FINAL REPORT

UPDATE OF
PAVEMENT MANAGEMENT PROGRAM
(Citywide)

2019-2024

City of Rancho Palos Verdes, CA
April 18, 2019

BUCKNAM | INFRASTRUCTURE GROUP, INC.

April 18, 2019

Mr. Charles Eder, P.E.
Senior Engineer
City of Rancho Palos Verdes
30940 Hawthorne Blvd.
Rancho Palos Verdes, CA 90275

Subject: Final Report - Update of the Pavement Management Program

Dear Charles:

As part of the 2019 Update of the Pavement Management Program for the City of Rancho Palos Verdes, Bucknam Infrastructure Group, Inc. is pleased to submit the Final Report for the City's pavement management program.

The information contained in this report was used to develop the recommended improvement program for the pavement network. The report covers the following categories:

- **Section I - Executive Summary**

- **Section II - Pavement Management Program Development and Reporting**

- **Section III - Pavement Conditions For Each Segment in the Network, PCI Report**
  The Pavement Condition Index report shows the present condition of each street in the pavement network. In addition, the report shows the basic geometry of each street segment.

- **Section IV - Forecast Maintenance Reports**

  - **Recommended Maintenance and Repair (M&R) Strategies**
    The recommended maintenance and repair strategies were used to generate the Forecasted Maintenance Report and were based on our 2019 inspections. Additionally, we have assessed and incorporated unit cost and maintenance application practices/types with our strategies.

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- **Projected Projects based on M&R Strategies**

  The Forecasted Maintenance Report projects the street maintenance activities required for the next five years, broken down to show maintenance levels for Arterials and Local streets. The report included in this section is broken down by fiscal year.

Our thorough analysis of previous and current Rancho Palos Verdes PMP strategies enabled our staff to make proactive recommendations to the City's pavement CIP. All comments received from the City have been incorporated in the reports that follow. All of the City's issues and needs that were brought to our attention are included in the report. It has been a pleasure working with you and the City on updating your Pavement Management Program. We look forward to the continued success of this project and future teamwork with City staff.

Sincerely,

Bucknam Infrastructure Group, Inc.

Peter J. Bucknam
Project Manager
Infrastructure Management – GIS Services

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Acronym Listing

Capital Improvement Program (CIP)
Geographic Information System (GIS)
Government Accounting Standards Board Statement 34 (GASB 34)
Hot-Mix Asphalts (HMA)
Los Angeles County MTA (METRO)
Maintenance and Repair (M&R)
Pavement Condition Index (PCI)
Pavement Management Program (PMP)

SECTION I
EXECUTIVE SUMMARY

2019 UPDATE OF PAVEMENT MANAGEMENT SYSTEM

This report reflects the continued dedication and proactive management of the City's Pavement Management Program (PMP); the last major update to the City's PMP was performed in 2016. As the City of Rancho Palos Verdes (RPV) continues to show limited growth with its population, demographics, infrastructure and maintenance needs, the street network has been running parallel as the system matures and capital street projects widen streets. The City of RPV developed its PMP with the use of an automated database program. Today, the City is currently using the Army Corps of Engineers software, MicroPAVER, to manage the street network. This system is essential to the City in that it assists Public Works staff in capturing funding for its arterial street system as well as cost-effectively manages the local network through proactive maintenance and scheduling. Under this project, the City has incorporated the development of a unique Pavement Management – GIS layer that will assist the City in spatially analyzing pavement conditions and other attribute information that resides in the MicroPAVER database.

The RPV PMP has been developed and maintained to assist City personnel in providing current data on the street network and to develop cost-effective maintenance strategies to sustain a desirable level of pavement performance on a network scale, while optimizing the expenditure of limited fiscal resources. The PMP efforts in 2019 consisted of analyzing the City's 2016 PMP dataset for quality and usability. In doing this, we were tasked to generate an updated Capital Improvement Program report that identified recommendations and deficiencies in the current operating and maintenance efforts put forth by the City.

For this project, our staff surveyed all arterial routes to assist the City in complying with Los Angeles County MTA (METRO) PMP requirements as well as surveyed all local streets and analyzed historical maintenance operations.

Specifically, the program provides administrators and maintenance personnel with:

- *The present condition status of the pavement network (arterial and local streets), as a whole and of any grouping or individual component within the City;*
- *A ranked list of all streets, or segments of streets, by condition within the network;*
- *Rehabilitation/maintenance needs of each street segment by year;*
- *An optimized priority maintenance and rehabilitation program based on cost/benefit analysis and various levels of funding;*
- *Optimum annual budget levels for pavement maintenance for the current and the following five (5) years;*
- *Prediction of the future performance of the City's pavement network and each individual street section;*
- *Updated PMP data to assist the City with GASB 34 compliance; and*

- *Pavement condition data and analysis presented in ArcGIS* that is compatible with City's existing GIS

Pavement is a dynamic structure where deterioration is constantly occurring; thus the pavement management system needs to be updated on a regular basis to reflect these changes in pavement conditions, pavement maintenance histories, and maintenance strategies based upon budgetary constraints. In our approach to develop the City's forecasted maintenance recommendations we worked with RPV staff in identifying unit costs for all maintenance practices used on an annual. Currently, based upon the City's maintenance practices and their associated unit costs, the total replacement value of the RPV pavement network is $194,619,000. This value clearly indicates that the City's pavement network is the most valuable and essential asset to RPV. The City's use of slurry seal and ARHM Overlay practices are typically applied at a seven year and fifteen year frequency respectively. These frequencies are typical but the City may see increases in deterioration rates due to environmental, load and high average daily traffic (ADT) volumes. For example, high ADT volumes along one of RPV's arterial streets will increase deterioration rates for a previously applied AC Overlay compared to a small local street. These deterioration rates are monitored through frequent inspections and functional class deterioration analysis within the City's PMP database.

This report reflects our findings and recommendations for the PMP and the current state of the City's pavement network. Furthermore, we have recommended detailed funding and maintenance strategies for the arterial/collector and residential networks for next five (5) years.

CITY'S PAVEMENT NETWORK

Within the Rancho Palos Verdes pavement management network there are approximately 41.5 section miles of Arterial streets. The Arterial network consists of approximately 6,997,925 SF of pavement which consists of 163 pavement sections. The Local network consists of approx. 17,620,075 SF of pavement which consists of 669 pavement sections totaling in 108.6 section miles. Combined, the entire network consists of 150.1 section miles of streets and 24,618,000 SF of pavement.

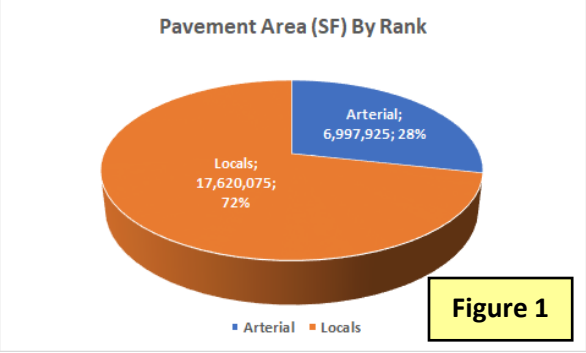

Figure 1

The City's pavement network is broken down into manageable groups that have similar characteristics, such as pavement rank, surface type and logical segmentation. Pavement segments are identified by their branch and section numbers. Pavement "branches" that have a common usage, such as Crest Rd., defines a "branch" within MicroPAVER. Pavement "sections" are pavement segments within the defined branch that have consistent pavement rankings, construction/maintenance histories and use. Representative inspection samples are then selected and visually surveyed to locate distress data. This data is used to calculate the pavement sections Pavement Condition Index (PCI) which includes distress type, extent of the distress and its severity.

The PCI is a condition rating that ranges from 100 (a new pavement section or recently overlaid or reconstructed) to 0 for a section that has structurally failed and deteriorated dramatically. Weighted average PCI of a given area/zone = pavement section PCI * its own area divided by the total square footage of the given area/zone. Table 1 summarizes the section conditions found within the City of Rancho Palos Verdes pavement network by rank.

- **The weighted average PCI for the City of Rancho Palos Verdes Arterial network is 87.4**

- **The weighted average PCI for the City of Rancho Palos Verdes Local network is 89.5**

The weighted PCI value associated with the Arterial and Local routes shown through our survey analysis is timely in that it is showing that a sensible amount of preventative, slurry seal, and overlay work will be needed over the next several years to maintain the level of condition (PCI) within a "preventative maintenance" state.

CURRENT CITYWIDE CONDITIONS (ARTERIALS AND LOCALS)

The overall condition of the City's pavement network is "Good" with a weighted average PCI of 88.9 based on the surface area of each segment. The distribution of the City's overall pavement network is shown in Section III of this report (Condition Distribution).

For comparison, Bucknam has performed pavement management studies for several other Los Angeles County agencies and has included their weighted PCI values; El Segundo (72.5), Culver City (73.6), Lomita (69.3), and Hermosa Beach (73.1).

