The 7 Steps of In-Place Recycling Implementation by Public Agencies

Virginia Pavement Recycling Conference

Glen Allen, Virginia
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Outline

- **The 7-Step Implementation Plan**
- Case Study (NDOT & Caltrans)
  - Why CIR &FDR?
  - Project Selection Criteria
  - Pavement Thickness Design
  - Mix Design
  - Geometric Design
  - Construction

Step 1: Task Force

- Establish a pavement recycling task force (TF) consisting of representatives from research, materials, construction, roadway design divisions as well as industry representatives such as , general and subcontractors, material suppliers, testing lab, and consultants with in-place recycling experience
- Appoint a TF leader for both agency and industry

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Step 2: Goals & Objectives

- Define agency’s objectives and quantify the benefits of in-place recycling
  - Conduct life-cycle cost analysis
  - Life-cycle assessment

Step 3: Training

- Provide training and workshops for the staff
  - NHI course, ARRA Manual
- Visit other agencies recycling projects under construction and learn from their experience
- Contact other agencies who have experience with in-place recycling

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Step 4: Specifications & Project Selection Criteria

- Establish project selection criteria using the "right strategy, at the right time, on the right project" concept
- Use other DOTs specifications to develop customized specifications for your agency that meet your agency goals and objectives
- Identify several potential projects for in-place recycling. Start slowly and keep increasing the number of projects

Step 5: Construction

- Finalize the design and specifications
- Make sure the right field personnel are selected for construction management
- Require 2-hour mandatory just in–time training prior to the start of recycling
- Provide timely input to the field personnel when a problems arise

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Step 6: Post Construction Meeting

- Conduct post-construction meeting with individuals involved with planning, design, and construction
  - Discuss the top 3 things that went **right** on the project
  - Discuss the top 3 things that went **wrong** on the project
  - Document lessons learned and improve specifications
  - Develop list of new projects
  - Provide a steady work flow to retain experienced contractor in your area

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Step 7: Performance

- Monitor short term and long term performance using pavement management data
- Publish your result and share your success and lessons learned with others
- Update life-cycle cost analysis, life-cycle cost assessment, structural number selected for the in-place recycling layer

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Result of Successful In-Place Recycling Implementation for 2011

		2011-CIR Projects in lane miles				
	CA	NV	UT	MT	ID	Total (lane miles)
Caltrans	250	235	120	31	8	
CA Local Agnecies	100					
						744

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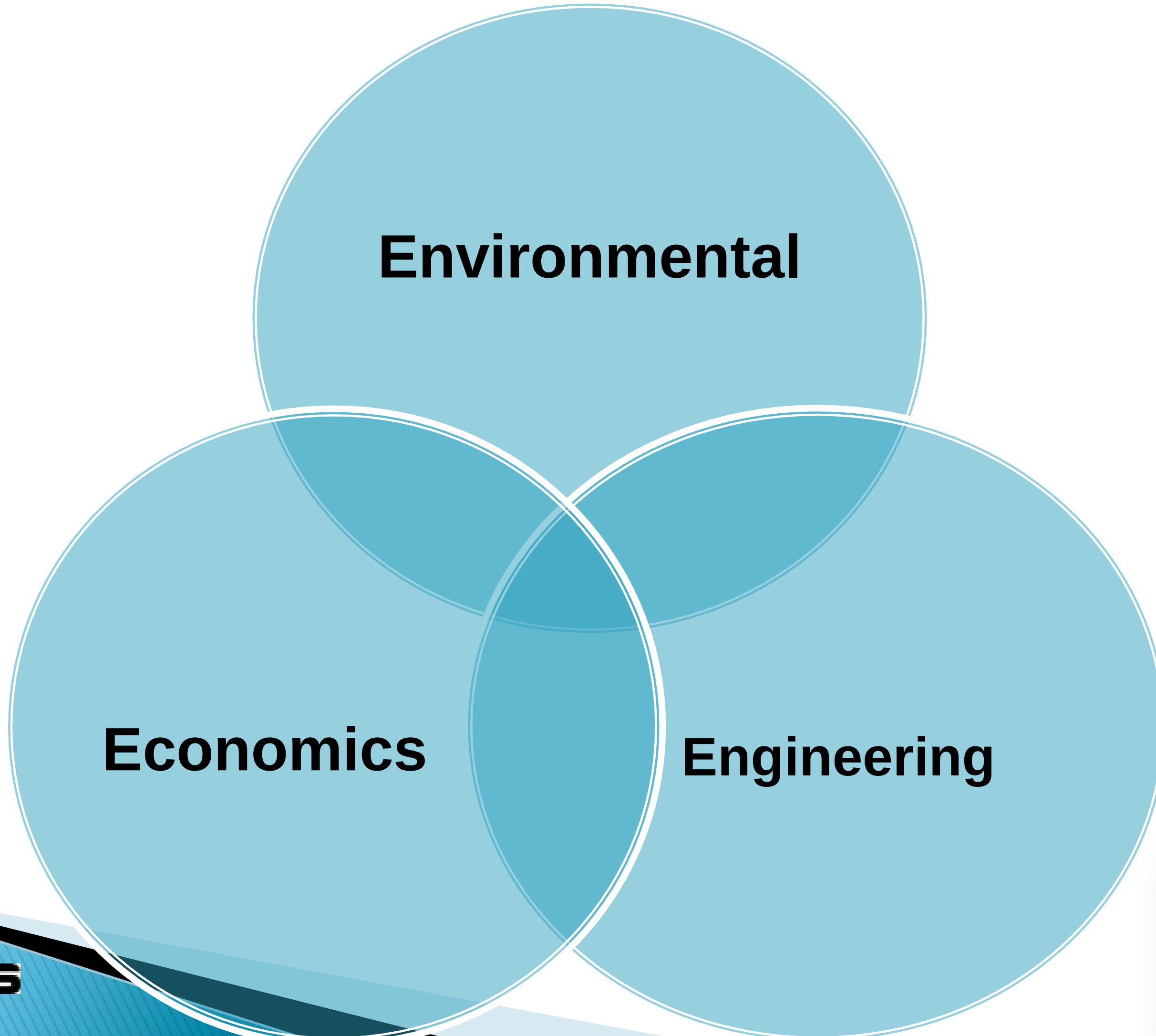
NV & CA Case Study:

Why In-Place recycling?



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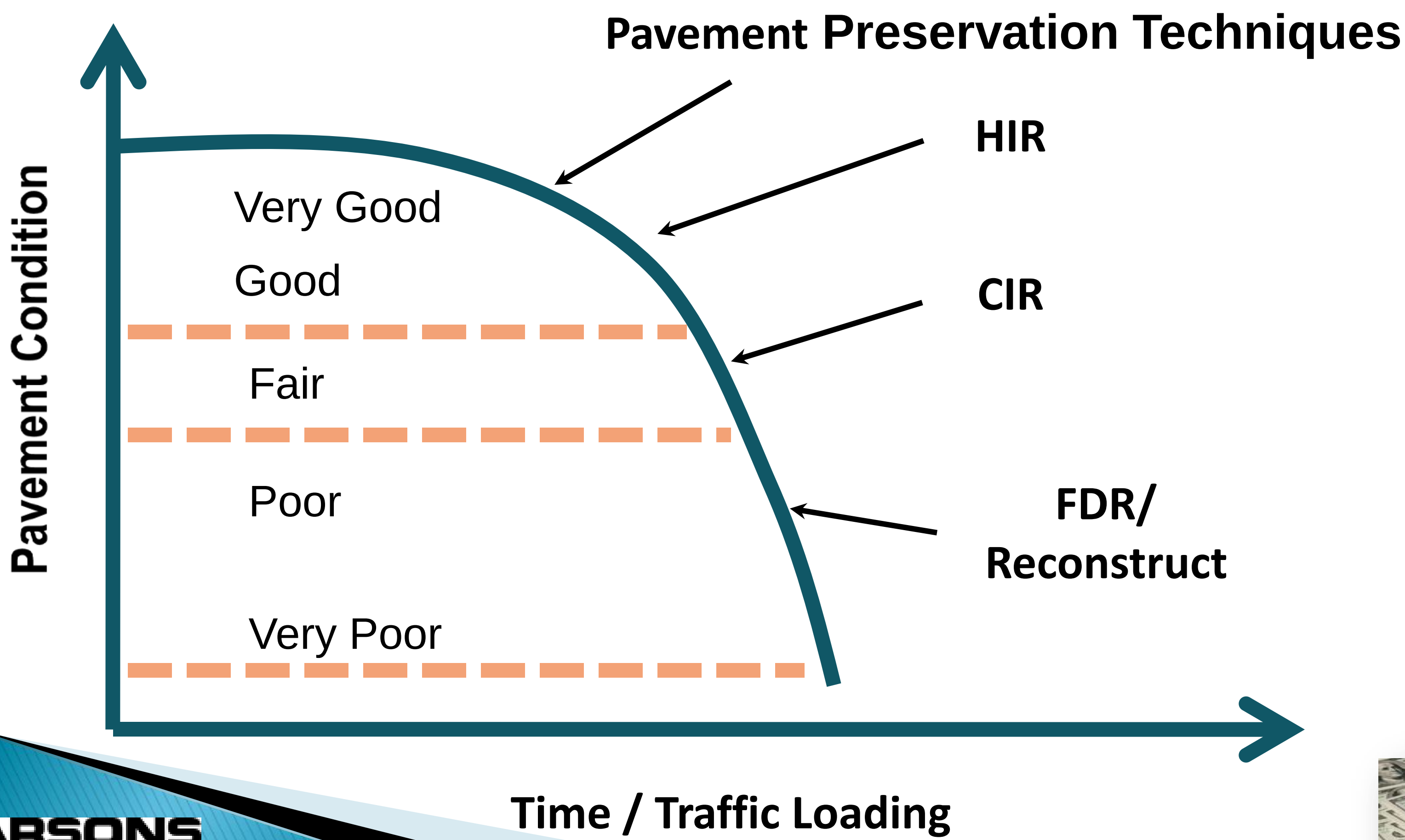
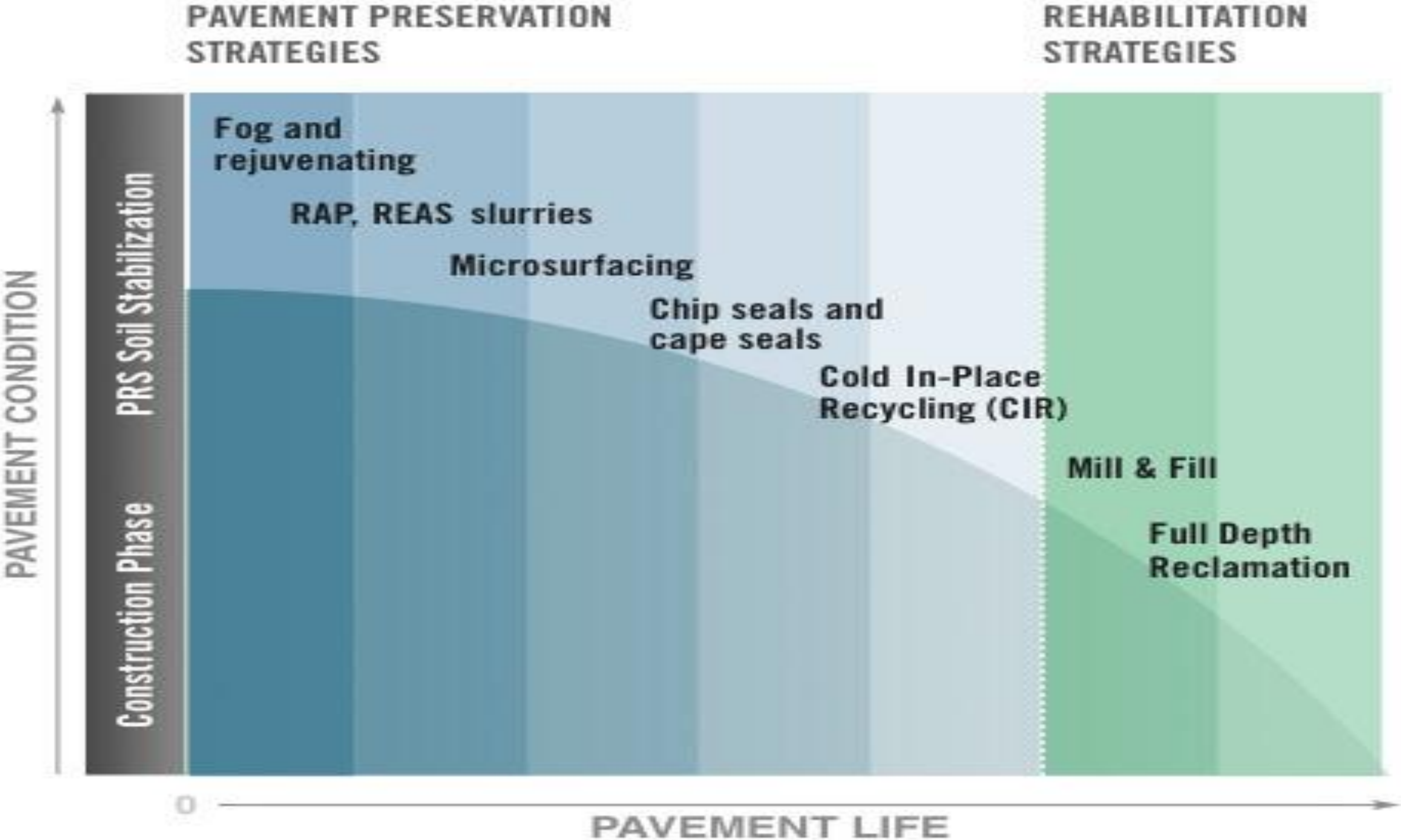
Timing of Rehabilitation Techniques

