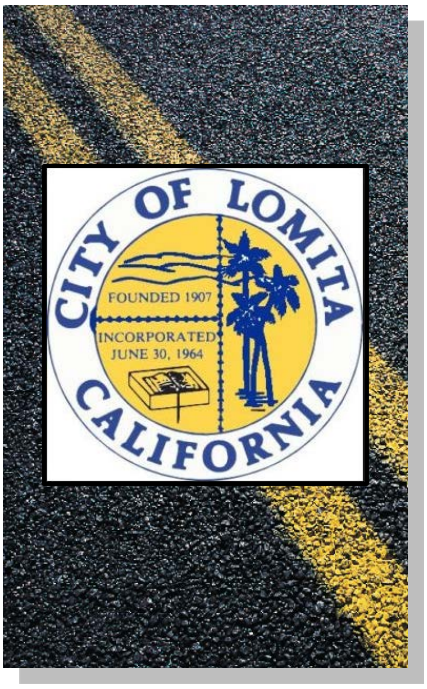
FINAL REPORT

UPDATE OF
PAVEMENT MANAGEMENT PROGRAM
(Citywide)

2018-2023



Submitted to:
City of Lomita, CA
January 16, 2018

BUCKNAM | INFRASTRUCTURE GROUP, INC.

January 16, 2018

Mr. Mark A. McAvoy, P.E.
Public Works Director
City of Lomita
24300 Narbonne Avenue
Lomita, CA 90717

Subject: Final Report - Update of the Pavement Management Program

Dear Mark:

As part of the 2018 Update of the Pavement Management Program for the City of Lomita, *Bucknam Infrastructure Group, Inc. (Bucknam)* is pleased to submit the Final Report for the City's pavement network.

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

- **Executive Summary (Section I)**
- **Pavement Management Program Development and Reporting (Section II)**
- **Pavement Conditions For Each Segment in the Network (PCI Report – Section III)**
  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.
- **Forecast Maintenance Reports (Section IV)**
  - **Recommended Maintenance and Repair Strategies**

The recommended maintenance and repair strategies were used to generate the Forecasted Maintenance Report and were based on our 2018 inspections.

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Additionally, we have assessed and incorporated unit cost and maintenance application practices/types with our strategies.

- **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 Arterial, Collector and Local streets. The report included in Section V is broken down by fiscal year.

Our thorough analysis of previous and current Lomita 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

TABLE OF CONTENTS

Table and Figure Reference **Page #**

Acronym Listing

Asphalt Concrete (AC)
Asphalt Rubber Hot Mix (ARHM)
Capital Improvement Program (CIP)
Geographic Information System (GIS)
Los Angeles County MTA (METRO)
Maintenance and Repair (M&R)
Master Plan of Arterial Highways (MPAH)
Portland Cement Concrete (PCC)
Pavement Condition Index (PCI)
Pavement Management Program (PMP)

SECTION I
EXECUTIVE SUMMARY

2017 UPDATE OF PAVEMENT MANAGEMENT PROGRAM

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 2014. As the City of Lomita infrastructure continues to mature and age the street network is an essential asset that needs to be continuously maintained, assessed and improved upon. Over fifteen years ago, the City of Lomita developed and implemented a PMP to achieve just that. Today, the City is currently using StreetSaver, 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 StreetSaver database.

The Lomita PMP has been developed to assist City personnel by providing current data on the City's street network and to develop cost-effective maintenance strategies to maintain a desirable level of pavement performance on a network scale, while optimizing the expenditure of limited fiscal resources. The PMP efforts in 2017 consisted of analyzing the City's 2014 dataset for quality and usability. City staff also provided key information pertaining to the ongoing maintenance that has occurred throughout the City since 2014. 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 the 2017 project, our staff surveyed all arterial and collector 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, collector, 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 program 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 Lomita staff in identifying unit costs for all maintenance practices used on an annual basis (these not only included the material costs but contingency costs for design and ADA improvements). Currently, based upon the City's maintenance practices and their associated unit costs, the total replacement value of the Lomita pavement network is $35,100,000. This value clearly indicates that the City's pavement network is one of the most valuable and essential asset to Lomita. The City's use of slurry seal, AC Overlay and R&R practices are typically applied at a five year, ten year and 25 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 Lomita'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.

SUMMARY OF CITY'S PAVEMENT NETWORK

Within the Lomita pavement management network there are approximately 32.1 section miles of streets, 310 pavement sections and 5,937,872 SF of pavement.. The Arterial and Collector network consists of approximately 1,214,521 SF of pavement which consists of 21 pavement sections totaling in 3.5 section miles. The Local network consists of approximately 4,723,351 SF of pavement which consists of 289 pavement sections totaling in 28.6 section miles.

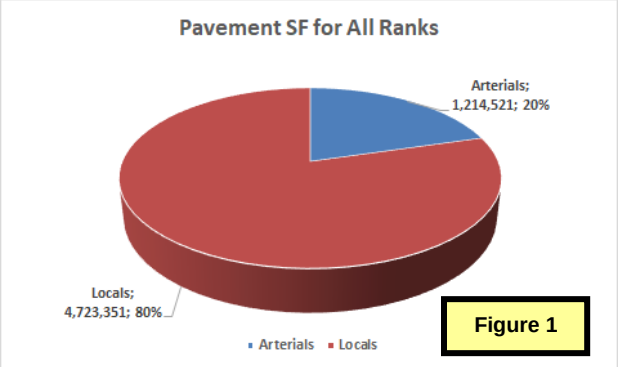

Figure 1

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 Narbonne Avenue, defines a "branch" within StreetSaver. 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 Lomita pavement network by rank.

- **The weighted average PCI for the Arterial / Collector network is 73.7**
- **The weighted average PCI for the Local network is 68.1**

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 large amount of preventative, slurry seal, and overlay work will be needed over the next several years to increase the level of condition (PCI) to a "preventative maintenance" state.

CURRENT CITYWIDE CONDITIONS (ARTERIALS, LOCALS)

The overall condition of the City's pavement network is "Good" with a weighted average PCI of 69.3 based on the surface area of each segment (includes alleys). The distribution of the City's overall pavement network is shown in Section III of this report (Condition Distribution).

Rank	2017	PCI 2014	PCI 2011	SF	Mi.
Arterials	73.7	70.2	66.8	1,214,521	3.5
Locals	68.1	59.2	56.9	4,723,351	28.6
	69.3	**61.8**	**59.2**	**5,937,872**	**32.1**

Table 1 – Lomita PCI Data (2017)

For comparison, Bucknam performed pavement management studies for several other Los Angeles County local agencies and have included their weighted PCI values; Sierra Madre (73.6), El Segundo (63.4), Culver City (62.9), Compton (59.4) and Huntington Park (60.1).

Condition	PCI Range	Arterials	Locals	Total Mi.	% of Network
Excellent	86-100	2.5	8.8	11.3	55%
Very Good	71-85	0.0	6.8	6.8	
Good	56-70	0.0	4.2	4.2	23%
Fair	41-55	0.2	3.1	3.3	
Poor	26-40	0.3	3.6	3.9	20%
Very Poor	11-25	0.5	1.0	1.5	
Failed	0-10	0.0	1.1	1.1	
		3.5	**28.6**	**32.1**	

Table 2 – Condition Distribution by Section Mileage for All Streets

As shown above, a large majority of segments are distributed through Excellent to Very Good condition categories (55%, approximately 18.1 miles). These findings indicate that large amount

of preventative slurry and overlay maintenance has continuously and recently been applied to the network; as the City moves into the next five years of PMP management proactive types of maintenance applications still need to be performed on the network. These condition ranges are defined by the Army Corps of Engineers.

With 28% of the City's Arterial pavement sections within the condition levels of "Fair to Failed" (approximately 1.0 miles), a proactive overlay rehabilitation program needs to be implemented and funded; this will maintain the citywide weighted PCI at its current conditions and will gradually increase the PCI to a higher condition level while reducing maintenance costs in fiscal years 2018 and beyond.

Local conditions show that 31% of the pavement network is within the condition levels of "Fair to Failed" (approximately 8.8 miles). These sections should be considered for slurry seal and overlay maintenance. The City implemented a slurry seal program in 2016 in which the City slurry seals one of seven zone annually. This program is already showing positive results through the Local conditions and should continue

In general, the Arterial network is showing higher condition levels compared to the Local network; there are only a handful of key overlay projects that should be proactively managed in the next few years of the Arterial & Local Streets CIP.

These findings are positive in that the amount of revenue to maintain the network is not overbearing or detrimental to the system as a whole. In fact, in the budgetary reports that follow, we have found that the planned expenditure levels that the City has scheduled to pavement maintenance will "increase" upon the conditions found today for the next five years.

