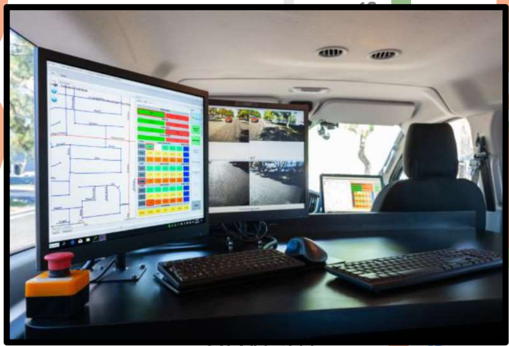
Johnsburg, IL

Pavement Management Report

August 2022



Village of Johnsburg
Settled 1841 – Incorporated 1956

IMS
Infrastructure Management Services

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1.0 Executive Summary

1.1. Project Summary

IMS Infrastructure Management Services, LLC (IMS) was retained by Johnsburg, IL (Village) to conduct a comprehensive pavement condition assessment and pavement management analysis on the Village's pavement network. The objectives of this project were to: (1) perform a network-level condition survey of the Village's 49 centerline miles of asphalt roadways (2) provide Village staff with a new implementation of the PAVER pavement management system, (3) estimate the rate of deterioration of the Village's pavements, and (4) estimate the future Maintenance and Rehabilitation (M&R) requirements for the Village's pavement infrastructure.

IMS mobilized its Laser Crack Measurement System (LCMS) Road Surface Tester (RST) in May 2022 to conduct an objective pavement condition survey of the Village-maintained pavements. The collected pavement imagery, surface distress data and roughness data were analyzed following industry standards to determine the Pavement Condition Index (PCI) as well as the International Roughness Index (IRI) for each segment of the roadways.

PCI scores provide an indication of a pavement's overall condition. The values range from 0, indicating a completely failed pavement, to 100, indicating a pavement in excellent condition. The Village's pavement conditions were categorized based on PCI values using the criteria shown in **Table 1. Table 1** also presents the recommended M&R for each PCI category.

Table 1 - Village's Pavement Condition Index Categories

Condition Assessment	Typical Pavement Distresses and M&R Recommendations	PCI Range
Good	Like-new pavement **Preventative Maintenance:** *Crack Sealing*	(85-100]
Satisfactory	Low severity longitudinal and transverse (L&T) cracking and weathering **Preventative Maintenance:** *Crack Sealing & Surface Treatments*	(70-85]
Fair	Moderate severity L&T cracking **Global preventive maintenance & localized repairs:** *Localized surface and/or full-depth patching, surface treatments, and thin overlays*	(55-70]
Poor	Severe L&T cracking, low severity alligator cracking **Moderate rehabilitation:** *Localized full-depth patching, mill and overlays*	(40-55]
Very Poor	Moderate alligator cracking **Major rehabilitation:** *Mill and overlays, and reconstruction*	(25-40]
Serious	Severe alligator cracking, rutting **Major rehabilitation:** *Partial and complete reconstruction*	(10-25]
Failed	Severe alligator cracking, rutting, and potholes **Major rehabilitation:** *Complete reconstruction*	[0-10]

The following **Figure 1** provides an overview of the conditions of the Village's pavement network. **The average PCI of the Johnsburg Pavement Network is 55, and the backlog is approximately $13.5M.**

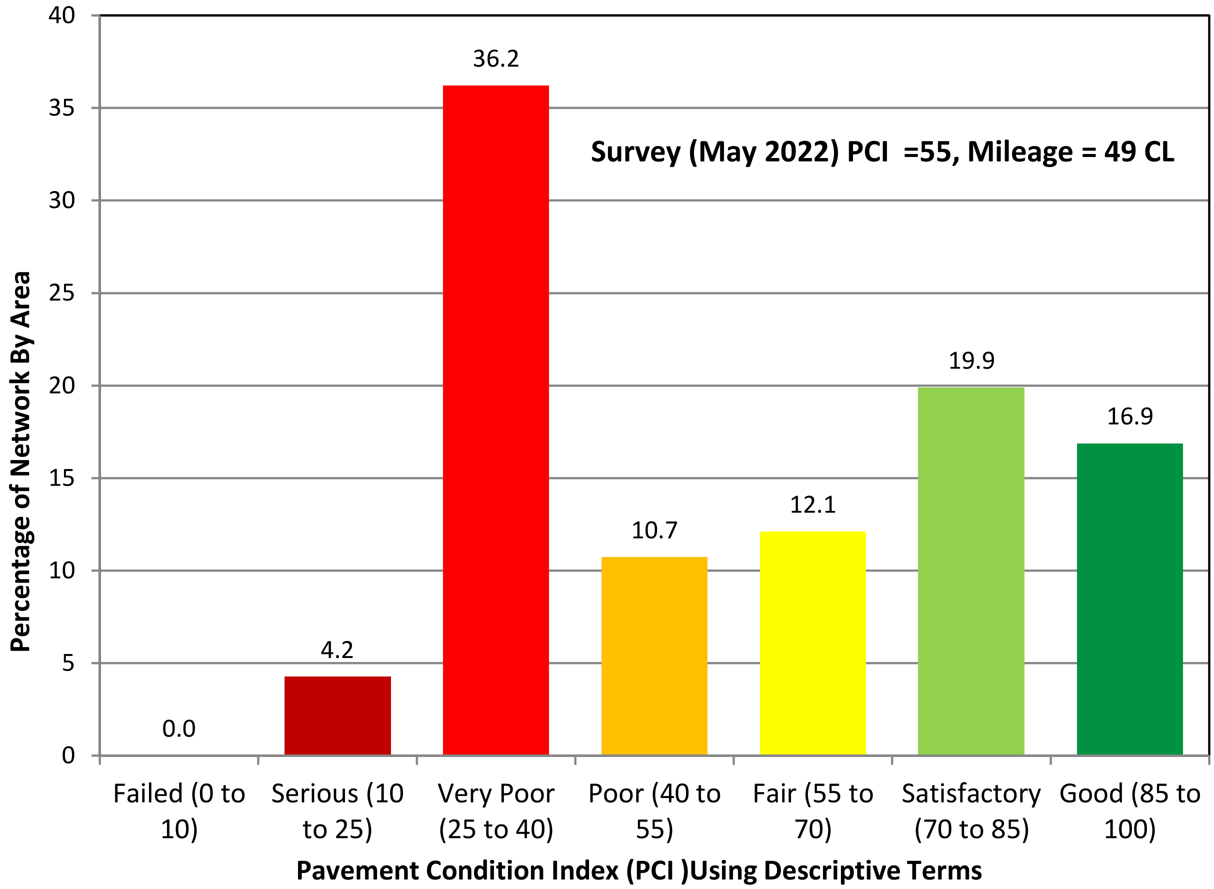

Figure 1 - Johnsburg Condition Distribution

1.2. Budget Scenarios and M&R Work Planning

The latest inventory and condition data captured during the survey were loaded into the PAVER software for analysis and M&R work planning.

The PAVER pavement management system was customized with the Village's rehabilitation strategies, unit rates, and deterioration models, and was used to run several "What-If" scenarios to depict the consequence of utilizing different funding levels as well as the outcome of using the Village's current funding on pavement network conditions.

Figure 2 depicts the network average PCI for the Village resulting from these different scenarios. The current funding level of approximately $600k per year will result in a 5-year PCI of 65, and the backlog will grow to approximately $21M. Backlog is defined as the total repair cost required to improve the conditions of pavements in a network with a PCI of less than or equal to 55 (Poor, Failed, Serious, and Very Poor) to a PCI greater than 55 (Fair, Satisfactory, and Good). To completely eliminate backlog, the Village must invest a predicted $3.71M/Yr, resulting in a PCI of 86.

