2018 "State of the Streets"

Final Report – 4/17/2019

Prepared for:

City of Hickory Hills, Illinois +
Chicago Metropolitan Agency for Planning

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1 INTRODUCTION

1.1 Background

In July of 2018, the Chicago Metropolitan Agency for Planning (CMAP) retained the services of Gorrondona and Associates, Inc. (G&AI) to assess the current condition of the City of Hickory Hills' roadway pavements and determine upcoming maintenance and rehabilitation (M&R) needs.

The project included the following major tasks:

1. Implementing a pavement management system to facilitate more proactive management of the City's roadway network,
2. Performing a comprehensive, semi-automated pavement condition survey of the City's roadways to assess existing conditions, and
3. Evaluating multi-year pavement M&R funding scenarios to estimate their impact on the overall condition of the City's roadway pavement network.

The City's roadway network is comprised of approximately 40 centerline miles of asphalt-surfaced pavements. The City's current annual funding level for the roadway network is approximately $400,000, with approximately $300,000 for resurfacing and $100,000 for microsurfacing.

1.2 Project scope and objectives

The scope of the CMAP-funded project included only those roads managed and maintained by the City. The primary objectives of this project are to implement a pavement management system, perform a network-level pavement condition survey, and estimate future pavement M&R needs. The project will provide the City with a better understanding of the current condition of its roadway network and the estimated future maintenance costs. Moving forward, the pavement management system will continue to serve as a repository for pavement condition data and M&R records.

1.3 Project approach

To successfully accomplish the objectives of this project, G&AI performed the following tasks:

1. Pavement management system implementation – *Developed an inventory of the City's roadway pavements and implemented the PAVER pavement management system*
2. Pavement Condition Index (PCI) inspection – *Performed a network-level Pavement Condition Index (PCI) inspection of the City's roadway pavements. (The pavement condition survey was performed during the week of 12 November 2018.)*
3. Roadway pavement M&R funding analyses – *Performed several five-year funding analyses using PAVER to estimate the City's future pavement M&R funding needs*

These tasks and their outcomes are described in Sections 2-5.

1.4 Pavement management overview

The use of a pavement management system is intended to provide municipal agencies with a systematic process for cost-effectively managing their pavement network, which may include roadways, parking lots, and alleys. The American Public Works Association (APWA) defines pavement management in the following way (1993):

> ***Pavement management is a systematic method for routinely collecting, storing, and retrieving the kind of decision-making information needed to make maximum use of limited maintenance (and construction) dollars.***

Combined with local knowledge and practical judgment, the recommendations from a pavement management system may be used to help make better roadway M&R decisions.

At the core of a pavement management system is the method for assessing pavement condition. The most widely used method for assessing pavement condition is the Pavement Condition Index (PCI), which is an industry standard defined in ASTM D6433. The PCI method outlines a process for more objectively assessing the condition of a pavement based on visual observations and measurements that take place during a field inspection. These observations and measurements are then distilled into a PCI value that ranges between 0 and 100. A PCI value of 0 indicates a failed pavement, and a PCI value of 100 indicates a pavement in excellent condition.

PCI values help determine the level of M&R needed to cost-effectively maintain or rehabilitate the pavement. When a pavement is in good condition, preventive maintenance can be applied to extend the life of the pavement. However, once a pavement falls below a pre-defined critical condition, preventive maintenance is no longer cost effective, and more significant and costly rehabilitation strategies should be considered.

The “Critical PCI” value for a pavement is the PCI value below which cost-effective preventive maintenance is no longer a viable option, and more significant rehabilitation and sometimes reconstruction. As shown in Figure 1, the primary objective of pavement management is to preserve pavements in good condition above the Critical PCI value rather than wait for them to deteriorate below the Critical PCI value, resulting in the need for significant rehabilitation or reconstruction.

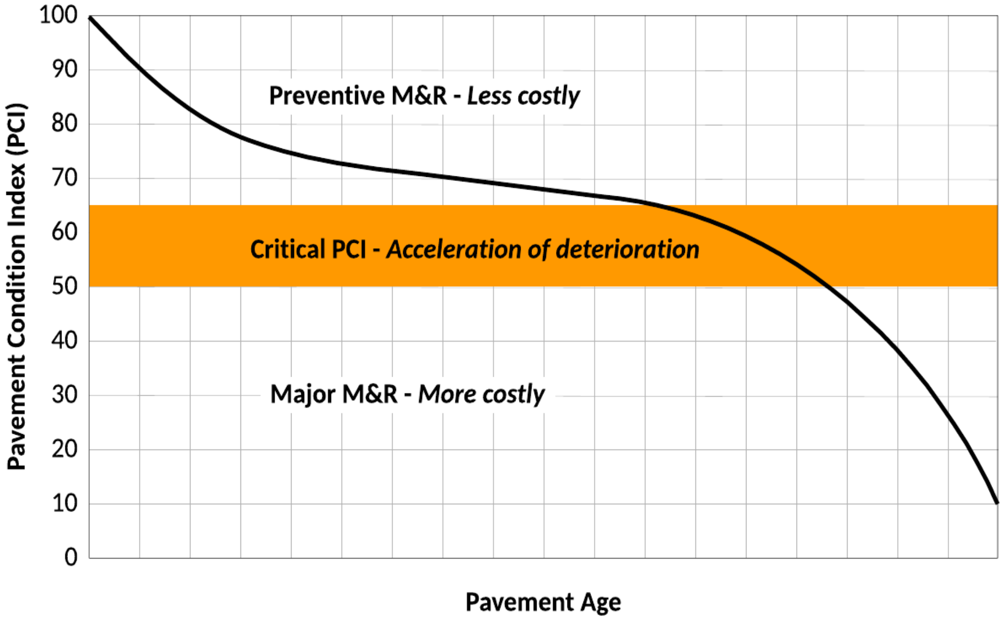


Figure 1. Correct timing of preventive and major M&R relative to the Critical PCI.

When the appropriate preventive maintenance treatments (e.g., crack sealing, seal coats, patching, etc.) are undertaken at the correct times during a pavement's service life, these relatively inexpensive preventive M&R treatments can extend the service life of the pavement, as shown in Figure 2.

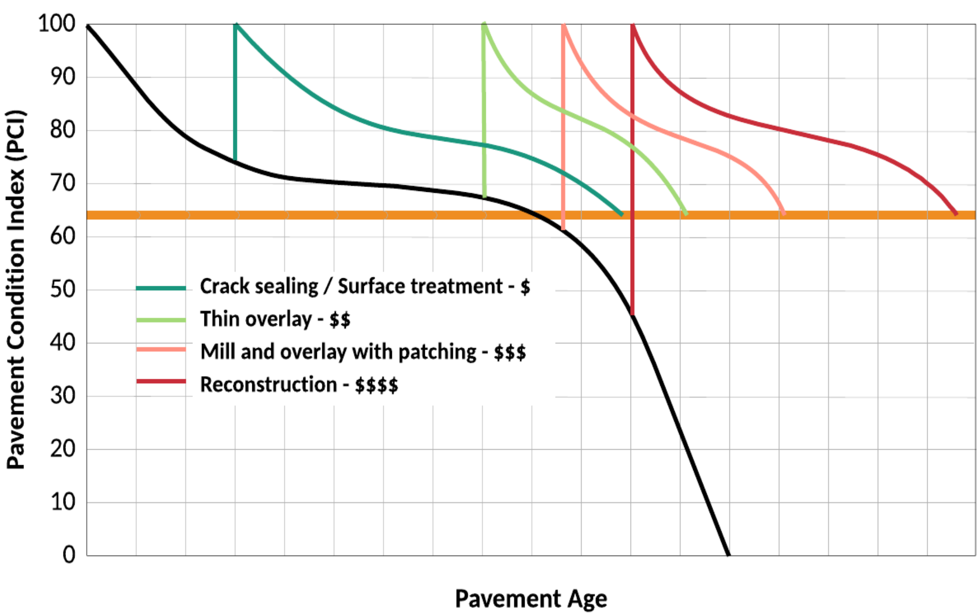


Figure 2. Increasing price and decreasing benefit of M&R.

As pavement management concepts have gained traction, computer-based pavement management systems have been developed to assist agencies in more optimally managing their pavements. Pavement management systems currently rely on a detailed pavement inventory, triennial pavement condition assessments, pavement performance modeling, and sophisticated analysis tools that can forecast future pavement condition and estimate future M&R needs and costs.

1.5 Incorporating pavement preservation strategies

The use of preventive maintenance (PM) early in the life of a pavement, before any significant deterioration, has been demonstrated to be a cost-effective way to extend the pavement’s service life. In the Federal Highway Administration (FHWA) publication, “Pavement Preservation, A Road Map to the Future,” PM is defined as “the planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without significantly increasing the structural capacity)”. FHWA adds that “PM is typically applied to pavements in good condition having significant remaining service life. As a major component of pavement preservation, PM is a strategy of extending the service life by applying cost-effective treatments to the surface or near-surface of structurally sound pavements.”

The following PM treatments have been demonstrated to be effective, when applied at the right time during a pavement’s service life.