Therefore, cost efficient preventative maintenance should be the focus of the Arterial PMP for the next several years. The Local network needs to receive additional proactive slurry seal and overlay maintenance in the short-term (FY 2018 thru 2023).

Furthermore, as large overlay and rehabilitation projects are considered for funding, the City should also consider using sub-grade R - Values, 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 with a better approach to the maintenance that should be applied.

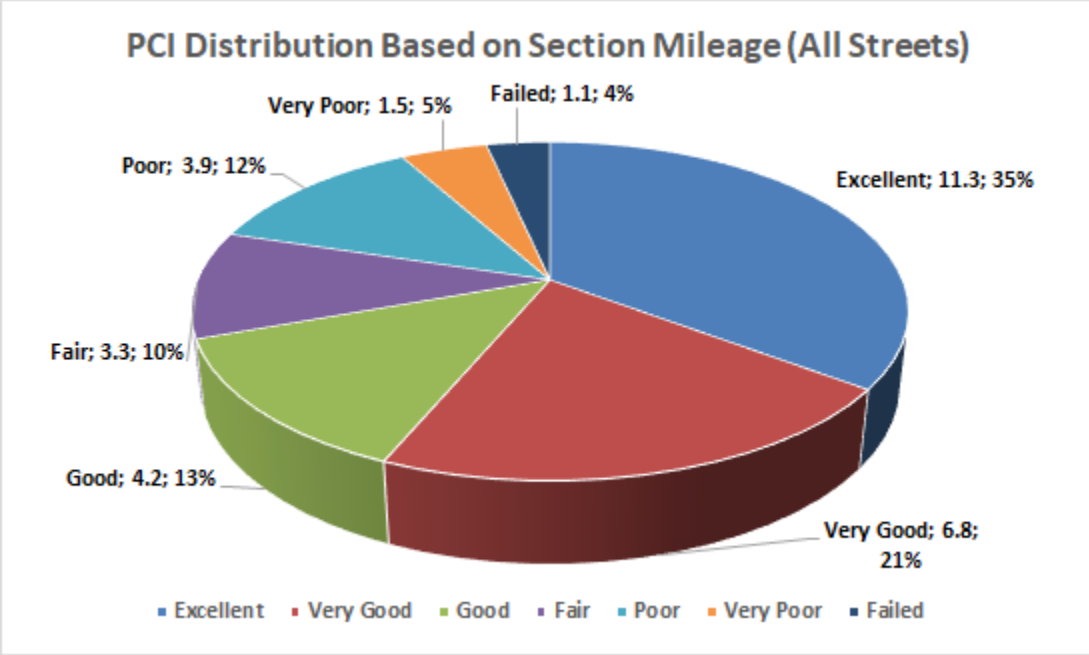

Figure 2 – PCI Condition Distribution by Section Miles for All Streets

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.

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 75 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 "75" as the minimum level of service. This means that any pavement section with a PCI greater than 75 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 2017 inspections.

These recommendations and results are shown in Section II of this report where we have demonstrated what level of funding is necessary to improve the current weighted condition level of 69.3 to a level of 75 by FY 2023.

As shown in Figure 2, 69% of the City's streets are in Excellent 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 "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.

Cape Seals (Global Maintenance*)

This is an application of a single layer of asphalt binder to a road surface immediately followed by a single layer of cover aggregate (chips). The single layer chip seal is then followed with a slurry seal application.

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.

3. Diamond Grinding (PCC pavements). A thin top layer can be milled off of an existing pavement to smooth out relatively small surface distortions prior to flexible or rigid overlay.

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.

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 applications benefits 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 StreetSaver 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 "Actual" Five-year Public Works street maintenance/capital budget performs against today's conditions;**

Gas Tax:	$50,000
Measure R Local Return:	$235,000
Measure M Local Return:	$252,000
Proposition C:	$314,000
SB1:	$338,000
General Fund:	$300,000
	$1,489,000/yr*

**City has indicated that it expects to receive the annual amount shown above based upon the listed funding sources.*

2. **Demonstrate budget allocation for pavement maintenance performs is necessary to "maintain" today's existing conditions until 2022;**

Based on current and future pavement maintenance needs, two annual work programs have been prepared and summarized below. Table 3 demonstrates how the City's annual budget performs against today's conditions (each scenario addresses arterial and local streets). Table 4 demonstrates what annual budget is necessary to "maintain" today's conditions.

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total $
2018-19	69.3	71.5	$109,838	$1,362,342	$1,472,180
2019-20	69.1	72.2	$110,244	$1,420,417	$1,530,661
2020-21	69.9	72.7	$63,274	$1,462,217	$1,525,491
2021-22	69.9	73.3	$410,138	$928,521	$1,338,659
2022-23	71.8	74.9	$64,122	$1,344,043	$1,408,165
			$757,616	**$6,517,540**	**$7,275,156**

Table 3 – Citywide Projection Utilizing "Actual" Budget

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total $
2018-19	69.3	70.2	$109,838	$715,115	$824,953
2019-20	68.8	70.0	$110,244	$705,644	$815,888
2020-21	68.6	70.3	$75,178	$823,455	$898,633
2021-22	68.9	70.2	$314,312	$685,319	$999,631
2022-23	68.5	70.0	$64,122	$561,300	$625,422
			$673,694	**$3,490,833**	**$4,164,527**

Table 4 – Citywide Projection Utilizing "Maintain" Budget

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 2017 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 Lomita 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 as specific site investigations requested by the City. Field check efforts were performed at the end of each week of survey.

This project included the survey of all streets; small area adjustments were made to the database as well as naming conventions corrections for a small handful of local streets. These corrections were made to both the StreetSaver database and the unique PMP-GIS layer.

Work History records for 2014 - 2017 street rehabilitations were entered into the database.

FINDINGS AND RECOMMENDATIONS

Through our assessment of historical maintenance performed within the City and through our discussions with City staff the conditional data found across the network clearly shows that the City has applied strong, preventative maintenance strategies over the past decade. We continue to see an annual conditional decrease within the Arterial program, however, the Local program is showing signs of improvement. Pavement management involves frequent preventative maintenance; as pavement deteriorates through heavy traffic impacts, weathering and time, preventative maintenances (such as slurry seal, stop gap, etc.) have limited benefits. More aggressive maintenance applications have to be used. Our study has shown that key MPAH and local overlay projects will be needed over the next five years to maintain the network's level of condition.

Currently, the City's two major streets networks (Local & Arterial) hold moderate weighted PCI values; it is our recommendation that a proactive, common sense overlay program be assessed and scheduled over the next several fiscal years. This will ensure that the citywide weighted PCI will sustain itself and allow for routine slurry seal maintenance to continue.

Through our analysis of the Lomita PMP we have found and recommend the following items which should be considered for a proactive approach to the PMP and future management of the program:

Arterials

The recent 2017 MPAH inspections and PCI results have indicated that the Lomita MPAH network is currently in "Very Good" condition (weighted avg. PCI of 73.7). At a minimum, to maintain this condition it is critical that preventive maintenance and overlay activities are funded at the levels identified on page 8 and its corresponding spreadsheet reports to maintain a "Very Good" network weighted average PCI value.

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

- The Arterial/Collector network has a weighted PCI of 73.7;
- The Arterial/Collector network consists of 4.2 miles and 1,494,381 SF of pavement;
- Currently, 28% of the arterial network (approx. 1.0 miles) qualify for overlay/reconstruction;
- Arterial maintenance projects should focus on increasing the current weighted PCI of 73.7 to 78.0 in the next five years;
- Develop a proactive fiscal and planned approach to identify arterial overlay projects based on the deterioration modeling within StreetSaver;
- Proactively schedule and appropriate the necessary 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 2018-19 and beyond to ensure the results shown in Table 3;

- Perform pavement inspections on the arterial network every two years to build a solid planning model within StreetSaver to track PCI deterioration;

- Demonstrated budget shown in Table 3 is ample to increase the arterial weighted PCI of 73.7 through five years, additionally, the citywide deferred backlog will decrease ($13.9 million to $754,000) after five years based upon the Actual budget; and

- Bucknam recommends that the City proactively budget pavement CIP projects and maintenance at the levels shown in Table 3 in order to improve upon the conditions found today.

Locals

The recent 2017 Local inspections and PCI results have indicated that the Lomita Local network is currently in "Good" condition (weighted avg. PCI of 68.1). At a minimum, to maintain this condition, it is critical that preventive maintenance and overlay activities are funded at the levels identified on page 8 and its corresponding spreadsheet reports to maintain a "Good" network weighted average PCI value.

