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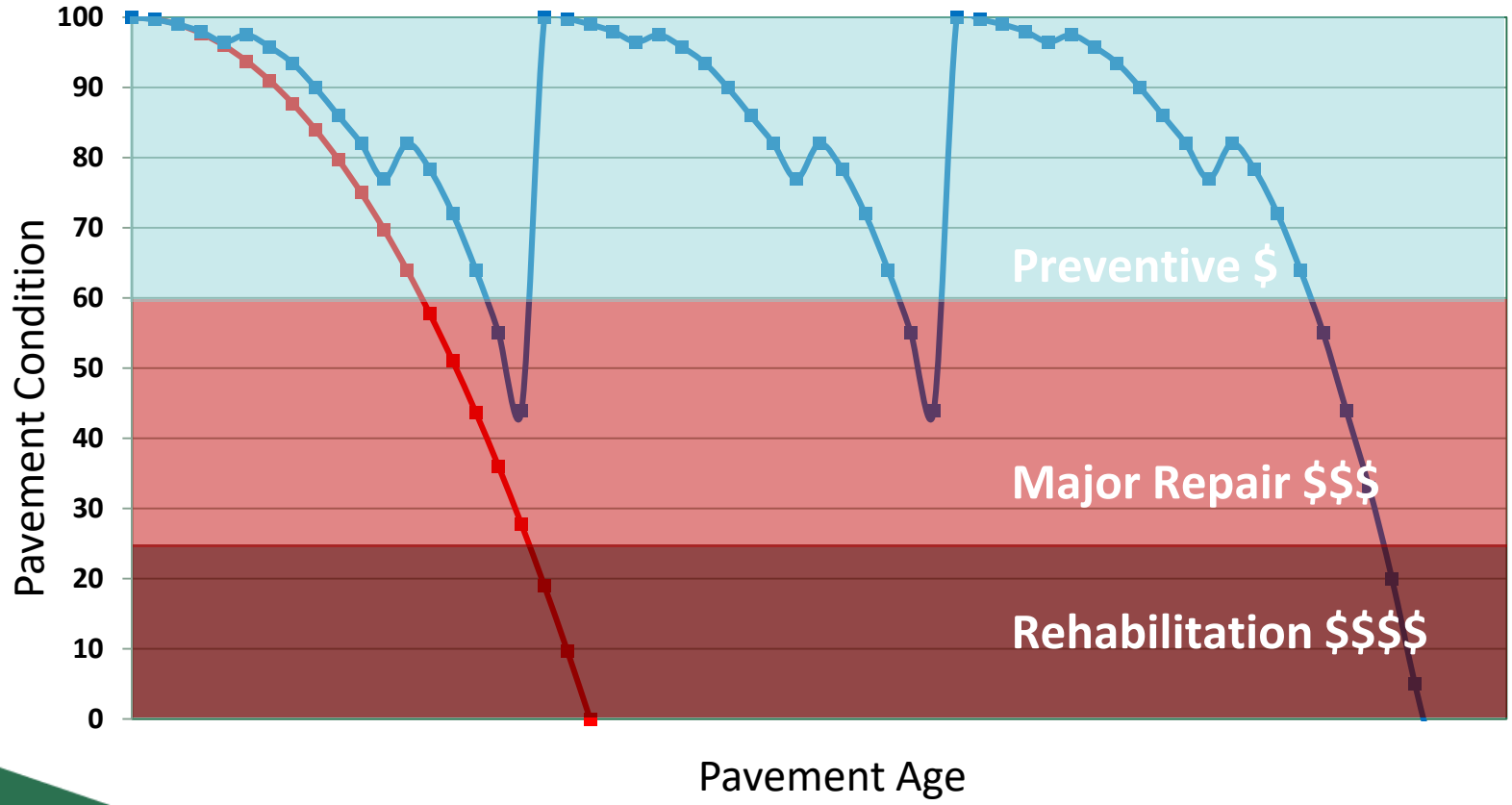
PAVEMENT MANAGEMENT AND MAINTENANCE – BEST PRACTICES

Amy Grothaus, PE

CEAM – January 26, 2022

Pavement Life Cycle



Pavement Management - Best Practices

1) Understanding characteristics of the pavement or pavement network

2) Upfront testing to ensure the right repair (at the right time on the right pavement)

3) Expanded maintenance & repair toolbox

4) Pavement finances & goal setting

1 - Pavement Characteristics

- What is the condition? (and condition over time)
- What is the pavement age?
- What's the history?
- What are the underlying soils?
- What is the traffic loading?

Pavement Condition Surveys

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The first step in making good decisions. Provides insight into repair options and causes for deterioration.

- ✓ Manual vs Automated
- ✓ Qualitative vs Quantitative
- ✓ Repeatable and objective
- ✓ Every 2-5 years

Identify Issues

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Distresses can be attributed too:

- **Climate (Environmental Effects)**
  - Transverse cracking
  - Block cracking
  - Faulting
- **Structural Deficiencies (Insufficient Strength)**
  - Alligator cracking
  - Rutting
  - Divided Slabs
- **Construction/Materials Problems**
  - Shoving
  - Bleeding
  - Popouts

Pavement Condition Trends

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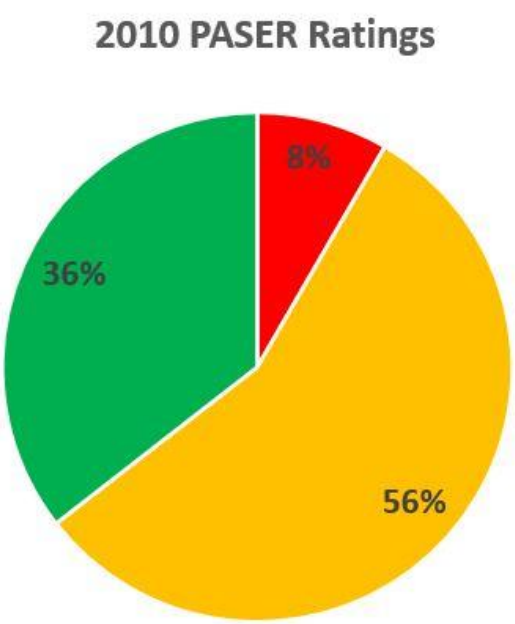
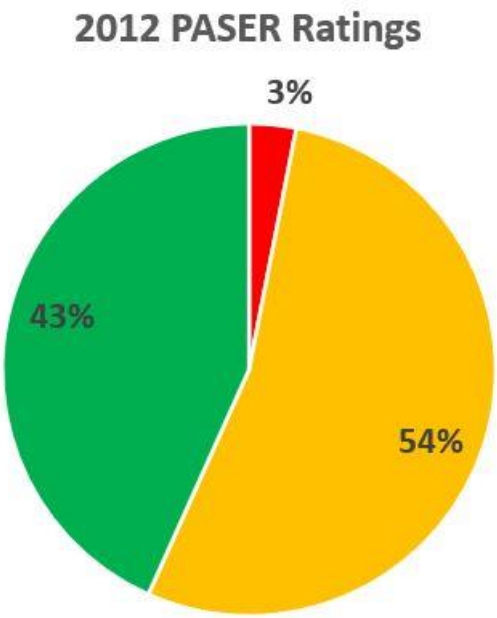
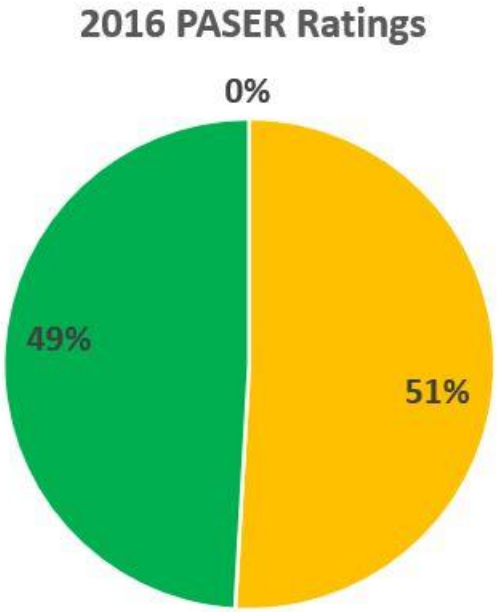