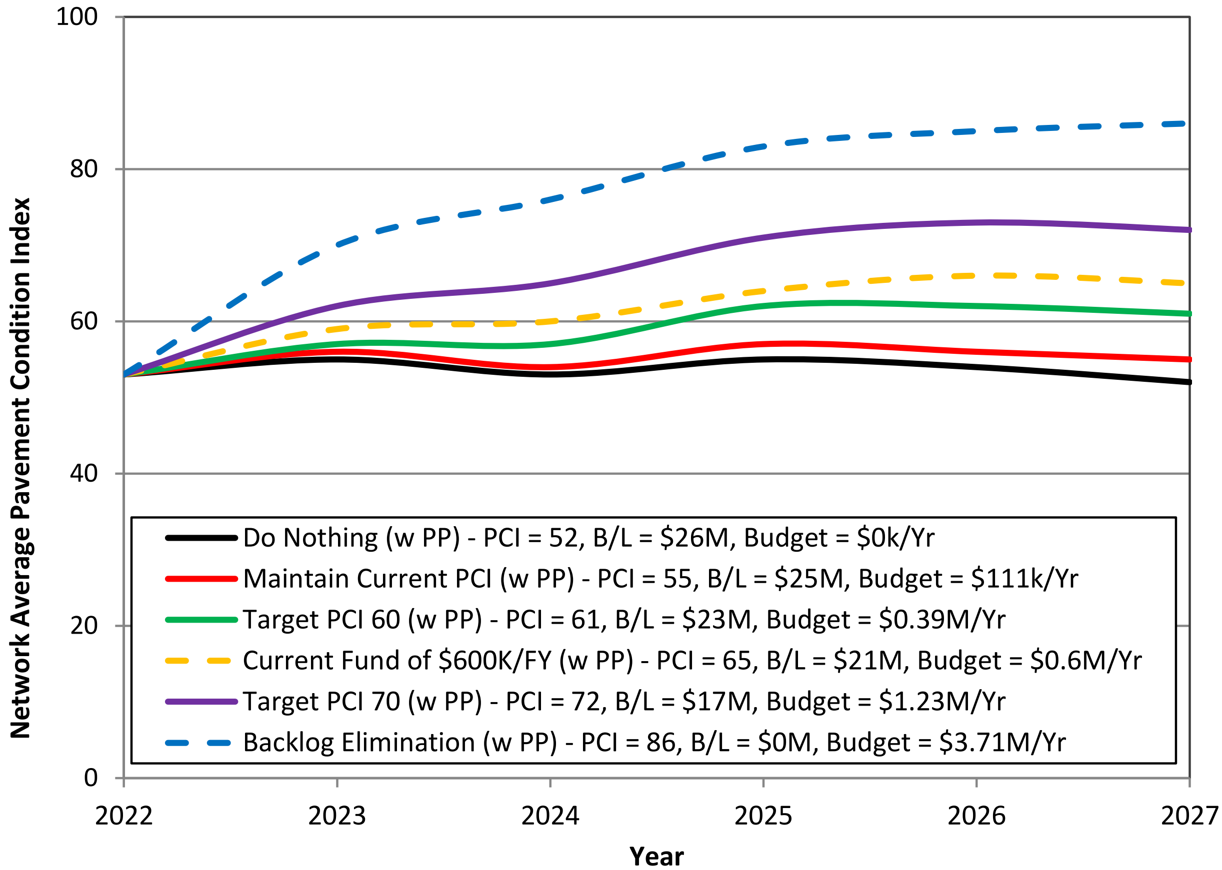

Figure 2 - Effect of Budget on Overall Roadway Pavement Conditions

Following the network-level budget analysis, the PAVER pavement management program was used to formulate recommended M&R projects for the Village with its current annual budget of $600k/Yr. The 5-year recommended M&R plan, which is color-coded by activity and year, is presented as a map and provided in **Appendix D**.

The analysis and data presented in this report are based on the inspections performed by IMS in May 2022 on the Village's pavement network, available work history, and other assumptions elaborated on in the report. The information presented in the Executive Summary is summarized from various sections of this report. It is essential that reviewers familiarize themselves with the detailed information provided in subsequent sections of this report prior to making any specific decisions based on the results.

2.0 Principles of Pavement Management

2.1. Foreword

This section discusses the fundamentals of pavement management. The goal of a pavement management program is to minimize the life-cycle costs of all pavements managed by the Village through performing preventative maintenance on pavements before they cross a threshold where more expensive rehabilitation activities are needed. A successful pavement management program requires periodic updates in pavement conditions, deterioration models, Maintenance and Rehabilitation (M&R) strategies, cost models, and evaluation of the effectiveness of M&R activities.

2.2. Pavement Preservation

Preservation of existing pavement systems has become a major activity for all levels of government. The best method to obtain the most optimal usage of available funds or to determine the required funding to achieve a predetermined level of service is through the use of a pavement management system. An effective pavement management system can assist agencies in developing long-term rehabilitation programs and budgets, assess the effectiveness of maintenance activities and new technologies, and store historical data and images.

Figure 3 illustrates typical pavement deterioration trends and life-cycle costs. Typically, pavements start deteriorating rapidly once they hit a specific threshold. A nominal investment in cheaper preventive maintenance at 40% lifespan is much more cost-effective than deferring maintenance until heavier reactive maintenance or rehabilitation is required just a few months or years later. Pavements that are repaired while in good condition will have an extended lifetime and will cost less overall than those left to deteriorate to a poor condition. Without an adequate preventative maintenance program, pavements will require more frequent reconstruction, thereby requiring significantly greater funding.

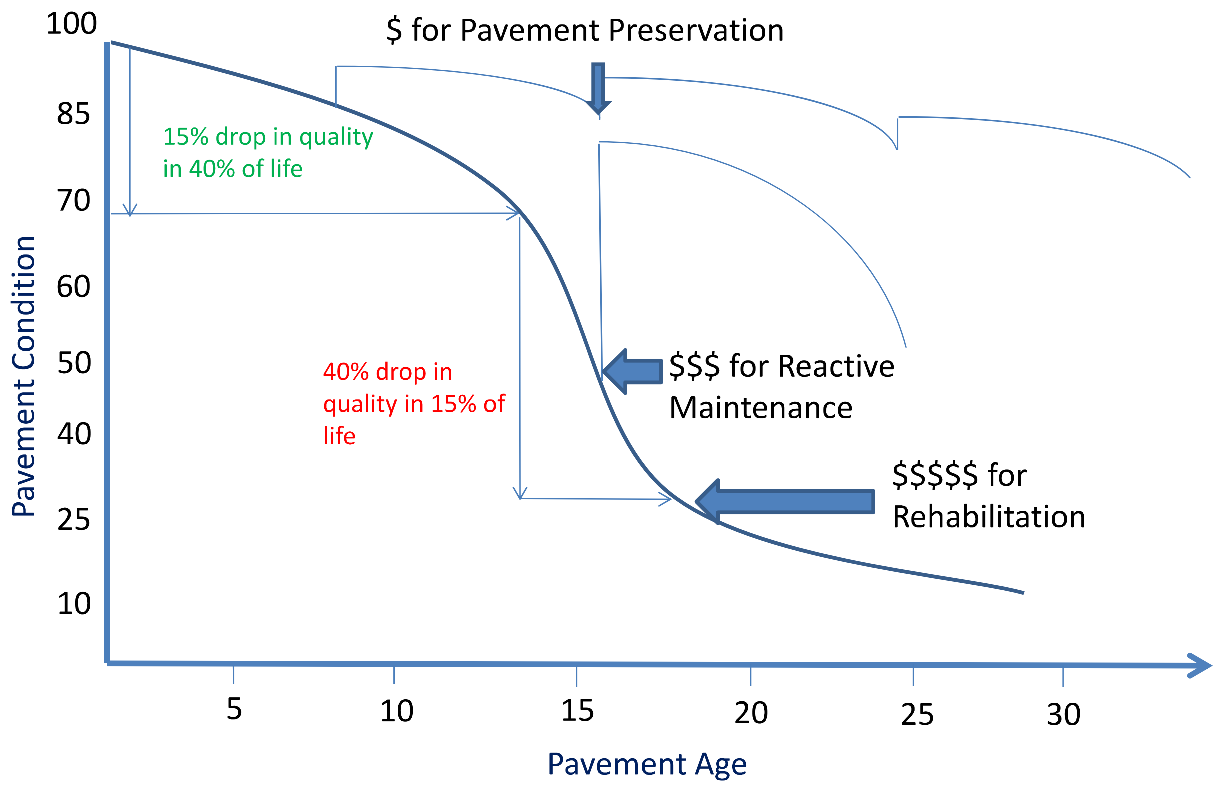

Figure 3 - Pavement Deterioration and Life Cycle Costs

(Values shown for illustrative purposes only)

The key to a successful pavement management program is to develop a reasonably accurate model of pavement deterioration and then identify an optimal timing and rehabilitation strategy based on the overall life-cycle costs. The outcome of this exercise is long-term cost savings and an increase in network level pavement quality over time.

A successful pavement management program requires periodic updates in pavement conditions, deterioration models, and cost models and evaluation of the effectiveness of M&R activities.

2.3. Summary

The goal of a pavement management program is to delay the inevitable total reconstruction of a pavement for as long as practical through the application of routine M&R strategies. The outcome of this exercise is long-term cost savings and an increase in network level pavement quality over time.

3.0 The Pavement Management Process

3.1. Foreword

This section reviews the process and standards that were followed to satisfy the scope of this project. This section also provides a summary of the PAVER pavement management system and reviews the technology that was mobilized by IMS to collect pavement condition data. Following a summary of each pavement distress, this section outlines the methods used in the PAVER system to calculate various pavement condition indices for each pavement segment.

3.2. IMS Pavement Management Process Overview

As shown in **Figure 4**, IMS mobilized its Laser Crack Measurement System (LCMS) Road Surface Tester (RST) to conduct an objective survey and to collect pavement imagery, pavement geometry, longitudinal and transverse profiles, and surface distress data.

The collected pavement imagery and surface distress data were analyzed according to American Society for Testing and Materials (ASTM) D6433 to determine the Pavement Condition Index (PCI). The pavement longitudinal profile data was also analyzed per ASTM E1926 to assess its roughness through the determination of the International Roughness Index (IRI).

Following the pavement condition assessment, the PAVER pavement management system was implemented with the latest inventory and condition data and was used to run several "What-if" scenarios to depict the consequence of utilizing different funding levels as well as the outcome of using the Village's current funding on pavement network conditions.

Figure 4 - Laser Road Surface Tester (RST)

3.3. PAVER Pavement Management System

PAVER is a pavement management software package developed by the U.S. Army Corps of Engineers' Construction Engineering Research Laboratory. The software package includes a set of engineering tools that assists agencies in determining 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 tools, or "modules", that will help the Village with the following tasks:

- Developing and organizing their pavement inventory.
- Assessing the current condition of their pavements.
- Developing models to predict future pavement conditions.
- Reporting on past and future pavement performance.
- Developing scenarios for M&R based on either funding or pavement condition goals.
- Planning M&R projects.

