

Section I
Executive Summary

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EXECUTIVE SUMMARY

The City of Berkeley currently maintains approximately 215 centerline miles of roads representing 39,039,981 square feet of pavement with an asset replacement value of approximately \$777,567,000 as calculated by StreetSaver[®].

Pavement Engineering Inc. (PEI) updated the City's Pavement Management System using the Metropolitan Transportation Commission's (MTC) StreetSaver[®] program. The purpose of a Pavement Management System is to track inventory, store work history and furnish budget estimates to optimize funding for improving the City's pavement system.

INTRODUCTION

A Pavement Management System has several distinctive uses:

- As a budgeting tool, a Pavement Management System uses treatment costs that are based on recently bid projects, by the participating agency, so that budgets reflect historical costs for the area.
- As an inventory tool, a Pavement Management System provides a quick and easy reference for pavement areas and use.
- As a pavement condition record, a Pavement Management System provides age, load-related, non-load related and climate-related pavement condition and deterioration information. The Pavement Management System uses pavement deterioration curves, based on nationwide research, which allow the program to predict a pavement's future condition.

A Pavement Management System is not capable of providing detailed engineering designs for a street. The Pavement Management System instead helps the user identify candidate streets for potential repair and maintenance. Project level pavement analysis and engineering is an essential feature of future pavement maintenance and rehabilitation projects. Additional investigation, or project level analysis, can optimize the City's pavement management dollars. Project level engineering examines the pavements in significantly more detail than the visual evaluation required for the Pavement Management System Update and optimizes designs for all of the peculiar constraints of a set of project streets.

When updating the Pavement Management System for the City of Berkeley, PEI had two primary goals:

1. Provide an accurate and complete inventory of the City's pavements and their condition.
2. Identify and quantify maintenance and rehabilitation needs and costs for the street system.



WORK PERFORMED

Pavement Distress Survey and Database Update

For this update, PEI performed inspections on all City-maintained streets. Field inspections were completed in September 2018.

PEI measured the following distress types as part of our review: alligator cracking (fatigue), block cracking, distortions, longitudinal & transverse cracking, patching & utility cut patching, rutting / depressions, weathering, and raveling. The work was performed in conformance to ASTM D6433. All the collected data were entered into the City's StreetSaver® database.

As part of our field review, all the streets were measured to confirm lengths and widths. Lengths were measured using a vehicle-mounted electronic measuring device and widths were measured using a hand-held measuring wheel.

Each segment was visually reviewed to determine if the StreetSaver® calculated PCI was representative of the observed overall pavement condition for that road segment. Once the initial ratings were completed, the field crew performed a 2nd rating on a randomly selected 10% of the segments. This 2nd rating is intended as a consistency check, which ensures that our raters are performing evaluations consistent with our allowable range of +/- 5 PCI points. Any segments that were found to be outside of +/- 5 PCI point range were re-rated by The Project Manager. Following the 10% Field Crew consistency check, an additional randomly selected 5% of segments were reviewed by The Project Manager. Additionally, PEI performed a quality control (QC) check on our work. PEI's QC check usually consists of performing a field review of any street segment where the PCI showed a decrease of 3 or more points per year or an increase of 5 or more PCI points when compared to the last inspection for the same road segment.

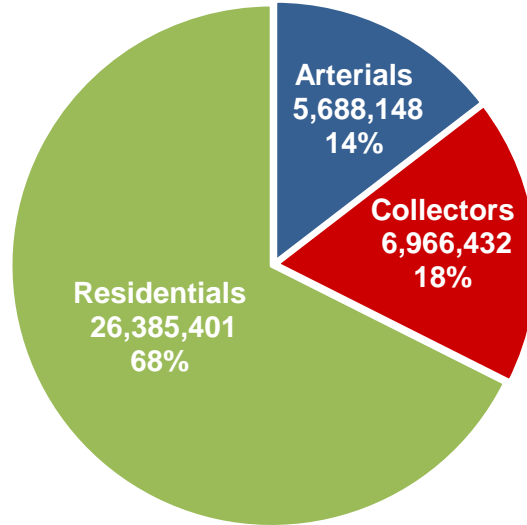
FINDINGS

The updated Pavement Management System showed that the City's overall average PCI is 59. The breakdown by functional classification is as follows:

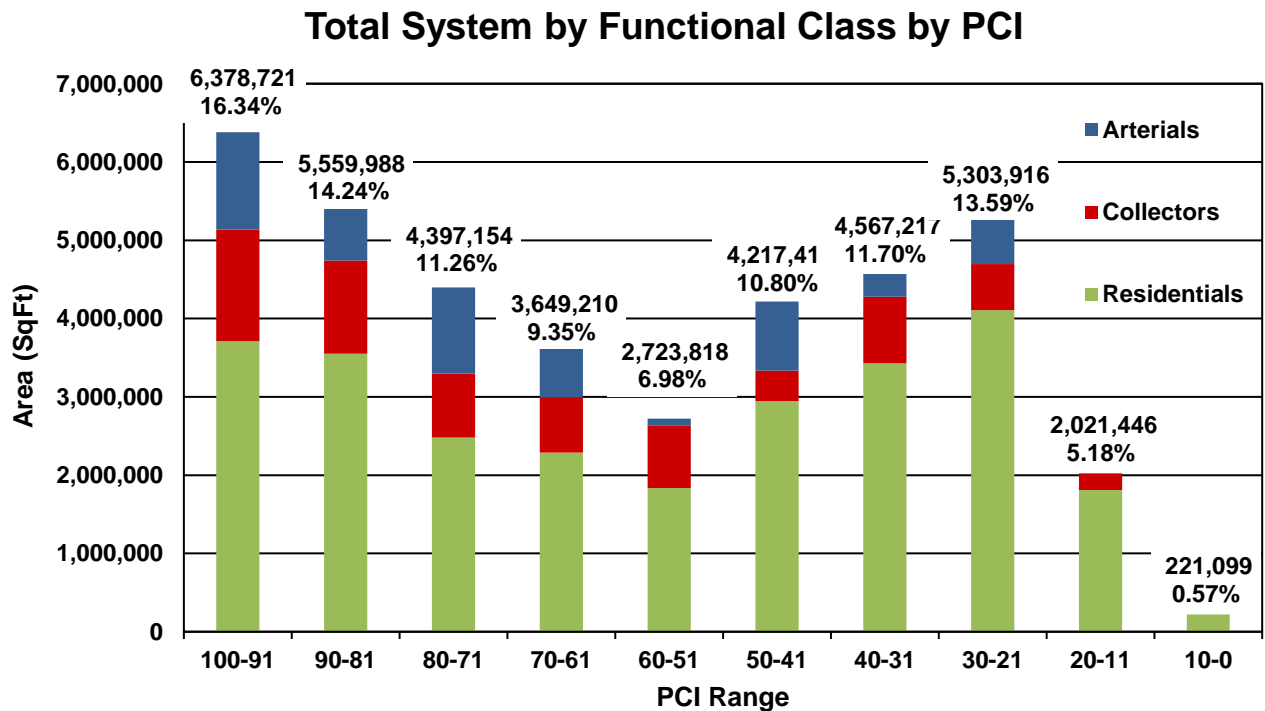
FUNCTIONAL CLASS	CENTERLINE MILES	AREA (SQUARE FEET)	PERCENT OF SYSTEM	AVERAGE PCI
Arterial	21.99	5,688,148	14.57%	67.9
Collector	36.99	6,966,432	17.84%	65.4
Residential	155.87	26,385,401	67.59%	56.4
TOTAL	214.85	39,039,981	100.00%	59.7



The pie chart below shows the percentage of each Functional Classification in the system.



The bar graph below shows a breakdown of your system into 10pt PCI ranges, by Functional Classification.





The table below shows the breakdown of your system into PCI Condition Categories.

CONDITION	PCI RANGE	% OF TOTAL	SQUARE FEET	CL MILES
EXCELLENT	100-91	16.34%	6,378,721	34.06
GOOD	90-71	25.50%	9,957,142	53.32
FAIR	70-51	16.32%	6,373,028	36.38
POOR	50-31	22.50%	8,784,629	48.35
FAILED	30-0	19.33%	7,546,461	42.74
		100.00%	39,039,981	214.85

The analysis shows that **42%** of the City's pavement is in **Excellent** to **Good** condition and that **39%** of the City's pavement is in **Fair** to **Poor** condition. Details of each street segment are provided in the **Reference Reports**.

BUDGET ANALYSIS

Decision Tree

StreetSaver® uses a decision tree to model the decision-making process that agencies follow to select a maintenance or rehabilitation strategy. The decision tree contains "branches" for each functional classification, surface type and condition category. Jurisdictions can outline their maintenance and rehabilitation strategy by choosing a treatment for each branch.

