Solutions for Pavement Life Extension

Date of Presentation: May 6, 2020
Presented by: Art Baker
Pavement Life Extension – What it is NOT

• Which roads am I going to pave this year?
• What roads do I get the most calls on?
• Which are my worst roads?
• Where am I patching the most potholes?
Pavement Life Extension

- A network approach
- A yearly program consisting of multiple treatments
- The ability to maximize the use of your available funding to best increase the overall condition of your network.
- Understanding network level decisions and the consequences that come with them.
- Knowing what you have – How can I manage what I don’t know I have?
Asphalt Cement Price History--1992 to Present
(Annual Average $ Per U.S. Liquid Ton)
Why Do We Need Pavement Preservation?

- Asphalt Cost
- Highway Budgets
- HMA Life Expectancy
Pavement Life Extension Tools

- EAC – Equivalent Annual Costs
- RSL – Remaining Service Life
- PMP – Pavement Management Plan
- RoadResource.org
### Tool #1
#### Equivalent Annual Costs (EAC)

<table>
<thead>
<tr>
<th>Treatment Alternative</th>
<th>Cost ($/Lane-Mile) *</th>
<th>Cost ($/SY)</th>
<th>Estimated Service Life (Years)</th>
<th>EAC ($/SY/Year)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crack Seal</td>
<td>$3,520</td>
<td>$.50</td>
<td>2</td>
<td>$0.25</td>
</tr>
<tr>
<td>Fog Seal</td>
<td>$8,800</td>
<td>$1.25</td>
<td>3</td>
<td>$0.42</td>
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<tr>
<td>Single Surface Treatment</td>
<td>$17,600</td>
<td>$2.50</td>
<td>5</td>
<td>$0.50</td>
</tr>
<tr>
<td>Double Surface Treatment</td>
<td>$31,680</td>
<td>$4.50</td>
<td>8</td>
<td>$0.56</td>
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<tr>
<td>Thin Overlays</td>
<td>$56,320</td>
<td>$8.00</td>
<td>10</td>
<td>$0.80</td>
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<tr>
<td>Mill-and-Fill</td>
<td>$91,520</td>
<td>$13.00</td>
<td>13</td>
<td>$1.00</td>
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<tr>
<td>Rehabilitation</td>
<td>$119,680</td>
<td>$17.00</td>
<td>15</td>
<td>$1.13</td>
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<tr>
<td>Reconstruction</td>
<td>$176,000</td>
<td>$25.00</td>
<td>20</td>
<td>$1.25</td>
</tr>
</tbody>
</table>

* Based on 12’ lane widths
EAC by Strategy ($/SY/Year)
### EAC Example – MA Municipality

Roadway Network = 100 centerline miles  
Average Paved Width = 26 feet  
Total Paved Area = 1,525,000 SY

<table>
<thead>
<tr>
<th></th>
<th>Preservation Approach (Chip Seal)</th>
<th>“Worst First” Approach (Rehab)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Network Area</td>
<td>1,525,000 SY</td>
<td>1,525,000 SY</td>
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<tr>
<td>Avg. EAC</td>
<td>$ 0.50/SY/Year</td>
<td>$ 1.13/SY/Year</td>
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<td>Required Annual Budget</td>
<td>$ 762,500</td>
<td>$1,723,250</td>
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**Save Money...Keep Good Roads Good!**
Progressive Pavement Management

Preservation vs. Rehabilitation

Preservation Strategy:
- Years 5, 14, 30 & 39: Crack Sealing
- Years 10 & 35: Micro Surfacing (Double)
- Years 17 & 42: Cape Seal
- Year 25: Mill & Pave

Total Cost/SY over 50 Years = $38.00

Rehabilitation Strategy:
- Year 15: Unstabilized FDR plus 4” HMA Overlay
- Year 30: Unstabilized FDR plus 4” HMA Overlay
- Year 45: Unstabilized FDR plus 4” HMA Overlay

Total Cost/SY Over 50 Years = $63.00

Note: these are present day costs without inflation
Tool #2 Remaining Service Life

