Maricopa County Department of Transportation

2003 Roadway Management System Report

Transportation Planning Division
Program & Systems Analysis

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PROGRAM OVERVIEW AND BACKGROUND

The Road Management System (RMS) is a tool that analyzes the physical attributes of roadways as well as the current condition of roadway pavement and ride quality. The information derived from the RMS is used to make recommendations to decision makers concerning how to best maintain and preserve county roads. The primary goal of the RMS is to ensure acceptable ride quality and safety for the traveling public in a cost efficient manner in accordance with the specifications of the MCDOT Roadway Design Manual.

Purpose of the RMS

All road surfaces deteriorate over time due to traffic and environmental conditions. MCDOT's analysis has shown that it costs the traveling public less to have good roads than bad roads but only if the roads are kept at a reasonable level of serviceability. Therefore, the County has set up a program to continuously monitor roadway conditions, report the roadway conditions to the decision makers through the RMS, and attempt to maintain all of its roadways at an acceptable level. Preventative maintenance is the soundest way to reduce pavement failure.

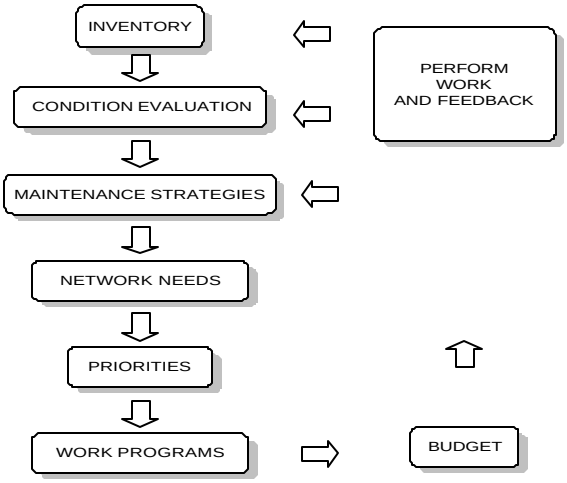
Preventative maintenance is the treatment applied to prevent or reduce the rate of deterioration on roads and the expenditures for pavement work. Preventative maintenance is limited to such activities as surface seals and thin overlays that do little to change the structural capacity of the pavement but do add years of life to the road surface. The old colloquial saying of "pay me now, or pay me later" truly applies to road surface maintenance.

The County's general framework for roadway management activities is shown in Figure 1. The first feature is an inventory of the pavements in the network; Second, a systematic procedure is used to evaluate the condition of these pavements and; Third, the RMS defines maintenance and rehabilitation strategies. Finally, based on the pavement condition, the RMS identifies the network maintenance and rehabilitation needs, selecting the most appropriate strategy for each pavement section. The RMS program repeats the analysis for a five-year period and projects the Pavement Condition Ratings (PCR's) over time so that long-term work plans and budgets can be prepared.

LAWS AND POLICIES AFFECTING THE RMS

The Maricopa County Transportation System Plan and Comprehensive Plan outlines four management systems to help plan and program future roadway improvement projects. These management systems include Roadway, Safety, Congestion and Bridge. All were patterned after those described and required in the Federal Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991.

Figure 1. Roadway Management Process



The 1998 implementation of the TEA 21, the Transportation Equity Act for the 21st Century, created changes to all of the Management Systems. While these reports are no longer required, Maricopa County has made a commitment to continue to collect data and carry out all management system reports for roadways under the County's Jurisdiction.

ROLES OF THE RMS IN CAPITAL IMPROVEMENTS PROGRAMMING

The RMS determines preventative maintenance, rehabilitation, and reconstruction needs over a five-year span. It also recommends strategies that maintain the overall network at a condition required by the MCDOT Roadway Design Manual and expected by the traveling public. These determinations are presented each November to the MCDOT Operations Division and Planning Division for consideration in the Transportation Improvement Program (TIP) or the internal Operations Division Work Program.

RMS reports generated for use by MCDOT include:

- Transportation Improvement Projects (TIP) recommending road widening.
- Recommending reconstructing various two-lane roads to improve sufficiency rating.
- Recommending roadways to receive structural overlays.
- Recommending roadways to receive thin (maintenance) overlays.
- Recommending roadways to receive surface treatments (i.e., chip seal, slurry seal, crack seal, fog seal, routine maintenance.)

ROADWAY EVALUATION PARAMETERS

The RMS uses six different categories of information to determine which roadways in the network require attention. These categories are both independently analyzed and mathematically combined to offer a snapshot for the decision makers to annually monitor roadway conditions.

Data included in the RMS are the road inventory, the pavement conditions rating, the international roughness index, the sufficiency rating, the work history data, and the traffic volumes data. All play important roles in determining: What work needs to be done annually.

Roadway Inventory Data

Roadway Inventory information comes from the Road Information System (RIS) Platform Conversion Application (RPCA) and RMS databases. The following types of information are available in the databases for roadways owned by the County:

- Road name, and cross road references
- Segment length
- Functional classification of the roadway
- Number of lanes
- Width of lanes
- Surface type
- Shoulder width and type
- Maintenance history
- Traffic volumes
- Right-of-way width

Pavement Condition Rating (PCR)

MCDOT's Road Management Section evaluates pavement conditions by inspecting all segments of paved roads in the County. The result allows for a quantifying of the overall pavement condition in the road network. Pavement conditions are updated annually on most section line roads (Principal Arterials) and every other year on collector and some local roads. Measuring surface distress types determines the Pavement Condition Ratings (PCR) (see Table 1) such as:

- Transverse cracking
- Longitudinal cracking
- Fatigue cracking
- Block cracking
- Rutting
- Raveling
- Shoving / Pushing / Corrugations

- Excess asphalt Patching

The above information is then combined so that each road is scored on a scale from 1 to 100 with 100 representing an excellent roadway surface.