Condition	PCI Range	Arterial	Local	Total	% of Network
Very Good	86-100	26.7	91.2	117.9	78.5%
Good	75-85	10.2	15.6	25.8	17.2%
Fair	60-74	3.4	1.6	5.0	3.3%
Poor	41-59	1.2	0.1	1.3	0.9%
Very Poor	0-40	0.0	0.1	0.1	0.1%
		41.5	**108.6**	**150.1**	

Table 1 – Condition Distribution by Mileage for All Streets

Rank	Mileage	SF	PCI 2013	PCI 2016	PCI 2019
Arterial	41.5	6,997,925	82.3	83.1	87.4
Locals	108.6	17,620,075	81.6	85.1	89.5
Citywide	**150.1**	**24,618,000**	**81.9**	**84.6**	**88.9**

Table 2 – Historical PMP Data for All Streets

As shown above, a large majority of segments are distributed through Good to Very Good condition categories (95%, approximately 143.7 section miles). These findings indicate that the proper maintenance has been performed on the pavement network for some time.

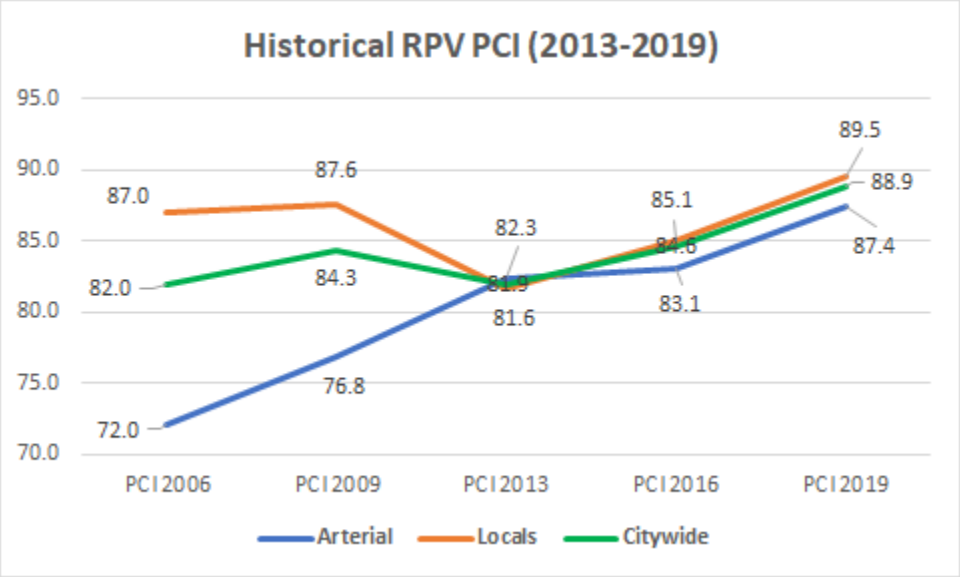

Figure 2 – Historical Rancho Palos Verdes PCI (2013-2019)

With 89% of the City's Arterial network pavement sections within the condition levels of "Good to Very Good" (approximately 36.9 section miles), a proactive preventative stop gap & timely overlay maintenance program needs to be continuously funded; this will maintain the citywide weighted PCI at its current conditions and will gradually decrease the existing overlay backlog on the network thus reducing maintenance costs in fiscal years 2019 and beyond.

Local/Residential network conditions show that 98% of the pavement network is within the condition levels of "Good to Very Good" (approximately 106.8 section miles). The remaining 2% of the Local network should be considered for slurry seal and overlay maintenance; this accounts for approximately 1.8 section miles of streets. The City utilizes a nine zone cycle approach which focus maintenance & rehabilitation efforts, on an annual basis, within strategic geographic areas.

The City's ability to proactively schedule effective Arterial CIP projects and Local M&R projects has resulted in very high citywide conditions. **These findings are positive in that the amount of revenue needed to maintain the network is not overbearing or detrimental to the system as a whole. Cost efficient preventative maintenance should be the focus of the Arterial & Local PMP for the next several years.**

Furthermore, as large overlay and rehabilitation projects are considered for funding, the City should also consider using sub-grade R - Values, non-destructive testing, structural design, distress severities and extents as parameters for determining whether a pavement section that lies within the Fair to Poor condition range should be overlaid or reconstructed.

PCI conditions reflect "surface" conditions; additional sub-surface data such as coring data, R-Values and asphalt depths will provide City to with a better approach to the maintenance that should be applied.

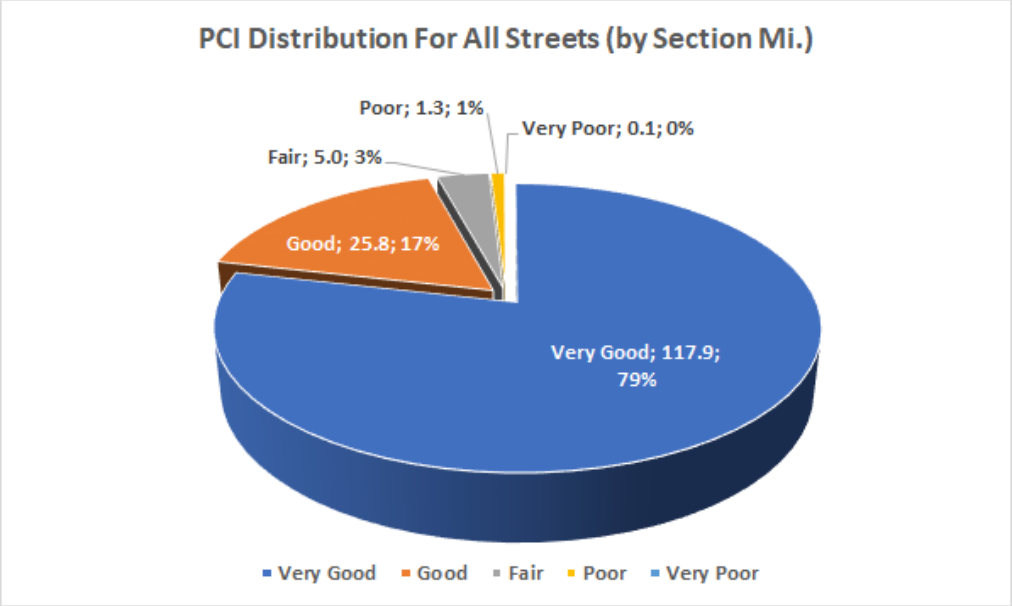

Figure 3 – PCI Condition Distribution All Streets (by Section Mi.)
Units shown above indicate total mileage (Table 1)

MAINTENANCE STRATEGY DEVELOPMENT

Based on the results of the condition survey and input from the City, pavement maintenance/rehabilitation strategies were developed. At the outset, the City and Bucknam staff identified a distribution of City maintenance funds that would be applied to the network over the next five years. This was based upon the desire to prevent the decrease in street conditions and not allow an increase in the maintenance backlog funds over the five-year program. All residential zone schedules were assessed and analyzed. Additionally, the RPV maintenance and rehabilitation zone cycle now utilizes a eight (8) cycle.

With this approach, Bucknam has recommended a "minimal level of service" which creates a major dividing line in determining pavement maintenance. Generally within pavement management programs, a PCI range between 55 to 70 determines the threshold of when preventative or major overlay maintenance is activated. Based on the City's weighted average PCI, condition distribution, maintenance practices, our team has identified a PCI of "65" as the minimum level of service. This means that any pavement section with a PCI greater than 65 will be recommended for preventative maintenance. This recommendation is indicated in Table 6, Section II.

Bucknam developed a multi-year Capital Improvement Program for the City based on the pavement records, yearly capital expenditures and the most recent 2019 inspections. These recommendations and results are shown in Section II of this report where we have demonstrated what level of funding is necessary to maintain the current PCI as well as how the City's current pavement budget performs against today's conditions.

As shown in Figure 3, 96% of the City's streets are in Very Good to Good condition. These sections will be targeted for "preventive" maintenance within our Capital Improvement Program (CIP) recommendations. The reasoning in doing this is to extend the life cycles of those "fair/good" pavement sections which accrues capital saving to aggressively rehabilitate those pavement sections that are below the "minimal level of service".

In order to achieve the most effective and optimum program for the City, certain strategies have been selected and/or analyzed. Below is a listing of the maintenance activities utilized in strategy development. Each activity is representative of the types of work that have been programmed as part of the long-term maintenance requirements of the City's street network.

General Repairs-Stop Gap (Localized Maintenance*)

For this maintenance type, small localized surface treatments are utilized as "holding action" solutions (stop gaps) to delay the need for pavement structural strengthening. They typically include activities such as crack sealing, deep patching, skin patching, grinding and leveling.

Slurry Seals (Global Maintenance*)

Surface treatments applied to pavements with minimal surface distress to provide new wearing surfaces and extend pavement life. Generally consists of a mixture of conventional or latex-modified emulsified asphalt, well-graded fine aggregate, mineral filler and water placed over an existing AC surface.