- Crack sealing, crack filling and joint sealing of flexible and rigid pavements
- Patching and edge repairs
- Chip seals
- Fog seals
- Slurry seals
- Micro-surfacing
- Thin “functional” and “maintenance” overlay projects
- Ultra-thin, hot-mixed, bonded overlay projects

A goal of this project is to strongly encourage municipalities within the CMAP region to incorporate PM into their pavement management toolbox. Based on initial observations made during the CMAP pilot project, it is evident that municipalities have attempted to incorporate PM activities – with varying levels of success – into their pavement management programs.

The most common PM activities used within the CMAP region include: crack sealing, crack filling, patching, edge repairs, and micro-surfacing. However, these PM activities do not appear to be uniformly applied within agencies. Too frequently these activities are applied as “stop-gap” treatments rather than preservation activities. PM strategies should be applied to pavements that are in relatively good condition, and the activities should be planned and applied systematically following either the resurfacing or reconstruction of a pavement.

Municipality-specific recommendations are provided in section 5 of this report and pavements that are candidates for PM activities are provided in the Appendix. The following FHWA website provides additional information for pavement preservation: https://www.fhwa.dot.gov/pavement/preservation/.

1.6 Benefits and costs of implementing a pavement management system

Pavement management systems provide:

- A centralized location for storing pavement condition and inventory data, including construction, maintenance, and rehabilitation records.
- Decision-making support tools for:
  - Evaluating maintenance and rehabilitation alternatives,
  - Analyzing the consequences of alternative funding levels on pavement conditions, and
  - Improved scheduling and coordination of M&R projects and other infrastructure projects.
- Reporting tools for distilling complex data and justifying funding needs to elected officials.

The benefits of implementing a pavement management system improve over time as more data are entered into the system. The costs associated with implementing a pavement management system include:

- Pavement inventory data collection and routine updates (typ. annually);
- Routine pavement condition data collection (typ. 1/3 agency’s network per year);
- Performing pavement analyses and developing reports (typ. annual updates);
- Software acquisition, installation, system maintenance, and updates; and
- Staff training.

To ensure the success of a pavement management systems, agencies should develop a plan for staffing, maintaining, and funding the system appropriately.

2 PAVEMENT MANAGEMENT SYSTEM UPDATE

2.1 Objective

The objective of this task was to implement a pavement management system for the City's roadway pavements. G&AI implemented the PAVER Pavement Management System, which is developed and continually updated by the US Army Corps of Engineers.

This task required: 1) developing an inventory of the City's roadway pavements, 2) collecting current pavement condition data, and 3) customizing PAVER's analysis modules to reflect the City's existing maintenance and rehabilitation (M&R) policies.

2.2 PAVER pavement management system overview

The PAVER pavement management system helps agencies determine when, where, and what level of pavement M&R is required and approximately how much it will cost. The system provides a suite of pavement management software tools that assist agencies in: 1) developing and organizing their pavement inventory, 2) assessing the current condition of their pavements, 3) developing models to predict future pavement conditions, 4) reporting on past and future pavement performance, 5) developing scenarios for M&R based on either funding or pavement condition goals, and 6) planning M&R projects. PAVER modules include:

- Inventory
- M&R history
- Inspection
- Prediction modeling
- Condition analysis
- M&R planning
- Project planning
- Reporting

A brief description of these modules is presented in the following sections.

2.2.1 Inventory and M&R history modules

The PAVER Inventory and M&R History modules are based on a hierarchical structure composed of networks, branches, and sections, with "section" being the smallest actively managed pavement area (e.g. street block). This structure allows users to easily organize their inventory and historical M&R data while providing a simple and efficient way for rolling-up data to higher levels of the pavement hierarchy.

2.2.2 Inspection module

PAVER uses the Pavement Condition Index (PCI) per ASTM D6433 as the primary measure of pavement condition. The PCI method is described in Section 3. The Inspection module enables agencies to store raw pavement condition survey data and then calculate PCI values.

2.2.3 Prediction modeling module

The Prediction Modeling module in PAVER groups pavements of similar construction that are subjected to similar traffic, weather, and any other factors affecting pavement performance. Historical pavement condition data are used to build models that can be used to predict future pavement performance. If historical pavement data are not available, PAVER provides default pavement prediction curves and allows the user to develop custom prediction curves.

2.2.4 Condition analysis module

The Condition Analysis module allows agencies to view the condition of the entire pavement network or any specified subset of the network over time. The module reports past conditions based on interpolated values between historical condition data, and it reports projected conditions based on prediction models.

2.2.5 M&R planning module

The PAVER M&R Planning module is a sophisticated, flexible tool for multi-year, network-level and project-level M&R planning, scheduling, and funding. The M&R Planning module can determine the consequence of a predetermined funding level on pavement condition and the resulting backlog of major work and is also able to determine funding requirements to meet specific management objectives. These capabilities enable agencies to develop optimal M&R programs given available resources and justify optimal M&R funding needs.

2.2.6 Reporting module

Each module of PAVER can generate reports that assist the user in analyzing and interpreting data. PAVER also comes equipped with several "canned" reports, which include:

- GIS reports – *Internal/external reporting of inventory and condition data*
- Summary Charts – *Simple graphs and data tables of inventory and inspection data*
- Inspection Reports – *Summary of collected pavement condition data*
- Work History – *Summary of historical maintenance, repair, and rehabilitation data*
- Branch Listing – *Summary of overall pavement inventory data*
- Branch Condition – *Summary of overall pavement condition data*
- Section Condition – *Summary of individual section data*

PAVER can generate "user-defined" reports, which can be tailored to meet the agency's specific reporting needs. PAVER user-defined reports enable the user to extract any data stored in the system and export it to either a spreadsheet or a text file.

2.3 PAVER database development

The first step in the PAVER implementation was to divide the City's roadways into pavement sections. Each section typically represents a single "block" of pavement (i.e., intersection to intersection). Pavement sections may be thought of as homogenous areas of pavement to which Major M&R (e.g., resurfacing and reconstruction) would be applied. The City's existing Geographical Information System (GIS) provided served as the foundation for the PAVER section definitions, and G&AI defined 393 pavement sections throughout the City. Private roads within the City are included in the database but were excluded from the analyses.

Figure 3 shows the distribution of the City's roadway pavement centerline mileage and average conditions by age.

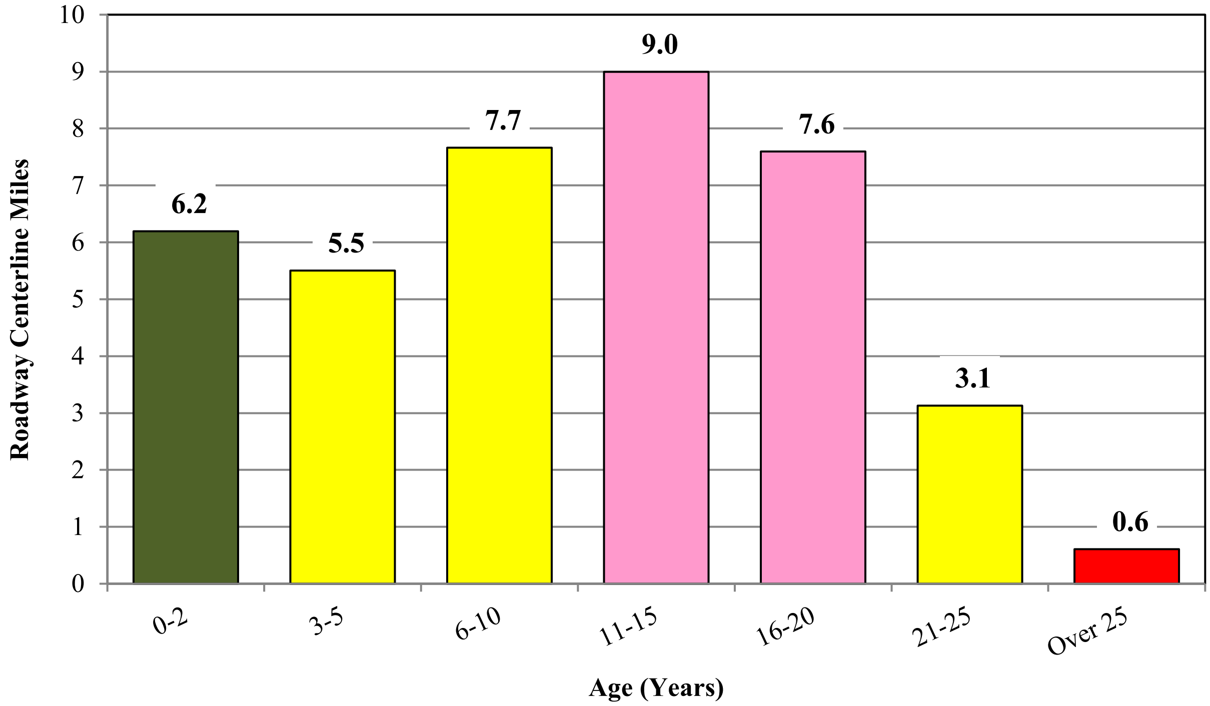


Figure 3. Roadway centerline miles by age.
(Note: Bar graph colors represent average pavement condition ranges, per Figure 4. Pavements with ages over 25 years may be missing historical construction data.)