The Maricopa County Department of Transportation relies on the PCR for looking into potential preventative maintenance strategies and long range planning. Pavement preventative maintenance treatments need to be performed before the pavement conditions get to the point of rehabilitation or reconstruction. Timely treatment strategies prove to be the most cost effective.

Figure 2 shows Maricopa County Department of Transportation's preventative maintenance strategy.

Figure 2. Pavement Maintenance Strategies

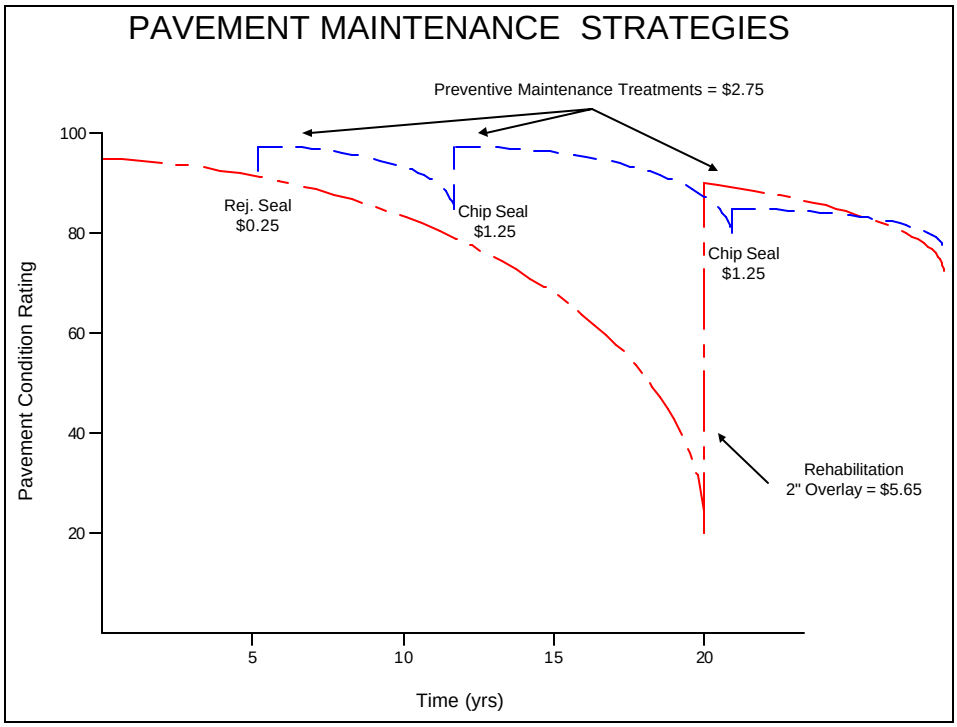


Table 1: Asphaltic Pavement Surface Distress Evaluation

ASPHALT PAVEMENT SURFACE EVALUATION
100 Point System

TRANSVERSE CRACKS

EXTENT SPACING	SEVERITY WIDTH <3/8"	SEVERITY WIDTH >3/8"
>50 ft.	1	4
12 ft. to 50 ft.	2	5
<12 ft.	3	6

LONGITUDINAL CRACKS

EXTENT	SEVERITY WIDTH <3/8"	SEVERITY WIDTH >3/8"
CENTERLINE SINGLE	1	4
WHEEL PATH SINGLE	2	5
MULTIPLES	3	6

FATIGUE CRACKING

EXTENT	SEVERITY WIDTH <1/8'	SEVERITY WIDTH >1/8"	Blocks
One or two < 50 sf	1	5	9
Three or more < 50 sf	2	6	10
One or two > 50 sf	3	7	11
Three or more > 50 sf	4	8	12

BLOCK CRACKS

EXTENT BLOCK SIZE	SEVERITY WIDTH <3/8"	SEVERITY WIDTH >3/8"
>50 ft.	1	4
12 ft. to 50 ft.	2	5
<12 ft.	3	6

RUTTING

EXTENT	SEVERITY DEPTH >1/2"
Localized or only partial length	1
Entire length of section	2

RAVELING

EXTENT	SEVERITY PITTING Minor	SEVERITY PITTING Major
Wheel Paths < 50% length	1	5
Wheel Paths > 50% length	2	6
Entire Width < 50% length	3	7
Entire Width > 50% length	4	8

SHOVING/PUSING/CORRUGATIONS

EXTENT	SEVERITY RIDE DISCOMFORT Mild	SEVERITY RIDE DISCOMFORT Harsh
At intersections only	1	4
Between intersections only	2	5
Present in entire section	3	6

PATCHING

EXTENT NUMBER	SEVERITY QUALITY OF REPAIR Good	SEVERITY QUALITY OF REPAIR Fair	SEVERITY QUALITY OF REPAIR Poor
< 5 Repairs	1	4	7
5 to 15 Repairs	2	5	8
>15 Repairs	3	6	9

EXCESS ASPHALT

EXTENT	SEVERITY FILM Thin	SEVERITY FILM Thick
Wheel Paths < 50% length	1	5
Wheel Paths > 50% length	2	6
Entire Width < 50% length	3	7
Entire Width > 50% length	4	8

Standard evaluation section should be minimum 10% of road termini length ie; 1 mile = 500' rating section and be subjectively selected to represent the general road way condition.