Leveling Courses (Global Maintenance*)

The existing pavement should be made as smooth as possible before being overlaid. It is difficult to make up elevation differences or smooth out ruts by varying overlay thickness. For flexible overlays, Hot-mix asphalt (HMA) tends to differentially compact; a rule of thumb is that conventional mixes will compact approximately 6 mm per 25 mm (0.25 inches per 1 inch) of uncompacted thickness.

Therefore, before applying the final surface course the existing pavement is typically leveled by one or both of the following methods:

1. Applying a leveling course (HMA pavements). The first lift applied to the existing pavement is used to fill in ruts and make up elevation differences. The top of this lift, which is relatively smooth, is used as the base for the wearing course.

2. Milling (HMA pavements). A top layer is milled off the existing pavement to provide a relatively smooth surface on which to pave. Milling is also commonly used to remove a distressed surface layer from an existing pavement.

Overlays (Major Maintenance*)

AC Overlay – Placement of a layer of hot-mixed asphalt concrete over the existing pavement surface (may include pavement fabric). Grinding (milling) is performed prior to the overlay to reduce the total height of asphalt and assure alignment with existing gutter lines.
This also includes "dig-outs" and crack sealing prior to the application of an overlay. This treatment provides a new wearing surface and increased structural strength to the pavement section. A conventional overlay should be designed for a ten-year life.

AC Over PCC – Placement of a layer of hot-mixed asphalt concrete over the existing PCC surface. Includes grinding, leveling course, joint sealing and localized repairs prior to AC overlay.

Asphalt Rubber Hot-Mix Overlay - The ASTM definition is: Asphalt-Rubber is a blend of asphalt cement, reclaimed tire rubber and certain additives in which the rubber component is at least 15% by weight of the total blend and has reacted in the hot asphalt cement sufficiently to cause swelling of the rubber particles. Specifically, using crumb rubber modified binders in pavement application benefit local agencies in that cities find:

- Pavement resists cracking by being more flexible;
- Cost savings come from a longer life cycle (from Bucknam's experience typically 20% longer), decreased maintenance and the use of less material
- Improvement in skid resistance;
- Decreased noise; and
- It provides long-lasting color contrast for marking and striping

Reconstruction (Major Maintenance*)

Removal of the existing pavement section to a prescribed depth followed by the placement of a conventional flexible pavement section using a structural AC Hot Mix or AR Hot Mix or a full depth asphalt. Each classification of road has a typical design cross-section upon anticipation traffic loading.

*Localized, Global and Major maintenance activities are default terms used within the MicroPAVER pavement software. Specific pavement repair applications are placed within each maintenance activity in order to develop multi-year maintenance forecast recommendations.

ANNUAL BUDGET PROJECTIONS

The budgeting process was approached with the following in mind; generate two unique work programs for the next five (5) years based upon actual road pavement conditions in order to:

1. Demonstrate how the City's current "Actual" budget allocation for pavement maintenance performs against the conditions found through our surveys

2. Recommend a proactive annual budget that, at a minimum, maintains the current weighted PCI on the network

The revenue shown below are baseline AC/PCC construction cost projections that the City utilizes for determining and scheduling key annual pavement section projects. Additional contingency costs, like those listed in Section II page 5, are calculated by City staff to determine the overall, proactive zone budget for the given fiscal year. The City is now utilizing an eight (8) year cycle for maintenance and rehabilitation.

Based on current and future pavement maintenance needs, two annual work programs have been prepared and summarized below. Table 3 demonstrates the pavement maintenance recommendations based upon the revenues available in the RPV five-year CIP program. Table 4 demonstrates the recommended budget that is needed to maintain the current weighted PCI on the network (each scenario addresses arterial and local streets).

Plan Year	PCI Before	PCI After	Slurry Seal	Overlay	Total $
2019-20	88.9	89.1	$336,500	$1,520,500	$1,857,000
2020-21	88.2	88.8	$81,400	$1,619,400	$1,700,800
2021-22	87.5	88.3	$576,900	$1,558,400	$2,135,300
2022-23	86.3	87.3	$476,900	$1,384,500	$1,861,400
2023-24	85.1	86.0	$631,000	$1,291,000	$1,922,000
			$2,102,700	**$7,373,800**	**$9,476,500**

Table 3 – Citywide Projection Utilizing "Actual" Budget

Plan Year	PCI Before	PCI After	Slurry Seal	Overlay	Total $
2019-20	88.9	89.1	$515,400	$1,520,500	$2,035,900
2020-21	88.2	88.8	$212,900	$1,619,400	$1,832,300
2021-22	87.5	88.9	$722,100	$1,287,500	$2,009,600
2022-23	87.7	88.5	$677,500	$1,447,100	$2,124,600
2023-24	87.5	88.3	$881,300	$1,305,400	$2,186,700
			$3,009,200	**$7,179,900**	**$10,189,100**

Table 4 – Five-Year Projection Demonstrating Required Budget to Maintain PCI of 88.9

Additional detail and breakdown of budget projections are demonstrated in Section IV of this report. All work program budgets generated are presented in terms of current 2019 dollars. All repair activities were based on distresses observed at the time of the field survey. These are recommendations and are to be used as "the best case scenario" for improving the City of Rancho Palos Verdes street network.

QUALITY CONTROL EFFORTS

As indicated in our scope of work, Bucknam performed numerous quality control checks in the field during survey efforts as well assessing the provided 2016 MicroPAVER database. Only minimal pavement segmentation corrections had to be made prior to field survey as well as the re-establishment of the PMP-GIS link. These included splitting sections based upon street width and/or age of asphalt; naming conventions for several sections were also made to ensure proper from-to designation.

Field check efforts were performed at the end of each week of survey. During in-house and field operations, we came across several issues with the previous databases. These included incorrect pavement section true areas; these were corrected through our assessment of the most recent/available RPV aerial and field inspections.

FINDINGS AND RECOMMENDATIONS

Arterials

The actual workload requirements identified indicate that the Arterial street network is currently in "Good" condition. To maintain this condition, it is critical that preventive maintenance and overlay activities are funded at the levels identified in Table 4 and the reports in Section IV to maintain a good network weighted average PCI value.

Our arterial findings for conditional data and recommendations for revenue expenditures are shown below:

- The Arterial network has a weighted PCI of 87.4;
- Currently, 8% of the arterial network (approx. 3.2 section miles) qualify for overlay rehabilitation; currently 28% qualifies for slurry seal maintenance (approx. 11.8 section miles);
- Arterial capital projects should focus on maintaining the current weighted PCI of 84 over the next five years;
- Develop a proactive fiscal and planned approach to identify arterial overlay projects based on the deterioration modeling within MicroPAVER;
- Maintain arterial revenues at the levels shown within the Section IV Forecasted Maintenance Report for a minimum of five years to generate the results identified within this report.
- Reassess/re-evaluate the arterial rehabilitation budget program every two years to improve on CIP forecasts for 2019-20 and beyond to ensure the results shown in Table 3 or 4;
- Perform pavement inspections on the arterial network every two years to build a solid planning model within MicroPAVER to track PCI deterioration.
- Demonstrated budgets shown in Table 4 is ample enough to maintain the arterial weighted PCI of 88.9 through five years,
- Bucknam recommends that the City proactively budget pavement maintenance at the levels shown in Table 4 in order to improve upon the conditions found today

Locals

The actual workload requirements identified indicate that the Local street network is currently in "Good" condition. To maintain this condition, it is critical that preventive maintenance and overlay activities are funded at the levels identified in Table 4 and the reports in Section IV to maintain a good network weighted average PCI value.

Our Local findings for conditional data and recommendations for revenue expenditures are shown below:

- The Local network has a weighted PCI of 89.5;
- Currently, 1% of the local network (approx. 1.1 section miles) qualify for overlay rehabilitation; currently 15% qualifies for slurry seal maintenance (approx. 16.3 section miles);
- Local maintenance projects should focus on maintaining the current weighted PCI of 84 over the next five years;
- Develop a proactive fiscal and planned approach to identify Local overlay projects based on the deterioration modeling within MicroPAVER;
- Increase Local revenues at the levels shown within the Section IV Forecasted Maintenance Report for a minimum of five years to generate the results identified within this report.
- Reassess/re-evaluate the Local rehabilitation budget program every two years to improve on budget forecasts for 2019-20 and beyond to ensure the results shown in Table 3 or 4;
- Perform pavement inspections on the Local network every three years to build a solid planning model within MicroPAVER to track PCI deterioration (1/3 of the City each year);
- Demonstrated budgets shown in Table 4 is ample enough to maintain the Local weighted PCI; proactive funding needs to be implemented to see these results.

