Integrating Pavement Preservation into StreetSaver®



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Keeping good roads good!

Outline

- □ Introduction to Pavement Preservation
- Preventive Maintenance
- □ Benefits
- Implementation of Pavement Preservation in StreetSaver®
- □ Appropriate treatments
- Use of Life Cycle Cost Analysis

Pavement Preservation Definition

□ AASHTO/FHWA

"A program employing a network level, longterm strategy that enhances functional pavement performance by using an integrated, cost-effective set of practices that extend pavement life, improve safety, and meet motorist expectations."

Pavement Preservation Concepts

- Apply:
 - the right treatment
 - to the right pavement
 - at the right time
- Focuses on preventive maintenance
 - Dedicate funds to preventive maintenance
- Can include minor rehabilitation
- Retard development of structural deterioration

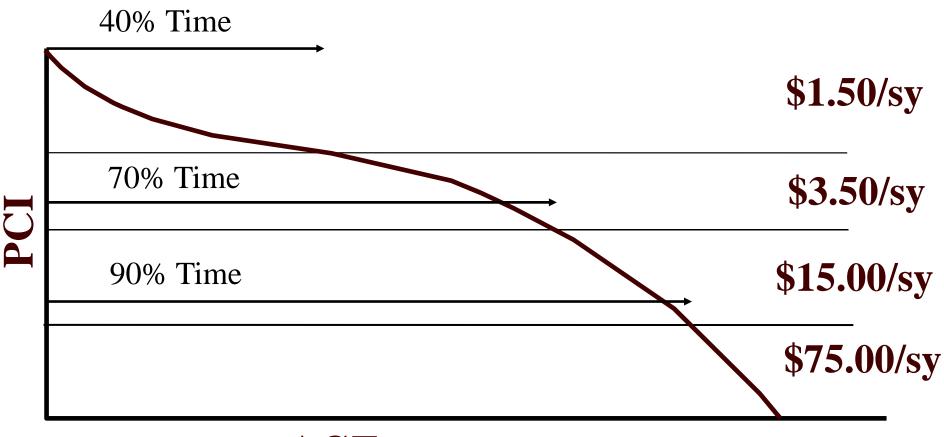
Preventive Maintenance

- Treatments applied to:
 - Preserve the existing structure
 - Retard deterioration
- Primarily prevent environmental caused deterioration
- PM Treatments
 - Applied before major structural damage
 - Relatively inexpensive
 - Results are long term

Common PM Treatments

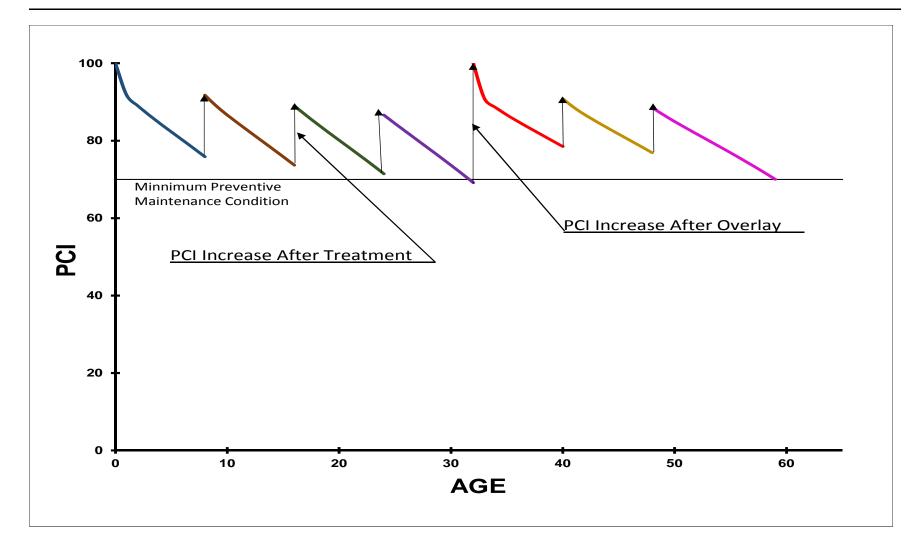
- □ Crack/joint seals
- □ Chip seals
- □ Slurry seals
- □ Micro-surfacing
- □ Thin HMAC overlays
- Diamond grinding
- Dowel-bar retrofit

Pay Me Now or Pay Me Later

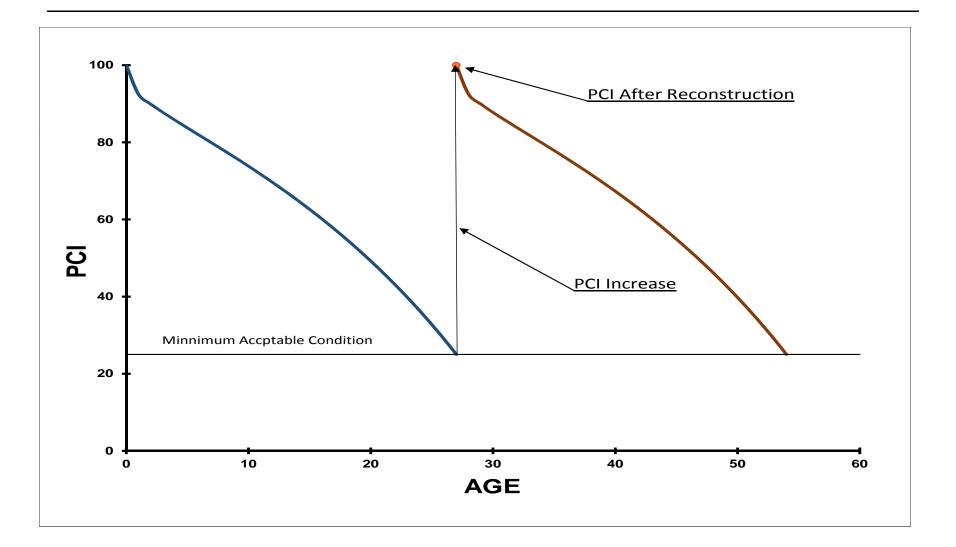


AGE

Preservation Approach



Build It, Let It Fail, Reconstruct It



Pay Me Now

- □ 3 Seal Coats at \$ 4.50 /sy ~32 yrs
- □ 1 Overlay Plus Mill at 6.50 / sy 8 yrs
- □ 2 Seal Coats at \$ 3.00 /sy ~19 yrs

□ Total \$14.00 /sy for ~59 yrs

Pay Me Later

- 1 Remove & Replace at \$ 75.00 /sy
 at ~28 yrs
- □ Total \$75.00 /sy for ~56 yrs

Compare

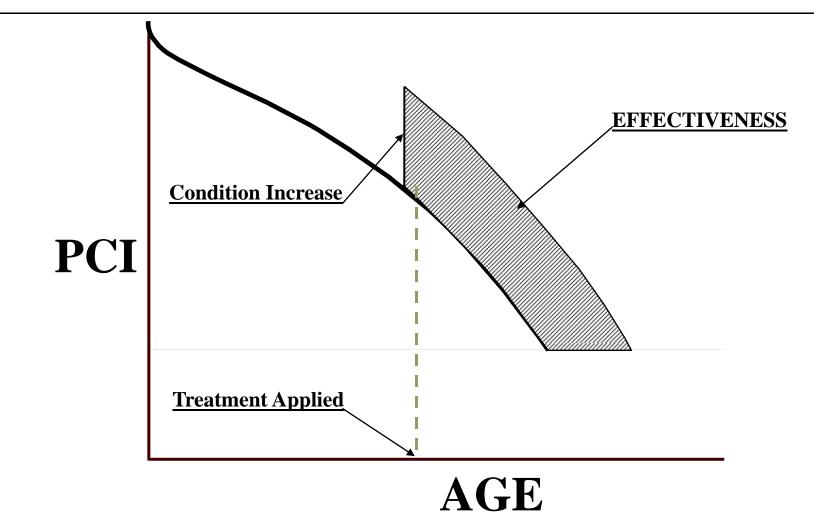
- □ Pay Me Now
 - Total \$14.00 /sy for 59 yrs
 - ~\$0.24 /sy/yr
- Pay Me Later
 - Total \$75.00 /sy for 56 yrs
 - At ~\$1.34 /sy/yr

Can keep ~5 pavement sections in good condition compared to fixing one in failed condition over ~56 year period

50 Surface Treatments for 1 Reconstruct in any given year

□ Which gave best service?