The PAVER User Manual, which is available as a navigable PDF file within the help menu of the PAVER software, provides more details on various functionalities of the program.

3.4. Pavement Condition Survey

One of the primary objectives of this project was to perform a comprehensive pavement condition survey on the Village's roadway and parking lot network and perform an imagery-based pavement condition survey on the collected data.

IMS used one of its RST units to collect observations on the condition of the pavement surface as well as high-definition digital imagery and spatial coordinate information. The RST is equipped with the second edition of the 3D Laser Crack Measurement System (LCMS-2) and provides a continuous scan of a 13 ft wide lane (shown in **Figure 5)** with 1mm resolution and can operate at speeds of up to 60 mph.

The LCMS-2 system allows for automated detection of pavement distresses, including various types of cracks, raveling, edge drop-offs, potholes, macrotexture, and rutting. The system also automatically determines the presence of paint stripes, which helps in identifying the pavement lane.

IMS conducted data collection during daytime and dry weather conditions, while observing all traffic rules and operating at posted speed limits.

Figure 5 - RST Equipped with the 3D LCMS-2 Camera

3.5. Pavement Condition Data Analysis

Following the pavement condition data collection, the 3D images and pavement profiles captured by the LCMS were analyzed following industry standards to determine the PCI and IRI for each segment of pavement. The following paragraphs describe the methods used to determine each index.

Pavement Condition Index (PCI) – Presented on a 0 to 100 scale, the PCI is an aggregation of the observed pavement distresses. Within the PCI, not all distresses are weighted equally. Certain load associated distresses (caused by traffic loading), such as structural rutting or alligator cracking, have a much higher impact on the PCI than non-load associated distresses like raveling or patching. Even at low extents and moderate severity – less than 10% of the total area – these distresses can drop the PCI considerably.

The following **Table 2** provides a description of major distress types identified in the network:

Table 2- Pavement Distress Descriptions

Alligator Cracking – Quantified by the severity of the failure and square footage. This cracking is caused by the repeated bending a pavement experiences as vehicles pass over it. The cracks propagate from the bottom, meaning that structural failure has occurred. As a load-associated distress, it has a significant impact on the condition score, even at low extents.

Rutting – Starting at a minimum depth of ¼ inch, ruts are quantified by their depth and square footage. Rutting is caused by the permanent deformation of the pavement and/or subgrade layers. Low densities of rutting can have a large impact on the final condition score due to their implication of possible structural failure. Rutting is also heavily penalized because of its tendency to cause water to pool on the pavement surface, which increases the risk for hydroplaning.

Longitudinal & Transverse Cracking – Quantified by their length and width. These cracks can be the result of pavement shrinkage due to natural daily and seasonal temperature cycles, construction issues, or other factors.

Block Cracking – Quantified by their width and square footage, these cracks form interconnected longitudinal and transverse cracks that divide the pavement into approximately rectangular pieces. Block cracking is the result of aging and environmental factors.

Patching – Quantified by the square footage and severity of patches. Even a good quality patch is considered a surface defect and affects the ride quality and condition of a pavement.

Raveling – This is the loss of coarse aggregate on the pavement surface and is measured by the severity and square footage affected.

Bleeding – This is the presence of free asphalt binder on the roadway surface, which is caused by either an excess of asphalt in the pavement or insufficient voids in the matrix. The result is a pavement surface with reduced skid resistance. This distress is measured by severity and square footage.

Edge Cracking – Running parallel to the road and usually within 1 to 2 feet of the outer edge of the pavement, this distress is caused by traffic loading and weakened base conditions resulting from poor drainage. It is measured in linear feet.

Distortion – This includes various localized unevenness in the surface of the pavement including bumps and sags, depressions, swell, corrugation, or shoving. This distress can be caused by a number of factors, including construction issues, subgrade failure, mixture failure, environmental influence, etc.

The 0 to 100 PCI scale is commonly divided into various ranges using descriptive terms. The divisions are not fixed but are meant to reflect common perceptions of pavement conditions. **Table 3** shows the seven categories used by the Village to represent pavement conditions. Each category is defined by a range of PCI values. Typical pavement distresses observed and the level of M&R needed for pavements in each category are shown in the table as well.

Table 3 - Pavement Condition Index Categories

Condition Assessment	Typical Pavement Distresses and M&R Recommendations	PCI Range
Good	Like-new pavement **Preventative Maintenance:** *Crack Sealing*	(85-100]
Satisfactory	Low severity longitudinal and transverse (L&T) cracking and weathering **Preventative Maintenance:** *Crack Sealing & Surface Treatments*	(70-85]
Fair	Moderate severity L&T cracking **Global preventive maintenance & localized repairs:** *Localized surface and/or full-depth patching, surface treatments, and thin overlays*	(55-70]
Poor	Severe L&T cracking, low severity alligator cracking **Moderate rehabilitation:** *Localized full-depth patching, mill and overlays*	(40-55]
Very Poor	Moderate alligator cracking **Major rehabilitation:** *Mill and overlays, and reconstruction*	(25-40]
Serious	Severe alligator cracking, rutting **Major rehabilitation:** *Partial and complete reconstruction*	(10-25]
Failed	Severe alligator cracking, rutting, and potholes **Major rehabilitation:** *Complete reconstruction*	[0-10]

International Roughness Index (IRI) - The captured longitudinal profile of the road was analyzed following ASTM E1926 to determine the IRI. IRI values are a measure of the roughness (vertical displacement over a fixed interval reported in inches per mile) of a pavement and provide a measure of ride quality. The network wide average IRI is 212 inches/mile.

- IRI values less than 200 inches/mile indicate a “smooth” pavement.
- IRI values between 200 and 400 inches/mile indicate a “marginally rough” pavement.
- IRI values greater than 400 inches/mile indicate a “rough” pavement.

3.6. Summary

This section reviewed the scope and standards used in this project. The LCMS-2 technology was mobilized to collect pavement condition information, including roughness and surface distresses. Pavement condition data was then loaded into the PAVER Pavement Management System and an accurate PCI was determined for each pavement segment. PAVER then used this data to develop pavement deterioration models and M&R recommendations.

4.0 Pavement Inventory and Condition Survey Results

4.1. Foreword

This section will review the results of the pavement condition survey performed in 2022. First is a summary of conditions of the roadways included in the Village's analysis. Next, this section will review photos of the network taken from the RST. Finally, a series of charts and tables will summarize the findings of the condition survey and the overall PCI distribution of the Village's pavement network. As of May 2022, **the Village's average PCI is 55, and the backlog is approximately $13.5M.**

4.2. Johnsburg Street Inventory and Condition Summary

The paved roadway network covers approximately 54 centerline miles of asphalt roadways. The Village's roadway network is divided into block-to-block segments, which typically extend from center of intersection to center of intersection.

Table 4 presents the Village's inventory and pavement condition breakdown over the different functional classes. **Appendix A** provides more detailed inventory and condition data for the Village's network.

Table 4 - Network Inventory Summary by Functional Class

	Network	Minor Arterial	Major Collector	Minor Collector	Local
Segment (Block) Count	479	49	21	2	407
Network Length (mi)	49.0	3.3	2.5	0	43
Average Width (ft)	25	31	27	24	24
Network Area (sf)	6,401,763	533,035	366,686	22,206	5,479,836
Last Survey PCI (May 2022)	55	35	50	54	58
Survey Major M&R Backlog (%)	51.2	Percentage of Network with a PCI <= 55			
International Roughness Index (IRI) in/mi	212	162	175	151	219

The following graph **(Figure 6)** plots the percentage of the network by area versus pavement condition in predefined descriptive terms.

- Seventeen percent (17%) of the network is in "Good" condition and requires only routine maintenance.
- Twenty percent (20%) of the network falls into the "Satisfactory" classification. These are roads that benefit most from preventative maintenance techniques, such as microsurfacing and slurry seals.
- Twelve percent (12%) of the pavements are rated as "Fair" and are candidates for lighter surface-based rehabilitations, such as thin overlays.
- Eleven percent (11%) of the network is considered to be in "Poor" condition, representing candidates for progressively thicker overlay-based rehabilitation. If left untreated, they will decline rapidly into reconstruction candidates.
- The remaining forty percent (40%) of the network is rated as "Very Poor", "Serious", or "Failed", meaning these pavements have failed or are past the optimal point for overlay or surface-based rehabilitation and may require progressively heavier forms of rehabilitation, such as local or total reconstruction.