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

- The Local network has a weighted PCI of 68.1;

- The Local network consists of 28.6 miles and 4,723,351 of pavement;

- Currently, 31% of the Local network (approx. 8.8 miles) qualify for overlay/reconstruction, while 36% qualify for Type II Slurry Seal (10.2 miles);

- Local maintenance projects should focus on increasing the current weighted PCI of 68.1 to a level of 75 in the next five years;

- Local forecasted maintenance plan for maintenance should be followed as shown in Section IV reporting;

- Develop a proactive fiscal and planned approach to identify Local overlay projects based on the deterioration modeling within StreetSaver;

- Increase Local funding 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 2018-19 and beyond to ensure the results shown in Table 3;

- Perform pavement inspections on the Local network every three years to build a solid planning model within StreetSaver to track PCI deterioration; and

- Demonstrated budgets shown in Tables 3 are ample enough to increase the Local weighted PCI; proactive funding needs to be implemented to see these results.

SECTION II
PAVEMENT MANAGEMENT PROGRAM / CAPITAL IMPROVEMENT PROGRAM

Bucknam Infrastructure Group, Inc. (Bucknam) performed the following services in accordance with the scope of services that was contracted with the City of Lomita. As a quick overview, the following tasks were performed to complete the work over the past several months:

2017 Pavement Management Work Efforts:

Task 1: Project Kickoff-Data Management
Task 2: Update of Maintenance Activities
Task 3: Pavement Condition Survey (approx. 32.8 miles)
Task 4: Budgetary Analysis and Capital Improvement Reports
Task 5: Executive Summary and Final CIP Reports
Task 6: Mapping of the Pavement Network

Summary of Pavement Management Program 2017

As a part of the 2017 update of the pavement management program, 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 2014 StreetSaver dataset, GIS, 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 updated into the City's StreetSaver database.

Work history information was provided by the City in the form of completed bid documents, field notes, 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 StreetSaver system.

Table 5 demonstrates PCI ranges defaulted within StreetSaver. Once a pavement inspection is complete, a PCI is calculated for each pavement section. Each PCI calculated falls within a defined PCI range category (Excellent, 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 StreetSaver to show how much square footage or percentage of area falls within a PCI range category.

PCI RANGE	CONDITION
86-100	Excellent
71-85	Very Good
56-70	***Good (Lomita Network 2017 = 69.3)***
41-55	Fair
26-40	Poor
11-25	Very Poor
0-10	Failed

Table 5 - PCI Range

These condition ranges are defined by the ASTM and defaulted within the StreetSaver software. The summary of all roads condition data and their representative PCI's can been 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 (Locals)	$0.35/SF
60-85	Type II Slurry (Arterials)	$0.40/SF
Minimal Level of Service (75)		
40-75	Cape Seal (Locals)	$0.85/SF
20-60	2" Grind / Overlay (Local)	$2.50/SF
20-60	2.5" ARHM Overlay (Arterial)	$4.00/SF
0-20	AC Remove & Replace (Locals)	$5.50/SF
0-20	AC Remove & Replace (Arterials)	$7.50/SF
0-20	PCC Reconstruction	$10.50/SF
	20% 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, Collector 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 StreetSaver 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 StreetSaver 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.

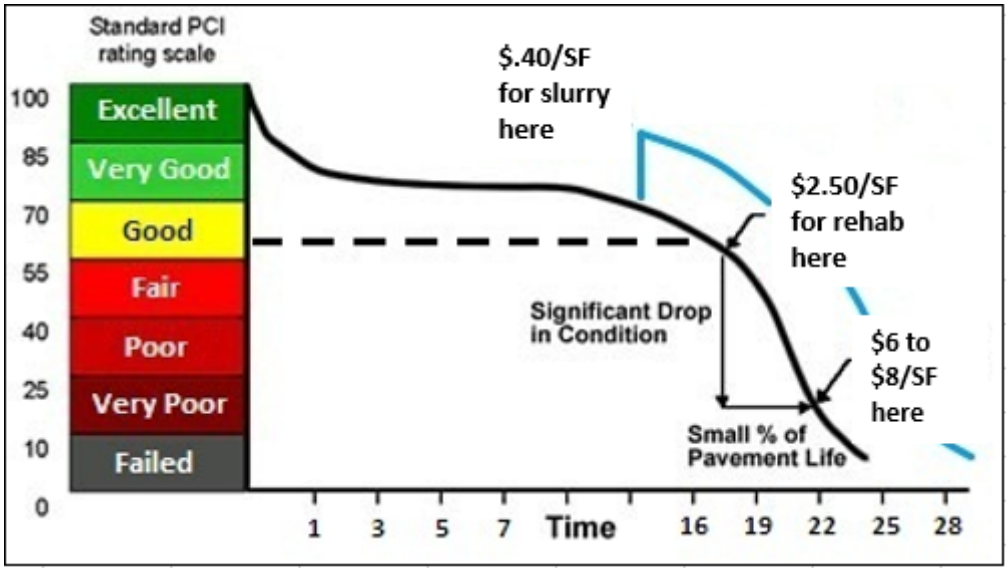

Figure 3 – Sample Pavement Life Cycle

ANNUAL WORK PROGRAM PROJECTIONS

The goal of these projections is to assist City policy makers in utilizing the recommendations of the StreetSaver system. By using the City of Lomita's 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 current FY 2018 through 2023 Public Works budgets perform against today's conditions;

Gas Tax:	$50,000
Measure R Local Return:	$235,000
Measure M Local Return:	$252,000
Proposition C:	$314,000
SB1:	$338,000
General Fund:	$300,000
	$1,489,000/yr*

**City has indicated that it expects to receive the annual amount shown above based upon the listed funding sources.*

MAINTAIN BUDGET – The Maintain budget was generated for the City to demonstrate what level of annual pavement CIP funding is necessary to maintain the current condition of 69.3;

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

ARTERIAL-COLLECTOR / LOCAL BUDGET PROJECTIONS

The annual projected revenues shown below only account for the cost of pavement maintenance and rehabilitation activities.

A 20% contingency was applied to the pavement costs. Additional soft costs not included within the cost of pavement maintenance include:

- Right-of-way, curb & gutter, ADA ramp improvements;
- Utility improvements;
- Tree removals;

ACTUAL ($7.5 Million, Five-Year) – The first key step in developing a proactive PMP is to model the City's existing conditions against an "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. Bucknam utilized the City's $7.5 Million five-yr budget to establish a benchmark scenario for pavement funding; the City provided Bucknam with current 2017 unit costs for pavement maintenance applications currently being used by the City.

$7.5 MILLON, FIVE-YR BUDGET PROGRAM

This budget program incorporates pavement sections that have a functional class of Arterial (A, C), Local (L).

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total $
2018-19	69.3	71.5	$109,838	$1,362,342	$1,472,180
2019-20	69.1	72.2	$110,244	$1,420,417	$1,530,661
2020-21	69.9	72.7	$63,274	$1,462,217	$1,525,491
2021-22	69.9	73.3	$410,138	$928,521	$1,338,659
2022-23	71.8	74.9	$64,122	$1,344,043	$1,408,165
			$757,616	**$6,517,540**	**$7,275,156**

Table 7 – Citywide Projection Utilizing $7.5 Million/ Five-Yr Budget

By modeling the existing pavement conditions against the City's actual/five-yr funding, we have found that two positive results occur, first, the weighted PCI for the entire network increases from a level of 69.3 to a level of 74.9 after the five year CIP (See Figure 4 below).

Secondly, the resulting deferred maintenance backlog decreases from $13.4 million to $689,000 by year 2022. This indicates that a $7.5 million/five-yr pavement budget is ample enough to generate the desired results on the pavement network.

As shown, this projection model does meet the initial goal of maintaining or increasing the City's pavement network PCI. In order for these scenarios to continue to produce these results proactive and continued funding is necessary; on a biennial basis, the City should 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 continue to accumulate.

We recommend that a stronger focus be placed on the Local network improvements due to the fact that the Local network is almost three times as large in total square footage and has a lower weighted PCI than the arterials. We still recommend minor maintenance to the arterial network, i.e. localized patching, slurry seal and the use of awarded SB1 & Measure M funds. But again, with the Local network showing a higher degree of negative results, a new focus for zoned area maintenance and proactive overlays should be implemented.

A local slurry/overlay maintenance "area" strategy should be established 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 five 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 Mill & Cap 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 seven 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 five to six years.