Better Condition Over Longer Time Gives Better Return on Funds Invested



Pavement Management

□ A decision making process

□ Used to

- Find cost-effective treatments
- At designated times
- To provide desired level of service

StreetSaver® PMP

- Network-level with some project selection components
- Help agencies planning & programming pavement work - M&R
- Show the impact of different funding
 - Levels
 - Approaches (PavPres vs Worst First)
- PM has always been a focus of StreetSaver

Network-Level Elements

- Inventory
- Condition Assessment
- Determination of Needed Work & Funds
- Identification of Candidate Projects
- Determination of Impacts of Funding Alternatives
- Feedback

To Incorporate PPP into PMP

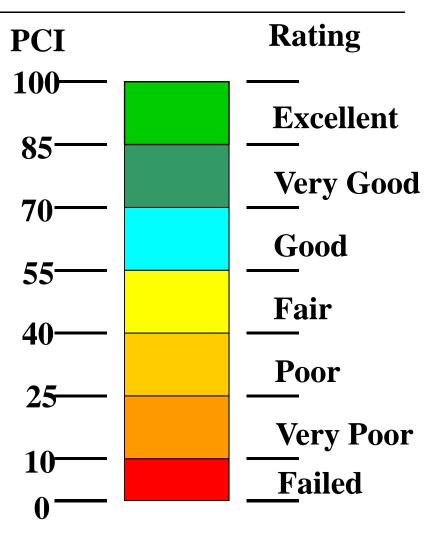
- Each of the elements were designed to address preventive maintenance (PM) & pavement preservation (PP)
- This presentation will focus on selecting appropriate strategies
- Part II will discuss actual decision tree setup

Short Introduction to PCI

- StreetSaver® uses PCI as the basic condition indicator
 - Used with other information to identify appropriate treatments

Condition Assessment

- Health of Individual
 Segments
 - Engineering
 - Functional
 - Safety
- Collectively Define Health of Network



Needs Analysis

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

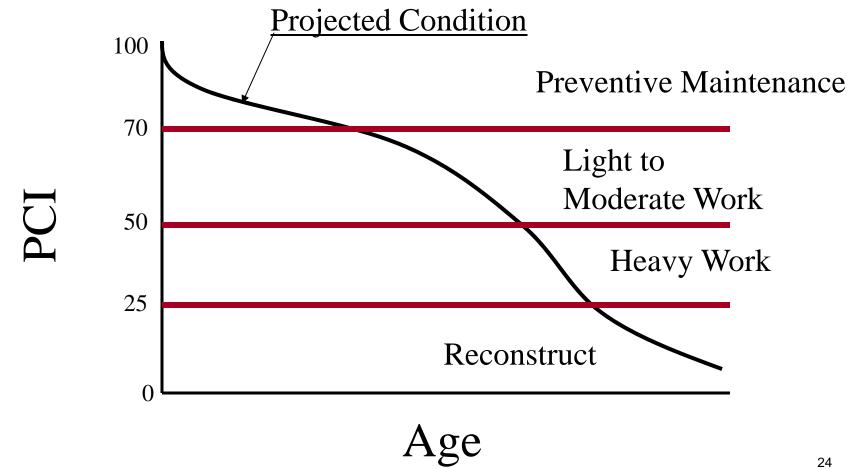
Needs Analysis Process

- □ Projects PCI to 1st analysis year
- □ Identifies treatments based on *decision trees*
- □ Makes adjustments if treatment identified
- □ Projects PCI to 2nd analysis year
- □ Repeats until analysis years completed
- □ No constraints on funds

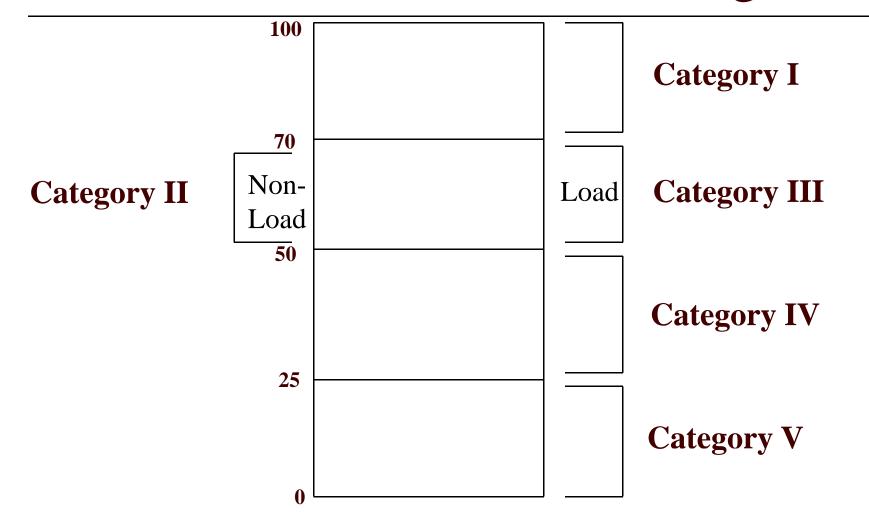
Scenarios Analysis

- □ Projects PCI to 1st analysis year
- Identifies segments for treatments based on <u>decision trees</u> & constraints (funding & targets)
- □ Makes adjustments if treatment identified
- □ Projects PCI to 2nd analysis year
- □ Repeats until analysis years complete

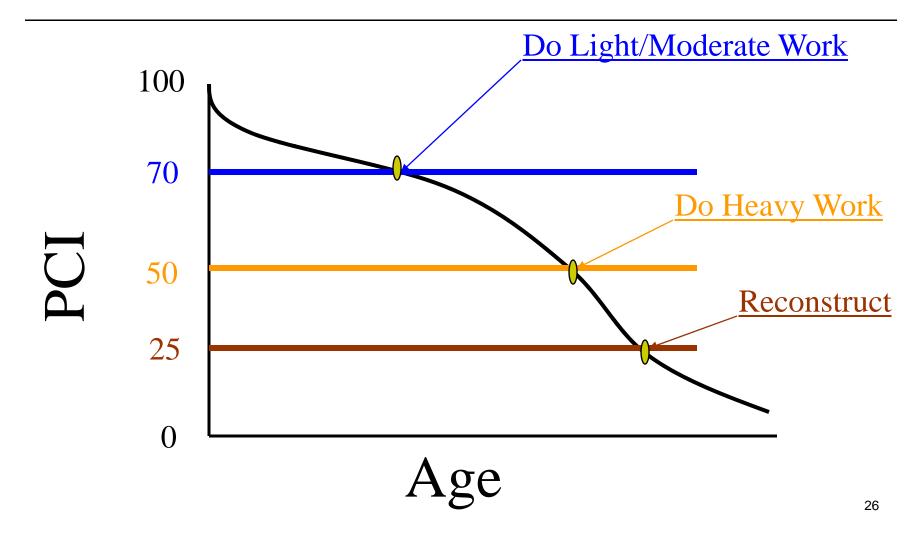
StreetSaver[®] Treatment Levels



StreetSaver® Condition Categories



Default Trigger Values



Set/Changed in Table Maintenance

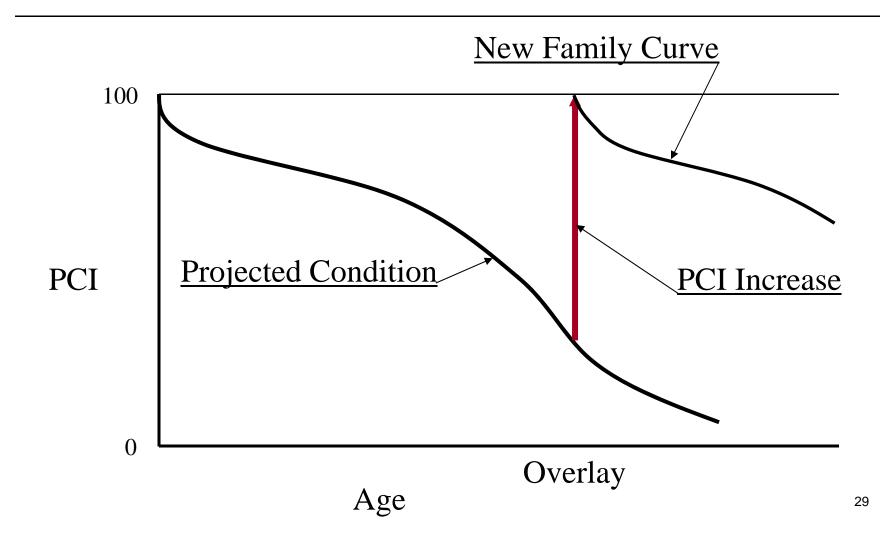
	(
Edit PCI V	alues:		(Unused com	binations of FC/Surfa	ce Type not shown.)	Selected PC	JI Display:		
Functional Class	Surface Type	PCI Cap	Breakpoint I	Breakpoint II/III	Breakpoint IVIV	Functional Class	Surface Type		
Arterial	AC	99	70	50	25	Arterial	AC		
Arterial	AC/AC	99	70	50	25				
Arterial	AC/PCC	99	70	50	25	Condit	ion Category	No	treatment will be
Arterial	ST	99	70	50	25	100	1		ileatifient will be
Arterial	PCC	99	70	50		PCI 99	99 Very Good		applied if PCI is
Collector	AC	99	70	50	25			app.	
Collector	AC/AC	99	70	50	25	70	JL III	area	ter than PCI Cap
Collector	AC/PCC	99	70	50	25	Load	Good Load	gica	uer man i Ci Cap
Collector	ST	99	70	50	25		insitional Windows		
Collector	PCC	99	70	50	25		(V		
Residential/Local	AC	99	70	50	25		Poor		Condition Categor
Residential/Local	AC/AC	99	70	50	25	25 Using Tra	nsitional Windows	100	X
Residential/Local	AC/PCC	99	70	50	25	,	Very Poor	PCI DO	
Residential/Local	ST	99	70	50	25		Very Foor	Cap 90	Very Good
Residential/Local	PCC	99	70	50	25				
Other	AC	99	70	50	25	Use Transitional Windows for Deferred Maintenance in Calculations?		70	n
Dther	AC/AC	99	70	50	25				Non Good Load
Other	AC/PCC	99	70	50	25	Apply PCIs to All			road
Other	ST	99	70	50	25	Surface Types in FC	Apply PCIs to All	50	Using Transitional Windo
Other	PCC	99	70	50	25				1
se these fields to en									Poor
nd apply it to the wh	ole column.	Apply	Apply	Apply	Apply			25	Using Transitional Windo

