LAMP
RYNEARSON

9001 State Line Rd., Ste. 200
Kansas City, MO 64114
[P] 816.361.0440
[F] 816.361.0045
LampRynearson.com

Pavement Condition Index Report

Prepared for:
City of Papillion, Nebraska

Project No. 0318069.01
July 2020 DRAFT
Revised 7-10-2020

Leaving a Legacy of
Enduring Improvements to
Our Communities
Lamp Rynearson Purpose Statement

City of Papillion, Nebraska
Pavement Condition Index Report

Lamp Rynearson PN 0318069.01

Table of Contents

Figures, Tables, and Images

Acronyms

1. PCI — Pavement Condition Index
2. ASTM — American Society for Testing and Materials
3. HMA — Hot Mix Asphalt
4. PCC — Portland Cement Concrete
5. ASR — Alkali Silica Reaction
6. UBAS — Ultra-Thin Bonded Asphalt Surface
7. PAVER — Pavement Management Software
8. RT3000 — Road Tester 3000
9. GPS — Global Positioning System
10. APWA — American Public Works Association

City of Papillion, Nebraska
Pavement Condition Index Report

Executive Summary

The City of Papillion Annexed 65 lane miles since the last PCI Report they received from Lamp Rynearson and hired Lamp Rynearson, partnering with Stantec, to provide an updated condition index of all the streets in Papillion, Nebraska.

Stantec utilizes a pavement inspection van called the Road Tester 3000 (RT3000), a leading-edge data collection vehicle which incorporates the latest in mobile laser, GPS and crack recognition technology. The RT3000 is a fully mobile solution, developed to collect pavement condition data accurately and efficiently. The RT3000 drastically reduces the time required collect pavement inspection data compared to an individual walking the streets and recording data.

Lamp Rynearson input Stantec's PCI data into a pavement management software (PAVER). PAVER is a pavement management system developed by the United States Department of Defense for managing maintenance and rehabilitation of its vast inventory of pavements. It uses inspection data rating from zero (failed) to 100 (excellent) for consistently describing a pavement's PCI and predicting maintenance and rehabilitation needs for future years. Lamp Rynearson operates PAVER 7.06 software from the American Public Works Association (APWA).

Using the new data gathered, and input into PAVER, Papillion has 349 lane miles (2,458,784 Square Yards) of pavement to maintain. Approximately 317.5 lane miles (91%) of the system appears to be full depth concrete paving and presents a maintenance challenge. The lane miles are derived by length input into PAVER from Stantec multiplied by the approximate width in that segment divided by 5280 feet and divided by 12-foot lanes. The width of the segment was determined by assuming all lanes were 12 feet and using google maps to measure center lane and turn lane widths. If most of a segment included turn lanes, then they were included in the width but segments with less than half of the length including turn lanes did not factor the turn lanes into the width.

Full depth asphaltic concrete paving can have various surface treatments applied, and major maintenance can include mill and overlays, often in the two-inch range. This is not a recommended technique with concrete pavements. Removing that much concrete weakens the base, potentially increasing the cracks coming to the surface, can conflict with any reinforcing present, and deteriorates the construction joints. Considering all options, we are recommending that the City consider testing out Ultra-thin Bonded Asphalt Surfacing (UBAS), after repairing base failures and possibly addressing joint issues, for the pavement maintenance.

Image 1: Stantec's Road Tester 3000

Study Objectives

The city of Papillion retained Lamp Rynearson to perform an assessment of their streets. Objectives of the study are as follows:

- Build a pavement database in PAVER including system development and integrate PCI GIS base mapping
- Populate street segments with current PCI data (2020)
- Populate additional right-of-way assets
- Coordinate with the subconsultant Stantec to provide:
    - Field survey
    - RT3000 pavement condition collection
    - RT3000 image collection
    - Data processing
    - Formatting to PAVER

