

# Pavement Condition Survey & Pavement Management Report for City of Harker Heights

## Harker Heights, TX

### Final Report

Robert R. Williams, P.E. (TX)

[rrwilliams@ara.com](mailto:rrwilliams@ara.com)

Ratul Mondal

[rmondal@ara.com](mailto:rmondal@ara.com)

Applied Research Associates, Inc.  
TBPE Firm No. F-4631

December 17, 2025

This document is not to be used for construction, bidding or permit purposes.



## Table of Contents

<b>1.</b>	<b>Introduction</b> .....	<b>4</b>
<b>2.</b>	<b>Data Collection and Analysis Methodology</b> .....	<b>3</b>
2.1.	ARA’s PathRunner .....	3
2.2.	Pavement Distress Data Interpretation .....	5
2.3.	Pavement Condition Index (PCI) Calculation .....	6
2.4.	Example Pavement Conditions and PCI Scores .....	9
<b>3.</b>	<b>Pavement Condition Inspection Results</b> .....	<b>14</b>
3.1.	Pavement Inventory.....	14
3.2.	PCI Statistics .....	14
3.3.	Ride Quality.....	18
<b>4.</b>	<b>Pavement Deterioration Models</b> .....	<b>20</b>
<b>5.</b>	<b>Maintenance and Rehabilitation Budget Analysis</b> .....	<b>21</b>
5.1.	Assumptions.....	21
5.1.1.	M&R Budget.....	21
5.1.2.	Inflation rate .....	21
5.1.3.	Treatment Techniques.....	21
5.1.4.	Maintenance Policies .....	23
5.2.	10- Year Work Plan .....	24
5.2.1.	Do Nothing Scenario .....	24
5.2.2.	Effect of Different Funding Level .....	25
5.2.3.	Maintaining Current Pavement Condition.....	28
5.2.4.	Detailed Work Plan .....	29
<b>6.</b>	<b>Summary and Recommendations</b> .....	<b>35</b>
6.1.	Summary .....	35
6.2.	Recommendations .....	35
6.3.	Electronic Files Accompanying this Report.....	36

## List of Figures

Figure 1: Location of the Project.....	2
Figure 2: PathRunner Hardware Components.....	4
Figure 3: Sample Pavement Images.....	4
Figure 4: PathView Processing Screen.....	5
Figure 5: PCI Condition Categories used in this Project.....	7
Figure 6: PCI Calculation Process.....	8
Figure 7: COMANCHE GAP RD (PCI=98.7, Good Condition).....	9
Figure 8: N ROY REYNOLDS DR NB (PCI=89.1, Good Condition).....	9
Figure 9: CATTAIL CIR (PCI=79.4, Satisfactory Condition).....	10
Figure 10: INDIAN TRAIL DR (PCI=76.3, Satisfactory Condition).....	10
Figure 11: E BEE LINE LN (PCI=69.2, Fair Condition).....	11
Figure 12: OAKRIDGE BLVD (PCI=60.5, Fair Condition).....	11
Figure 13: MODOC DR (PCI=46.2, Poor Condition).....	12
Figure 14: S ANN BLVD (PCI= 43, Poor Condition).....	12
Figure 15: CITATION LOOP (PCI=29.2, Very Poor Condition).....	13
Figure 16: S ROY REYNOLDS DR (PCI= 38.1, Very Poor Condition).....	13
Figure 17: City of Harker Heights PCI Map (2025).....	15
Figure 18: Overall Pavement Condition- PCI (Miles).....	16
Figure 19: Percent by Length based on Pavement Condition Index (PCI).....	17
Figure 20: Percent by Area based on Pavement Condition Index (PCI).....	17
Figure 21: IRI Distribution Histogram.....	18
Figure 22: IRI Cumulative Frequency Distribution.....	19
Figure 23: Typical IRI Ranges for Various Pavement Types and Functions.....	19
Figure 24: Pavement Performance Model.....	20
Figure 25: Overall Roadway Pavement Conditions Change over Time at Different Budget Level.....	24
Figure 26: Do Nothing Scenario – Change in Pavement Condition over Time.....	25
Figure 27: Current Funding Scenario – Change in Pavement Condition over Time.....	25
Figure 28: City of Harker Heights PCI Map (2035).....	26
Figure 29: Decreased Funding Scenario - PCI Change over Time.....	26

List of Figures

Figure 30: Increased Funding Scenario - PCI Change over Time ..... 27

Figure 31: Maintaining Current Condition – Change in Pavement Condition over Time..... 28

Figure 32: FY 26 Pavement Maintenance Plan ..... 30

Figure 33: FY 27 Pavement Maintenance Plan ..... 30

Figure 34: FY 28 Pavement Maintenance Plan ..... 31

Figure 35: FY 29 Pavement Maintenance Plan ..... 31

Figure 36: FY 30 Pavement Maintenance Plan ..... 32

Figure 37: FY 31 Pavement Maintenance Plan ..... 32

Figure 38: FY 32 Pavement Maintenance Plan ..... 33

Figure 39: FY 33 Pavement Maintenance Plan ..... 33

Figure 40: FY 34 Pavement Maintenance Plan ..... 34

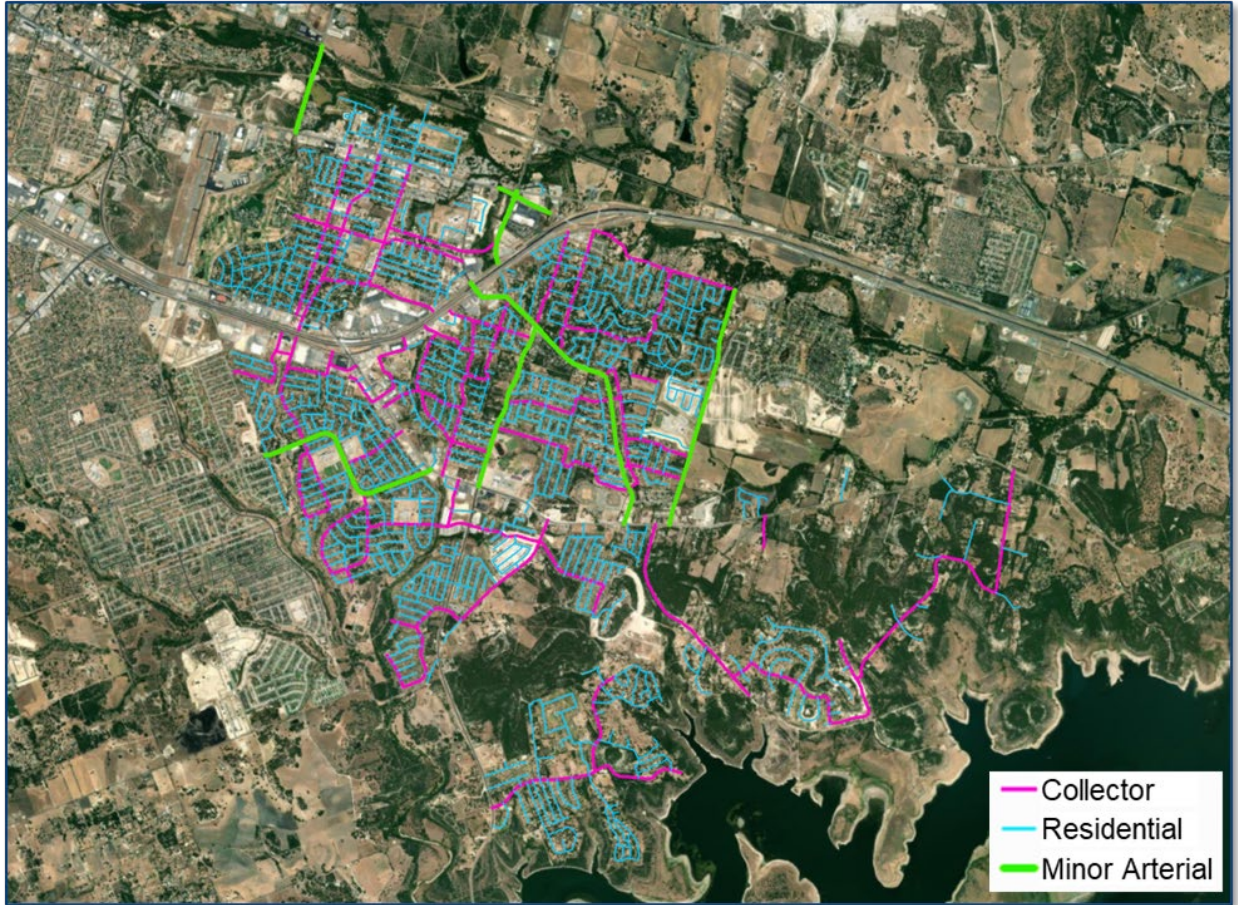
Figure 41: FY 35 Pavement Maintenance Plan ..... 34

## List of Tables

Table 1: Asphalt Pavement Distress Types .....	6
Table 2: Pavement Survey Statistics .....	14
Table 3: Pavement Survey Statistics by Functional Class .....	14
Table 4: PCI Distribution by Condition Category – Surveyed Roads.....	14
Table 5: PCI Scores by Functional Classification .....	15
Table 6: PCI Condition Categories by Test Miles .....	16
Table 7: Assumed Treatment Unit Cost.....	23
Table 8: Do Nothing Scenario - PCI Change over Time.....	24
Table 9: Current Funding Scenario - PCI Change over Time.....	25
Table 10: Decreased Funding Scenario - PCI Change over Time .....	26
Table 11: Increased Funding Scenario - PCI Change over Time.....	27
Table 12: Unlimited Funding Scenario - PCI Change over Time .....	28
Table 13: Maintaining Current Condition - PCI Change over Time.....	28
Table 14: Electronic Files Accompanying This Report .....	36

### 1. Introduction

City of Harker Heights contracted with Applied Research Associates, Inc. (ARA) to perform automated pavement condition assessment of city-owned streets for approximately 157.9 test lane miles within the city limit. Gravel and unpaved roadways were not included in this survey. Additionally, areas with restricted access or roadways under construction were not surveyed, or dirt. An overview of the project location is shown in Figure 1 with each roadway color-coded by functional class. Pavement inspection services were performed using the Pavement Condition Index (PCI) method as defined by ASTM 6433. Data collection was done in both directions on arterial roads and one direction on the collector and residential roads. Scores were provided for each direction surveyed. This project also includes the pavement management analysis to set up a 10-year pavement maintenance plan.



*Figure 1: Location of the Project*

## 2. Data Collection and Analysis Methodology

### 2.1. ARA's PathRunner

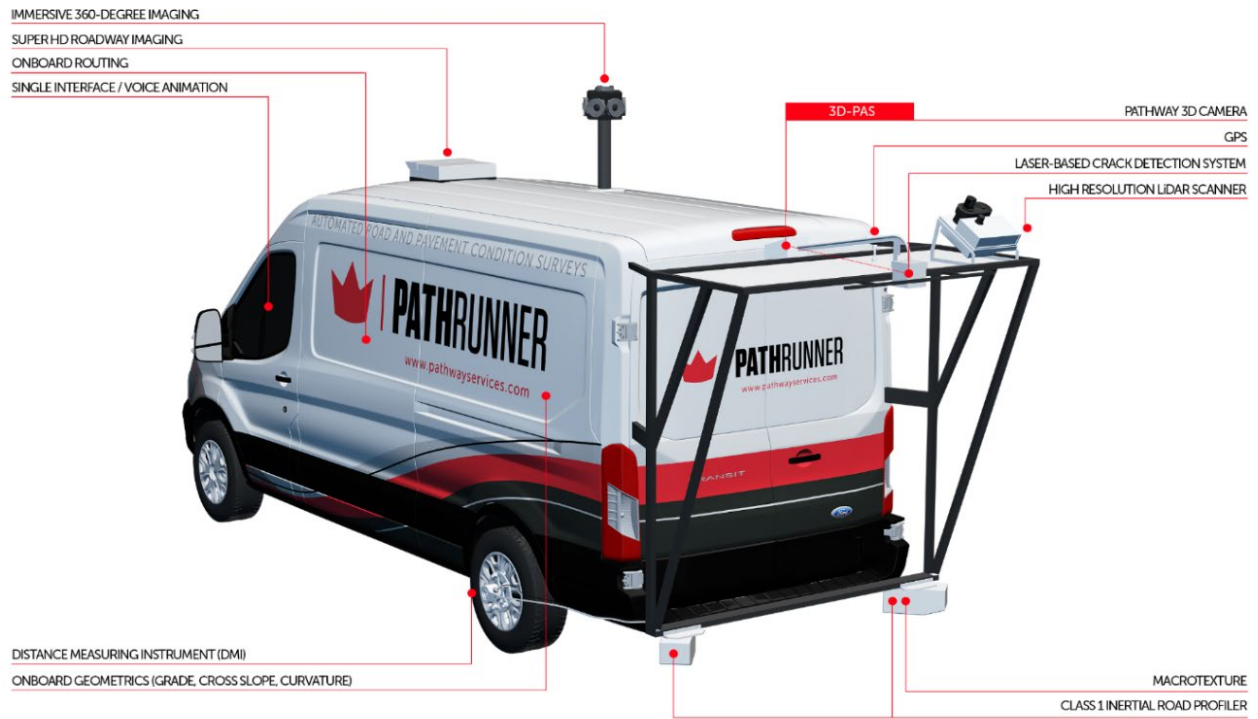
Automated pavement condition surveys were performed in December 2025. ARA deployed our PathRunner data collection system to collect high-quality pavement imagery with a 3D scanning laser, pavement profile measurements, and sub-meter accuracy GPS data. The PathRunner is also equipped with Right-of-Way Cameras, a 360° Ladybug Camera, and LiDAR data collection systems, which were disabled for the data collection effort for security reasons. During data collection, this vehicle is driven at posted speed limits (up to 60 mph). Traffic control is not required for this type of pavement testing equipment. The survey van is equipped with appropriate flashing lights and sign markings for additional safety. Additionally, all vans used for collection are marked with the company name. All pavement condition data will be collected using ARA's PathRunner system. Right-of-way images, 360° Ladybug images, and LIDAR data was not collected due to security protocols.