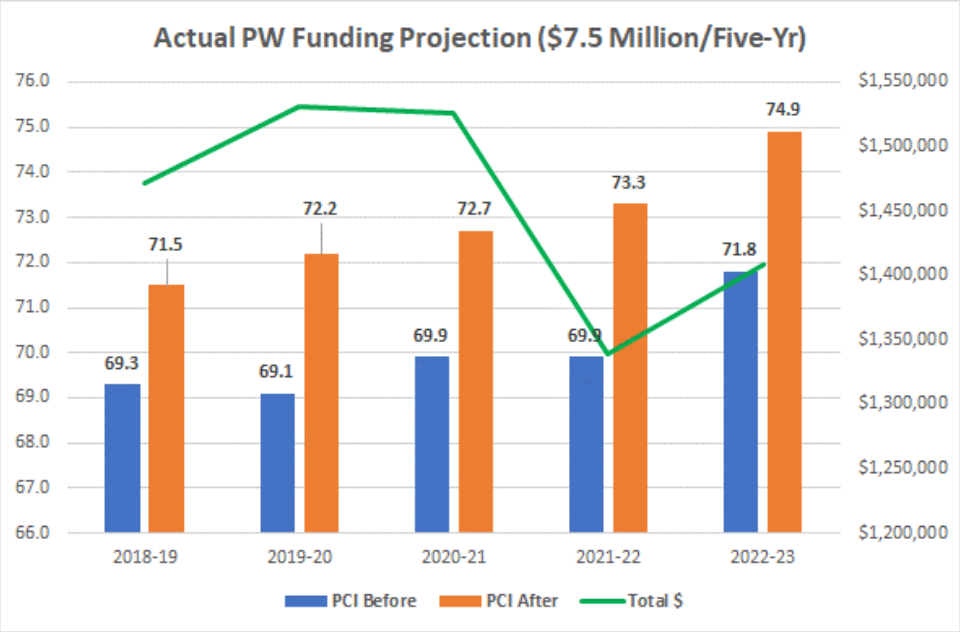

Figure 4 – Resulting Network PCI ($7.5 Million/Five-yr Budget)

The resulting "increase of the weighted PCI" shown above demonstrates how applying adequate capital funds to specific areas of the network allows the City's pavement to improve at a rate that is conducive to a successful PMP (i.e. proper/timely application of preventive maintenance and extension of section life-cycles through timely overlays). Additionally, even with an ample budget, the City should continue to implement localized maintenance (i.e. deep patching, leveling courses, crack sealing, etc.) prior to any major slurry seal and/or overlay maintenance. By performing stop gap measures to individual pavement sections the overall performance of the sections condition will improve over time and sustain itself longer than if no preventive maintenance was performed.

On the flip side, if limited annual funding is applied to the network over the next five years (i.e. citywide budget of $500,000/yr) an additional drop in overall weighted PCI will occur and deferred maintenance/CIP projects will exceed $18 million. Limited funding equals deferred projects which does not allow necessary overlay projects to be completed in a timely manner on the arterial, collector and local networks.

MAINTAIN – A common question from City staff is "what level of funding is necessary to maintain the asset?" Bucknam modeled this scenario against the conditions found through our recent field surveys. Several iterations were modeled and assessed for viability and a common sense approach to Lomita's pavement network

The resulting PCI conditions and maintenance distributions are shown below.

MAINTAIN BUDGET PROGRAM

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

Plan Year	PCI Before	PCI After	Slurry / Cape	Overlay / Recon	Total $
2018-19	69.3	70.2	$109,838	$715,115	$824,953
2019-20	68.8	70.0	$110,244	$705,644	$815,888
2020-21	68.6	70.3	$75,178	$823,455	$898,633
2021-22	68.9	70.2	$314,312	$685,319	$999,631
2022-23	68.5	70.0	$64,122	$561,300	$625,422
			$673,694	$3,490,833	$4,164,527

Table 8 – Citywide Projection Utilizing "Maintain" Budget

By modeling the existing pavement conditions utilizing the City's current unit costs and cost projections, we have found that one positive and one negative result occurs over the five year CIP. (See Figure 5 on the following page). First, the weighted PCI for the entire network does maintain itself (69.3 to 70.0) over the five year period based upon an average $841,800/yr budget. This result is positive in that the PCI does not drop for a long-term, however as described below, the amount of deferred maintenance that accumulates on the network by FY 2022 is not something that City should consider.

The resulting deferred maintenance backlog shows that it remains at a high level ($13.2 million to $14.8 million) after the five years program which indicates that an annual $832,900 budget is not ample enough to sustain deferred maintenance on the pavement network in FY 2022. Limited funding does not allow necessary overlay projects to be completed on the arterial, collector, and local networks; this in turn defers maintenance to latter years of the CIP thus increasing the costs of maintenance. This problem will continue to build upon itself unless an influx of overlay revenue is generated by the City.

Note this projection model does meet the initial goal of maintaining or increasing the City's pavement network PCI; if this model is extended to FY 2027 the City would see a decrease in PCI and further increases in deferred maintenance. 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 build up of more overlay work in the five-year time frame is not a debt that City will want to accept.

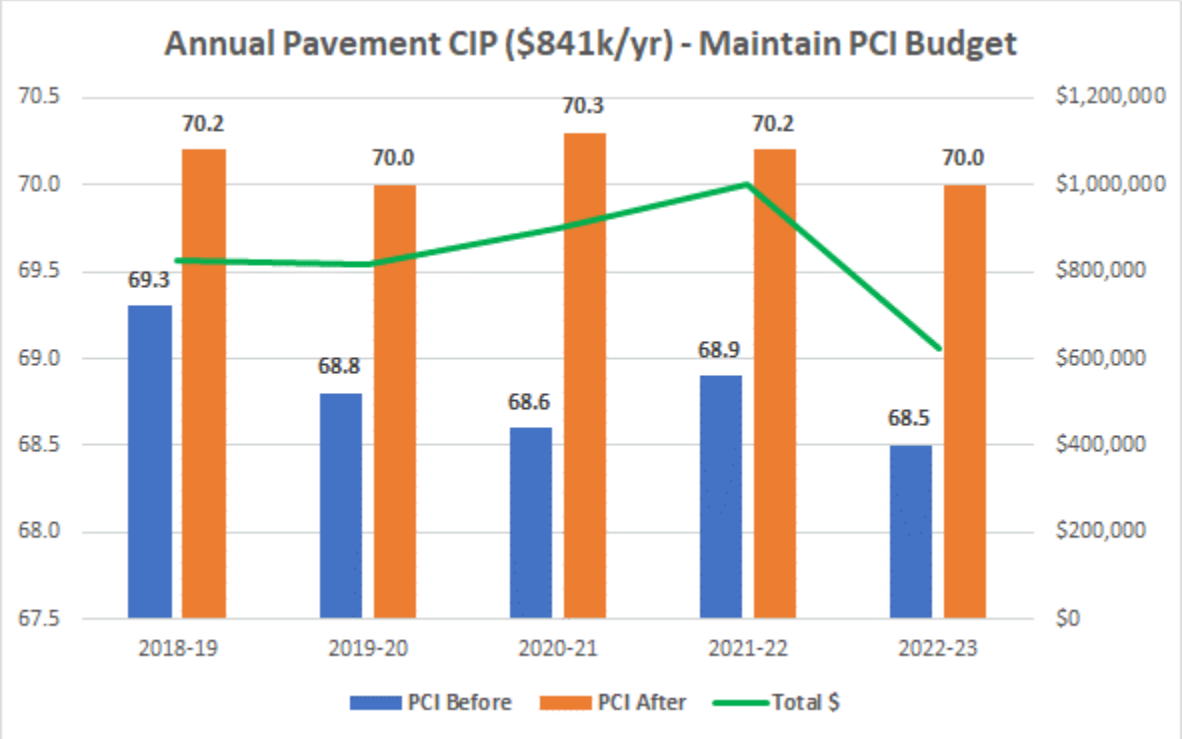

Figure 5 – Resulting Network PCI (Maintain Budget)

DEFERRED MAINTENANCE

Delaying repairs on streets where pavement conditions indicate a need generates deferred maintenance or "backlog". Deferred maintenance is work that is postponed to a future budget cycle, or until funds are available. As maintenance is deferred, the opportunity to apply preventive, life extending pavement treatments is forfeited and the ultimate cost of rehabilitation multiplies (i.e. slurry seal costs to overlay costs). By using the City's pavement maintenance applications and their associated unit costs, when a budgetary model is exercised within the PMP software the amount of deferred maintenance is calculated. Based upon the available budget applied to the model, deferred maintenance will increase or decrease.

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

Through Bucknam 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 2004 will need proper overlay maintenance approximately around fiscal year 2018-19 and beyond.