(The Right Project, at The Right Time, and The Right Strategy)



Pavement Preservation & Rehabilitation Tool Box



What is a good strategy for surface raveling?

HIR

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What is a good strategy for medium and wide transverse and block cracking?

What is a good strategy for alligator cracking?

Project Selection Criteria

1. Existing pavement condition and design
   - Distress type, level, and extent
   - Traffic loading
2. Environmental condition
3. Roadway geometry
4. Project site consideration

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Additional Factors to Consider

(continued)

5. Initial funding constraint
6. Life-cycle cost based on long-term performance
7. Traffic control

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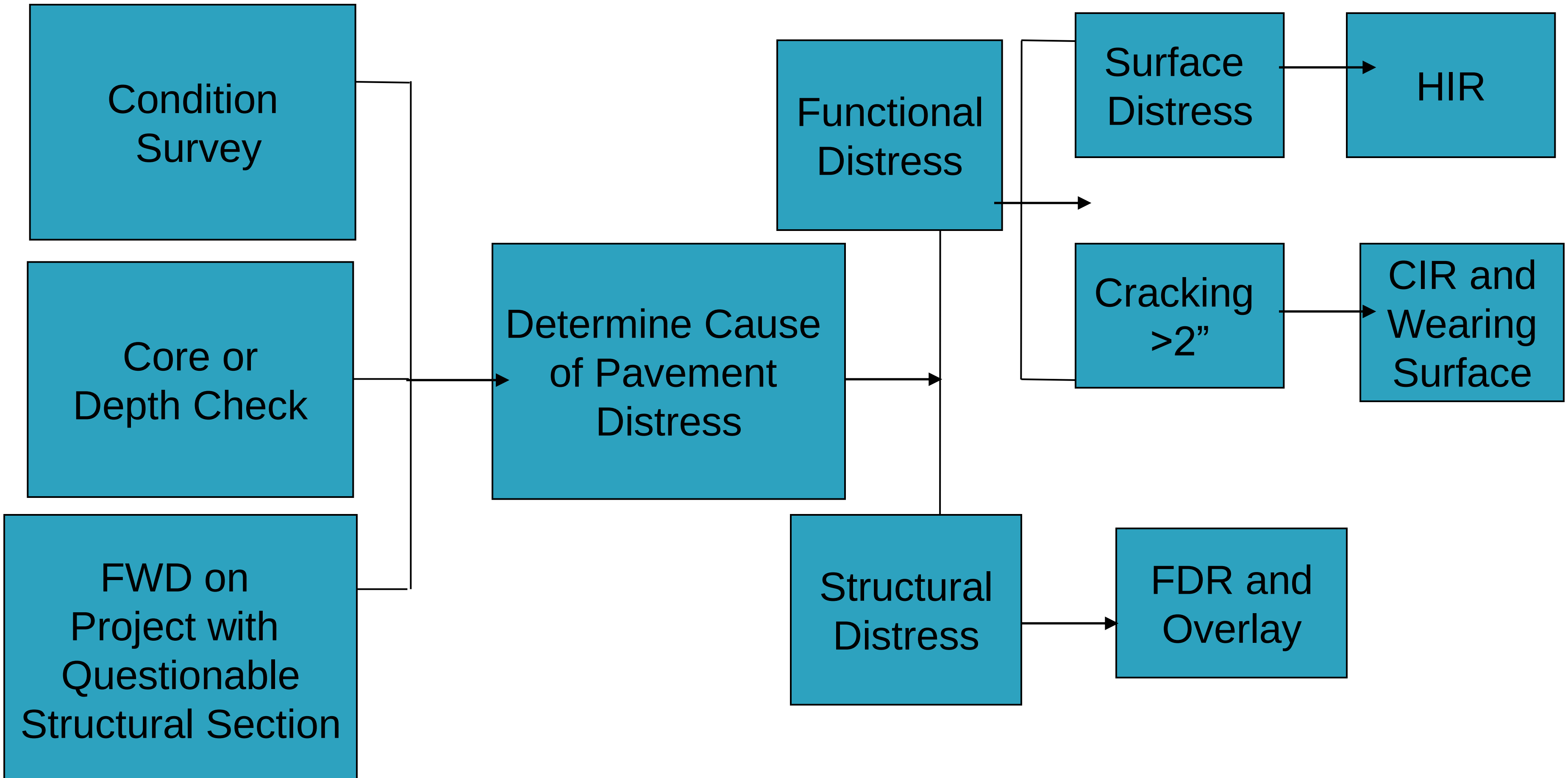
Existing Pavement Evaluation