The pavement survey vehicle is equipped with industry standard sensors and hardware required for accurate, high-quality pavement data collection, including:

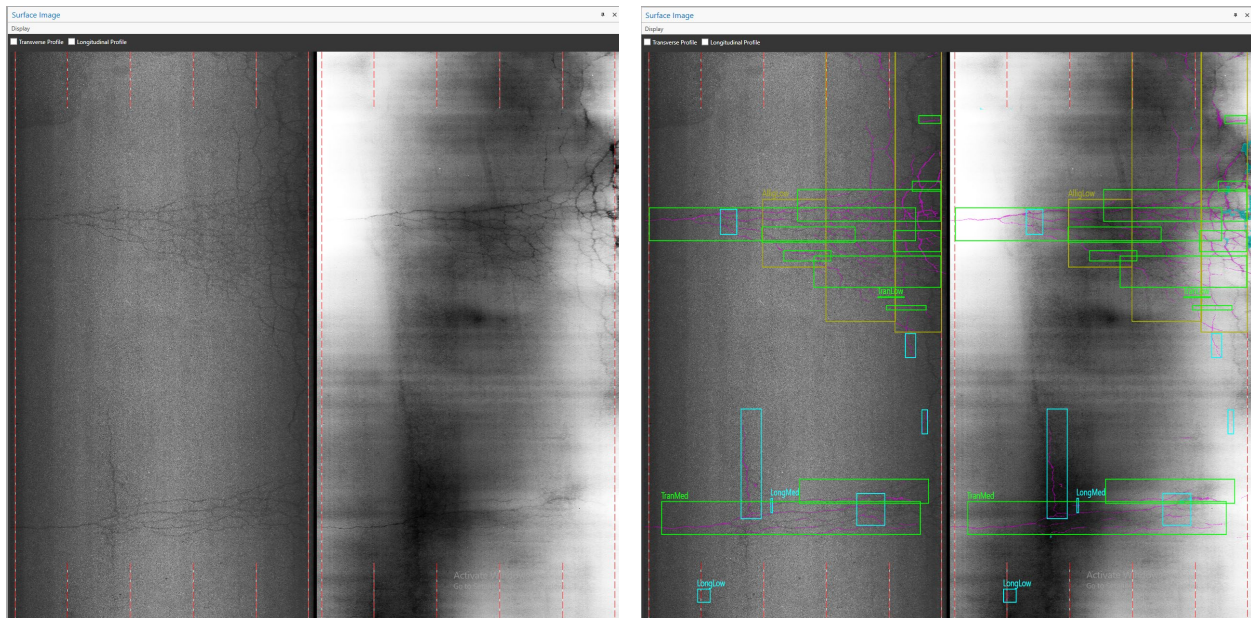
1. **3D Pavement Imaging Sensor:** This sensor captures detailed images and measurements of the pavement surface in three dimensions, which is crucial for assessing pavement conditions such as cracking, rutting, and surface texture.
2. **360° Ladybug Camera:** The Ladybug camera provides panoramic images, allowing for a comprehensive view of the surrounding environment. This can be useful for contextual information and for documenting the conditions around the surveyed area.
3. **Right of Way (ROW) Cameras:** With multiple ROW cameras, the vans can capture panoramic images along the sides of the road. These images are valuable for documenting the conditions of the roadside and surrounding infrastructure.
4. **High-Definition, 3D LIDAR System:** LIDAR (Light Detection and Ranging) technology is used to create detailed 3D maps of the road surface and surroundings. It's capable of precise measurements and can detect subtle changes in elevation and surface features and can be utilized for right-of-way asset feature extraction.
5. **Class-1 Roadway Surface Profiler:** This profiler measures macrotexture of the road surface. Macrotexture affects skid resistance and drainage, both important factors for pavement safety and durability.
6. **Integrated Sub-meter Accuracy GPS/IMU System:** The GPS (Global Positioning System) and IMU (Inertial Measurement Unit) system provides accurate positioning and orientation data. This is essential for geo-referencing survey data and for accurately mapping the survey route.

The 3D Pavement Imaging Sensor system allows 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 help in identifying the pavement lane. A picture of the ARA-owned PathRunner with the 3D Pavement Imaging

System is shown in Figure 2. Sample pavement images are shown in Figure 3. Data collection was performed during daytime and under prevailing traffic conditions.



**Figure 2: PathRunner Hardware Components**



**Figure 3: Sample Pavement Images**

## 2.2. Pavement Distress Data Interpretation

Data acquired with the PathRunner system allows the automated detection/identification of various types of distresses including all types of cracking, rutting, raveling, potholes, edge drop-off, sealed cracks, lane markings, and macrotexture. However, it should be noted that for PCI based condition surveys, the ASTM D 6433 standard includes 20 distress types for both asphalt and concrete surface types. ARA does not believe that all distress identification and classification can be fully automated. We believe that for PCI surveys, distress rating/analysis by trained pavement inspectors is more accurate. All pavement images acquired in this project were rated/evaluated by trained and experienced pavement inspectors working in an office environment.

The image-based distress analyses were performed using customized distress analysis software, which was developed specifically for performing PCI surveys on image data. The software provides the pavement inspector/rater with a graphical representation and with the ability to edit all the data sets collected using the PathRunner. These datasets include pavement images, Right-of-Way (ROW) images, pavement profiler datasets, distance measurements (DMI) and GPS readings. Workstations multiple monitors are used by experienced pavement inspectors to identify, classify and report the pavement surface distresses using PathView, the rating software for processing PathRunner data. Figure 4 shows a screen capture from the software.

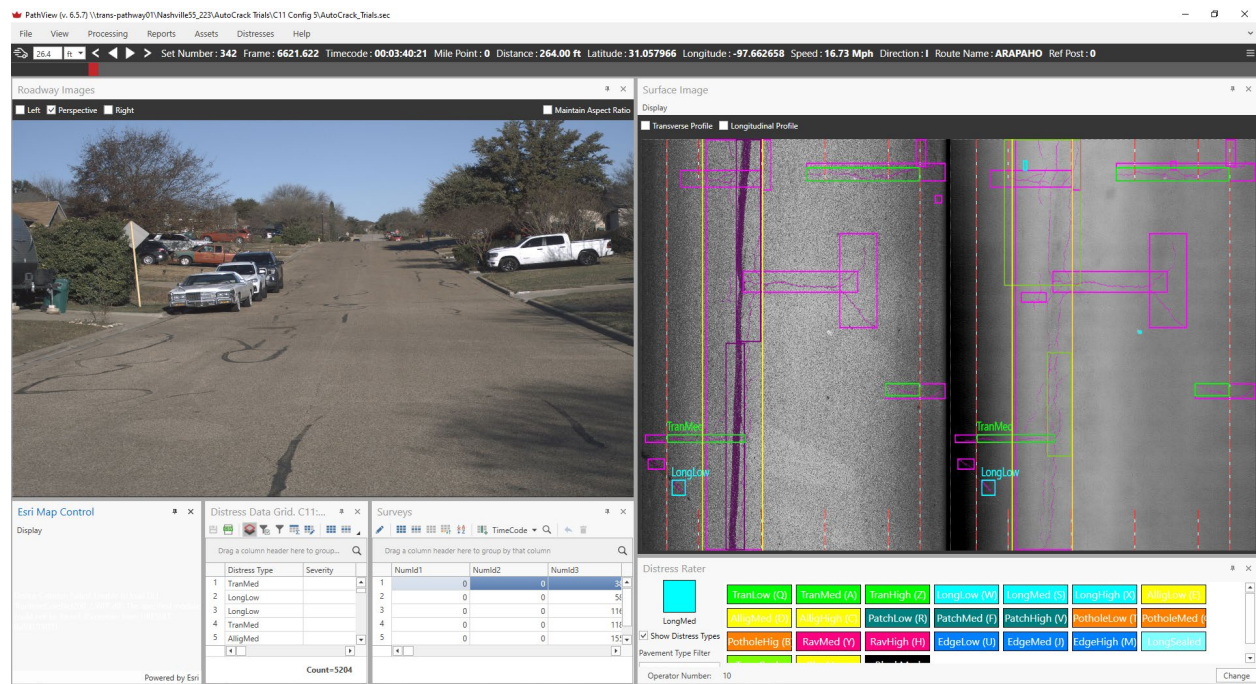


Figure 4: PathView Processing Screen

Pavement distresses were marked on 100% of the surveyed pavement area (vehicle drive path). Distresses were marked on the pavement surface using the guidance provided in ASTM D6433 – Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys. The distress types for asphalt pavements are shown in Table 1. Distresses shown in **RED** have the most

detrimental impact on the PCI score. Additionally, moderate and high severity Long/Trans cracking also impact the PCI score significantly.

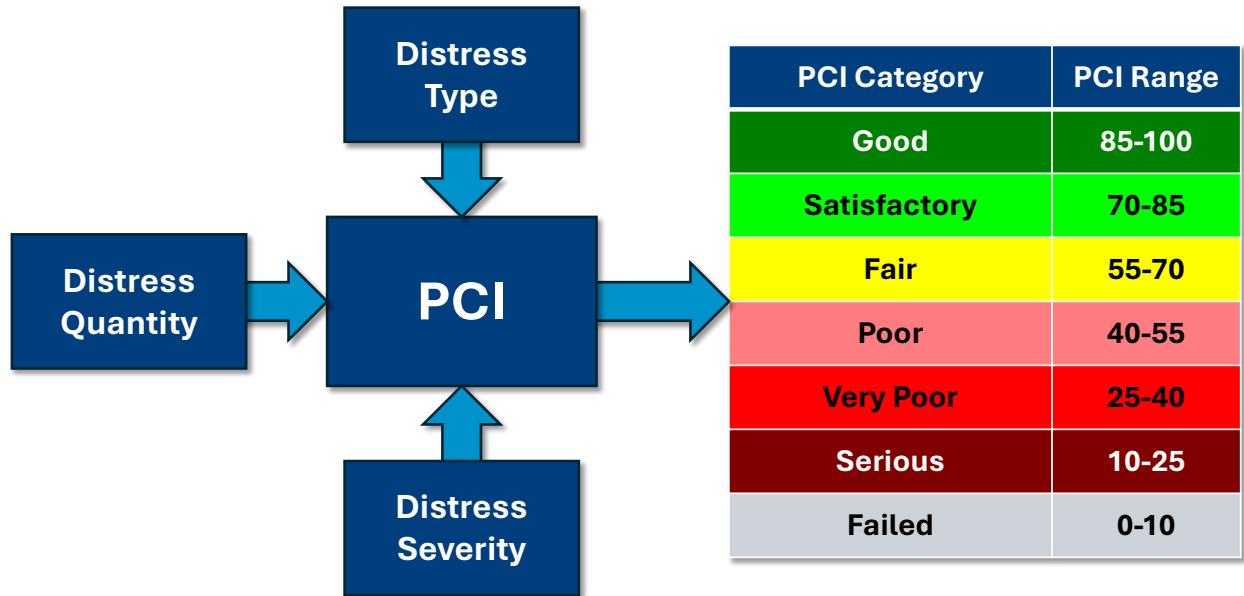
**Table 1: Asphalt Pavement Distress Types**

Code	Distress Type	Cause	Included in Study
01	<b>Alligator Cracking</b>	Load	Yes
02	Bleeding	Other	No
03	Block Cracking	Climate/Durability	Yes
04	Bumps and Sags	Other	No
05	Corrugation	Other	No
06	Depression	Other	No
07	Edge Cracking	Load	Yes
08	Joint Reflection Cracking	Climate/Durability	Yes
09	Lane/Shoulder Drop-Off	Other	Yes
10	Longitudinal and Transverse Cracking	Climate/Durability	Yes
11	Patching and Utility Cut Patching	Other	Yes
13	<b>Pothole</b>	Load	Yes
14	Railroad Crossing	Other	Yes
15	<b>Rutting</b>	Load	Yes
16	Shoving	Other	No
17	Slippage Cracking	Other	Yes
18	Swell	Other	No
19	Raveling	Other	Yes
20	Weathering	Climate/Durability	Yes

### 2.3. Pavement Condition Index (PCI) Calculation

The Pavement Condition Index (PCI) methodology for roadways and parking lots – commonly used with PAVER – is defined in American Society for Testing and Materials (ASTM) standard D6433. The PCI is an objective and repeatable method for assessing pavement condition and is used by agencies worldwide. The PCI procedure was developed for manual, foot-on-ground pavement inspections but have now been adapted for automated, vehicle-based data collection techniques.

The project’s condition assessment scale is shown in Figure 5. PCI scores range from 0 to 100, with 0 representing the worst pavement condition and 100 representing the best possible condition. If properly designed and constructed, new pavements begin their service life with a PCI of 100. Due to the effects of loading and aging, the pavement deteriorates over time and its PCI decreases. To obtain a section’s PCI, the type, extent, and severity of pavement distresses are recorded on representative samples and are used to calculate a deduct value. PCI is calculated through subtracting the deduct values from 100, and its PCI decreases. Pavement management software, including PAVER, calculate the PCI scores for each pavement section based on a combination of distress types, severities, and quantities.

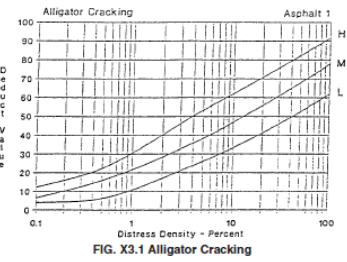
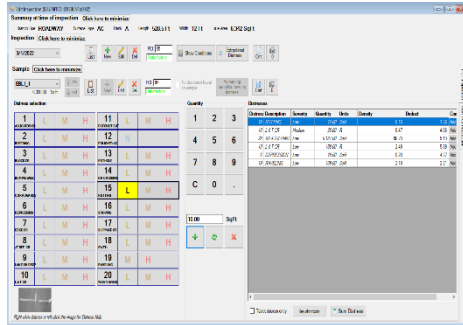


*Figure 5: PCI Condition Categories used in this Project.*

Detailed pavement distress (type, severity and extent) data were imported into the U.S. Army Corps of Engineer’s PAVER software to calculate PCI scores for each segment. PAVER calculates the PCI score for each ‘sample unit’ (for this project approx. 2400 sq. ft), and then calculates an area weighted average PCI value for the pavement section. An overview of the PCI calculation process is shown in Figure 6. The steps involved are as follows:

1. In each Sample Unit, distresses are recorded along with their types, severity levels and extents (quantities)
2. Deduct values are calculated and the distresses are sorted in descending order.
3. Through an iterative process, the cumulative deduct values are calculated.
4. The final PCI score for the Sample Unit is calculated as  $100 - (\text{max}) \text{ cumulative deduct value}$ .
5. Section PCI score is calculated as the area weighted average of individual Sample Unit PCI scores in that section.

# 2025 Pavement Management Report – City of Harker Heights Data Collection and Analysis Methodology



$$m = 1 + (998)(100 - 25.1) = 79 < 8$$

Use highest 7 deducts and 0.9 of eighth deduct.  
0.9 x 5.1 = 4.8

#	Deduct Values								Total	q	CDV
1	25.1	23.4	19.5	11.2	7.5	6.5	4.8	1047.9	8	51.0	
2	25.1	23.4	19.5	11.2	7.5	6.5	2	101.9	7	50.0	
3	25.1	23.4	19.5	11.2	7.5	7.5	2	56.0	6	46.0	
4	25.1	23.4	19.5	11.2	7.5	2	2	90.5	5	47.0	
5	25.1	23.4	19.5	11.2	2	2	2	94.4	4	48.0	
6	25.1	23.4	19.5	2	2	2	2	95.4	3	48.0	
7	25.1	23.4	2	2	2	2	2	99.5	2	44.0	
8	25.1	2	2	2	2	2	2	38.1	1	38.0	
9											
10											

ASPHALT SURFACED ROADS AND PARKING LOTS CONDITION SURVEY DATA SHEET FOR SAMPLE UNIT		SKETCH	
BRANCH	SECTION	DATE	SAMPLE AREA
1. Alligator Cracking    5. Depression    11. Patching & Old Grit Fixing    15. Shoving 2. Bleeding    6. Edge Cracking    12. Polished Aggregate    17. Slippage Cracking 3. Block Cracking    7. Rutting/Cracking    13. Poorly Compacted    18. Spall 4. Surface and Seals    8. Sand/Gravel Stripping    14. Rutting    19. Weathering/Raveling 9. Compaction    10. Long & Transverse Cracking    16. Raveling			
DEFECTS SEVERITY	QUANTITY	TOTAL	DENSITY VALUE
1.0	1.0	1.0	1.0
1.1	1.0	1.0	1.0
1.2	1.0	1.0	1.0
1.3	1.0	1.0	1.0
1.4	1.0	1.0	1.0
1.5	1.0	1.0	1.0
1.6	1.0	1.0	1.0
1.7	1.0	1.0	1.0
1.8	1.0	1.0	1.0
1.9	1.0	1.0	1.0
1.0	1.0	1.0	1.0
1.1	1.0	1.0	1.0
1.2	1.0	1.0	1.0
1.3	1.0	1.0	1.0
1.4	1.0	1.0	1.0
1.5	1.0	1.0	1.0
1.6	1.0	1.0	1.0
1.7	1.0	1.0	1.0
1.8	1.0	1.0	1.0
1.9	1.0	1.0	1.0
1.0	1.0	1.0	1.0
1.1	1.0	1.0	1.0
1.2	1.0	1.0	1.0
1.3	1.0	1.0	1.0
1.4	1.0	1.0	1.0
1.5	1.0	1.0	1.0
1.6	1.0	1.0	1.0
1.7	1.0	1.0	1.0
1.8	1.0	1.0	1.0
1.9	1.0	1.0	1.0

Max CDV	=	51
PCI = 100 - Max CDV	=	49
Rating	=	F

Figure 6: PCI Calculation Process

\*Adapted from ASTM D6433 – Standard Practice for Pavement Condition Surveys on Road and Parking Lots Pavements

## 2.4. Example Pavement Conditions and PCI Scores

In this section, examples of various pavement conditions are presented in Figure 7 through 16 with the corresponding PCI score. These images provide an overview for readers in differentiating between the different PCI categories.