Can Only Select Established Treatments

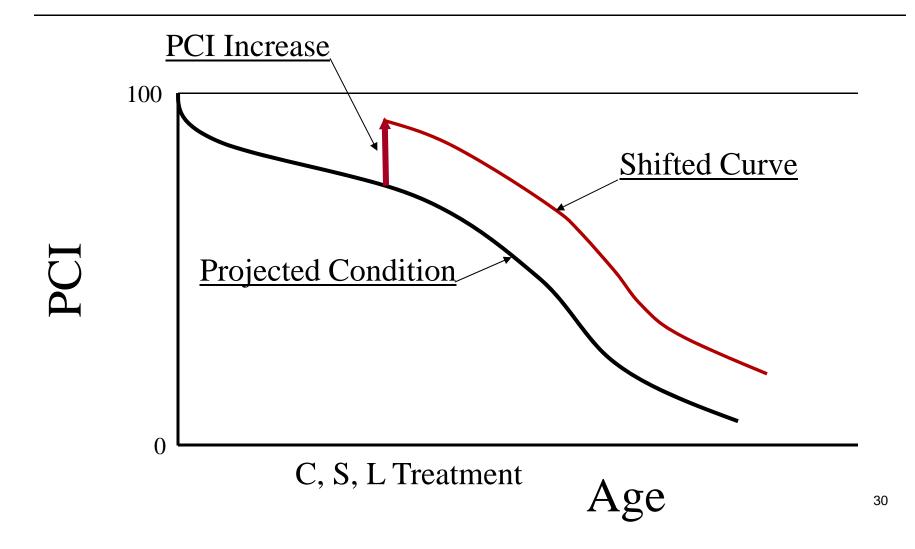
File Windows					14
Name	Overlay Code	GIS Color	Active	Read Only?	Last Modified
CHIP SEAL AND SLURRY SEAL	S - Surface Seal			V	6/25/1996 12:24 PM
DEEP PATCH	L - Localized Treatment		7	V	9/16/1997 12:18 PM
O DO NOTHING	D - Do Nothing	-	V	V	9/16/1997 12:18 PM
O DOUBLE CHIP SEAL	S - Surface Seal		V	V	9/16/1997 12:18 PM
HEATER SCARIFY & OVERLAY	OA - Overlay with AC		V	V	9/16/1997 12:18 PM
G MILL AND DOUBLE CHIP SEAL	S - Surface Seal		V	V	6/25/1996 12:24 PM
G MILL AND SINGLE CHIP SEAL	S - Surface Seal			V	6/25/1996 12:24 PM
G MILL AND THICK OVERLAY	OA - Overlay with AC		V	V	9/16/1997 12:18 PM
MILL AND THIN OVERLAY	OA - Overlay with AC	L	V	V	9/16/1997 12:18 PM
BECONSTRUCT STRUCTURE (AC)	RA - Reconstruct as AC		V	V	6/25/1996 12:24 PM
RECONSTRUCT STRUCTURE (G)	RG - Reconstruct as Gravel		V	V	11/15/2002 12:00 AM
G RECONSTRUCT STRUCTURE (PC	RP - Reconstruct as PCC		V	4	11/15/2002 12:00 AM
RECONSTRUCT STRUCTURE (ST)	RS - Reconstruct as ST		V	V	11/15/2002 12:00 AM
RECONSTRUCT SURFACE (AC)	RA - Reconstruct as AC		V	1	9/16/1997 12:18 PM
BECONSTRUCT SURFACE (G)	RG - Reconstruct as Gravel		V		11/15/2002 12:00 AM
BECONSTRUCT SURFACE (PCC)	RP - Reconstruct as PCC		V	1	11/15/2002 12:00 AM
RECONSTRUCT SURFACE (ST)	RS - Reconstruct as ST		V	V	11/15/2002 12:00 AM
RUBBERIZED CHIP SEAL	S - Surface Seal		V	V	6/25/1996 12:24 PM
3 SEAL CRACKS	C - Crack Sealing		V	V	9/16/1997 12:18 PM
SHALLOW PATCH	L - Localized Treatment		1	v	6/25/1996 12:24 PM
😡 SINGLE CHIP SEAL	S - Surface Seal		1	v	6/25/1996 12:24 PM
😧 SLURRY SEAL	S - Surface Seal		1	V	9/16/1997 12:18 PM
THICK AC OVERLAY(2.5 INCHES)	OA - Overlay with AC		1	V	9/16/1997 12:18 PM
3 THIN AC OVERLAY(1.5 INCHES)	OA - Overlay with AC		1	V	9/16/1997 12:18 PM
THIN OVERLAY w/FABRIC	OA - Overlay with AC		V	V	9/16/1997 12:18 PM

🤽 Overlay Code
<u>File Wi</u> ndows
Overlay Code
C - Crack Sealing
D - Do Nothing
L - Localized Treatment
OA - Overlay with AC
RA - Reconstruct as AC
S - Surface Seal
RP - Reconstruct as PCC
RS - Reconstruct as ST
RG - Reconstruct as Gravel
OP - Overlay with PCC

Overlay & Reconstruction (O & R)



Surface Seal, Crack Seal, Localized (S, C, & L)



PM in StreetSaver®

- □ Applied if PCI above Cat II/III trigger value
- Projected to remain above for next three years
- □ Applied based on
 - Time of last treatment

and

Designated sequence time

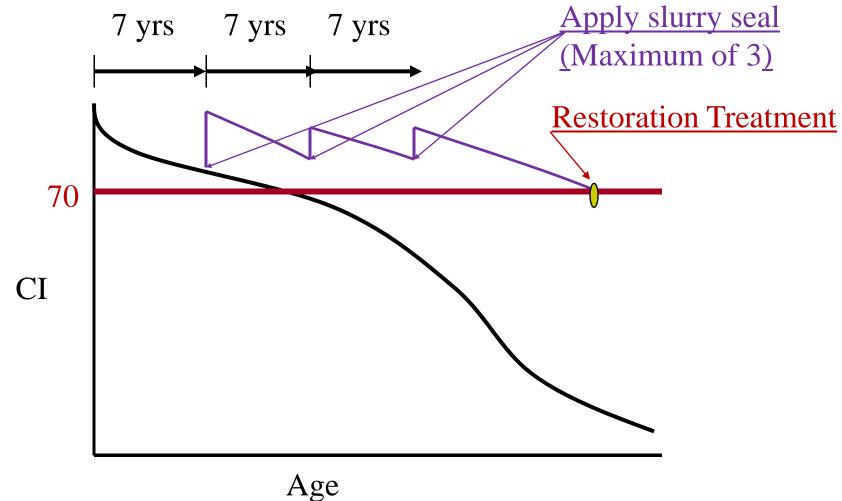
PM in StreetSaver®

- □ Seal Coat (Chip Seal, Slurry, etc.)
 - Enter Treatment
 - Enter Years between Application
 - Enter maximum number of seals
 - Enter Costs
- Application Interval Begins
 - At Construction
 - At Overlay
 - At Prior Seal Coat

Restoration Treatment

- □ When maximum number of seals reached
 - No further seals
 - Programmed for restoration treatment when PCI reaches Cat II/III trigger value
- Based on issues of instability created by several sequential seals
- □ Normally includes a mill & overlay