PEI worked with City staff to develop maintenance and rehabilitation strategies that address the current condition of the system, as well as, available funding. These strategies are reflected in the Decision Tree

The Decision Tree assigns a treatment action and estimated cost to each street segment based on the pavement's current PCI. For this update, PEI analyzed several scenarios, which are summarized below.

A copy of the Decision Tree can be found in **Appendix A** of this report.

Unit Prices

Accurate unit prices are critical to incorporate into a pavement management system. PEI researched recent bid tabulations and worked with the City to calculate and confirm base construction unit prices. In addition to the base construction unit prices, the costs were adjusted to include the financial impact of design, construction management, contingencies, and other relevant construction costs (ADA ramps, curb & gutters, striping etc.) This forms a more comprehensive unit cost for the selected treatments.



The final unit prices used for the City of Berkeley pavement management system can be found on the following table:

TREATMENT	ARTERIAL (COST/ SQYD)	COLLECTOR (COST/ SQYD)	RESIDENTIAL (COST/ SQYD)
Crack Seal (LF)	\$2.20	\$1.80	\$1.60
Light Maintenance	12.00	10.00	8.00
Heavy Maintenance	27.00	23.00	20.00
Light Rehab.	81.00	61.00	52.00
Heavy Rehab.	104.00	93.00	80.00
Reconstruct	240.00	187.00	164.00

Treatment Descriptions

TREATMENT CATEGORY	TYPICAL TREATMENT
Light Maintenance	<ul style="list-style-type: none"> • Slurry Seal • Micro-Surface • Fog Seal • Scrub Seal
Heavy Maintenance	<ul style="list-style-type: none"> • Chip Seal • Cape Seal • Slurry Seal with Digouts • Micro-Surface with Digouts • Thin Maintenance Overlay (TMO)
Light Rehab.	<ul style="list-style-type: none"> • Overlay (2" and under) • Thin Mill and Fill
Heavy Rehab.	<ul style="list-style-type: none"> • Overlay (greater than 2") • Thick Mill and Fill • Cold-In-Place Recycling • Full Depth Reclamation • Pulverize and Resurfacing
Reconstruct	<ul style="list-style-type: none"> • Full Section Reconstruction