The overall condition of the City's pavements is typical, with older pavements in worse condition. As shown in Figure 3, pavements between the ages of 11 and 25 years are in relatively similar condition. This stabilization of condition is due to localized maintenance activities targeted to provide temporary repairs to address the more severe pavement distresses.

2.4 PAVER database customization

Following completion of the PAVER database update, G&AI customized PAVER's system tables, which provide the foundation for all PAVER analyses. The system tables include M&R policies, estimated M&R unit costs by pavement condition, and M&R priorities. The system tables were established to reflect the City's M&R practices, priorities, and funding levels. G&AI also established pavement condition prediction models using both the City's historical pavement construction data and the results of the PCI inspection.

2.5 Summary

The City's PAVER database was updated to include relevant data pertaining to the City's roadway pavement network. The PAVER software was customized to reflect the City's existing and planned pavement management policies. The suite of tools provided by PAVER will enable the City to more effectively manage its roadway pavement network.

3 PAVEMENT CONDITION INSPECTION

3.1 Objective

The objective of the pavement condition inspection was to assess the existing condition of the roadway pavements within the City. This was accomplished by performing a semi-automated network-level pavement condition inspection based on the Pavement Condition Index (PCI) method. Both the pavement condition inspection procedure and general findings of the inspection are discussed in this chapter.

3.2 Pavement Condition Index (PCI) procedure

The pavement condition survey was performed following a modified approach of the PCI method described in ASTM D 6433. The PCI procedure is an objective and repeatable method for determining existing pavement condition. A PCI value provides an indication of the structural integrity and operational condition for a pavement section. The PCI procedure consists of a routine (typically triennial) visual inspection, during which pavement distress types, severity levels, and quantities are identified and recorded. These data are then input into the PCI algorithm to calculate a PCI value that ranges from 0 to 100, as shown in Figure 4.

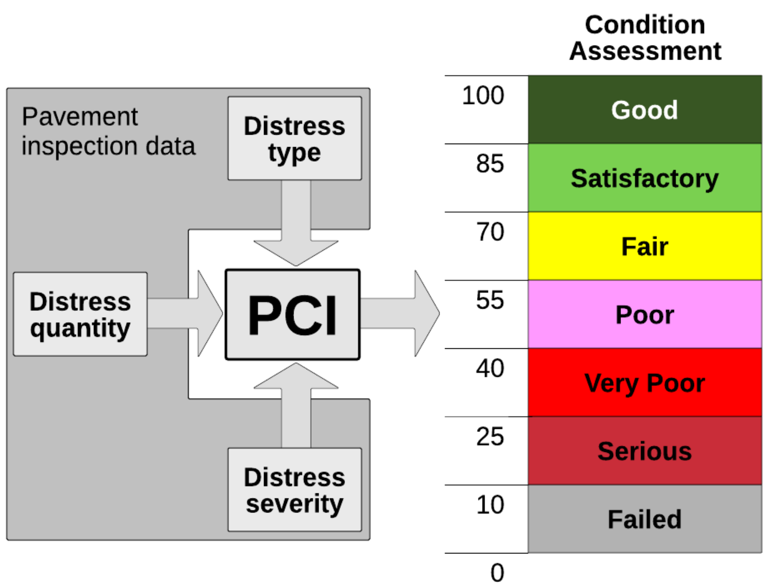


Figure 4. PCI inputs and the City’s condition assessment scale.

If properly designed and constructed, a new pavement begins its service life with a PCI of 100. Because of distress caused by vehicle loads and aging, a pavement deteriorates over time. For each combination of distress type, severity level, and quantity observed during the inspection, points are deducted from the initial value of 100, thereby decreasing the PCI. When multiple distresses are present, the deduct values are modified such that the impact of multiple distresses is somewhat lessened. Due to the complexity of the PCI algorithm, PCI values are typically computed using a pavement management software package, such as PAVER.

During a PCI inspection, twenty (20) distress types are identified and evaluated for asphalt pavements and nineteen (19) distress types for concrete pavements, as shown in Table 1 and Table 2.

Table 1: Asphalt pavement distress types.

Code	Distress	Cause
01	Alligator Cracking	Load
02	Bleeding	Other
03	Block Cracking	Climate/Durability
04	Bumps and Sags	Other
05	Corrugation	Other
06	Depression	Other
07	Edge Cracking	Load
08	Joint Reflection Cracking	Climate/Durability
09	Lane/Shoulder Drop-Off	Other
10	Longitudinal and Transverse Cracking	Climate/Durability
11	Patching and Utility Cut Patching	Other
13	Pothole	Load
14	Railroad Crossing	Other
15	Rutting	Load
16	Shoving	Other
17	Slippage Cracking	Other
18	Swell	Other
19	Raveling	Climate/Durability
20	Weathering	Climate/Durability

Table 2: Concrete pavement distress types.

Code	Distress	Cause
21	Blowup/Buckling	Climate/Durability
22	Corner Break	Load
23	Divided Slab	Load
24	Durability ("D") Cracking	Climate/Durability
25	Faulting	Other
26	Joint Seal Damage	Climate/Durability
27	Lane/Shoulder Drop-Off	Other
28	Linear Cracking	Load
29	Patching, Large and Utility Cuts	Other
30	Patching, Small	Other
31	Polished Aggregate	Other
32	Popouts	Other
33	Pumping	Other
34	Punchout	Load
35	Railroad Crossing	Other
36	Scaling, Map Cracking, and Crazing	Other
37	Shrinkage Cracks	Climate/Durability
38	Spalling, Corner	Climate/Durability
39	Spalling, Joint	Climate/Durability

3.3 Semi-automated Pavement Condition Index (PCI) data acquisition

G&AI deployed one of its state-of-the-art PathRunner pavement data collection systems to collect high-quality pavement imagery and profile data necessary for the semi-automated PCI survey of the City’s pavements. The PathRunner system is shown in Figure 5. The PathRunner was driven on all City roads.

G&AI’s PathRunner survey team collected all pavement condition data, including:

- High-resolution 3D downward images for detecting cracking,
- Rutting measurements, and
- High-resolution, forward-facing, right-of-way images.

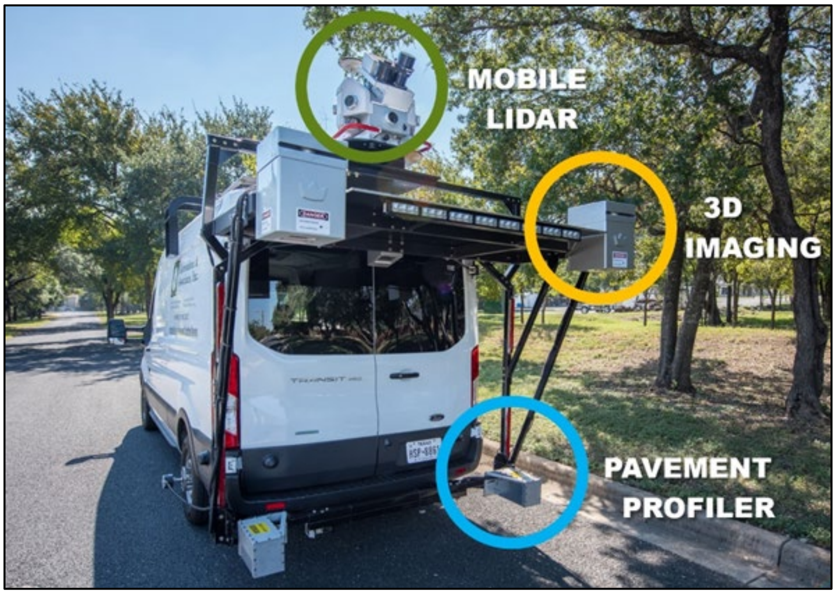


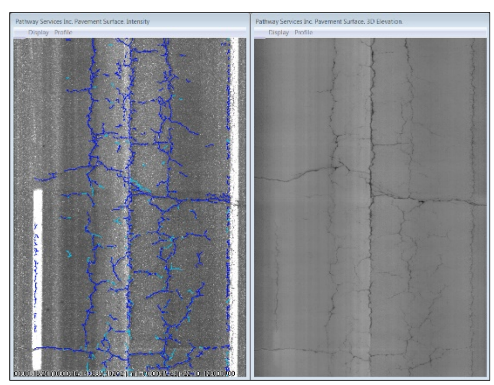
Figure 5: G&AI’s PathRunner pavement data collection system.

3.4 Pavement Condition Index (PCI) data interpretation

G&AI used the ASTM D6433-based modified PCI inspection method developed by the US Army Corps of Engineers (USACOE) for performing image-based PCI inspections. This method incorporates systematic random sampling and requires that distresses be recorded by trained inspectors using software that enables the inspectors to identify and record pavement distress types, severities, and quantities visible on collected downward images. The modified PCI inspection method is described in the textbook, “Pavement Management for Airports, Roads, and Parking Lots,” 2nd Ed. by M. Y. Shahin, Ph.D., P.E., 2006.