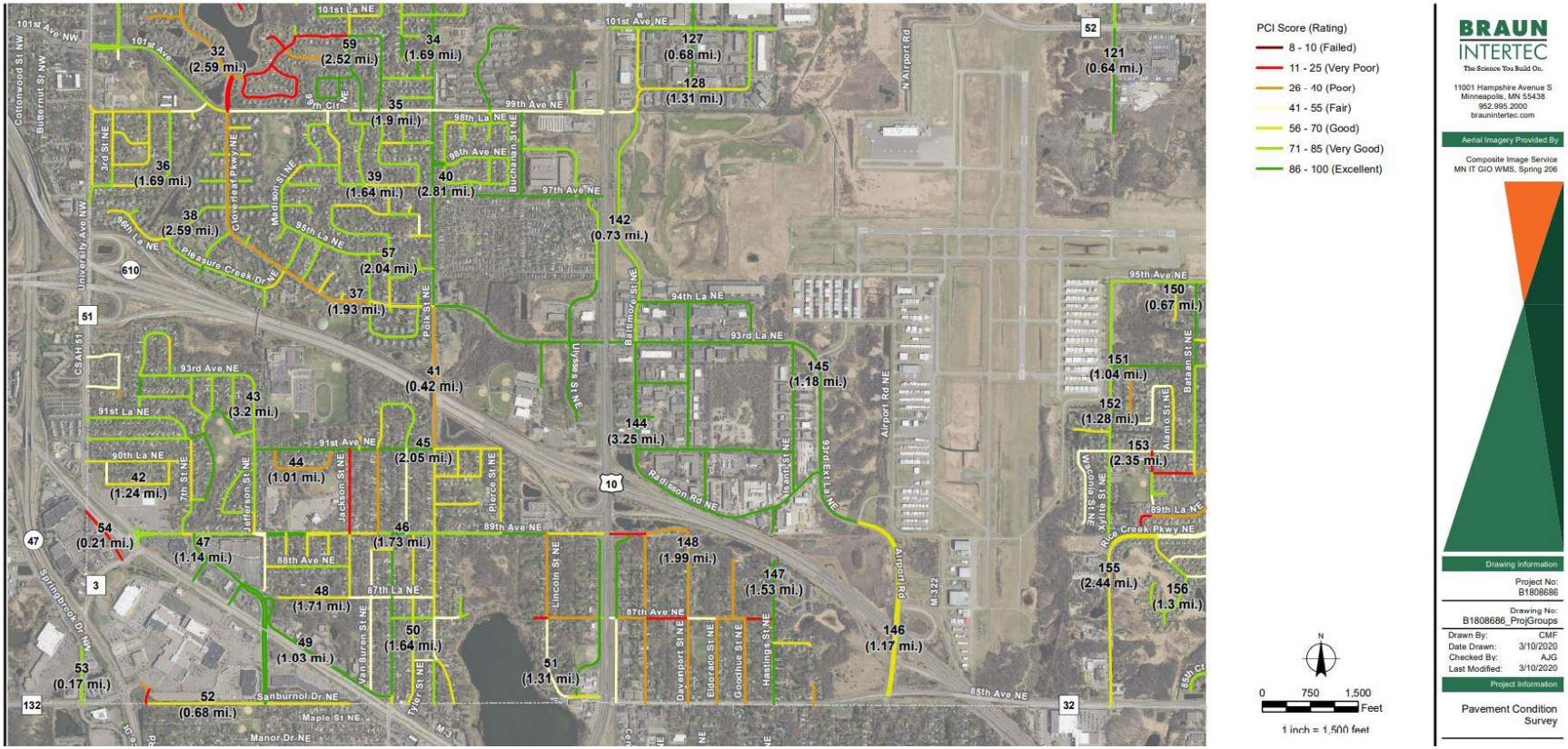


Failed, Very Poor or Poor – PASER 1 to 3

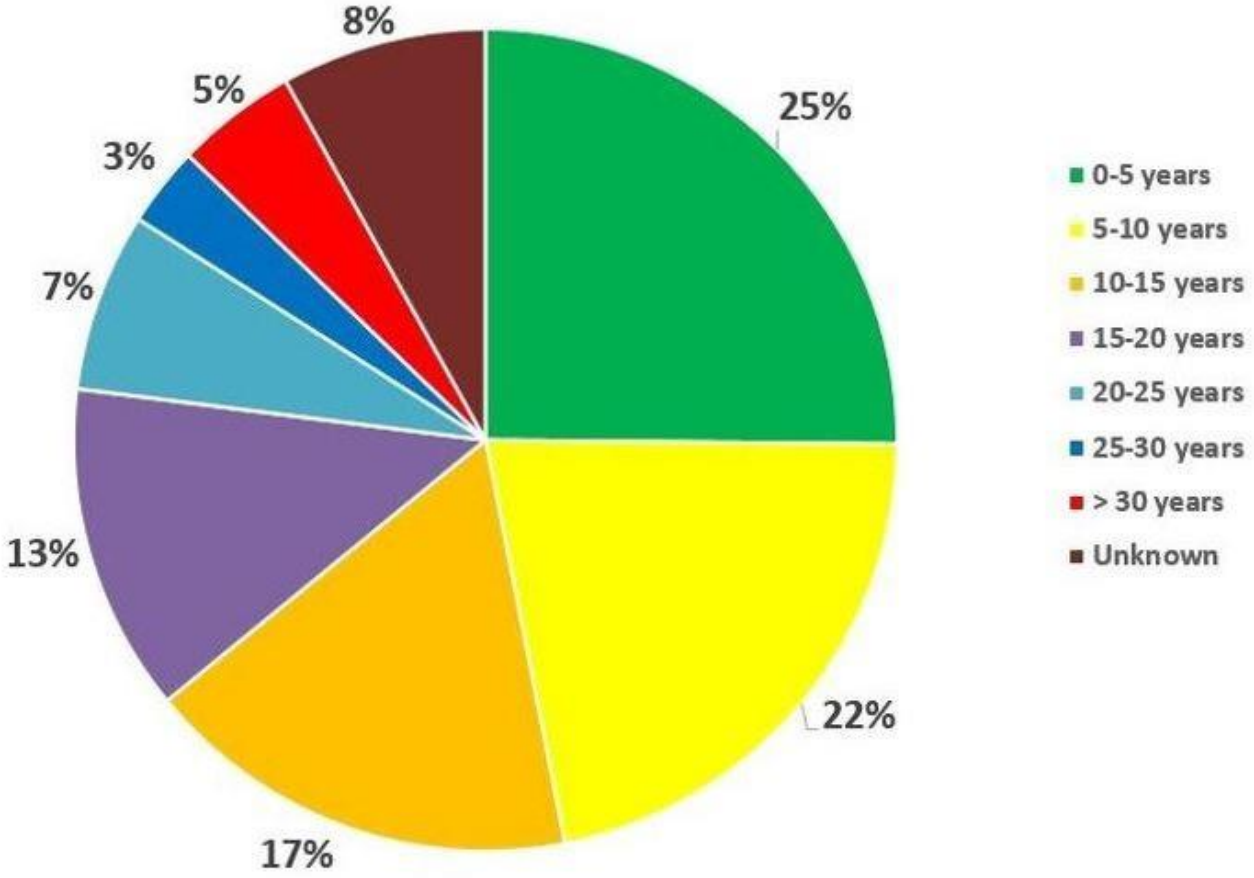
Fair or Good – PASER 4 to 7

Very Good or Excellent – PASER 8 to 10

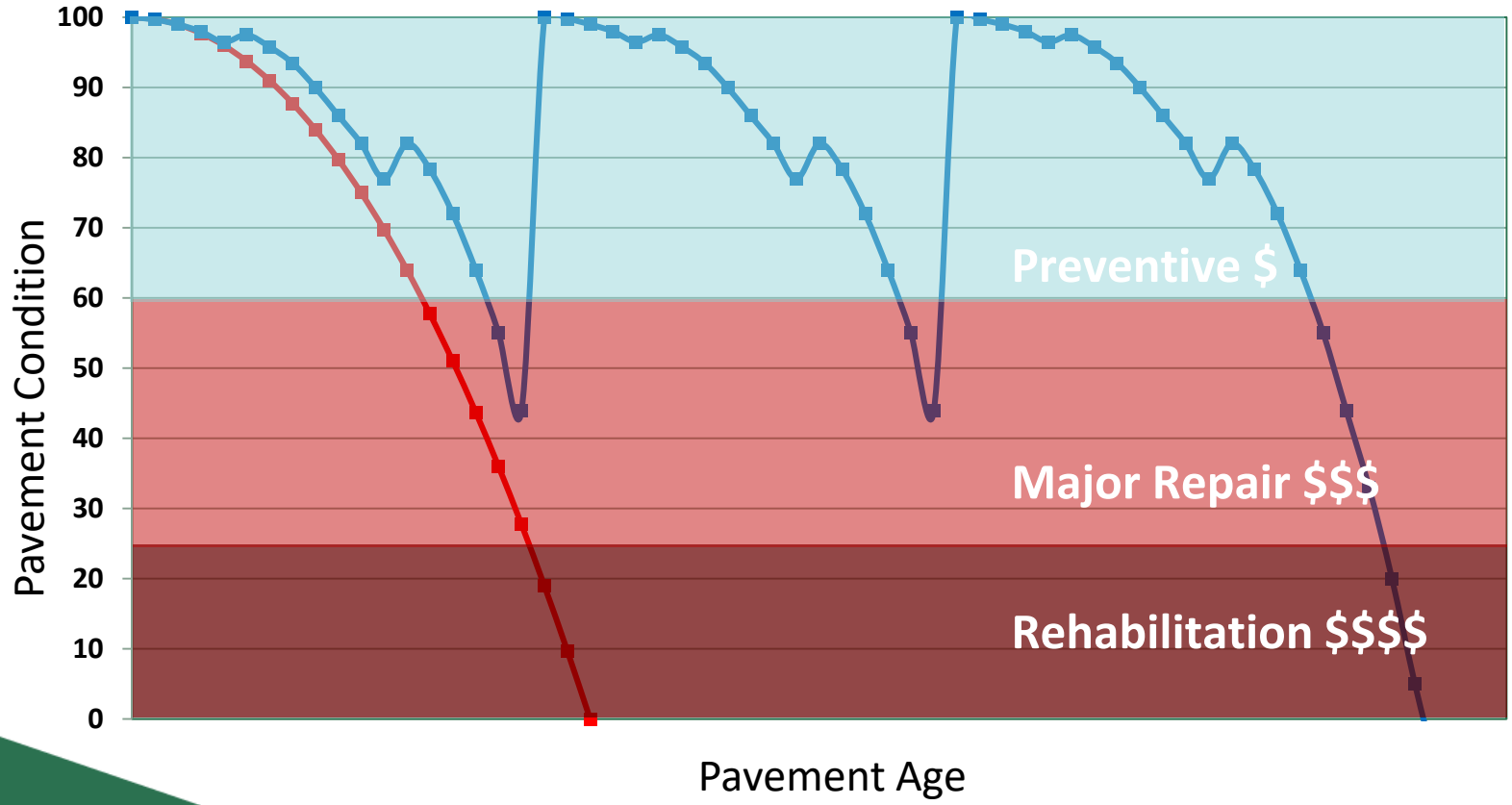
Pavement Assessment - Surface Evaluation



Pavement Age



Pavement Life Cycle



2 – Upfront Pavement Testing

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- **Surface** (Condition) Evaluations
- Pavement coring & hand auger borings
- Ground Penetrating Radar (GPR)
- Falling Weight Deflectometer (FWD) testing
- Soil borings

Sub-surface

Pavement Testing - Coring (and Hand Auger Borings)

- Confirm inplace materials and review underlying conditions
- Coring performed in non-cracked (sound) pavement areas, as well as on cracks to assess extent of cracking

Pavement Coring

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Ground Penetrating Radar

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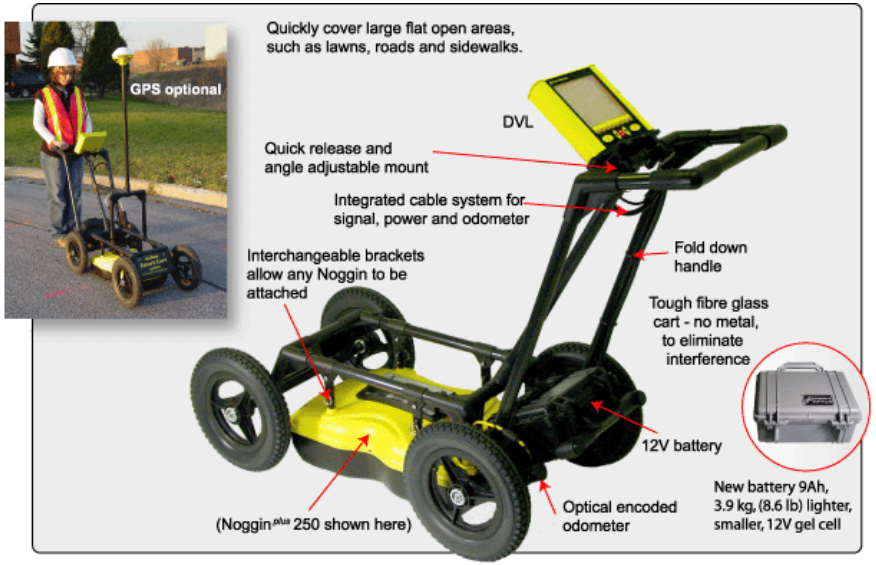
Ground-coupled GPR



Air-coupled GPR

Pavement Testing - GPR

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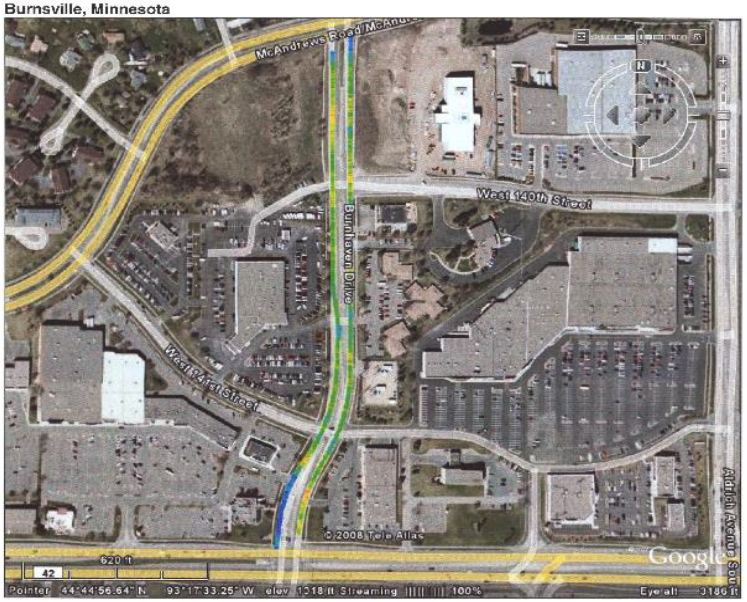
- Determining **continuous** inplace layer thicknesses
- Determination of mill or reclaim depths
- Estimation of construction removal quantities
- Layer thicknesses for FWD

GPR Data – Mill and Reclaim Depths

Project LV-08-01831
2008 Street Rehabilitation

BRAUN INTERTEC CORPORATION
Minneapolis, Minnesota

GPR Thickness Overview
Burnhaven Drive – Bituminous Surface
Burnsville, Minnesota



LEGEND:

- 3"
- 4"
- 5"
- 6"
- 7"
- 8"

Pavement Testing – FWD

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- Identify pavement strength/capacity
- Identify potential pavement failures
- In-situ R-value for use in pavement design
- Design overlay thickness
- Evaluate feasibility of repair options that leave material inplace