**Figure 7: COMANCHE GAP RD (PCI=98.7, Good Condition)**



**Figure 8: N ROY REYNOLDS DR NB (PCI=89.1, Good Condition)**



**Figure 9: CATTAIL CIR (PCI=79.4, Satisfactory Condition)**



**Figure 10: INDIAN TRAIL DR (PCI=76.3, Satisfactory Condition)**



*Figure 11: E BEE LINE LN (PCI=69.2, Fair Condition)*



*Figure 12: OAKRIDGE BLVD (PCI=60.5, Fair Condition)*



*Figure 13: MODOC DR (PCI=46.2, Poor Condition)*



*Figure 14: S ANN BLVD (PCI= 43, Poor Condition)*



**Figure 15: CITATION LOOP (PCI=29.2, Very Poor Condition)**



**Figure 16: S ROY REYNOLDS DR (PCI= 38.1, Very Poor Condition)**

### 3. Pavement Condition Inspection Results

#### 3.1. Pavement Inventory

The analyzed data was summarized for each road segment. The city-maintained roads include 157.9 miles of roads comprised of asphalt concrete or dirt surface. The data analysis includes PCI scores and maintenance plan for 10 years. The PCI calculation was performed using PAVER software which calculates the PCI at sample level as per ASTM D6433. Detailed results are presented in the accompanying Excel data file. Table 2 and Table 3 show the statistics of roadways surveyed. All surveyed miles are AC roadways.

**Table 2: Pavement Survey Statistics**

Surface Type	Length (mi)	Area (SY)
AC	157.3	2,949,278
Dirt/ Gravel	0.6	8,716
Total	157.9	2,980,671

**Table 3: Pavement Survey Statistics by Functional Class**

Functional Class	Length (mi)	Area (SY)	Percent by Length
Minor Arterial	13.36	310,083	8%
Collector	37.70	690,331	24%
Residential	106.85	1,980,257	68%

#### 3.2. PCI Statistics

Overall Pavement Condition Index (PCI) scores are shown in Figure 17 and summarized in Table 4 & Table 5. As described earlier, the PCI scale was divided into the seven (7) default PAVER condition categories to assess pavement conditions. From the analyzed result, approximately 15% of the project’s roadway sections were found to be in “Good” condition (PCI > 85). Overall, 43% road pavement’s PCI is above 55 (Fair to Good Condition).

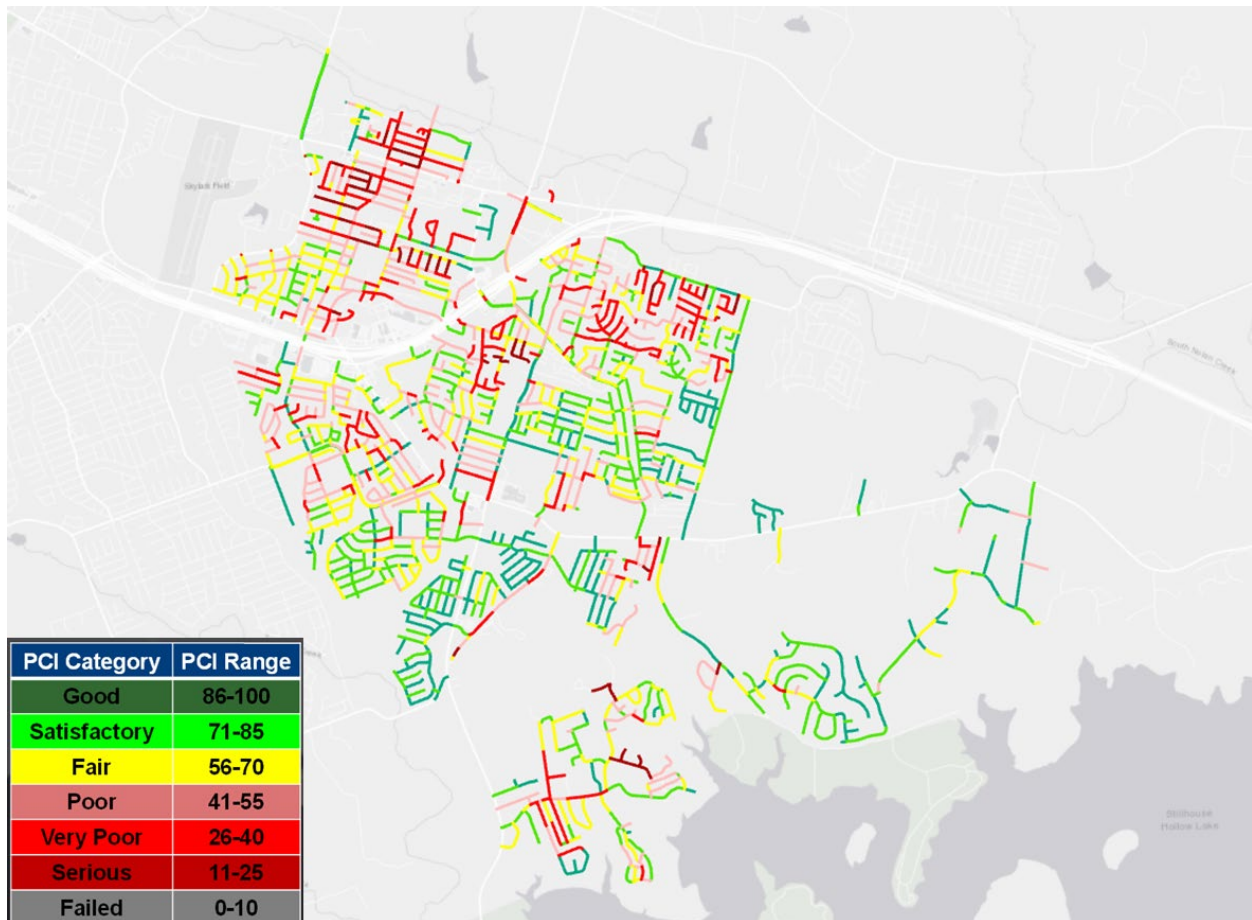
**Table 4: PCI Distribution by Condition Category – Surveyed Roads**

PCI Condition Category	No of Section	Pass Length (mi)	% Total
Good	286	25.9	15%
Satisfactory	426	40.2	23%
Fair	368	33.8	20%
Poor	343	32.2	22%
Very Poor	246	20.2	15%
Serious	59	5.1	4%
Failed	0	0.0	0%
<b>Total</b>	<b>1740</b>	<b>157.4</b>	<b>100%</b>

**Table 5: PCI Scores by Functional Classification**

Functional Classification	PCI Score
Minor Arterial	68.46
Collector	66.56
Residential	62.26
Overall	64.18

The overall score of 64.18 excludes road not tested for any reason. Roadways under construction are assumed to revert the PCI score to 100 after construction.

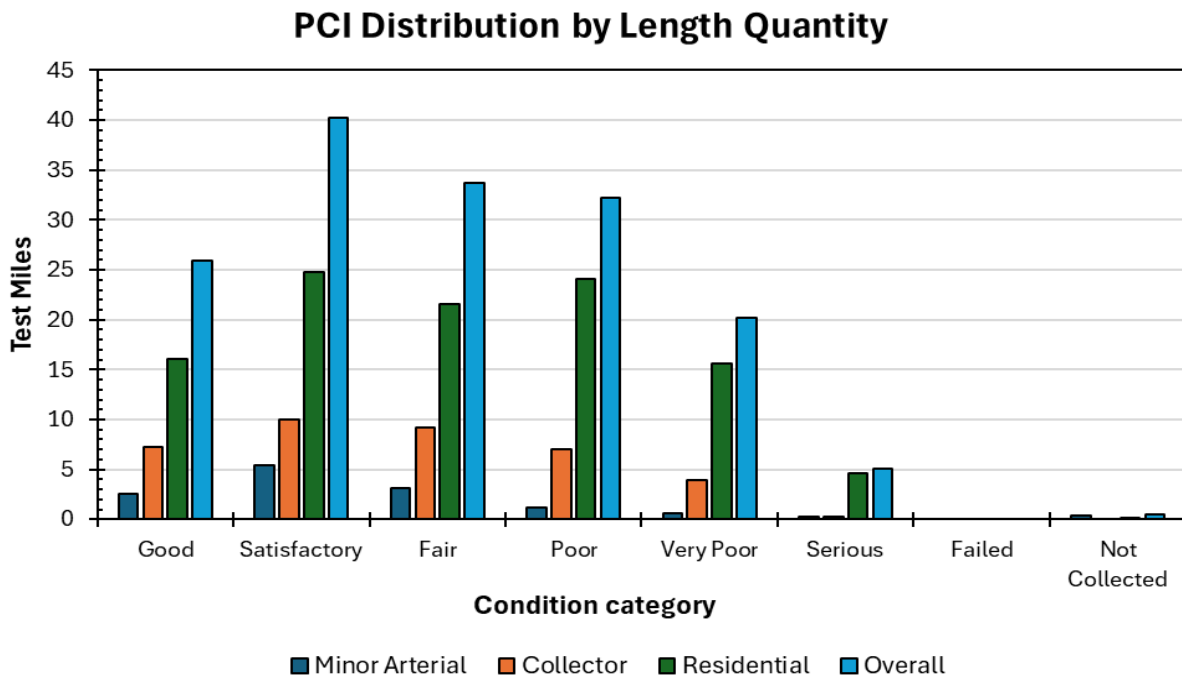


**Figure 17: City of Harker Heights PCI Map (2025)**

The PCI data are also shown in Table 6 and graphically Figure 18 to Figure 20. Arterial roads were tested in two directions (2 test miles per centerline mile) and collector & residential roads were tested in one direction (1 test mile per centerline mile)

**Table 6: PCI Condition Categories by Test Miles**

Functional Class	PCI Category								Overall
	Good	Satisfactory	Fair	Poor	Very Poor	Serious	Failed	Not Collected	
Minor Arterial	2.58	5.36	3.08	1.17	0.61	0.22	0.00	0.33	<b>13.36</b>
Collector	7.27	10.03	9.16	7.02	3.95	0.28	0.00	0.00	<b>37.70</b>
Residential	16.03	24.82	21.52	24.03	15.65	4.62	0.00	0.19	<b>106.85</b>
<b>Overall</b>	<b>25.88</b>	<b>40.21</b>	<b>33.75</b>	<b>32.23</b>	<b>20.20</b>	<b>5.12</b>	<b>0.00</b>	<b>0.52</b>	<b>157.92</b>



**Figure 18: Overall Pavement Condition- PCI (Miles)**

PCI Distribution by Length Percent

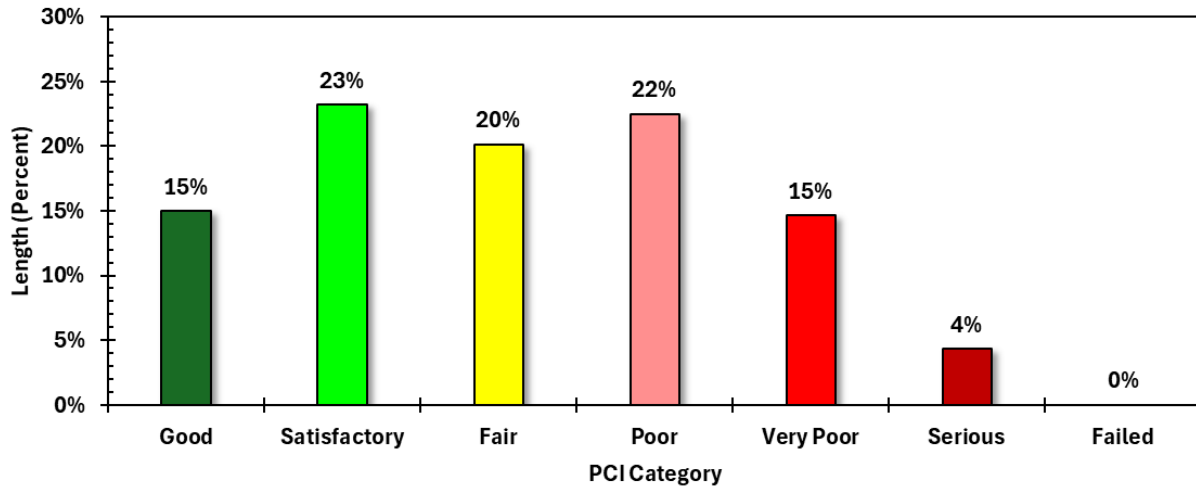


Figure 19: Percent by Length based on Pavement Condition Index (PCI)