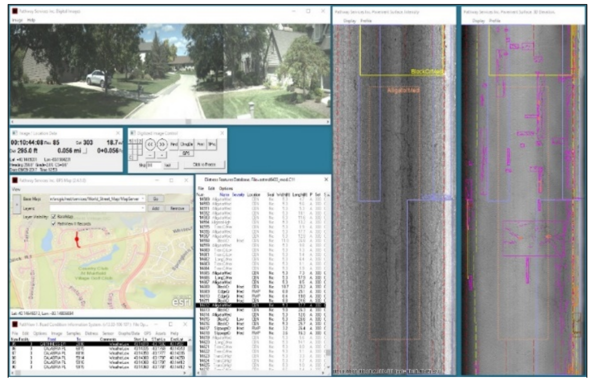
During the data collection effort, the G&AI team extracted pavement distress data from pavement survey field measurements and georeferenced digital images to determine PCI values. This was a four-step process which employed:

1. **AutoCrack™ Software** – This software detects cracking in the pavement imagery.
2. **AutoClass™ Software** – This software classifies the type of cracking detected.
3. **Manual image rating** – This step involves G&AI’s team of trained and experienced raters evaluating the imagery and identifying any distress types that the automated crack detection and classification software did not observe or incorrectly identified.
4. **QC/QA rating** – This step involves G&AI’s team of raters and project engineers reviewing the rated data prior to import into PAVER.



Steps 1 and 2: ***Initial Automated Crack Detection and Rutting Analysis***

The QC/QA rating is the single most important step in the project. The G&AI team uses the PathView™ software for evaluating distresses using both automated algorithms and manual supplemental rating. All QC/QA is performed using PathView™. The same software system has been used for more than 25 state DOTs and several municipal agency pavement condition survey projects.



Steps 3 and 4: *Manual Rating + QC/QA using PathView™*

3.5 Existing pavement conditions and field observations

The City's improved roadway network consists of approximately 40 centerline miles. The collected pavement inspection data was used to calculate a PCI value for each pavement section. Table 3 shows the PCI condition assessment criteria used to analyze the pavement network.

Table 3: City's pavement condition assessment criteria.

Condition Assessment	PCI Value
Good	86-100
Satisfactory	71-85
Fair	56-70
Poor	41-55
Very Poor	26-40
Serious	11-25
Failed	0-10

At the time of G&AI's November 2018 inspection, the City's pavements were found to be in overall "Fair" condition, with an average PCI of 63. The condition distribution of the City's pavements at the time of inspection is shown in Figure 6, and detailed condition maps can be found in Appendix A.

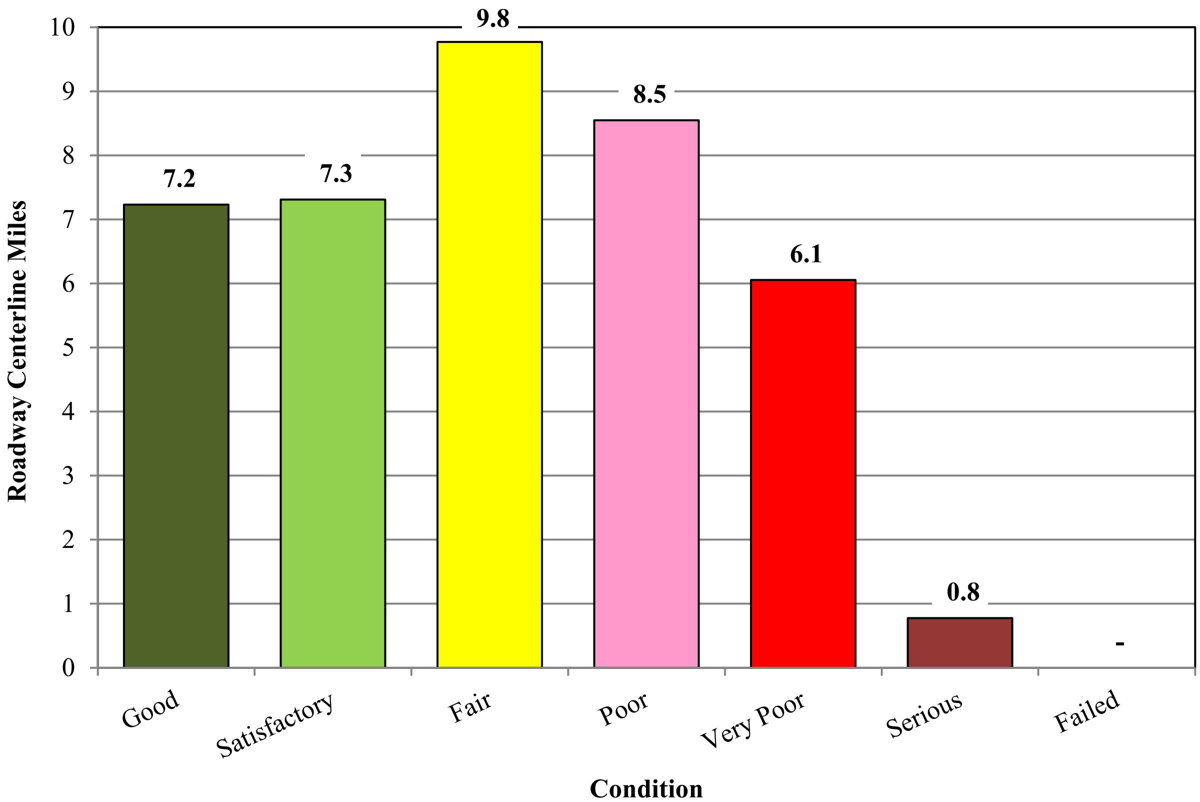


Figure 6. Overall pavement conditions by centerline mileage.

The causes of pavement deterioration may be divided into the following three general categories: 1) vehicle load related, 2) climate/durability related, and 3) other (e.g., material issues, construction defects, etc.). Table 4 shows the primary causes of pavement deterioration observed throughout the City's pavement network.

Table 4. Categorization of observed pavement distresses

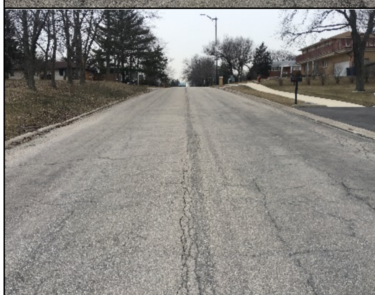
Distress Category	Example Distresses	Percentage of Observed Distresses
Load Related	Asphalt pavement distresses such as rutting and alligator cracking.	44%
Climate/ Durability Related	Asphalt pavement distresses such as longitudinal and transverse cracking, and block cracking.	53%
Other	Pavement distresses such as bleeding, patching, and slippage cracking for asphalt pavements.	3%

The deterioration observed on the City's pavements was caused primarily by a mixture of climate- and load-related distresses. Climate-related distresses – including longitudinal and transverse cracking and block cracking – were found across the City's pavement inventory. In addition, vehicle load-related distresses – including alligator cracking and rutting – were pronounced on many of the City's roadways and accounted for most of the distress negatively impacting overall roadway conditions.

3.6 Example pavement conditions

Figure 7 illustrates a variety of pavement conditions observed throughout the City during the November 2018 survey.

	Location + History	PCI	Recommended M&R Activity (Typical)
	94th Street *Cold mill and overlay in 2017*	95	Preventive maintenance *Seal joints between pavement and curb and gutter*
	77th Avenue *Cold mill and overlay in 2016*	94	Preventive maintenance *Seal joints between pavement and curb and gutter*
	85th Court *Cold mill and overlay in 2002*	72	Preventive maintenance *Seal paving lane seam + re-seal joints between pavement and curb and gutter + edge patching*
	78th Court *Constructed in 1994 (No resurfacing records available.)*	65	Major M&R *Localized structural patching + microsurfacing*
	93rd Street *Between 78th Court and 78th Avenue* *Microsurfacing 2016*	57	Major M&R *Localized structural patching + cold mill and overlay*

	79th Court (30) *Cold mill and overlay in 2006*	49	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*
	91st Street (140) *Microsurfacing 2015*	47	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*
	93rd Street *Between 77th Avenue and 76th Court* *Microsurfacing 2016**	46	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*
	85th Street *Cold mill and overlay in 2001*	36	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*
	90th Street *Cold mill and overlay in 2005*	28	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*

	Colette Lane *Microsurfacing 2014**	16	Major M&R *Reconstruction*

Figure 7. Pavement conditions observed during PCI inspection.

A distress observed on several of the City's pavements was unsealed paving lane cracking that had progressed into alligator cracking, as shown in Figure 8. The impact of this distress on PCI values can be significant, and full-depth patching is required to fix this distress. By sealing and routinely re-sealing paving lane seams immediately following paving, this type of deterioration may be prevented.

