

City Of Milwaukee Pavement Management System Implementation



June 25, 2015

PAVEMENT MANAGEMENT CONCEPTS

Pavement Management is an integral a part of an overall Asset Management Strategy for the City

Sets out to answer key questions with respect to the City's road network:

- What do we have?
- What condition is it in?
- What level of funding is required to maintain it?
- What are the priorities?

Pavement Management System -assist staff in development of yearly rehabilitation programs

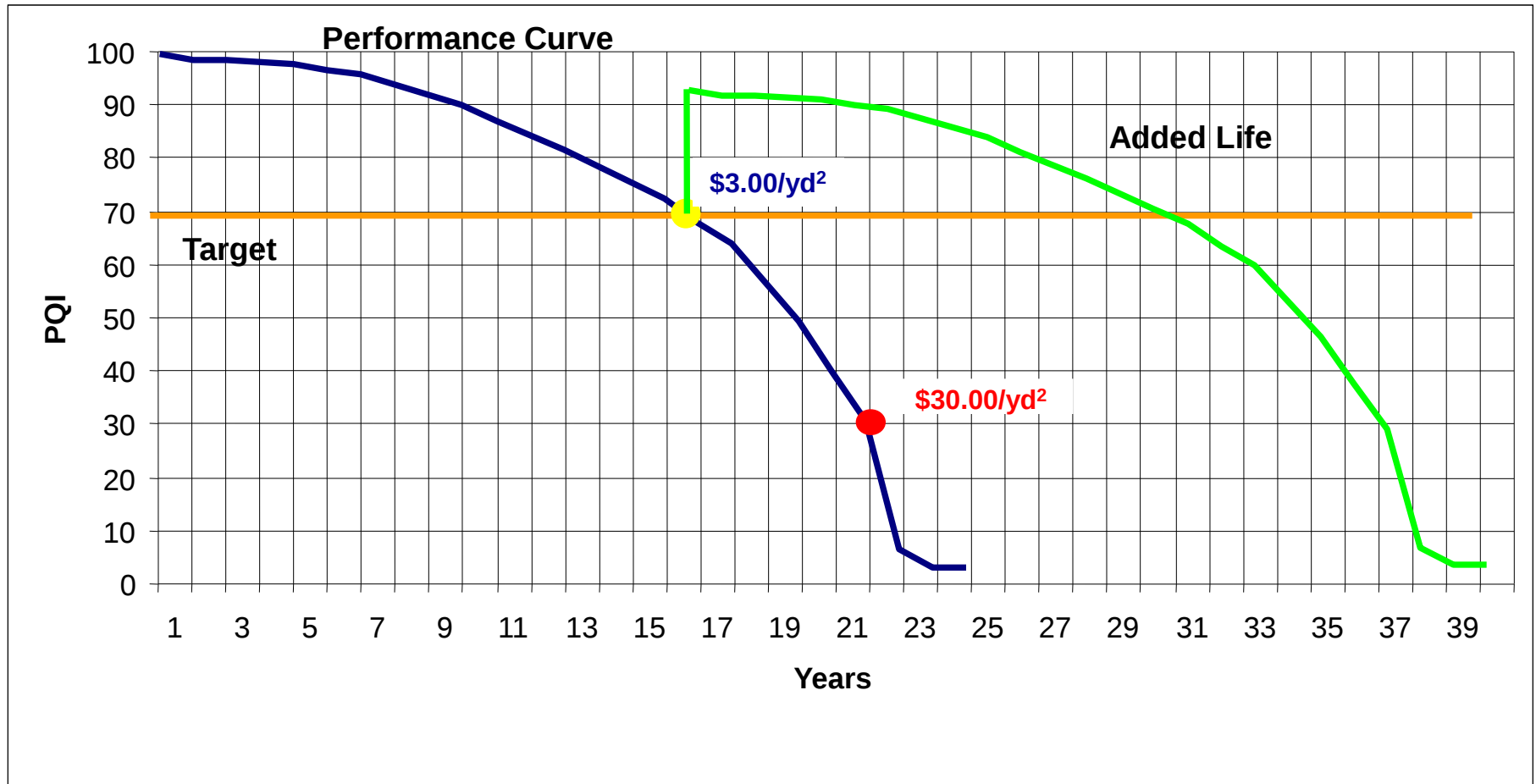
PAVEMENT MANAGEMENT REALITY

Roads make up a large portion of a City's infrastructure and thus its annual capital and operating expenditures

Pavements will continue to deteriorate due to various factors:

- Deficiencies in construction materials and practices
- Environmental and climatic conditions
- Traffic loading
- Funding

WHY DO PAVEMENT MANAGEMENT?



ROADMATRIX PAVEMENT MANAGEMENT SYSTEM

Computer based software system

Uses field data for qualitative assessment

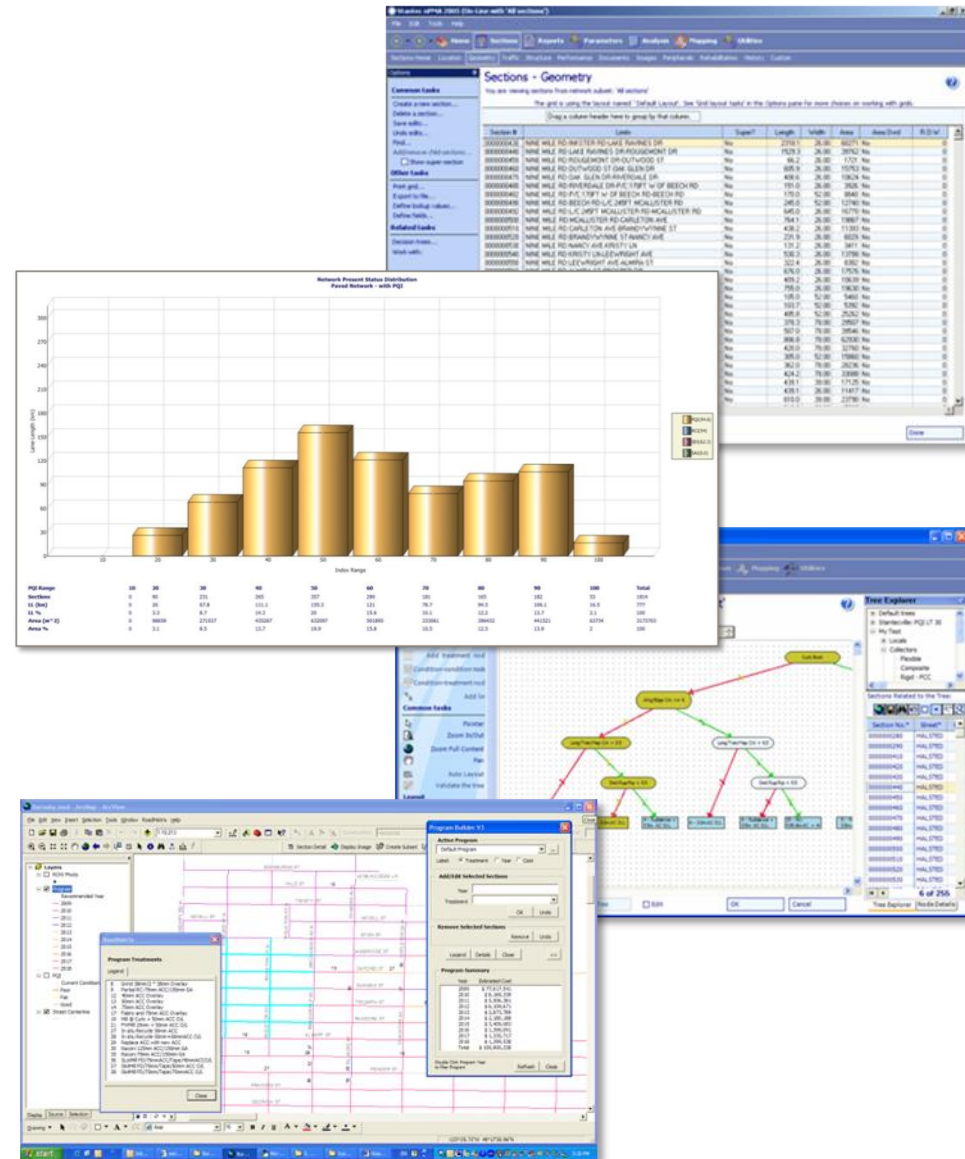
Stores road network data, including:

- pavement condition
- parametric data (e.g. traffic volumes, pavement material types/thickness)
- historical information (completed projects)

Models pavement deterioration and predicts future performance

Assesses rehabilitation needs

Prioritizes rehabilitation work based on budget scenarios



ROADMATRIX PAVEMENT MANAGEMENT SYSTEM – PAVING PROGRAM

DPW - Project Programming maintains a database of street and alley locations that are in need of improvement.

- Potential paving project locations are obtained from the Pavement Management Analysis - RoadMatrix
- Locations which are viewed due to REQUESTS

Resident

Business

Alderpersion

City engineering

City field operations

RoadMatrix program planning tools

- Assesses rehabilitation needs
- Prioritizes rehabilitation work based on budget scenarios
- Create Programs in RoadMatrix
 - What if program scenarios – monetary limits, condition goals, rehabilitation choices
 - Propose and approve – possibly several iterations
 - Commit program projects – store work history, update rating and plan next stage

MILWAUKEE ROADMATRIX EVOLUTION

- Pavement Management System (PMS)
 - Created in the late 1980's
 - Several iterations of enhancements
- SuperPMA system implemented the 1990's
- 2012 upgrade to RoadMatrix software
 - Introduced a new road segment definition (DIME)
 - Reconcile old data with new framework – On going
- Pavement Condition Rating Surveys
 - 1993 1996-97 2000-01 2006-07

WHAT HAPPENED IN 2013-2014

- **Pavement condition data collection on entire road network and additional various State/ County roads (approximately 1700 CL miles)**
 - Pavement ratings are part of submittal requirements to the Wisconsin Department of Transportation
- **High-resolution digital images collected on the entire network**
- **Pavement Management System Review was completed in order to maximize the return on investment**
 - System setup/configuration assistance
 - Training
 - Database integrity
 - Summary Report

PAVEMENT CONDITION DATA COLLECTION



RT3000 Survey Vehicle

DATA COLLECTION DEMO

November 2013



PAVEMENT CONDITION DATA COLLECTION

Surface Defects

Visual and automated keyboard computer entry

Roughness/Rutting - Laser sensors

Images – every 16 feet, total over 1.25 million

GPS – data recorded with GPS and assigned to the proper road segments as defined in the DIME file