PAVEMENT MANAGEMENT PROGRAM REPORTS (SPREADSHEETS)

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 1999-2010, 2017 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 StreetSaver 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 / collectors every two years and Locals every three. One recommendation the City may consider to keep the program “managed” is:

- Survey the arterials every two years; 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 and Collector 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 StreetSaver 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 "Excellent" to "Failed"; with an "Excellent" condition corresponding to a pavement at the beginning of its life cycle, and a "Failed" 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

Excellent (86-100) - Minor to low distress, no significant distress;

Very Good (71-85) - Little distress, with the exception of utility patches in good condition, or slight hairline cracks; may be slightly weathered;

Good (56-70) - Slight to moderately weathered, slight distress, possibly patching; ***(City of Lomita citywide weighted average PCI is 69.3);***

Fair (41-55) - Severely weathered or slight to moderate levels of distress, generally limited to patches and non-load-related cracking;

Poor (26-40) - Moderate to severe distresses including load-related types, such as alligator cracking;

Very Poor (11-25) - Severely distressed, large quantities of distortion or alligator cracking;

Failed (0-10) - Failure of the pavement, distress has surpassed tolerable rehabilitation limits.

CALCULATION OF PCI

In order to calculate a Pavement Condition Index (PCI) value within StreetSaver, specific street section data needs to be inputted into StreetSaver 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)