Sufficiency Rating

The geometric information for each section of the road is maintained and used in this rating. This information is collected by the MCDOT Road Management Section for each roadway. The rating identifies how each roadway segment compares to the MCDOT Roadway Design Manual's standards for each road segment's functional classification. The following information is maintained in the RMS for each County roadway segment:

- Lane width
- Shoulder width
- Bottleneck features
- Drainage features
- Vertical sight distance
- Horizontal sight distance

The above information is then combined so that each roads is scored on a scale from 1 to 100 scale with 100 representing a road in complete compliance with the RDM standards.

International Roughness Index (IRI)

International Roughness Index (IRI) is determined by a CLASS II direct profile measuring devise as classified in the Highway Performance Monitoring System (HPMS) Field Manual published by the Federal Highway Administration. IRI rating (inches per mile) is achieved by dividing the total roughness count by the distance measured and reported as a whole number.

MCDOT uses Laser Road Profiler (LRP) and a Distance Measuring Instrument (DMI) mounted in a two wheel drive vehicle. The LPR measures the vertical displacement (upwards and downwards) that a passenger would experience traveling at the posted speed limit. This is accomplished by measuring with the laser the distance between the road surface and the laser pick up every three inches (seven and half centimeters). The road roughness is measured in tenths of an inch (two and half millimeters) increments and converted through the IRI software. The DMI accumulates and records the total distance traveled. To ensure accuracy, all equipment is periodically calibrated according to ADOT's established profiles.

This information is then combined so that each roads is scored on a sliding scale from 1 to 500 scale with 500 representing an extremely rough section of a road.

Work History Data

The work history on each roadway is kept in the surface treatment RCPA database maintained by the Road Inventory Section. Records of major construction and

maintenance activities performed on pavements are maintained by MCDOT and contain the following types of information:

- Type of work
- Material used, types, and thickness
- Completion date

Traffic Volume Information

The MCDOT Traffic Engineering Section conducts all traffic counts for MCDOT. Raw traffic count information is converted to Average Daily Traffic (ADT) volumes on all roadways within the network. The County conducts annual traffic counts on section line roads classified as either collectors or arterials. Local roads are counted as needed. This data is used to determine preservation strategies and traffic congestion levels throughout the County.

Current State of the System

The RMS report is in its fifth year. Annual data for the five years have been combined to show the 5-year comparison for each of the three roadway indicators. Tables 2c, 3c, 4c, and 5b show this comparison. This method allows broader visibility to the progress of the County's roadway network with regards to improvements and changes throughout the 5 years.

From fiscal year 1999 to fiscal year 2003, the County roadway system has declined due to the annexation of roads from various cities throughout the County and the absence of local roadways within the analysis. As a whole, most of the County roadways remain in excellent or very good condition requiring only preventative maintenance throughout the year.

The Pavement Condition Ratings in Tables 2a & b show that 77% of the system is currently in "excellent" condition. This is an increase of nearly 7% from fiscal year 1999. Another 18% received a "very good" score, a negative difference of 6% from FY99. This positive and negative correlation indicates equilibrium in the system.

The Sufficiency Rating in Tables 3a & b follows the same pattern. There was an increase in the number of miles with an "excellent" rating and corresponding numbers to confirm it. The figures were the same or down slightly in the other columns.

Similarly, the International Roughness Index in Tables 4a & b has improved its two top scores roughly (no pun intended) 7% from fiscal year 1999. The increase also affected the lower ratings negatively. This correlation shows the aforementioned equality in the roadway network.

Table 2a. Pavement Condition Rating

PCR	Pavement	FY1999	FY 2000	FY 2001	FY 2002	FY 2003
100-85	Excellent	979.04	858.04	935.61	934.12	983.14
% of system		70.30	63.00	69.80	72.40	77.00
84-71	Very Good	333.94	388.44	288.82	283.24	227.70
% of system		24.00	28.60	21.50	22.00	18.00
70-55	Good	73.34	105.24	103.38	51.96	38.23
% of system		5.30	7.70	7.70	4.00	3.00
54-40	Fair	5.81	9.64	12.68	20.48	24.01
% of system		0.40	7.00	0.90	1.60	2.00
>40	Poor	0.11	0.00	0.00	0.15	0.50
% of system		0.00	0.00	0.00	0.00	0.00
	Total	**1,392.24**	**1,361.36**	**1,340.49**	**1,289.95**	**1,273.58**