Survey – One pass on 2-3 lane roads

Divided or 4-lanes or more - two passes

SURFACE DISTRESSES

Asphalt Rating System		Portland Rating System	
Distress Description	Abbrev. ϕ	Distress Description	Abbrev. ϕ
Patching (ACC)	Pat	Patching (PCC)	Pat
Rippling & Shoving	Rip	Scaling	Sca
Raveling & Streaking	Rav	Raveling (PCC)	Rav
Flushing & Bleeding	Flu	Polishing	Pol
Deformation & Distortions	Dis	Distortion, Frost Heave, Depress	Dis
Excessive Crown	Exc	Corner 'C' & 'D' Cracking	DCr
Progressive Edge Cracking	Edg	Coarse Aggregate Loss	CAL
Alligator Cracking	Alg	Potholes (PCC)	Pot
Potholes (ACC)	Pot	Joint Sealant Loss	JSL
Map Cracking	Map	Linear Cracking (PCC)	LCr
Longitudinal Cracking	Lon	Transverse Cracking (PCC)	TCr
Transverse Cracks (ACC)	Trn	Joint Spalling	Spl
Wheel Track Rutting	Rut	Joint Faulting/Stepping	Flt

SURFACE DISTRESSES

Example alligator cracking

Slight < - - - - > Moderate < - - - - > Severe

Moderate



Severe



SURFACE DISTRESSES

Example Rutting

Slight < - - - - > Moderate < - - - - > Severe

Moderate

Severe



SURFACE DISTRESSES

Example Faulting/Joint Stepping

Slight < - - - - > Moderate < - - - - > Severe

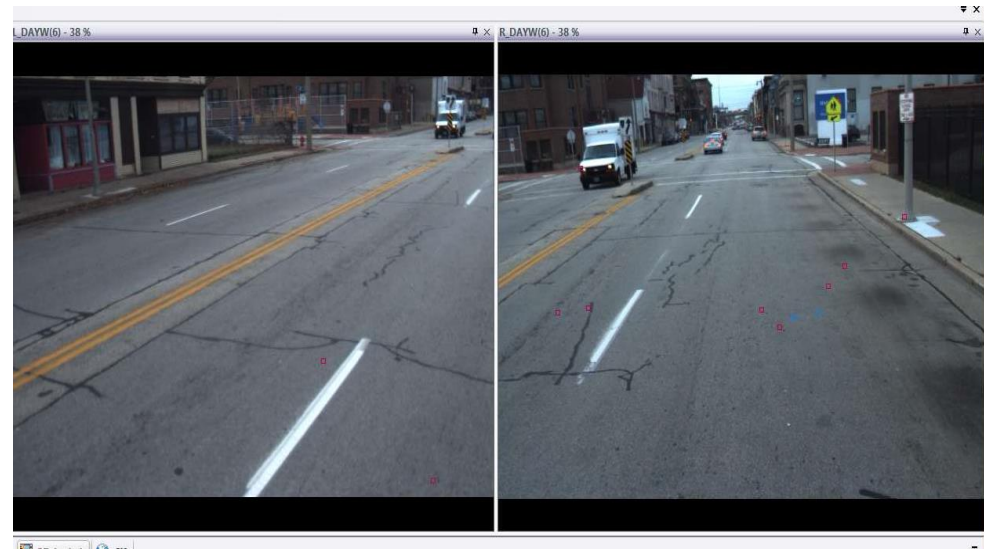
Moderate

Severe

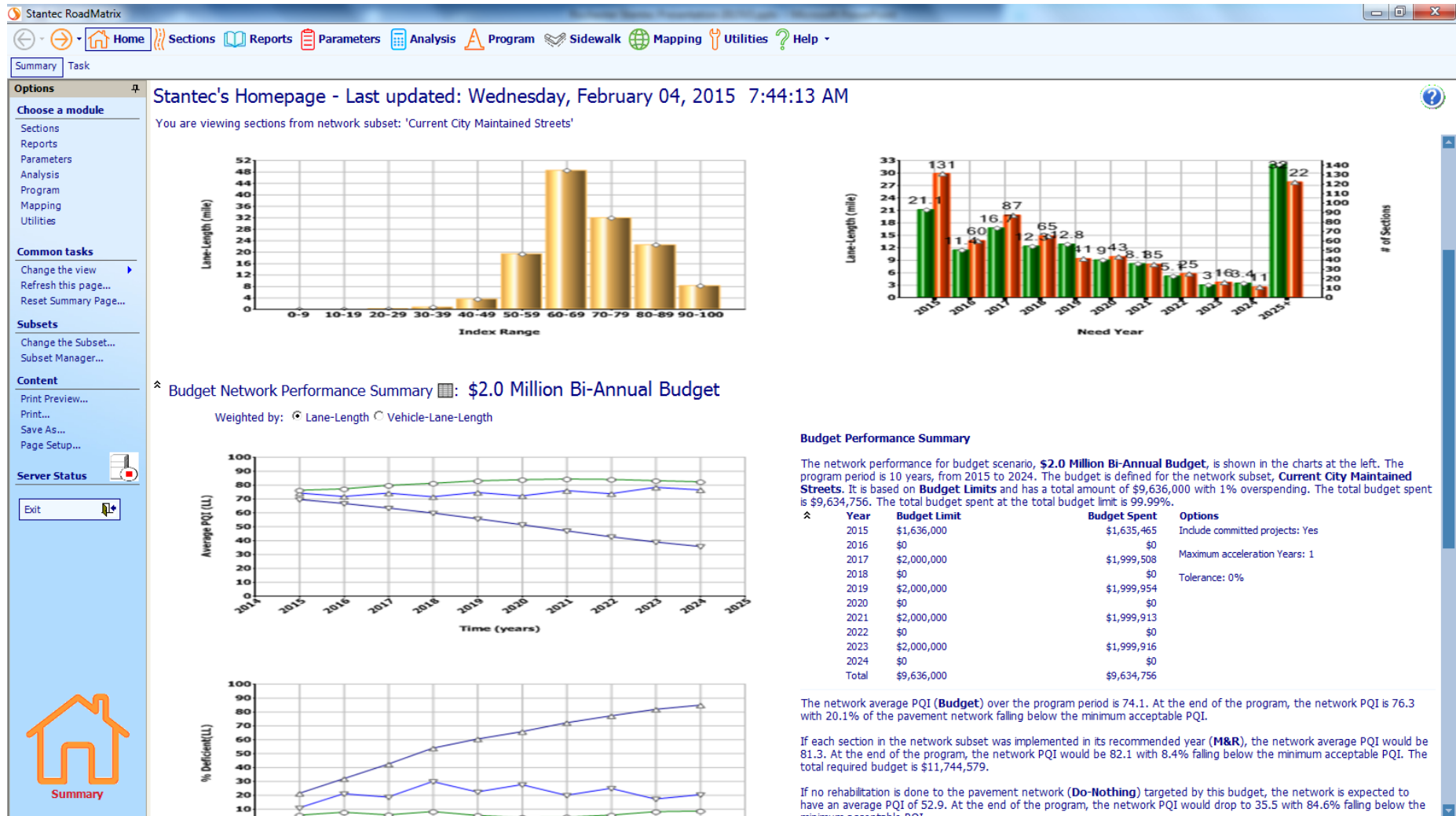


STREET VIEW IMAGES

- Provides a virtual drive through of City streets
- Review pavement condition and confirm/update road attributes
- Digital record - Legal



ROADMATRIX



ATTRIBUTES

Home

Sections

Reports

Parameters

Analysis

Program

Sidewalk

Mapping

Utilities

Help

Sections

Home

Location

Geometry

Traffic

Structure

Performance

Survey

Documents

Images

Peripherals

Rehabilitation

History

Custom

Assets

Options

Common tasks

Copy a section...

Delete a section...

Save edits...

Undo edits...

Find and Replace...

Show super-section

Highlight Analysis Fields

Other tasks

Print grid...

Export to file...

Define lookup values...

Define fields...

Related tasks

Decision trees...

Show location...

Pavement types...

Layer types...

Subsets

Change the subset...

Go to subset manager

Refresh grid data...

Grid layout

Add / Remove columns

Modify column headers

Save grid layout as...

Choose layout

Expand All

Collapse All

Sections - Structure

You are viewing sections from network subset: 'City Maintained Local Collector'

Drag a column header here to group by that column.

Search From*

Section #	Sort Field	Street Name	From*	To*	PaveType	Layer 1 - Surface	Thick1	EF1	Layer 2	Thick2	EF2	EGT	EGT Ovr
21060	20,102	W EUCLID AV	CENSUS BOUNDARY	S 30TH ST	Rigid	Pcc	7	3	None/Not	0	0	21	N
21061	20,100	W EUCLID AV	S 31ST ST	CENSUS BOUNDARY	Composite	Ac	3	2	Pcc	7	3	27	N
21062	20,090	W EUCLID AV	S 32ND ST	S 31ST ST	Composite	Ac	3	2	Pcc	7	3	27	N
21063	20,780	W EUCLID AV	S 39TH ST	S 38TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21064	20,770	W EUCLID AV	S 40TH ST	S 39TH ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21035	19,370	W EUCLID AV	S 7TH ST	S 6TH ST	Flexible	Ac	3	2	Surface tr	1	1.25	13.25	N
21036	19,360	W EUCLID AV	S 8TH ST	S 7TH ST	Flexible	Ac	3	2	Surface tr	1	1.25	13.25	N
21037	19,350	W EUCLID AV	S 9TH ST	S 8TH ST	Flexible	Ac	3	2	Surface tr	1	1.25	13.25	N
21038	19,340	W EUCLID AV	S 9TH PL	S 9TH ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21039	19,330	W EUCLID AV	S 10TH ST	S 9TH PL	Composite	Ac	3	2	Pcc	7	3	27	N
21055	20,140	W EUCLID AV	S 27TH ST	S 26TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21040	19,320	W EUCLID AV	S 11TH ST	S 10TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21041	19,310	W EUCLID AV	S 12TH ST	S 11TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21042	19,300	W EUCLID AV	S 13TH ST	S 12TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21043	19,290	W EUCLID AV	S 14TH ST	S 13TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21044	19,280	W EUCLID AV	S 15TH ST	S 14TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21045	19,270	W EUCLID AV	S 15TH PL	S 15TH ST	Composite	Ac	3	2	Pcc	7	3	27	N
21065	20,760	W EUCLID AV	S 41ST ST	S 40TH ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21066	20,750	W EUCLID AV	S 42ND ST	S 41ST ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21086	26,860	W EUCLID AV	S 97TH ST	S 98TH ST	Rigid	Pcc	7	3	None/Not	0	0	21	N
21078	23,542	W EUCLID AV	CUL-DE-SAC	S 63RD ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21079	23,530	W EUCLID AV	S 67TH CT	S 66TH ST	Flexible	Ac	3	2	Gravel	10	1	16	N
21080	23,522	W EUCLID AV	S 67TH ST	S 67TH CT	Flexible	Ac	3	2	Gravel	10	1	16	N
21082	23,510	W EUCLID AV	S 69TH ST	S 68TH ST	Flexible	Ac	2	2	Gravel	6	1	10	N
21073	22,610	W EUCLID AV	S 53RD ST	S 54TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21074	22,620	W EUCLID AV	S 54TH ST	S 55TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21075	22,630	W EUCLID AV	S 55TH ST	S 56TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21076	22,640	W EUCLID AV	S 56TH ST	S 57TH ST	Rigid	Pcc	8	3	None/Not	0	0	24	N
21077	22,650	W EUCLID AV	S 57TH ST	DEAD END	Rigid	Pcc	7	3	None/Not	0	0	21	N
21081	23,520	W EUCLID AV	S 68TH ST	S 67TH ST	Flexible	Ac	3	2	Gravel	10	1	16	N