	Location + History	PCI	Recommended M&R Activity (Typical)
	89th Place *Cold mill and overlay in 2001*	50	Major M&R *Localized structural patching + cold mill and overlay <u>or</u> reconstruction*

Figure 8. Failure partially initiating along unsealed paving lane joint.
Note: Visible sealant added post failure.

4 MAINTENANCE AND REHABILITATION FUNDING ANALYSES

4.1 Objective

The Maintenance and Rehabilitation (M&R) Planning module in PAVER provides *recommendations* for when and where M&R activities are needed and approximately how much they will cost. M&R plans may be developed either by assuming an annual funding level or by specifying a desired pavement condition. Based on either an inputted annual funding level or a desired condition, PAVER will output an economically viable work plan. The following five-year M&R funding analyses were performed on the City's pavements:

- Determine effect of current funding level of $400K/YR
- Determine funding needed to stabilize the current network average condition of 63: $662K/YR
- Determine funding needed to improve the network average condition to 70: $1.2M/YR
- Determine funding needed to eliminate the Major M&R backlog: $2.0M/YR
- Determine the effect of the worst-case funding scenario of no Major M&R: $0/YR

Note: These scenarios consider funding for Major M&R (i.e., microsurfacing, resurfacing and reconstruction). These scenarios do not include funding for routine maintenance such as pothole filling.

4.2 Assumptions

The M&R funding analyses were based on the data stored in the City's PAVER database, unit cost data provided by the City for each pavement type, and the City's existing Major M&R policies were used in the analyses. An inflation rate of 3% was used for all analyses.

Pavement deterioration curves were developed based on existing pavement age and collected condition data. The critical PCI value was set to 55 for all roadways. The critical PCI value represents the condition at or below which Major M&R is recommended.

4.3 Results

Figure 9 illustrates the estimated five-year change in pavement condition resulting from the analyzed funding scenarios while Figure 10 depicts the estimated change in the City's Major M&R backlog for each funding scenario.

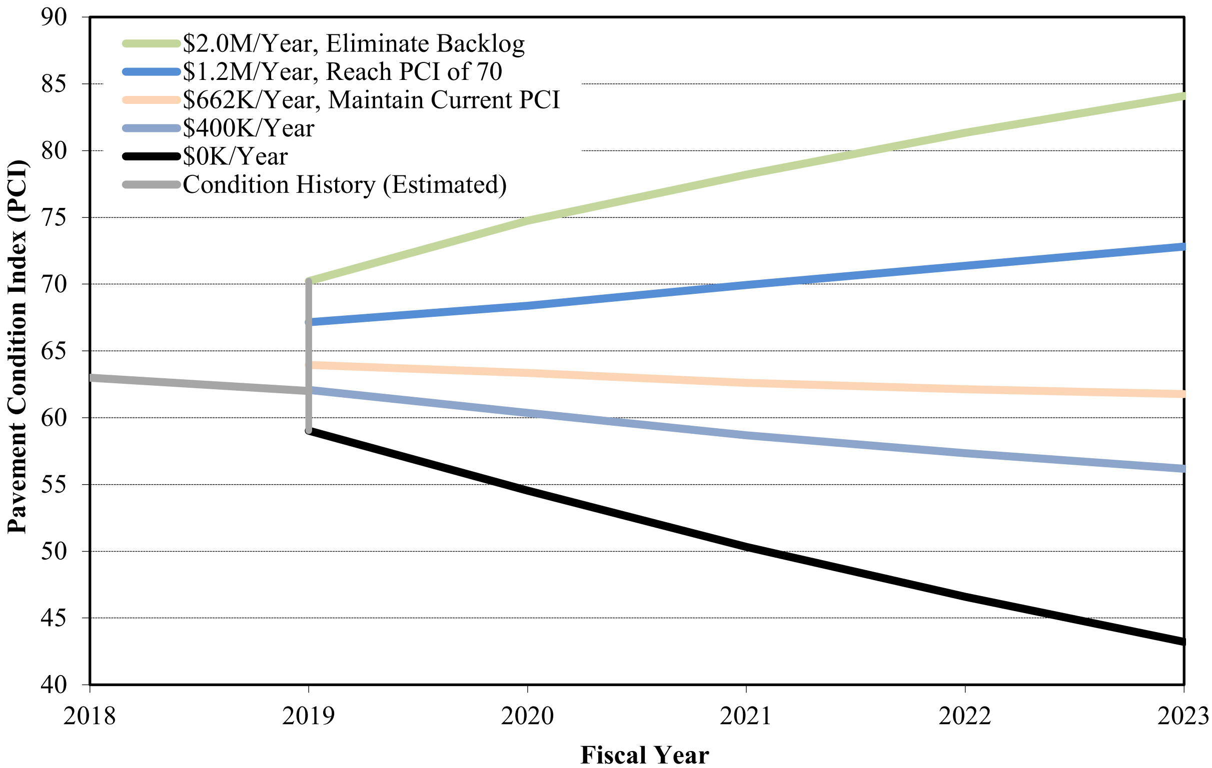


Figure 9: Effect of funding levels on overall pavement conditions by year.

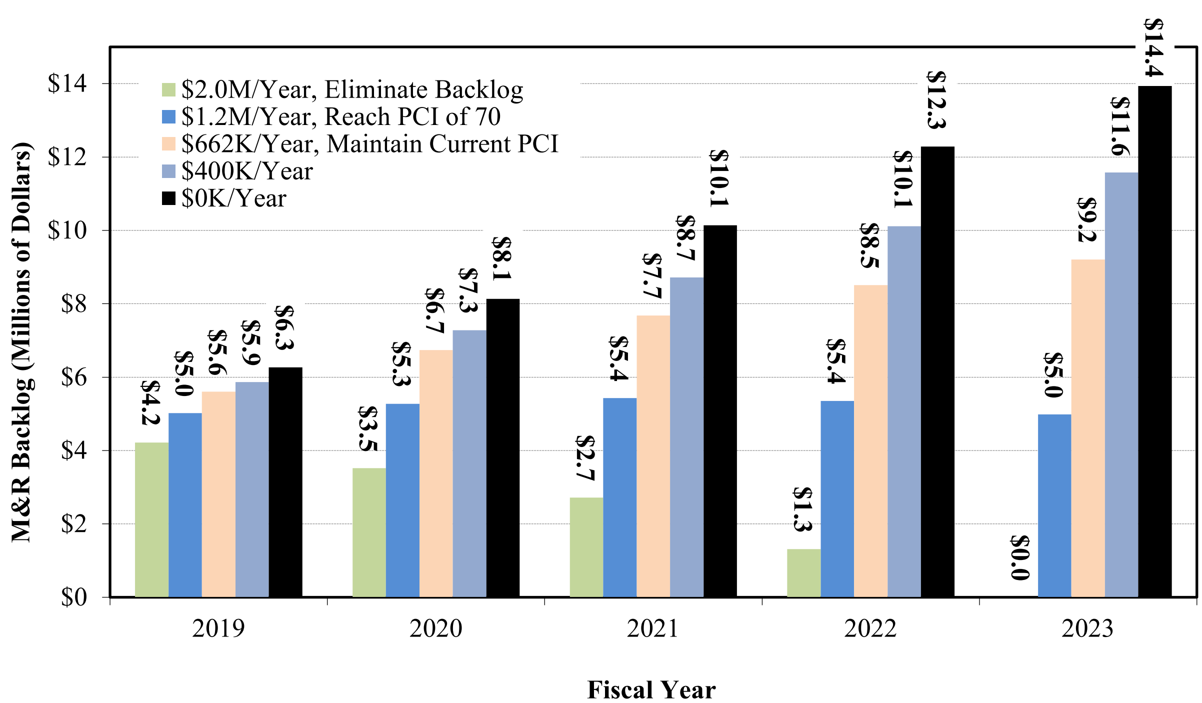


Figure 10: Effect of funding levels on pavement M&R backlog by year.

The consequences of the annual funding scenarios are shown in Table 5. This table illustrates the concept of "total cost." By treating both the total annual M&R expenditures and the remaining M&R backlog at the end of the five-year period as costs to the City, the benefit of increasing annual funding – which results in a smaller M&R backlog – may be more clearly illustrated. Consequently, eliminating the M&R backlog over a five-year period results in the lowest total cost to the City.

Table 5. Estimated Five-year Pavement M&R Costs

Funding Scenario	Total Five Year M&R Costs (2019-2023)	Remaining M&R Backlog[1)] (2023)	Total Five-year Cost[2)]	Projected PCI (2023)
$400K/YR (Existing Funding Level)	$2M	$11.6M	$13.6M	56
Maintain Current Conditions ($662K/YR)	$3.3M	$9.2M	$12.5M	62
Increase Overall PCI to 70 ($1.2M/YR)	$6M	$5M	$11M	73
Backlog Elimination ($2.0M/YR)	$10M	$0M	$10M	84
No Major M&R	$0	$14.4M	$14.4M	43

1) "M&R Backlog" equals the lump-sum cost to resurface/reconstruct all pavements at or below their critical PCI value.
2) "Total five-year cost" equals the sum of the five year Major M&R expenditures plus the remaining Major M&R backlog at the end of the five-year analysis period.