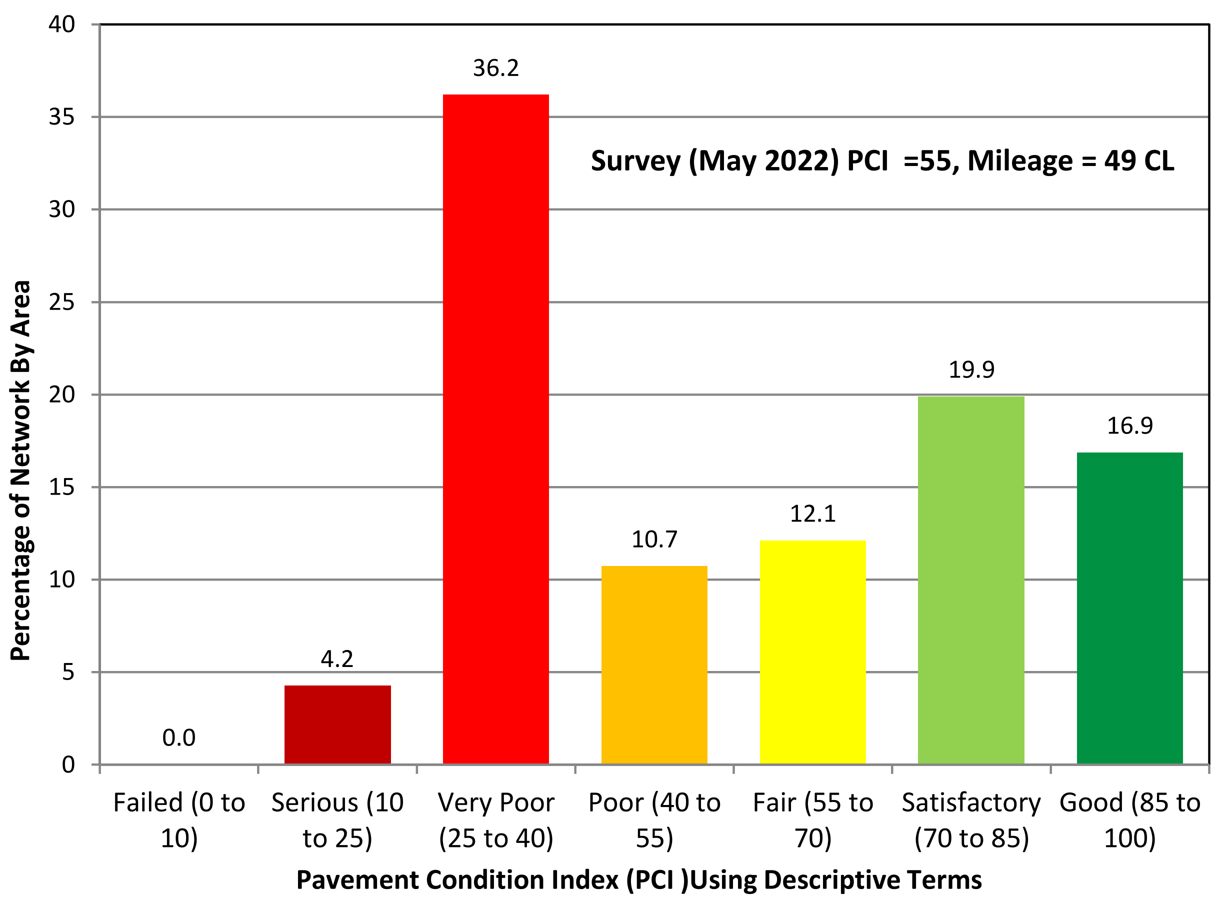

Figure 6 – Roadway Network Pavement Condition Using Descriptive Terms

Figure 7 shows the percentage of the network by area versus pavement condition for each functional class.

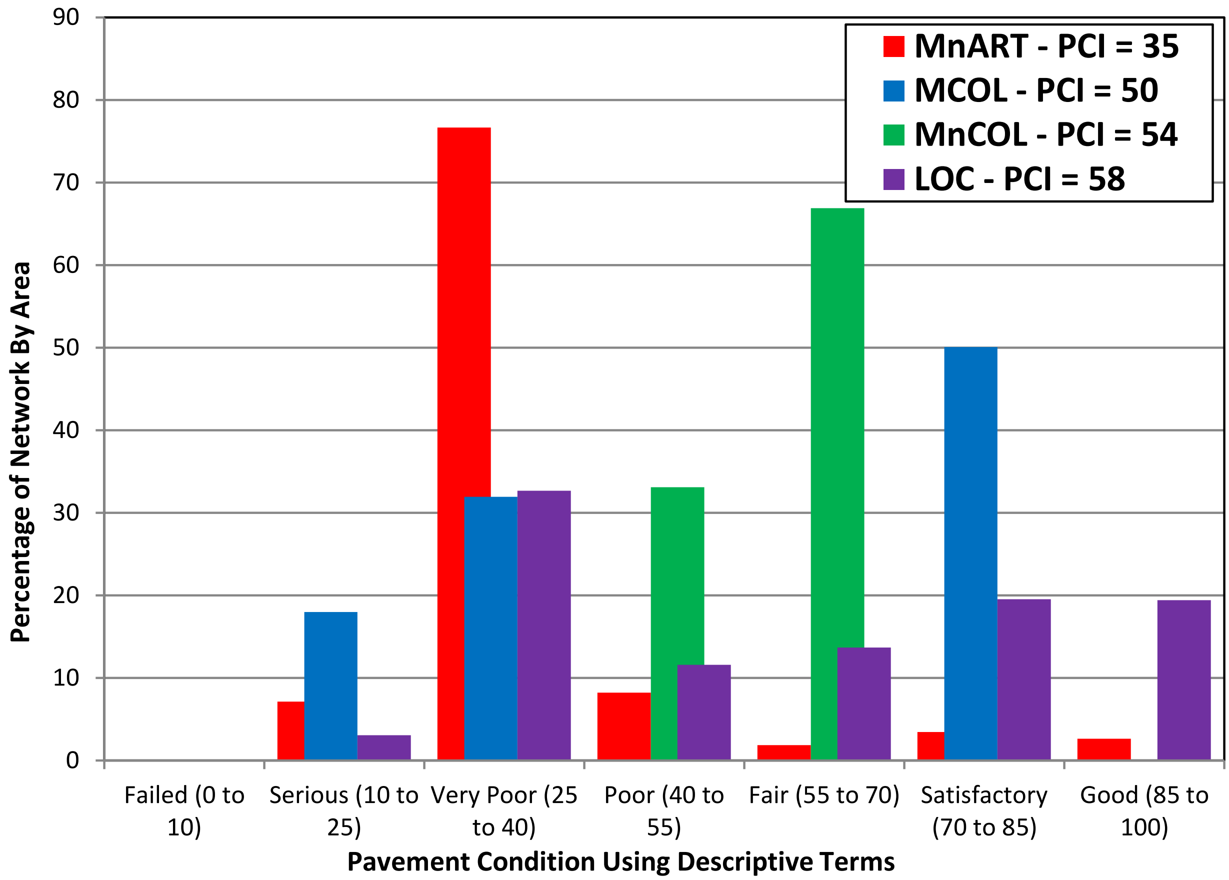

Figure 7 – Roadway Network Pavement Condition by Functional Class

4.3. Johnsburg Network Condition Imagery

The images presented below provide examples of the Village's pavements that fall into the various condition categories. Potential rehabilitation strategies are also discussed.

Failed (PCI = 0 to 10) – Complete Reconstruction

Figure 8 – Example of a Pavement Rated as Failed

River Terrace Drive from End-of-pavement to Linden Avenue (GISID 1856, PCI = 6) – As the only segment in the network rated as Failed at the time of the survey, this pavement displays spreading base failure as evidenced by the severe alligator cracking and potholes. A mill and overlay on this street would not be suitable and would not meet an extended service life of at least 15 years. This street requires a full reconstruction.

Deferral of reconstruction of pavements rated as Failed will not cause a substantial decrease in overall pavement quality. The pavements have passed the opportunity for overlay-based strategies, meaning that reconstruction, which is expensive, is the most suitable solution. Failed pavements are often deferred in favor of rehabilitating more segments at lower costs, resulting in a greater net benefit to the Village. This strategy however must be sensitive to citizen complaints forcing the street to be selected earlier. In addition, this type of street can pose a safety hazard for motorists since severe potholes and distortions may develop. It is important to consistently monitor these pavements and check for potholes or other structural deficiencies until the street is eventually rebuilt.