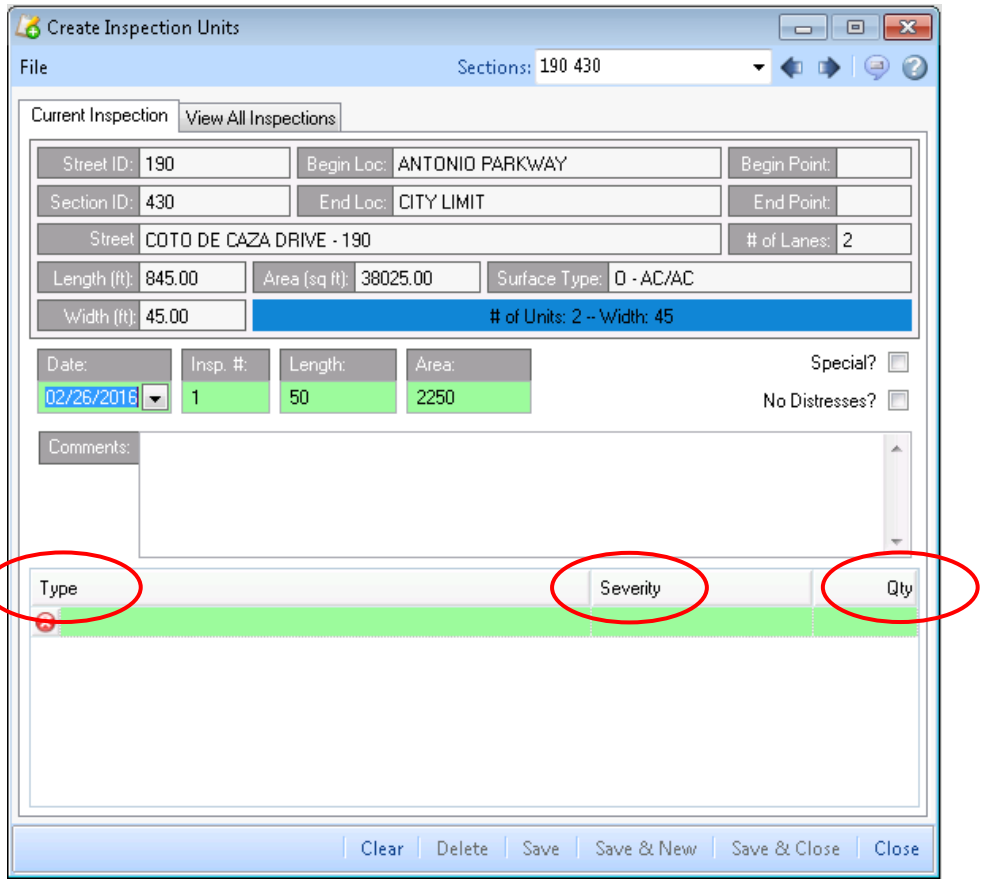

Figure 6 – PCI Calculation Worksheet

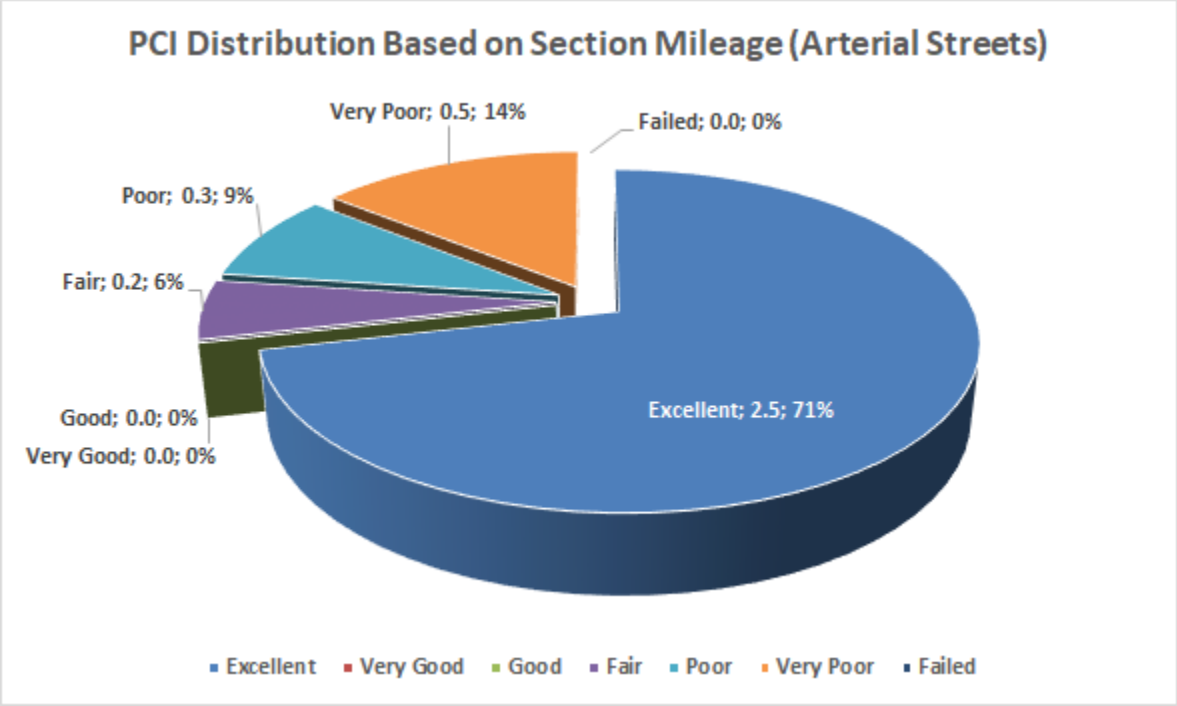

Figure 7 – Arterial Condition Distribution

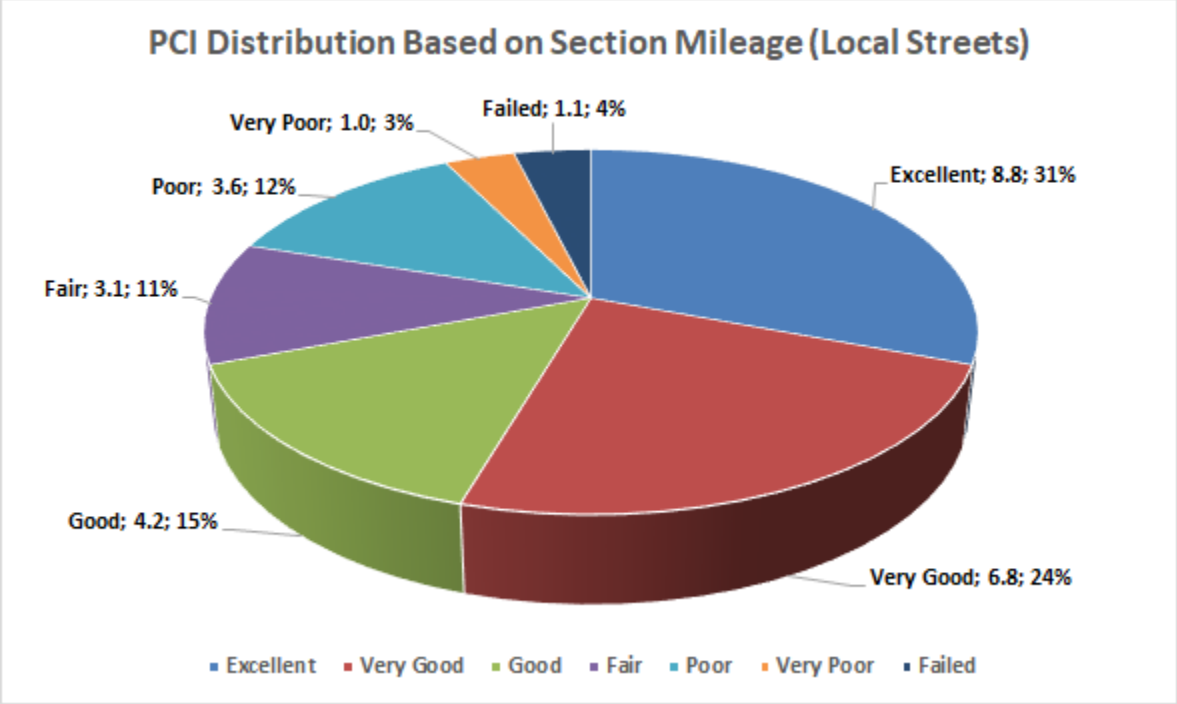

Figure 8 – Local Condition Distribution

SECTION III

CITYWIDE
PAVEMENT CONDITION INDEX REPORT

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

PAVEMENT CONDITION INDEX (PCI) REPORT – DATA DEFINITIONS

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 three functional classifications as the inventory unit appears in this column are represented below. Basically, units are classified according to traffic volume.

CODE	DESCRIPTION
A, C	Arterial, Collector (MPAH)
L	Local

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 to recommend slurry seal, overlay or reconstruction projects for street sections. For instance, there may be two street segments that have a PCI of 60 respectively, however, one section has 80% climate based distress which may require a crack seal/slurry application while the other section has 80% load bearing distress which may require a grind/overlay application.

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.

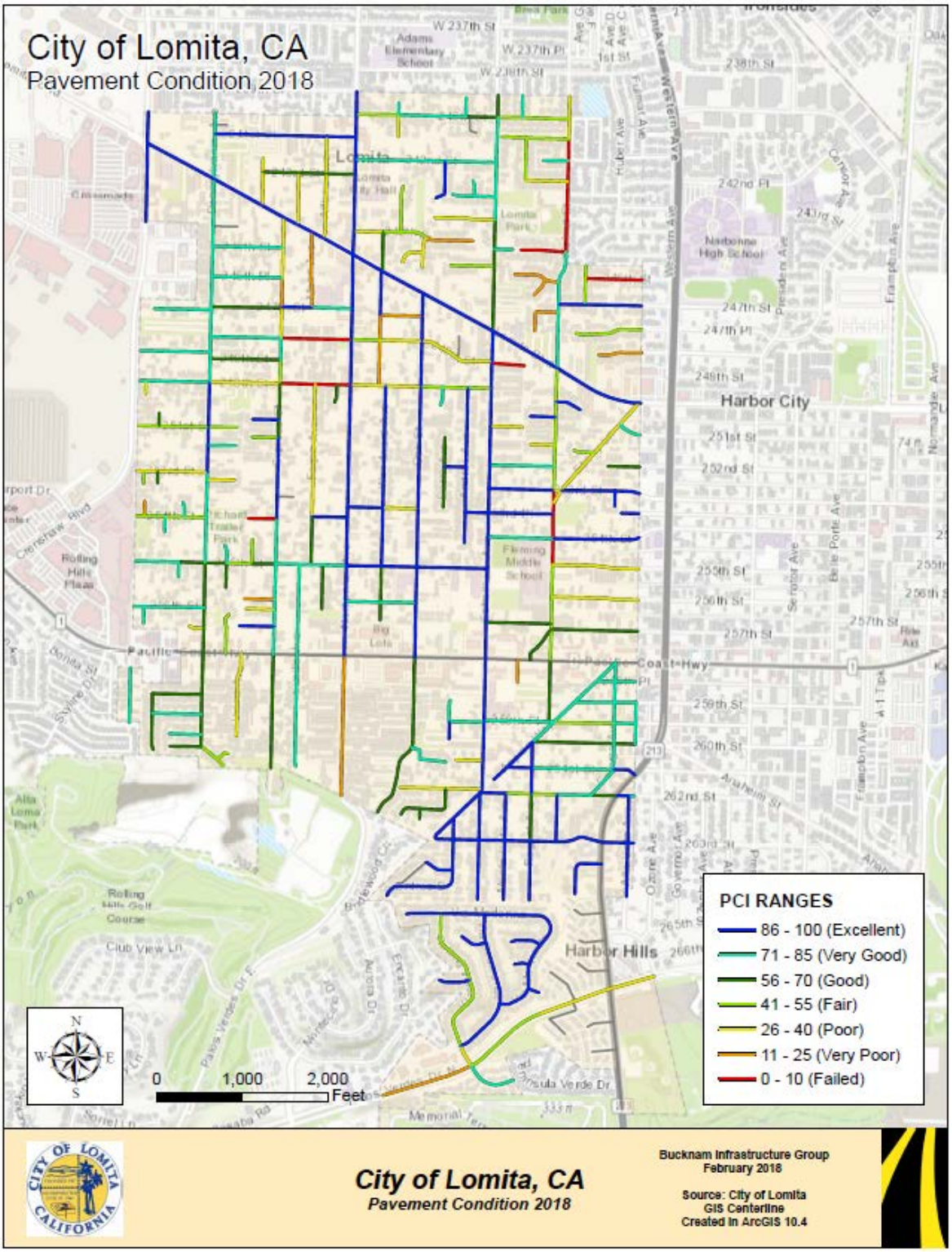

Figure 9 – Lomita PCI Map - 2017

SECTION IV
FORECASTED MAINTENANCE REPORT

A. Forecasted Maintenance Maps (2018-2023)
B. Recommended Budget, Five Year Plan (2018-2023)

FORECASTED MAINTENANCE REPORT

Listed in chronological order by rank, plan year, 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 current FY 2018 through 2023 Public Works budgets perform against today's conditions;

1. **Demonstrate how the City's "Actual" Five-year Public Works street maintenance/capital budget performs against today's conditions;**

Gas Tax:	$50,000
Measure R Local Return:	$235,000
Measure M Local Return:	$252,000
Proposition C:	$314,000
SB1:	$338,000
General Fund:	$300,000
	$1,489,000/yr*

We have sorted the following report by functional class (rank) for easy review (Arterial – Local, A to Z order).