PCI Distribution by Area Percent

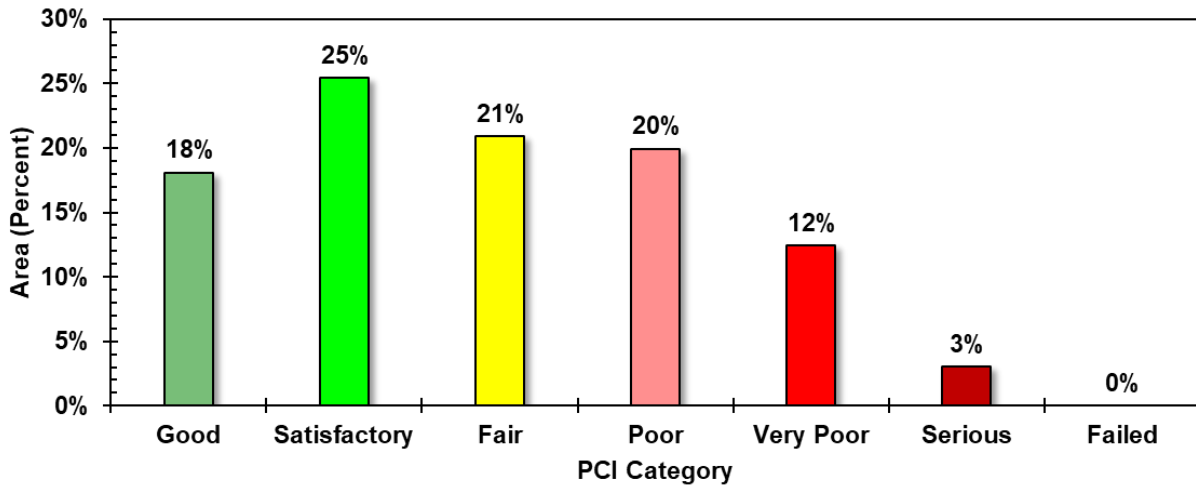


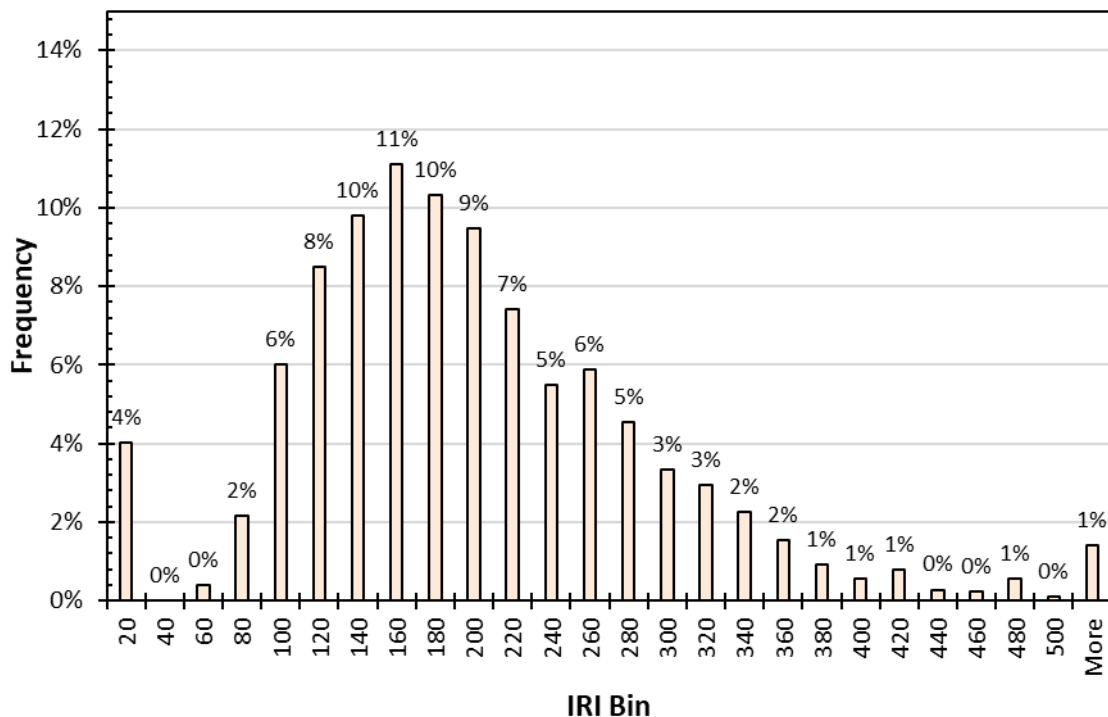
Figure 20: Percent by Area based on Pavement Condition Index (PCI)

### 3.3. Ride Quality

In addition to the pavement distress survey, ride quality measurements have been collected using a high-speed road surface profiler. The index for ride quality is the International Roughness Index and is reported in inches per mile (in./mi). The lower this number is, the smoother the roadway and the “better” the ride quality. As this number increases it is indicative of more bumps and pavement roughness along the roadway.

Figure 21 below presents the International Roughness Index (IRI) distribution for the City’s roadway network. In addition, Figure 22 presents the plots of the IRI and the cumulative percentage for local roads and for the overall network. It should be noted that IRI was filtered out where the data collection speed was less than 15 mph. The reason for this is because when collection speeds drop below 15 mph, the measured IRI values are not considered as accurate when collected above this speed. This is a known and documented limitation of IRI measurements. This resulted in some sections with no reportable IRI value.

Most pavement sections have IRI between 100 and 240 inches/mile, as shown in Figure 21 below. Figure 22 shows that the minor arterial roads have significantly lower IRI values (which means better ride quality), than collectors or residential roadways and the network. Figure 23 demonstrates the typical ranges for IRI values by pavement function as classified in “The Little Book of Profiling”. Generally, roads with higher PCI values also have lower IRI values, but this is not absolute in every situation.



**Figure 21: IRI Distribution Histogram**

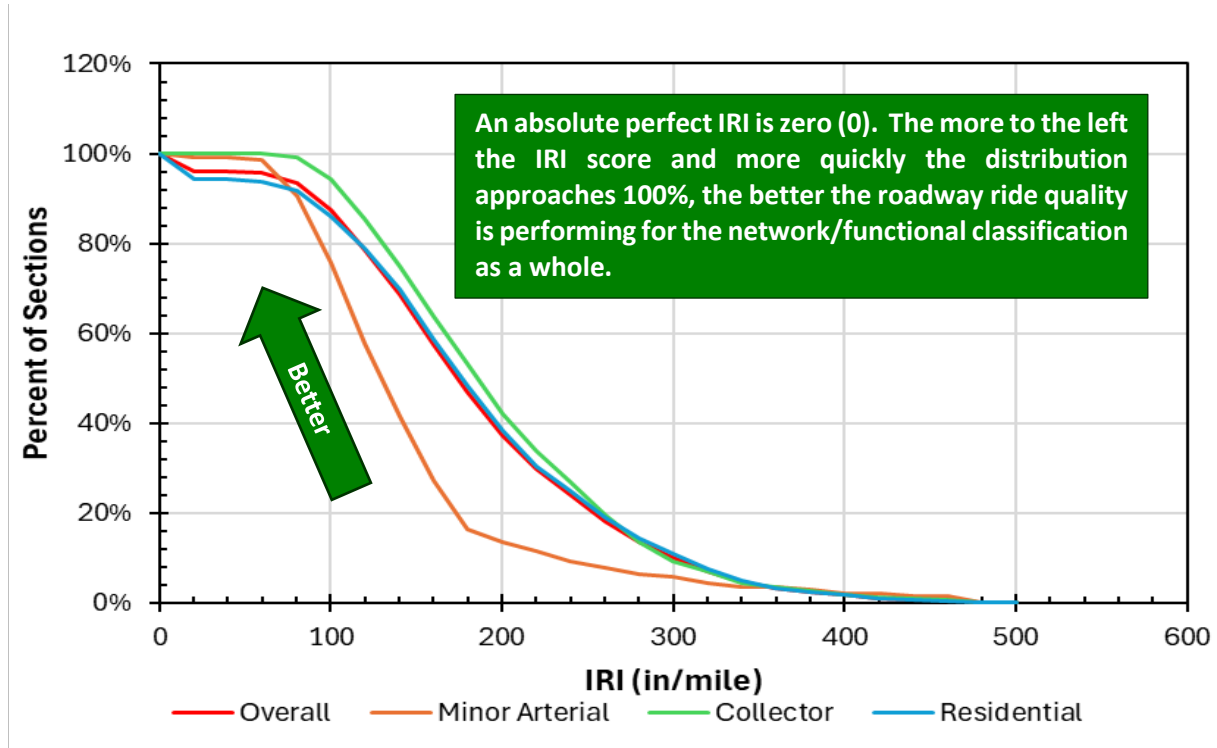


Figure 22: IRI Cumulative Frequency Distribution

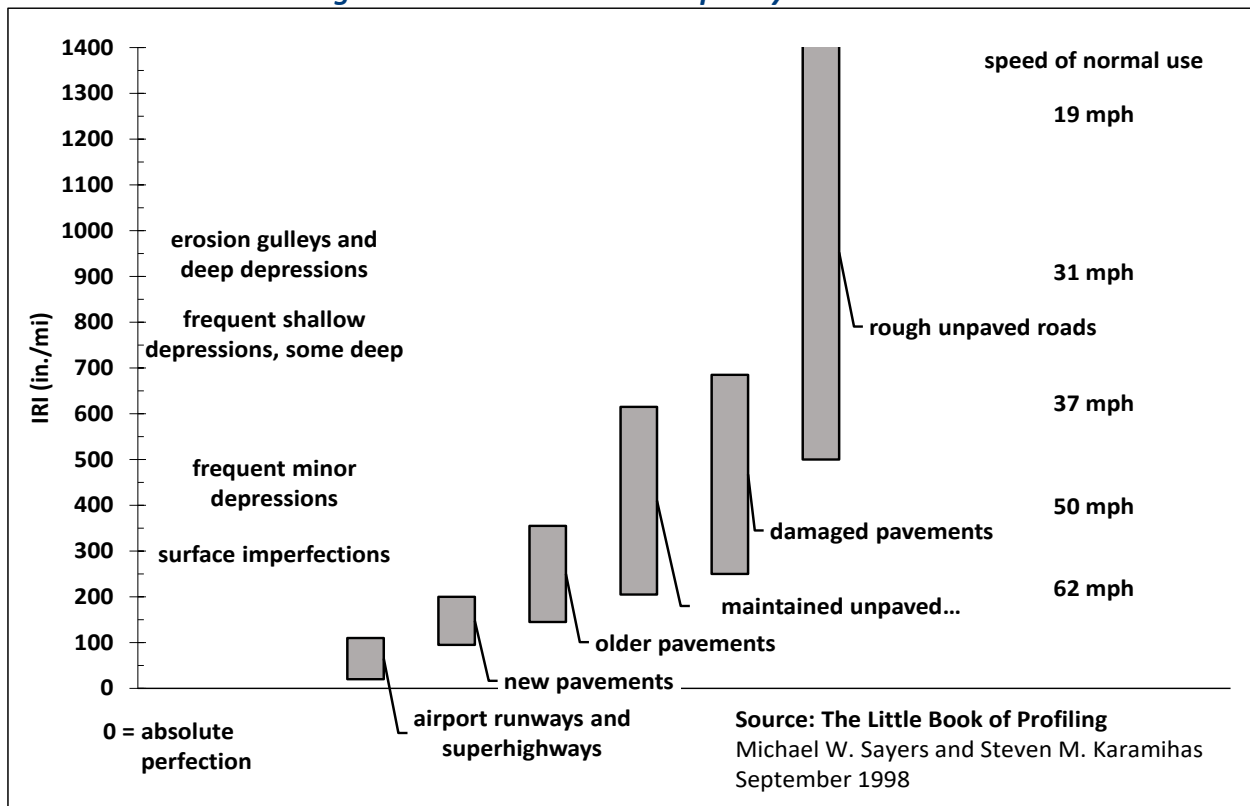


Figure 23: Typical IRI Ranges for Various Pavement Types and Functions

#### 4. Pavement Deterioration Models

Pavements experience deterioration over time due to factors such as traffic loads, traffic volume, pavement structure, materials, and subgrade conditions. The rate of deterioration varies, prompting the classification of pavements with similar characteristics into distinct 'families' for management purposes. To manage these pavements effectively, deterioration models are developed for these groups. In the PAVER system, prediction models estimate future pavement conditions based on historical data. Accurate predictions necessitate knowledge of the pavement section's age, which is defined as the time elapsed since its last major maintenance or rehabilitation. Deterioration rates are classified as high if they exceed PCI 4 points per year for asphalt pavements (since the last construction) or PCI 5 points per year (since the last inspection), and more than PCI 2.5 points per year for concrete pavements.

In this analysis, due to the unavailability of historical data, ARA utilized an initial performance model used for small agencies on other projects. This performance model will be updated based on PCI scores from future surveys once they are performed.

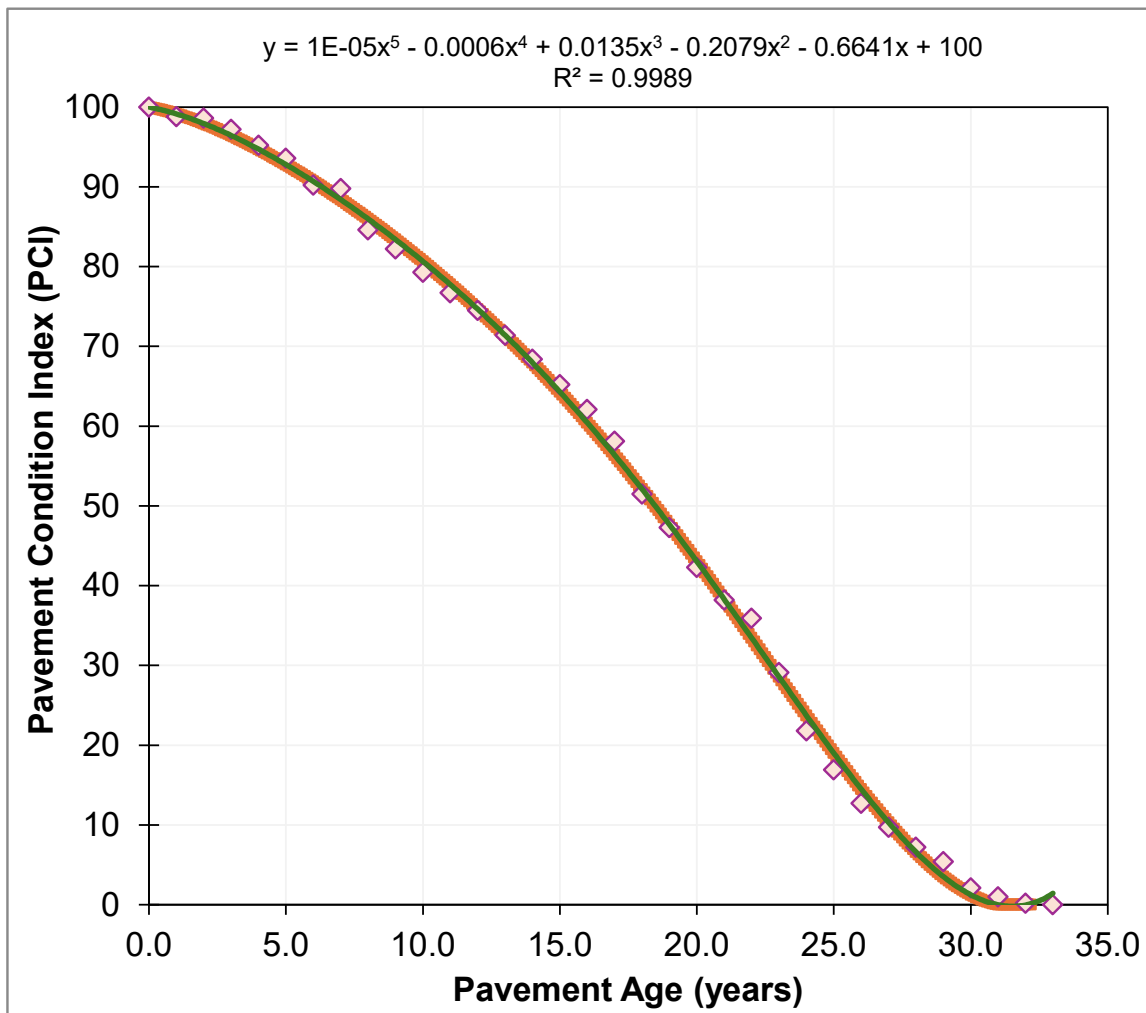


Figure 24: Pavement Performance Model

## 5. Maintenance and Rehabilitation Budget Analysis

The objectives of a pavement Maintenance and Rehabilitation (M&R) budget analysis are to maintain satisfactory overall pavement conditions and to progressively reduce the Major M&R backlog. Achieving these objectives will ultimately ensure that all pavements within the City are maintained in good condition, thereby enabling their management in a cost-effective manner through preventive maintenance and infrequent, less costly rehabilitation projects. By integrating recommendations and data from pavement conditions into its decision-making processes, the City will be better positioned to optimize and prioritize the allocation of its existing M&R funds. Additionally, this approach will enhance the City's ability to substantiate both immediate and long-term funding requirements for roadway pavement M&R.