Serious (PCI = 10 to 25) – Partial Reconstruction

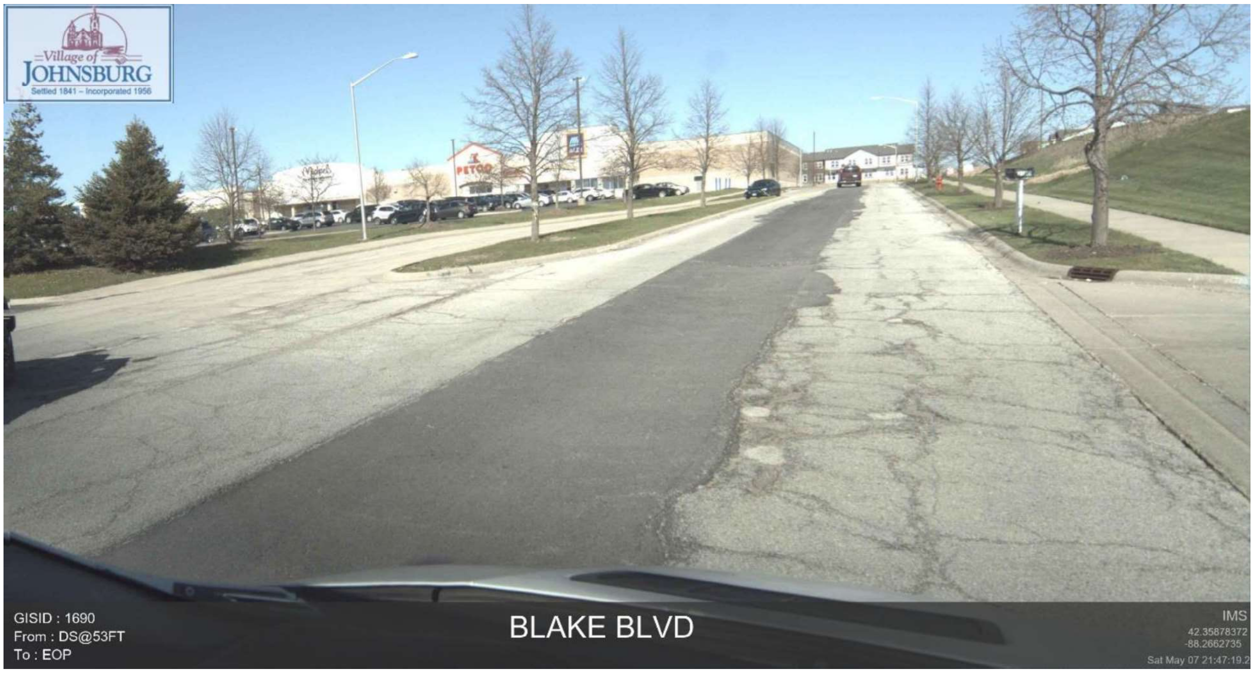

Figure 9 - Example of a Pavement Rated as Serious

Blake Boulevard from DS53FT to End-of-Pavement (GISID 1690, PCI = 15) – Rated as Serious, this segment is rapidly approaching the end of its service life. As evident in the imagery, a fair amount of alligator cracking and potholes contribute to the lower PCI score of this segment. If left untreated, within a short period of time, a full reconstruction would be required.

Heavily trafficked pavements in serious condition often require a full reconstruction. On local pavements, partial reconstruction is typically required, that is the removal of the pavement surface through grinding or excavation, base repairs, restoration of the curb line and drainage, and then placement of a new surface.

Very Poor (PCI = 25 to 40) – Thick Overlays

Figure 10 - Example of a Pavement Rated as Very Poor

Garfield Road from Claremont Road to Grant Road (GISID 1811, PCI = 30) – On this segment, the evidence of deterioration is the alligator and edge cracking, which can be clearly seen in the image above.

Very Poor pavements that display high amounts of load associated distresses are selected as a priority for rehabilitation, as they provide the greatest cost/benefit to the Village. If left untreated, Very Poor pavements with high amounts of load associated distresses would deteriorate to become partial reconstruction candidates. Very Poor pavements that are failing due to materials issues or non-load associated failures may become suitable candidates for thick overlays, if deferred, without a significant cost increase.

Poor (PCI = 40 to 55) – Moderate Overlays

Figure 11 - Example of a Pavement (roadway) Rated as Poor

Deerchase Court from Briarwood Drive to End-of-Pavement (GISID 2010, PCI = 47) – Several distresses are present, but tend to be more localized and moderate in severity (primarily edge cracking). The existing edge cracking is only present on the right-hand side of this road. (as seen in the image above)

Fair (PCI = 55 to 70) – Surface Treatments to Thin Overlays

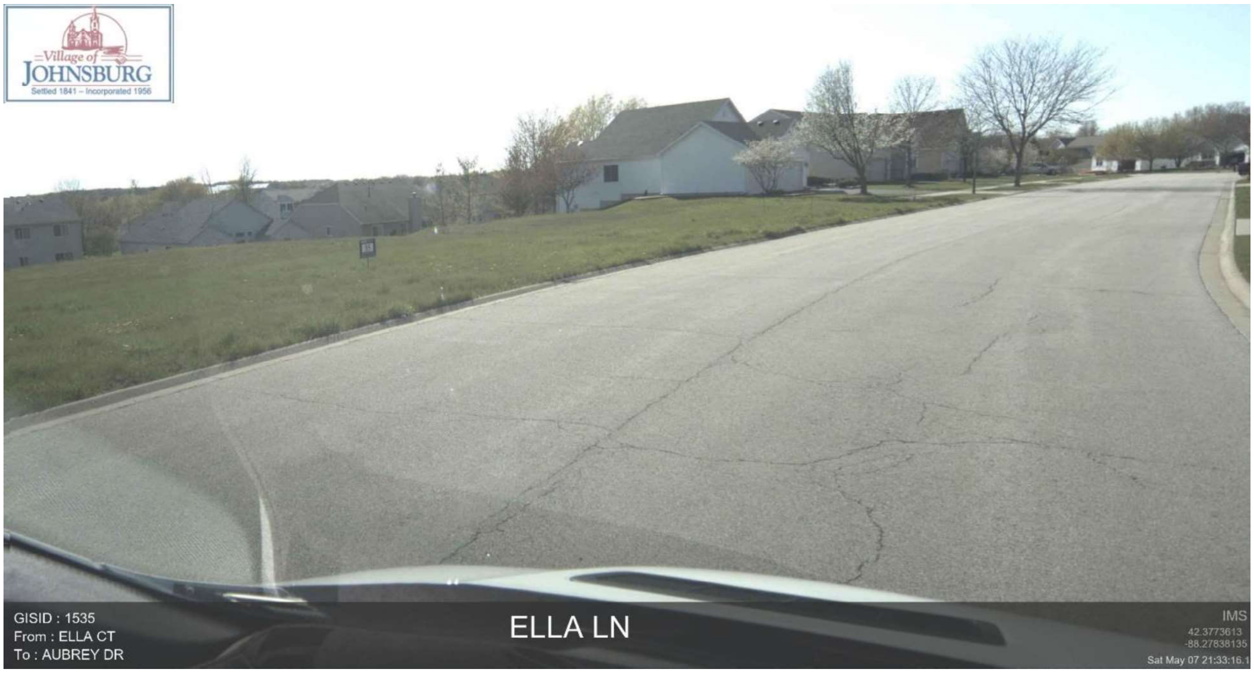

Figure 12 - Example of a Pavement Rated as Fair

Ella Lane from Ella Court to Aubrey Drive (GISID 1535, PCI = 64) – Rated as Fair with the transverse and longitudinal cracking as the primary cause of deterioration. The existing distresses could be sealed, and the pavement surface restored further with a heavier surface treatment, such as microsurfacing, to fully waterproof the pavement and cover the localized edge patches.

Satisfactory (PCI = 70 to 85) – Surface Treatments and Localized Rehabilitation

Figure 13 - Example of a Pavement Rated as Satisfactory

Miller Road from DS974Ft to Highland Prairie Drive (GISID 2163, PCI = 72) – Rated as Satisfactory, this road displays minor amounts of transverse cracking. This street is an example of a candidate for preventative maintenance, such as crack sealing, to extend its service life.

Routine maintenance, such as crack sealing and localized patching, allows the cracks to be as waterproof as possible. By keeping water out of the base layers, the pavement life is extended without the need for heavier rehabilitation.

Good (PCI = 85 to 100)

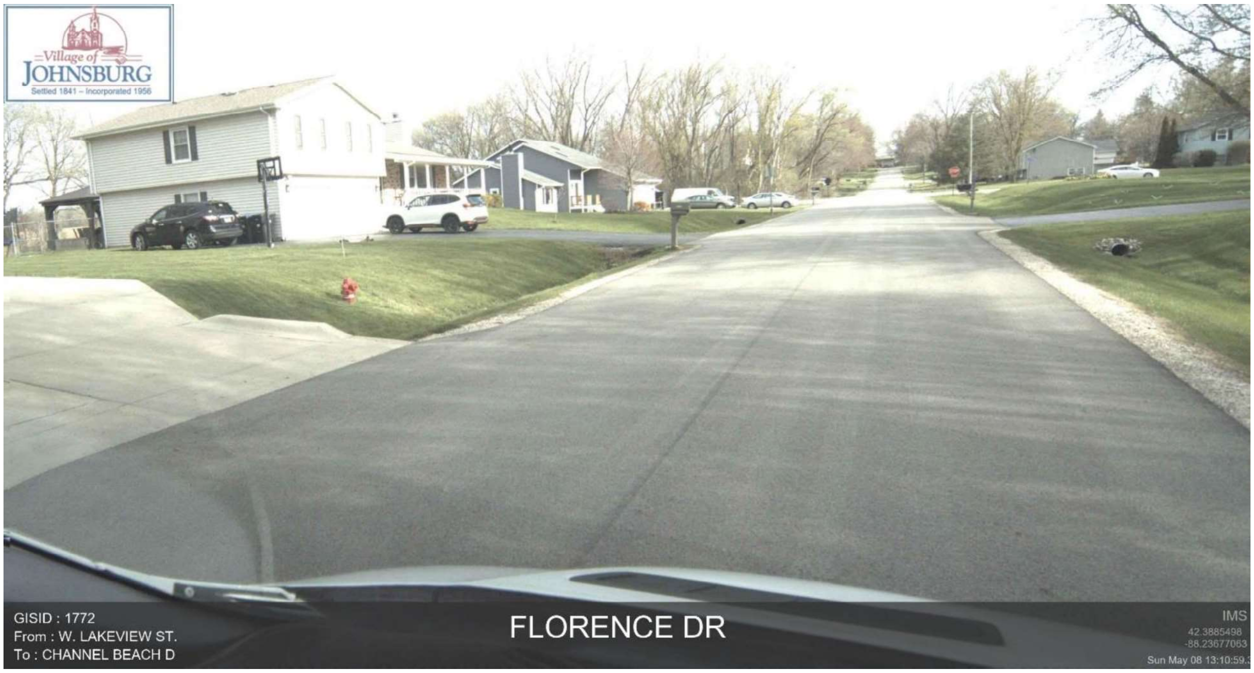

Figure 14 - Example of a Pavement Rated as Good

Florence Drive from West Lakeview Street to Channel Beach Drive (GISID 1772, PCI = 95) – Rated as Good, displaying little to no surface distresses. The ride quality is smooth, and the surface and base are intact.