Street Condition Inspection

Methodology

The city street pavements were inspected with the RT3000 which uses the process standardized by ASTM D 6433-07 to categorize and quantify all surface defects in the pavement and estimate the condition of the pavement on a 0 – 100-point scale. The general sections on this scale are shown:

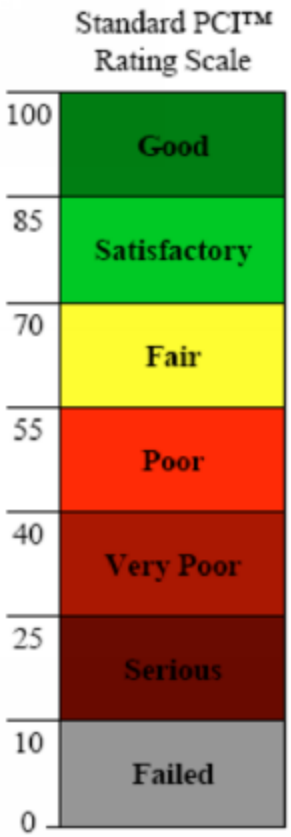


Figure 1—Pavement Condition Index Values

The RT3000 finds any of the 20 categories of surface defects seen in asphaltic concrete pavement, and 19 categories of surface defects seen in concrete pavement and analyzes to a severity following ASTM D 6433-07. PAVER weights the surface defects in each category and severity to generate a PCI in each segment of pavement.

Street Assessment

The city of Papillion has 317.5 lane miles of concrete streets, 30 lane miles of asphalt and 1.3 lane miles of gravel roads to maintain. The network was split up into 1270 segments of concrete, 115 segments of asphalt and 3 segments of gravel streets. A segment generally is from one intersection to another, or to the end of a street, or to the city limits. The weighted average PCI for the asphalt streets is 47, falling in the poor range. The weighted average PCI for the concrete streets is 72, falling in the satisfactory range. It is important to note that PCI data below includes projected deterioration of the streets inspected in 2018 using the PCI deterioration curve.

Table 1: Current Papillion Street Conditions

MEASUREMENT	FAILED	SERIOUS	VERY POOR	POOR	FAIR	SATISFACTORY	GOOD
Lane Miles	0.8	10	11	33	65	104	125
Square Feet	51,072	642,744	665,976	2,108,900	4,140,726	6,590,431	7,929,210
Square Yards	5,675	71,416	73,997	234,322	460,081	732,270	881,023
%	0%	3%	3%	9%	19%	30%	36%

Table 1 lists Papillion's current street conditions in different measurements. Its noteworthy that 16% of Papillion's streets are less than fair condition. A street with a PCI less than fair is generally viewed as requiring more than typical street maintenance. Base repairs or full reconstruction may be necessary, with significant additional costs. Typically, a street in a minimum of fair condition can be upheld with routine maintenance.

The majority of the street segments annexed improved the overall PCI since the last report. However, there are also more streets in failed or serious conditions due to the PAVER program modeling the PCI deterioration curve and predicting a new falling PCI since the last inspection.

Table 2: Lane Miles of Papillion Streets

Year	FAILED	SERIOUS	VERY POOR	POOR	FAIR	SATISFACTORY	GOOD
2020	1 (0%)	10 (3%)	11(3%)	33 (9%)	65 (19%)	104 (30%)	125 (36%)
2021	3 (1%)	11 (3%)	9 (3%)	39 (11%)	62 (18%)	100 (28%)	125 (36%)
2022	6 (2%)	9 (3%)	11 (3%)	39 (11%)	66 (19%)	100 (29%)	119 (34%)
2023	7 (2%)	10 (3%)	13 (4%)	40 (11%)	64 (18%)	98 (28%)	119 (34%)
2024	8 (2%)	10 (3%)	18 (5%)	39 (11%)	67 (19%)	102 (29%)	107 (31%)

As seen in table 2, one of the features of the PAVER program is to predict pavement deterioration, assuming no maintenance is performed, and what the condition of the streets will look like within the next 5 years. In 5 years, the streets with less than fair condition will jump to 21% from the current state of 15% if no maintenance is performed. It is important to keep up with maintenance to keep costs as manageable as possible.

