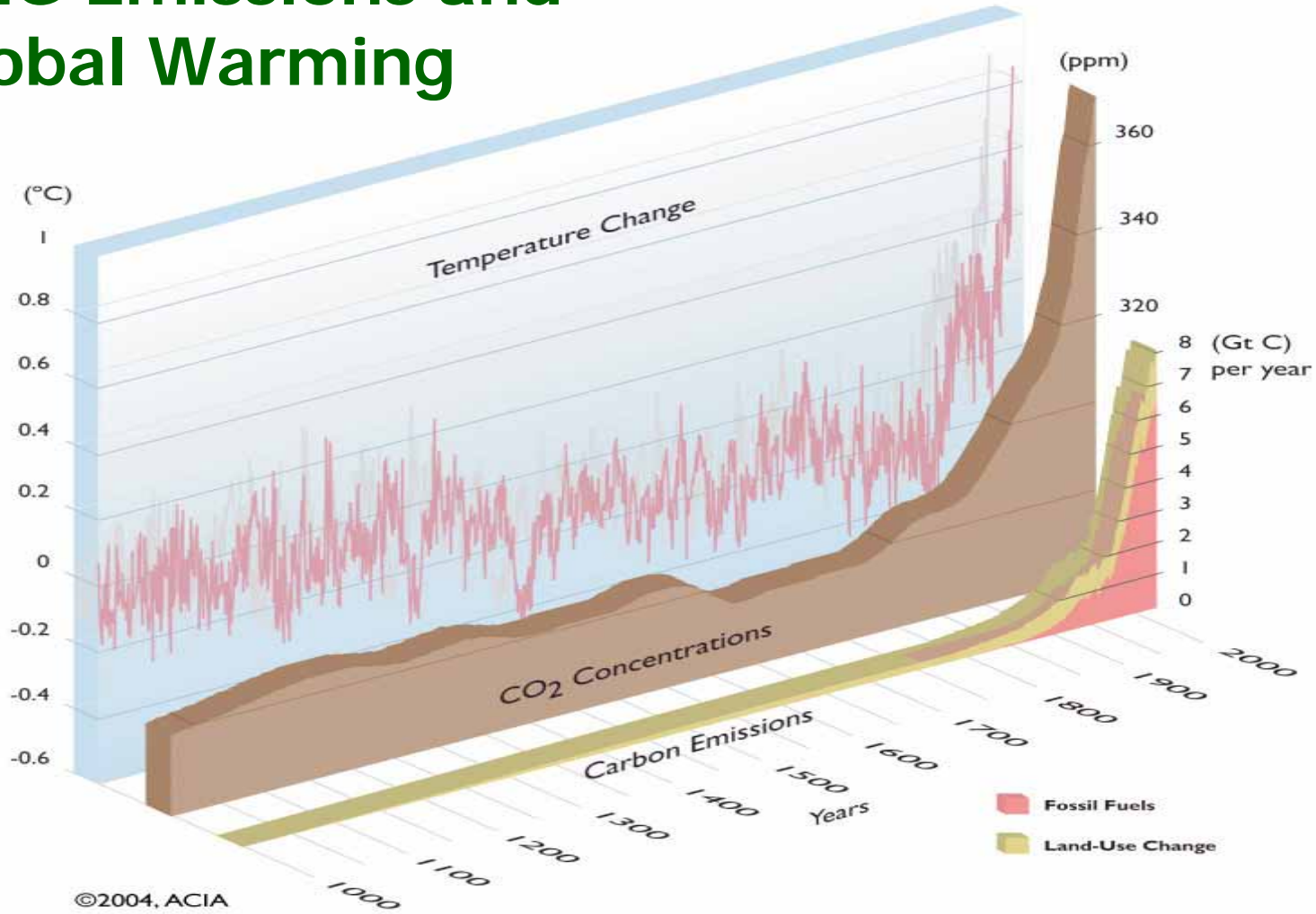


# Towards a Sustainable Future

To achieve sustainability, every corporate decision should consider the impact of the triple-bottom-line.

“What are the Social, Economic, and Environmental (SEE) Impacts of the decision”