Table 2b. 2003 Pavement Condition Rating

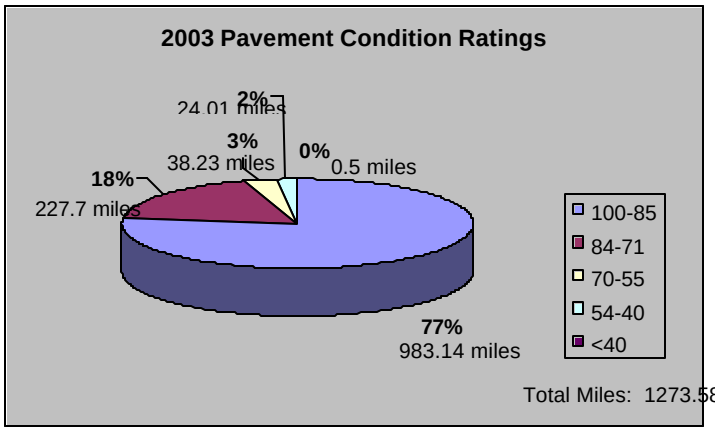


Table 2c. PCR 5 Year Comparison

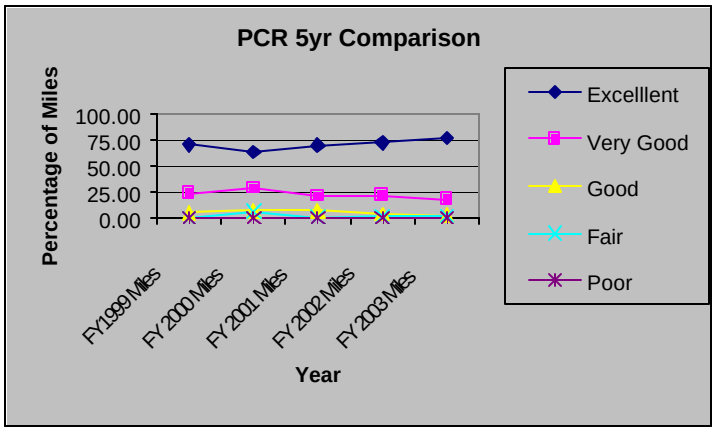


Table 3a. Sufficiency Rating

Sufficiency	Road	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
100-85	Excellent	690.54	667.05	655.70	650.10	644.79
% of system		54.60	54.60	54.90	55.80	55.00
84-71	Very Good	443.08	424.09	416.19	401.43	402.19
% of system		35.00	34.70	34.80	34.40	35.00
70-55	Good	121.01	120.09	112.98	105.35	101.49
% of system		9.60	9.80	9.50	9.00	9.00
54-40	Fair	10.46	10.46	9.47	8.57	8.57
% of system		0.80	0.90	0.80	0.70	1.00
>40	Poor	0.00	0.00	0.00	0.00	0.00
% of system		0.00	0.00	0.00	0.00	0.00
	Total	**1,265.09**	**1,221.69**	**1,194.34**	**1,165.45**	**1,157.04**

Table 3b. 2003 Sufficiency Rating

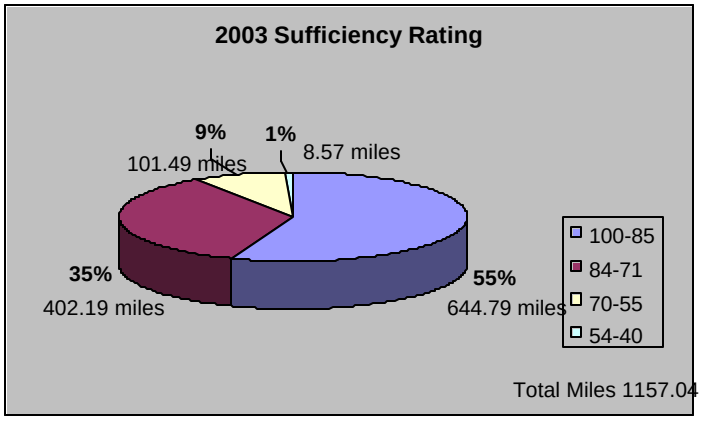


Table 3c. Sufficiency Rating 5 Year Comparison

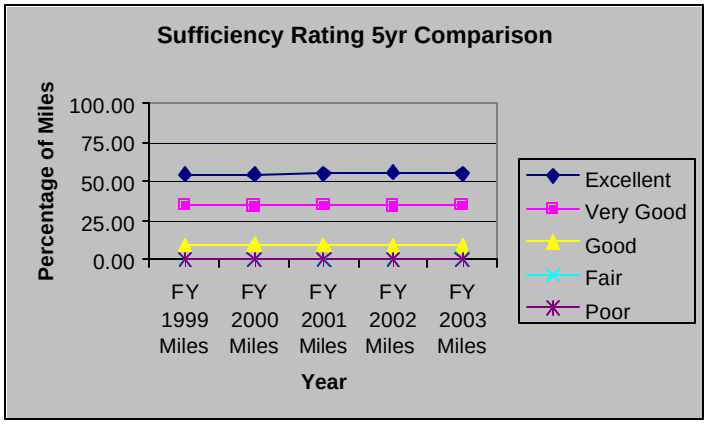


Table 4a. IRI Rating

Roughness	Ride Quality	FY1999	FY 2000	FY 2001	FY 2002	FY 2003
0-59	Very Smooth	67.94	66.50	90.73	91.49	69.36
% of system		5.40	5.20	7.00	7.20	6.00
60-94	Smooth	192.55	190.60	239.01	257.82	281.15
% of system		15.20	14.80	18.50	20.40	22.00
95-170	Average	734.86	730.63	668.50	653.09	653.04
% of system		58.10	56.90	51.70	51.70	52.00
170-220	Rough	219.88	241.89	239.62	214.23	197.61
% of system		17.40	18.80	18.50	17.00	16.00
>220	Very Rough	50.19	54.83	55.93	46.19	50.02
% of system		4.00	4.30	4.30	3.70	4.00
	Total	**1,265.42**	**1,284.45**	**1,293.79**	**1,262.82**	**1,251.18**