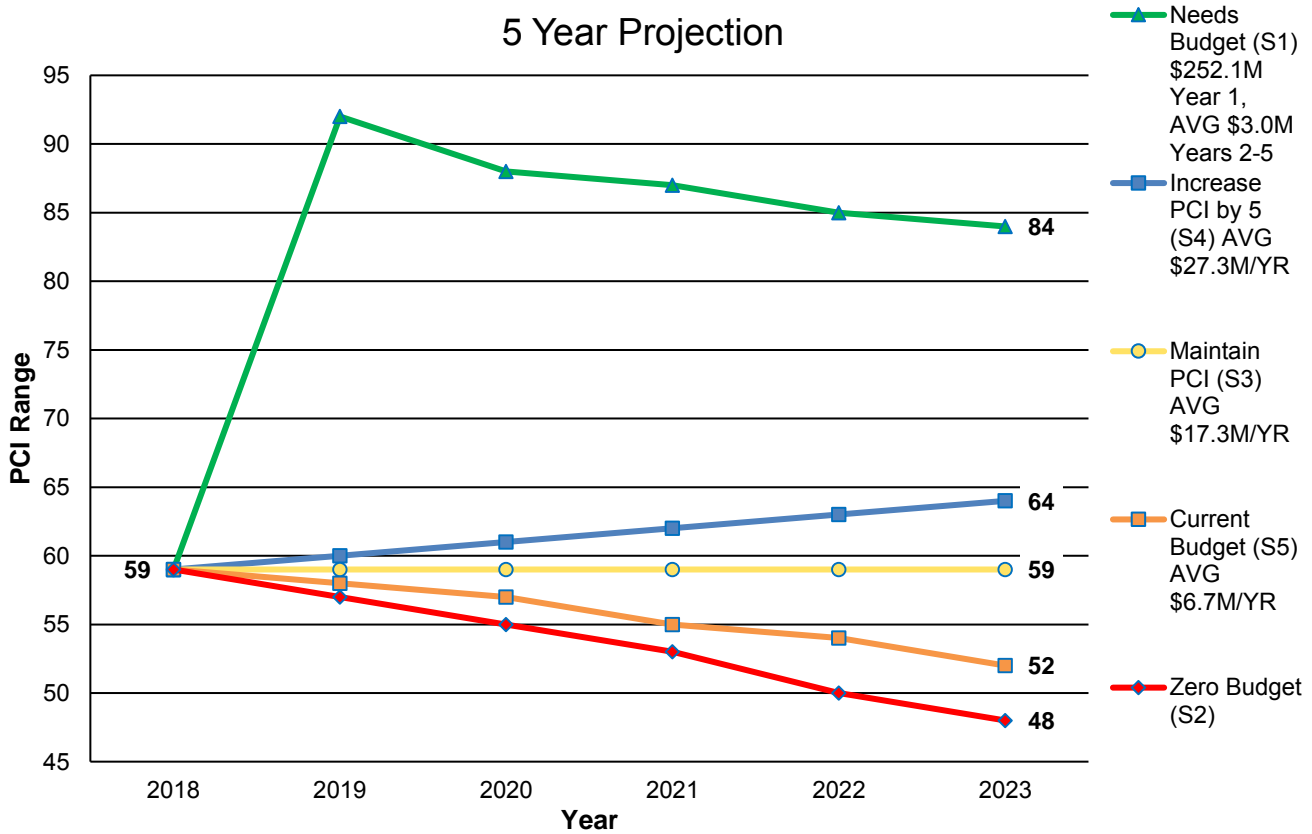
Unconstrained or Needs Budget

As an initial starting point, it is always helpful to calculate the overall needs of the entire system. For the “Needs” analysis, the PMP computes the next recommended treatment for each street segment, the year the treatment would be applied and the estimated cost of the treatment. The total “Needs” cost for 5 years is \$264,242,642. Spending this amount of money would bring the total system to a PCI of 84.

To gain a more realistic analysis of the impact on various levels of funding, PEI prepared additional budget scenarios. These include:

- Amount of funds needed to maintain current PCI
- Impact of the current funding amount (5 Year Plan)
- Budget needed to increase the overall PCI level by 5 points
- What happens if zero dollars are spent on the City’s street system?

For each of these scenarios, PEI performed 5-year projections, represented by the graphs below.





A brief summary of the 5-year scenarios are as follows:

Scenario 1 (S1): Represents the budget required based on the “Needs” of the system. Assumes all pavements are treated at their optimum timing. With an initial investment of \$252.1M in year one and an average of \$3.0M in years 2-5, the PCI increases from 59 to 84.

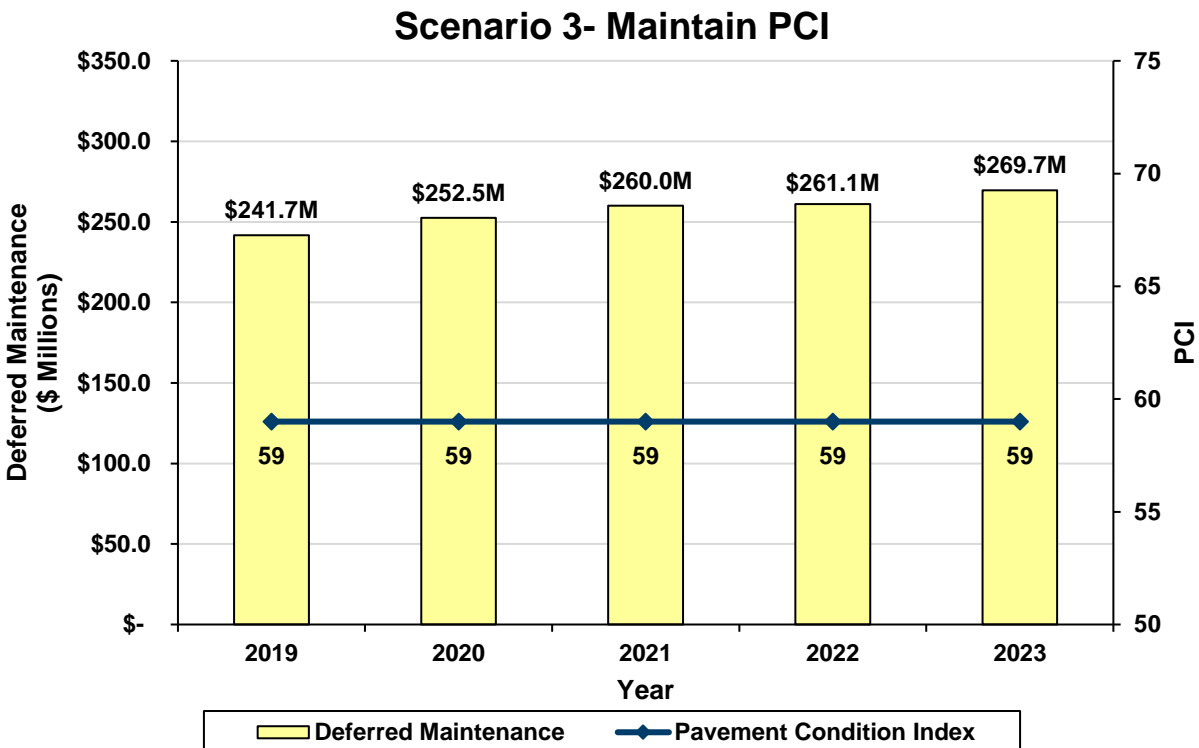
Scenario 2 (S2): Represents the impact to the PCI if Zero dollars are spent.