PERFORMANCE INDICATORS

PQI (Pavement Quality Index)

- 0 - 100 scale (100 being ideal)
- indicator of overall level of service for a road section or network

PQI is calculated through a combination of:



RCI (Ride Comfort Index)

- based on collected profile measurements (IRI) and user perception of pavement roughness



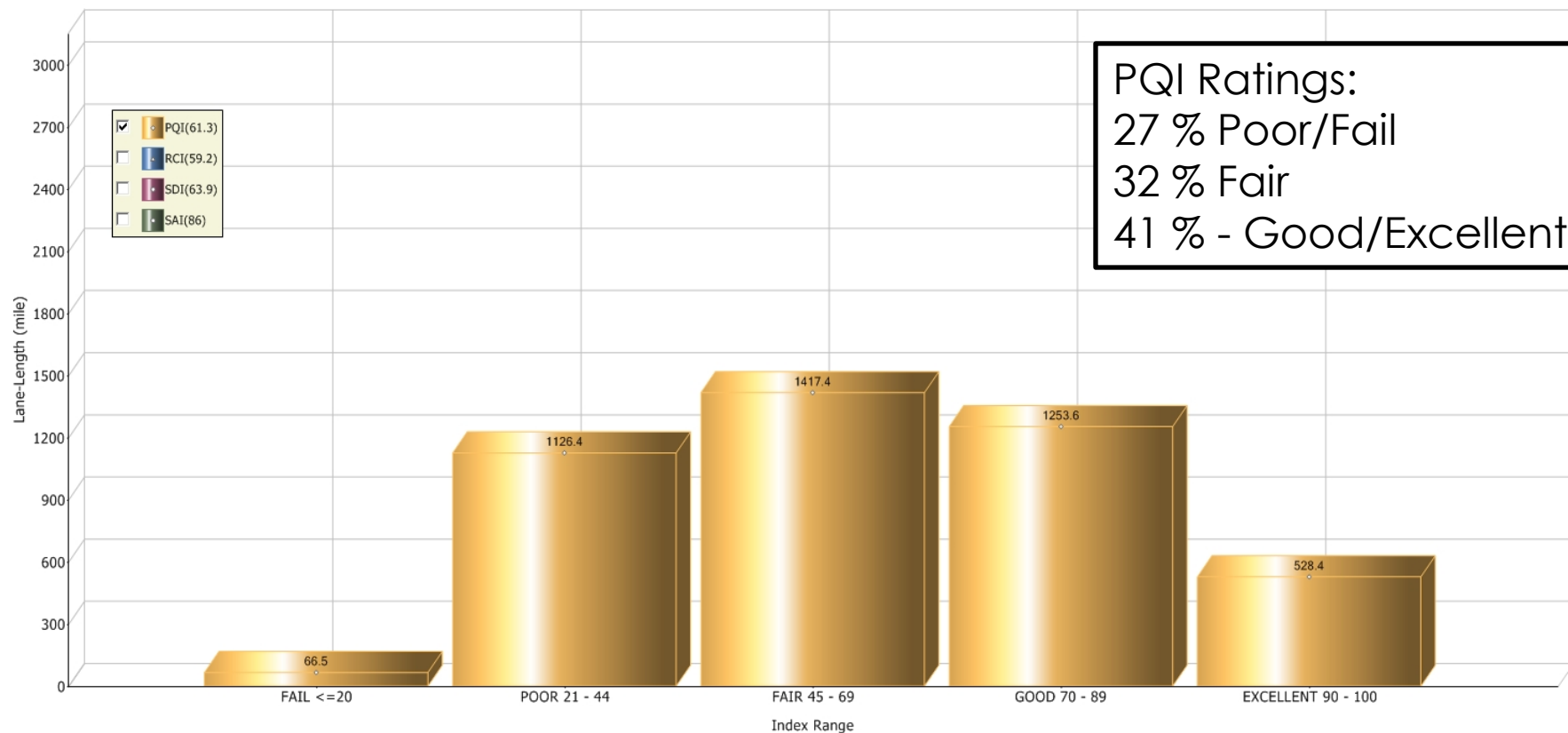
SDI (Surface Distress Index)

- measure of pavement surface deterioration from the distress ratings
- primary means of determining rehabilitation needs and strategies

RoadMatrix Reporting - Network Status

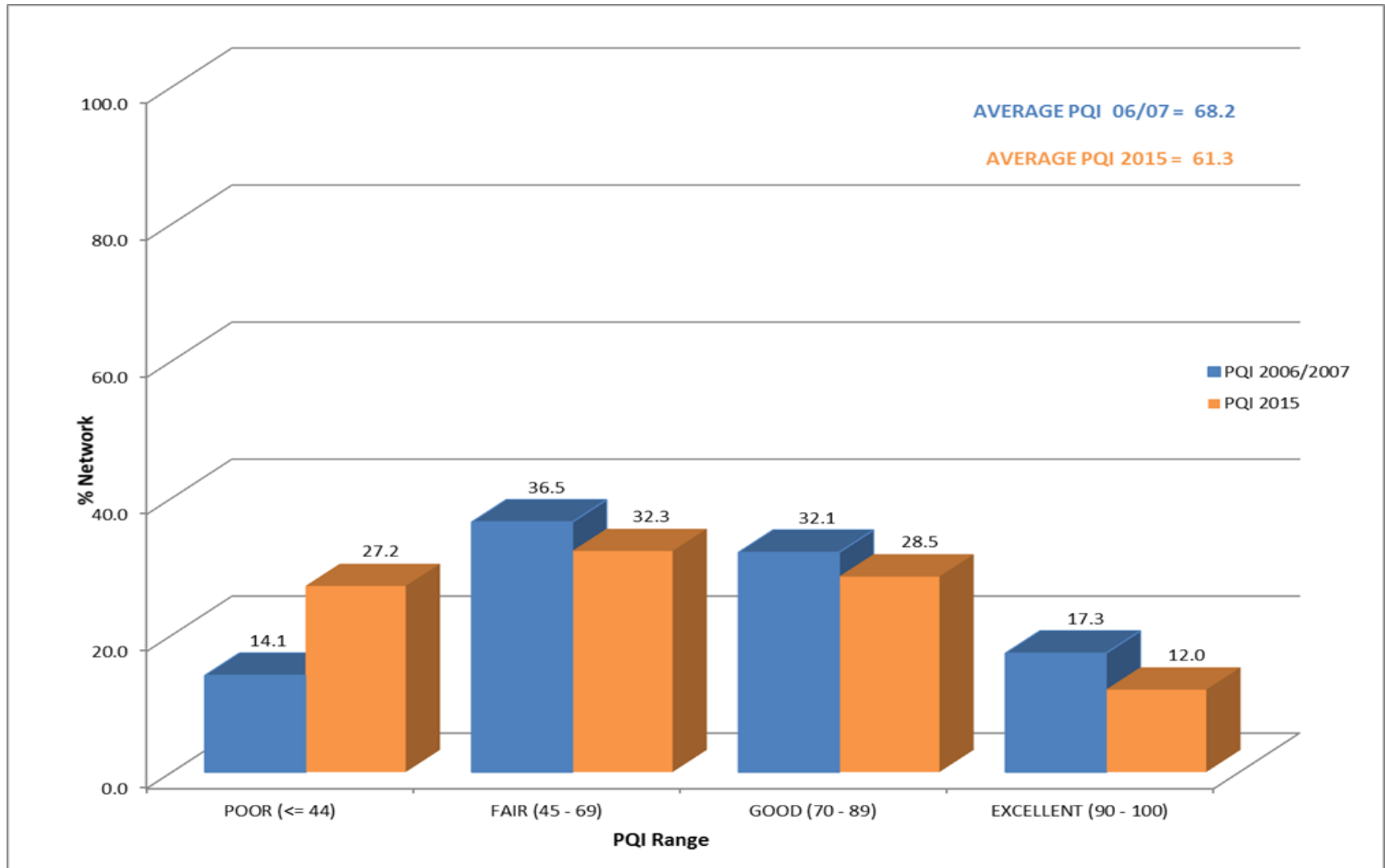
(City Maintained 2015 PQI)

Network Present Status Distribution - 2015 PQI
City Maintained



PQI Range	FAIL <=20	POOR 21 - 44	FAIR 45 - 69	GOOD 70 - 89	EXCELLENT 90 - 100	Total
Sections	271	4209	5380	5027	2081	16968
LL (mile)	66.5	1126.4	1417.4	1253.6	528.4	4392.3
LL %	1.5	25.6	32.3	28.5	12	100
Area (yd^2)	465984.2	7802604.9	9619008	8822445.7	3820230	30530272.8
Area %	1.5	25.6	31.5	28.9	12.5	100