SECTION II
PAVEMENT MANAGEMENT SYSTEM / CAPITAL IMPROVEMENT PROGRAM

Bucknam performed the following services in accordance with the scope of services that was contracted with the City of Rancho Palos Verdes. As a quick overview, the following tasks were performed to complete the work over the past several months:

2019 Pavement Management Work Efforts:

Task 1: Project Kickoff-Data Management

Task 2: Update of Maintenance Activities

Task 3: Pavement Condition Survey (approx. 145.5 miles)

Task 4: Budgetary Analysis and Capital Improvement Reports

Task 5: Executive Summary and Final CIP Reports

Task 6: Mapping of the Pavement Network

Pavement Management Update 2019

As a part of the 2019 update of the pavement management system, a major element of work was to complete a comprehensive assessment of the existing street network and PMP database within the City. This included assessing the City's existing 2016 MicroPAVER database, GIS street centerline, street naming conventions and work history information. From there, Bucknam worked with the City to confirm public and private street listings which set the foundation for accurate CIP reporting. All data was then verified or updated within the City's new MicroPAVER database.

Work history information was provided by the City in the form of completed bid documents, institutional knowledge, and previous dataset and Excel documents. This information was entered into the proper pavement segments that match the limits of those projects. From there, CIP pavement recommendations were performed (discussed and demonstrated below) where the pavement maintenance information the City provided (PMP material practices, unit costs, and capital budgets) were used to generate recommendations through the MicroPAVER system.

Table 5 demonstrates PCI ranges defaulted within MicroPAVER. Once a pavement inspection is complete, a PCI is calculated for each pavement section. Each PCI calculated falls within a defined PCI range category (Very Good, Very Poor, etc.). Furthermore, a weighted PCI was calculated for the each functional class within the network (arterials and locals).

The PCI is a condition rating that ranges from 100 (a new pavement section or recently overlaid or reconstructed) to 0 for a section that has structurally failed and deteriorated dramatically. Weighted average PCI of a given area/zone = pavement section PCI multiplied by its own area divided by the total square footage of the given area/zone. This information can also be represented through MicroPAVER to show how much square footage or percentage of area falls within a PCI range category.

PCI RANGE	CONDITION
86-100	***Very Good (RPV Network 2019 = 88.9)***
75-85	Good
60-74	Fair
41-59	Poor
0-40	Very Poor

Table 5 - PCI Range

These condition ranges are defined by the Army Corps of Engineers and defaulted within the MicroPAVER software. The summary of all roads condition data and their representative PCI's can be seen in the Pavement Condition Report in Section III.

STRATEGY ASSIGNMENT TABLE

Once the appropriate activities from the above listings were selected by the City, a Maintenance Strategy Table was defined within the system that allocated the appropriate actions to the specific repair needs of the street. In defining the maintenance strategy list, emphasis was placed on defining pavement condition thresholds and using the PCI for the specific maintenance activities within these categories.

Strategy Assignment Table

All Streets		
PCI Range	**Description**	**Unit Cost**
20-100 Varies by Activity	Preventative, Stop Gap, Patching	Varies by Activity
60-85	Type II Slurry Seal	$0.26/SF
60-85	Cape Seal (ARAM + Type II Microsurface)	$0.87/SF
Minimal Level of Service (65)		
20-60	3" AC Grind & Overlay (Local)	$3.55/SF
20-60	3" AC Grind & Overlay (Arterial)	$4.46/SF
0-20	AC Recon 4" / 6" CAB	$7.90/SF
0-20	PCC Recon	$10.90/SF
	30% Contingency included within All Unit Costs	

Table 6 - Strategy Assignments

The Strategy Assignments List, shown in Table 6, was developed to identify the most critical segments in each of the work programs (Arterial and Local). Segment priorities were established by determining the range of PCI's requiring first attention based on the relative value of each segment's PCI, thus maximizing the annual maintenance budget. Also, distress quantity, area extent, type and severity were critical elements in the decision process for recommending maintenance.

The assignment table is used as a guide within MicroPAVER to recommend maintenance, however, further assessment by City staff and/or outside parties can override maintenance recommendations. This can be done by reviewing and assessing distress extents and their weighted percentages.

Once the strategy assignments were set within the system, budgets and work assignments were generated for each work program on an annual basis. Using pavement deterioration curves for each type of pavement surface and class of road, both current year and future years work requirements for each pavement segment within the City were determined. In forecasting the maintenance requirements in future years, the current PCI value is reduced annually for each pavement segment based on the MicroPAVER deterioration curves within the City's database.

Likewise, maintenance activities performed in a given year increase the PCI value as they are applied to the segment. The overall program is dynamic in that each strategy consists of a cyclic series of actions that simulates the pavement anticipated life cycle.

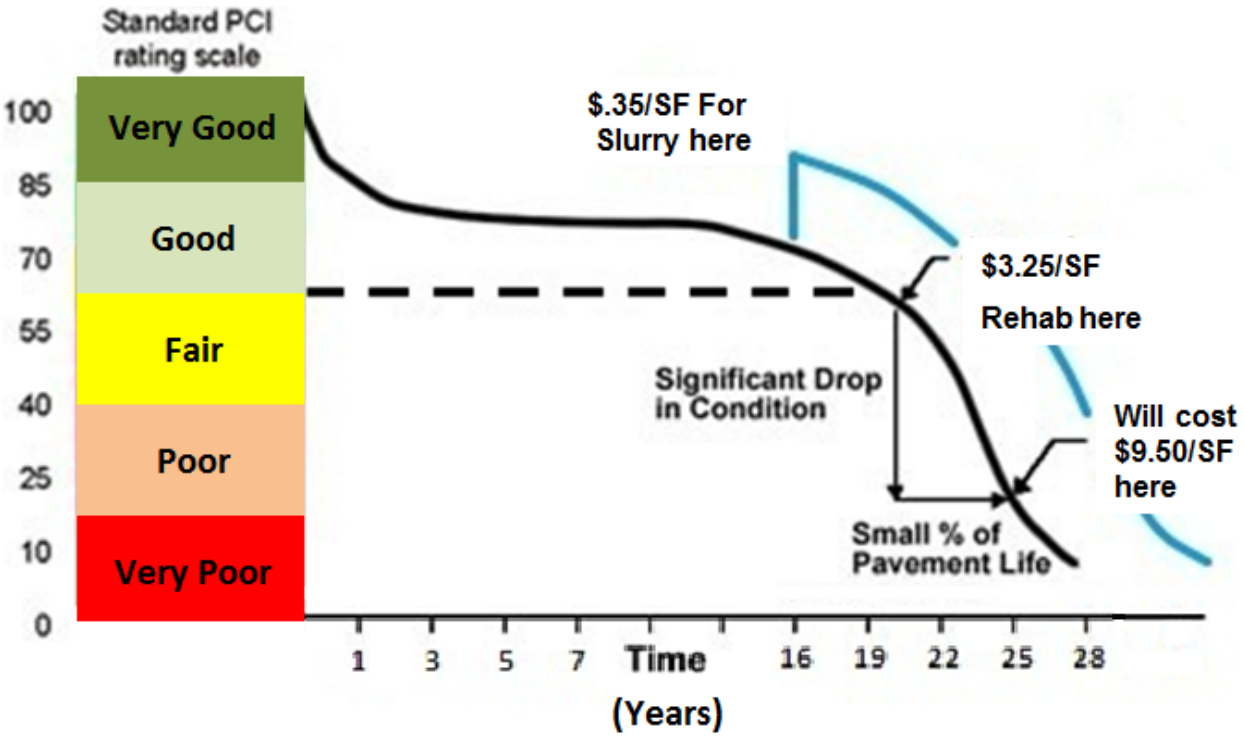

Figure 4 – Sample Pavement Life Cycle

MULTI-YEAR ANNUAL CIP/M&R PROGRAM PROJECTIONS

The goal of these projections is to assist City policy makers in utilizing the recommendations of the MicroPAVER system. By using the City of Rancho Palos Verdes' current budgets and maintenance practices the system will develop "section unique" improvements and strategies. Each segment will be tied to a specific fiscal year. As shown in the following pages, we have assessed the budgets that have been projected to meet the maintenance and rehabilitations needed to maximize the City's return on investment. The budget forecasting goal for the City network focused on:

- Establishing a proactive multi-year Maintenance & Rehabilitation Program;
- Developing a preventive maintenance program; and
- Selecting the most cost-effective repairs based on City strategies

ACTUAL BUDGET – The Actual budget was generated for the City to demonstrate how the City's 5-Year Roadway Infrastructure funding allocation performs against the current citywide conditions.

- City's Actual budget includes:
  - Arterials projects (Crenshaw and Highridge were included within Arterial projections)
  - Local are funded at:
    - FY 2019-20 - $5,500,000 (Zone 5)
    - FY 2020-21 - $5,500,000 (Zones 9)
    - FY 2021-22 - $5,500,000 (Zone 8)
    - FY 2022-23 - $5,500,000 (Zones 3 & 4)
    - FY 2023-24 - $5,500,000 (Zone 1)
  - Projects are funded through General Fund, Proposition C, STPL, & Measure R

MAINTAIN BUDGET – A Maintain budget was generated for the City to demonstrate the necessary funding that is required to maintain the current weighted PCI level of 88.9 through a five year model.