3 – Review/Expand Toolbox

Preventive ($)	Major Repair ($$$)	Complete Rehabilitation ($$$$)
• Crack Repair/Sealing	• Overlay • Mill & Overlay	• Full Reconstruction

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Expanded Toolbox

Preventive ($)	Major Repair ($$$)	Complete Rehabilitation ($$$$)
• Crack Repair/Sealing • Chip seals • Fog seals • Microsurfacing • HIR	• Mill & Overlay • Texas Underseal • FDR • SFDR • CIR	• Reconstruction

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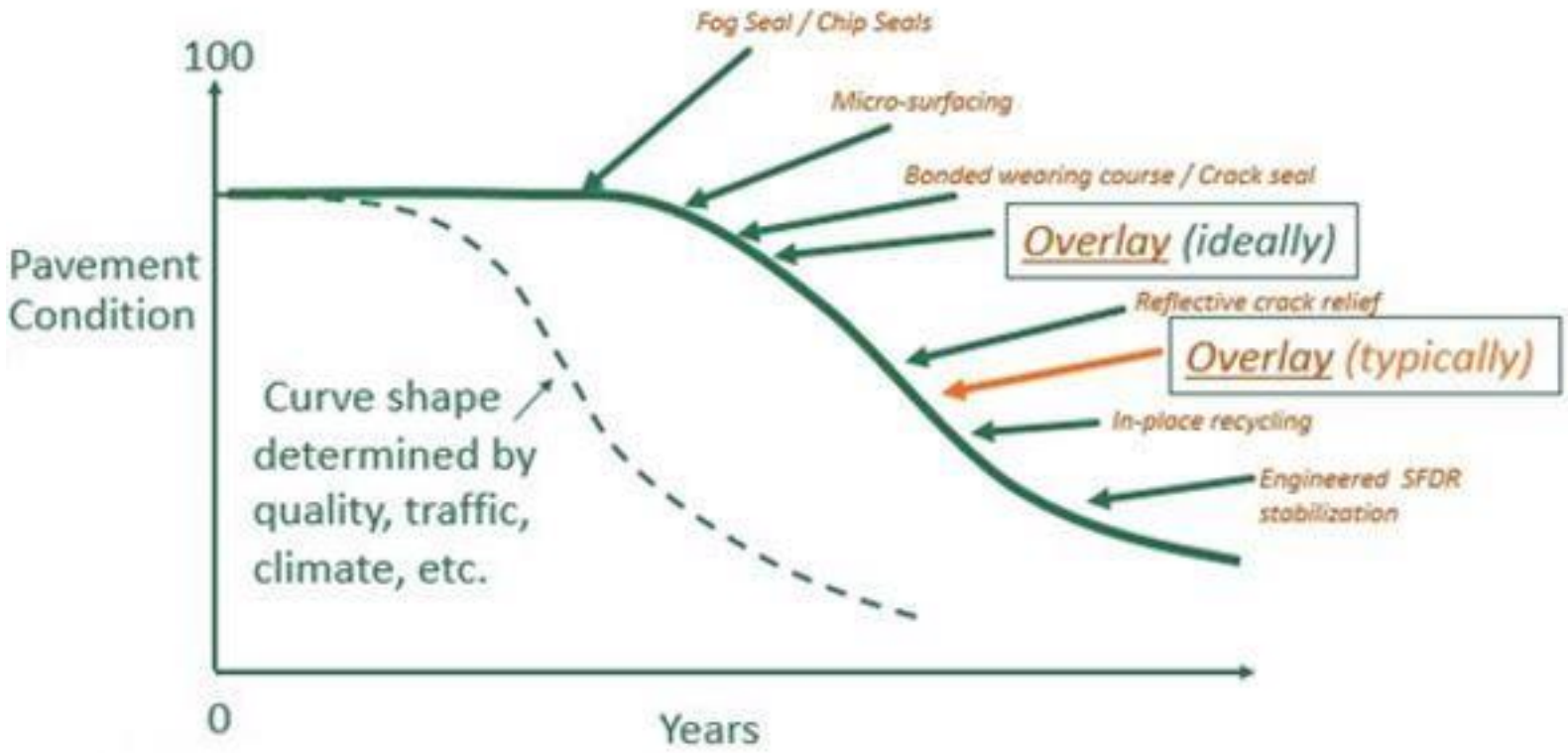
Wrong Repair, Wrong Time vs Right Repair, Right Time



Expanded Toolbox

Chip Sealing/Fog Seals – Fog seal includes light application of diluted, slow-setting asphalt emulsion, Rejuvenator or Bio Seal product without aggregate cover. Creates a "brand new" appearance to the street

Microsurfacing - Microsurfacing is a homogenous mixture of aggregate and asphalt emulsion. Benefits include filling pavement ruts, improving ride, and improving friction

FDR - Existing bituminous and a portion of aggregate base are pulverized, mixed together and compacted as base material, followed by the placement of a new bituminous overlay. May require the removal of some reclaim material

SFDR – FDR with asphalt emulsion, Portland cement or other additive to increase structural capacity, then overlaid

CIR - Renews upper 2-5 inches of asphalt surface with cold injection of emulsion. Similar to mill-and-overlay but significantly more cost effective by mitigating reflective cracking from the underlying structure

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Roadresource.org

Hot In-Place Recycling

MORE TREATMENTS...

Overview > About

FIND A CONTRACTOR/SUPPLIER

FOR PAVEMENT CONDITION A B C (PCI of 60 or greater)

Hot In-place Recycling (HIR) is an on-site, in-place pavement preservation and corrective maintenance technique that when combined with an asphalt overlay can be classified as structural rehabilitation. There are three sub-disciplines of HIR; Surface Recycling, Remixing and Repaving. All HIR sub-disciplines consist of heating, softening, scarifying/hot milling, mixing, placing and compacting the existing pavement. Rejuvenating agents and additives can be integrated into HIR mixtures to improve the characteristics of the recycled pavement. HIR should be considered whenever mill and fill or a leveling course is required prior to an asphalt overlay.

- 20-40% more cost effective than conventional maintenance/rehabilitation techniques
- Reduces greenhouse gases by up to 30%
- Reuses 100% of existing materials
- Same day return to traffic
- Extends pavement life by 7-15 years (dependent on the ability to restore asphalt viscosity and mitigate any existing asphalt mixture deficiencies)
- Structural Layer (a) Coefficients between 0.42 and 0.44 (equivalent to agency values for HMA)

Issues Addressed
- Oxidation
- Uneven surface profile
- Top down cracking
- Minor rutting
- Raveling
- For a complete list, see Table 6-1 of the BARM

Attributes
- Rejuvenates oxidized asphalt binder restoring pavement flexibility
- Conserves non-renewable resources and reduces trucking
- Eliminates defects within the recycling depth
- Maintains curb reveal and overhead clearances
- Retards crack mitigation from underlying aged asphalt layers

4 – Pavement Finances & Goal Setting

Understand Condition and Set Goal(s)

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Otter Tail County Tiered Preservation System Analysis

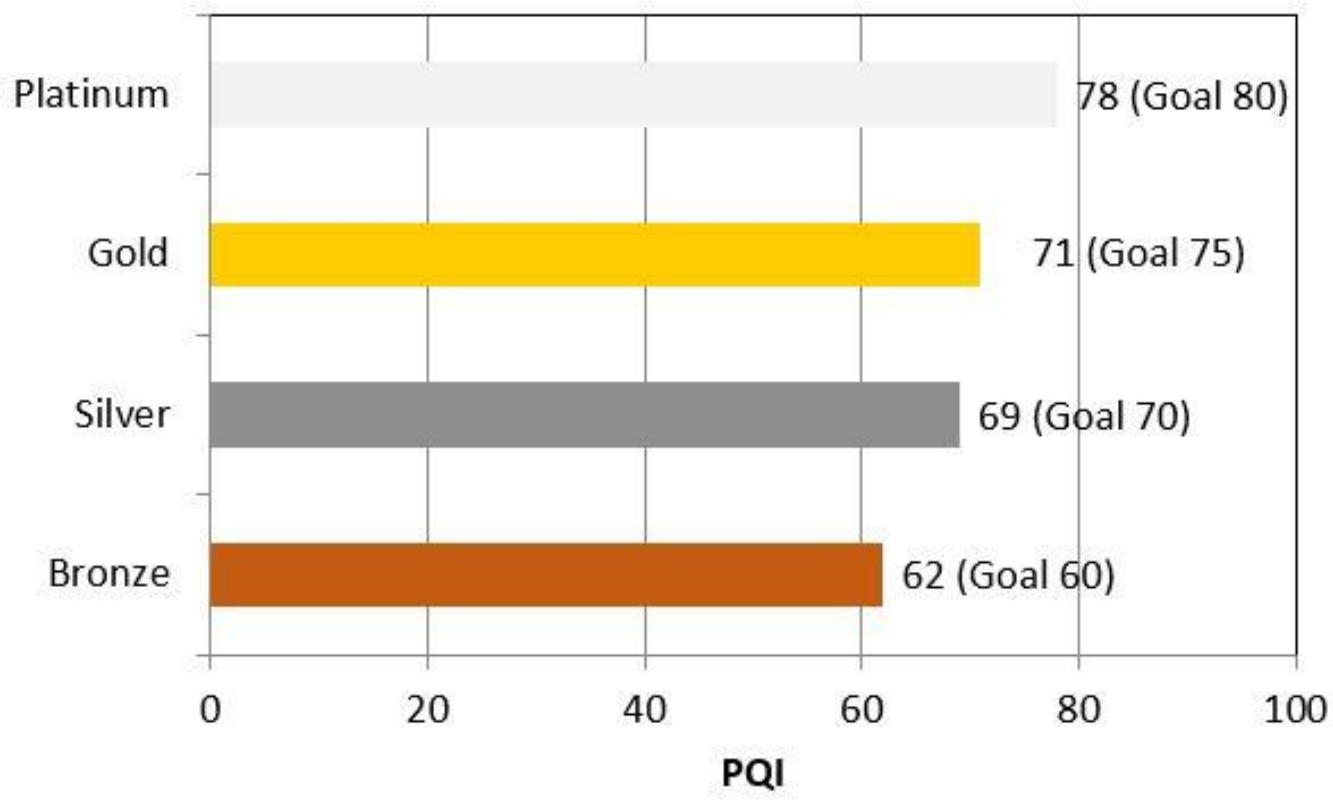
Current Highway System

Tiered System Criteria: Average Daily Traffic	Tiered System Criteria: Freight Routes	Refinement and Verification*	Tiered Maintenance Description	Tiered Maintenance
> 800	< 9 Ton Routes		**PLATINUM:** These routes are the backbone of the County's network. Common traits of these routes include: typically having higher traffic volumes, are on the current or proposed freight network, and provide connectivity to MnDOT's roadway network and population centers throughout the County. Platinum priority routes, totaling 371.08 miles (35%), would be targeted for the highest maintenance standards and schedules.	• 1st seal coat applied at year 3 after any major repair • 2nd seal coat applied 7 years after 1st seal coat • Apply major repair before PQI reaches 65 • Overall average PQI cannot be lower than 80
> 400	County 9 - 10 Ton Routes Proposed Freight Routes Conceptual 10-Ton Network			
400 - 800	< 9 Ton Routes		**GOLD:** This second tier of routes, totaling 280.42 miles (26%), serves mid-level traffic volumes, lower freight movements, and connectivity throughout Otter Tail County by linking to the Platinum Routes. While Gold Routes generally function at a lower classification than Platinum Routes, they are regionally significant due to the additional connectivity. These routes would have mid-level maintenance standards and schedules.	• 1st seal coat applied at year 3 after any major repair • 2nd seal coat applied 7 years after 1st seal coat • Apply major repair before PQI reaches 50 • Overall average PQI cannot be lower than 75
200 - 400	County 9 - 10 Ton Routes Proposed Freight Routes Conceptual 10-Ton Network			
200 - 400	< 9 Ton Routes		**SILVER:** This tier, making up 251.12 miles (24%) of the roadway network, serves lower traffic, decreased freight movements, and provides relatively short connections between Platinum and Gold Routes. These routes generally function at a lower classification and would have lower maintenance standards and longer schedules.	• 1st seal coat applied at year 3 after any major repair • 2nd seal coat applied 10 years after 1st seal coat • Apply major repair before PQI reaches 35 • Overall average PQI cannot be lower than 70
< 200	County 9 - 10 Ton Routes Proposed Freight Routes Conceptual 10-Ton Network			
< 200	< 9 Ton Routes		**BRONZE:** These roadways totaling 164.25 miles (15%), have the lowest traffic volume, restricted weight limits, and low functional classification. These routes would receive the lowest maintenance and may be recommended for an alternate surface or a turnback.	• Apply preservation methods before PQI reaches 25 • Overall average PQI cannot be lower than 60

- Evaluation of the current system includes proposed future turnbacks, which will be maintained at the appropriate tier until turned back to local jurisdiction

***Refinement and Verification Process:**

- Tiered system analysis findings were supplemented by local knowledge to verify route terminus, rankings, and "smoothing" of routes.
- Minor adjustments were made to ensure all cities located within Otter Tail County had at least one Platinum Route, Gold Route, or connection to the Trunk Highway System.
- Future additions to the tiered maintenance system will be evaluated based on the identified criteria, at the time of transfer.