PQI COMPARISON



Ratings 2006-07 and 2015 City Maintained – All

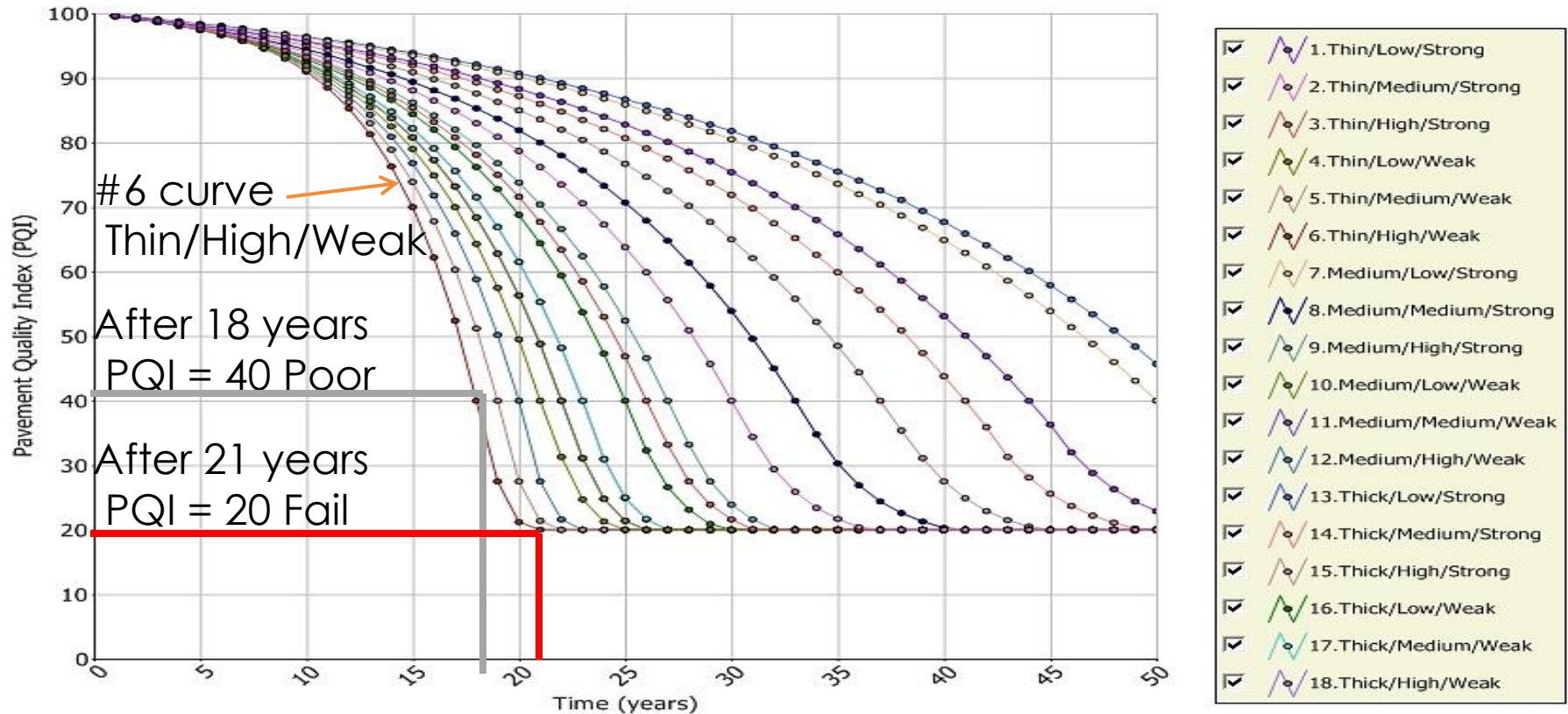
DETERIORATION MODELS

Predict how each road segment will perform over time using variations in levels of the pavement **thickness**, **traffic volume** and **subgrade strength**

Example

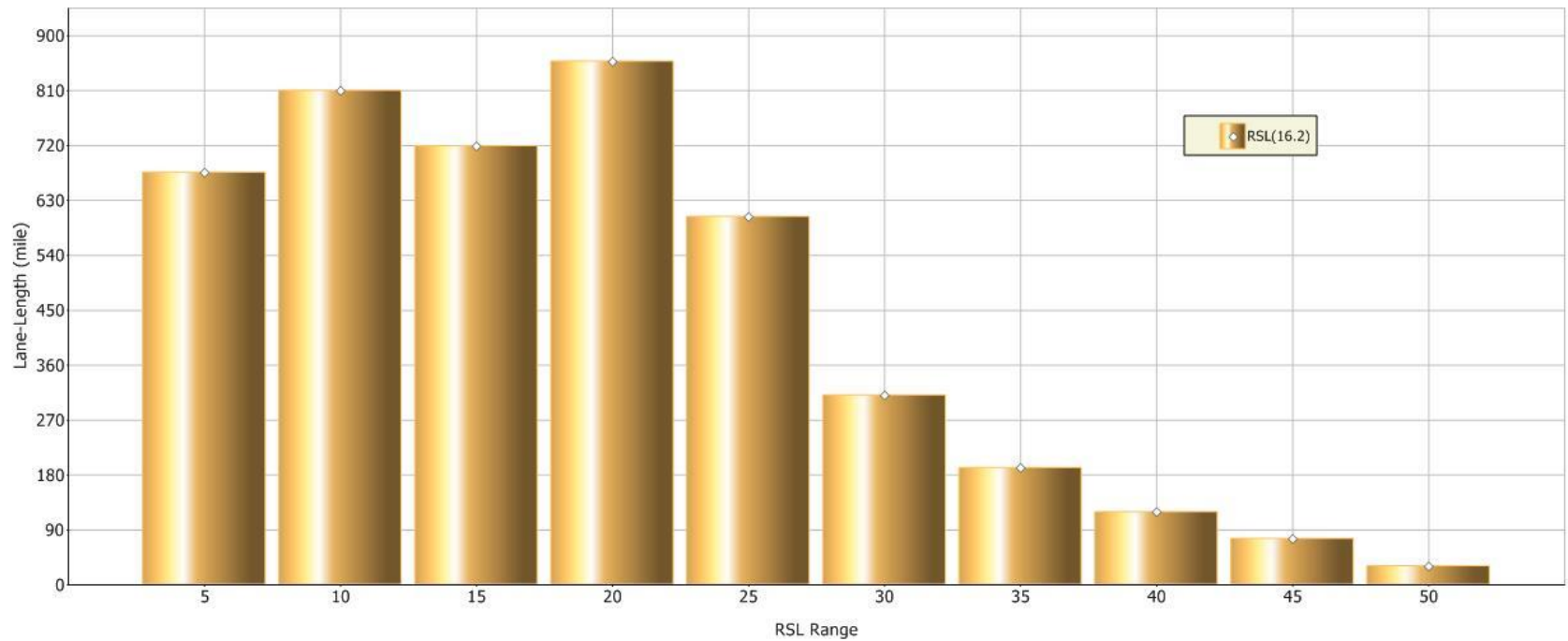
Local Road 18 curves

Pavement Performance Curves
PQI Set1 Local



REMAINING SERVICE LIFE

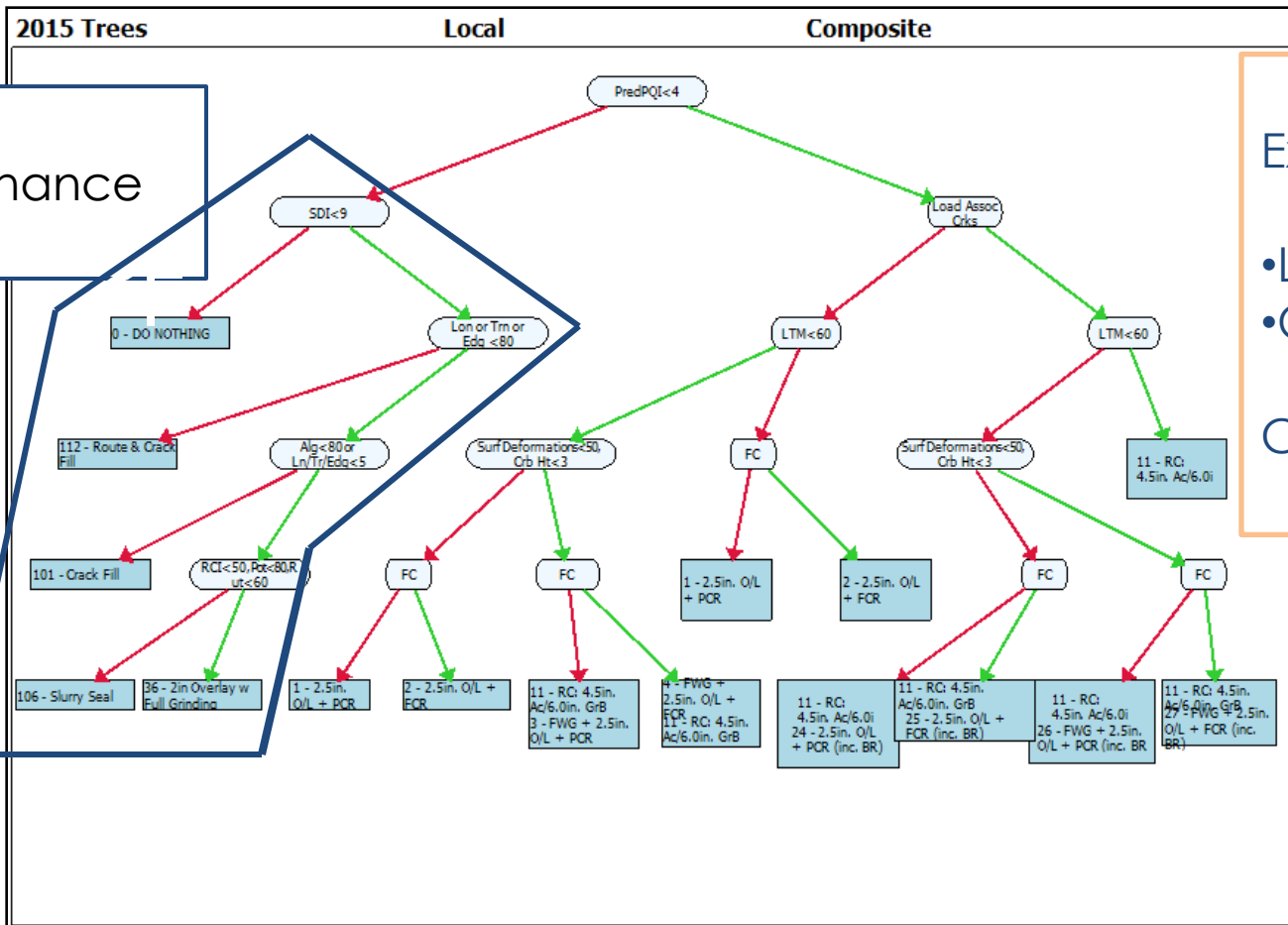
Network Remaining Service Life Distribution
City Maintained All



RSL Range	5	10	15	20	25	30	35	40	45	50	Total
Sections	2550	3013	2691	3342	2427	1256	800	494	282	110	16965
Lane-Length (mile)	675.6	809.9	718.9	857.5	603.1	310.5	191.7	119.3	75.4	30.3	4392.2
Lane-Length %	15.4	18.4	16.4	19.5	13.7	7.1	4.4	2.7	1.7	0.7	100
Area (yd^2)	4711107.9	5654730.8	4993807.4	5826608.2	4160892.6	2201205	1377003.2	861307.7	542895.4	200714.6	30530272.8
Area %	15.4	18.5	16.4	19.1	13.6	7.2	4.5	2.8	1.8	0.7	100