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Engineering Requirements

- Subsurface Investigation:
  - Coring to determine pavement thickness

Coring Plan

- Look for lift locations
- Digout thickness
- Deep lifts of asphalt concrete
- fabric

Joe Peterson, Caltrans, 2008 In-Place Recycling Presentation

Structural Layer Coefficient

FDR Method	Minimum Thickness of Riding Surface	Typical Structural Coefficient
Mechanical	2" HMA	0.10 – 0.12
Bituminous	Surface Treatment or Structural HMA	0.20 – 0.28
Cement	Surface Treatment or Structural HMA	0.15 – 0.20

Mike Voth, FHWA, 2008 In-Place Recycling Presentation

Mix Design Process

1) RAP: Cores or Grindings from Project	Cores or Milling are crushed to passing 1”
2) Mixing	3 emulsion contents and H20 content are made
3) Compaction	Use Gyratory Compactor
4) Curing of Specimens	48 hours
5) Cured Specimens Measurements	2 sets: dry and soaked
6) Mix Design Selection	Determine optimum emulsion content

Mix Design Process

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2. Environmental Condition

(Climate conditions must be considered when selecting in-place recycling)

Factors to consider

- Good drainage is a MUST
- Type and thickness of the wearing surface (Slurry seal, double chip seal, hot mix overlay, and friction course)
- PG grade binder

NCHRP Synthesis 421

Ranking of climates that can influence the choice of in-place recycling processes

Climate	HIR	CIR	FDR
Cold/Wet	Fair	Good	Very Good
Hot/Wet	Good	Good	Very Good
Cold/Dry	Good	Very Good	Very Good
Hot/Dry	Very Good	Very Good	Very Good

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Project Selection Criteria

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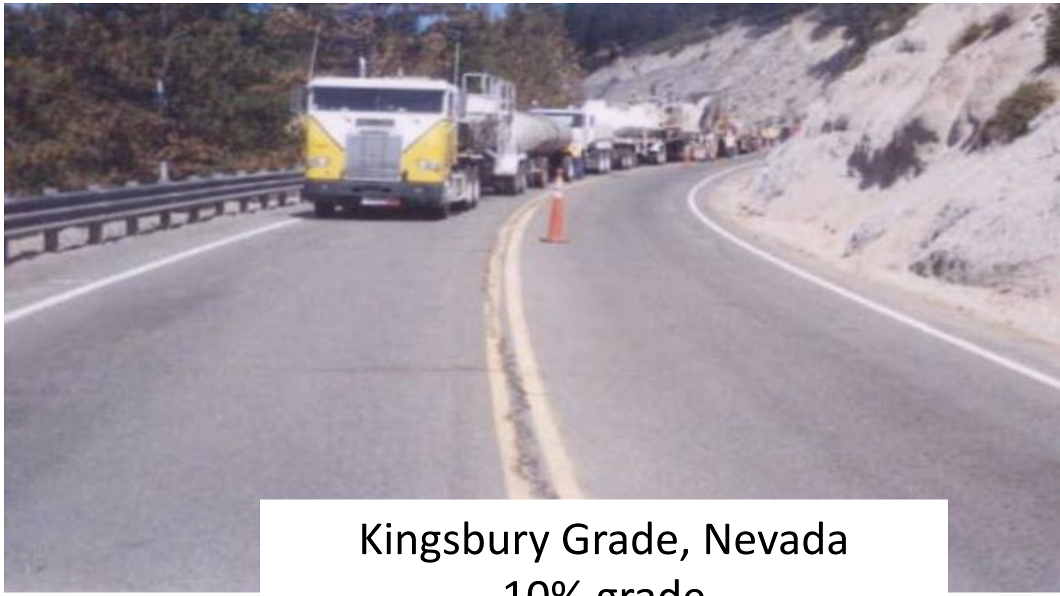
3. Roadway Geometry