To select the M&R treatment effectively, ARA developed an interactive spreadsheet which can be used to see the effect of a treatment of both budget and pavement condition. The following 10-year M&R budget analyses were performed on the City's roadway pavements.

- Effect of performing no maintenance (Do Nothing)
- Effect of unlimited funding
- Effect of the current annual budget (\$1.5 M/Year)
- Effect of reduced annual budget (\$1 M/Year)
- Effect of increased annual budget (\$2.5 M/Year & \$3.5 M/Year)
- Annual budget needed for maintaining current condition

The following sections summarize the assumptions underlying the analyses performed and then present the findings of the analyses.

### 5.1. Assumptions

#### 5.1.1. M&R Budget

The analysis assumed \$1.5 M / Year for maintenance and rehabilitation budget for FY26-FY35. It was assumed that the budget level would not change for the 10-year analysis period.

#### 5.1.2. Inflation rate

ARA assumed the inflation rate of 3.0% for this project. Any change in inflation rate will have an impact on the recommended plan by ARA. After 10 years, this results in only 77% of the spending power in year 1 per dollar. This equates to a 23% reduction in the amount of work that can be done.

#### 5.1.3. Treatment Techniques

ARA considered the following maintenance and rehabilitation techniques for this analysis:

- I. Crack Sealing: Crack Sealing is designed to prevent water infiltration and extend pavement life by filling cracks with flexible sealants such as asphalt-based or polymer-modified products. The process involves cleaning the cracks, applying the sealant, and smoothing it to ensure proper adhesion. This technique effectively reduces maintenance costs and prevents further pavement damage. It is applicable to pavements with a PCI

ranging from 80 to  $\leq 95$ . These are often planned outside of the pavement management plan for major work such as chip seal or mill & overlay. This treatment can be applied at any PCI level to prevent further deterioration if funding is not available for major rehabilitation.

- II. **Seal Coat:** Seal Coat serves to protect and extend the life of asphalt pavements by sealing and rejuvenating the surface. This technique involves mixing aggregates with liquid at a plant, which is then spread and compacted on the road surface to create a smooth finish. Seal coating provides a protective layer against UV rays, water, and traffic wear, thereby improving the pavement's appearance and reducing maintenance costs. It is applicable to pavements with a PCI ranging from 70 to  $\leq 80$ .
- III. **Chip Sealing:** This involves applying a protective layer of liquid asphalt followed by aggregate (crushed stone or chips) to the pavement. After the chip sealing, a fog seal is applied to smooth the rough surface and reduce noise. This provides a cost-effective maintenance solution. Chip sealing is suitable for pavements with a PCI ranging from 70 to  $\leq 80$ .
- IV. **Slurry Seal:** Slurry Seal comprises a blend of polymer-modified asphalt emulsion, finely graded high-quality aggregate, mineral filler, water, and additional additives. This mixture is carefully proportioned, combined, and applied onto a paved surface. Its purpose is to address minor cracks, seal sections of aged pavements, reinstate a consistent surface texture, safeguard against moisture and air infiltration, and enhance skid resistance. It is applicable to pavements with a PCI ranging from 70 to  $\leq 80$ . Slurry, Chip and Seal Coat can be selected as an alternative to each other based on distress severity, application feasibility and budget.
- V. **Mill & Overlay:** Mill & Overlay involves resurfacing the pavement by removing the existing layer, typically 1 to 3 inches deep, with a milling machine to create a rough surface for better adhesion. A new layer of asphalt is then laid and compacted over the prepared surface to restore pavement structure and smoothness. This technique enhances pavement appearance, improves surface quality, and extends the life of the road. Mill & overlay is suitable for pavements with a PCI ranging from 40 to  $\leq 70$ , with potential application at lower PCI values depending on the type and severity of pavement distress.
- VI. **Full Depth Reclamation (FDR):** Reclamation refers to a process where the existing pavement materials, including asphalt and underlying layers, are pulverized and mixed to form a new base for the pavement structure. This process is often used in road construction and rehabilitation projects as a sustainable and cost-effective method to recycle existing materials and improve the overall pavement performance. Suitable application range is from 30 to  $\leq 40$ . This technique can be utilized to lower PCI ranges as it reduces the material hauling cost.

### 5.1.3.1. Cost by Treatment Type

For this budget analysis ARA assumed the treatment unit cost based on combining input from recently completed projects, TxDOT material specification, input from the City. The assumed unit cost is presented in Table 7.

**Table 7: Assumed Treatment Unit Cost**

General PCI Application Range		Treatment Type	Cost (\$/SY)	PCI After Treatment	Treatment Life (Years)
From	To				
0	≤ 30	Reconstruction*	\$ 54.64	100	15
30	≤ 40	FDR	\$ 50.62	100	12
40	≤ 70	Mill & Overlay	\$ 27.25	100	8
70	≤ 80	Slurry/ Chip/ Seal Coat	\$ 6.36	90	5
80	≤ 95	Crack Seal	\$ 1.23	+8	3
Any Range		Patching	\$ 36.00	No Impact	-

\*Reconstruction with subgrade stabilization may require additional cost ~ \$60 per SY

### 5.1.4. Maintenance Policies

ARA initially determined the appropriate treatments for individual pavement sections using a decision matrix that is based on general Pavement Condition Index (PCI) ranges within the constraints of the city budget. Following this initial selection, ARA further refined the choice of treatments by considering the specific type and severity of pavement distress observed.

In some cases, a pavement section may exhibit isolated areas of high-severity distress, which can result in a lower overall PCI score. To address this issue, the city may opt for a more tailored approach: first, conducting spot repairs on the severely distressed portions of the pavement. Subsequently, lighter treatments, such as those suited for higher PCI ranges, can be applied to the remaining areas. This method ensures that the budget is utilized both effectively and economically, addressing critical distress points while optimizing the overall expenditure on pavement maintenance and repair. This approach not only enhances the longevity and performance of the pavement but also ensures that financial resources are allocated in a manner that maximizes their impact.

### 5.2. 10- Year Work Plan

The results of the budget analyses are shown in the following figures. Figure 25 illustrates the estimated 10-year change in pavement conditions resulting from the budget scenarios analyzed. This shows the impact of the current funding on the PCI score as well as the “Do Nothing” scenario, in which no repairs are considered, and the network continues to deteriorate. The impact of not maintaining the roadways results in approximately a 12-point PCI difference. Preventive maintenance such as Crack Sealing and major rehabilitation projects such as capital Reconstruction will help improve the overall network PCI. On the first year’s analysis only preventive measures were considered due to budget being already allocated to certain projects in FY 2026.

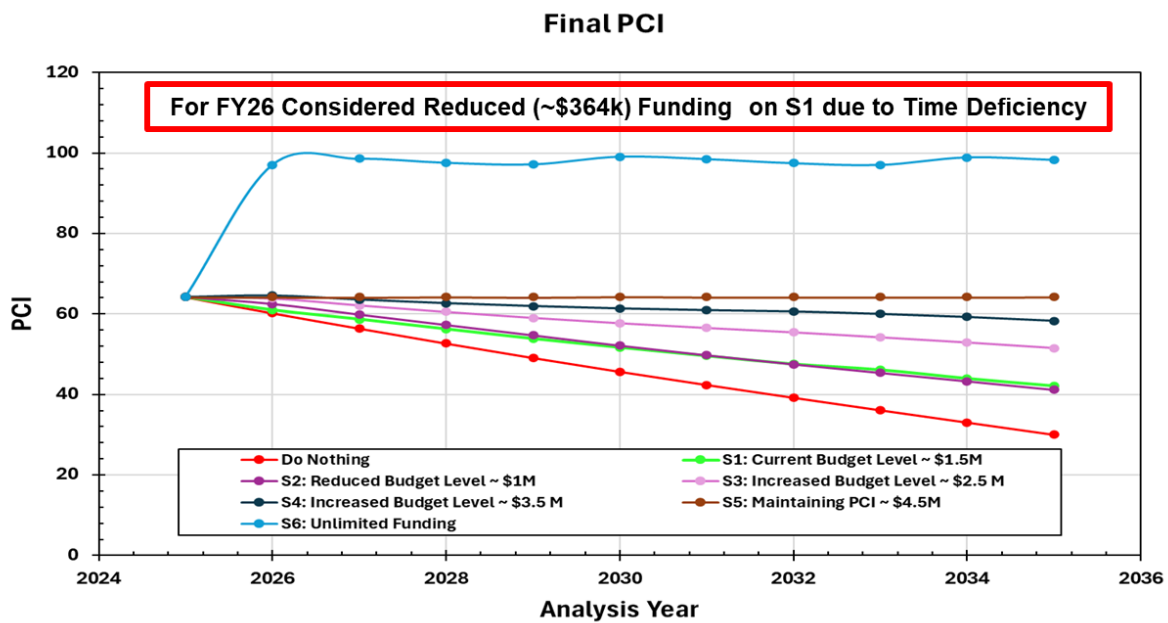


Figure 25: Overall Roadway Pavement Conditions Change over Time at Different Budget Level

#### 5.2.1. Do Nothing Scenario

Do-nothing scenario is an unrealistic scenario where no streets got any type of treatment in the next 10 years. The scenario provides a quantitative measure of how the city road would be if any measures are not taken into consideration. As per the analysis the city over all PCI would be 30.04 at the end of FY 2035. The change in condition is given in Table 8 & Figure 26.

Table 8: Do Nothing Scenario - PCI Change over Time

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Do Nothing	64.18	60.18	56.38	52.67	49.10	45.68	42.40	39.23	36.13	33.08	30.04

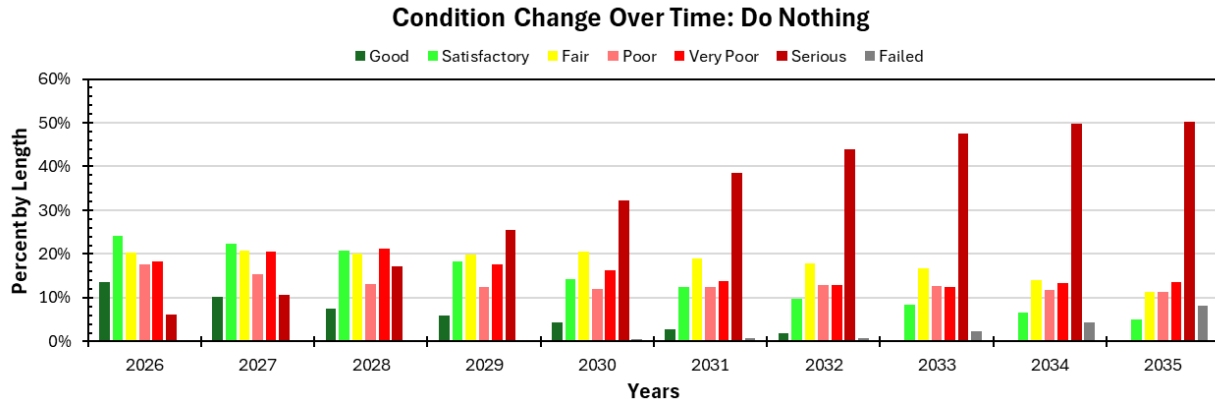


Figure 26: Do Nothing Scenario – Change in Pavement Condition over Time

### 5.2.2. Effect of Different Funding Level

#### 5.2.2.1. Current Funding

This scenario (S-1) estimates the condition changes over time while utilizing the city’s current funding (\$ 1.5M per year). The output from the S-1 is shown in Figure 27 & Table 9. As per the analysis, the network overall PCI will drop to 42.11 which implies the need for additional funding for the improvement of the network. Figure 28 presents the PCI map of the city after every treatment at the end of FY 2035.

Table 9: Current Funding Scenario - PCI Change over Time

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
S-1: \$1.5 M Per Year	64.18	60.97	58.66	56.24	53.85	51.66	49.56	47.53	46.11	43.96	42.11

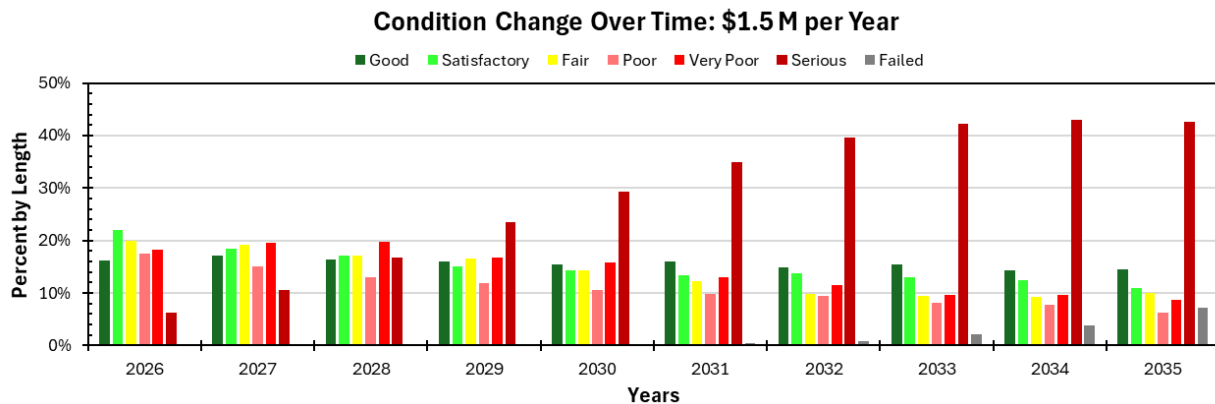


Figure 27: Current Funding Scenario – Change in Pavement Condition over Time

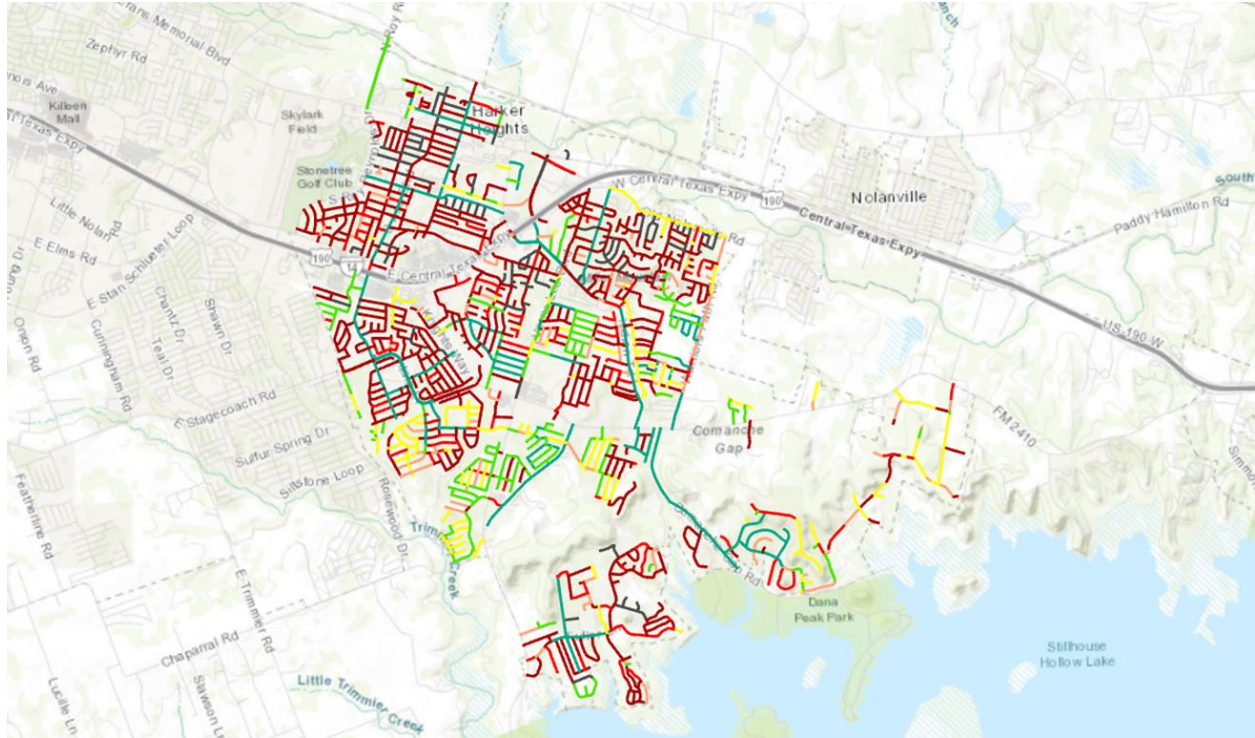


Figure 28: City of Harker Heights PCI Map (2035)