DECISION TREES

Rehabilitation and Maintenance Treatments

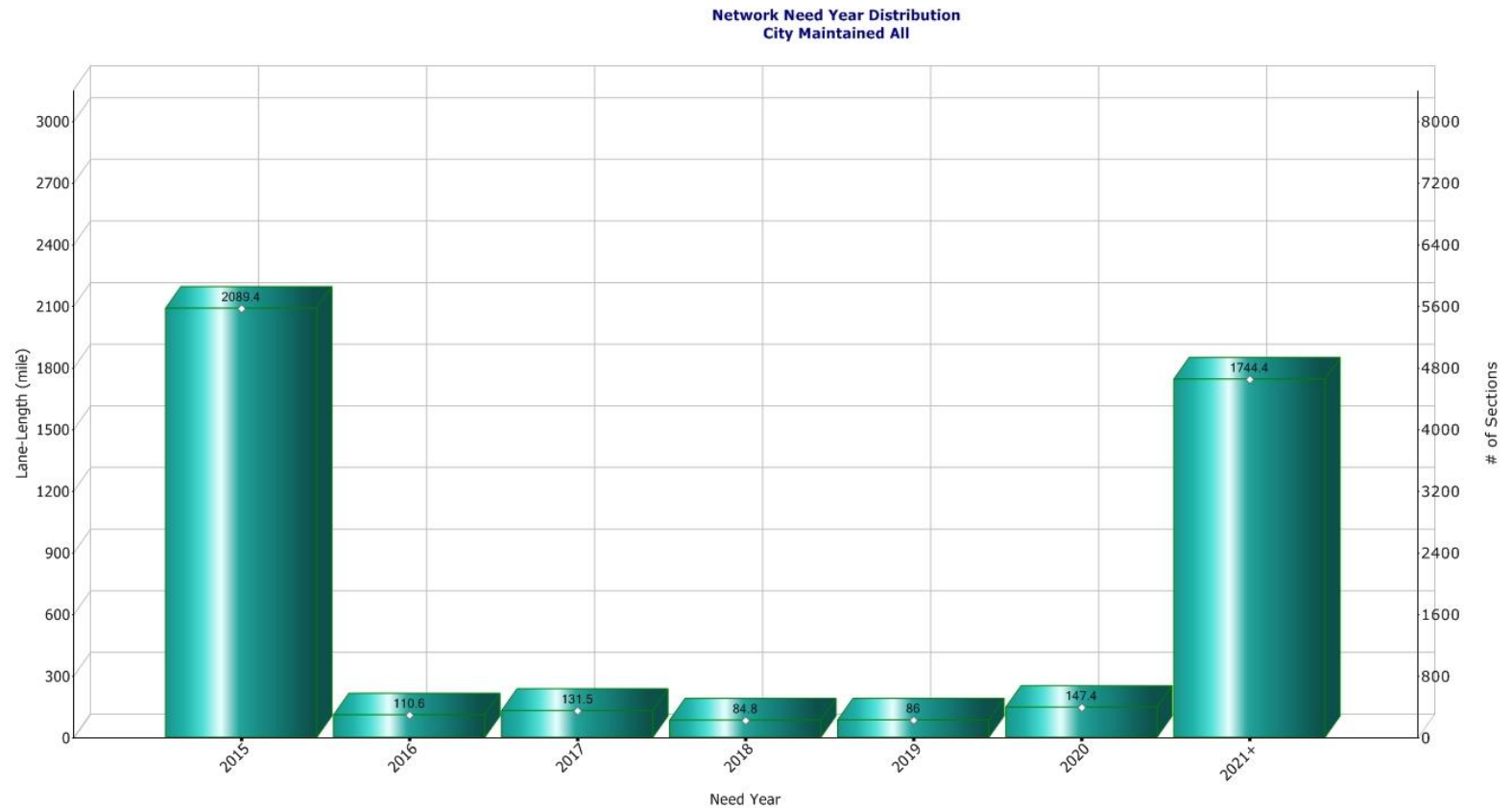


Street
maintenance
options

Example Tree

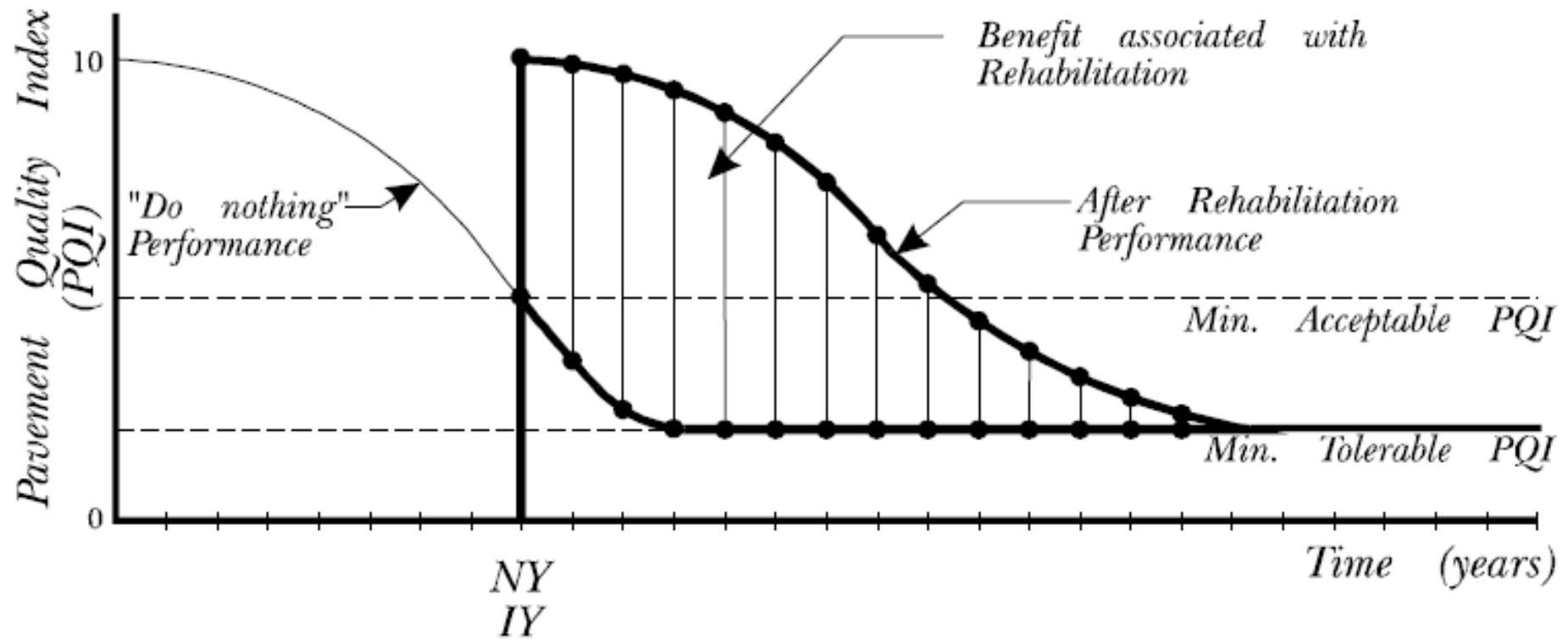
- Local Road
- Composite :
Asphalt on
Concrete

NEED YEAR DISTRIBUTION



Need Year	2015	2016	2017	2018	2019	2020	2021+	Total
Sections	7843	416	518	316	320	564	7008	16985
LL (mile)	2089.4	110.6	131.5	84.8	86	147.4	1744.4	4394.1
LL %	47.6	2.5	3	1.9	2	3.4	39.7	100
Area (yd^2)	14217348.2	791171.1	895443.8	615781.9	607260.4	1016687.6	12399468.4	30543161.4
Area %	46.5	2.6	2.9	2	2	3.3	40.6	100

COST EFFECTIVENESS



$$CE = \text{Benefit} / \text{Cost}$$

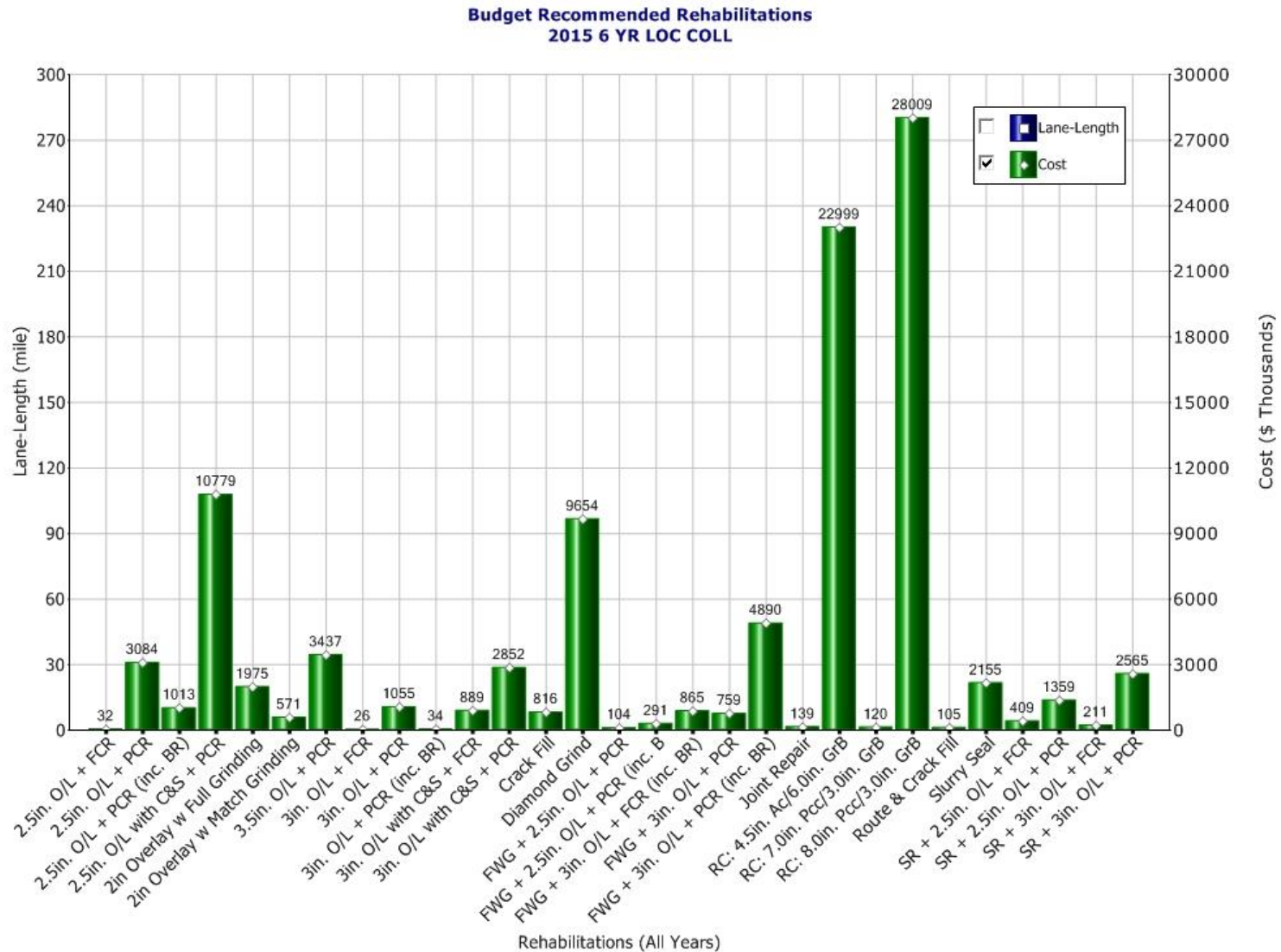
2015 - 6 YEAR BUDGET SCENARIO

YEAR	FUNDING
2015	\$14,700,000.00
2016	\$16,600,000.00
2017	\$14,600,000.00
2018	\$19,100,000.00
2019	\$17,100,000.00
2020	\$19,100,000.00