4.4. Summary

Section 4 reviewed the results of the condition survey for the Village. The section described each of the functional classifications in the Village and outlined their respective conditions on the PCI scale. This section included a discussion of the overall pavement condition distribution in Johnsburg and some useful charts that help put the survey results into perspective. The PCI scale was explained further through a series of pavement photographs that were taken during the 2022 survey. **The network average PCI in Johnsburg is 55 with a backlog of approximately $13.5M.**

5.0 Rehabilitation Plan and Budget Development

5.1. Foreword

This section discusses the results of the pavement management analysis that was performed using the PAVER pavement management system. First is an overview of the assumptions that were used when implementing the system. Next, the results of each of the various budget simulations are detailed, along with their resulting conditions. This is highlighted further through a series of charts that are used to demonstrate the advantages and disadvantages of various funding models. Finally, the Village's selected budget is presented through a map and chart outlining the predicted condition by the end of the plan.

5.2. Key Analysis Set Points and Assumptions

The PAVER program requires user inputs to complete its condition forecasting, prioritization, and budget analysis. The M&R analyses were based on the results of the May 2022 PCI survey and the pavement inventory and historical work records provided by the Village. The other assumptions made in the analyses include:

- **Pavement Performance Curves:** Pavement performance curves (aka deterioration curves) are used to predict future pavement conditions. PAVER allows for historical M&R and inspection data to be used to build deterioration models that reflect actual pavement conditions over time for pavement families that share similar characteristics (e.g. functional class, pavement use, pavement type, pavement strength, AADT, soil properties, and construction methods).
- **Critical PCI:** Paver allows the user to pick a point in the pavement performance curve where rehabilitation is deemed most necessary. The Critical PCI value represents the condition at or below which Major M&R (e.g., resurfacing and reconstruction) is typically recommended. A PCI value of 55 has been chosen for all the Village's pavements, as this numerical value straddles the "Fair" to "Poor" condition categories in the Village's PCI scale. Performing major M&R on pavements that are closer to the critical PCI of 55 rather than waiting for these pavements to deteriorate further is generally more cost effective and is prioritized in PAVER.
- **M&R Categories, Rates, and Policies:** PAVER groups M&R activities into four categories designated as Major, Global Preventive, Localized Preventive, and Localized Stopgap work.
    - **Major M&R:** includes structural overlays, mill and overlays, and partial and full reconstruction activities. These activities reset the PCI to 100 within PAVER. **Table 5** presents estimated unit costs and recommended PCI ranges for various major M&R activities provided by the Village. The estimated costs presented should be considered rough estimates based on the assumed unit costs only and should not be considered engineering estimates.
    - **Global Preventive M&R:** includes surface treatments, such as Slurry Seal. This type of treatment should be applied to pavements in good or satisfactory conditions with minimal load associated distresses. The estimated unit costs and recommended PCI ranges for global preventive work are represented in **Table 6**.

- ○ **Localized Preventive M&R:** includes localized activities, such as crack sealing and patching, that are applied to pavements above critical PCI. This is represented in **Table 7.**
- ○ **Localized Stopgap M&R:** includes localized stopgap (safety related) activities, such as patching, that are applied to severe distresses posing a safety concern on pavements with a PCI below critical, pending the availability of major M&R funds. The Distress and maintenance policy are represented in **Table 8** and **Table 9**

- **Selection and Prioritization of Rehab Candidates**
  - ○ **Priority ranking** - analysis in Paver uses prioritization for rehabilitation candidate selection based on segments' Use and Rank. In the program, "Use" defines the role the pavement plays (Arterial, Collector, Local), while "Rank" defines its functional class. Generally, higher trafficked functional classes receive a higher priority. This ensures that pavements servicing the most residents undergo rehabilitation first to provide as much benefit per person as possible.
  - ○ **Proximity to Critical PCI** - when selecting major M&R candidates for pavements below critical PCI, pavements with PCI values closer to the critical PCI of 55 receive a higher priority to allow for more resurfacing projects, rather than waiting for these pavements to deteriorate further to become reconstruction candidates.

Table 5 - Major M&R Strategies and Unit Rates

Rehab Code	Typical Rehab Activity	PCI	Unit Rate ($/sf)
NC-AC	New Construction - AC	0-20	13.3
CR-AC	Complete Reconstruction - AC	0-20	13.3
FDR	Full Depth Reclaimation	30	3.7
SR-AC	Surface Reconstruction - AC	40	2.7
MOL-1	Cold Mill and Overlay - 1 Inch	50-60	1.1
EM-OL	Edge Mill and 1" Overlay	70	1.0
OL-AT	Overlay - AC Thin	80	0.9
AR-CO	AC Surface Recycling - Cold	90	0.5

Table 6 - Global M&R Strategies and Unit Rates

Rehab Code	Typical Rehab Activity	PCI	Application Interval	Delta T (Year)	Unit Rate ($/sf)
SS-RE	Surface Seal - Rejuvenating	65-85, minimal climate-related and skid-causing distress	5	3	0.22

Table 7 - Localized Preventative and Stopgap M&R Strategies and Unit Rates

Pavement Type	Rehab Code	Rehab Activity	Unit Rate ($)	Unit
AC	CS-AC	Crack Sealing - AC	$ 1.00	Ft
AC	PA-AD	Patching - AC Deep	$ 5.56	SqFt

Table 8 – Localized Preventive Distress Maintenance Policy

Distress	Severity	Description	Code	Work Type	Work Unit
1	Medium	ALLIGATOR CR	PA-AD	Patching - AC Deep	SqFt
1	High	ALLIGATOR CR	PA-AD	Patching - AC Deep	SqFt
3	Medium	BLOCK CR	CS-AC	Crack Sealing - AC	Ft
3	High	BLOCK CR	CS-AC	Crack Sealing - AC	Ft
4	Medium	BUMPS/SAGS	PA-AD	Patching - AC Deep	SqFt
4	High	BUMPS/SAGS	PA-AD	Patching - AC Deep	SqFt
5	Medium	CORRUGATION	PA-AD	Patching - AC Deep	SqFt
5	High	CORRUGATION	PA-AD	Patching - AC Deep	SqFt
6	Medium	DEPRESSION	PA-AD	Patching - AC Deep	SqFt
6	High	DEPRESSION	PA-AD	Patching - AC Deep	SqFt
7	High	EDGE CR	PA-AD	Patching - AC Deep	SqFt
7	Medium	EDGE CR	CS-AC	Crack Sealing - AC	Ft
8	Medium	JT REF. CR	CS-AC	Crack Sealing - AC	Ft
8	High	JT REF. CR	PA-AD	Patching - AC Deep	SqFt
9	High	LANE SH DROP	PA-AD	Patching - AC Deep	SqFt
9	Medium	LANE SH DROP	PA-AD	Patching - AC Deep	SqFt
10	High	L & T CR	PA-AD	Patching - AC Deep	SqFt
10	Medium	L & T CR	CS-AC	Crack Sealing - AC	Ft
11	High	PATCH/UT CUT	PA-AD	Patching - AC Deep	SqFt
13	High	POTHOLE	PA-AD	Patching - AC Deep	SqFt
13	Medium	POTHOLE	PA-AD	Patching - AC Deep	SqFt
13	Low	POTHOLE	PA-AD	Patching - AC Deep	SqFt
15	Medium	RUTTING	PA-AD	Patching - AC Deep	SqFt
15	High	RUTTING	PA-AD	Patching - AC Deep	SqFt
16	Medium	SHOVING	GR-PP	Grinding (Localized)	Ft
16	High	SHOVING	GR-PP	Grinding (Localized)	Ft
17	High	SLIPPAGE CR	PA-AD	Patching - AC Deep	SqFt
17	Medium	SLIPPAGE CR	PA-AD	Patching - AC Deep	SqFt

Table 9 - Localized Stopgap Distress Maintenance Policy

Distress	Severity	Description	Code	Work Type	Work Unit
4	High	BUMPS/SAGS	PA-AD	Patching - AC Deep	SqFt
5	High	CORRUGATION	PA-AD	Patching - AC Deep	SqFt
9	High	LANE SH DROP	PA-AD	Patching - AC Deep	SqFt
11	High	PATCH/UT CUT	PA-AD	Patching - AC Deep	SqFt
13	Medium	POTHOLE	PA-AD	Patching - AC Deep	SqFt
13	High	POTHOLE	PA-AD	Patching - AC Deep	SqFt
15	High	RUTTING	PA-AD	Patching - AC Deep	SqFt
16	High	SHOVING	PA-AD	Patching - AC Deep	SqFt
17	High	SLIPPAGE CR	PA-AD	Patching - AC Deep	SqFt