4.3.1 Consequence of existing funding level

PAVER analyses were performed to determine the consequence of the City's existing M&R funding level, which is $400K/YR. It was estimated that the City's existing funding level may result in up to a seven-point drop in the City's average roadway PCI score over the upcoming five years. Hence, the City's current funding level appears to be inadequate to maintain the current overall average condition of the roadways.

4.3.2 Funding level required to eliminate Major M&R backlog

PAVER was used to determine the annual funding required to eliminate the City's Major M&R backlog. This plan allocates funding to all pavements that require Major M&R so that, at the end of the five-year period, all City maintained pavements are either at or above their critical PCI value.

It was estimated that a funding level of approximately $2.0M/YR is needed to eliminate the City's existing pavement Major M&R backlog over the next five years. This scenario results in a significant overall estimated PCI increase from 63 to 84 over the five-year period.

It is important to note that if the $2.0M/YR funding level were to be implemented, the average annual M&R funding required for years 2024 through 2028 is estimated to be approximately $500K/YR for Major M&R. This significant drop in required funding results from all the City's pavements being in overall good condition at the end of the five-year period and only requiring less expensive rehabilitation in years six through ten.

4.3.3 Funding required to stabilize and improve conditions

Additional PAVER analyses were performed to estimate the funding levels needed to reach the following goals:

- Determine annual funding to stabilize the current network average condition of 63: $662K/YR.
- Determine annual funding to improve the network average condition to 70: $1.2M/YR.

It is estimated that a funding level of approximately $662K/YR is needed to stabilize the City’s network average PCI value of approximately 63 over the next five years. The $662K/YR funding level keeps conditions relatively stable over the next five years but results in a modest increase in the backlog of Major M&R.

An estimated funding level of approximately $1.2M/YR is required to raise the City’s overall PCI value from 63 to 70. In addition to raising the overall average condition of the City’s roadways, the $1.2M/YR funding level results in an estimated $500K decrease in the Major M&R backlog at the end of five years, when compared to the impact of the City’s current funding level.

4.3.4 “Worst case” funding scenario

For comparison purposes, a “worst case” funding scenario of no Major M&R ($0/YR) was considered. This funding scenario shows that no funding towards the City’s roadways over the next five years may result in a twenty-point PCI drop in overall roadway conditions. Furthermore, a significant increase in the Major M&R backlog from approximately $5.9M to more than $12.3M may be realized.

5 SUMMARY AND RECOMMENDATIONS

5.1 Summary

The goals of a pavement management program include maintaining satisfactory overall pavement conditions and reducing the Major M&R backlog over time. Doing so will eventually ensure that all pavements in the City are in good condition, and that they are therefore being managed more cost effectively through preventive maintenance and less costly and less frequent rehabilitation and reconstruction projects.

The PAVER pavement management system was successfully implemented for the City's roadway pavement network. This system provides the City with a tool for more objectively and cost-effectively planning and programming M&R for its roadways. The system provides tools for analyzing the performance of the City's roadways, and it also provides a repository for storing historical M&R data and routinely collected pavement condition data.

The first comprehensive pavement condition survey was performed on the City's roadway pavements in November 2018. The City's roadway pavements were found to have an average PCI value of 63, which indicates that the City's pavements are in overall fair condition. The majority of the City's pavements exhibited both climate- and load-related distresses, and several of the City's roadway pavements require Major M&R (e.g., mill and overlay or reconstruction).

Five-year M&R funding analyses were performed using PAVER to: 1) evaluate the adequacy of the City's existing funding level, 2) estimate the funding level needed to maintain the City's existing roadway conditions, 3) estimate the funding level needed to modestly raise the overall condition of the City's roadways, and 4) estimate the funding level needed to eliminate the City's backlog of Major M&R.

It was determined that the City's existing funding level for Major M&R is likely to be inadequate to maintain the current condition of the City's roadway pavements. To maintain existing conditions, an increase in funding of approximately $500K/YR would likely be needed.

5.2 Recommendations

5.2.1 Prioritize existing M&R funding to maximize shared benefit

Currently, the City's roadway M&R funding needs exceed available funding. It is recommended that the City focus Major M&R activities on its primary roadways (i.e., the roads that handle the most traffic). Doing so should maximize the overall shared benefit of the funds spent. Furthermore, the City should focus on applying routine preventive maintenance to newly resurfaced or reconstructed roadways. Preventive maintenance activities, such as crack sealing and localized patching, can cost-effectively extend the life of a pavement.

5.2.2 Evaluate the effectiveness of microsurfacing

It was observed that several roads that had been recently microsurfaced were exhibiting significant distress, and the average rate of deterioration of microsurfaced roads was higher than for roads that were resurfaced. To get the most benefit from microsurfacing, it is recommended that it be applied to pavements in relatively good condition to preserve them. The effectiveness of microsurfacing may be improved if it is preceded by localized patching of existing distresses. Applying microsurfacing to pavements exhibiting severe distress may not significantly extend the life of the pavements.

5.2.3 Seal paving lane seams following construction

It was observed that some paving lane seams throughout the City had not been sealed. Moisture penetrates unsealed paving lane seams and compromises the base structure of the pavement. Sealing the paving lane seams is a simple, cost-effective method for pavement preservation, and it may be included in construction specifications.

5.2.4 Determine when pavements should be reconstructed rather than resurfaced

As the City’s asphalt-surfaced pavements age and are resurfaced multiple times, the performance of successive resurfacing projects will likely diminish. This is because the sublayers (i.e., the pavement structure below the asphalt surface) of the pavement continue to deteriorate due to moisture infiltration, freeze-thaw damage, and damage due to vehicular loading. The City should carefully track the performance of resurfaced roadways and determine the optimal number of resurfacing projects that may be performed prior to reconstructing the pavement.

5.2.5 Increase funding for pavement maintenance and rehabilitation

Based on the results of the pavement condition survey and forecasts of future pavement condition, the City’s current level of funding ($400K/YR) is likely inadequate to maintain the overall current condition of the City’s roadways, which is currently 63 on a scale of 0 to 100.

Managing a pavement network at an overall average PCI closer to 80 is more cost effective since funding is spent on less costly preventive maintenance and preservation activities rather than more expensive Major M&R. As the City moves forward, it is recommended that additional funding be allocated for M&R to improve the overall condition of the roadways so that they may be managed more cost-effectively.

5.2.6 Routinely update the PAVER pavement management system

At a minimum, the PAVER system should be updated annually to capture Major M&R activities, routine maintenance activities, and pavement inventory changes (i.e., new roads, jurisdictional changes, realignments, etc.). PAVER relies on updated inventory and work history data in order generate meaningful recommendations.

5.2.7 Perform regular pavement condition inspections – every three years

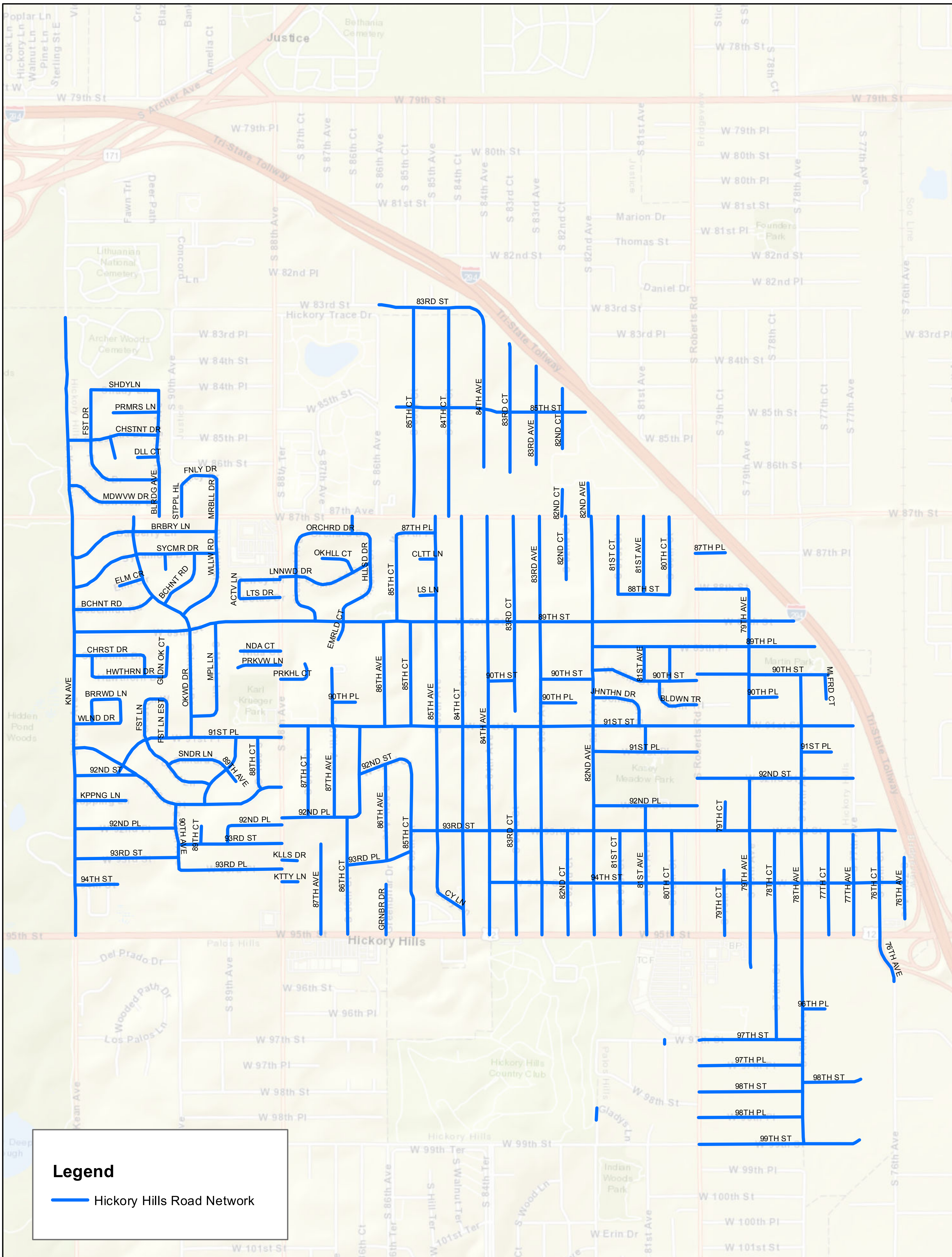
To capitalize on this PCI inspection effort and better track the condition of its pavements, it is recommended that the City continue to perform PCI surveys on a three-year cycle. Doing so will enable the City to:

1. Better track the deterioration of its pavements,
2. Improve pavement deterioration trends to better predict future pavement conditions, and
3. Assess the effectiveness of its pavement preservation and Major M&R activities.

The deterioration trends developed for this project were based on only one set of inspection data. Additional inspection data will help validate these trends and will improve forecasts, which may impact forecasted pavement conditions and recommended future funding needs.

APPENDIX A – MAPS

1. Pavement network identification map
2. Pavement surface type map
3. Pavement Condition Index (PCI) map
4. Five-year Major M&R recommendations – *All needs, unlimited funding*
5. Pavement preservation – *Current needs*



Feet
0 1,000 2,000

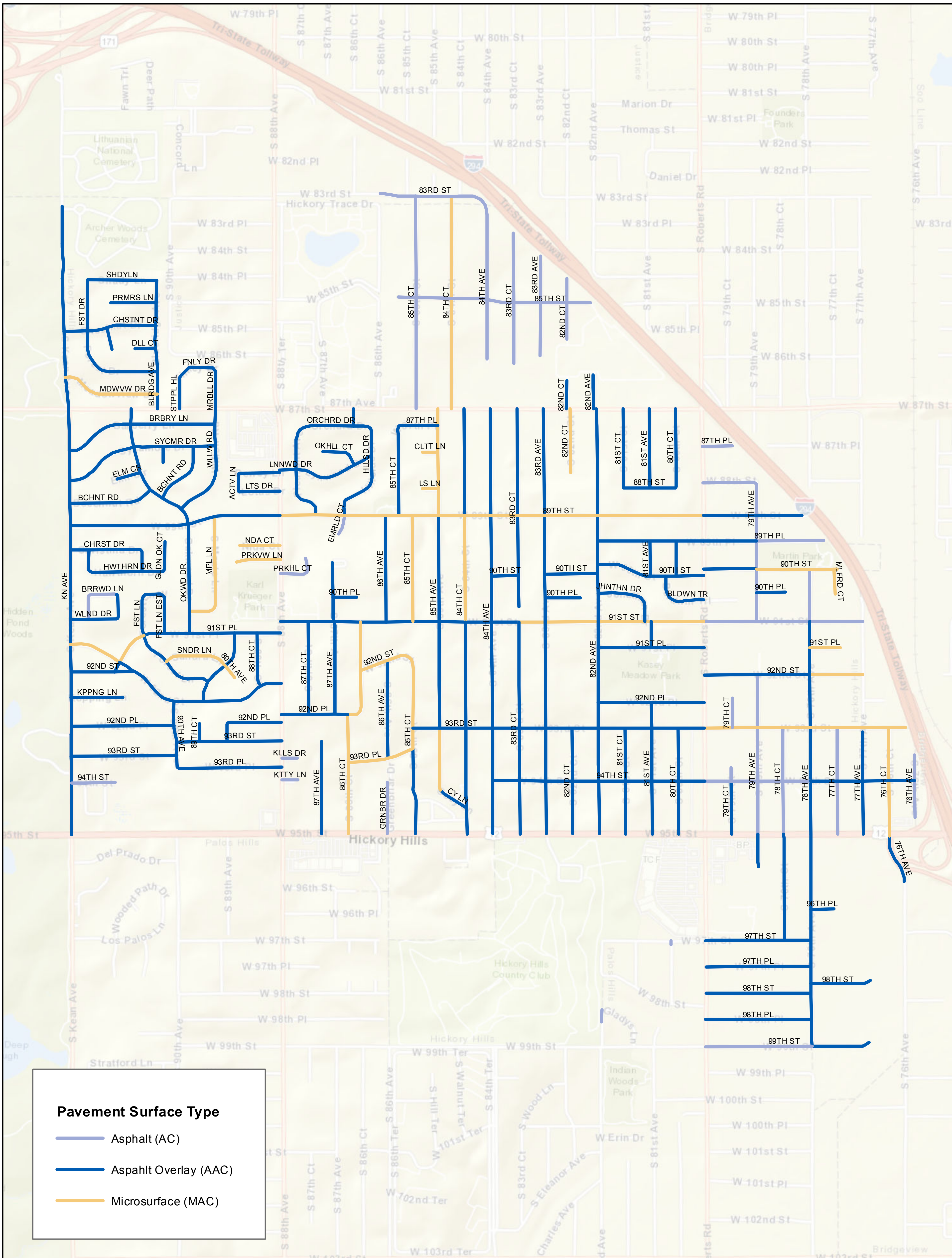
Network Identification

Hickory Hills, Illinois

Pavement Assessment

Gorrondona & Associates, Inc.

Urban GIS
your world, your way



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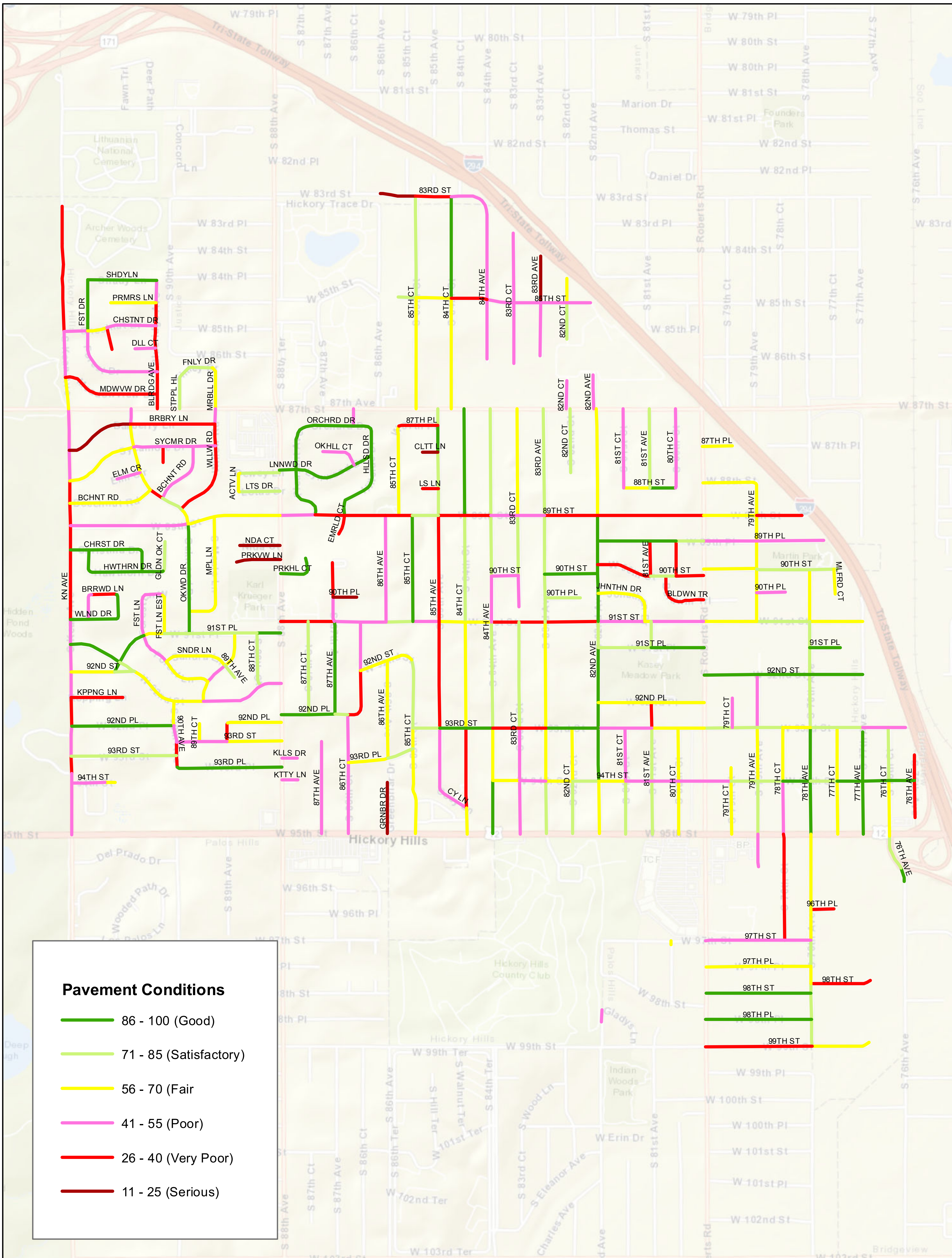
Pavement Surface Types

Hickory Hills, Illinois

Pavement Assessment

Gorrondona & Associates, Inc.