Table 3: Area Weighted PCI Average

Year	2020	2021	2022	2023	2024
Average Weighted PCI	75.00	74.05	73.11	72.16	71.21

Table 3 provides a PCI weighted by street area for all the streets in Papillion and predicts the future average PCI.

Table 4: Area Weighted PCI Average for Annexed Streets

Year	2020	2021	2022	2023	2024
Average Weighted PCI	85.34	84.74	84.15	83.55	82.95

Table 4 provides a PCI weighted by street area for only the annexed streets consisting of 76 branches and 226 street segments.

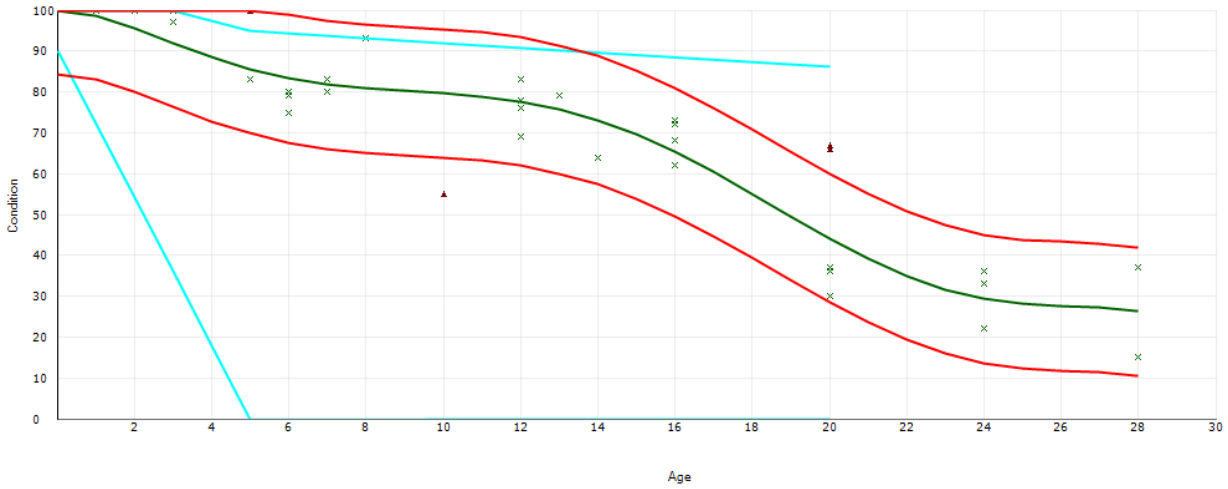


Figure 2: Typical Street PCI Deterioration Curve

This is a curve that the PAVER program uses to predict pavement deterioration. The rate at which a street deteriorates is determined by loading, pavement quality and climate. The deterioration rate above is not specific to any street in Papillion but is gathered by nation wide data to give the best representation. Achieving an accurate representation of the rate at which Papillion streets deteriorate will require continuing inspections on a regular basis.