All multi-year budget projections include a 3% inflation rate for the term of the budget forecast.

ARTERIAL / LOCAL
BUDGET PROJECTIONS

The annual projected revenues shown below only account for the cost of pavement maintenance and rehabilitation activities. A 30% construction contingency was applied and included to the pavement costs shown in Table 6. Additional soft costs not included within the cost of pavement maintenance include:

Rancho Palos Verdes Incidental PMP Costs	
Sidewalk Repairs	Traffic control signing
Driveways	Street markings
Cross gutters	Utility adjustments
Local depressions	AC Localized repairs
Asphalt berms	Engineering-Construction Management
Tree root pruning	Inspection
Striping	Material testing
Right-of-way, curb & gutter, ADA improvements	Tree removals

These incidental costs are monitored and applied to the City's annual zone construction & maintenance cost projections. Additional incidental contingency factors of approximately 100% to 120% have been calculated by City staff. These added contingencies assist City staff in identifying how to allocate the annual $5,500,000/yr budget. The following budget projections demonstrate AC/PCC construction costs only.

Our projections demonstrate an industry standard five-year PCI / Deferred M&R program; the City of Rancho Palos Verdes utilizes a eight-year maintenance cycle which is assessed and reported on every two-years through these types of PMP studies. This proactive audit allows staff to monitor RPV's weighted PCI's and allocated budgets which in turn ensures solid management practices.

ACTUAL – The first key step in developing a proactive PMP is to model the City's existing conditions against the "actual" annual budget. In doing this, PCI performance, deferred maintenance and pavement application uses are able to benchmarked and demonstrated in a positive or negative result. The City's existing 5-Yr Roadway Infrastructure budget was used for this model; the City provided Bucknam with current 2019 unit costs for pavement maintenance applications.

The resulting PCI conditions and resulting M&R distributions are shown below. Bucknam worked with the City's Public Works staff to review previous methodologies and schedules applied by the City. The City provided information on the current work schedules and yearly goals for asphalt application. With this scenario, our initial goal is to provide the City with a budgetary outlook and conditional impact report that can be used to eventually create a solid, preventative maintenance program.

ACTUAL BUDGET PROGRAM

Actual Budget Program incorporates pavement sections that have a functional class of Arterial (A), Collector (C) and Locals (E).

Plan Year	PCI Before	PCI After	Slurry Seal	Overlay	Total $
2019-20	88.9	89.1	$336,500	$1,520,500	$1,857,000
2020-21	88.2	88.8	$81,400	$1,619,400	$1,700,800
2021-22	87.5	88.3	$576,900	$1,558,400	$2,135,300
2022-23	86.3	87.3	$476,900	$1,384,500	$1,861,400
2023-24	85.1	86.0	$631,000	$1,291,000	$1,922,000
			$2,102,700	$7,373,800	$9,476,500

Table 7 – Citywide Projection Utilizing "Actual" Budget ($5.5 Mil/yr)

By modeling the existing pavement conditions against the City's available funding, we have found that three major positive results occur over the five year CIP. (See Figure 5 on the following page). First, the weighted PCI for the entire network remains very high over the five year CIP (PCI results in 86 by FY 2023-24); this reduction in overall PCI is expected through the natural/necessary degradation of PCI. Pavement sections with high level PCI >85 should be allowed to natural deteriorate to a PCI that triggers proper maintenance (<85).

Secondly, the resulting deferred maintenance backlog shows that it decreases as well from $8.7 million to $1.2 million after the five years program which indicates that an annual "Roadway Infrastructure" budgets are ample enough to improve upon the deferred maintenance (or backlog of maintenance) on the network. The current budget allocation is allowing the necessary zone slurry seal & overlay projects to be completed on the arterial and local networks; this in turn reduces a potential high amount of maintenance to latter years of the CIP thus decreasing the costs of maintenance.

This result should be discussed further among City staff. Combined with the positive results found with the weighted PCI and deferred maintenance we recommended that this 5-yr maintenance schedule be followed.

This situation indicates that the City is in an excellent situation where a continued proactive slurry seal program, combined with strategic and timely overlays, will allow the City to remain in a "preventative maintenance" condition. This equates to lower cost annual maintenance costs for FY 2023 and beyond and proactive management of RPV streets and right-of-ways.

With today's economic issues at the Federal, State and local levels; the City should continuously monitor the management of overlay deferred maintenance. The potential delay in projects and the resulting buildup of more overlay work in the five-year time frame is not a debt that City will want to accept.

Through Bucknam's analysis of the previous pavement database, work history dates and our experience with AC Overlay deterioration rates, it is important to point out that pavement sections that were overlaid in fiscal year 2006 will typically need proper overlay maintenance around fiscal year 2019-20 and beyond.

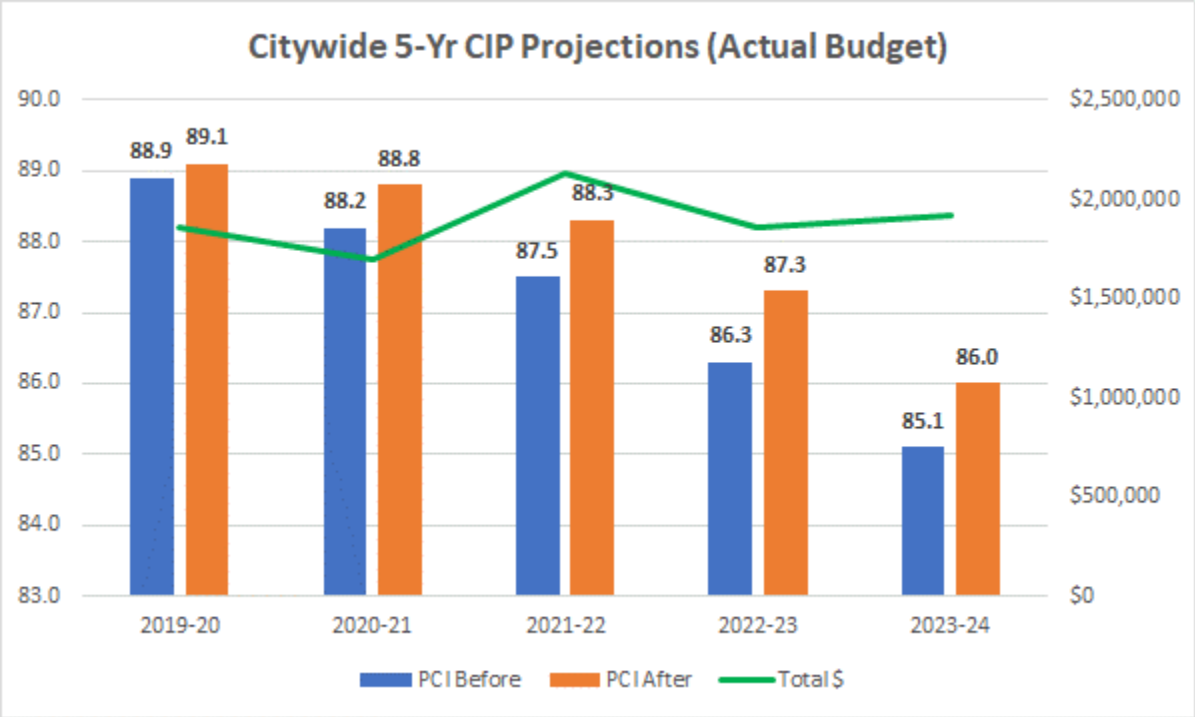

Figure 5 – Resulting Network PCI and Budget Expenditures (Actual Budget)

The resulting "increase of the weighted PCI" for the entire network demonstrates how applying proper funds to the network is preventing the City's pavement from deteriorating at a rate that is not conducive to a PMP success. Based on available funding or programmed funding identified by the City's long-term CIP, there may be an opportunity to proactively schedule or appropriate funds to areas of the City that have been annually deferred due to high maintenance costs.

Additionally, the City should continue to implement local, stop gap maintenance (i.e. deep patching, crack sealing, etc.) prior to any major slurry seal or overlay maintenance. By performing stop gap measures to individual pavement sections the overall performance of the sections condition will increase and sustain itself longer than if no preventative maintenance was performed.

MAINTAIN PCI PROGRAM (FIVE YEAR MODEL)

With the City striving to show proactive maintenance across all City pavements, a budget program was generated to show the greatest return on investment through the application of slurry seal, mill & cap, and alternative overlay maintenance. Our goal under this model is to maintain the current 2019 weighted PCI of 88.9 through a five-year program. This model will demonstrate the necessary funding to achieve this goal.

Again, we used the "Actual" 5-yr PMP model (shown above) as a cornerstone for our modeling within the "maintain" program. Combining the previous reporting model with a realistic and achievable annual budget, we found positive results.