Simple (but effective) planning, education and communication tool:

A Quick Check of Your Highway Network Health

By Larry Galehouse, Director,
National Center for Pavement Preservation
and

Jim Sorenson, Team Leader,
FHWA Office of Asset Management

Available at:
http://www.fhwa.dot.gov/pavement/pub_details.cfm?id=478
A Quick Check of Your Highway Network Health

Remaining Service Life (RSL) Concept

- Every road segment has a Remaining Service Life (in years)
- Every road segment loses one year of Remaining Service Life every year
- 100 centerline miles with NO REPAIRS or MAINTENANCE in a given year, will lose 100 mile-years of Remaining Service Life
- Annual work plans should match condition goals (“outcome based budgeting”)
For Each Treatment Used:

\[ \text{Miles of Treatment} \times \text{Service Life of Treatment} = \text{Mile - Years} \]

\[ = \text{Added Network Service Life} \]
RSL Example

Network = 100 miles
Budget = $1,000,000 ($0.71/SY)

“Worst-First” or Preservation?
Which program will add more service life?
Pavement Network Evaluation Worksheet
Total Network Lane Miles =

<table>
<thead>
<tr>
<th>Reconstruction</th>
<th>Project</th>
<th>Design Life</th>
<th>Lane-Miles</th>
<th>Lane-Mile-Years</th>
<th>Lane-Mile Costs</th>
<th>Total Cost</th>
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| Total = | Total = |

<table>
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<tr>
<th>Rehabilitation</th>
<th>Project</th>
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<th>Lane-Mile-Years</th>
<th>Lane-Mile Costs</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>CIPR</td>
<td>X</td>
<td>=</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Mill &amp; Fill</td>
<td>X</td>
<td>=</td>
<td></td>
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</table>

| Total = | Total = |

<table>
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<tr>
<th>Pavement Preservation</th>
<th>Project</th>
<th>Design Life</th>
<th>Lane-Miles</th>
<th>Lane-Mile-Years</th>
<th>Lane-Mile Costs</th>
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<tr>
<td></td>
<td>UTBO</td>
<td>X</td>
<td>=</td>
<td></td>
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<tr>
<td></td>
<td>Micro Surfacing</td>
<td>X</td>
<td>=</td>
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<tr>
<td></td>
<td>Chip Seal</td>
<td>X</td>
<td>=</td>
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<td>Fog Seal</td>
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<td>Crack Seal</td>
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</table>

| Total = | Total = |
# Network Trend

## “Worst First”

<table>
<thead>
<tr>
<th>Programmed Activity</th>
<th>Miles</th>
<th>Mile Years</th>
<th>Total Cost</th>
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<tbody>
<tr>
<td>Reconstruction</td>
<td>1</td>
<td>20</td>
<td>$352,000</td>
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<tr>
<td>Rehabilitation</td>
<td>4</td>
<td>50</td>
<td>$661,760</td>
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<tr>
<td>Preservation</td>
<td>0</td>
<td>0</td>
<td>$0</td>
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<tr>
<td><strong>Totals:</strong></td>
<td>5</td>
<td>70</td>
<td><strong>$1,013,760</strong></td>
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</table>

Programmed Activity (Mile-Years) = 70

- Rehabilitation minus

Total Network (Mile-Years) = 100

Gain (+) / Deficit (-) = -30

## Preservation

<table>
<thead>
<tr>
<th>Programmed Activity</th>
<th>Miles</th>
<th>Mile Years</th>
<th>Total Cost</th>
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</thead>
<tbody>
<tr>
<td>Reconstruction</td>
<td>0.5</td>
<td>10</td>
<td>$176,000</td>
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<tr>
<td>Rehabilitation</td>
<td>2</td>
<td>25</td>
<td>$330,880</td>
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<tr>
<td>Preservation</td>
<td>21</td>
<td>86</td>
<td>$492,800</td>
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<tr>
<td><strong>Totals:</strong></td>
<td>23.5</td>
<td>123</td>
<td><strong>$999,680</strong></td>
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</tbody>
</table>