5.3. Network Budget Analysis Models

An analysis containing a total of 5 profile budget runs were prepared for the Village. The analysis results are summarized below: (note that all budgets include work already planned by the Village)

- **Do Nothing** (illustrated by a black line in **Figure 17**) – This option identifies the effect of spending no capital for 5 years. This scenario results in a network average PCI drop from 55 to 52 and an increase in backlog to nearly $26M after five years.
- **Johnsburg Budget** (Yellow Line) – This represents the Village's current average annual budget of $600k/Yr dedicated to pavement preservation and rehabilitation for pavements. The Village's current budget will result in a PCI of 65 and a backlog of $21M after five years**.**
- **Maintain PCI** (Red line) – This budget represents the funds needed to maintain the PCI at 55. This model will cost approximately $111k/Yr and result in a backlog of $25M after five years.
- **Target PCI 60** (Green line) **–** A PCI target budget was developed in order to maintain a minimum target PCI of 60. This will cost approximately $390k/Yr and result in a backlog of $23M after five years.
- **Target PCI 70** (Purple line) **–** A PCI target budget was developed in order to maintain a minimum target PCI of 70. This will cost approximately $1.23M/Yr and result in a backlog of $17M after five years.
- **Eliminate Backlog** (Red Line) **-** A budget was run to determine the cost needed to reduce the backlog to $0 in 5 years. This budget is approximately $3.71M/Yr and will achieve a PCI of 86 after five years.

Table 10 Below provides the breakdown of the five options with associated annual levels of funding.

Table 10 - Funding Model Breakdown

Scenario	Average Total funding per year *	Total Backlog	Post PCI
Do Nothing	$0	$26M	52
Maintain PCI	$1.37M	$29.2M	58
Target PCI of 60	$390k	$23M	60
Current Budget	$600k	$21M	65
Target PCI of 70	$1.23M	$17M	72
Backlog Elimination	$3.71M	$0	86

*The PCI projections for all of the above scenarios include the planned projects (PP) for the three arterials in the village. However, the cost of the PP has not been included in the annual budgets as these projects are funded through other sources (e.g. STP funds).

The results of the analysis are summarized in **Figure 15**. The X-axis highlights the annual budget, while the Y-axis plots the 5-year Post Rehab Network Average PCI value. The solid black line shows the results of the pavement analysis (the Johnsburg model profile).

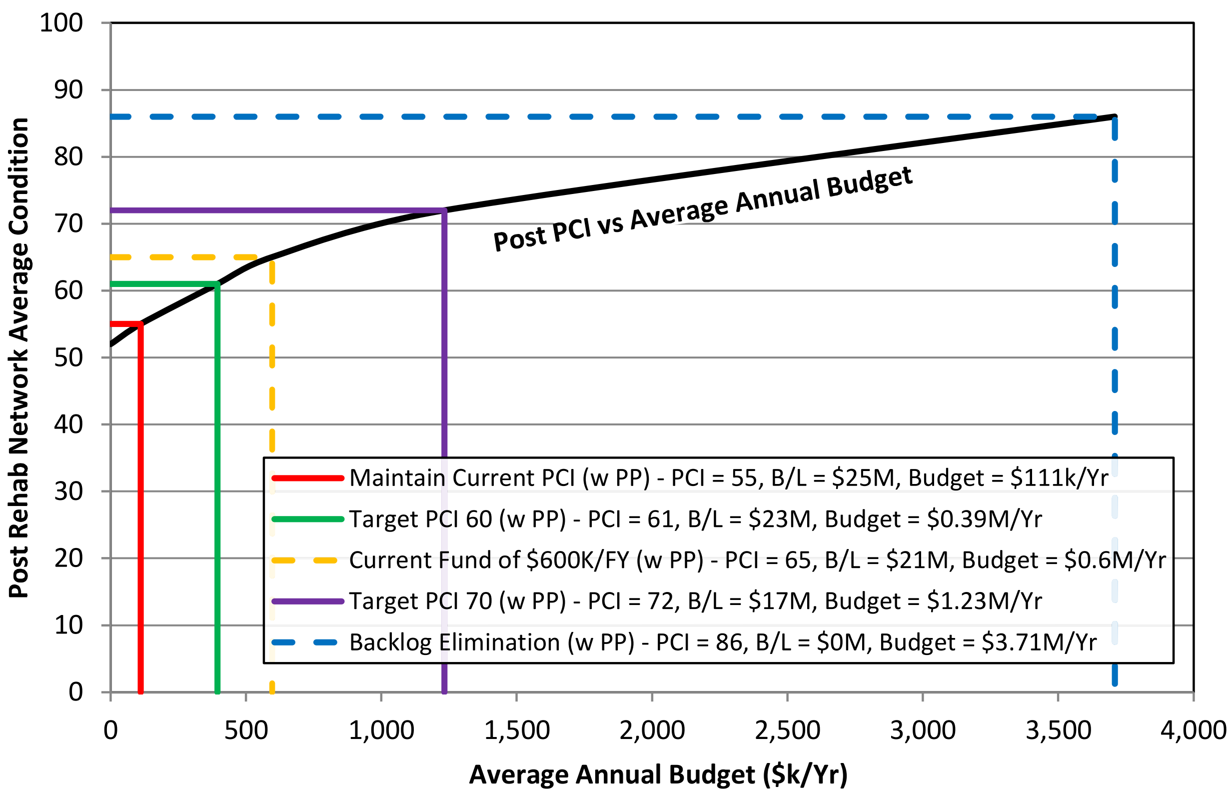

Figure 15 – 5-Year Post Rehab Network PCI Analysis Results

Figure 16 presents the resultant network backlog plotted against annual budget. This plot is similar to **Figure 15**, but instead of plotting the average PCI score, the solid black diagonal line represents the total backlog after 5 years.

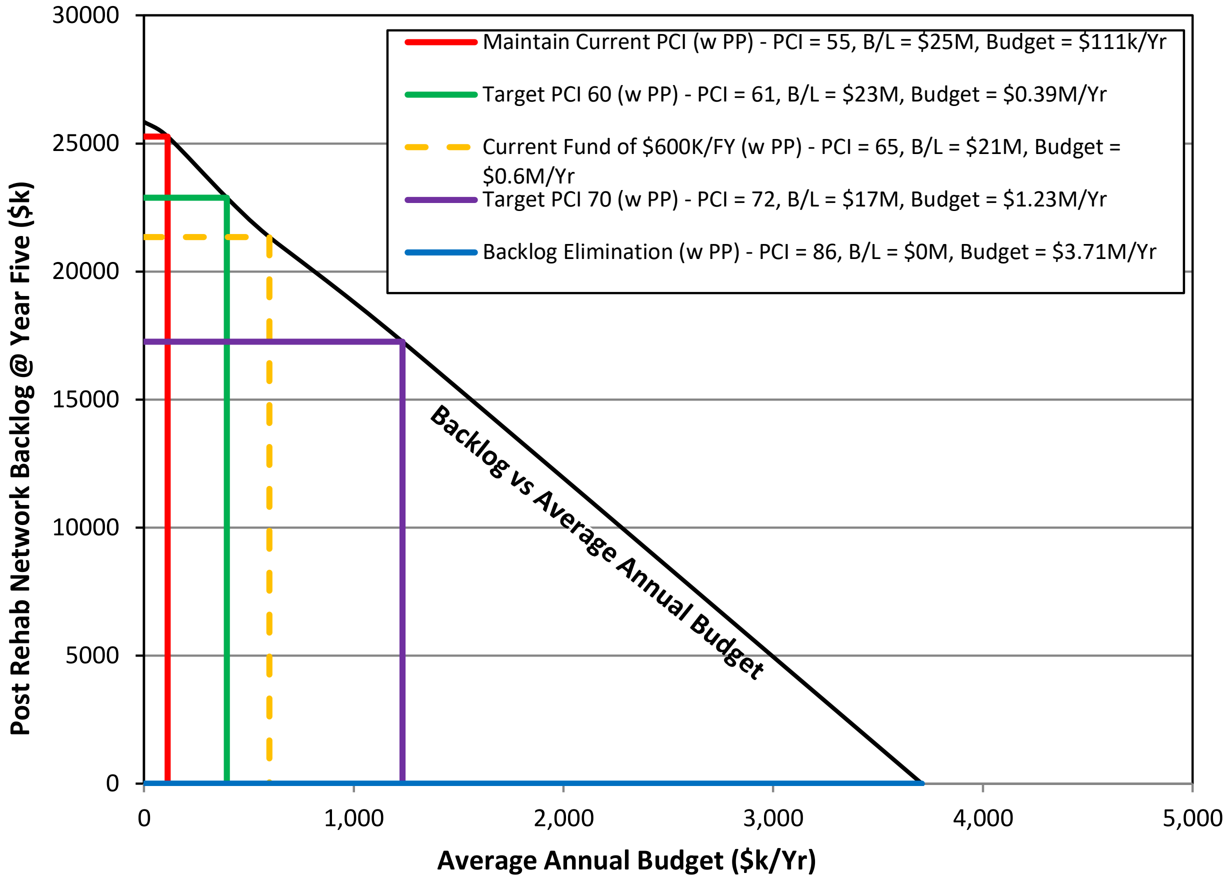

Figure 16 – 5-Year Post Rehab Network Backlog Results

Figure 17 presents the analysis results on an annual basis.