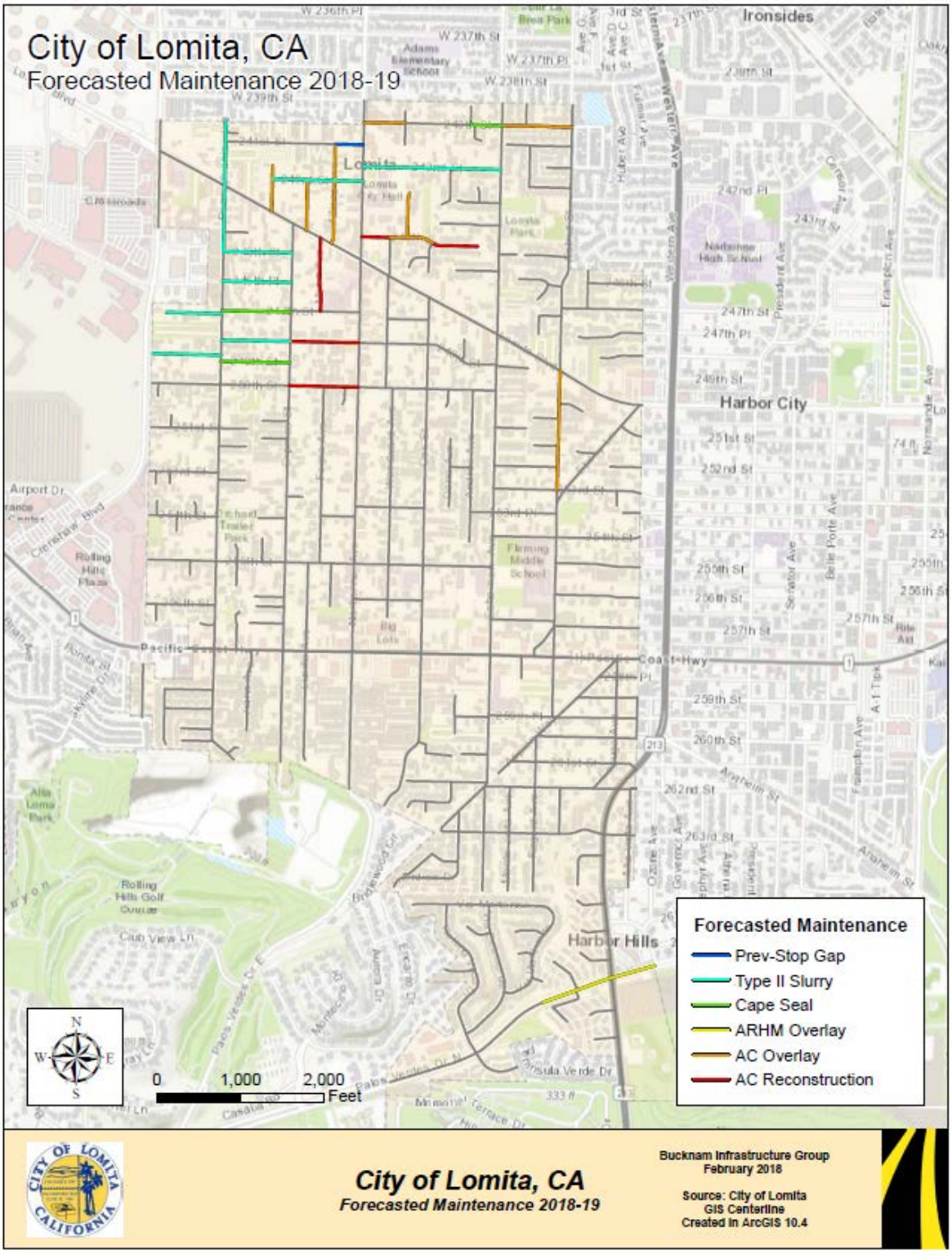

Figure 10 – 2018-19 Forecasted Maintenance

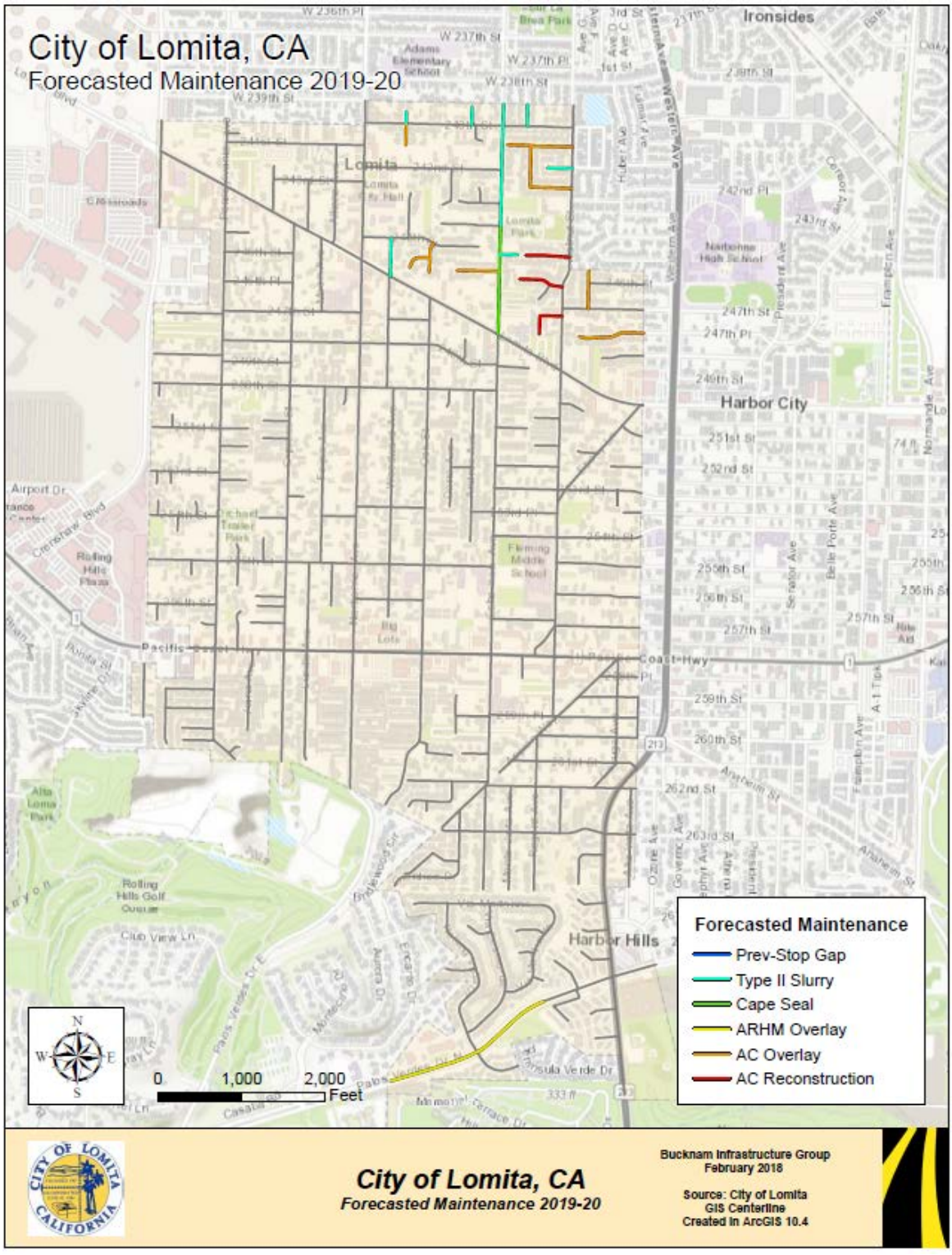

Figure 11 – 2019-20 Forecasted Maintenance

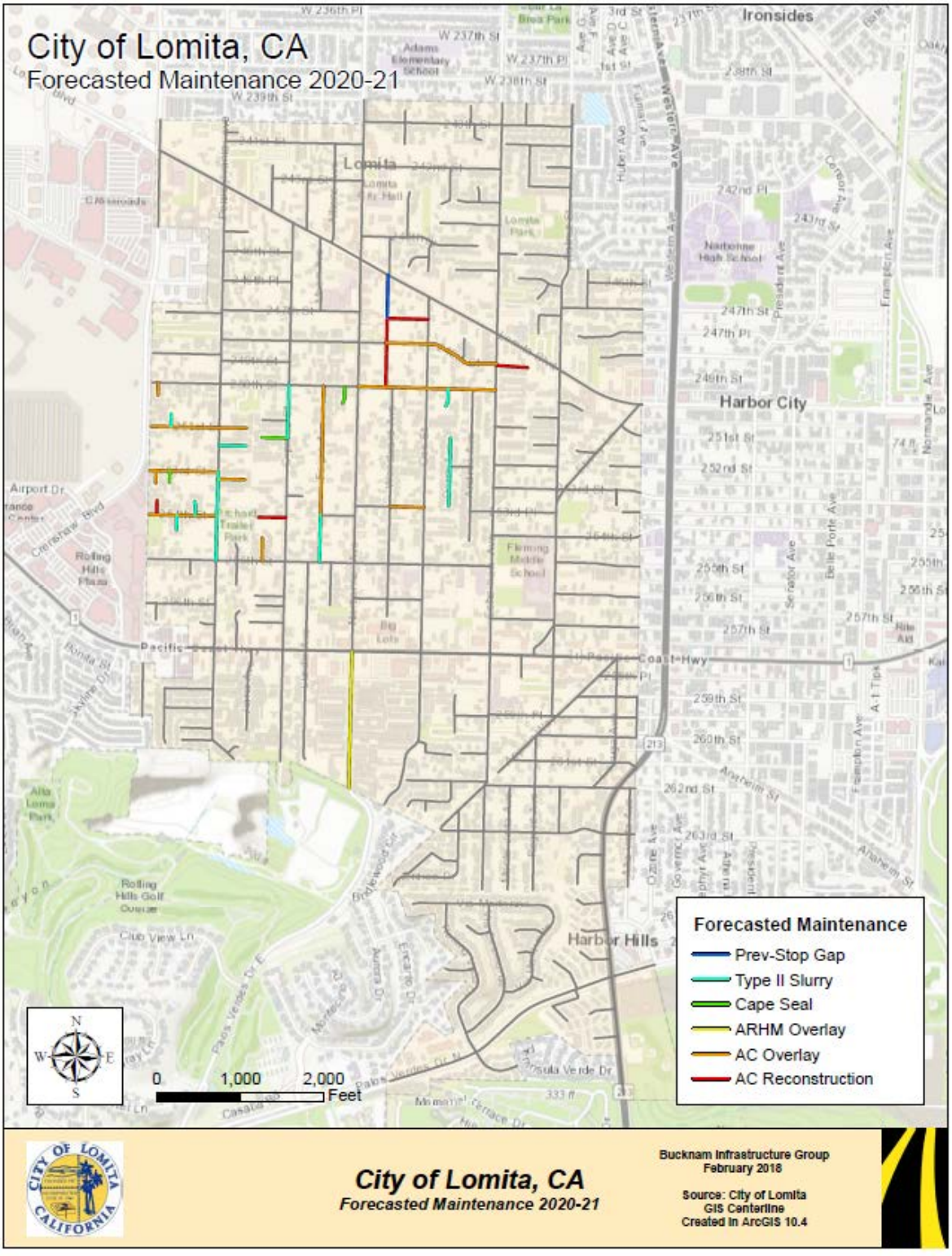