The Recommended Program incorporates pavement sections that have a functional class of Arterial (A), Collector (C) and Local (E).

Plan Year	PCI Before	PCI After	Slurry Seal	Overlay	Total $
2019-20	88.9	89.1	$515,400	$1,520,500	$2,035,900
2020-21	88.2	88.8	$212,900	$1,619,400	$1,832,300
2021-22	87.5	88.9	$722,100	$1,287,500	$2,009,600
2022-23	87.7	88.5	$677,500	$1,447,100	$2,124,600
2023-24	87.5	88.3	$881,300	$1,305,400	$2,186,700
			$3,009,200	$7,179,900	$10,189,100

Table 8– Five-Year Projection Demonstrating Required Budget to Maintain PCI of 88.9

Referring to Table 8, it is noted that the weighted PCI remains at 88.9 after the five-year budget analysis. Furthermore, the annual deferred maintenance total also decreases from $8.7 million to $750,000 at the end of the five-years if the City utilizes an annual budget average of $2,037,800/yr for slurry maintenance and overlay rehabilitation. We found that annual average square footage breakdowns of maintenance areas were consistent and well balanced.

We recommend that the CIP/maintenance funds be focused on the Local & Arterial networks evenly due to the fact that both networks are now within a less than 1% PCI variance.

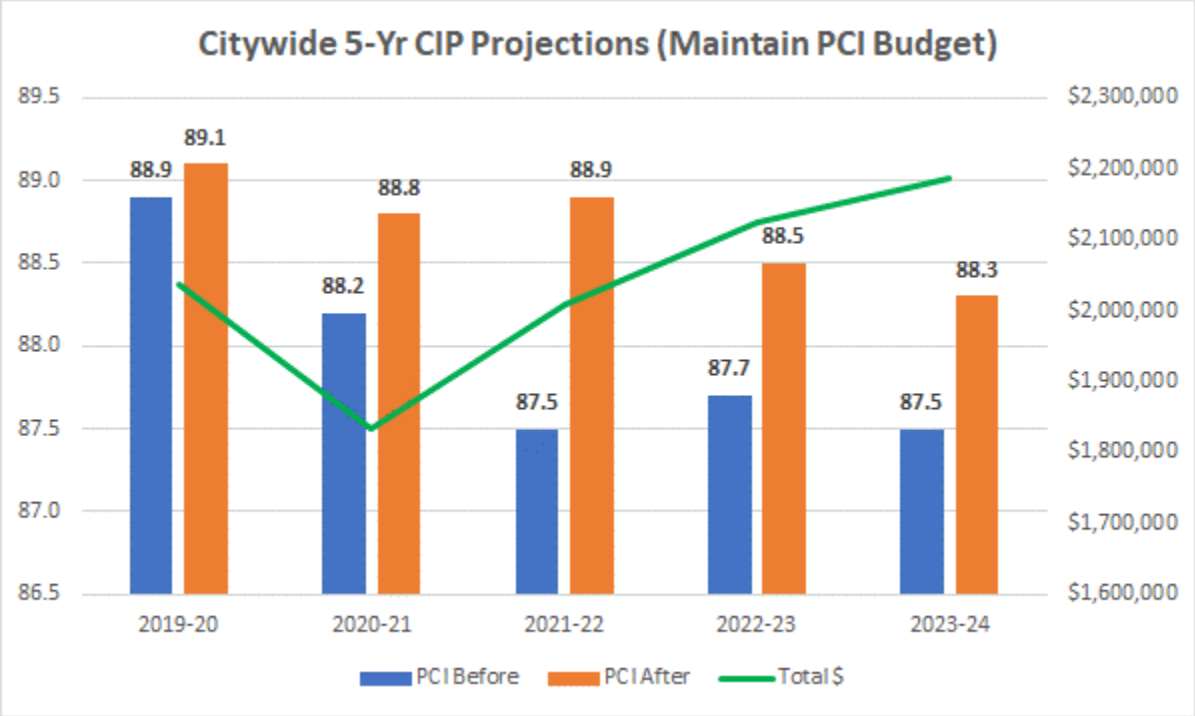

Figure 6 – Resulting Network PCI and Budget Expenditures (Maintain Budget)

As mentioned above, a local slurry/overlay maintenance "zone/area" strategy should be continued for several reasons. With the City applying a maintenance area methodology to the local network, four beneficial impacts occur:

1) Planned / Maintenance areas are addressed every seven years which creates a dedicated project schedule for City staff and constituent inquiries;
2) Deferred overlay maintenance can be addressed in a more effective manner due to accrued revenues
3) A preventative maintenance strategy is more cost-effective in a long-term PMP rather than implementing a maintenance approach that addresses only the "worst-first" streets.
4) All maintenance alternatives are available due to the increased funding and focused maintenance within one zone per year.

On the negative side, if low weighted PCI values occur within a given zone, all streets within that zone may not be able to be addressed with maintenance when that zone is scheduled for maintenance. The deferred maintenance will have to be scheduled for maintenance in future years or simply will have to wait until the zone cycle repeats.

The Local maintenance model that has been developed under the Actual budget can be used as a benchmark to monitor the City's annual budget allocations as the network continues to mature and age; the proper amount of funding for slurry seal and overlay maintenance needs to be the City's highest priority.

Additionally, it is recommended that the City continue to monitor the application of Slurry Seal or Grind & Overlay as an asphalt application for the specific local sections. Specific sections are now qualifying for maintenance that warrants a stronger application rather than a typical slurry seal. With a five to eight year cycle in motion, it is essential to address local sections that have PCI's less than 65 with the proper maintenance since crews will not be back within that area for seven to eight years.

DEFERRED MAINTENANCE

Delaying repairs on streets where pavement condition indicates a need creates deferred maintenance. Deferred maintenance includes pavement maintenance / rehabilitation that is needed across the entire network, but cannot be performed due to the lack of available funding and is pushed to the next budget cycle. The actual repairs that are being deferred are often referred to as a "backlog".

As maintenance is deferred, the opportunity to apply life extending preventive pavement applications is lost and the ultimate cost of rehabilitation multiples.

PAVEMENT MANAGEMENT SYSTEM REPORTS

In addition to the annual budget scenario, this report contains a comprehensive and complementary assemblage of pavement management reports ranging from summary reports to annual maintenance and rehabilitation schedules (Forecasted Maintenance Report, Section IV). Collectively as well as individually, the reports represent reasonable projections of pavement maintenance needs and performance based on visual condition assessments, unit cost estimates, and pavement deterioration models.

It is important to note that pavement segment dimensions and surface area (recorded during 1999-2016, 2019 inspections, along with the action and repair costs, as presented within the reports are accurate within tolerable limits. This is noteworthy due to the "implied" accuracy of reporting length and width to the nearest foot, surface area to the nearest square foot, and action and repair unit costs and project estimates to the nearest penny and dollar, respectively.

NEXT STEPS

As with any infrastructure management software program, time investments need to be made by key Public Works staff to maintain the integrity of the data as well as the accuracy. Bucknam can perform training sessions in the use of the MicroPAVER system and demonstrate how to generate standard maintenance reports to assist City staff in developing yearly budgets, project level analysis, and CIP projections. This will be key to future staff management of the pavement program and reporting. City personnel need to maintain their commitment to the preventive maintenance system, while working toward reducing the City's present backlog of rehabilitation projects.

In order to ensure that report outputs are accurate and credible, it is essential that the integrity of all data files be maintained. This will require performing all necessary updates when changes are made to scheduling scenarios, unit cost information, historical data, etc.
In addition, the entire pavement network will have to be re-inventoried at regular intervals. This typically includes surveying arterial every two years and locals every three. One recommendation the City may consider to keep the program “managed” is”

- Survey half the arterials each year; and
- One-third of the locals each year

This will not only allow work to be scheduled based on the most current condition data available, but will provide City personnel with a means to monitor actual rates of pavement deterioration so appropriate modifications can be made to the system curves. To be compliant with the MTA requirements, the City must generate a triennial Arterial network pavement management report indicating condition ratings.

Bucknam will be supporting the City with staff level support to assist in the continuous updates with the MicroPAVER system. This will include work history updates, generating reports from the system, unit cost updates, and future inspections.

CONDITION DISTRIBUTION REPORT

This report graphically depicts the distribution of the pavement condition throughout the street network by area.

The condition scheme ranges from "Very Good" to "Very Poor"; with a "Very Good" condition corresponding to a pavement at the beginning of its life cycle, and a "Very Poor" condition representing a badly deteriorated pavement with virtually no remaining life.

The table below shows the general description for each pavement condition:

Condition Description – PCI Range - Description

Very Good (86-100) - Minor to low distress, no significant distress. Little distress, with the exception of utility patches in good condition, or slight hairline cracks; may be slightly weathered ***(City of Rancho Palos Verdes citywide weighted average PCI is 88.9).***

Good (75-85) - Slight to moderately weathered, slight distress, possibly patching

Fair (60-74) - Severely weathered or slight to moderate levels of distress, generally limited to patches and non-load-related cracking.