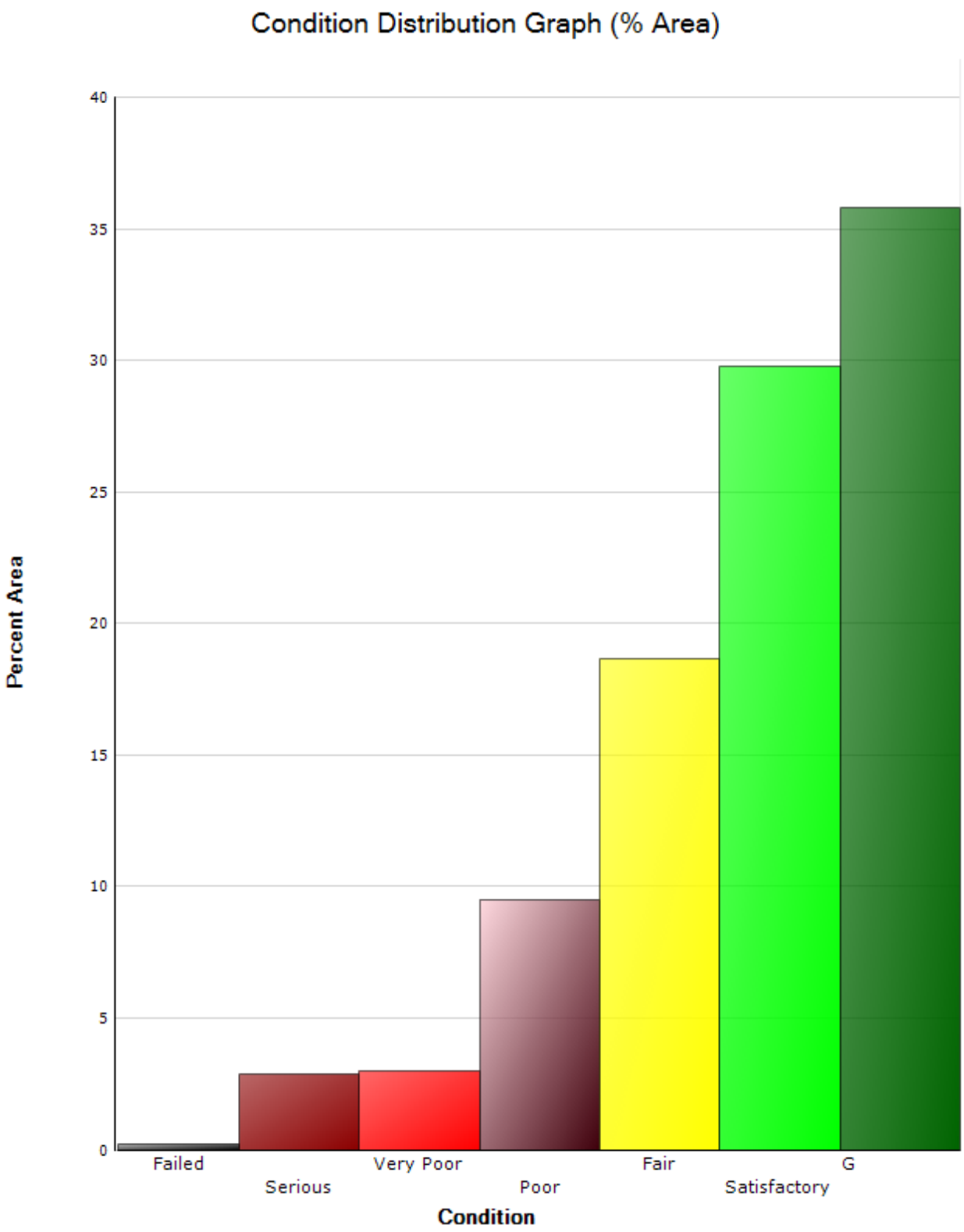


Figure 3: Papillion Street Condition by Area

Figure three is a graphical representation for the data in table 3.