Table 4b. 2003 IRI Rating

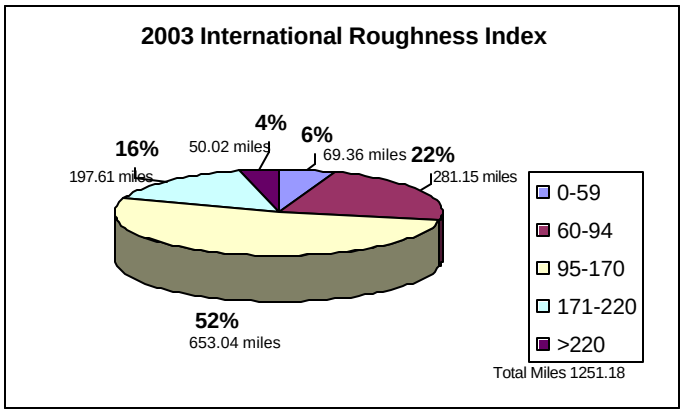
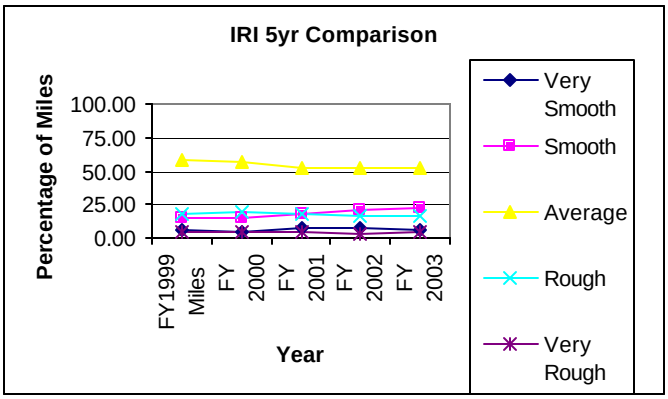


Table 4c. IRI 5 Year Comparison



Preservation Strategies and Maintenance

The Preservation Strategy Table (table 5a&b) confirms that providing timely preventative maintenance curtails roadway failure and reconstruction. While the total mileage in the system has decreased, the percentage of preventative or low maintenance strategies has remained stable. There is only one roadway segment

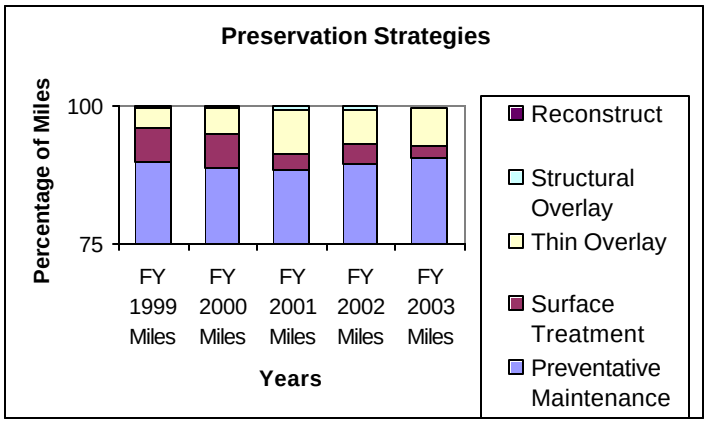
needing reconstruction.

As the matrices in table 6 shows a roadway's roughness and pavement conditions are the determinants as to what preservation strategy is necessary. Additionally, if a road is deemed insufficient (a rating below 35) then reconstruction is recommended.

Table 5a. Preservation Strategies

Preservation Strategy	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Preventative Maintenance	1621.61	1768.72	1190.89	964.35	976.68
% of system	89.7	88.7	88.5	89.5	90.6
Surface Treatment	111.26	125.36	37.4	38.43	23.89
% of system	6.2	6.3	2.8	3.6	2.2
Thin Overlay	65.81	91.91	106.3	66.68	72.63
% of system	3.6	4.6	7.9	6.2	6.7
Structural Overlay	8.74	8.84	11.14	8.15	3.17
% of system	0.5	0.4	0.8	0.8	0.2
Reconstruct	0	0	0	0	0.5
% of system	0	0	0	0	0
Total	**1807.42**	**1994.83**	**1345.73**	**1077.61**	**1076.87**

Table 5b. Preservation Strategies 5 Year Comparison



Recommended Roadway Widening

The RMS not only uses traffic volumes to recommend improvement strategies but also widening suggestions. Each roadways number of lanes and accompanying average daily traffic (ADT) affect possible expansion. Roads that have two or less lanes and currently experience more than 5,000 ADT are recommended for study. Additionally, roads that are projected to have more than 7,000 ADT within six years are also recommended. Future ADT counts are estimated by using current data compounded annually 3.5%.

Table 7 shows the 47.51 miles of County roadways recommended for widening.