Poor (41-59) - Moderate to severe distresses including load-related types, such as alligator cracking.

Very Poor (0-40) - Severely distressed, large quantities of distortion or alligator cracking. Failure of the pavement, distress has surpassed tolerable rehabilitation limits.

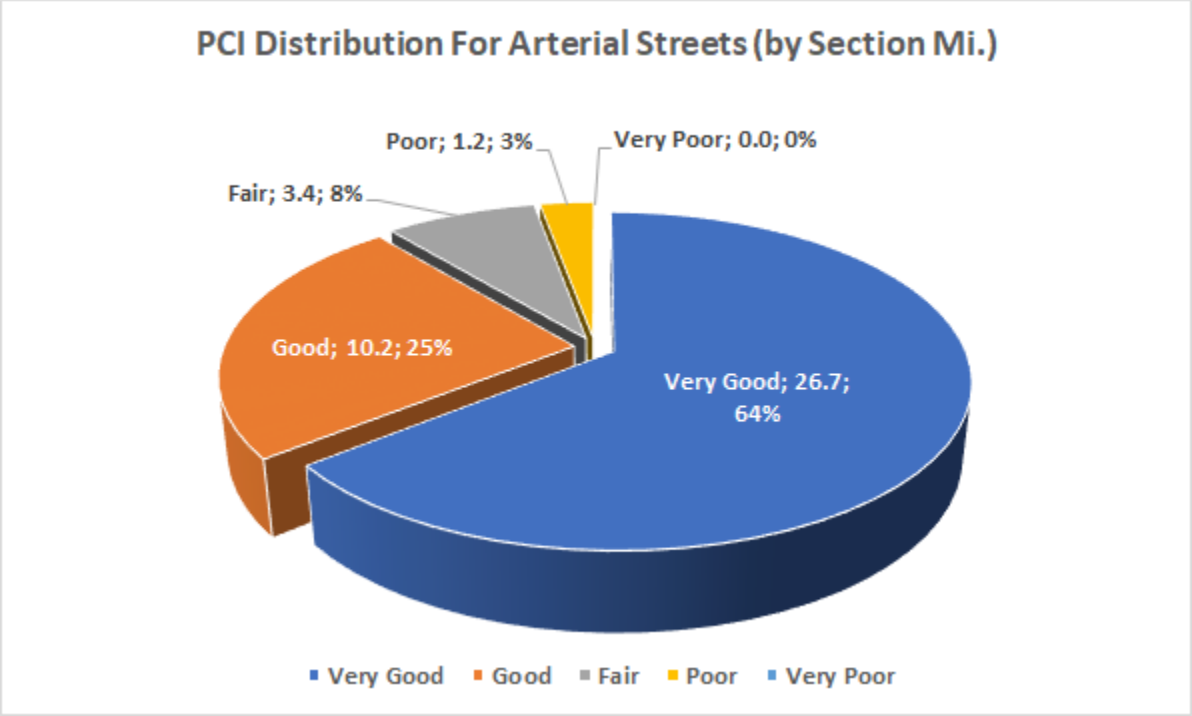

Figure 7 – Arterial Condition Distribution

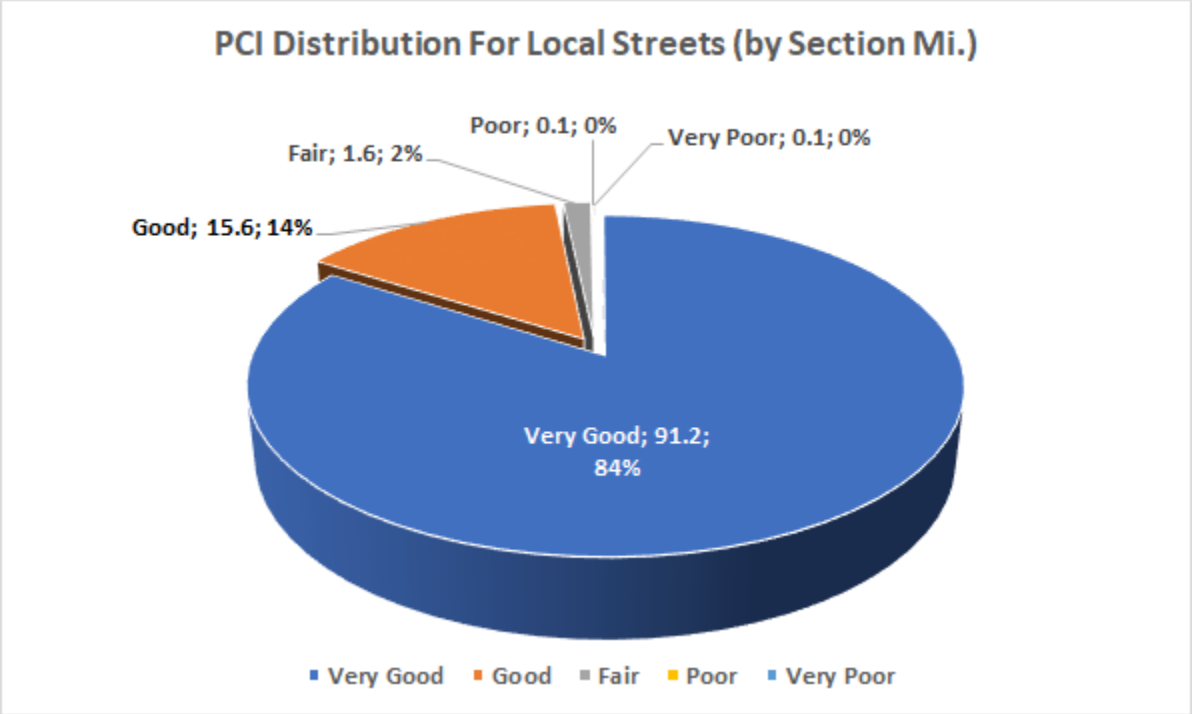

Figure 8 – Local Condition Distribution

CALCULATION OF PCI

In order to calculate a Pavement Condition Index (PCI) value within MicroPAVER, specific street section data needs to be inputted into MicroPAVER to define the survey limits, asphalt types, pavement age and metrics. Pavement "sections" are pavement segments within the defined branch that have consistent pavement street classifications, construction/maintenance histories and use. Representative inspection samples are then selected and visually surveyed to locate distress data. This data is used to calculate the pavement sections Pavement Condition Index (PCI) which includes distress type, extent of the distress and its severity.

The PCI is a condition rating that ranges from 100 (pavement section that is in perfect condition) to 0 for a section that has structurally failed and deteriorated dramatically. The PCI is calculated from three major data entries from our inspectors:

1. Distress Type (one of 20 AC or 19 PCC types); these include alligator cracking, bleeding, block cracking, corrugations, depressions, long/trans cracking, patch/utility cut, potholes, rutting, weathering, raveling, etc.
2. Distress Quantity (the square footage, length or count of a specific distress)
3. Distress Severity (the level of severity determined for each distress found; low, medium or high)

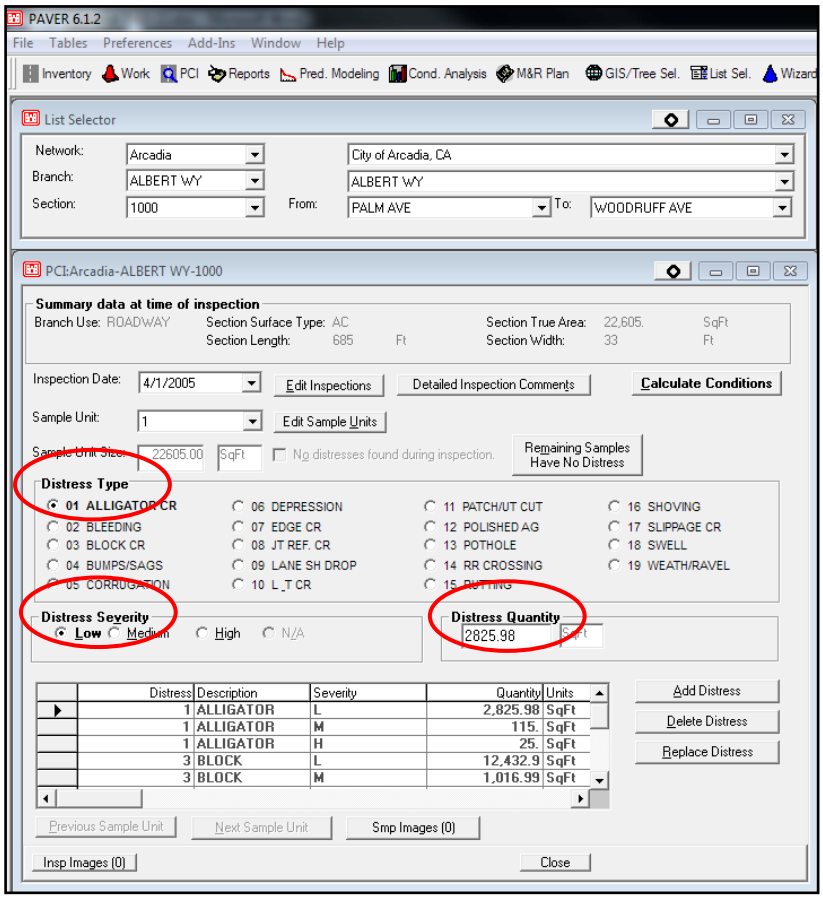

Figure 9 – PCI Calculation Worksheet

SECTION III

CITYWIDE
PAVEMENT CONDITION INDEX REPORT

A. PCI Map
B. A to Z
C. PCI Order

PAVEMENT CONDITION INDEX REPORT

Listed alphabetically by street name or PCI, this report provides the City with a listing of pertinent inventory and pavement condition data for each inventory unit within the City's pavement network. The Pavement Condition Index (PCI) Report notes the names, limits, classification, dimension, surface type, and lane configuration of each inventory unit.