Scenario 3 (S3): Amount of funding to maintain the current PCI of 59 - \$17.3M/Yr. (Avg.)

Scenario 4 (S4): Budget to increase overall PCI by 5 points – \$27.3M/Yr. Avg. (Raises the PCI from 59 to 64).

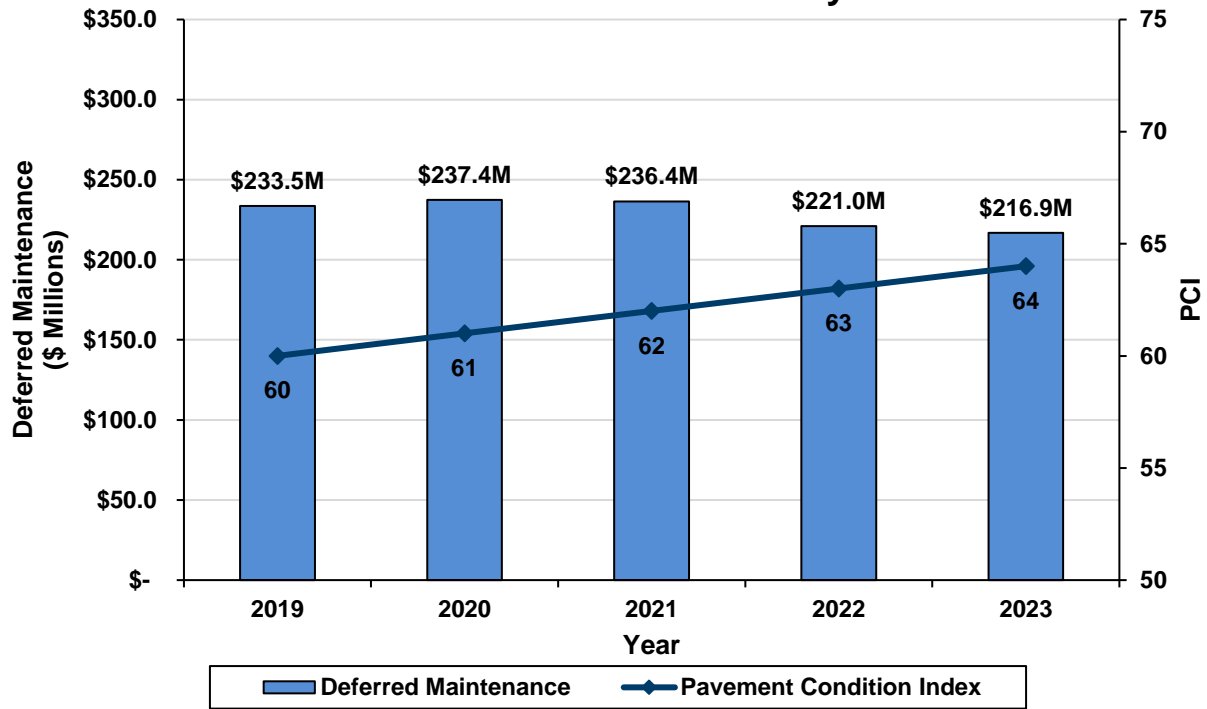
Scenario 5 (S5): Impact of the current 5 Year Plan (averaging \$6.7M/Yr.) The overall system PCI would be 52.

The following 3 graphs show Scenarios 3, 4, & 5 and the deferred maintenance amounts over the 5 years.