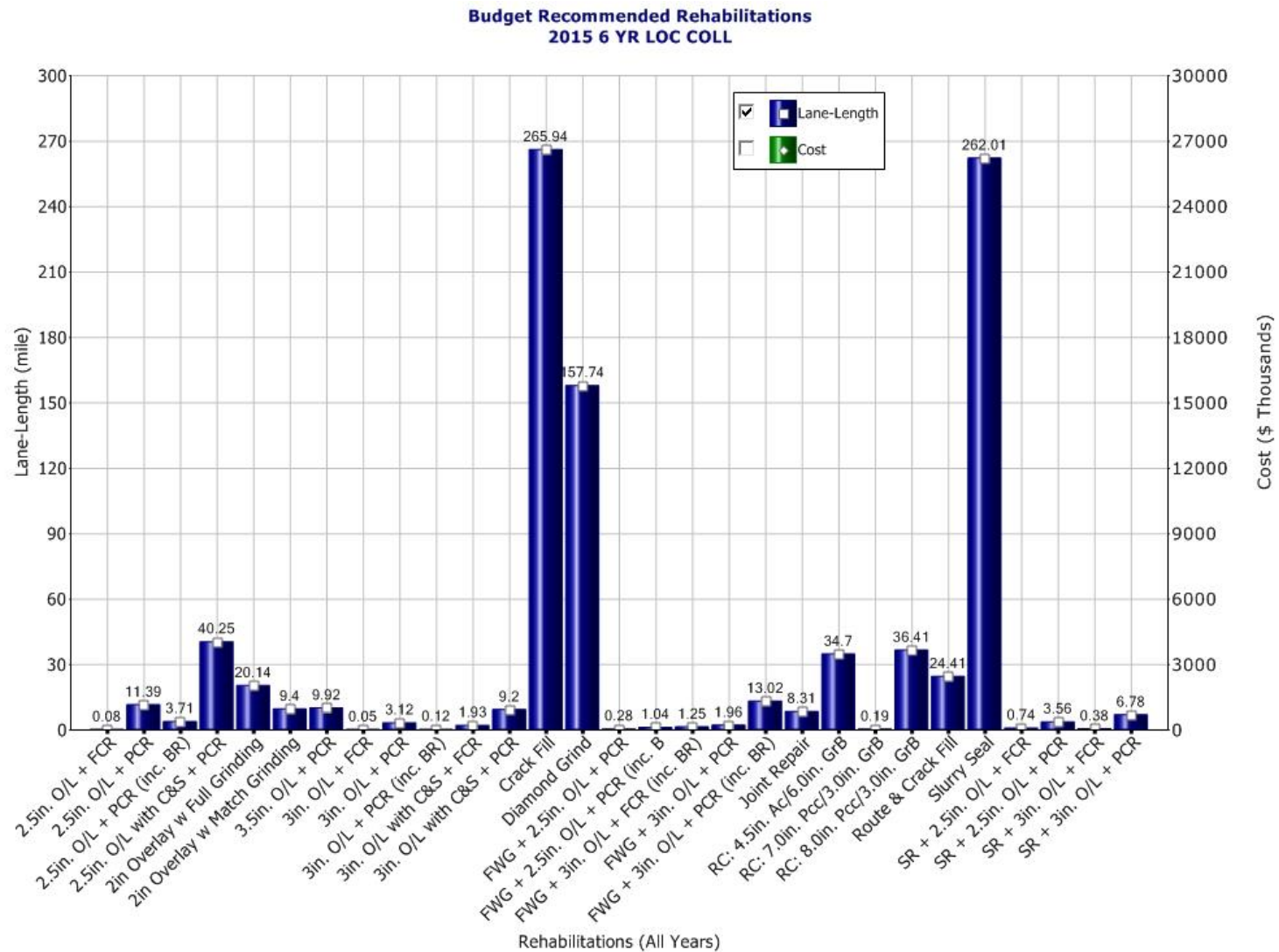
TOTAL \$101,200,000

CITY MAINTAINED – LOCAL AND COLLECTORS:
Includes Local, High Impact, LRIP, Maintenance

BUDGET RECOMMENDED TREATMENTS (COST, All Years)

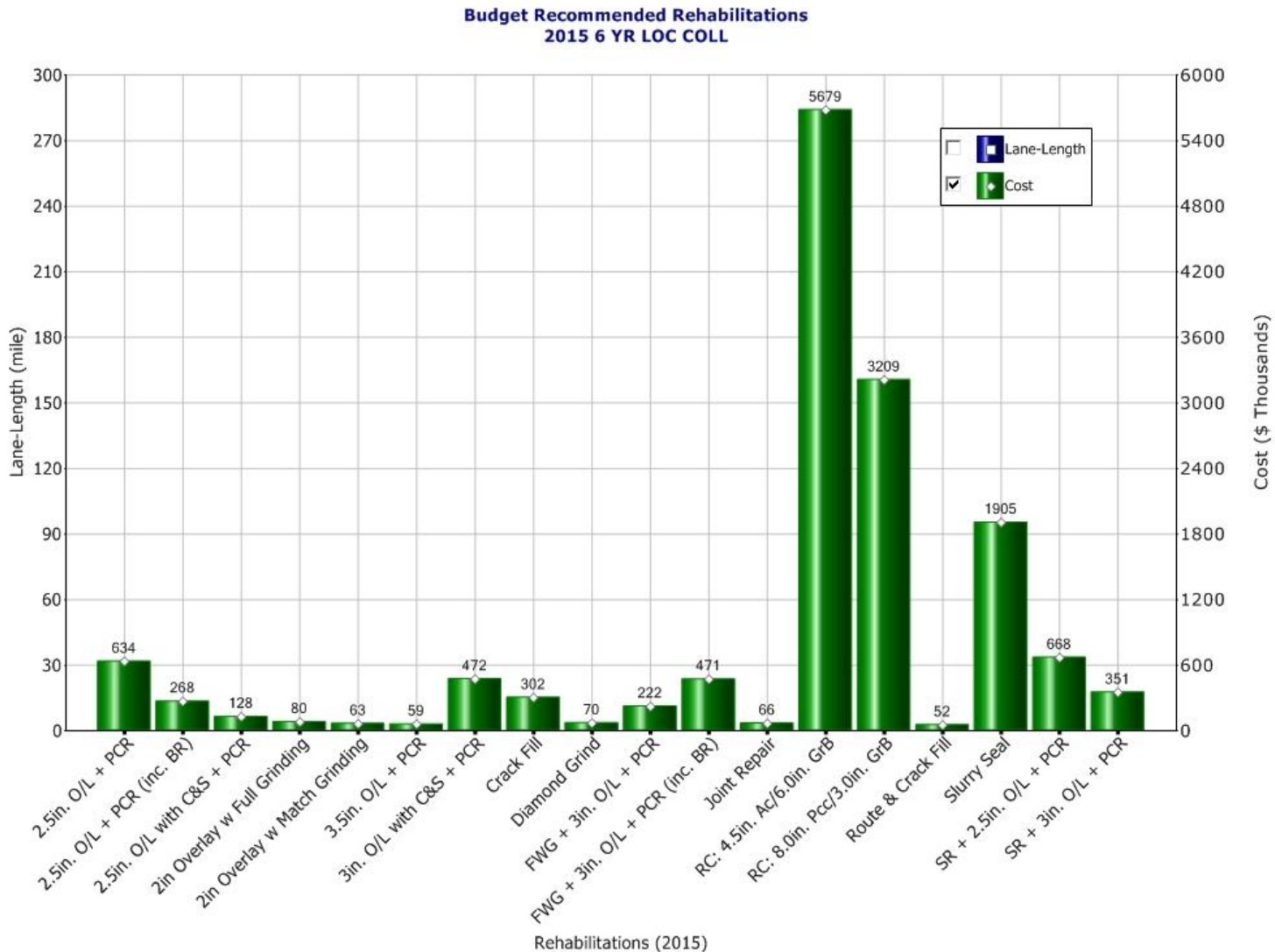


BUDGET RECOMMENDED TREATMENTS (LENGTH, All Years)



BUDGET RECOMMENDED TREATMENTS

(COST, First Year = 2015)



BUDGET SELECTED PRIORITY

Stantec RoadMatrix

Home Sections Reports Parameters Analysis Program Sidewalk Mapping Utilities Help

Reports Home Inventory Performance Rehabilitation

Options

Common tasks

- Change view
- Print Preview...
- Print...
- Page Setup...
- Save As...
- Customize...

Batch Print Options

Change the subset...

Go to subset manager...

Favorite Reports

- Add to my favorite
- Remove from my favorite

Grid layout

- Expand All
- Collapse All

Drag a column header here to group by that column.