Table 6. PCR vs. IRI Preservation Strategy Matrix

Maricopa County Department of Transportation
Operations Division
Roadway Management System

PCR vs. IRI Preservation Strategy Matrix

PCR	IRI <=95	IRI <=17	IRI >170
>=70	PM	PM	TO
>=40	ST	ST	SO
<40	TO	SO	RE

PCR vs. IRI Preservation Strategy Matrix

PCR	IRI <=12	IRI <=22	IRI >220
>=70	PM	PM	TO
>=40	ST	ST	SO
<40	SO	SO	RE

Legend

PM = Preventive Maintenance	(Crack Seal and/or Fog Seal)
ST = Surface Treatment	(High Volume or Low Volume Chip Seal or Slurry)
TO = Thin Overlay	(<= 2" Asphalt Rubber Overlay)
SO = Structural Overlay	(>= 2" Asphalt Rubber Overlay)
RE = Reconstruct	(Replace Pavement Structure)

All chip seals and overlays are repaired (patched) and crack sealed prior to resurfacing

A "Sufficiency Rating" below 35 indicates a road section of poor design and will generate a recommendation to "Reconstruct"

Traffic volume also influence the recommended strategy, if projected ADT > 7,000 and the road section is two lanes then a "Reconstruct 2 to 4 lanes" strategy is generated.

PROJECTED (6) YEAR ADT = 3.50% Compounded Annually (22.8% / 6 years)

Section Line Collectors and higher	1995 ADT	2001 ADT
Source : Cathy Arthur, MAGTPO 5/22/95	5500	7000

Mathematical models are used to generate recommended strategies, priority values and estimated cost for each road section for each of the next five fiscal years

Table 7. Recommended Roadway Widening Projects

Road	From	To	Total Miles	Current ADT	Current Lanes	Future ADT
35th Ave	Baseline Rd	Southern Ave	1.00	5,724	2	7,029.07
56th St	I-10 Freeway	Gila River Indian Reservation	0.30	10,879	2	13,359.41
67th Ave	Pinnacle Peak Rd	Happy Valley Rd	1.00	7,686	2	9,438.41
83rd Ave	Peoria City Limits	Pinnacle Peak Rd	0.93	8,740	2	10,732.72
91st Ave	Camelback Rd	Northern Ave	3.00	19,810	2	24,326.68
99th Ave	Glendale City Limits	Loop 101	0.10	40,038	2	49,166.66
Alma School Rd	Mc Kellips Rd	Mcdowell Rd	0.68	6,658	2	8,176.02
Camelback Rd	El Mirage Rd	115th Ave	1.00	5,937	2	7,290.64
Carefree Hwy	7th Ave	52nd St	6.50	18,514	2	22,735.00
Cave Creek Rd	Phoenix City Limits	Cave Creek City Limits	0.90	16,719	2	20,530.93
Del Webb Blvd	Bell Rd	107th Ave	0.27	18,651	2	22,903.43
Ellsworth Rd	Empire Blvd	Germann Rd	5.00	6,640	2	81,53.00
Hayden Rd	Henshaw Rd	Mc Kellips Rd	1.00	24,651	2	30,271.43
Maricopa Rd	Queen Creek T. I.	I 10 Fwy	2.08	13,656	2	16,769.57
Mc Dowell Rd	Alma School Rd	Arizona Ave	0.77	13,536	2	16,622.21
Mc Kellips Rd	Mesa City Limits	Crismon Rd	0.51	5,513	2	6,769.96
Meridian Rd	Broadway Rd	Apache Tr	0.50	8,477	2	10,409.76
Northern Ave	115th Ave	Loop 101	2.12	9,335	2	11,463.38
Olive Ave	Reems Rd	Dysart Rd	3.00	6,309	2	7,747.00
Olive Ave	El Mirage City Limits	99th Ave	3.01	15,204	2	18,670.50
Peoria Ave	111th Ave	Peoria City Limits	2.00	9,923	2	12,185.00
Recker Rd	University Dr	Adobe Rd	0.50	10,613	2	13,032.76
Riggs Rd	I-10 Freeway	Price Rd	1.57	12,355	2	15,171.94
Rittenhouse Rd	Williams Field Rd	Recker Rd	0.95	6,216	2	7,633.25
Rittenhouse Rd	Power Rd	Ellsworth Rd	3.71	9,235	2	11,340.58
Southern Ave	35th Ave	27th Ave	1.00	5,886	2	7,228.01
Thunderbird Blvd	98th Ave	Peoria City Limits	0.49	20,844	2	25,596.43
Union Hills Dr	107th Ave	99th Ave	0.62	12,177	2	14,953.36
University Dr	Ellsworth Rd	Meridian Rd	3.00	18,633	2	22,881.32
		Total Miles	**47.51**			

Figure 3:

2003 Roadway Pavement Condition Ratings

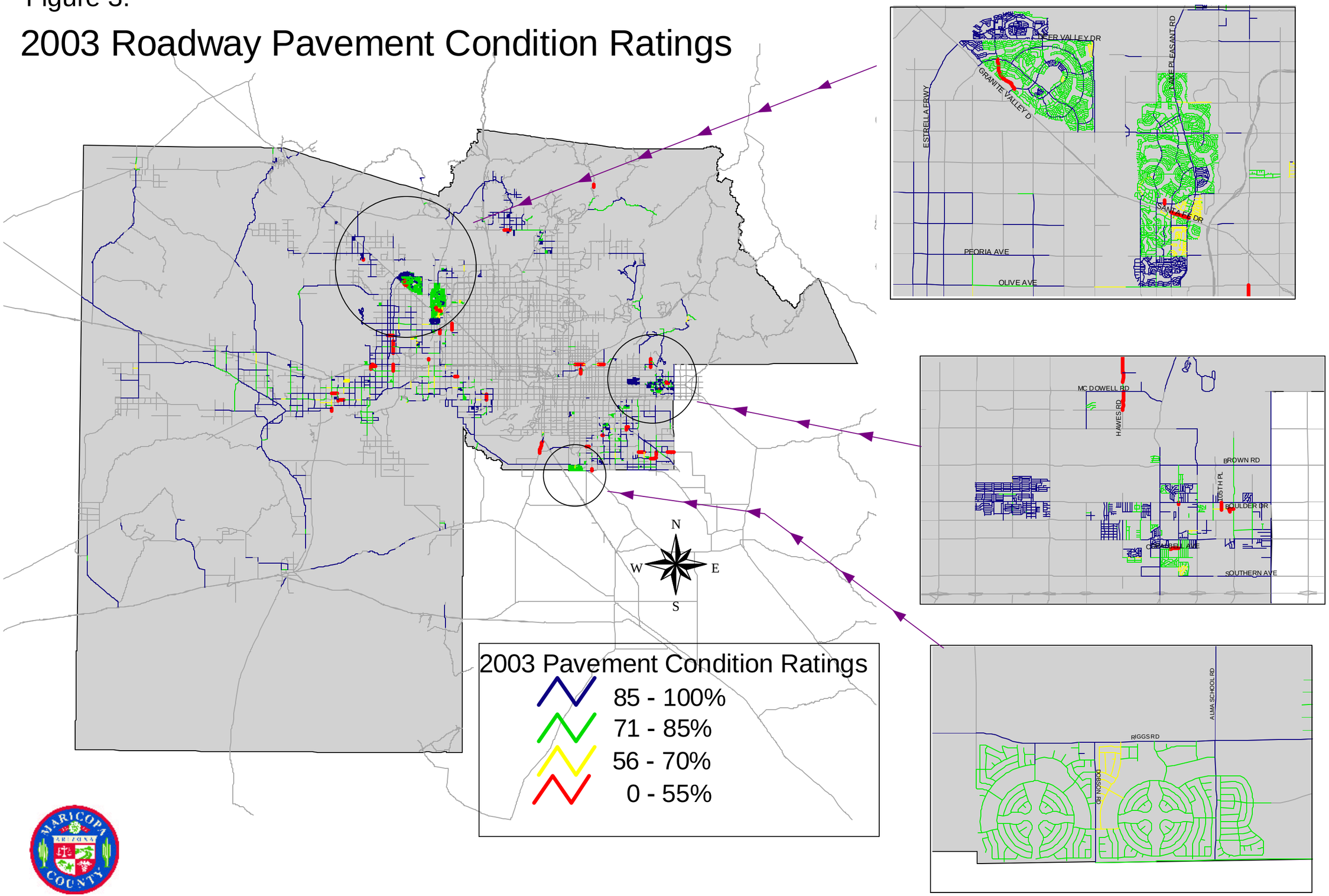
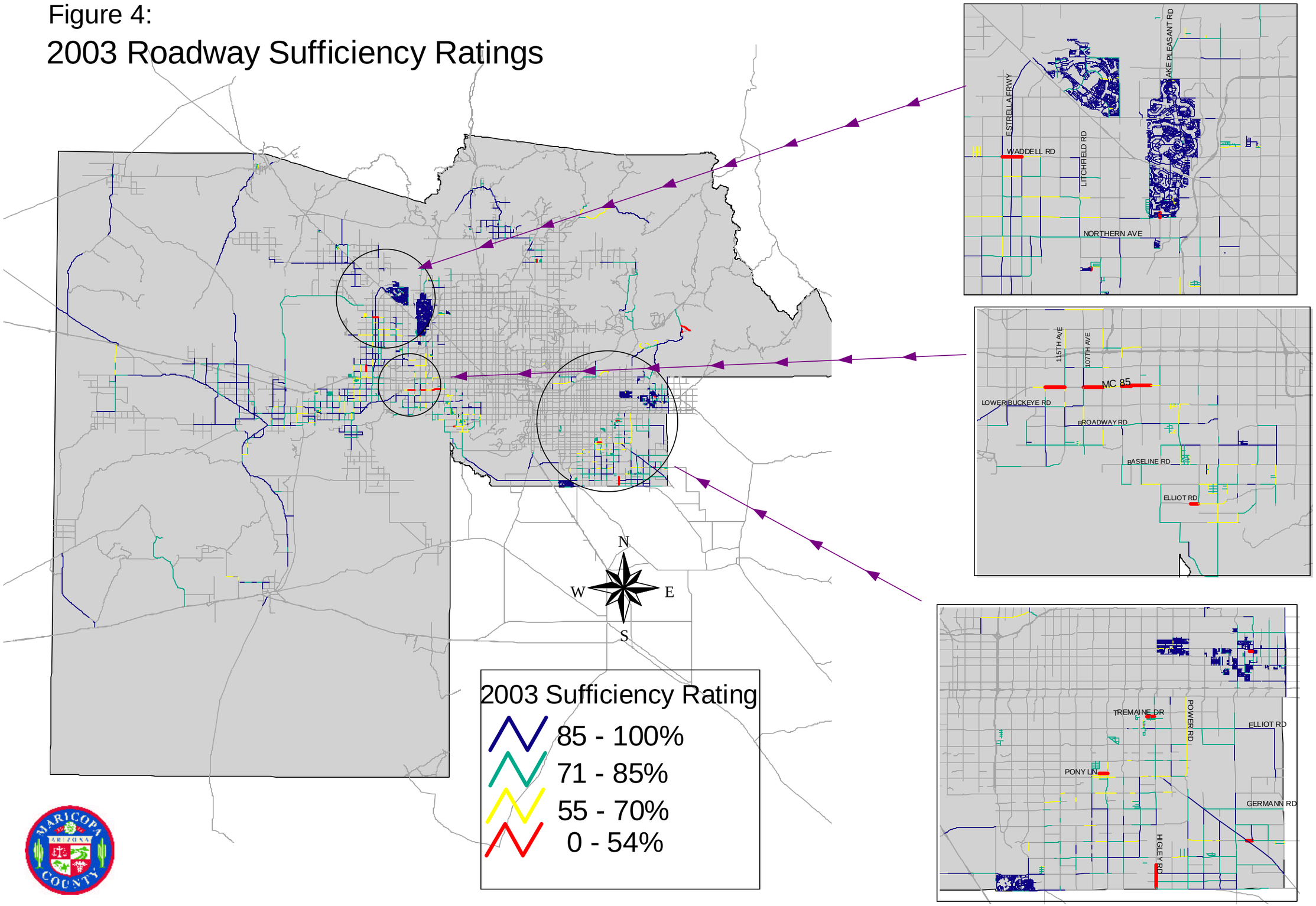