Different goals set for each "tier"

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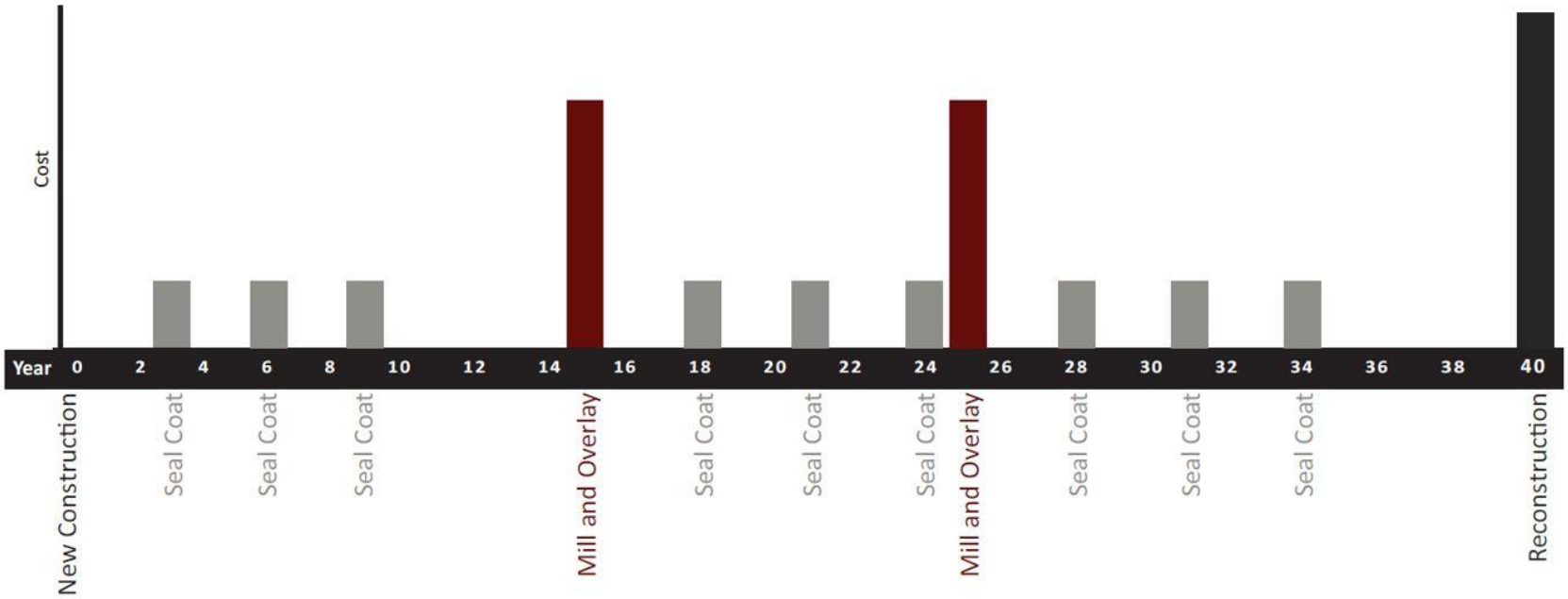
Establish Schedule of Maintenance and Repairs



Funding Scenarios

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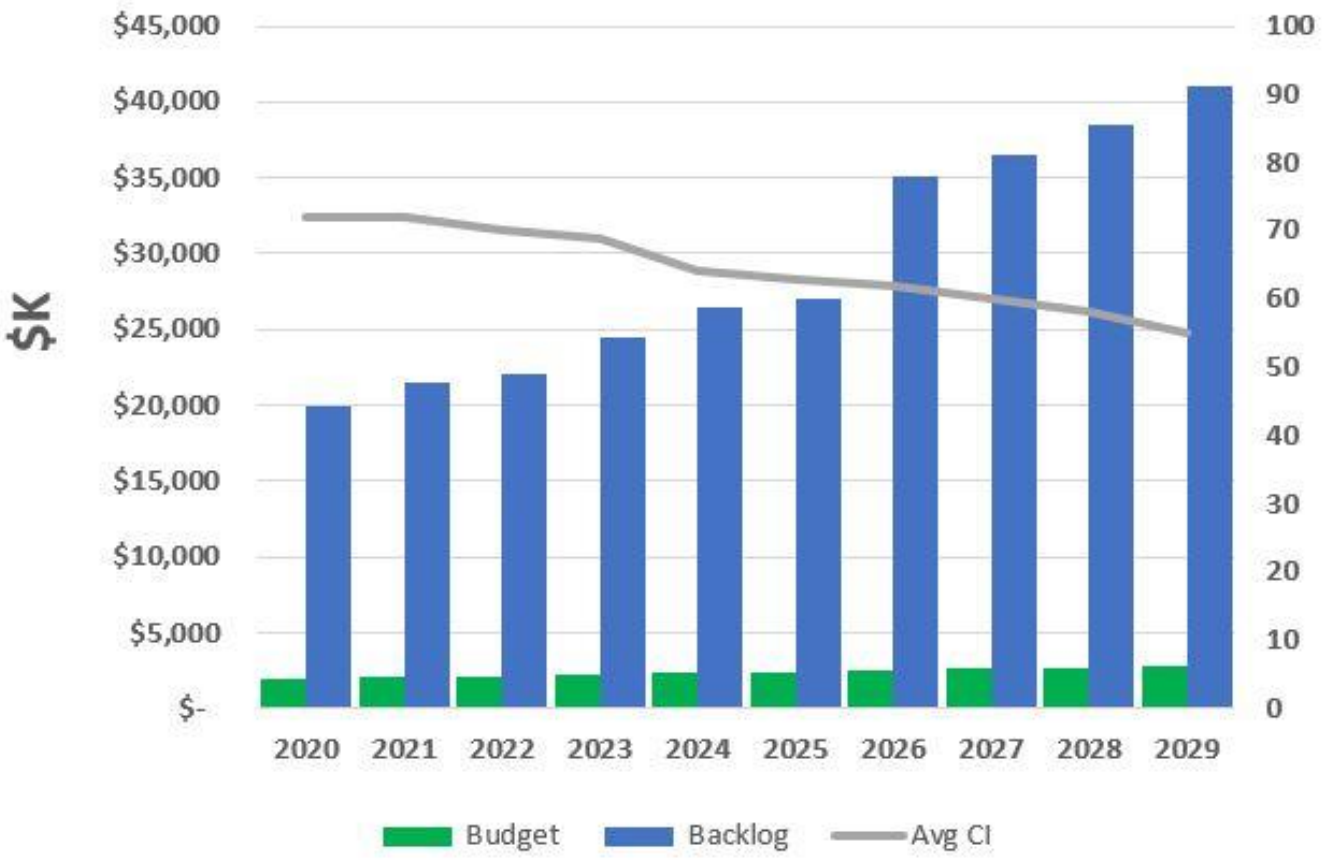
Funding vs Backlog



Understand Funding Gap/Shortfall

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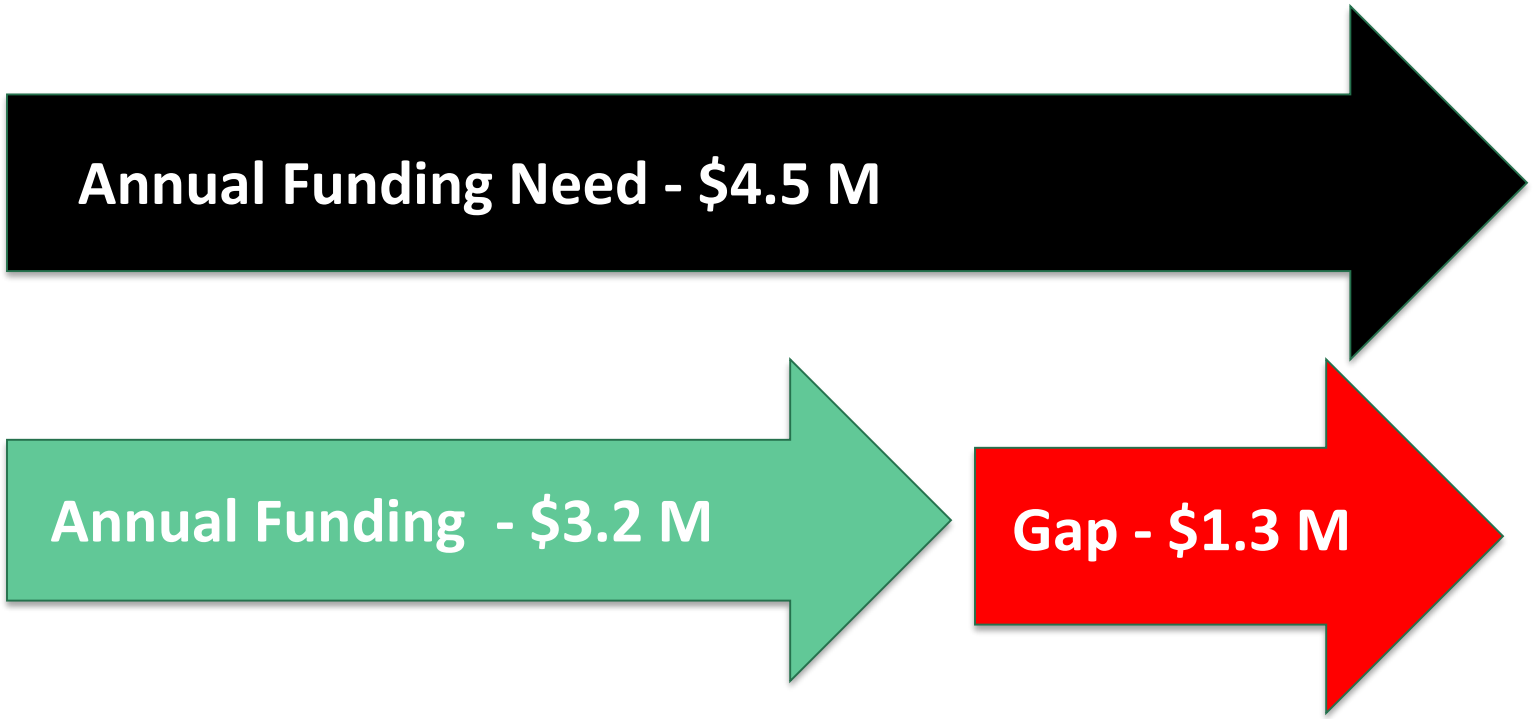


How Does the Gap get addressed?

Other Funding Options/Sources

- Increase general fund
- Bonding
- Assessments
- Wheelage/sales tax
- State Aid/federal funding
- Franchise fees

QUESTIONS?