Search Section #

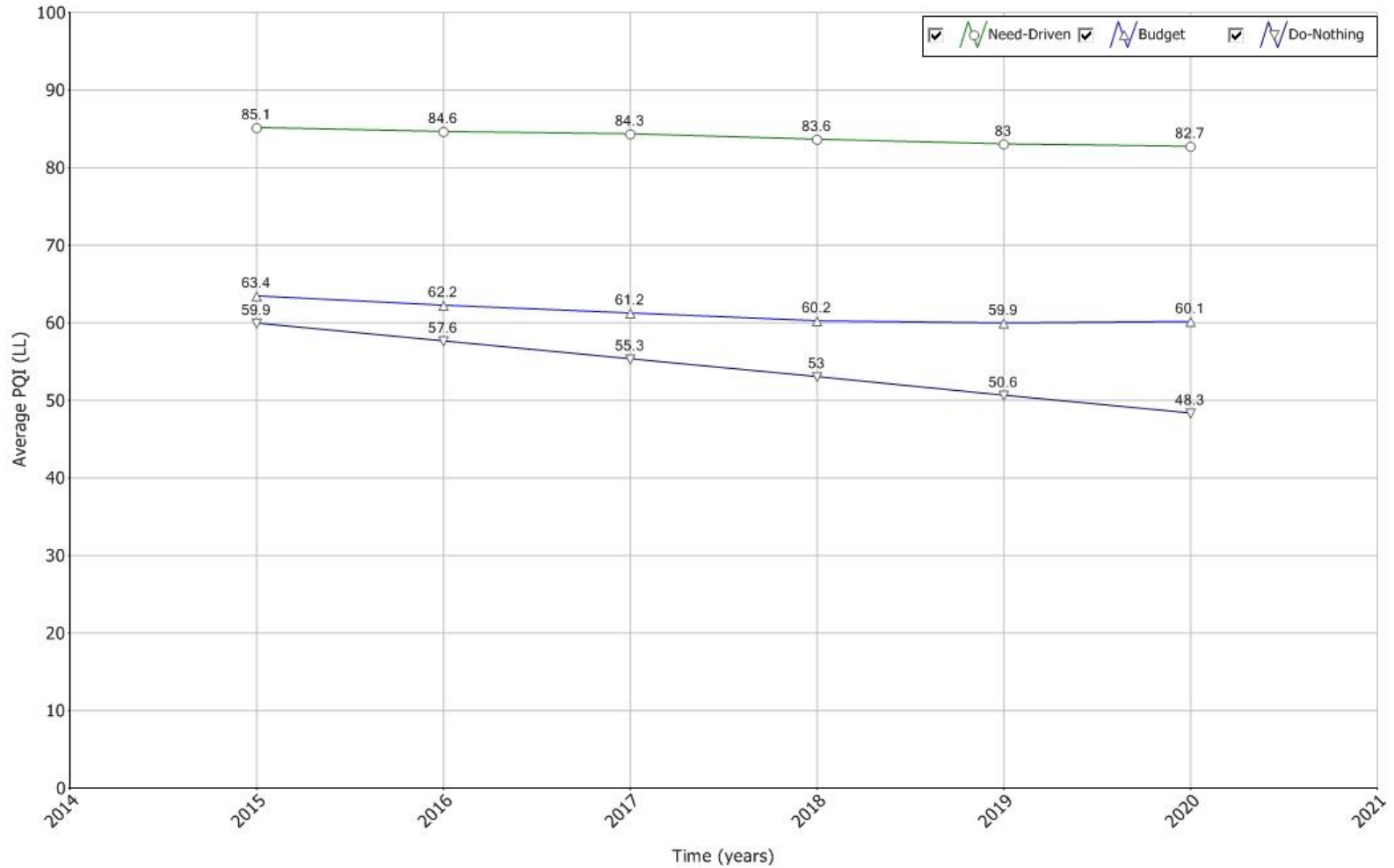
Section #	Street*	Limits (To and From)	LengthxLanes	Budget Rehab Imp.	Budget Rehab Need Year	Budget Rehab	Budget Rehab CE	Budget Rehab Cost
800116	N 100TH ST	CITY BOUNDARY-CITY BOUNDARY	60	2,020	2,020	Slurry Seal	256.023	102
8904	N 100TH ST	W HIGHWOOD AV-CITY BOUNDARY	932	2,020	2,020	Slurry Seal	254.034	1,585
8905	N 100TH ST	CITY BOUNDARY-W NASH ST	272	2,019	2,019	Slurry Seal	265.194	453
8917	N 100TH ST	W SARASOTA PL-W FIEBRANTZ AV	932	2,019	2,019	Joint Repair	89.132	2,774
8918	N 100TH ST	W FIEBRANTZ AV-MUNI BOUNDARY	836	2,017	2,017	Joint Repair	78.524	2,392
8921	N 100TH ST	MUNI BOUNDARY-W GRANTOSA DR	1,552	2,017	2,017	Joint Repair	85.464	4,440
8922	N 100TH ST	W GRANTOSA DR-W GRANTOSA DR	220	2,015	2,015	Joint Repair	106.263	605
901655	N 100TH ST	W JUNIPER ST-W GREENWOOD TR	2,034	2,015	2,015	Crack Fill	43.554	1,085
901756	N 100TH ST	W NASH ST-CITY BOUNDARY	1,520	2,019	2,019	Slurry Seal	40.249	2,534
8915	N 100TH ST	W LISBON AV-W CAPITOL DR	1,002.4	2,015	2,015	Crack Fill	516.069	551
900217	N 103RD CT	W JONEN ST-END	648	2,019	2,019	Slurry Seal	16.344	1,047
900224	N 105TH ST	W DAPHNE ST-W KIEHNAU AV	777	2,015	2,015	Crack Fill	43.344	414
800119	N 107TH ST	W BENDER RD-W MILL RD	2,067	2,017	2,017	Crack Fill	252.655	1,075
800535	N 107TH ST	N GRANVILLE RD-W BROWN DEER PL	1,251	2,020	2,015	FWG + 3in. O/L + PCR	12.817	91,160
801407	N 107TH ST	W FOUNTAIN AV-W FOUNTAIN AV	240	2,015	2,015	FWG + 3in. O/L + PCR (inc	40.737	15,264
801408	N 107TH ST	W FOUNTAIN AV-W BRADLEY RD	4,458	2,016	2,015	RC: 8.0in. Pcc/3.0in. GrB	33.369	622,051
9177	N 107TH ST	W GREENWOOD TR-W CALUMET RD	5,344	2,019	2,015	RC: 8.0in. Pcc/3.0in. GrB	15.015	1,186,983
9195	N 107TH ST	W MILL RD-W JONEN ST	3,940	2,020	2,020	Crack Fill	123.588	2,719
9196	N 107TH ST	W JONEN ST-W GREEN TREE RD	6,284	2,017	2,017	Crack Fill	87.483	4,086
9199	N 107TH ST	W GOOD HOPE RD-W PARK PL	2,830.5	2,016	2,015	RC: 8.0in. Pcc/3.0in. GrB	33.349	394,957
9200	N 107TH ST	W PARK PL-W GREENWOOD TR	1,572	2,019	2,015	RC: 8.0in. Pcc/3.0in. GrB	14.852	349,165
9201	N 107TH ST	W CALUMET RD-W FOUNTAIN AV	15,768	2,018	2,015	FWG + 3in. O/L + PCR	16.906	1,104,386
9204	N 107TH ST	W VILLA AV-W DONNA DR	5,826	2,015	2,015	Slurry Seal	278.955	9,788
801892	N 108TH ST	W HERITAGE DR-W GREEN TREE RD	1,366	2,016	2,015	Crack Fill	29.018	1,115
9230	N 108TH ST	W JEFFREY LA-W STARK ST	861	2,015	2,015	Crack Fill	37.34	459
9231	N 108TH ST	W STARK ST-W CAMERON AV	858	2,015	2,015	Crack Fill	38.395	458
9232	N 108TH ST	W CAMERON AV-W HARVEST LA	906	2,015	2,015	Crack Fill	34.576	483
1093	N 10TH ST	W WELLS ST-164 FT NORTH OF W WELLS ST	492	2,018	2,018	Slurry Seal	162.799	877
1116	N 10TH ST	W NASH ST-W ABERT PL	2,328	2,016	2,015	Slurry Seal	26.788	3,324
52277	N 10TH ST	W ST PAUL AV-N HIBERNIA ST	823.2	2,016	2,016	Crack Fill	44.17	560
52278	N 10TH ST	N HIBERNIA ST-END ARC	696.6	2,015	2,015	Route & Crack Fill	128.645	536
802225	N 110TH ST	W SANCTUARY DR-W MEADOWCREEK CT	714	2,015	2,015	Crack Fill	46.642	536
9342	N 110TH ST	END OF ROAD-W HAMPTON AV	549	2,016	2,015	Slurry Seal	27.93	836
902400	N 114TH ST	W MILL RD PL-W MILL RD	242	2,019	2,019	Crack Fill	77.315	367
901816	N 115TH ST	W APPLETON PL-W GREEN TREE RD	1,718	2,017	2,017	Crack Fill	39.308	1,341
800120	N 118TH ST	W MILL RD-W MILL RD	270	2,016	2,015	Slurry Seal	27.863	411
1204	N 11TH ST	W KILBOURN AV-W STATE ST	1,737	2,017	2,017	Joint Repair	81.475	6,024