5.2.2.2. Decreased Funding

This scenario assumes that the city receives decreased funding of \$1M per year after FY 2025 for road maintenance. The resulting PCI scores are shown below:

Table 10: Decreased Funding Scenario - PCI Change over Time

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
S-2: \$1 M Per Year	64.18	62.50	59.86	57.28	54.70	52.13	49.75	47.50	45.37	43.28	41.16

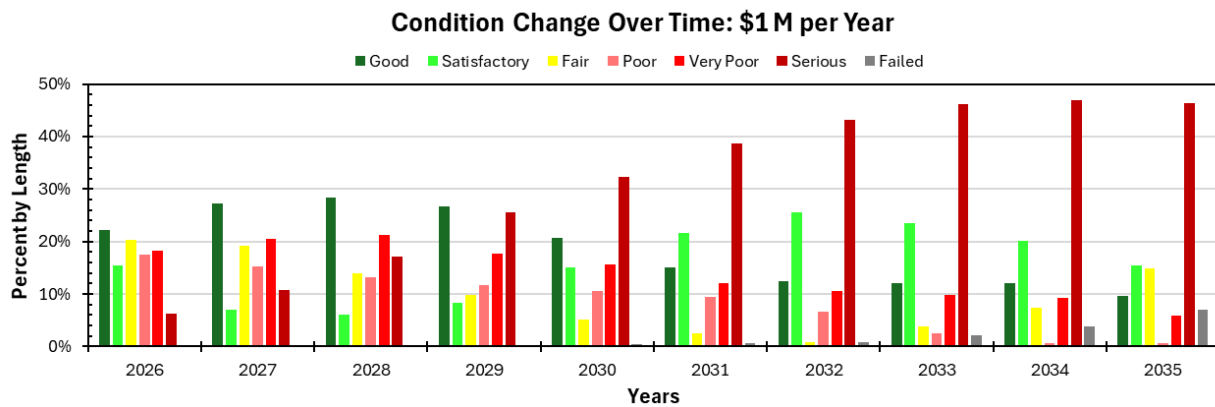


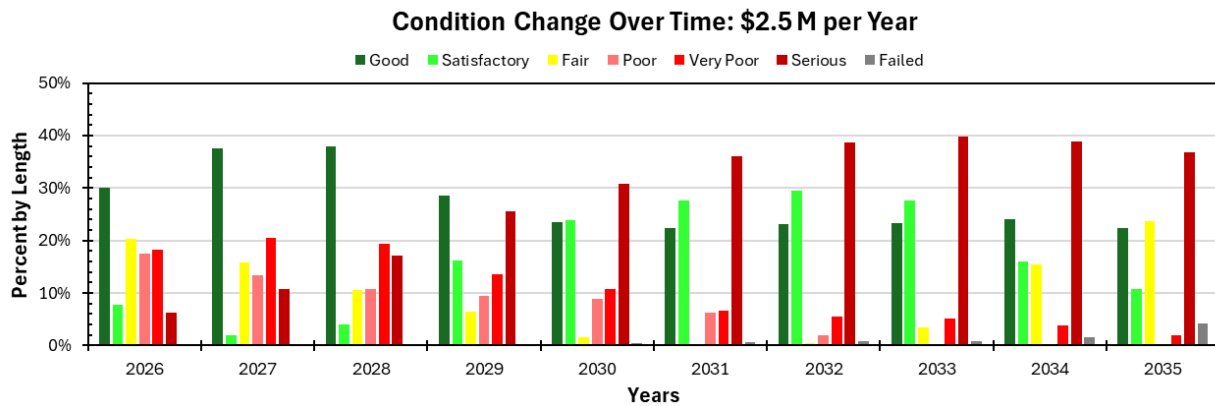
Figure 29: Decreased Funding Scenario - PCI Change over Time

5.2.2.3. Increased Funding

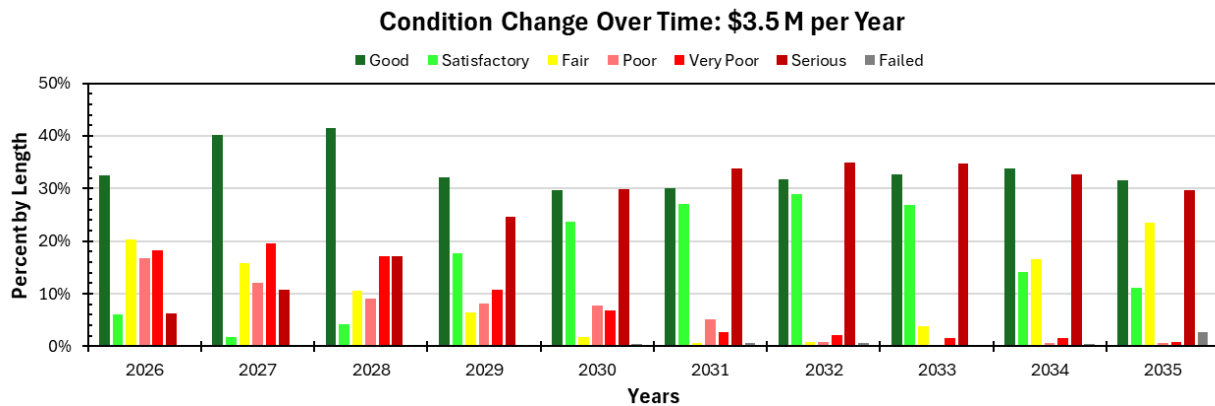
This scenario assumes that the city receives increased funding of S-3: \$2.5M per year and S-4: \$3.5M per year after FY 2025 for road maintenance. The resulting PCI scores are shown below:

**Table 11: Increased Funding Scenario - PCI Change over Time**

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
S-3: \$2.5 M Per Year	64.18	63.85	62.15	60.52	59.03	57.71	56.52	55.44	54.20	52.91	51.53
S-4: \$3.5 M Per Year	64.18	64.55	63.56	62.66	61.95	61.36	60.95	60.62	60.01	59.26	58.32



(a)



(b)

**Figure 30: Increased Funding Scenario - PCI Change over Time**

5.2.2.4. Unlimited Funding

Unlimited funding scenario means that the city has unlimited budget to fix every street within the city limit. This scenario is unrealistic, but it portrays a picture about the funding level the city needs to work on every street in today’s dollar amount. For Harker Heights, this turns out to be \$ 70M in FY 2026. But if the treatment work is delayed the cost will increase exponentially, resulting in \$91M in FY 2035. This scenario considers fixing every street in FY 2026 and necessary

light preventive maintenance each year. This bumps the score to 97 in 2026. The change in condition is presented Table 12.

**Table 12: Unlimited Funding Scenario - PCI Change over Time**

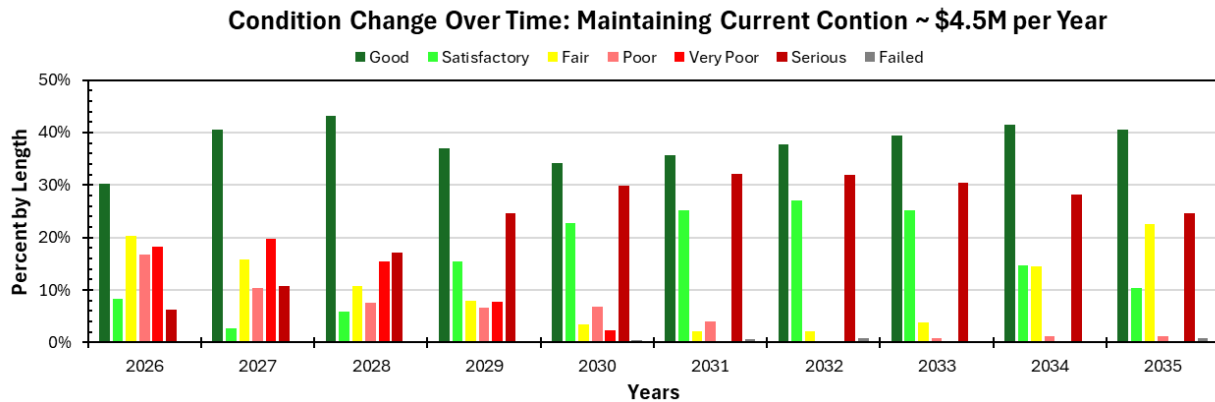
Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Unlimited Funding each year	64.18	97.00	98.55	97.55	97.15	99.06	98.46	97.45	97.01	98.89	98.27

### 5.2.3. Maintaining Current Pavement Condition

Pavements naturally deteriorate over time, and maintaining their current condition requires applying treatments that offset annual declines in performance. When a network is already in good condition, this objective can typically be achieved through preventive maintenance strategies which are relatively low in cost. However, once the network drops into the fair or poor condition categories, restoring or even maintaining performance becomes substantially more difficult and significantly more expensive. This analysis also provides insight into the funding levels necessary to preserve network conditions over time. Based on the results, the city of Harker Heights requires approximately \$4.5 million per year within its pavement management program to maintain its current condition. The change in condition is presented in Figure 31 & Table 13.

**Table 13: Maintaining Current Condition - PCI Change over Time**

Year	2025	2026	2027	2028	2029	2030	2031	2032	2033	2034	2035
Maintaining Current Condition ~ \$4.5M per year	64.18	64.18	64.18	64.19	64.18	64.19	64.18	64.18	64.19	64.18	64.19



**Figure 31: Maintaining Current Condition – Change in Pavement Condition over Time**

#### 5.2.4. Detailed Work Plan

Pavement sections are selected based on their current Pavement Condition Index (PCI) scores, the presence or absence of load-related distresses, maintenance policies, repair and construction types, as well as budget constraints. To develop long-term, practical work plans, agencies must also consider additional factors such as forthcoming utility work, capital improvement projects, and strategically important locations. The recommended treatment matrix should serve as a guide for network-level planning; however, actual treatment selection must be based on field conditions, practical considerations, specific distress locations and types, traffic levels, and other relevant factors.

The full recommended treatment plan (10 years) is presented on year-by-year in maps from Figure 32 to Figure 41.