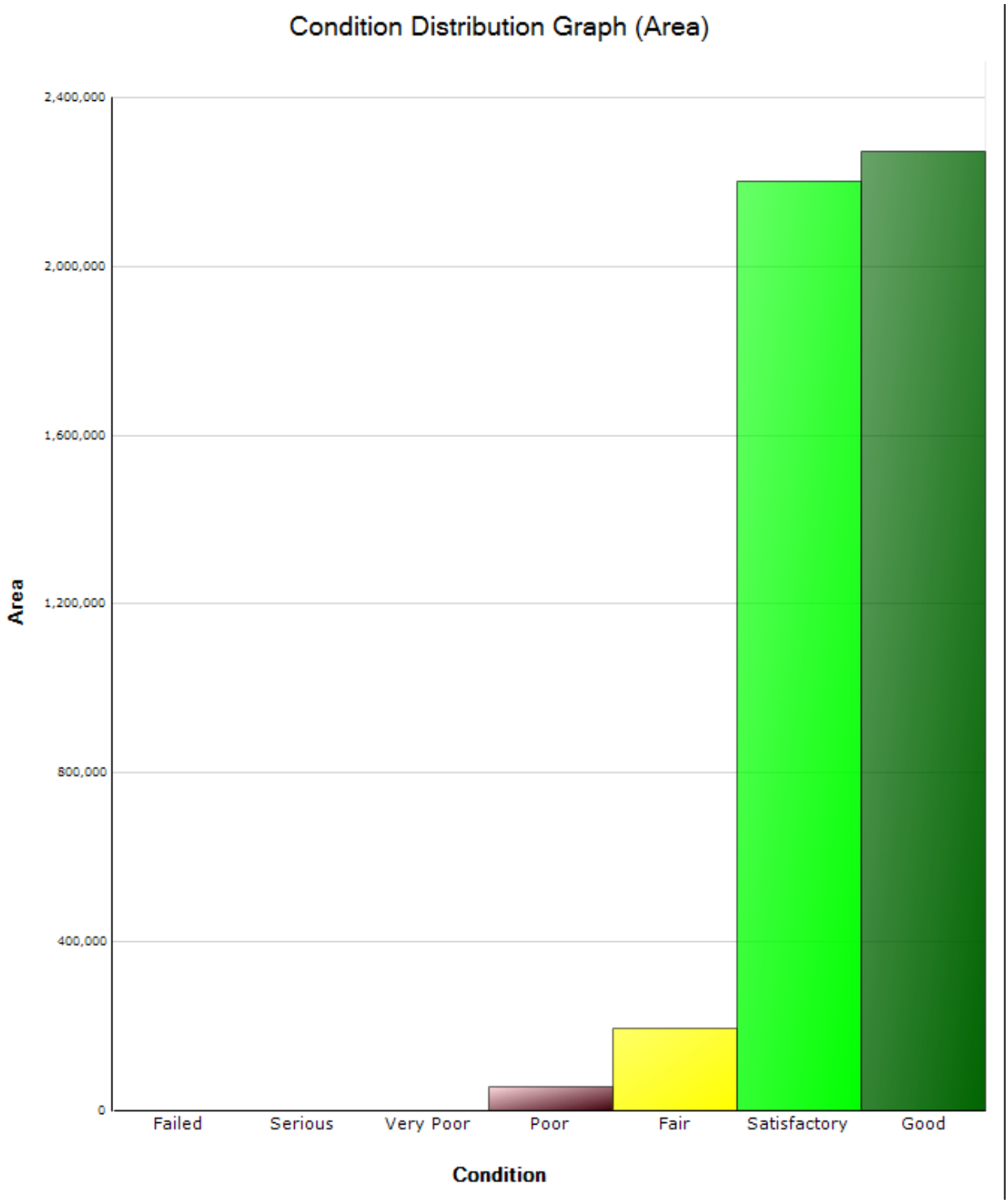


Figure 4: Papillion Street Condition by Area for Annexed Streets

Figure 4 is a graphical representation for the data in table 4.

Recommended Repairs

Papillion desires to develop a maintenance plan to keep their streets serviceable. Overall, the concrete streets are in better condition than the asphalt streets, but without maintaining those streets the damage and costs will accelerate. When water finds its way into concrete cracks and goes through a freeze-thaw cycle it will deteriorate the aggregate in the concrete. The water will wear on the durability of the concrete and begin to crack in the aggregate at the base of the concrete and works its way to the surface. This is known as D-cracking. The best way to prevent D-cracking, and other failure modes, is to seal up the surface and prevent the water from getting into the concrete.