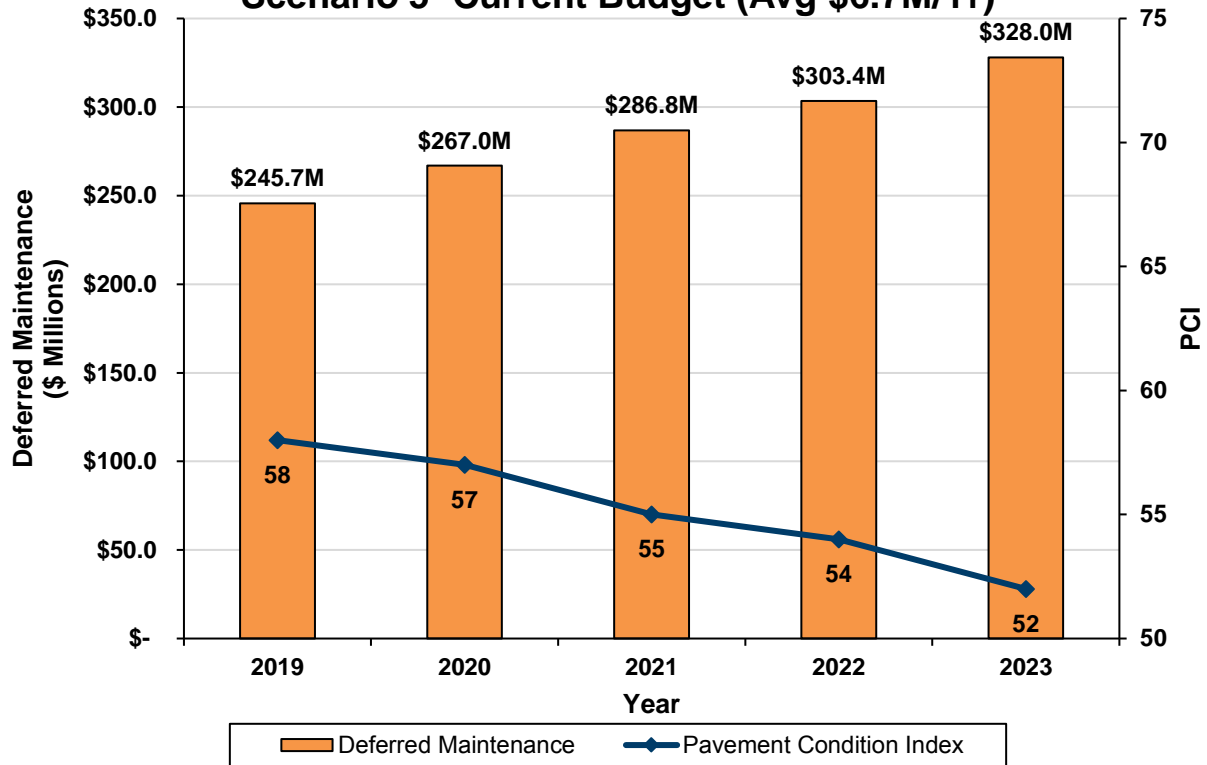




Scenario 4- Increase PCI by 5



Scenario 5- Current Budget (Avg \$6.7M/Yr)





CONCLUSIONS AND RECOMMENDATIONS

This Executive Summary provides a review of the 2018 Pavement Management System Update performed by PEI. PEI inspected and performed QC on all of the road segments in the City. The average overall PCI for the City is 59.

To maintain the system at its current overall PCI of 59, the City will need to spend an average of \$17.3M annually over the next 5 years. With the current budget in place at \$6.7M annually, over the next 5 years the PCI will be at a 52.

A review of the City's street system, by functional classification, shows that the arterial streets have the highest average PCI of 68, followed by the Collector streets with an average PCI of 65. Followed by the Residential streets, which have an average PCI of 56. As a general rule, agencies typically try to keep their arterials in the best condition because they carry the bulk of the traffic and loading, followed by collectors, then the residential/ local streets.

Moving forward, PEI recommends the City Implements a 5 year plan that will carefully evaluate the overall annual budget to determine the amount it wants to commit to pavement maintenance and rehabilitation projects. We recommend the City set priorities for each functional classification and perhaps certain streets within each classification.

This Pavement Management System will assist the City in its efforts to monitor treatments and track their effectiveness and help the City in setting future priorities and treatment policies. PEI suggests the City update its Pavement Management System on a regular basis and review entire system every three years. As the City maintains and updates its Pavement Management System, the program will continue to be a valuable tool in its efforts to maximize performance and minimize the spending for pavements.