2025 Pavement Management Report – City of Harker Heights  
 Maintenance and Rehabilitation Budget Analysis

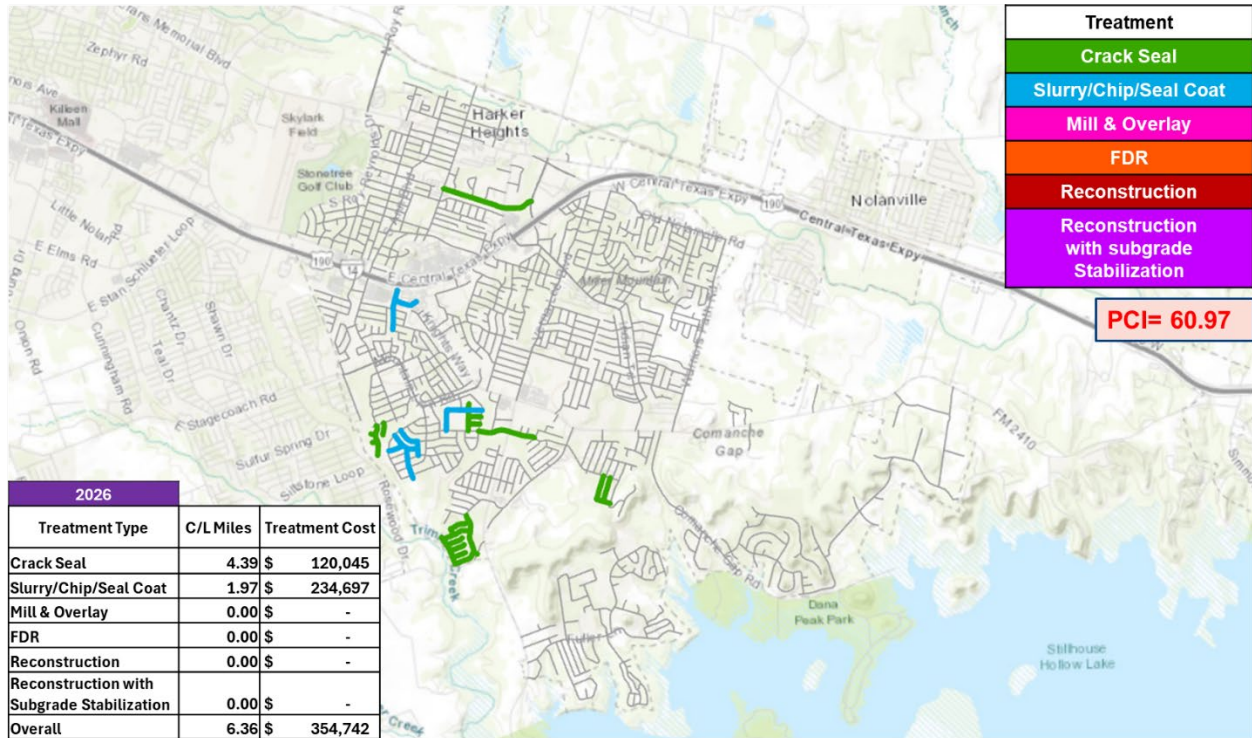


Figure 32: FY 26 Pavement Maintenance Plan

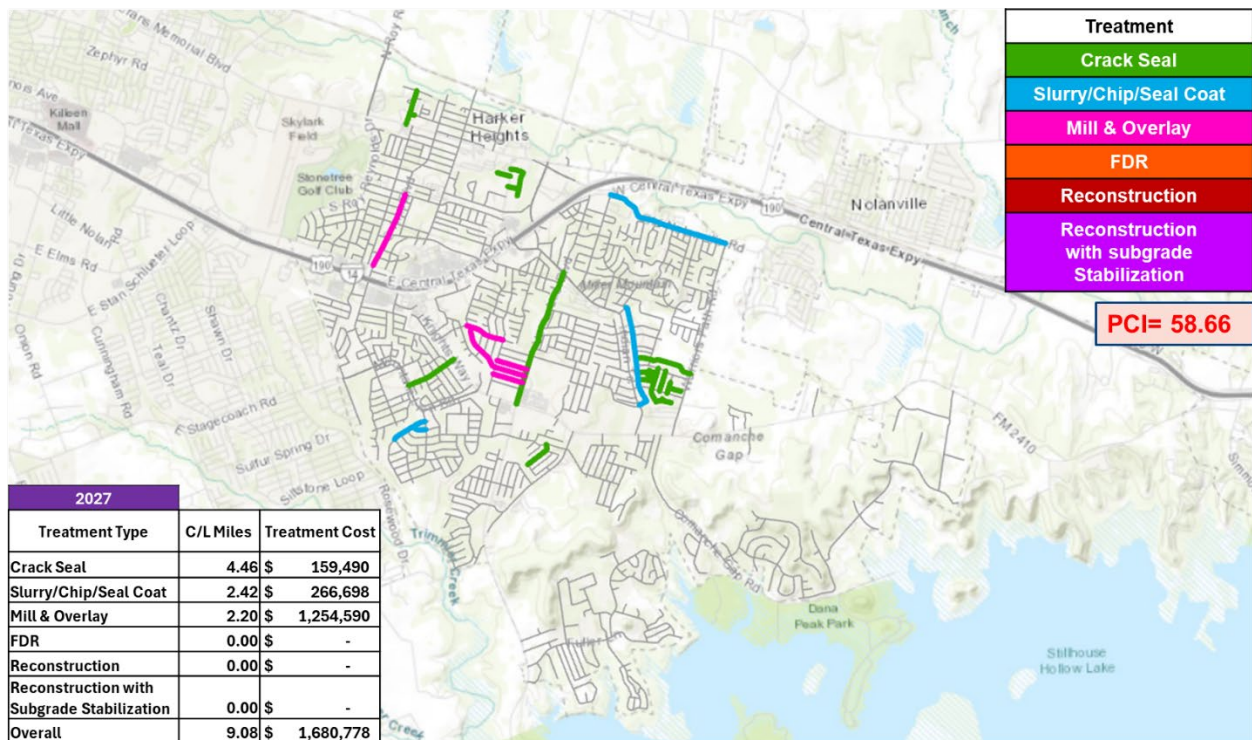


Figure 33: FY 27 Pavement Maintenance Plan

2025 Pavement Management Report – City of Harker Heights  
 Maintenance and Rehabilitation Budget Analysis

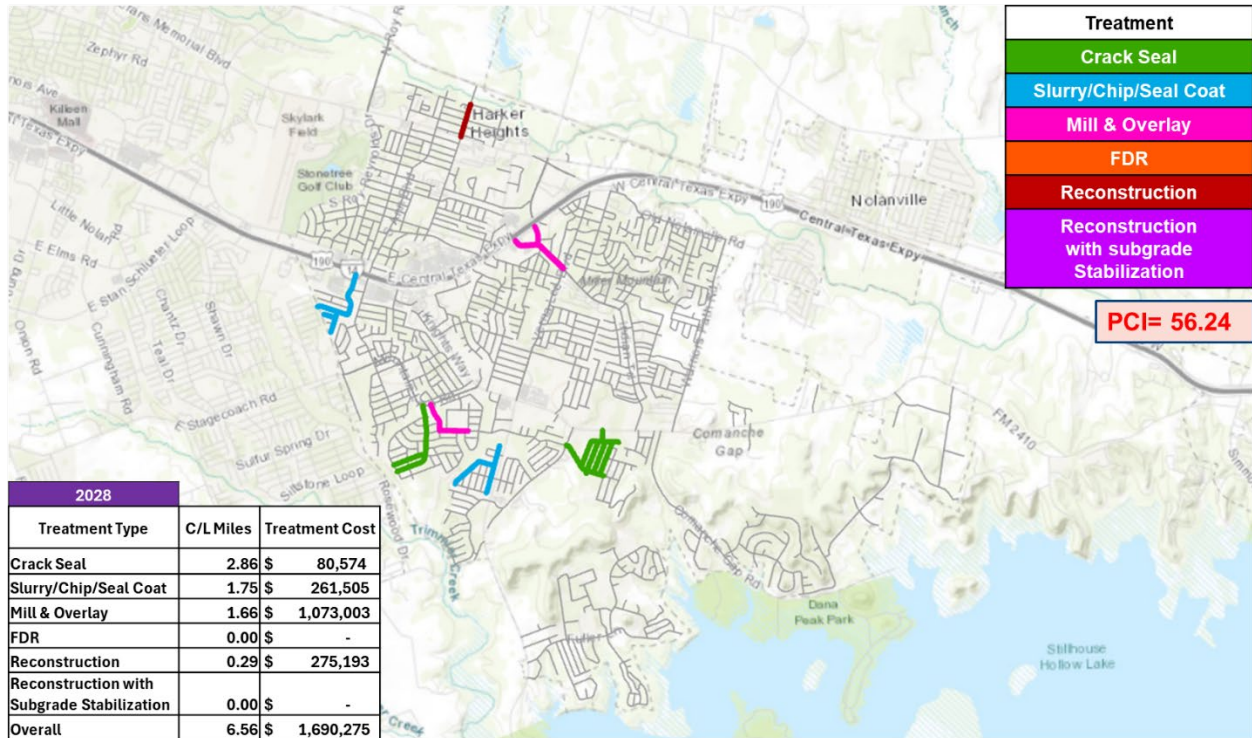


Figure 34: FY 28 Pavement Maintenance Plan

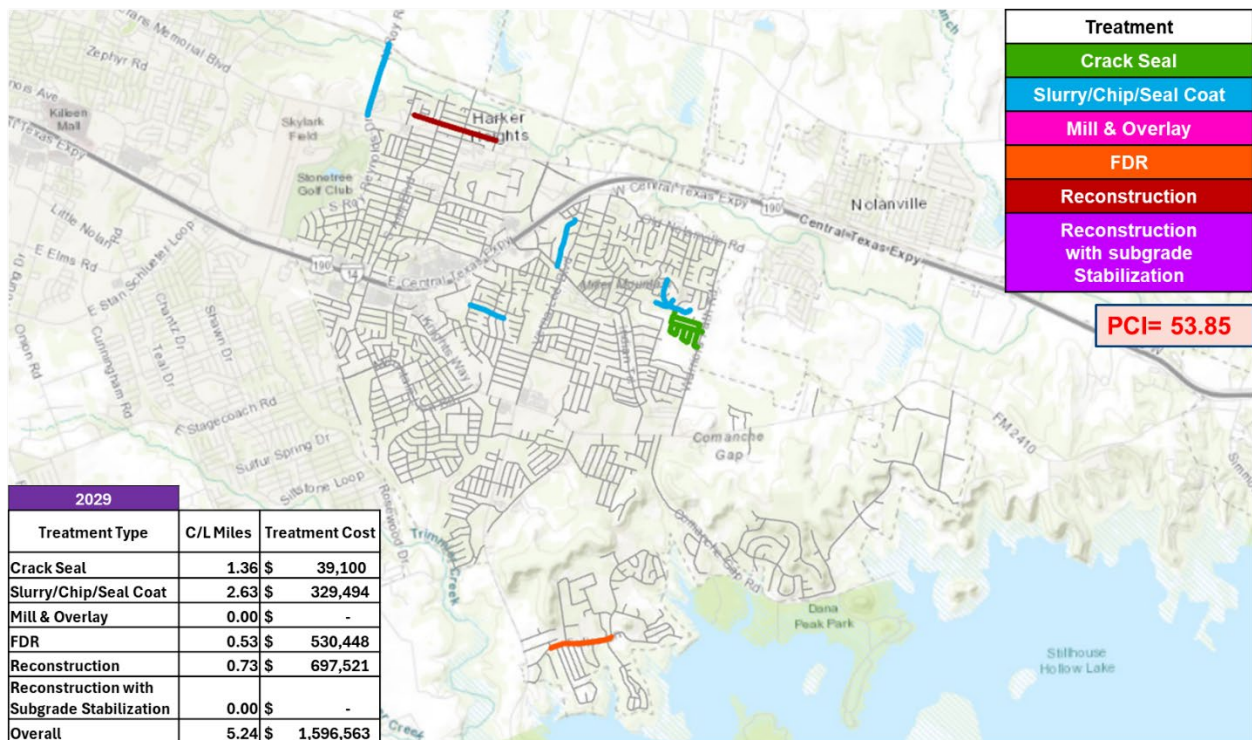


Figure 35: FY 29 Pavement Maintenance Plan

2025 Pavement Management Report – City of Harker Heights  
 Maintenance and Rehabilitation Budget Analysis

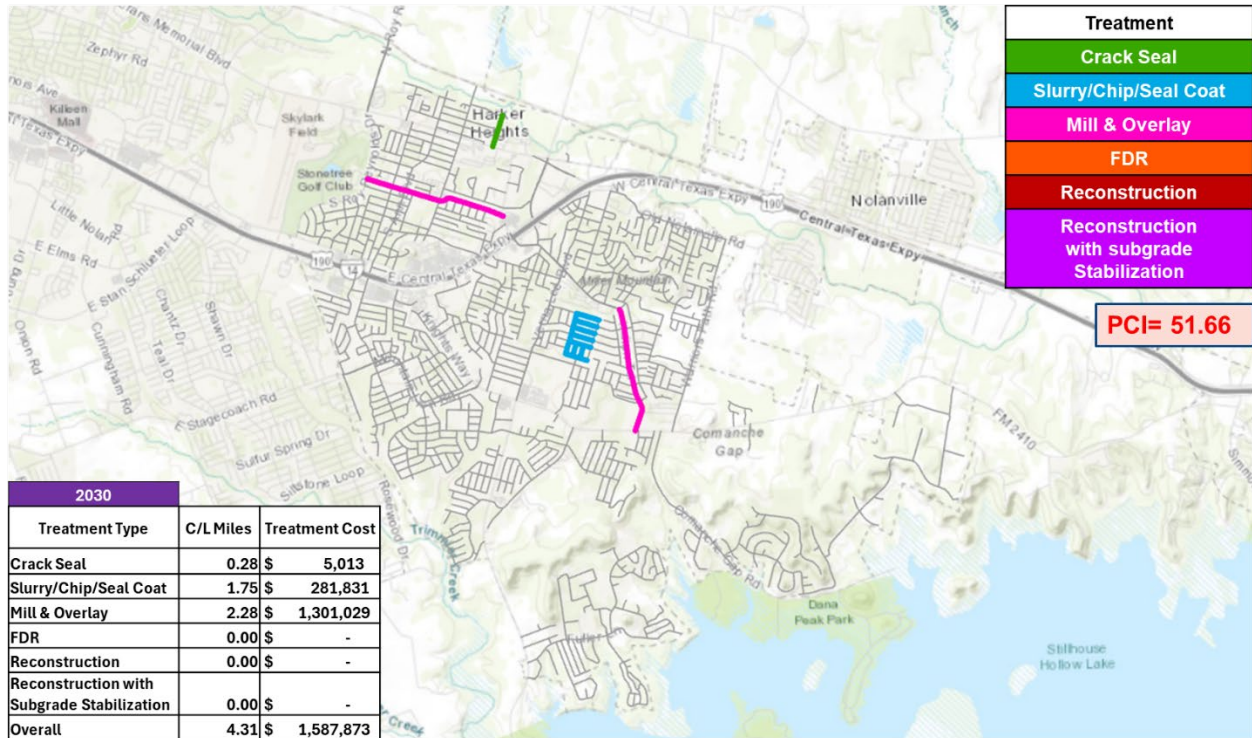


Figure 36: FY 30 Pavement Maintenance Plan

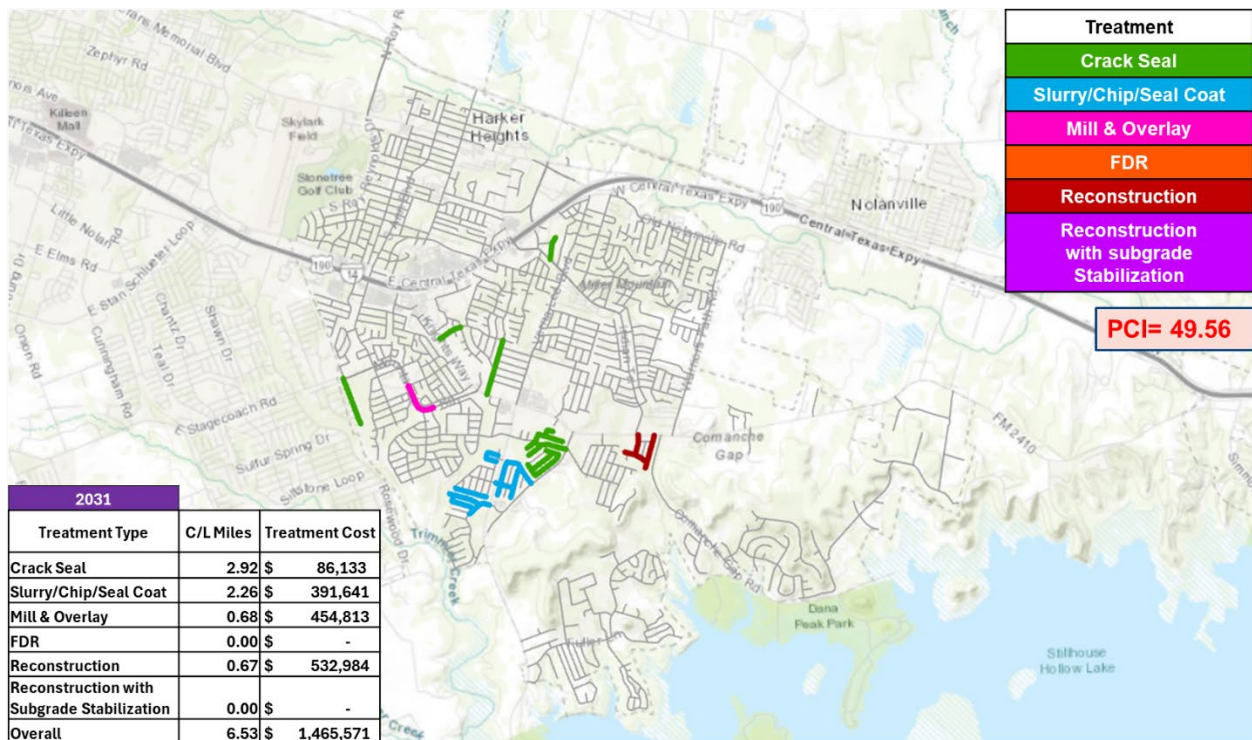


Figure 37: FY 31 Pavement Maintenance Plan

2025 Pavement Management Report – City of Harker Heights  
 Maintenance and Rehabilitation Budget Analysis

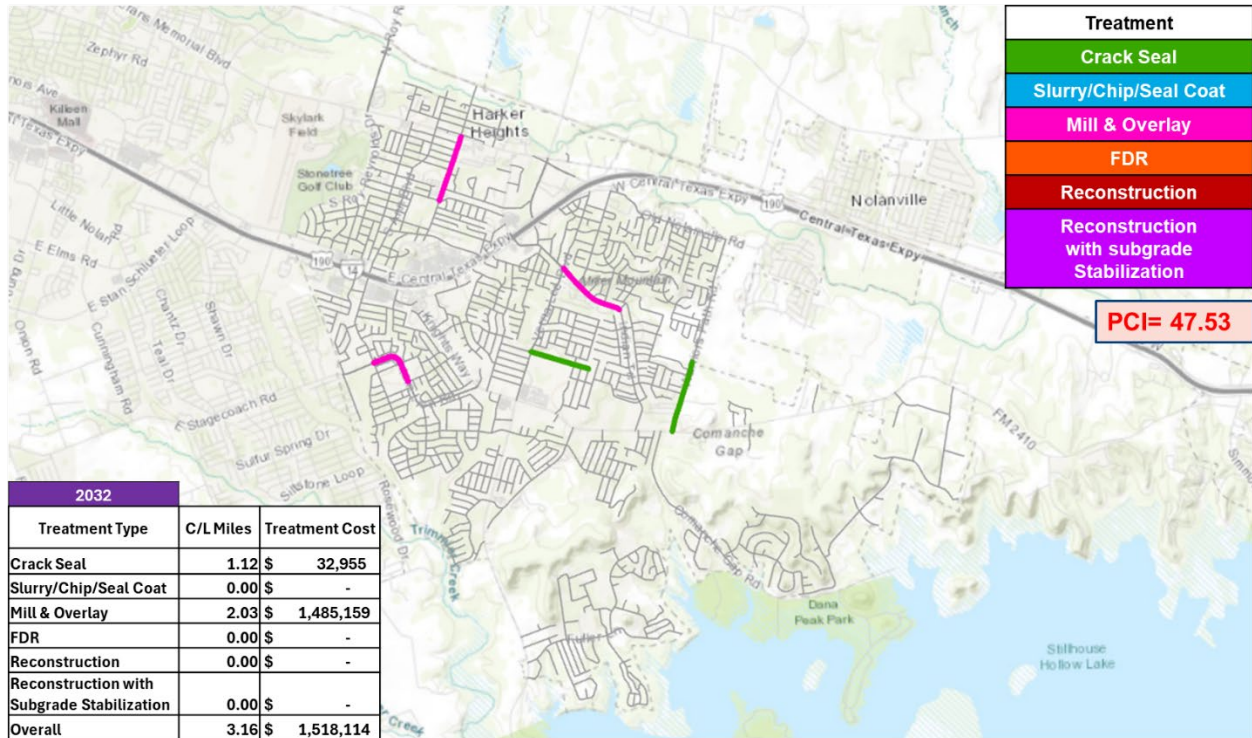


Figure 38: FY 32 Pavement Maintenance Plan

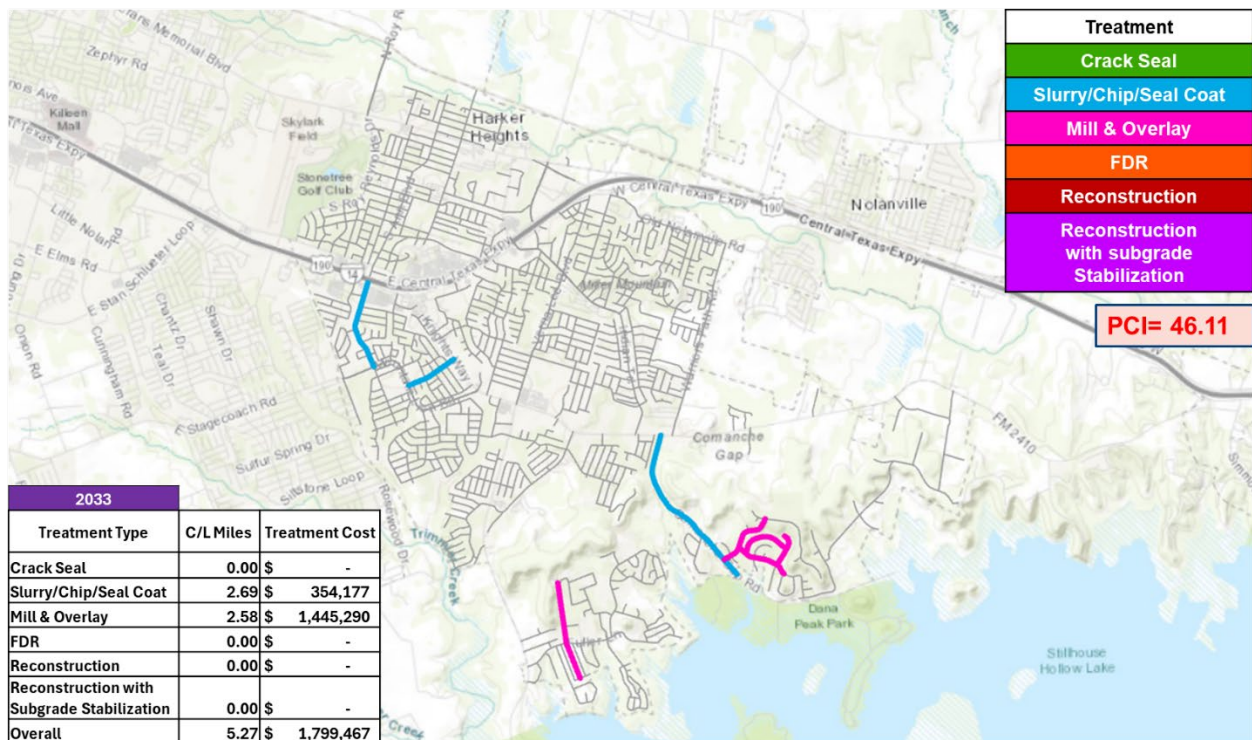


Figure 39: FY 33 Pavement Maintenance Plan

2025 Pavement Management Report – City of Harker Heights  
 Maintenance and Rehabilitation Budget Analysis

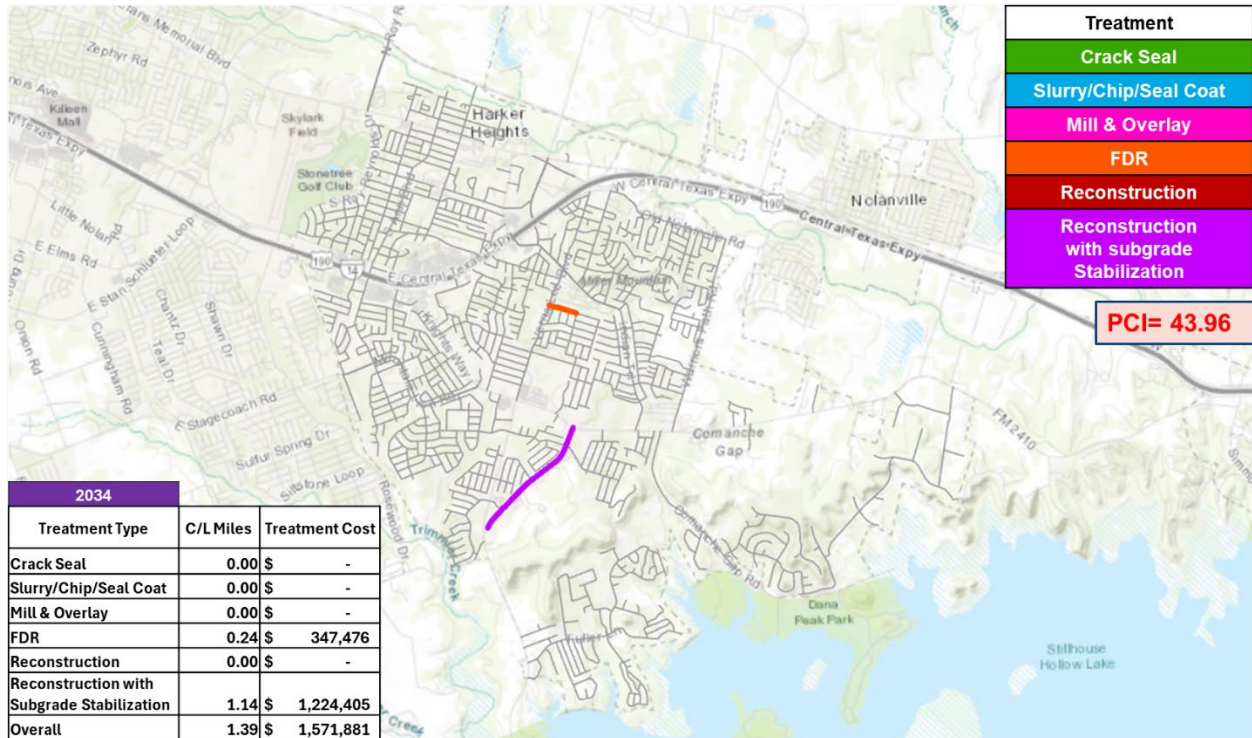


Figure 40: FY 34 Pavement Maintenance Plan

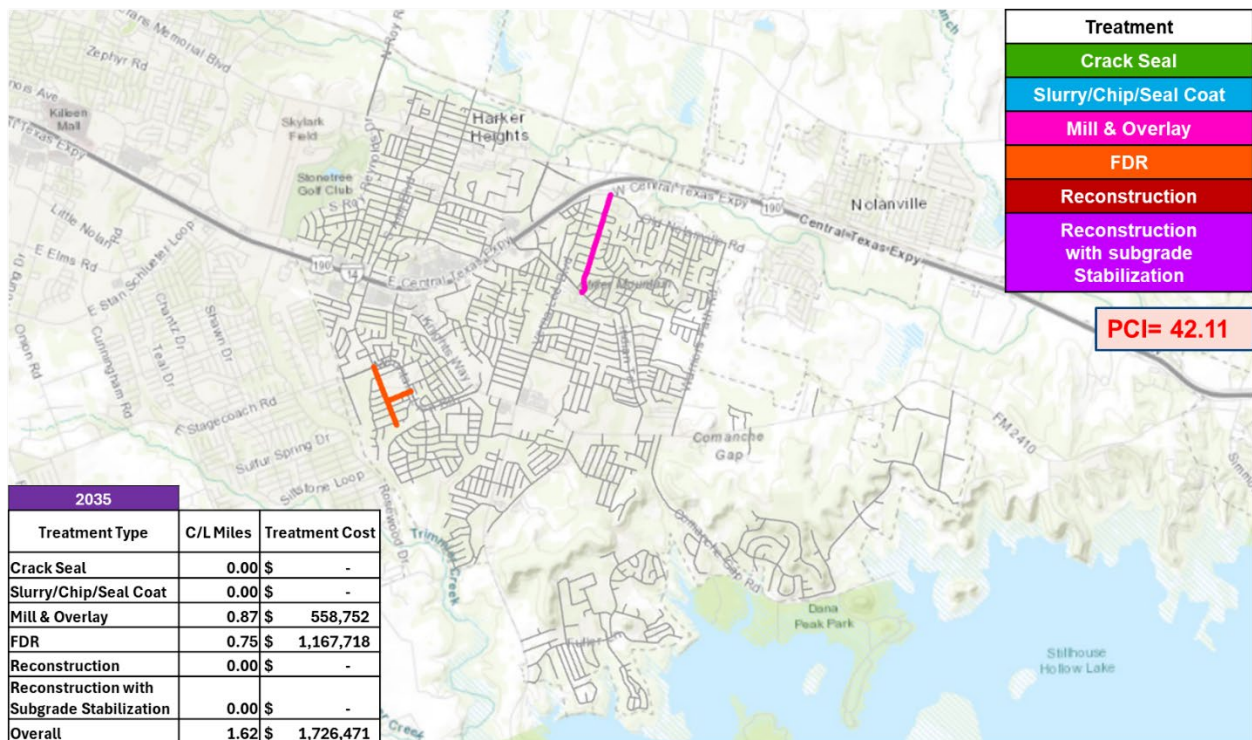


Figure 41: FY 35 Pavement Maintenance Plan

## 6. Summary and Recommendations

### 6.1. Summary

The objectives of this project were to: (1) perform an automated pavement condition survey on the city-maintained roads, (2) Perform distress rating according to ASTM D6433 and calculate the PCI, (3) Perform pavement management analysis to estimate the future maintenance and rehabilitation (M&R) requirements of City of Harker Heights’s pavements for 10 years, (4) Providing color coded map based on analyzed PCI scores, (5) Providing color coded map based on analyzed treatment activity of each year, (6) Preparing an Excel file summarizing PCI scores for every road section, (7) Provide street report that summarizes the pavement survey findings and pavement management analysis report.

1. The data collection scope of the project included approximately 157.9 lane miles (paved and unpaved) of which 157.3 lane miles of paved roads were accessible for the survey, that is, not blocked, restricted, or under construction.
2. The following observations were made regarding the pavement condition data:
  - a. In 2025, the average PCI of pavement network is 64.18 at time of inspection.