Figure 4:

2003 Roadway Sufficiency Ratings



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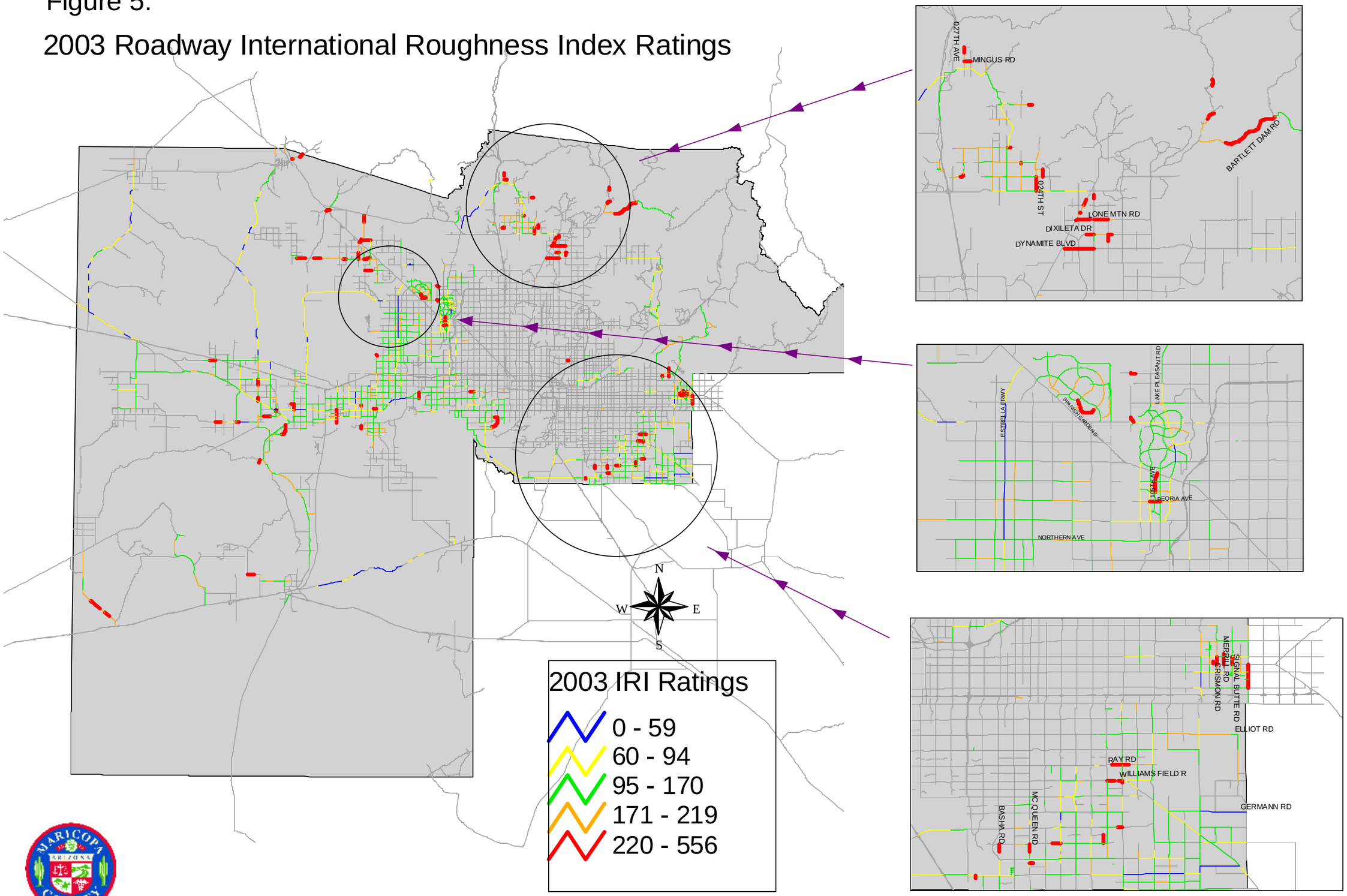
2003 Roadway International Roughness Index Ratings