- Profile grade
- Drainage ditches
- Guard rail
- Overhead
- Cross slope



Kingsbury Grade, Nevada
10% grade

Project Selection Criteria

1. Existing pavement condition and design
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4. Project Site Consideration

- Contractors availability
  - Contact ARRA - www.arra.org
- Project length
  - At least 4 miles for HIR and CIR
- Construction season

Additional Factors to Consider

(continued)

5. Initial funding constraint
6. Life-cycle cost based on long-term performance
7. Traffic control

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Mill & Overlay vs. CIR & Overlay

93-AASHTO Design

3” Mill & 3” HMA

- Existing HMA (SN-0.2/inch)
- New HMA (SN-0.42/inch)

- Total SN-
- (3”*0.42)-3*0.2=0.66

3” CIR & 1.5” HMA

- 0.3-CIR (SN-0.3/inch)
- 0.42 New ACP (SN-0.42/inch)

- Total SN-
- (3*(0.3-0.2)+0.42*1.5=0.93

40% Increase in SN value

Cost Comparison

3” Mill & 3” overlay

- 3” Milling-$1.5/ Sq. Yd.
- 3” HMA- $18/ Sq.Yd.

- Total cost for one mile (32’ wide)= $370 K

3” CIR & 1.5” overlay

- 3” CIR-$4.5
- 1.5” HMA- $9/ Sq.Yd.

- Total cost for one mile (32’ wide)= $253K

30% Cost decrease

5. Initial Funding Constraint

(Nevada DOT Cost Comparison)

Category	ESALs	Strategy	Total structural number	Strategy Cost	Reduced Cost/ Mile	Change in SN
LOW	< 1 Million	2” Mill &fill	2”(0.35-0.18)= 0.34	625K	63%	(12%)
		3” CIR Double Chip Seal	3(0.28-0.18) =0.30	230K		
MEDIUM	> 1 Million < 3 Million	3” Mill 3” HMA	3”(0.35-0.18)=0.51	910K	37%	60%
		3” CIR 1.5” HMA	3” (0.28-0.18) +1.5” *0.35=0.82	570K		
HIGH	> 3 Million	3” Mill 6” HMA	(6”)(0.35)-(3”)(0.18)=1.56	1.82 M	28%	10%
		3” CIR 4” HMA	3(0.28-0.18) +4(0.35)=1.70	1.3 M		

Additional Factors to Consider

(continued)

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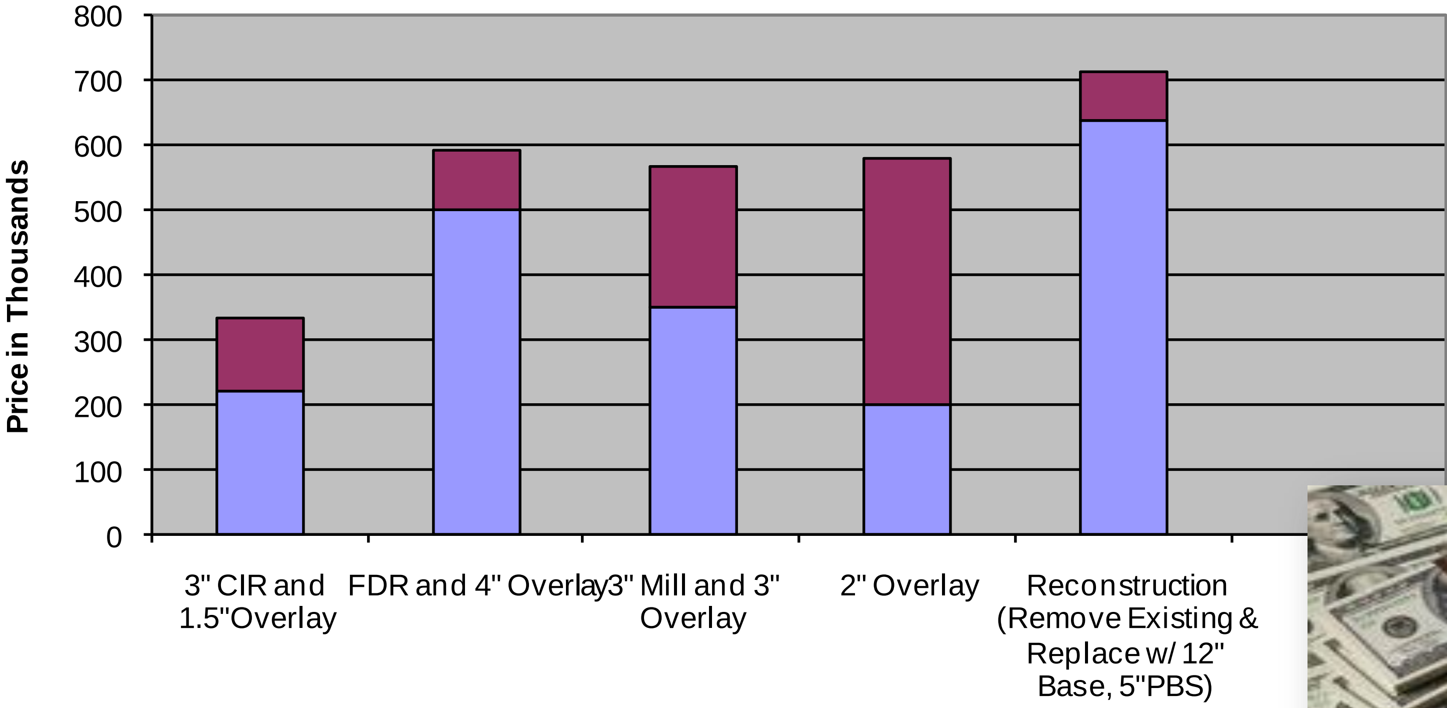
6. Life-cycle Cost Analysis