  - b. At the time of ARA’s December 2024 inspection, 44% of roadways are in Good to Satisfactory condition (70-100), 41% in Fair to Poor (40-70), and the remaining 15% in Very Poor or worse condition.
  - c. Cracking was found to be the dominant distress type during the survey.
3. With the current projected budget levels (\$1.5M per year), the estimated network will continue to deteriorate, resulting in a PCI of 42.11 by the end of 2035.

### 6.2. Recommendations

1. Regular Inspections: Conduct PCI surveys every two to three years to track deterioration, predict future conditions and assess maintenance effectiveness.
2. Keep Track of Work History: Keep rehabilitation work records current to improve predictions of pavement deterioration trends.
3. Expand Preventive Maintenance: Explore global preventive techniques (e.g., slurry seal) and increase the preservation budget to extend service lives of satisfactory roads.
4. Enhanced M&R Strategies: Focus on localized repairs and prioritize maintenance for heavily traveled roads while considering pavement strength through non-destructive testing.
5. Funding for Reconstruction: Future Capital Reconstruction projects are not included at this budget level. Alternative funding sources should be considered for major reconstruction projects. A Priority reconstruction list will be attached in a separate spreadsheet.

### 6.3. Electronic Files Accompanying this Report

The following electronic files are provided separately with this report.

**Table 14: Electronic Files Accompanying This Report**

File Name	File Type	Description
Harker Heights Pavement Maintenance Plans_10Yrs.xlsx	Excel	Spreadsheet with 2025 PCI scores and all 10yrs of recommended work plan
Harker Heights_Pavement Maintenance Plans_10Yr.kmz	kmz	Google earth file shows the color-coded map of 10 yrs project location
Reconstruction Priority List.xlsx	Excel	Reconstruction priority list for 10 yrs when external funding is available (Capital Projects)

## 7. Closing

All preceding analyses were based on the results obtained in the field, as well as other input and analysis assumptions as outlined herein. ARA has made every attempt to base their procedures on sound methodology. This report should not be used for purposes outside of its intended use.

Please use the above data and information, therefore, as guidelines for this project analyzed and reported herein.

Sincerely,

**Applied Research Associates, Inc.**  
**TBPE Firm Registration No. F-4631**



Robert R. Williams, P.E., APMP  
Principal Engineer



Ratul Mondal, E.I.T.  
Staff Civil Engineer