Detailed descriptions of the information appearing on this report are presented below:

BRANCH NAME - The name of each inventory unit appears in this column. Generally, the inventory unit name is taken directly from a street sign; however, where no street signs are posted, the name appearing on the network map is noted instead.

A sample set of street name suffix abbreviation definitions is presented below:

AV -	Avenue	CT -	Court	CIR -	Circle
DR -	Drive	LN -	Lane	RD -	Road
ST -	Street	WAY -	Way	EB -	East Bound
NB -	North Bound	SB -	South Bound	WB -	West Bound

FROM - A description of the beginning limit of each inventory unit appears in this column. If the beginning limit exists between intersections, then the beginning limit description may be an address, post mile marker, or a distance from a known point of reference (e.g., "500' N/MAIN ST").

TO - A description of the ending limit of each inventory unit appears in this column. Like BEGIN limit, the END limit description may consist of a street name, an address, or a distance from a known point of reference. In the case of cul-de-sacs, or dead-ends, the END limit consists of and address, or a directional reference, such as "NORTH END," when no address is available.

RANK - The codes for the four functional classifications as the inventory unit appears in this column are represented below. Basically, units are classified according to traffic volume.

CODE	DESCRIPTION
A	Arterial
C	Collector
E	Local
O	Alley

SURFACE TYPE - A code was assigned to each inventory unit to describe surface type.

CODE	DESCRIPTION
AC	Asphalt Concrete
PCC	Concrete

LENGTH - The length of the section within each branch.

UNITS - The unit of measurement for the section length, typically linear feet (LF).

AREA - The area of each section within a branch.

UNITS - The unit of measurement for the section area, typically square feet (SF).

PCI - Pavement Condition Indices were calculated for inventory units based on severity and extent of distress manifestations observed within the inventory unit. Ranging between 0 and 100, a PCI of "100" corresponds to a pavement at the beginning of its life cycle, while a PCI of "0" corresponds to a badly deteriorated pavement which is at or near the end of its life cycle.

PCI CLIMATE, LOAD AND OTHER – reflects "Section Extrapolated Distress"; these values are shown within the Sample Distresses tab within the PCI window. Distresses are aggregated based on the type and severity level. For random samples, distress quantities are adjusted to reflect the extrapolated value based on the sections total area. Extrapolated distress deducts are classified as resulting from Climate, Load and Other distresses. The Distress Classification portion of the tab shows the "percent" of extrapolated distress deduct belonging to Climate, Load and Other (these %'s are shown within the PCI reports herein). These values are beneficial in that they support the decision whether recommend slurry seal, overlay or reconstruction project for street sections.

INSPECTION DATE – Represents the most recent inspection date performed on a given sections. PCI shown is historical in value and may not indicate what "today's" PCI is due to variance in time. Pavement deterioration calculations can be performed on a section(s) to demonstrate a deteriorated PCI based upon a new current date.

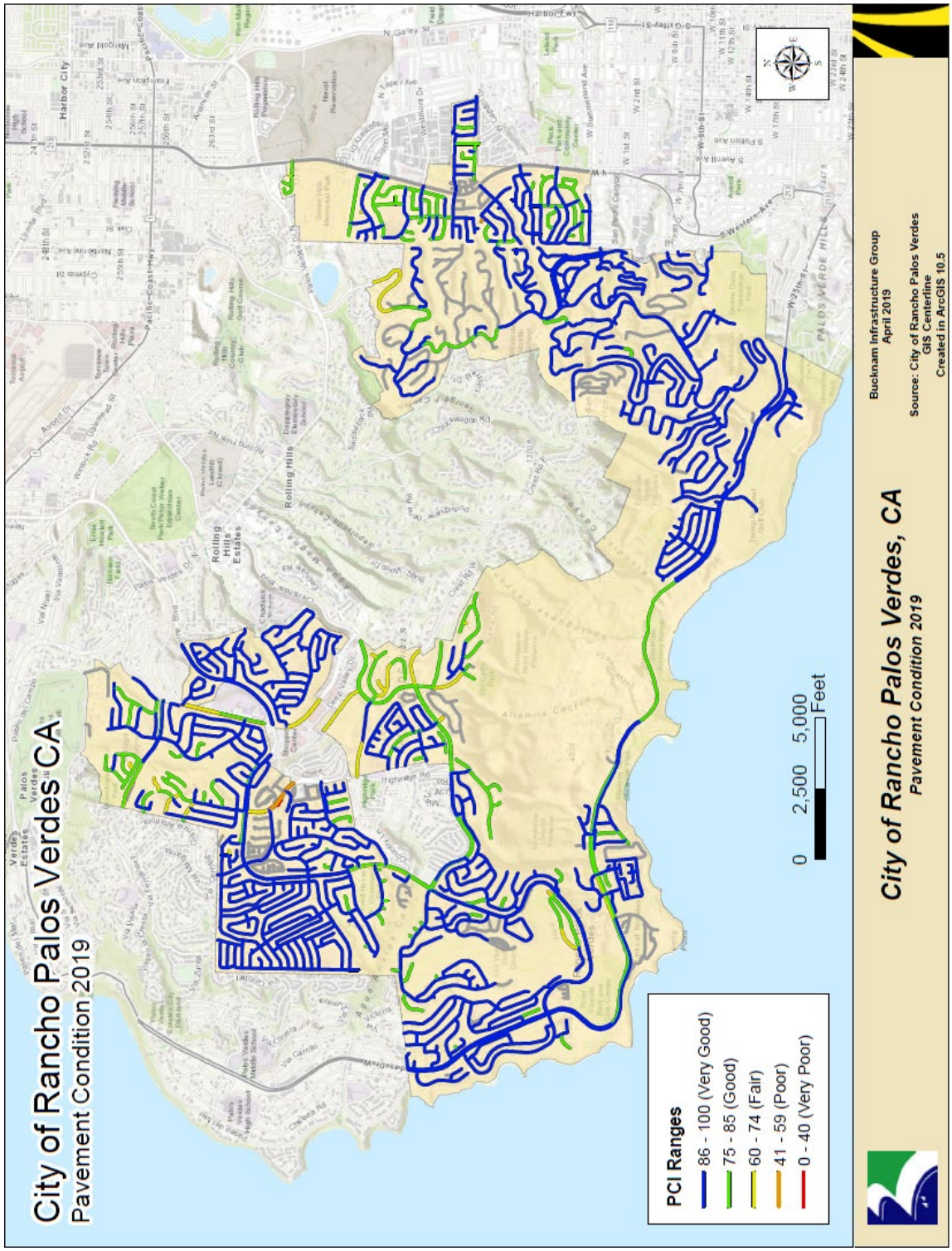

Figure 10 – Rancho Palos Verdes PCI Map -2019

SECTION IV
FORECASTED MAINTENANCE REPORT

A. Actual Budget / Forecasted Streets; Five Year Plan (2019-2024)

FORECASTED MAINTENANCE REPORT

Listed in chronological order by plan year, rank then alphabetically by street name, this report presents the year and action corresponding to the next scheduled work activity for each segment within the pavement network.

ACTUAL BUDGET – The Actual budget was generated for the City to demonstrate how the City's 5-Year Roadway Infrastructure funding allocation performs against the current citywide conditions.

- City's Actual budget includes:
  - Arterials projects (Crenshaw, Silverspur & Highridge were included within Arterial projections)
  - Local are funded at:
    - FY 2019-20 - $5,500,000 (Zone 5)
    - FY 2020-21 - $5,500,000 (Zones 9)
    - FY 2021-22 - $5,500,000 (Zone 8)
    - FY 2022-23 - $5,500,000 (Zones 3 & 4)
    - FY 2023-24 - $5,500,000 (Zone 1)
  - Projects are funded through General Fund, Proposition C, STPL, & Measure R

The following report is sorted by Fiscal Year, then by Rank (functional classification), then by street name.