Figure 12 – 2020-21 Forecasted Maintenance

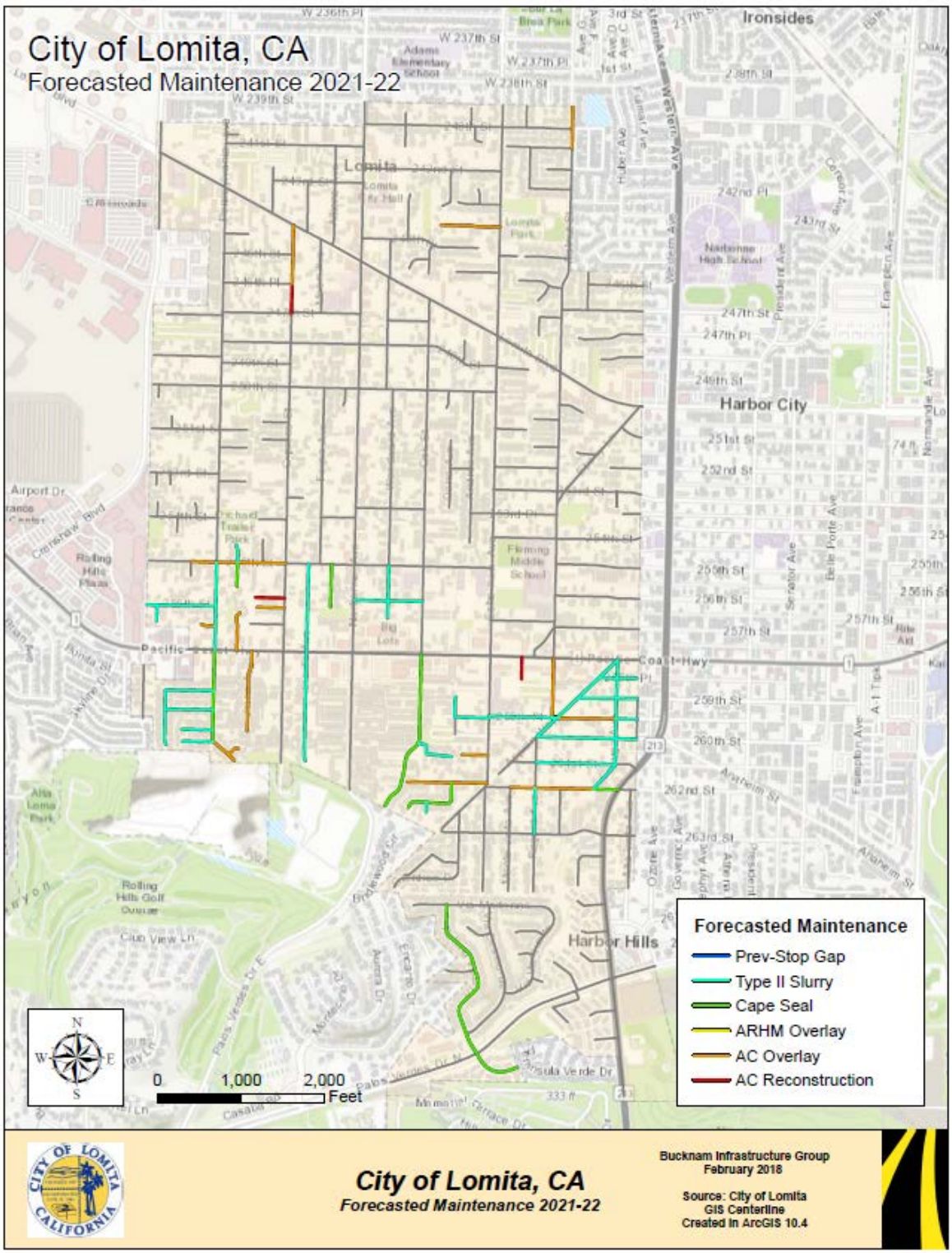

Figure 13 – 2021-22 Forecasted Maintenance

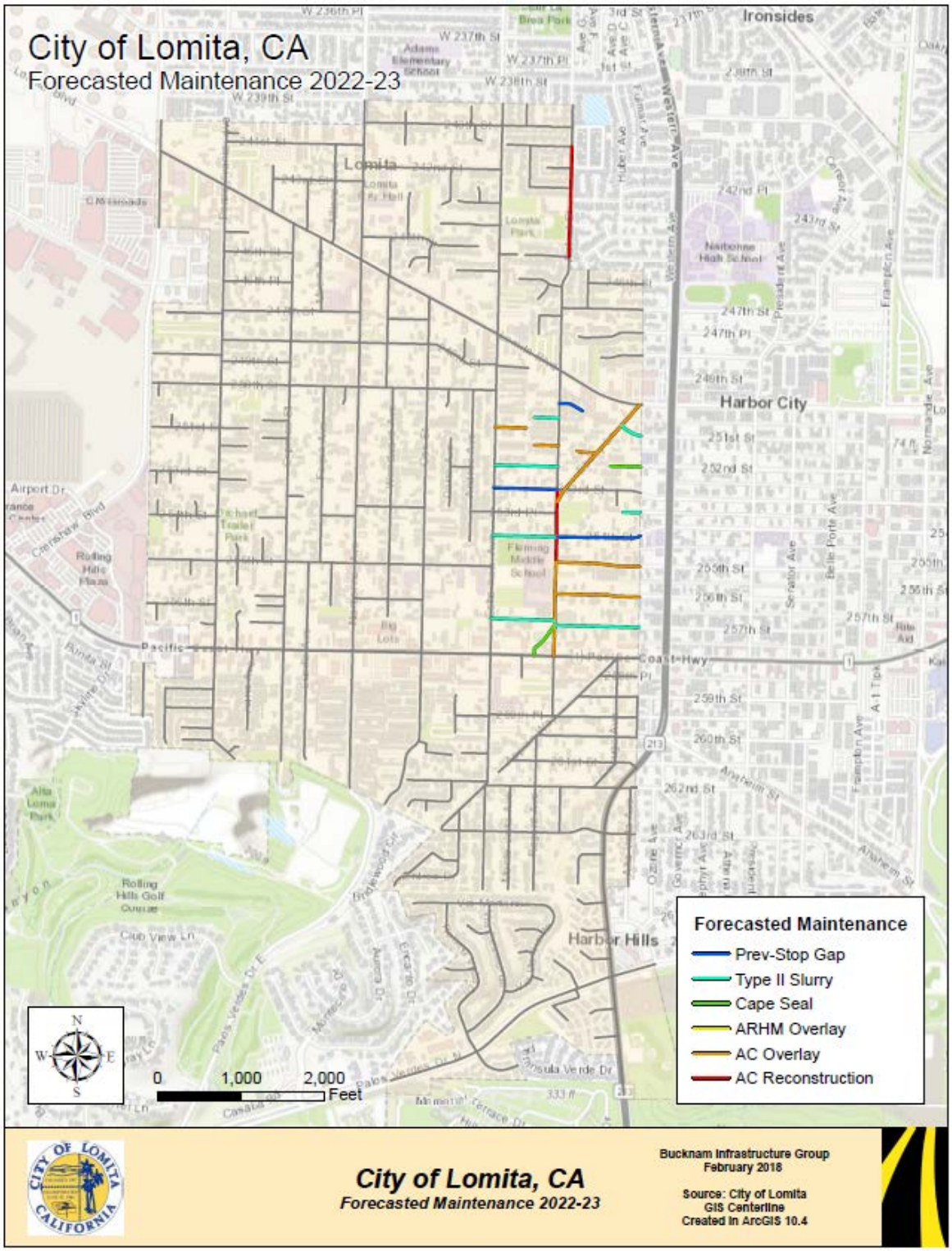

Figure 14 – 2022-23 Forecasted Maintenance