Present Worth for Pavement Rehabilitation

State-of-the-Practice on CIR and FDR Projects
NDOT, Nov. 21, 2005



Long-Term Performance

10-year Performance

CIR and 2” Overlay Section, Reno, Nevada

Long-Term Performance

20-year Performance

US-95 NV

Additional Factors to Consider
(continued)

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7. Traffic Control

Extremely Important

Factors to consider:

- Day time vs. night time construction
- ADT and type of traffic (cars vs. trucks)
- Opening to traffic
- Intersections and other stop and go
- Access to local business

CIR on I-80 in Nevada

I-80 at Pequop

Agency: NDOT District 3
Contractor: Road & Highway Builders
Subcontractor: Valentine Surfacing
2007-2008

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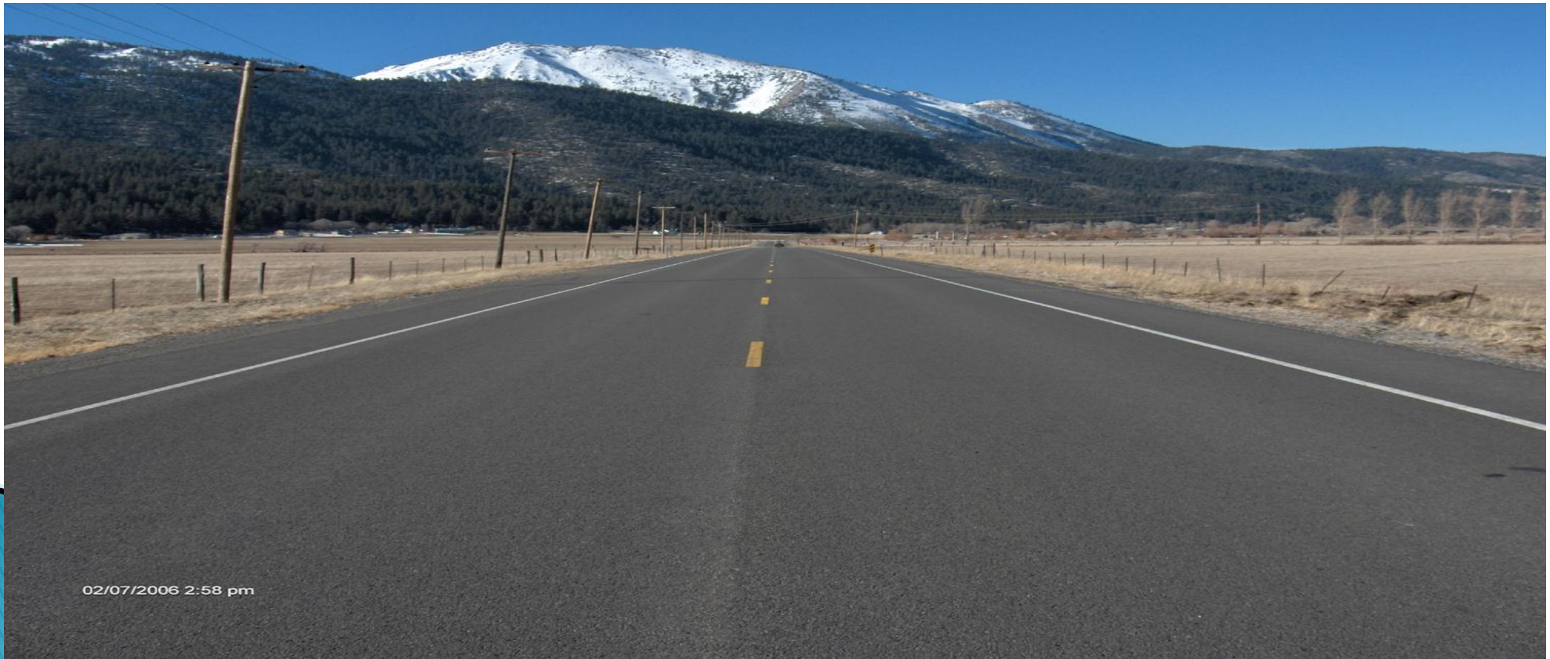
Lake Almanor, Caltrans Project-2011