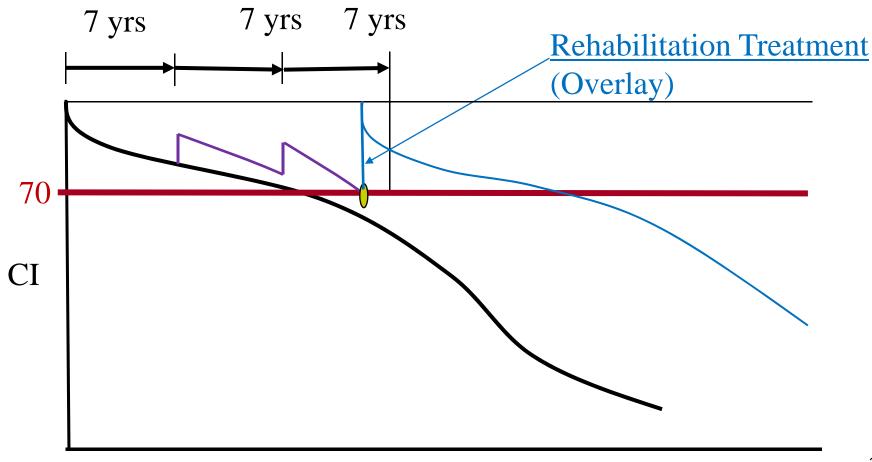
Preventive Maintenance - Time Driven



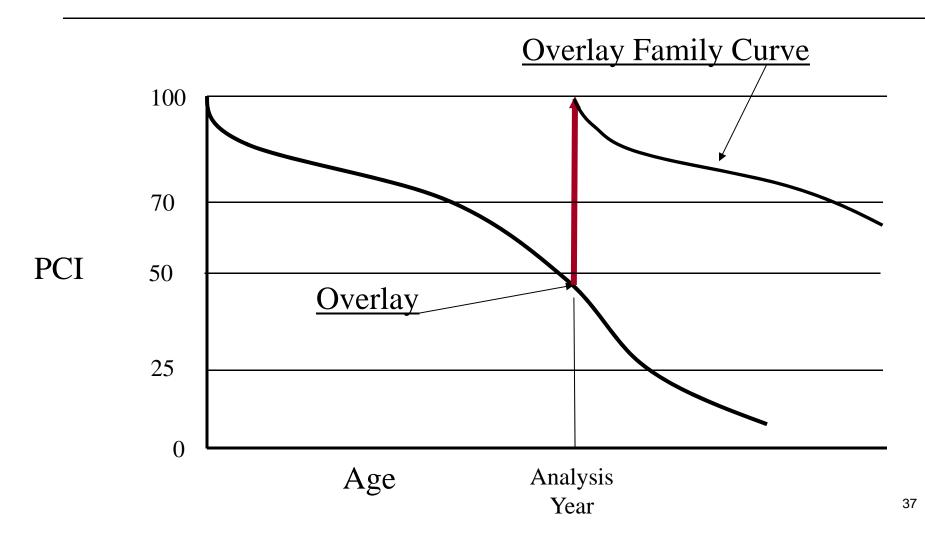
Rehabilitation Treatment

- Identified for application when PCI projected to reach one of the Cat II through III trigger values
- Can still be a seal normally with significant surface repair prior to treatment
- □ Localized & Do-Nothing can be used

Rehabilitation Following PM



Rehabilitation with No Prior PM



Decision Tree Approach

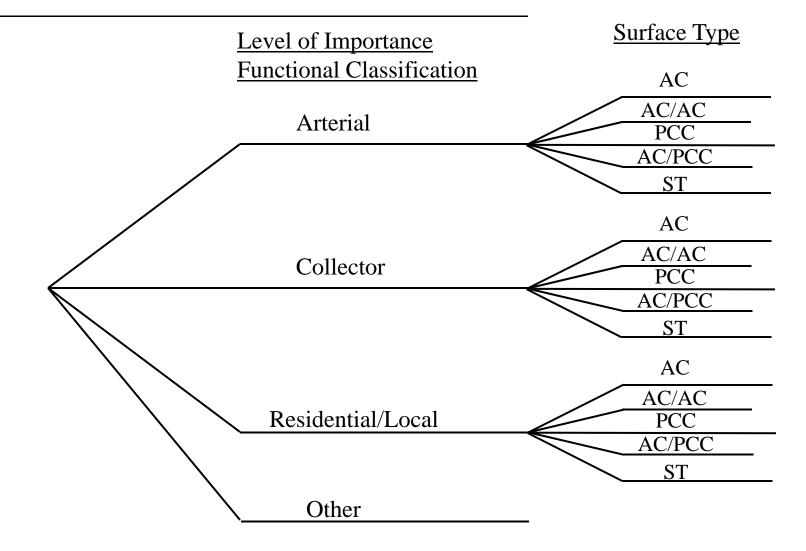
- Connects selected information to a treatment
- Network-level planning treatment
 - Assigned each section needing work
 - During analysis period (5 to 30 yrs)
 - Costs connected to treatments

Factors Considered in StreetSaver®

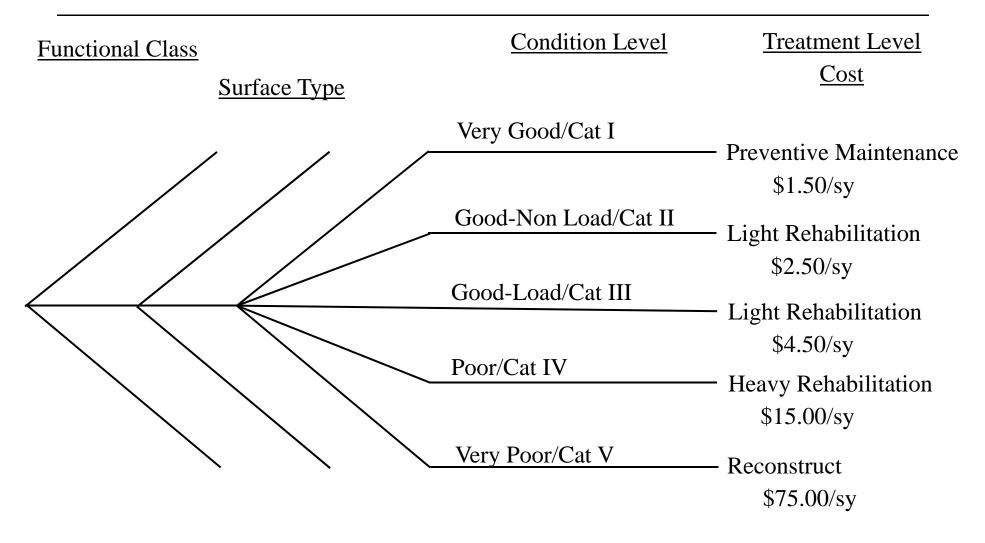
□ Condition

- Projected PCI
- Cause of damage
- Functional classification
 - Usage
 - Construction
- □ Surface type
 - Construction

StreetSaver® Decision Trees



StreetSaver® Decision Trees



All StreetSaver® Databases Have Default Decision Trees

Decision Tree	
-⊘ Arterial ⊕-⊘ AC	Treatment Information
in the second se	
Restoration Treatment	
Condition Category III - Good, Load Related	
Condition Category IV - Poor	
Condition Category V - Very Poor	
Condition Category I - Very Good	
Crack Treatment	
- Surface Treatment	
Restoration Treatment	
Condition Category II - Good, Non-Load Related	
Condition Category III - Good, Load Related	
Condition Category IV - Poor	
Condition Category V - Very Poor	
AC/PCC	
Condition Category - Very Good	
Crack Treatment	
- Surface Treatment	
- Condition Category II - Good, Non-Load Related	
- Condition Category III - Good, Load Related	
Condition Category V - Very Poor	
Ψ- ST	
Condition Category - Very Good	
Condition Category V - Very Poor	
Collector	
Pesidential/Local	
-📂 Other	
Update Costs by Treatment	
:t Modified: 5/27/2014	Print Save Save & Close Canc

Selecting Appropriate Treatments

- □ Treatment applied
- □ Treatment cost
- □ Treatment timing for seals
 - Surface seals
 - Crack seals

Some Preservation Treatments

- □ Crack sealing
- Fog/RejuvenatingSeals
- □ Chip seals
- □ Slurry seals
- □ Scrub seals
- □ Microsurfacing

Non-Structural Activities

44

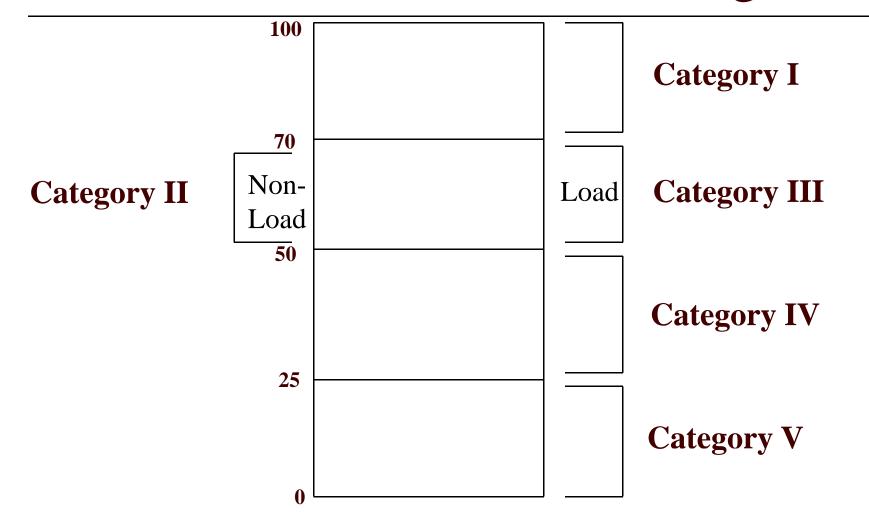
- Open graded
 friction course
- RHMA-O, RHMA-HB
- □ PBA-G
- □ BWC
- □ BWC-Rubber
 - **Thin Overlays**

Dr. Hicks, Cal PPC

Only PM as Preservation?