Contact:

Amy Grothaus, PE
Braun Intertec
651.261.7122
agrothaus@braunintertec.com

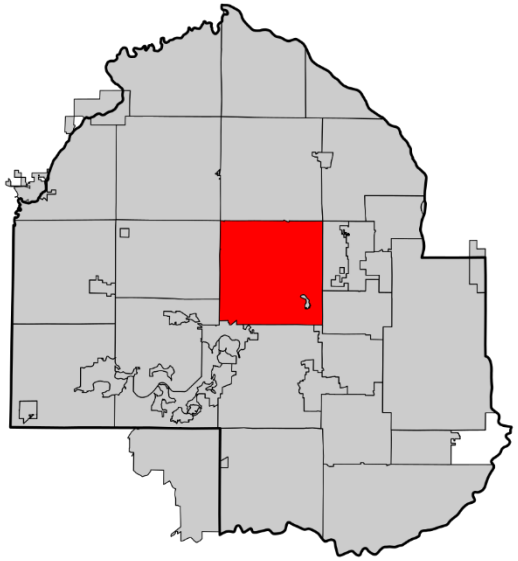
CEAM Annual Conference

Pavement Management & Maintenance – January 26, 2022

City of Plymouth

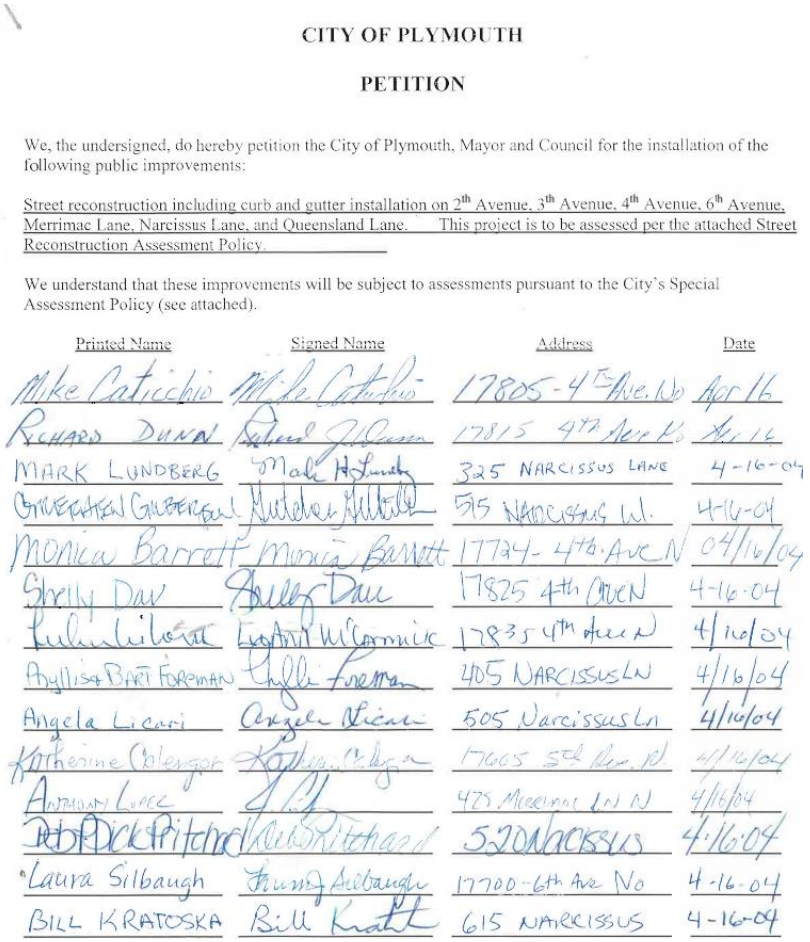
Background Information

- Population – 81,026
- 35 square miles
- 329 centerline miles of city streets



History of Pavement Management

- 1987 – Start of Program
  - Focused on street reconstruction and pavement work
    - Not reconstruction as practiced today
- Early 2000's
  - Pavement condition deteriorated
  - 36 petitions mailed between 2002 and 2005
    - Many turned into street reconstruction projects
  - Began mill and overlays
  - Implemented ICON street rating system



CITY OF PLYMOUTH

PETITION

We, the undersigned, do hereby petition the City of Plymouth, Mayor and Council for the installation of the following public improvements:

Street reconstruction including curb and gutter installation on 2th Avenue, 3th Avenue, 4th Avenue, 6th Avenue, Merrimac Lane, Narcissus Lane, and Queensland Lane. This project is to be assessed per the attached Street Reconstruction Assessment Policy.

We understand that these improvements will be subject to assessments pursuant to the City's Special Assessment Policy (see attached).

Printed Name	Signed Name	Address	Date
Mike Caticchio	Mike Caticchio	17805-4th Ave. No	Apr 16
RICHARD DUNN	Richard J. Dunn	17815 4th Ave No	Apr 16
MARK LUNDBERG	Mark H Lundberg	325 NARCISSUS LANE	4-16-04
GWENDALEN GUTBERGEL	Gwendalen Gutbergel	515 NARCISSUS LN.	4-16-04
Monica Barrett	Monica Barrett	17724-4th Ave N	04/16/04
Shelly Dau	Shelly Dau	17825 4th Ave N	4-16-04
[illegible]	[illegible] McCormick	17835 4th Ave N	4/16/04
Phyllis Bart Foreman	Phyllis Foreman	405 NARCISSUS LN	4/16/04
Angela Licari	Angela Licari	505 Narcissus Ln	4/16/04
Katherine Colergor	Katherine Colergor	17605 5th Ave N	4/16/04
Anthony Lopez	[illegible]	475 Merrimac Ln N	4/16/04
Rick Pitchford	Rick Pitchford	520 NARCISSUS	4/16/04
Laura Silbaugh	Laura Silbaugh	17700-6th Ave No	4-16-04
BILL KRATOSKA	Bill Kratoska	615 NARCISSUS	4-16-04

History of Pavement Management

- 2005 – “Mix of Fixes”
  - Pavement condition was a concern
  - Pavement rating was 6.6 – Direction to obtain 7.0
  - Introduced temporary overlays & expanded seal coat program

- 2010 – Pavement Management 2010 & Beyond
  - Funding for reconstruction tripled between 2005 & 2010
  - Pavement ratings decreased to 6.0
  - Increased mill & overlay and reconstruct streets that need it

History of Pavement Management

- 2016 – Update on Mill & Overlay Program
  - Ratings increased to 7.4

- 2018 – State of the Streets
  - Consultant analyzed street network, history, and practices
  - Provide recommendations for program moving forward
  - Add full depth reclamation (FDR) & fog seal program
  - Pavement rating goal of 7.5

Maintenance & Repair Procedures

- Pothole Patching
- Crack Sealing
  - 3-5 years after mill and overlay
  - 10-15 years after new construction, reconstruction, FDR
  - 410,000 LF in 2021
  - In-house and contracted forces
- Fog Sealing
  - 2-3 Years after new construction, reconstruction, FDR, or mill & overlay with engineered section
  - 7-10 Year review and perform if needed
  - 20,000 gal in 2021

Maintenance & Repair Procedures

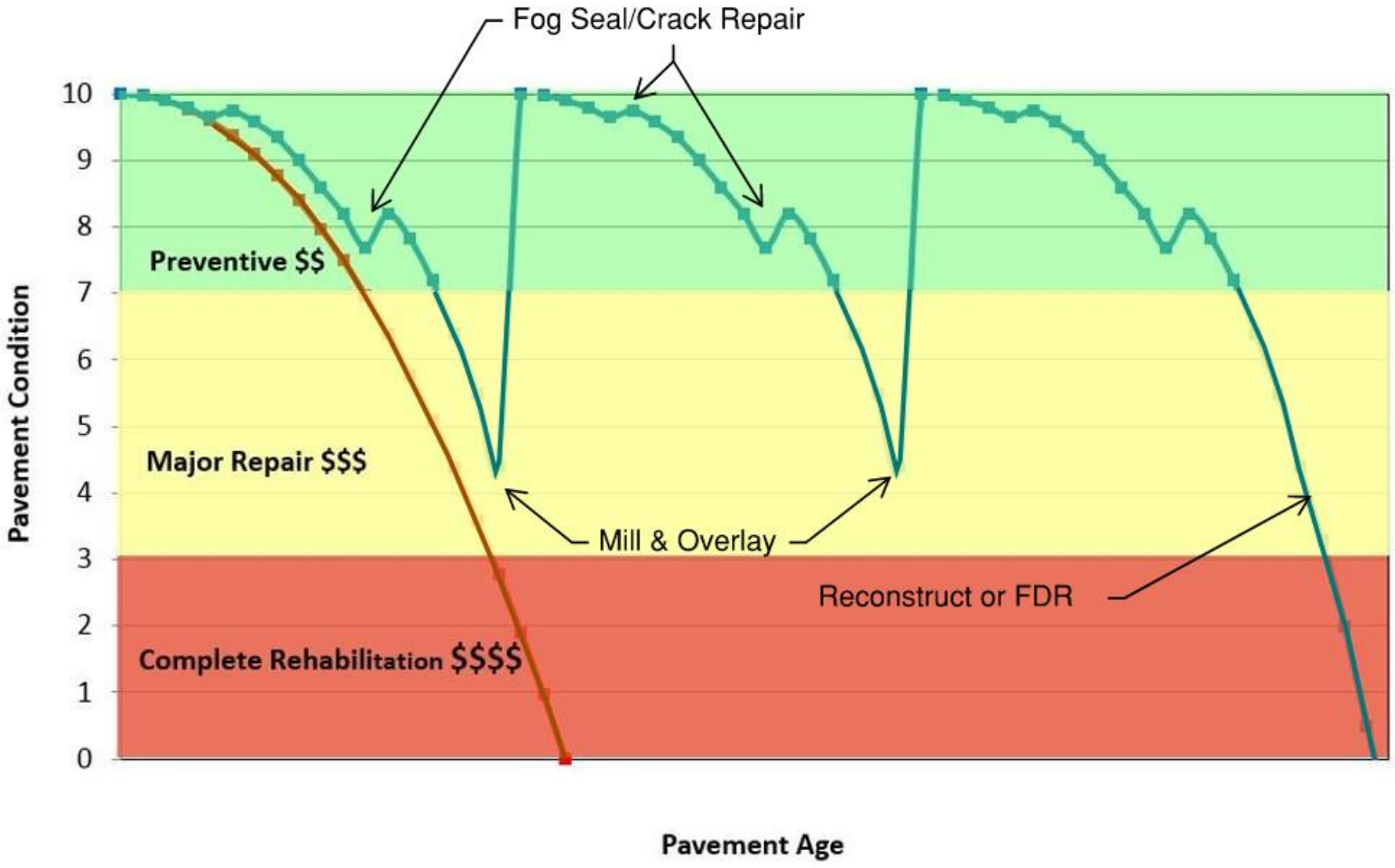
- Mill and Overlay
  - Edge mill & full width mill
  - 15-20 Years after construction/reconstruction
  - 10-15 Years after 1st overlay
  - 6.1 miles in 2021
  - In-house and contracted forces

- Full Depth Reclamation (FDR)
  - Streets that need more than mill & overlay
  - Already have concrete curb & gutter & don’t require major utility work
  - Geotechnical investigation
  - 3.4 miles in 2021