Recommendations

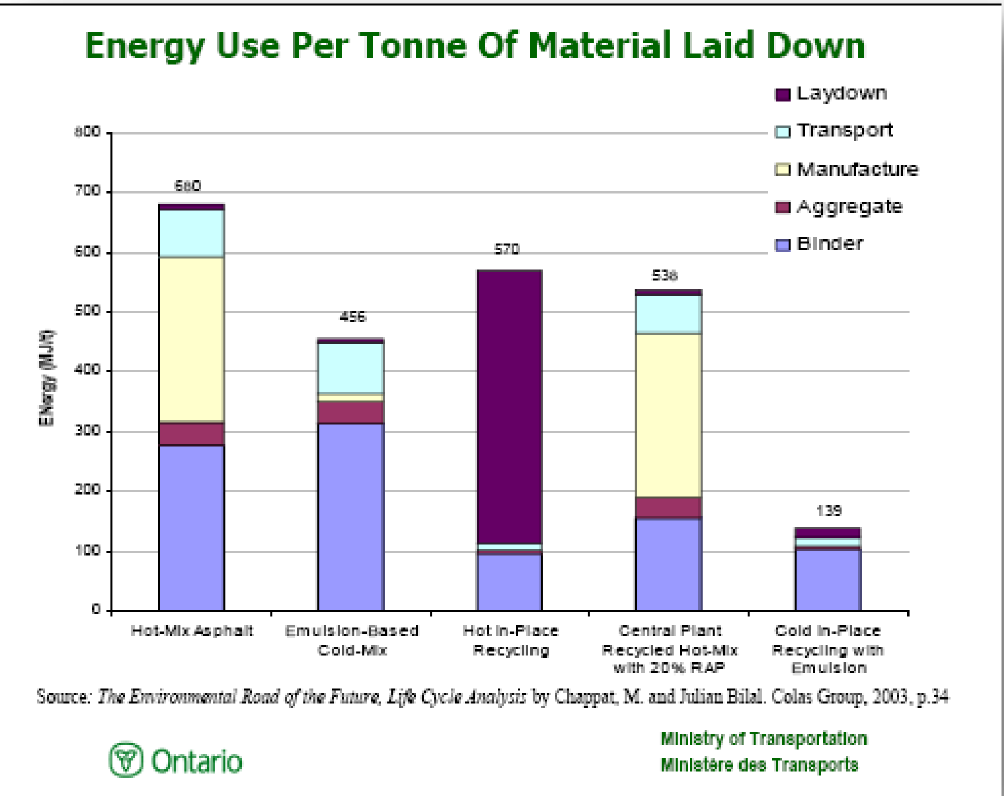
- Agencies cannot afford not utilizing HIR, CIR, and FDR rehabilitation strategies in their tool box
- Start slowly and get contractors involved early
- Continue improving the process



Conclusions

HIR, CIR and FDR Meet the 3E Challenge

Sustainability



20-Yr CIR Performance

$600M Cost-Saving with CIR and FDR

Let’s Create a Sustainable Future!

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