- □ PM treatments will be preservation treatment
- Some rehabilitation treatments can be preservation treatments
 - Primarily Cat II & Cat III

StreetSaver® Condition Categories



GENERAL GUIDELINES FOR EFFECTIVE MAINTENANCE

Pa	ramete	ers																						Frea	tment L	ife Base	d On Tr	affic Vo	lumes &	Paven	nent Co	ndition
				Rut	tina		Cl	imate		Tra	affic V	olume	19							1	reatment	Costs			adt -	< 5000	ad	t>5000<	:30,000	i	adt >30,	000
													-						t e				atment Only)				Pave	ment Co	ondition			
Preventive Treatments	Raveling	Oxidation	Bleeding	<1/2"	>1/2"	Desert	Valley	Coastal	Mountains	adt < 5000	adt>5000<30,000	adt >30,000	Night	Cold	Stop Points	urban	Rural	High Snow Plov	Cost per lane-mile (Total Project Cost includes traffic control)	Large Projects	Medium Projects	Small Projects	Addtl Premium for night work \$/SQ YD Addtl Premium Proi Addtl Work	Zones \$/SQ YD Good	Fair	Poor	Good	Fair	Poor	Good	Fair	Poor
Crack/Joint Seal																																
Emulsion	Ν	Ν	Ν	Ν	Ν	G	G	G	G	G	G	G	N	N	G	G	G	G	8,000	0.50-0.65	0.60-0.75	0.70-0.8	0.15-0.2+0.60-	1.00 <mark>2 to</mark>	8 2 to	6 1 to 4	2 to 7	2 to 5	1 to 4	2 to 6	2 to 4	1 to 4
Modified (Rubber)	Ν	Ν	Ν	Ν	Ν	G	G	G	G	G	G	G	G	G	G	G	G	G	8,000	0.55-0.70	0.65-0.80	0.75-0.9	0.15-0.2+0.60-	1.00 <mark>5 to</mark>	9 3 to	7 N	5 to 8	3 to 6	Ν	3 to 7	2 to 5	Ν
Seal Coats																																
Fog Seal (See note 1)	F	G	N	N	N	G	G	G	G	F	F	N	N	Р	F	G	G	F	13,000	0.15-0.30	0.15-0.30	0.15-0.3	+0.05 +0.1	0 1 to	3 N	N	1 to 2	N	N	1 to 2	N	N
Rejuvenator (See note 1)	G	G	Ν	Ν	N	G	G	G	G	G	F	Ν	N	Ν	Ν	G	G	F	15,000	0.20-0.50	0.20-0.50	0.20-0.5	+0.10 +0.2	0 <mark>3 to</mark>	6 3 to	4 2 to 3	2 to 4	2 to 3	2 to 3	2 to 4	2 to 3	1 to 3
Scrub Seal (See Note 4)	G	G	Ν	Ν	N	G	G	G	G	G	F	Ν	N	G	Ν	F	G	Р	17,000	2.15	2.15	2.15	N/A N/A	4 to	7 3 to	6 3 to 4	3 to 6	2 to 4	2 to 3	2 to 3	2 to 3	2 to 3
Slurry Seals																																
Type II (See note 1)	F	G	Ν	N	Ν	G	G	G	F	G	G	G	N	Ν	G	G	G	Р	23,000	1.60-2.20	1.75-2.40	.90-2.6	N/A +0.3	0 B to	10 4 to	6 2 to 4	7 to 10	4 to 6	1 to 4	7 to 10	3 to 5	1 to 3
Type III	G	G	Ν	F	Ν	G	ŋ	G	F	G	G	G	Ν	Ν	G	G	G	Ρ	24,000		1.75-2.40		N/A +0.3	0 <mark>B to</mark>	10 4 to	6 2 to 4	7 to 10	4 to 6	1 to 4	7 to 10	3 to 5	1 to 3
REAS	G	G	Ν	F	Ν	G	G	G	F	G	G	G	N	N	G	G	G	Р		1.20-1.80	1.20-1.80	.20-1.8	N/A +0.3	0 <mark>8 to</mark>	10 5 to	7 N	7 to 10	5 to 7	N	7 to 9	5 to 7	Ν
Microsurfacing																																
Туре II	G	G	Ν	G	F	G	ŋ	G	G	G	G	G	G	Ν	G	G	G	Ρ	31,000	2.00-2.80	2.10-2.90	2.25-3.0	0.10-0.2 N/A	B to	12 5 to	8 2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
Type III	G	G	Ν	G	G	G	G	G	G	G	G	G	G	N	G	G	G	Р	31,000	2.00-2.80	2.10-2.90	2.25-3.0	0.10-0.2 N/A	s B to	12 5 to	8 2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
Chip Seals																																
PME - Med. Fine (See Note 4)	G	G	Ν	F	Ν	G	G	F	F	G	G	Ν	Ν	Ν	Р	Р	G	Р	27,000	1.80-2.00	2.25-2.75	8.00-3.5	N/A +0.50-	1.00 <mark>8 to</mark>	12 5 to	8 2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
PME - Medium (See Note 4)	G	G	Ν	F	Ν	G	ŋ	F	F	G	Ν	N	Ν	Ν	Р	Р	G	F	27,000	1.80-2.00	2.25-2.75	8.00-3.5	N/A +0.50-	1.00 <mark>8 to</mark>	12 5 to	8 2 to 4	7 to 12	5 to 7	2 to 4	7 to 10	3 to 6	1 to 4
PMA - Medium (See Note 3.)	G	G	Ν	F	Ν	G	G	G	G	G	G	Ν	Ν	G	Р	Р	G	F	24,000				N/A	8 to	12 6 to	9 4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
PMA - Coarse (See Note 3.)	G	G	Ν	F	Ν	G	Ð	G	G	G	Ν	N	Ν	G	Р	Р	Ð	G	24,000				N/A	8 to	12 6 to	9 4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
AR - Medium	G	G	Ν	F	Ν	G	G	G	G	G	G	Ν	G	G	Р	Р	G	F		3.75-4.55			N/A +0.50-	1.00 <mark>8 to</mark>	12 6 to	9 4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
AR - Coarse	G	G	Ν	F	Ν	G	ŋ	G	G	G	Ν	Ν	G	G	Р	Р	G	G	65,000	3.75-4.55	4.00-4.75	.25-5.0	N/A +0.50-	1.00 <mark>8 to</mark>	12 6 to	9 4 to 6	7 to 12	5 to 7	4 to 6	7 to 10	4 to 6	3 to 5
Cape Seals																																
Slurry	G	G	Ν	F	Ν	G	ŋ	G	G	G	G	G	Ν	Ν	G	G	G	Ρ						9 to	147 to	10 5 to 7	8 to 12	6 to 8	5 to 7	8 to 10	5 to 7	4 to 6
Micro	G	G	Ν	G	F	G	ŋ	G	G	G	G	G	Ν	Ν	G	G	G	Ρ						1 <mark>0 to</mark>	1 8 to	10 5 to 8	8 to 12	6 to 8	5 to 8	8 to 10	5 to 7	4 to 6
PM Alternative to a Seal Coat > 30,000 ADT																																
PBA-O	G	G	Р	F	Ν	G	ŋ	G	G	G	G	G	F	F	G	G	G	Ρ	65,000	8-12	8-14	10-16	+1.20-	1.00 <mark>8 to</mark>	146 to	12 4 to 7	8 to 12	6 to 10	4 to 5	8 to 10	5 to 7	3 to 5
RAC-O	G	G	Р	F	Ν	G	G	G	G	G	G	G	F	Р	G	G	G	Р	60,000	10-14	10-14		+1.50-	3.50 <mark>8 to</mark>	14 5 to	12 4 to 7	8 to 12	5 to 10	4 to 5	8 to 10	5 to 9	3 to 5
RAC-O High Binder (HB)	G	G	Р	F	Ν	G	G	G	G	G	G	G	F	Р	G	G	G	Р	65,000	10-14	10-14		+1.50-	3.5 <mark>6 to</mark>	156 to	12 4 to 8	10 to 1	26 to 12	4 to 6	8 to 12	5 to 10	4 to 5
RAC-G	G	G	Р	G	F	G	G	G	G	G	G	G	F	F	G	G	G	G	65,000	10-14	10-14		+1.50-	3.50 <mark>8 to</mark>	146 to	10 4 to 6	8 to 12	5 to 9	4 to 5	8 to 10	5 to 7	3 to 5
PBA-G	G	G	Р	Ρ	Ν	G	G	G	G	G	G	G	F	F	G	G	G	G	60,000	8-12	8-14	10-16	+1.20-	4.0 <mark>6 to</mark>	146 to	12 4 to 7	8 to 12	6 to 10	4 to 5	8 to 10	5 to 7	3 to 5
Thin Bonded Wearing Course (BWC)	G	G	Р	F	Ν	G	G	G	G	G	G	G	F	F	G	G	G	G	85,000	10-14	10-14		+1.50-	3.50 <mark>8 to</mark>	125 to	10 4 to 6	8 to 10	5 to 9	4 to 5	8 to 10	5 to 9	3 to 4
Thin Bonded Wearing Course Rubber (BWC-RAC O/G	G	G	Р	F	Ν	G	G	G	G	G	G	G	F	F	G	G	G	G	85,000	10-14	10-14		+1.50-	3.50 <mark>8 to</mark>	125 to	10 4 to 6	8 to 10	5 to 9	4 to 5	8 to 10	5 to 9	3 to 4
Maintenance Treatments																																
Thin Lifts Overlays																																
Conventional	G	G	Р	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	45,000	8-12	8-14	10-16				10 4 to 6				6 to 8	4 to 6	1 to 3
PBA	G	G	Ρ	G	G	G	G	G	G	G	G	G	G	G	G	G	G	G	60,000	8-12	8-14	10-16				12 4 to 7				8 to 10	5 to 7	3 to 5
RAC	G	G	Р	G	F	G	G	G	G	G	G	G	F	F	G	G	G	G	65,000	10-14	10-14		+1.50-	3.5 <mark>6 to</mark>	145 to	12 4 to 7	8 to 12	5 to 10	4 to 5	8 to 10	5 to 9	3 to 5
Digouts	Р	Р	G	Ν	G	G	G	G	G	G	G	G	G	G	G	G	G	G	125,000													