Urban GIS
your world, your way



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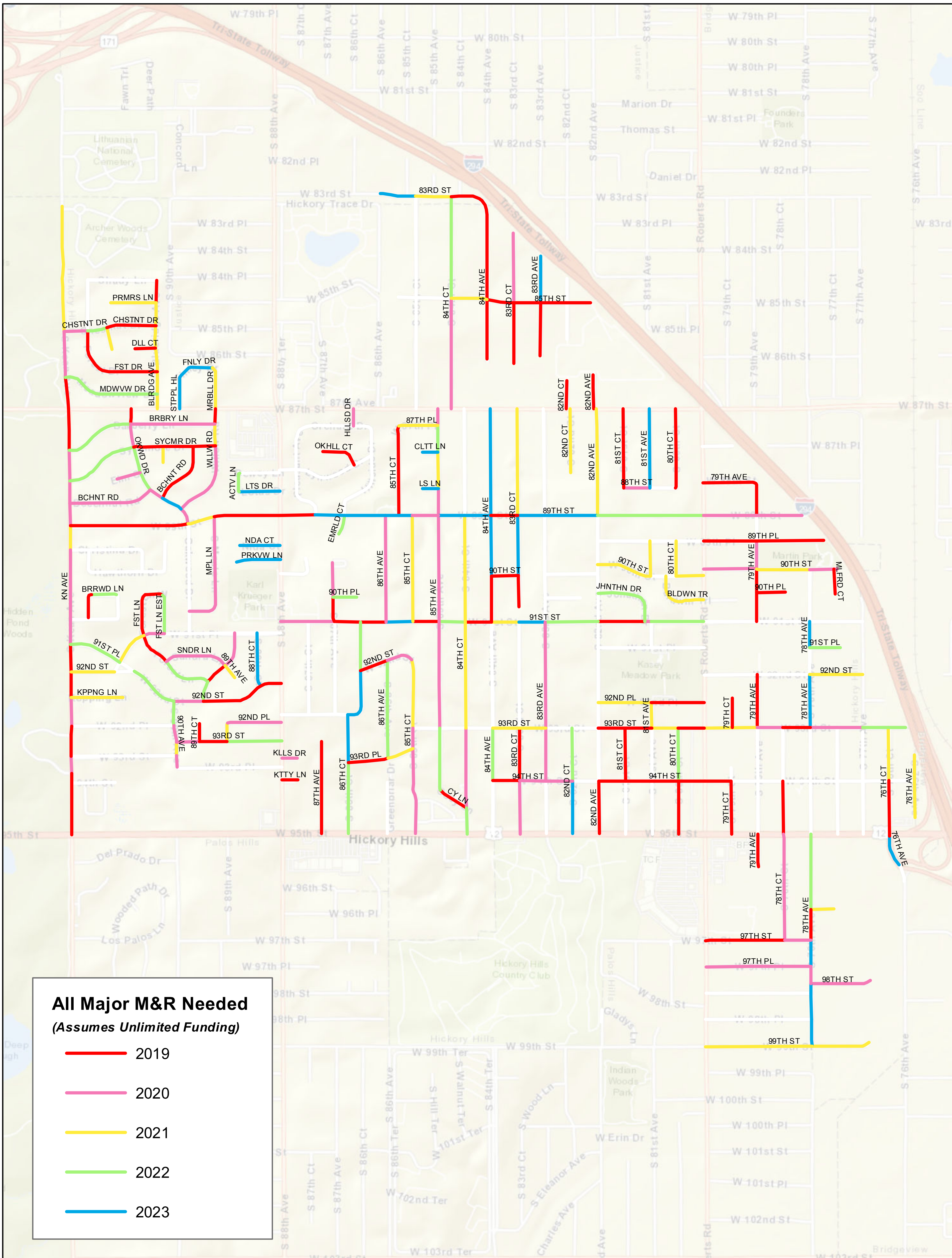
Pavement Conditions

Hickory Hills, Illinois

Pavement Assessment

Gorrondona & Associates, Inc.

Urban GIS
your world, your way



Feet
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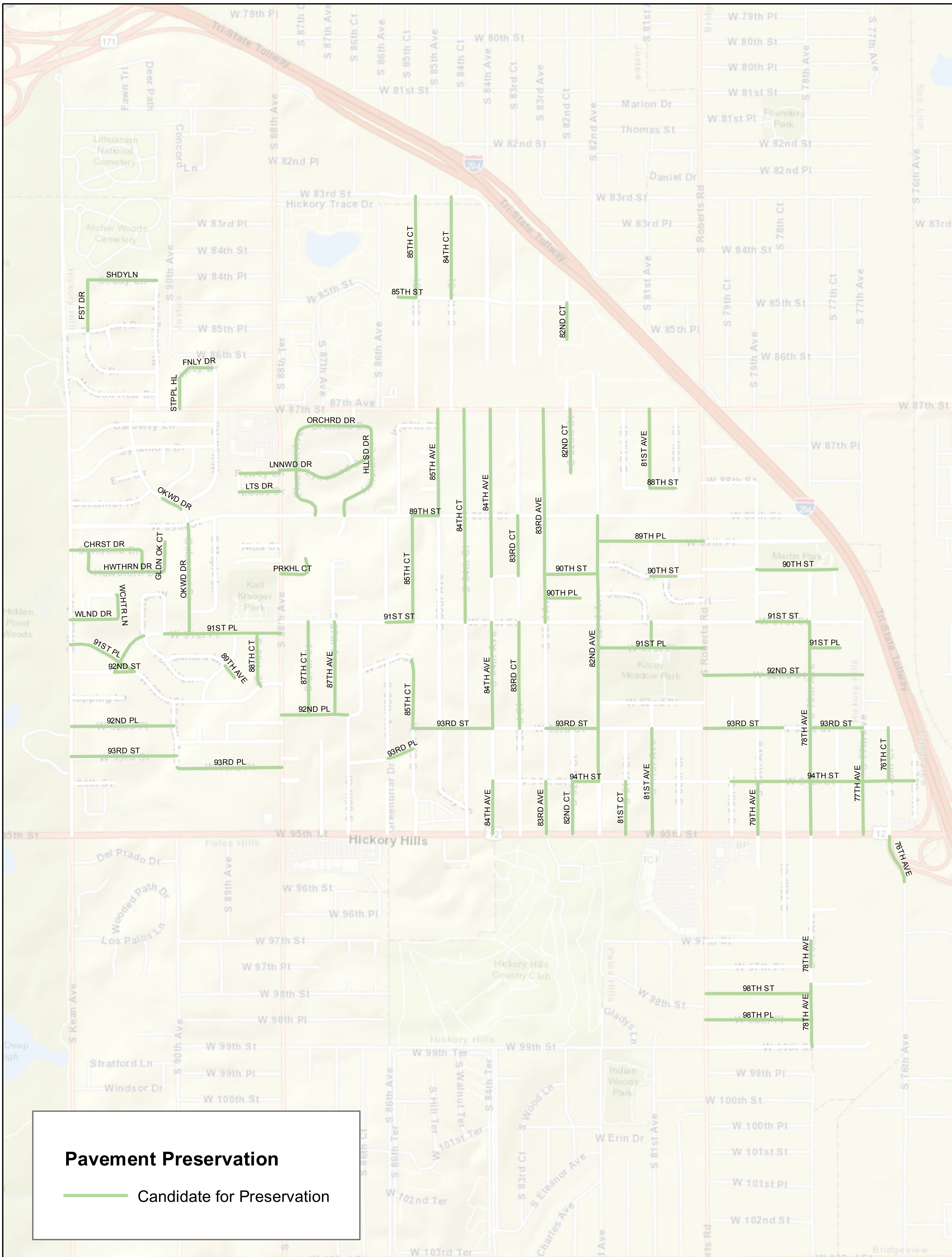
All Major M&R Needed
(Assumes Unlimited Funding)

Hickory Hills, Illinois

Pavement Assessment

Gorrondona & Associates, Inc.

Urban GIS
your world, your way



Feet

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Pavement Preservation

Hickory Hills, Illinois

Pavement Assessment

Gorrondona & Associates, Inc.

Urban GIS
your world, your way