Maintenance & Repair Procedures

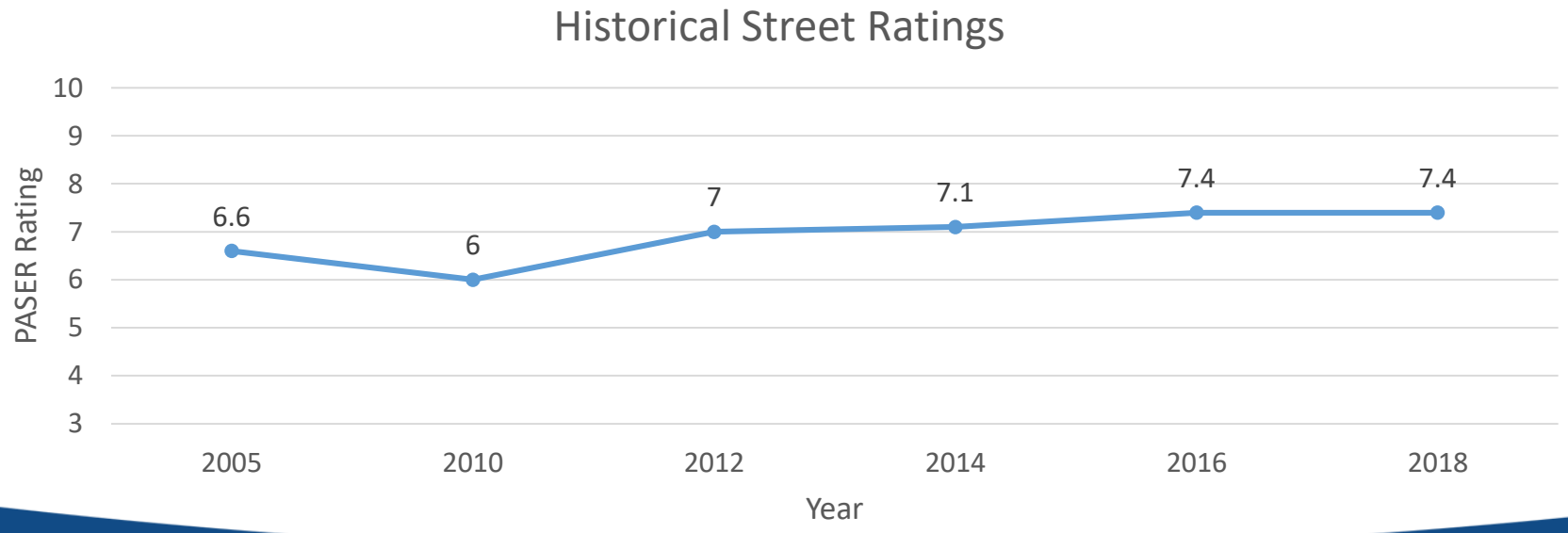
- Reconstruction
  - Street ratings 4 or less
  - Streets without concrete curb and gutter
  - Streets with utility issues
  - Long term reconstruction plan
  - 3.8 miles in 2021

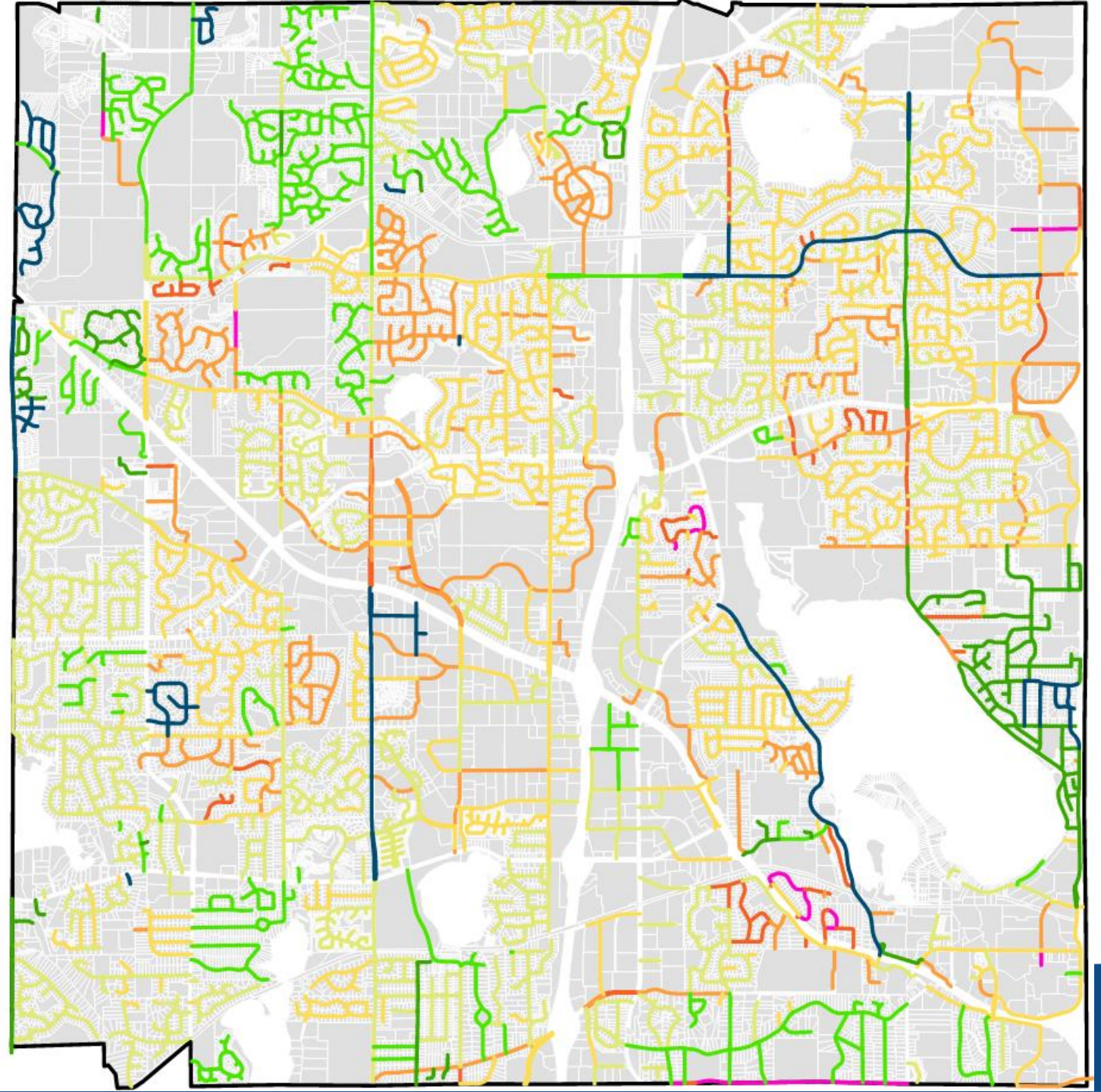
Pavement Life Cycle



Street Ratings

- Pavement Surface Evaluation & Rating System (PASER)
  - Implemented in 2010
  - 1-10 System
  - Easy/quick implementation and maintenance
  - Rate streets every 2 years





2020 Street Ratings

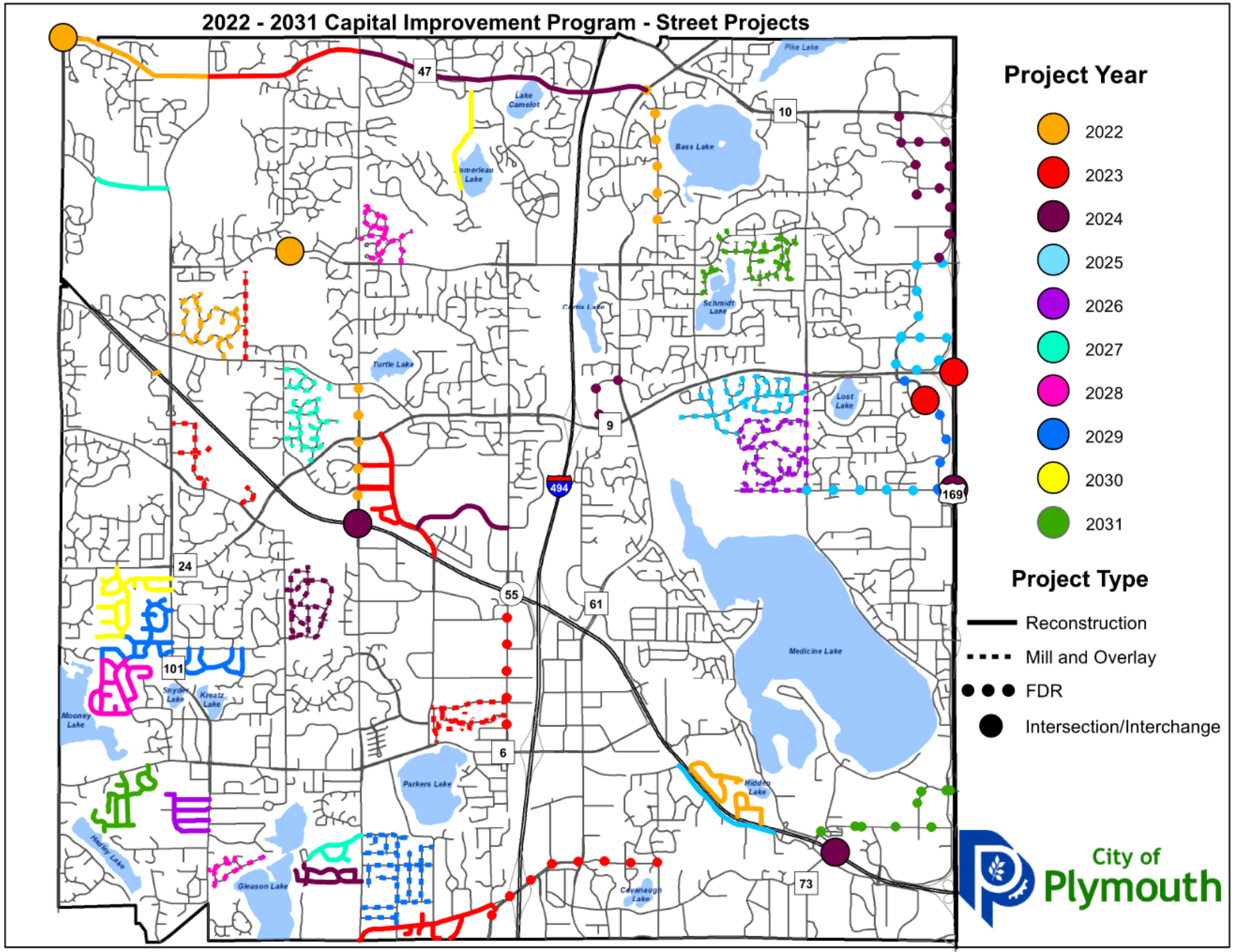
Paser Rating

- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10

Capital Improvement Program

- 10 Year Program
- Updated Yearly
- Projects 1-3 years out are set
  - Remaining projects are flexible to account for changes in pavement performance
- 2022 – 2031 CIP - $194,235,000

Capital Improvement Program



Funding

- Levy
  - Street Reconstruction Fund
  - Street Maintenance Budget
- State Aid
- Franchise Fees
- Special Assessments
- Utility Funds
  - Utility replacement with street reconstruction
- Bonding
- Other Agencies

Questions

- Mike Payne, PE
  - Assistant City Engineer
  - mpayne@plymouthmn.gov
  - (763) 509-5538