251 of 3190

Choose a budget scenario: (25) 2015 6YR

BUDGET IMPACT ON PQI

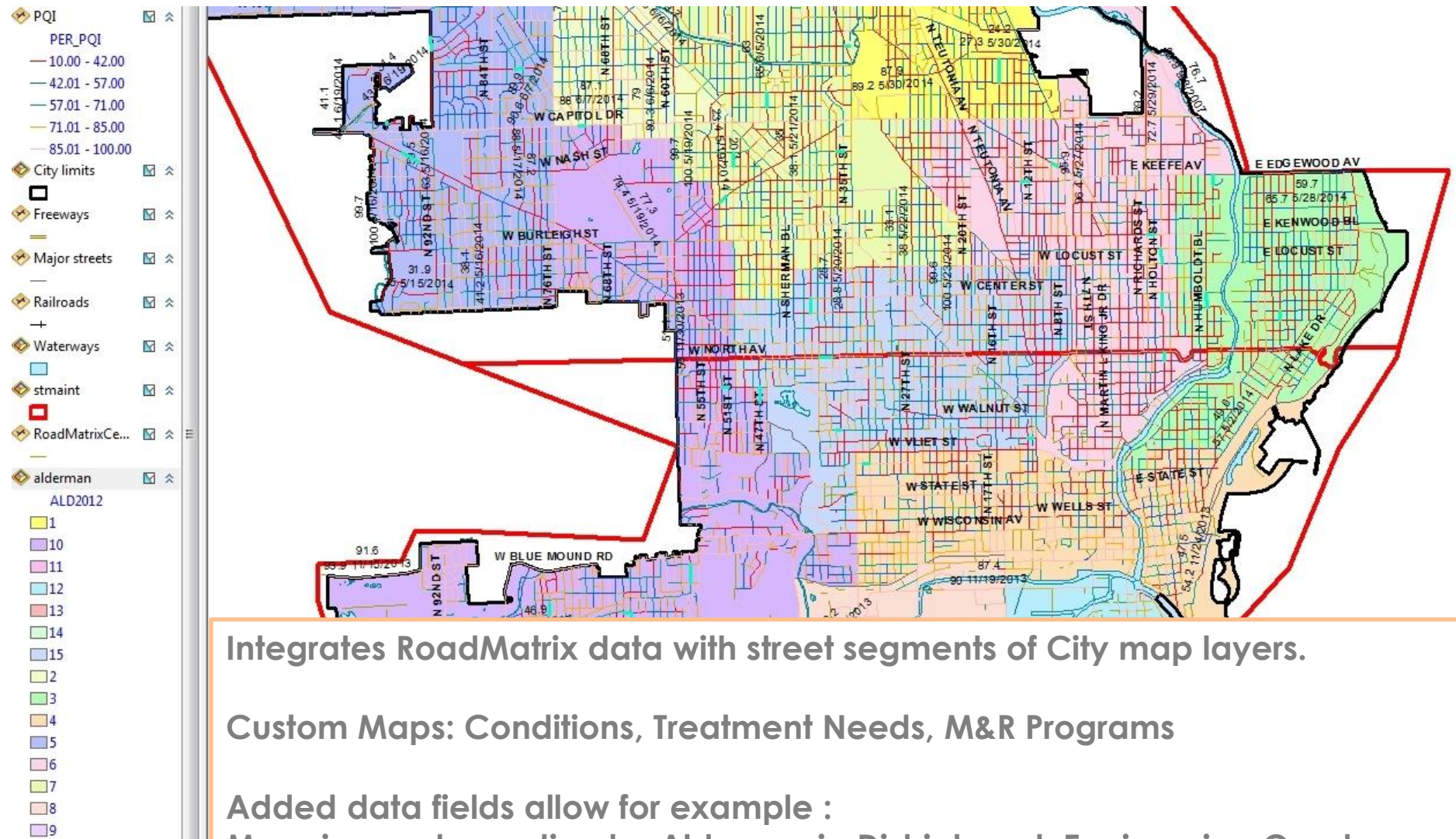
Network Performance (Average PQI - LL Weighted)
2015 6 YR LOC COLL W/ HI



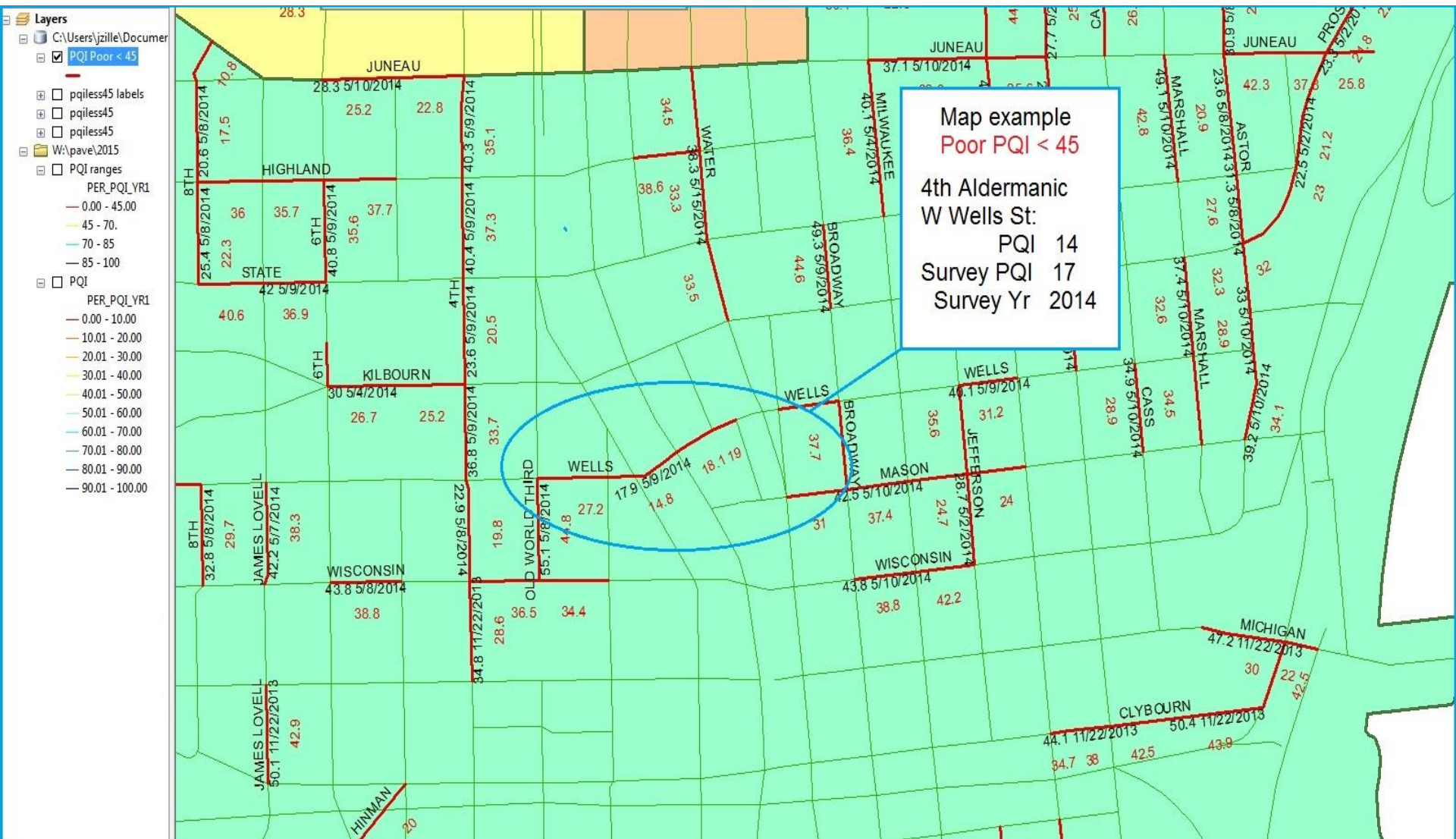
WHAT IF FUNDING SCEANRIOS

- Various Annual Budgets
- Budgets to maintain/achieve PQI levels
- Split/Super Budgets
 - Proportion budgets by Functional Class
 - Proportion budgets by Treatment needs
 - Maintenance/Rehabilitation/Capital Reconstruction
 - High Impact Overlay Program
 - Combine into Super Budget to see PQI impact on the entire network

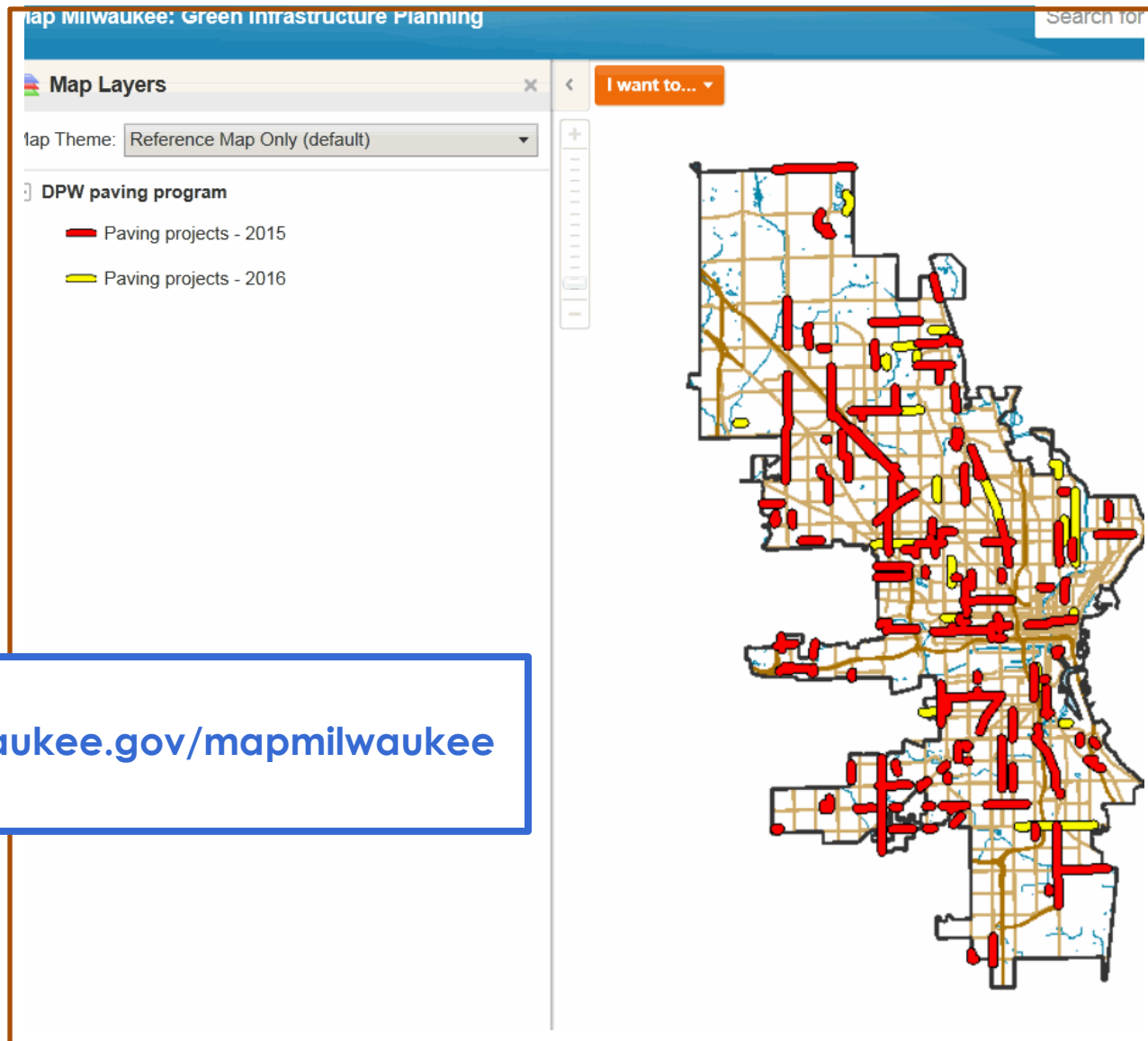
ArcMAP INTEGRATION



ArcMAP INTEGRATION



MAP/PUBLISH ANNUAL PROGRAMS



www.milwaukee.gov/mapmilwaukee

MOVING FORWARD

- **Segment attributes need to be maintained**
- Maintenance and rehabilitation unit costs should be reviewed/updated annually
- Decision trees should be reviewed/updated annually
- **Completed work should be updated in the system on a quarterly basis (Program Module)**
- Pavement condition data collection should be conducted approximately every 3-4 years
- **Training**

City Of Milwaukee Pavement Management System Implementation



June 25, 2015