Estimated Life of Treatments

Treatment	Good Condition (PCI=80)	Fair Condition (PCI=60)	Poor Condition (PCI=40)
Fog Seal	3 - 5	1 - 3	1 - 2
Chip Seal	7 - 10	3 - 5	1 - 3
Slurry Seal	7 - 10	3 - 5	1 - 3
Micro- surfacing	8 - 12	5 - 7	2 - 4
Thin HMA	10 - 12	5 - 7	2 - 4

Maintenance Treatment Guidance

- WSDOT Pavement Preservation Guide for Local Agencies
 - <u>http://www.wsdot.wa.gov/research/reports/fullreport</u> <u>s/800.1.pdf</u>
- National Center for Pavement Preservation
 - http://www.pavementpreservation.org/fhwa/
 - Pavement Preservation Checklist Series
- California Pavement Preservation Center
 - <u>http://www.csuchico.edu/cp2c/Strategy%20Selection</u> <u>.shtml</u>

Crack Sealing Applicability

- Applicable to medium severity cracks (maybe low severity) in pavements with low & moderate amounts of cracking and little or no faulting of cracks
- Often applied prior to slurry seals & microsurfacing as pre-treatment
- Effectiveness a function of selecting right pavement, crack preparation, crack sealing material, environment, and pavement materials

Seal Coats Address

- □ Weathering & Raveling
- □ Minor cracking
- □ Minor surface irregularities
- □ Skid problems (except fog seals)
- □ Reduce surface permeability

Fog Seal Applicability

- Asphalt surfaced pavements in good condition before significant cracking, or weathering and raveling
- □ Add additional binder to dry chip seal
- □ Generally lower volume roads
- □ Some concern about impact on skid resistance
- Effectiveness a function of selecting the right pavement, environment, and pavement materials

Rejuvenator Seal Applicability

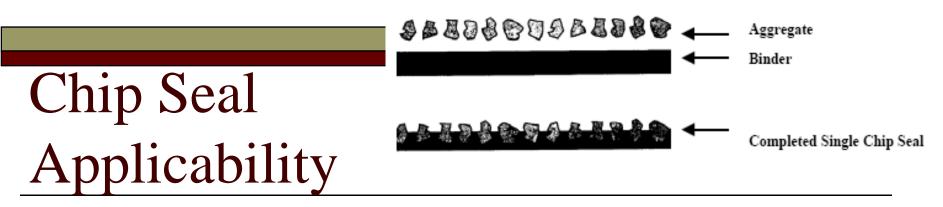
- Asphalt surfaced pavements in good condition before significant cracking, with minor weathering and raveling
- □ Generally lower volume roads
- □ Some concern about impact on skid resistance
- Effectiveness a function of selecting the right pavement, environment, and pavement materials

Slurry Seal Applicability

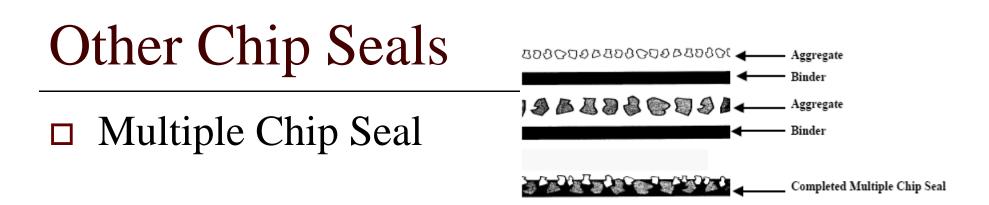
- Asphalt surfaced pavements in good condition before significant cracking but with low severity weathering & raveling
- □ Generally lower volume roads
- Effectiveness a function of selecting right pavement, mix & application of material, traffic levels, and weather at time of application

Micro-Surfacing Applicability

- Asphalt surfaced pavements in good condition before significant cracking but with low to medium severity weathering & raveling and moderate to severe rutting
- □ Generally higher volume roads
- Opened to traffic loadings quickly
- Effectiveness a function of selecting right pavement, mix & application of material, and weather at time of application



- Asphalt surfaced pavements in good condition before significant cracking but with low to medium severity weathering & raveling and rutting
- □ Can improve skid resistance
- □ Generally lower volume roads
- □ Aggregate loss and surface texture are issues
- Effectiveness a function of selecting right pavement, properties & application of material, and traffic at time of application



- □ Stress Absorbing Membrane (SAM) Seal
 - Normally high application rate of asphalt rubber binder
- Stress Absorbing Membrane Inter-layer
 (SAMI)
 - Normally like SAM but applied prior to overlay

Other Chip Seal Binders

- □ Asphalt Emulsion: Polymer-modified emulsions (PME)
- Performance-Based Asphalt (PBA) Cements: Hot applied modified binders
- Asphalt Rubber Binder: Binders modified with high levels of crumbed tire rubber and a high natural rubber content material – applied hot and require hot chips pre-coated with asphalt
- Rejuvenating Emulsion: Emulsions modified with rejuvenating oils (and sometimes polymers) used to penetrate and soften existing asphalt pavements

CALTRANS Maintenance TechnicalAdvisory Guide (MTAG) – Chap 5

Table 2: Binder/Chip Seal Combinations for Addressing Specific Distress Mechanisms

Binder/ Chip Seal Combination	Raveling	Aged Pavements	Bleeding/Flushing	Load Associated Cracks	Water Proofing	Climate Associated Cracks	Heavy Traffic Volumes	Stone Retention	Improve Skid Re sistance
PME/Single	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PME/Double	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PME/Sand	Yes	Yes	No	No	Yes	No	No (light)	Yes	No
PBA/Single	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes
PBA/Double	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
PBA/Sand	Yes	Yes	No	No	Yes	No	No	Yes	No
AR/SAM	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes	Yes
Rejuvenating Emulsion	Yes	Yes	No	No	Yes	No	Yes	Yes	Yes

Cape Seal Applicability

- Asphalt surfaced pavements in good to poor condition with some cracking and low to medium severity weathering & raveling
- Where chip seal texture or chip loss are unacceptable but chip seal is right treatment
- Effectiveness a function of selecting right pavement, properties & application of material, and traffic at time of application

Cape Seal Options

- □ Chip seals with PBA or RA binders
 - Provides more crack sealing capability
 - Can work as flexible surfacing on low volume pavements with considerable cracking if pavement is still stable
- □ Micro-surfacing instead of slurry
 - When surface needs to be opened quickly
 - Rut filling
 - Skid resistance
 - Longer life

Thin Overlay Applicability

- Asphalt surfaced pavements in good to fair condition with some cracking and low to medium severity weathering & raveling
- □ Where seal coats are unacceptable
- □ Higher volume roads
- Effectiveness a function of selecting right pavement, properties & application of material, and environment

Structurally Inadequate

- □ Overlay or other strengthening approach required
 - *Not preservation* treatments
- □ Reconstruction remove & replace
 - Use new design procedure
- Overlay add additional surface layer
 - Use overlay design procedure
 - Use in-place material property values for layers left in place

Planning Treatment/Cost Category

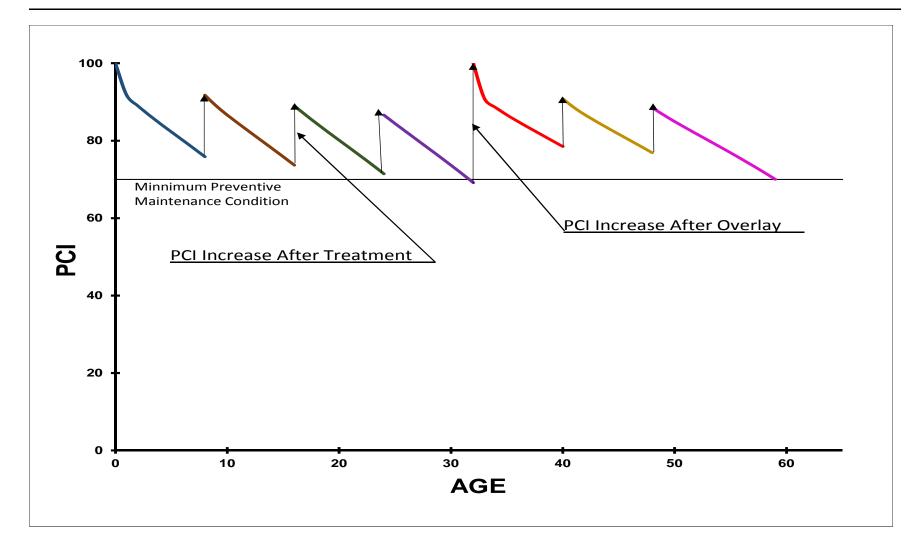
□ Cost more important than actual treatment