HENNEPIN COUNTY

MINNESOTA

Hennepin County Pavement Management Program

Transportation Operations, Trudy Elsner, Program Management

Transit and Transportation network

Road and bridge

- 2,200 lane miles
- 148 bridges*

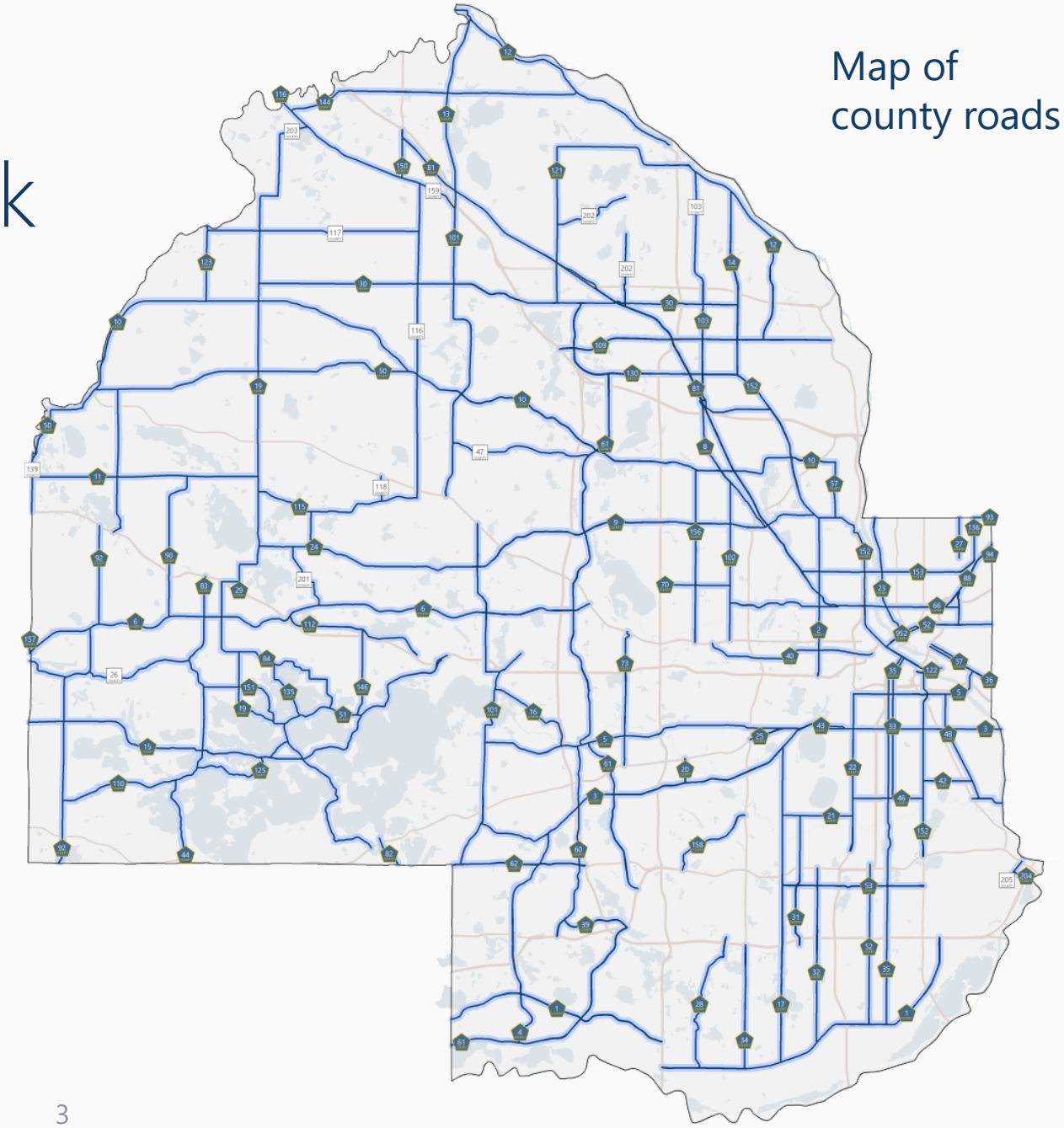
* does not include 34 HCRRA bridges

Bike and pedestrian

- 810 bikeway miles
- 400 sidewalk miles

Transit

- 90 transit routes on system
- 20 miles of transitways/LRT



Map of county roads

Hennepin County

2020 Highway System Statistics

Square miles in Hennepin County	**607**
Population of Hennepin County (2017)	**1.25 M**
Number of cities in the county	**45**
Number of county owned roads	**95**
System wide PSR (ride rating)	**3.18**
System wide PCI (pavement condition)	**65**
System wide PQI (pavement quality)	**64**

ROADWAYS

Hennepin County	**Center Line Miles**		**Lane Miles**	
	570		**2,214**	
County State Aid Highway (CSAH)	532	93%	2,105	95%
County Roads (CO RD)	38	7%	109	5%
Urban roadways	326	57%	1,394	63%
Rural roadways	244	43%	820	37%

Pavement type	**Center Line Miles**		**Lane Miles**	
Bituminous	504	88%	1,901	86%
Bituminous over concrete	47	8%	213	10%
Concrete	9	1%	57	2%
Concrete bridges	10	1%	43	2%

Age of county road system	**Center Line Miles**		**Lane Miles**	
50 years and older	283	50%	923	42%
40 to 49 years	39	7%	170	7%
20 to 39 years	134	23%	596	27%
Younger than 20 years	114	20%	525	24%

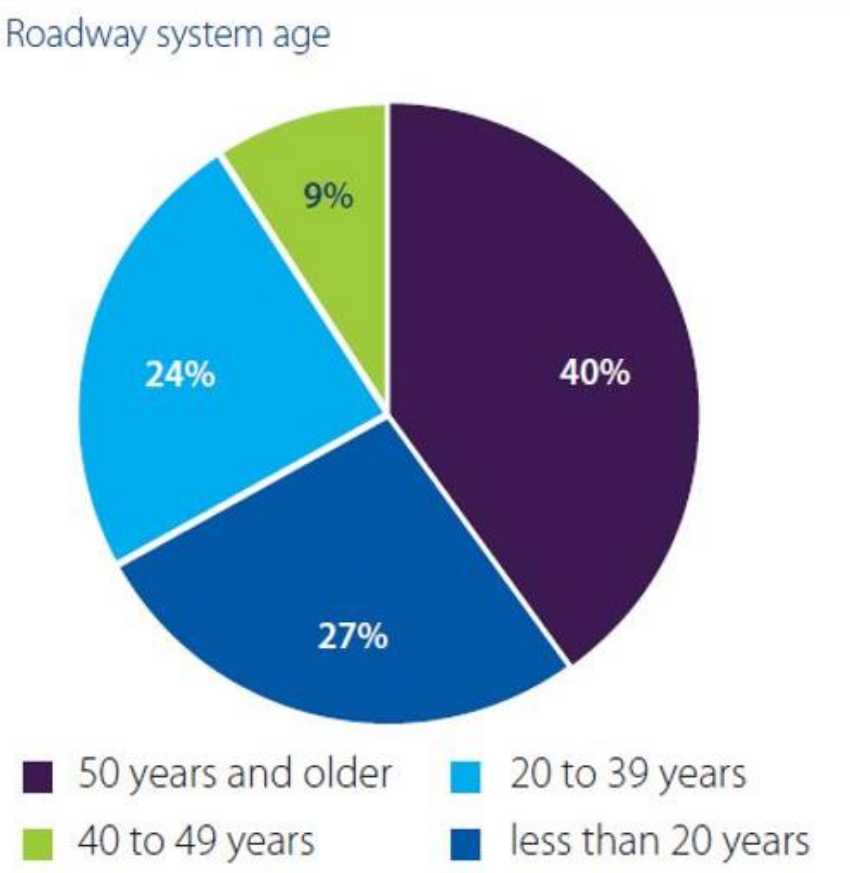
* Age of road system includes bridges

Roadway type	**Center Line Miles**		**Lane Miles**	
Miles of two-lane roadway	332	58%	1,047	47%
Miles of multi-lane roadway	238	42%	1,167	53%

Hennepin County Roads

2,214 Lane Miles (LM) or 570 centerline miles

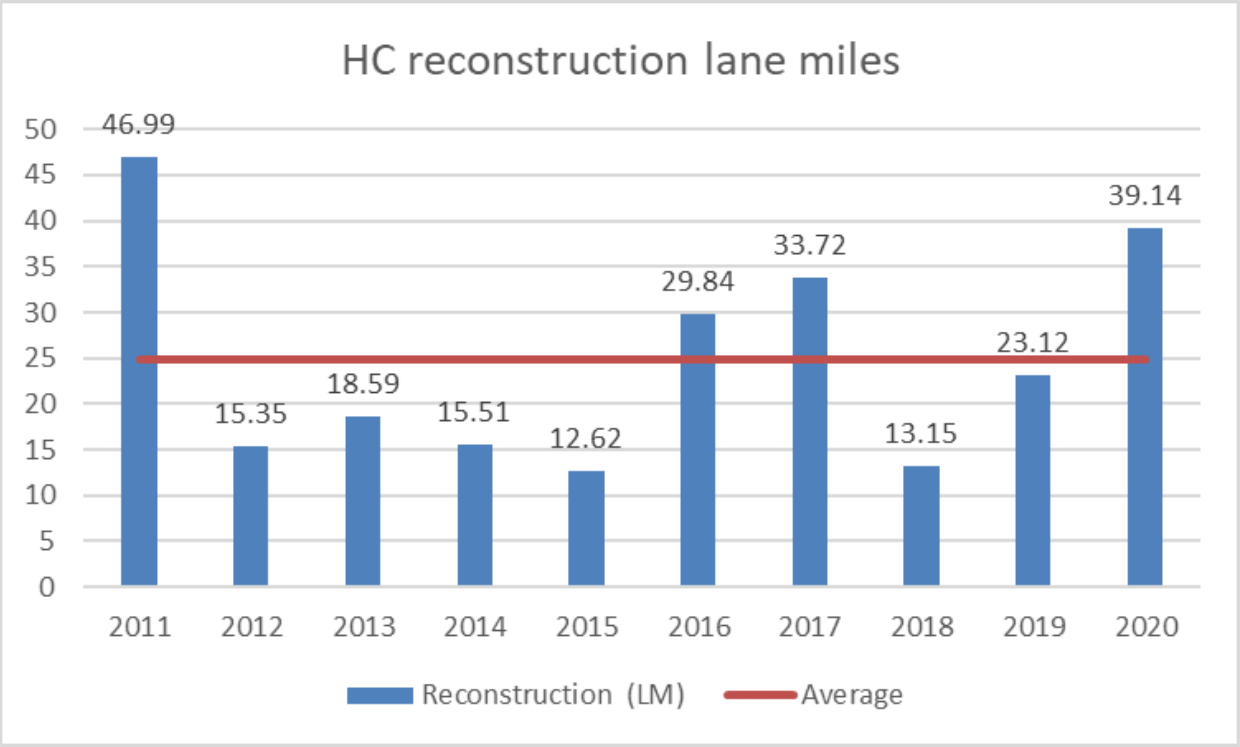
- 2,105 LM CSAH and 109 LM Co Rd
- 2,114 LM Bituminous and 100 LM Concrete
- 63% Urban and 37% Rural
- 73% of HC roads have an ADT over 5,000
- 42% over 50 years old and another 7% over 40 years old (1,093 LM)