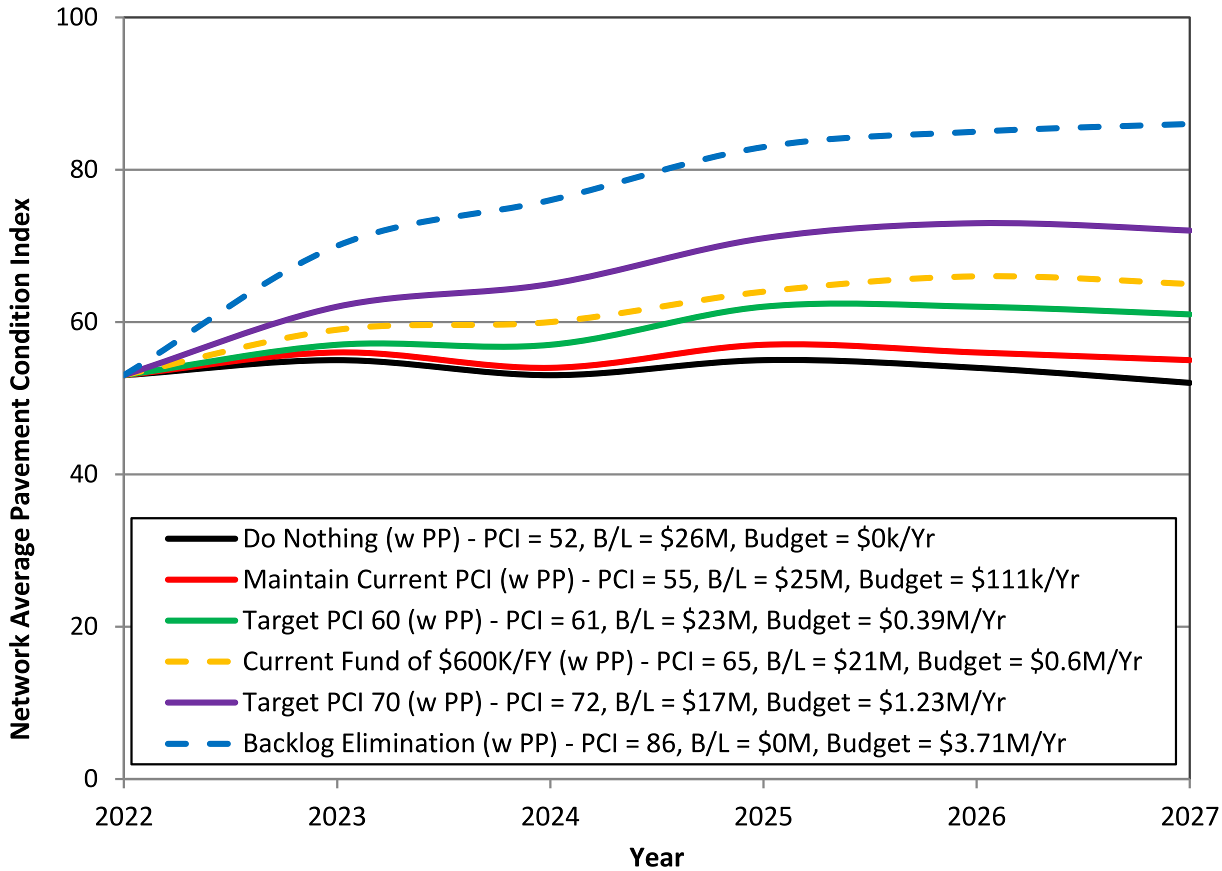

Figure 17 – 5-Year Annual PCI

5.4. Post Rehabilitation Condition

Figure 18 compares the current network condition distribution (red) to what the 5-year post rehabilitation distribution would be at with the current budget of $600k/Yr (blue). With the Village's current annual budget dedicated to pavement M&R and previously planned projects, the average PCI is expected to increase to 65 by the end of the five-year plan.

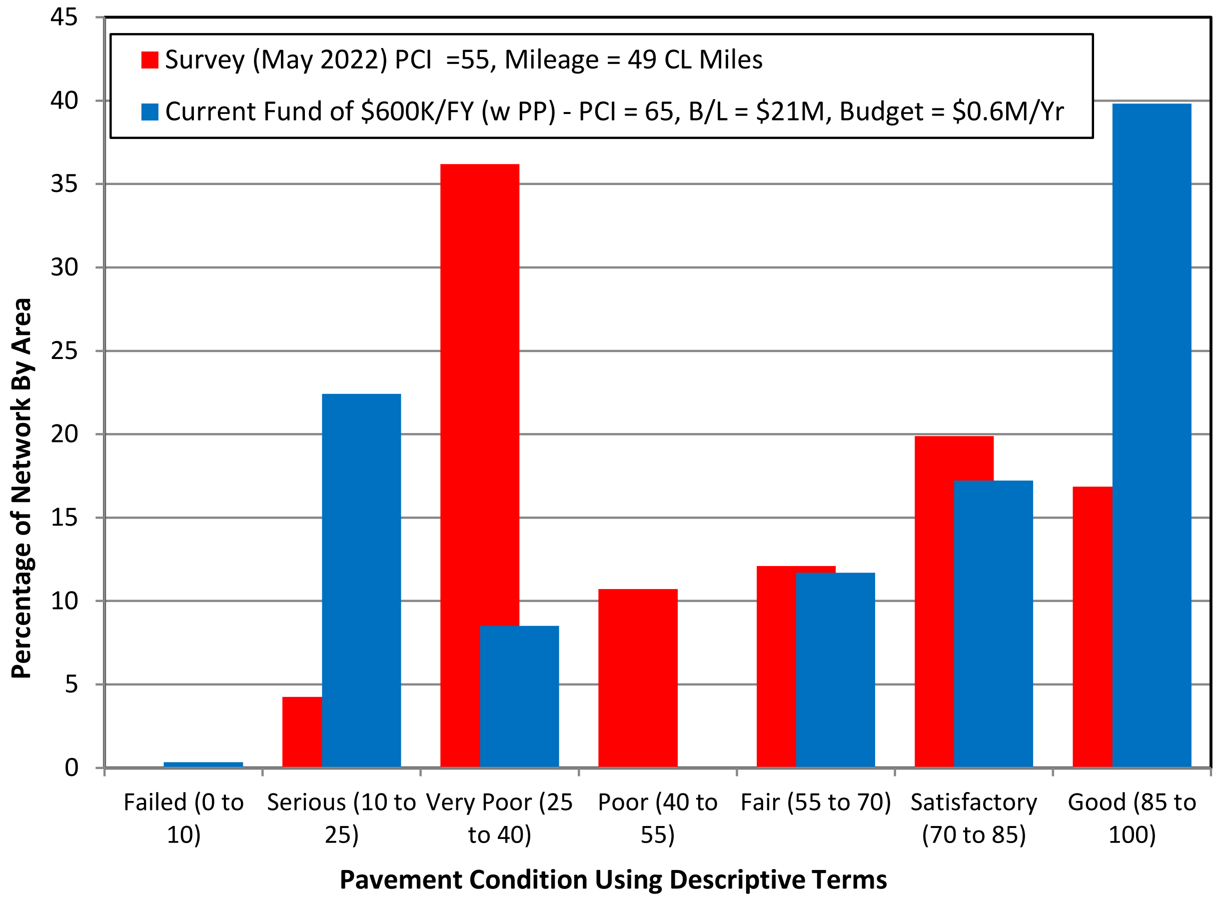

Figure 18 – 5-Year Post Rehabilitation Condition Distribution

Finally, the PAVER pavement management program was used to formulate practical projects for the Village with its current annual budget of $600k. This data is presented in **Appendix B**.

6.0 Project Recommendations and Comments

6.1. Project Summary and Recommendations

A pavement condition survey was performed in May 2022 on the Johnsburg network. The results of the condition survey were loaded into the PAVER pavement management system. This system was used to organize a georeferenced pavement inventory, develop an accurate model of the network conditions and predicted deterioration, and provide funding recommendations for various level-of-service goals.

For the Village to get the most out of its PAVER system, it must be updated regularly with routinely collected pavement condition data, M&R strategies, and unit costs. This report outlines the most recent efforts to update and maintain the Village's pavement management system.

The following recommendations are presented to the Village as an output from the pavement analysis and must be read in conjunction with the previous sections of this report.

1. Johnsburg should adopt a level-of-service policy statement to maintain PCI at or above a 65. The currently suggested budget of $600k/Yr. achieves this goal.
2. To completely eliminate all the backlog (streets with a PCI below 55) the village is estimated to need an annual investment of $3.71M.
3. The full suite of proposed rehabilitation strategies and unit rates should be reviewed annually, as these can have considerable effects on the final program.
4. The Village should keep track of M&R work performed and update the pavement management system with the newly repaired pavements.
5. The Village should resurvey their pavements every few years to update the condition data and rehabilitation program.

6.2. Closing

The IMS Team greatly appreciates the opportunity to work with Johnsburg on this pavement management project. Over the course of this study, it has become clear that the Village staff demonstrates a strong commitment to provide a higher level-of-service to their community. IMS stands ready to assist the Village for training and technical support as necessary, and we welcome the opportunity to work with the Village on future pavement management projects.