# GHG Emissions and Global Warming



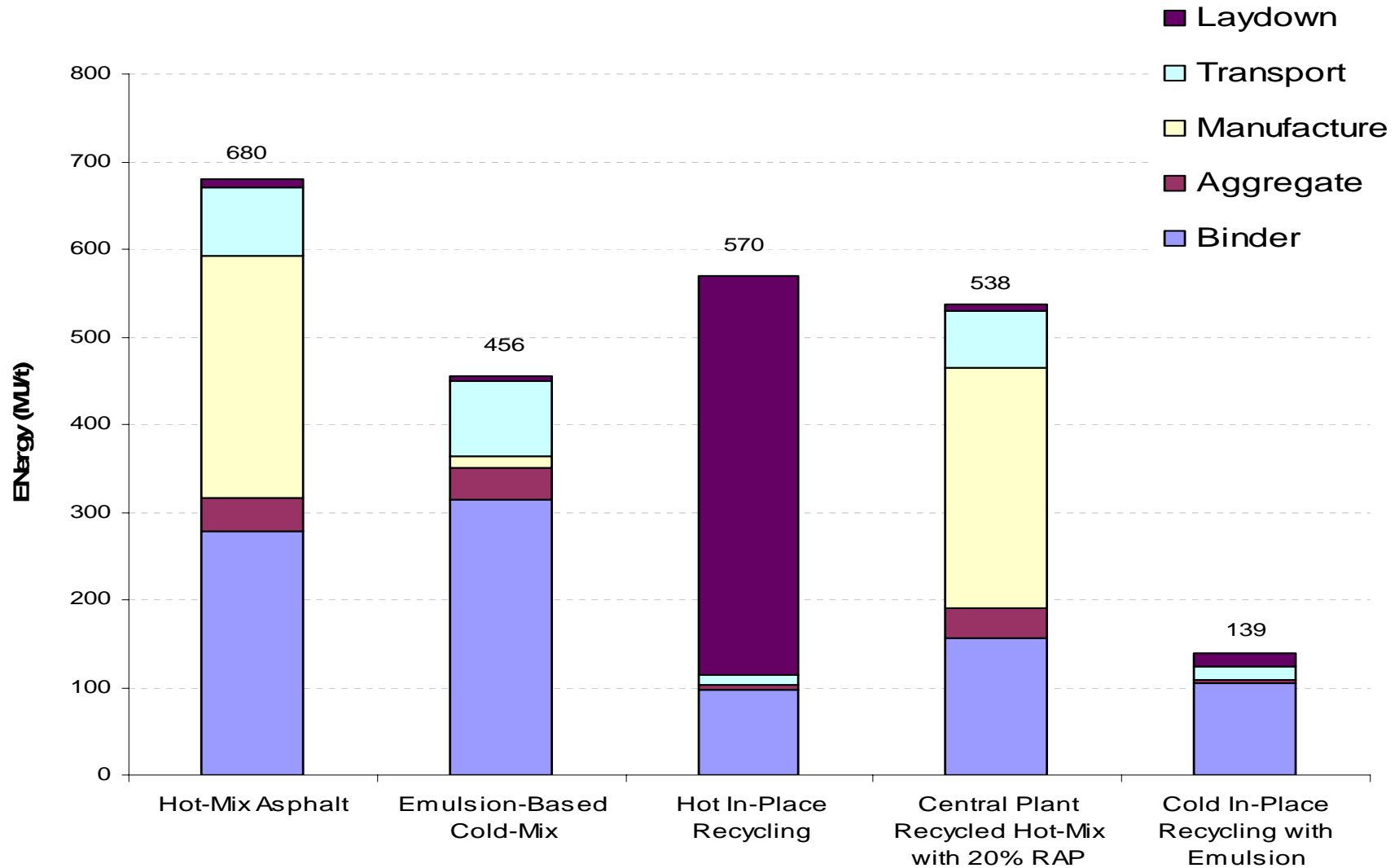
## Variation in Mean Surface Temp and CO<sub>2</sub> Concentration

# Sustainable Pavement Criteria

“ ....safe, efficient, environmentally friendly pavements meeting the needs of present-day users without compromising those of future generations”

- In-situ recycling technologies address the main criteria for a sustainable pavement:
  - Optimizing the use of natural resources
  - Reducing energy consumption
  - Reducing greenhouse gas emissions
  - Limiting pollution
  - Improving health, safety and risk prevention
  - Ensuring a high level of user comfort and safety

# Energy Use Per Tonne Of Material Laid Down



Source: *The Environmental Road of the Future, Life Cycle Analysis* by Chappat, M. and Julian Bilal. Colas Group, 2003, p.34



Ministry of Transportation  
Ministère des Transports

# Sustainable Pavements

- The COLAS report concludes that recycling technologies are the most promising tool to assist in the selection of environmentally friendly pavements.
- MTO's primary pavement design/rehabilitation goal is to provide safe durable roads that maximize the use of recycled materials.

# Sustainable Pavements in Ontario

- MTO currently uses numerous innovative in-situ recycling technologies that conserve aggregates, reduce GHG emissions, and minimize energy consumption
- A key MTO sustainability strategy is to implement these technologies on a larger scale and encourage their use province wide.
- These technologies support a “zero waste” approach and will assist in meeting our GHG reduction commitments while addressing the triple-bottom-line (SEE).

# What's next?

- Current Life Cycle Costing (LCC) in PM includes:
  - Initial, and discounted main/rehab and remaining life costs
  - User costs
- We now have the tools to calculate GHG emissions and energy savings – PaLATE software
- Moving towards including an environmental component into LCC (Environmental costs).
- Insures that the best treatment is selected to benefit economic, social and environmental needs
  - a Sustainable Approach.

# Conclusions

- There is a well established and increasing focus on asset preservation in Ontario, both provincial and municipal levels
- Pavement preservation incorporating timely preventive treatments and planned holding strategies can significantly extend pavement life, and result in improved network performance over time
- We need to continue to develop and foster use of Asset Management principles and tools
- Implementation of **sustainable** AM principles and performance measures are critical to addressing infrastructure investment requirements and **environmental stewardship** over the long-term