Pavement reconstruction

- Reconstruction varies year to year

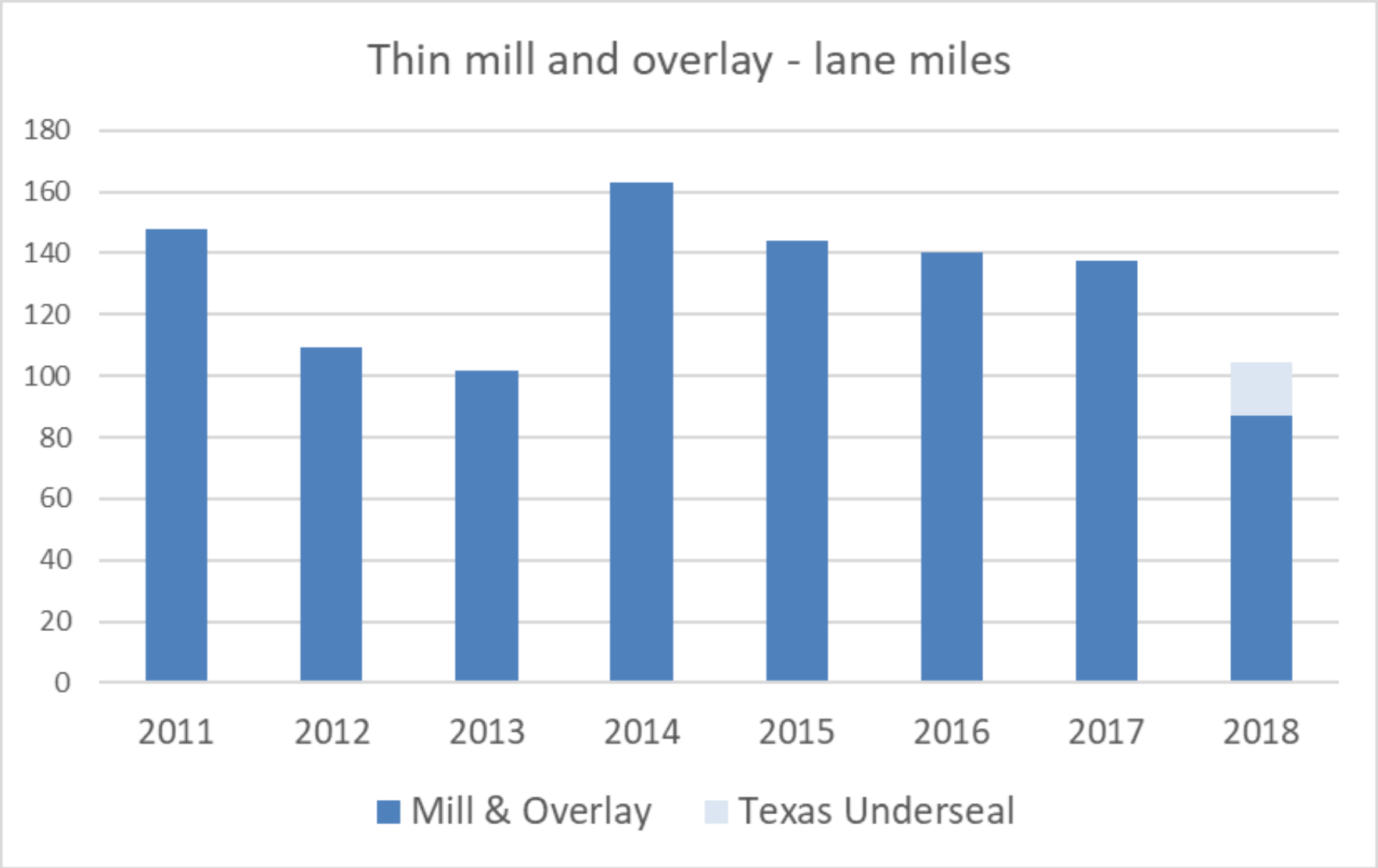
  10-year average is just under 25 lane miles per year

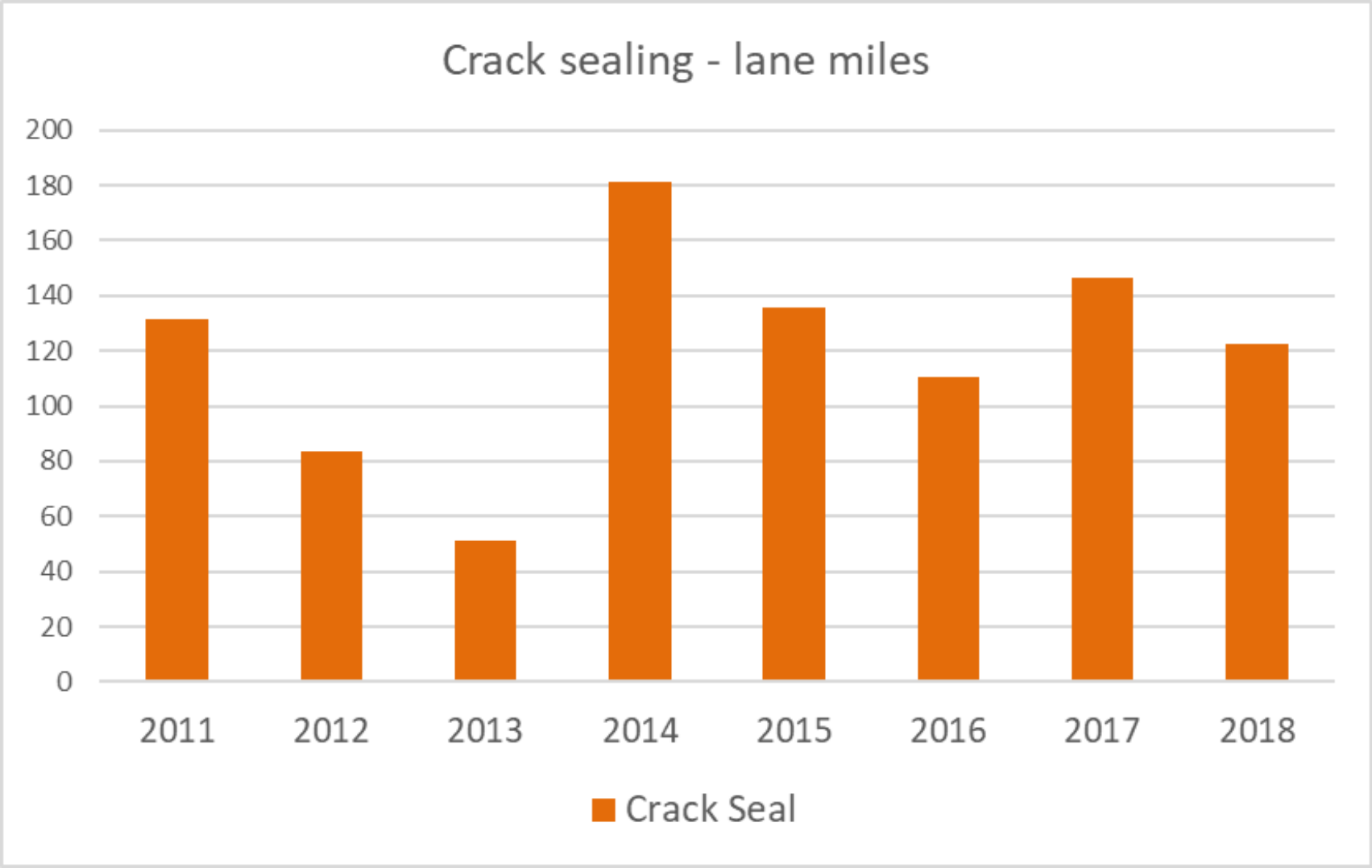


Pavement management - asphalt

- Strategy prior to 2018

Reconstruct Thin mill and overlay Crack seal


Thin mill and overlay - lane miles
180
160
140
120
100
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
2018
Mill & Overlay
Texas Underseal


Crack sealing - lane miles
200
180
160
140
120
100
80
60
40
20
0
2011
2012
2013
2014
2015
2016
2017
2018
Crack Seal

Pavement data

- Pavement Condition Index (PCI)
  - Overall condition and cracking – scale of 0-100
- Pavement Serviceability Rating (PSR)
  - Ride – scale of 0-5
  - County target is to have 67% good (3.0) or better
- Last pavement treatment

Preservation

- Keep good roads in good condition using all the treatment options
  - Crack sealing
  - Chip seals
  - Micro surfacing
  - Cape seals
  - Ultra thin bonded wear course
  - Mill and overlay
  - Texas underseal

Rehabilitation

- Needed more information…
  - Ground penetrating radar
  - Cores and borings
  - Falling weight deflectometer testing
  - MnPAVE designs for rehab strategy
- Options
  - Cold in-place recycling (CIR)
  - Hot in-place recycling (HIR)
  - Full depth reclamation (FDR)
  - Stabilized FDR (SFDR)

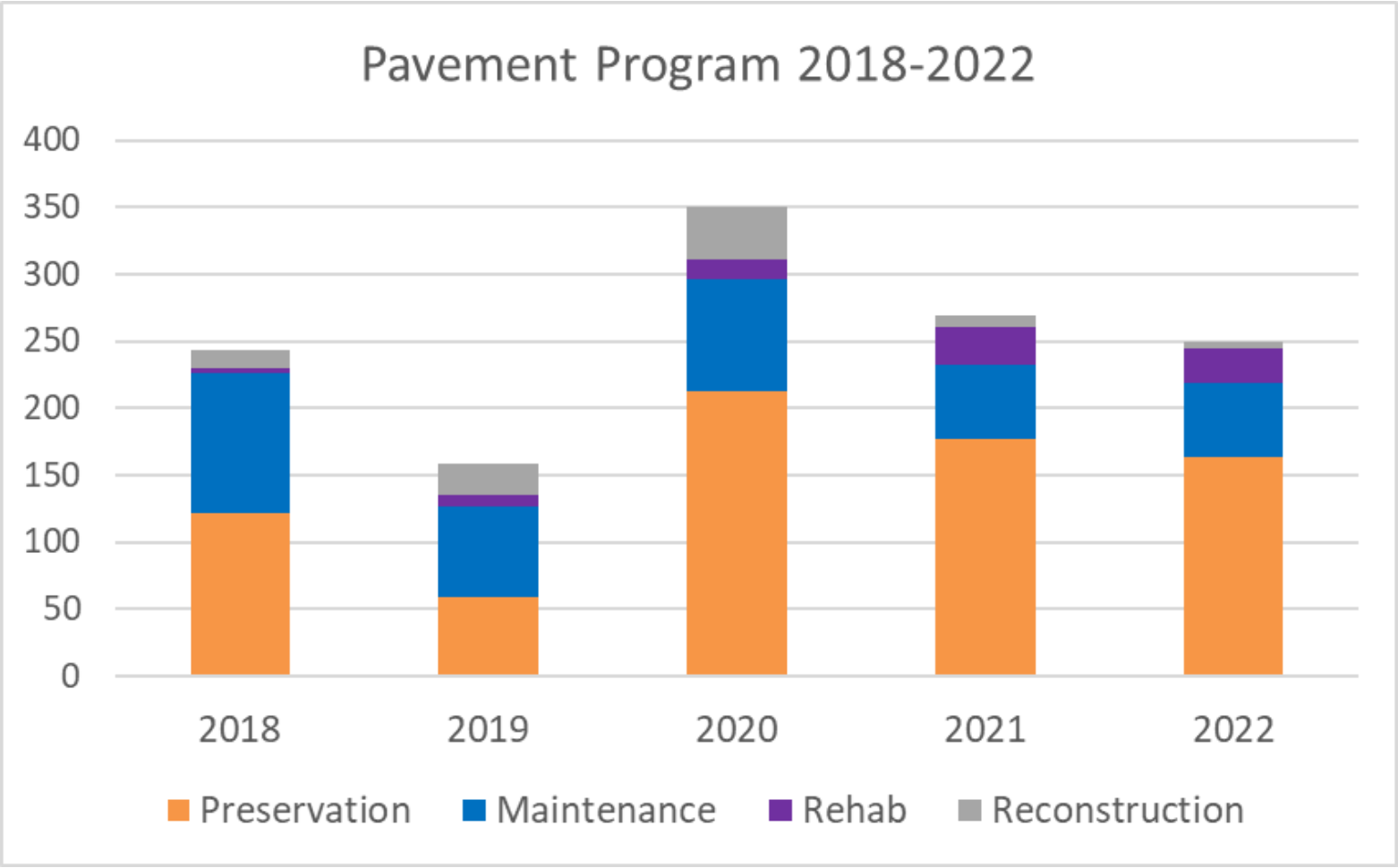
Incremental change

- 2018 - Added Texas underseals to M/O program
- 2019 - Added chip seals, micro surfacing, first CIR
- 2020 – Continued with chip seals, micro surfacing, first SFDR/FDR

Mill Street, CSAH 82 – Texas underseal

Current pavement program

LANE MILES TREATED	2020	2021	*2022*
Mill & Overlay	79	52	*35*
Crack Seal	127	114	*140*
Texas Underseal	0	3	*11*
Chip Seal	64	44	*24*
Micro Surfacing	21	19	*0*
UTBWC	4	0	*9*
Concrete Rehab	0	0	*14*
CIR	0	11	*12*
FDR/SFDR	15	18	*0*
Reconstruction	39	8	*5*
Total	350	269	*249*


Pavement Program 2018-2022
400
350
300
250
200
150
100
50
0
2018
2019
2020
2021
2022
Preservation
Maintenance
Rehab
Reconstruction

Rebecca Park Trail, CSAH 50
Cold In-place Recycling (CIR)

County Road 92, CSAH 92
Stabilized Full Depth Reclamation (SFDR)

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Questions