 Actual treatment selected later in Project-Selection Level

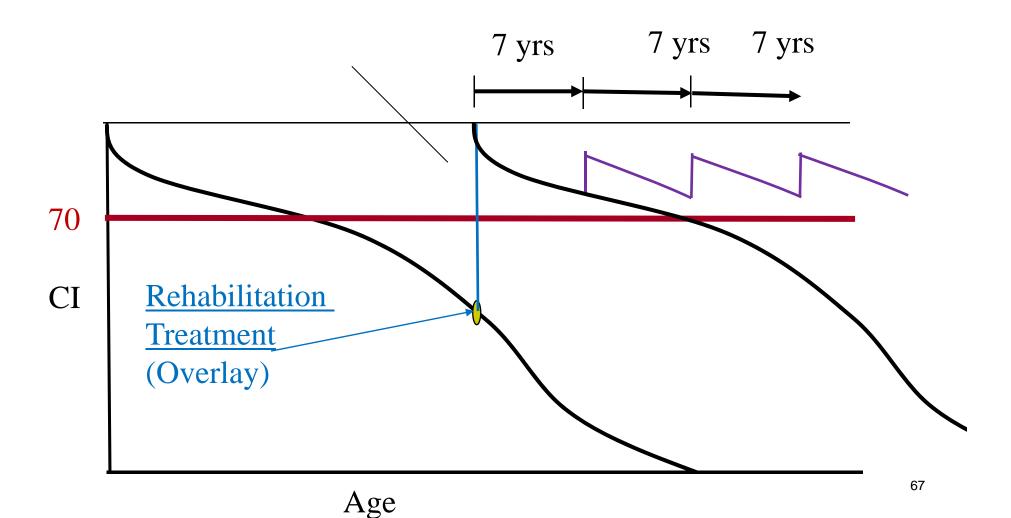
Select Best Treatments

- □ Which treatment is best?
 - Actually looking at treatments in a strategy
 - One that provides desired performance
 - Often several are appropriate
- Which provides desired performance for least cost?
 - Life cycle cost analysis

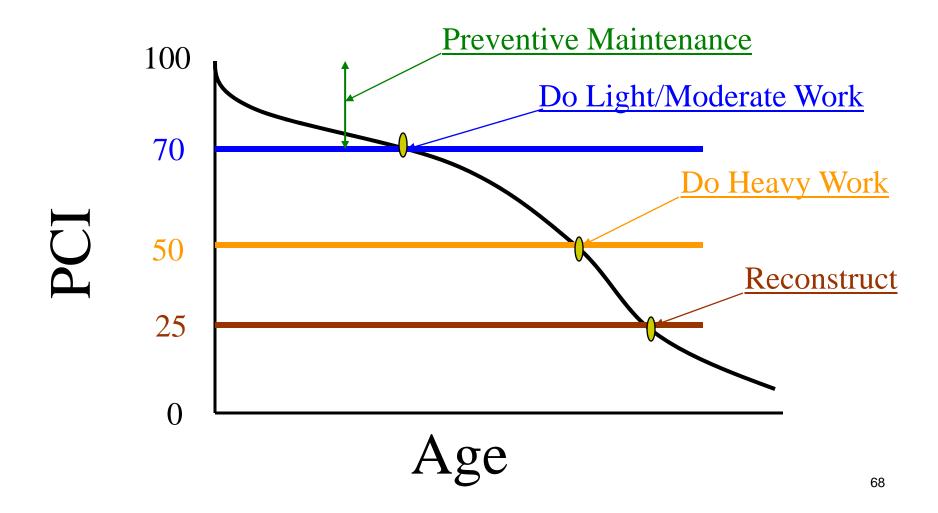
Strategy to Preserve Pavement



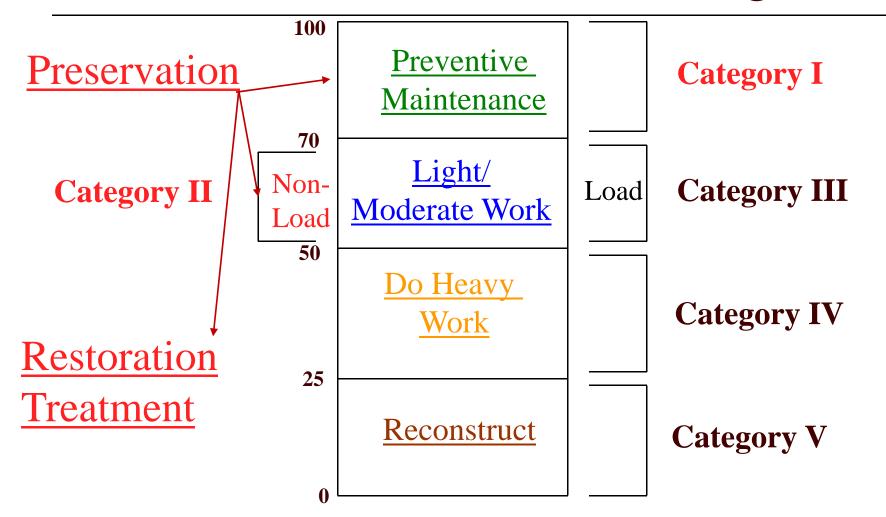
Treatment to Return Pavement to Preservable Condition



Treatments for Each Trigger Value



Preservation Condition Categories



Preferred Method

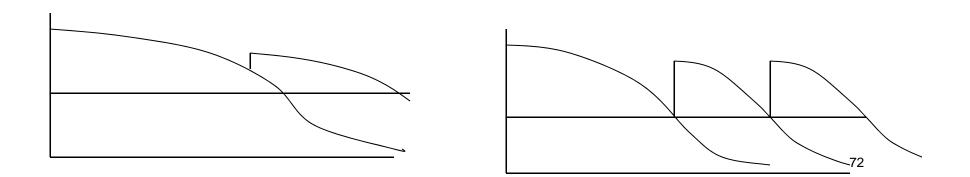
- Conduct a series of life-cycle cost analyses to identify the most cost effective set of treatments for
 - Each FC/ST combination for
 - Each condition category

Pavement Life Cycle Cost Analysis

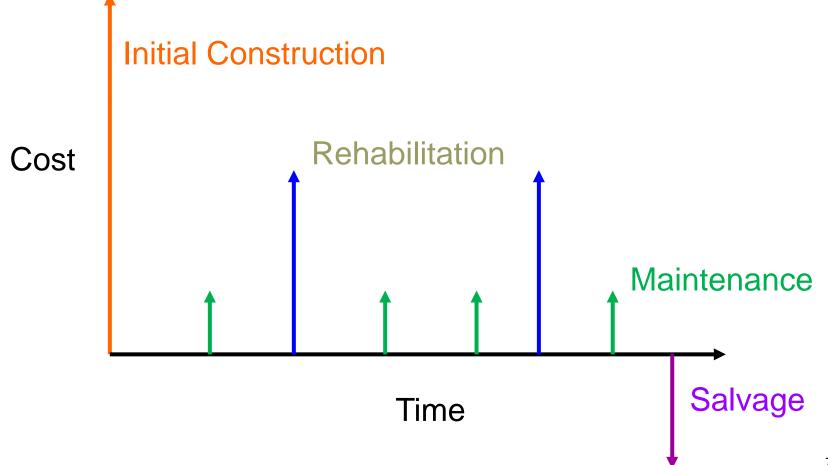
- Pavement LCCA is an economic evaluation technique to determine "total cost" of owning and operating a facility over some period of time (life)
- □ Purpose of LCCA:
 - Estimate overall costs of pavement alternatives and
 - Select alternative that will provide lowest overall cost over life (analysis period) consistent with required performance and other constraints
- □ LCCA is a Decision Support Tool