Our recommendation on concrete streets in need of maintenance is a relatively new process called Ultra-Thin Bonded Asphalt Surface (UBAS). Prior to the UBAS we recommend application of a joint sealer to all the concrete joints in the streets and allow a period of time to let that cure. Next, a milling machine macrotextures the street about one half inch to create a rough surface. Then a spray paver is used to place a heavy layer of polymer modified asphalt emulsion and UBAS in a single pass. The gap graded modified hot mix asphalt (HMA) layer placed on the polymer emulsion is a method primarily used on asphalt pavements to correct surface distresses or restore surface characteristics like friction and smoothness. This is also a less damaging solution compared to mill and overlay to perform on concrete streets in need of maintenance because it only requires a half inch of milling. This maintains the base thickness of the street and avoids damaging the street, as opposed to removing two inches for a conventional mill and overlay. Public acceptance of this method is high as often it drives smoother than a mill and overlay, is long lasting and less expensive than a mill and overlay.

Image 2: UBAS Operation

The best options for maintenance to the asphalt streets in Papillion are a Mill and Overlay, UBAS and Chip Seal, depending on structural characteristics and condition of each street. The advantages and disadvantages are as follows:

Mill and Overlay:

- Advantages
  - Most appealing visually to residents
- Disadvantages:
  - Most expensive option because of the quantity of material used.
  - Most damage to existing street base materials because of construction equipment weight, and depth of pavement removed for overlay.
  - Requires either a UBAS or chip seal in 10-15 years.
  - Requires crack seal approximately 3 years after placement, sooner than other options.

Ultrathin Bonded Asphalt Surface (UBAS)

- Advantages
  - Looks substantially like a conventional mill and overlay, visually appealing.
  - Less expensive than mill and overlay.
  - Minimal milling depth, and fewer material trucks, puts less strain on existing street base materials.
  - Probably longest lasting without repeated crack seal maintenance.
- Disadvantages
  - More expensive than chip seal.
  - Still requires crack seal some years after placement, however, it is expected that crack seal of UBAS is less than what is required for a mill and overlay.

Chip Seal

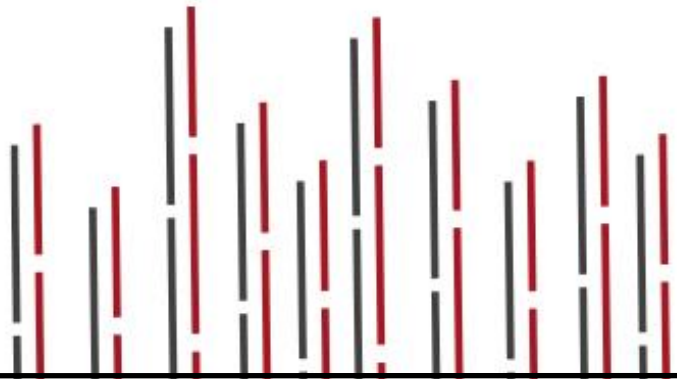
- Advantages
  - Lowest cost.
  - Best performance for the funds expended.
  - Least amount of strain on existing street base materials, no milling.
- Disadvantages
  - Leftover aggregate requires sweeping and is messy.
  - Street looks like a gravel surface and is rough.
  - Potential for asphalt emulsion to bleed through aggregate.

Budgeting

A good plan to follow is to attempt to perform maintenance on a street segment every eight years. Some maintenance operations last longer but the worse shape the street is in the more frequent it will require maintenance. To perform maintenance every eight years would mean averaging about 12% of the city's lane miles each year. Papillion has 349 lane miles so 42 lane miles a year would be a good place to start.

The pavement areas used in this report are not meant to be used for project estimating. We have assumed 12-foot lane widths and did not pick up all turn lanes in our estimates. For an annual maintenance program, the pavement widths should be evaluated in the field to ensure an accurate quantity is calculated.