Programmed Activity (Mile-Years) = 123

- Rehabilitation minus

Total Network (Mile-Years) = 100

Gain (+) / Deficit (-) = 23
How much newly added network service life did the Town of Southwick, MA achieve last year?
### Remaining Service Life (RSL) calculation

**Prepared for:** Southwick, MA

**Centerline Road Miles:** 88 Miles

**Total Road Mile Years** **LOST if NO work is performed:** 88 Mile-Years

**Work Performed:** 2019

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Miles</th>
<th>Service Life</th>
<th>Service Life Injected to Network</th>
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</thead>
<tbody>
<tr>
<td>Fog Seal</td>
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<tr>
<td>Crack Seal</td>
<td>6.9</td>
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<td>20.7</td>
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<tr>
<td>Microsurfacing</td>
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<td>7</td>
<td>4.2</td>
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<tr>
<td>Chip Seal Traditional</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Chip Seal 10%</td>
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<td></td>
<td>0</td>
</tr>
<tr>
<td>Chip Seal 20%</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Cape Seal</td>
<td></td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>Shim Pave</td>
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<tr>
<td>Overlay</td>
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<td>0</td>
</tr>
<tr>
<td>Mill &amp; Overlay</td>
<td>0.7</td>
<td>12</td>
<td>8.4</td>
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<td>Cold-In-Place Recycle</td>
<td>1.4</td>
<td>15</td>
<td>21</td>
</tr>
<tr>
<td>Reclaim &amp; Pave</td>
<td>1.3</td>
<td>20</td>
<td>26</td>
</tr>
</tbody>
</table>

**Total Service Life Injected:** 80.3 Mile-Years

**Pavement Life Lost:** -88 Mile-Years

**Total Improvement or Decline to network:** -7.7 Mile-Years
Tool #3: Pavement Management Plan

If you made the right decision on ONE road, wouldn’t that pay for the cost of a good plan?
Repair Methods & Unit Costs

- No Maintenance Required - $0 SY
- Routine Maintenance - $0.50 SY
  - Crack Sealing
  - Fog Seal
- Preventative Maintenance - $6.00 SY
  - Chip Seal
  - Microsurfacing
  - HMA Overlay
- Minor Rehabilitation - $14.00 SY
  - Mill & Overlay
- Major Rehabilitation - $40.00 SY

* Please note that unit prices reflect curb to curb improvements only
Asphalt Deterioration Curve

Applying the Right Treatment, to the Right Road, at the Right Time

Condition/PCI

Excellent 100
Good 80
Fair 60
Poor 40
Very Poor 20
Failed 0

Time (years)

Fog Seal
Crack Seal
Slurry Seal, Chip Seal or Micro Surfacing (Single)
Chip Seal or Micro Surfacing (Double)
Cape Seal or Ultrathin Overlay
Hot In-place Recycling & Wearing Course
Mill & HMA Overlay
HMA Shim & Overlay
Cold In-place Recycling & Wearing Course
Full Depth Reclamation
Full Depth Reconstruction
CIP Development
RSR Forecasting – 5 Years (Standard Model)

Projected RSR By Year

2019 2020 2021 2022 2023

Current RSR 64.30

Amount Spent Per Year (Present Day Dollars)

- $1.25 Mil
- $1.1 Mil
- $925K
- $750K
- $600K

Roadway Forecast Model Percentage Breakdown:
- Crack Seal – 10%
- Preventative – 25%
- Rehabilitation – 40%
- Reclamation – 25%

*City Accepted Paved Roadways Only*
Tool #4 RoadResource.org
April 2016

June 2015 – Age 10 Months

August 2014 – Age 20 Months
Pavement Preservation Saves Money!

2004: Mill & Fill
2010: Crack Sealing & Micro Surfacing
2018: Crack Sealing
Optimizing Limited Roadway Funding

• “Worst-First” is unaffordable
• Deferring maintenance does **NOT** save $$$
• A balanced approach is best (PMP)
• Use EAC, RSL concepts & roadresource.org to better manage your network
Thank you!

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