Questions Addressed

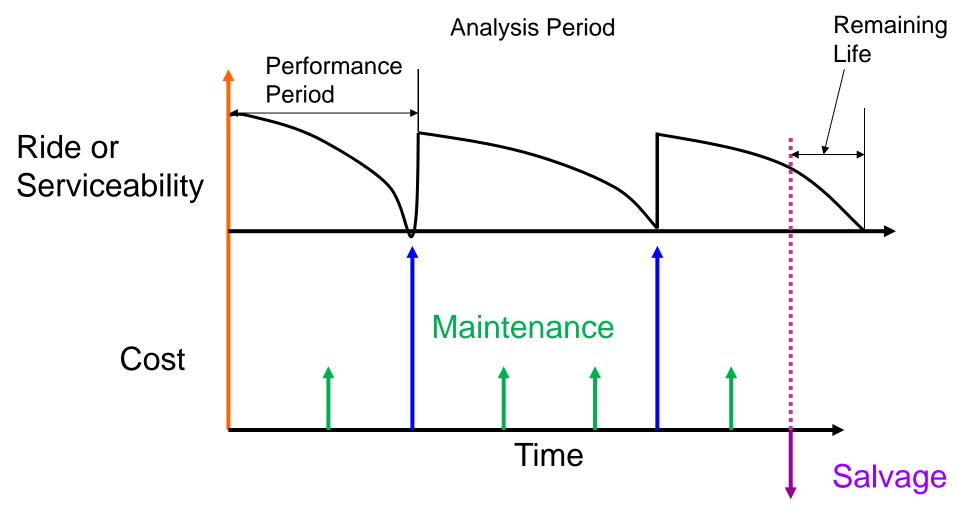
- □ Select from several alternative approaches
- Build strong and preserve with preventive maintenance or design for short period and rebuild frequently







Performance & Costs

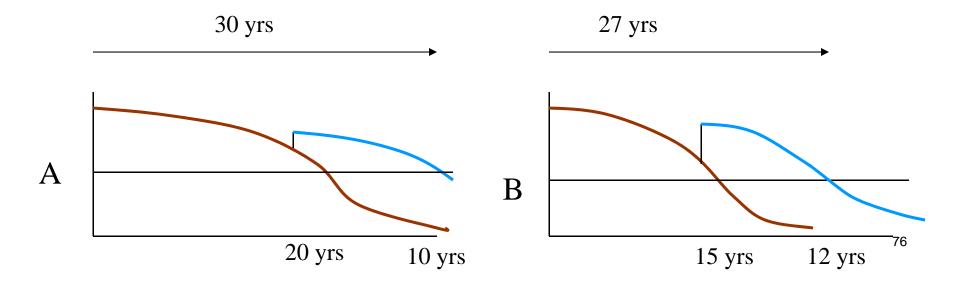


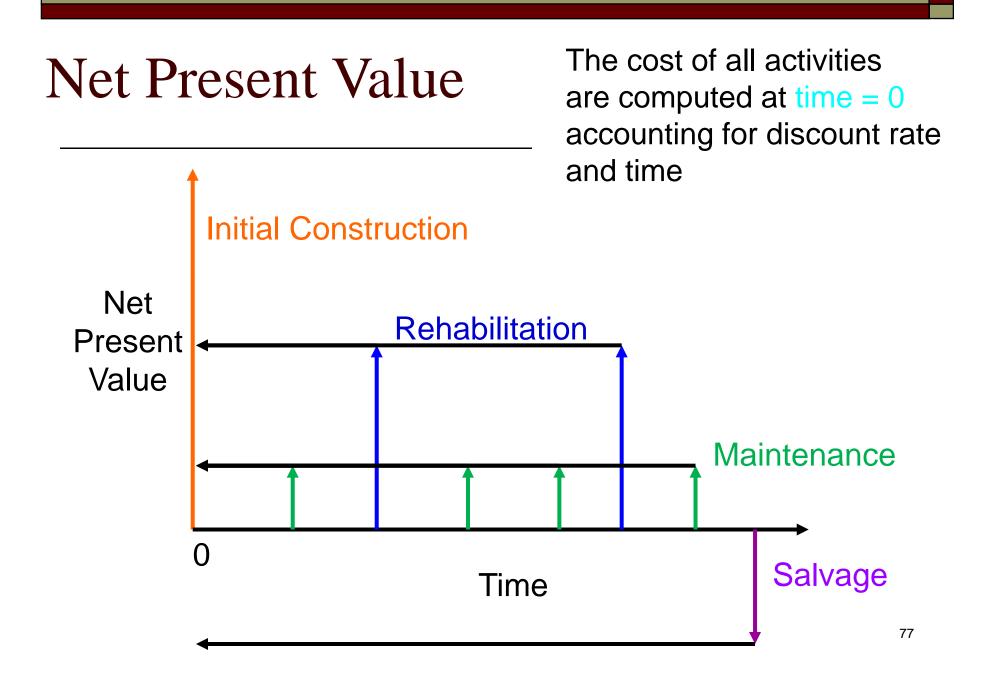
Most of Agency Cost is in:

- Initial Construction
 - **70 to 90%**
- Rehabilitation
 - 10 to 25%
- Reactive Maintenance Almost no effect
- □ Salvage Value Very little effect

Life Cycle Cost Analysis Unequal Total Lifes

- NPV Considering Salvage value
- Equivalent Uniform Annual Cost





Salvage Value

- Residual Value
 - Value of materials remaining at the end of pavement life – typically not much difference among alternatives
- □ Service Life
 - Remaining life at end of analysis period
- Used with alternatives that have significant differences in total life

The annual cost of all **Equivalent Uniform** activities to provide the Annual Cost (NPV x CRF) pavement at a designated level of service **Initial Construction** Net Rehabilitation Present Value Maintenance $\mathbf{0}$ Salvage Time \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ \$ 79

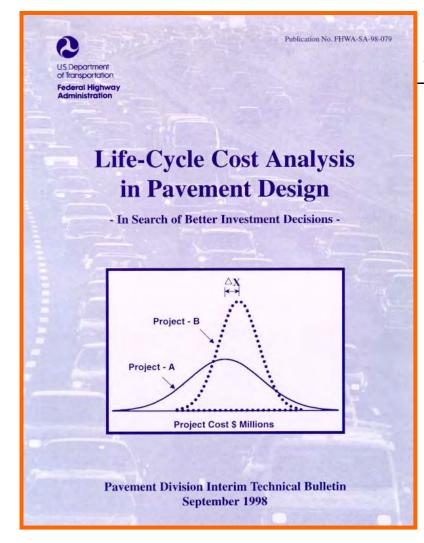
Analysis Period

□ New pavement design

- At least through the life of the first major rehabilitation treatment after initial performance period
- □ Rehabilitation
 - At least through the life of the subsequent major rehabilitation treatment after initial performance period
- Longer periods are better (avoid salvage value differences)

Discount (Interest) Rate

- □ Time value of money
- Often inflation protected interest rate (10-year Treasury Inflation Protected Security)
- □ In local agencies
 - Check with financial folks (what do they use?)
 - Typically the agency bond rate



http://restructure.fhwa.dot.gov/dp115/



FHWA Has Software Available

🗠 Life Cycle Cost Analysis - Untitled	
<u>File V</u> iew <u>H</u> elp	
General Project Inputs	Alternative Specific Information Alternative Specific Information ALTERNATIVE: 1
Project Number: 0 O Probabilistic O Deterministic	
General Project Description: Enter Brief Description Here	Description: Enter Brief Description
Analysis Period: 35 years View and/or Modify Added Time, Vehicle Project Length: 1 miles Burning and Idling Costs	Number of Work Zones Scheduled over Analysis Period (include original construction)
	Initial Construction/Rehabilitation/ Maintenance Inputs
Number of Lanes: 1 (each direction) Posted Speed Limit: 55 mph	Alternative: 1 Work Zone: Next Work Zone
Number of Design Alternatives: 1 (maximum 4)	Description: Enter Brief Description
Min Mean Max Distribution Discount Rate (%): 2 4 6	Work Zone Length: 1 miles
Traffic & Roadway Capacity Inputs	Work Zone Speed Limit: 40 mph
	Work Zone Dissipation Capacity: 1700 veh/hour/lane
Truck Equivalency Factor: 1	Work Zone Capacity: 1260 veh/hour/lane
Base Year AADT: 100	
Heavy Vehicle Factor:	Number of Work Zone Lanes: 1 (open in each direction)
% Trucks: 10 Lane Width Factor: 1	Required Time to Complete 1 hours Work Zone Activity:
% SU Trucks: 5 Max Service Flow Rate: 2200 pcphpl	Expected year in which the work occurs (0 is base year):
% CU Trucks: 5 Service Flow Rate: 2200 vph	Number of Years before Next Scheduled Work Zone
View and/or Modify Traffic Distribution	Min Mean Max Distribution
Min Mean Max Distribution: Traffic Growth 2 4 6 Normal	
Executing Analysis and Viewing Results	Bid Item Costs Time Related Costs Work Zone Timing and Costs
Run Simulation	Agency Cost Variability:
Graphical Options:	+/- 10 %
Plot All Alternatives 💽 1 Agency Costs 💽 Graph It	
For Full Help File, press F1. For Pop-Up Help, press Shift+F1	

ODOT

ODOT Pavement Design Guide

□ Chapter 9: Life Cycle Cost Analysis

WSDOT

FHWA 98 Reoirt FHWA RealCost LCCA Software

http://www.fhwa.dot.gov/infrastructure/asstmgmt/rc21toc.cfm

Feedback Activity

- □ At end of construction season
- □ Review treatments applied
 - Do you need to change decision tree treatment?
 - Was the treatment applied the appropriate treatment or "stop-gap" treatment?
- Review costs for treatments
 - Adjust costs to reflect those from the latest season

Questions