Appendix A



PCI Map

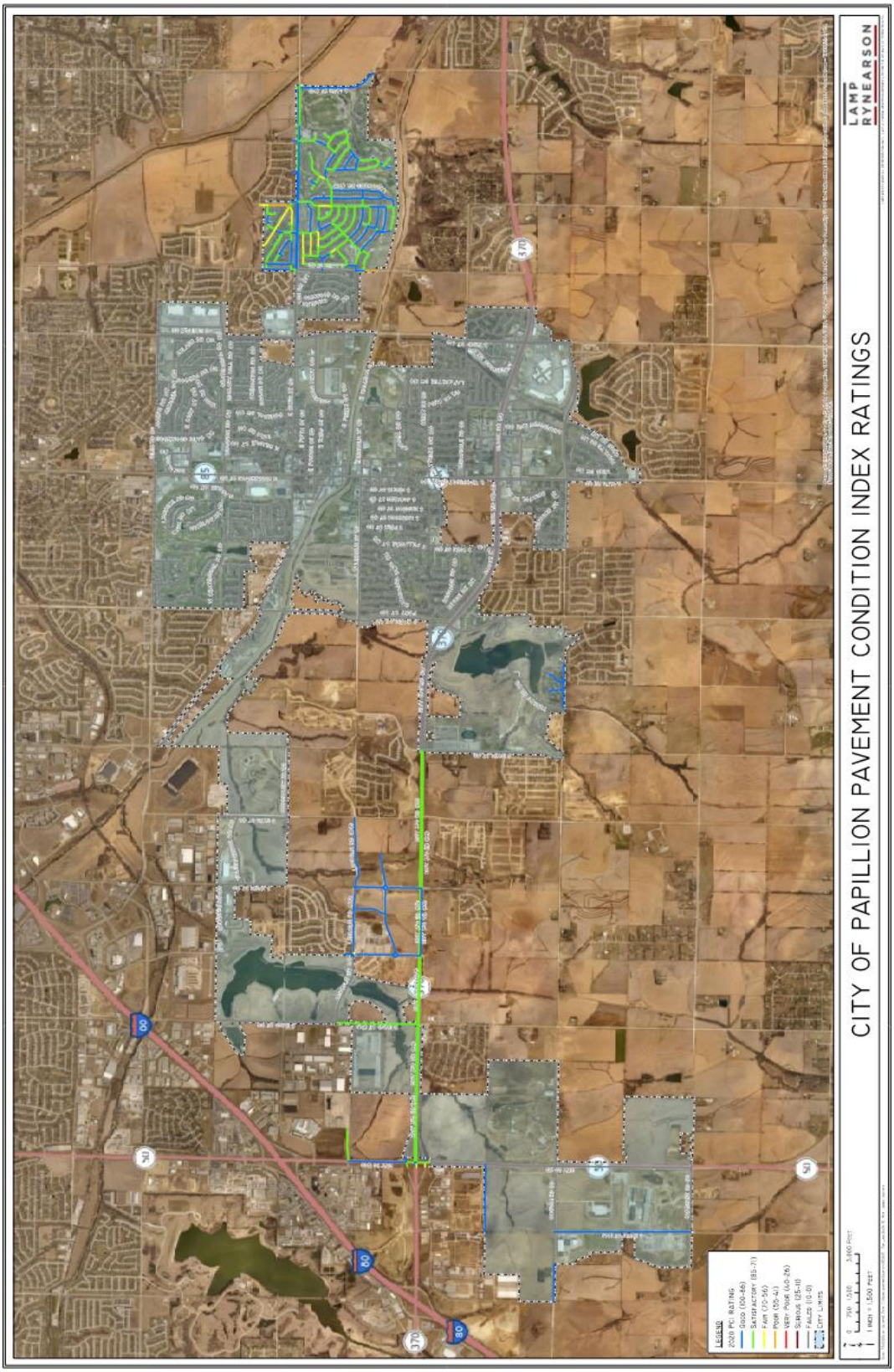


Image 3: Papillion Annexed Streets PCI Map