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October 13, 2023

2023 PAVEMENT MANAGEMENT REPORT

Rollingwood, TX

PREPARED FOR: CITY OF ROLLINGWOOD

403 NIXON DRIVE

ROLLINGWOOD, TX 78746

WSB PROJECT NUMBER: 023272-000

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I. Executive Summary

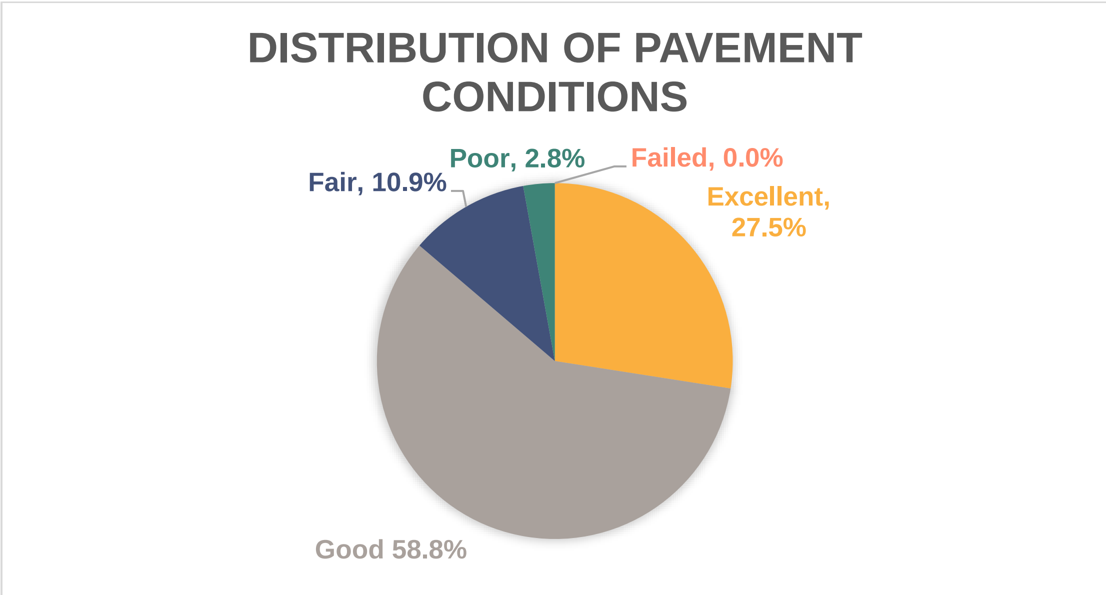
This report summarizes the findings of the pavement inspection of the road segments in Rollingwood performed by WSB and completed in August 2023. The report gives an overview of the condition of roads in the City but is not intended to be a final document on public policy or city planning and is subjected to change upon review by City Council. Additionally, pavement analysis was performed using the PAVER program to project the future condition of the City's pavement and make maintenance recommendations. Several scenarios were tested to determine the best maintenance strategy. These recommendations and the budgets needed to achieve them are included as part of the provided 5-year Capital Improvements Program (CIP). Gravel roads and segments the City did not want included in the analysis are not covered in this document.

A summary of the pavement condition report is listed below:

- 10.4 miles of City road were evaluated in Rollingwood.
- The current weighted average Pavement Condition Index (PCI) for bituminous roads in Rollingwood is 84.4. PCI is based on a 0 to 100 scale, with higher PCI values corresponding to better road conditions. This weighted average is calculated from the PCI values generated on each segment of roadway. A road's PCI is based on the quantity and severity of pavement distresses identified in the field. Any type of road maintenance (i.e. patching or crack sealing) done prior to inspections is accounted for in the PCI value.

Each segment of bituminous roadway was sorted into one of five broad categories based on their PCI value. Figure I.1. shows the percentage of bituminous roadways in each condition category in terms of surface area.

Figure I.1. Percent of System in Each Pavement Condition Category.



Most roadways qualified for the Excellent or Good categories. Additionally, 0% of the City's roads are in Failed condition. The analysis included aims to protect the investment already made in the network's better sections by establishing maintenance standards and prioritizing maintenance treatments. It also seeks to recommend the most cost-effective ways to improve the segments that need major repairs.

Three different scenarios were tested to show potential impacts to the CIP. Each version of the model examined different budgets or goals that could possibly be implemented over the next five years. A summary of the results is displayed in Table I.1.

Table I.1. 5-Year CIP Scenario Comparison

Scenario	Total 5-Year Budget	2028 Average PCI
1: No Maintenance	$0	72.8
2: Increase Every Segment PCI > 75	$2,575,000	83.0
3: Maintain Average PCI Over 84.4	$1,254,000	84.7

An annual budget of approximately $275,000 to $300,000 appears necessary to keep Rollingwood's pavement in the current condition its residents are accustomed to over the next 5 years.

II. Introduction

A pavement management program includes a systematic method of conducting a detailed distress survey to evaluate the condition of roads in a network, followed by performing a cost-effective analysis of various maintenance and rehabilitation strategies. This assists decision makers in making the best decision on the use of available resources. The pavement management ideology, if successfully implemented, can result in improvement of the life cycle costs, performance, and service life of roads. The main objectives of a pavement management program are to maintain a high-level network, evaluate the effectiveness of different alternatives, and optimize timing of maintenance and rehabilitation activities. These objectives can be met by routinely conducting inspections and determining the condition of a system of roads. The data is typically managed within a pavement management software which can manage, sort, and store the collected information. Through this software, various models can be generated that allow the user to customize maintenance protocols, run different budget scenarios, and evaluate the outcomes of each scenario.

By conducting a pavement management analysis, the City is showing their willingness to continue looking for ways to improve their network of roads and extend the life of their pavement. On top of that, the benefits of a pavement management program extend beyond helping a City improve the average condition of its pavement. Better pavement results in less wear and damage to vehicles that travel the roads. Extending the life of a road reduces the frequency of major reconstruction projects that require lengthy detours and delays to travelers. Safety is improved by giving drivers a surface that allows them to stop quickly and predictably. Achieving the maximum service life of a road is also more sustainable for the environment by reducing the amount of material and fuel that is needed when pavement needs to be completely replaced.

Overall, a pavement management plan should improve the safety for a road network's users and the sustainability of its pavement maintenance while minimizing the costs to taxpayers. This document is designed to act as a guide to help the City manage its pavement. However, it is not the only source of information decision makers should use. It is important to also consult with maintenance staff and review other factors that cannot be accurately included in a model. Circumstances unique to a specific City are hard to capture in a scientific analysis and may take precedent over the recommendations provided.

III. Pavement Condition Report Update

Pavement Lifecycle

Pavement is constructed to meet the demands of traffic and the environment for a certain design period. The Pavement Condition Index (PCI) of the roadway declines as traffic and time slowly take their toll on newly constructed pavement. Figure III.1. shows the typical life expectancy of pavement based on data obtained from the Army Corps of Engineers.

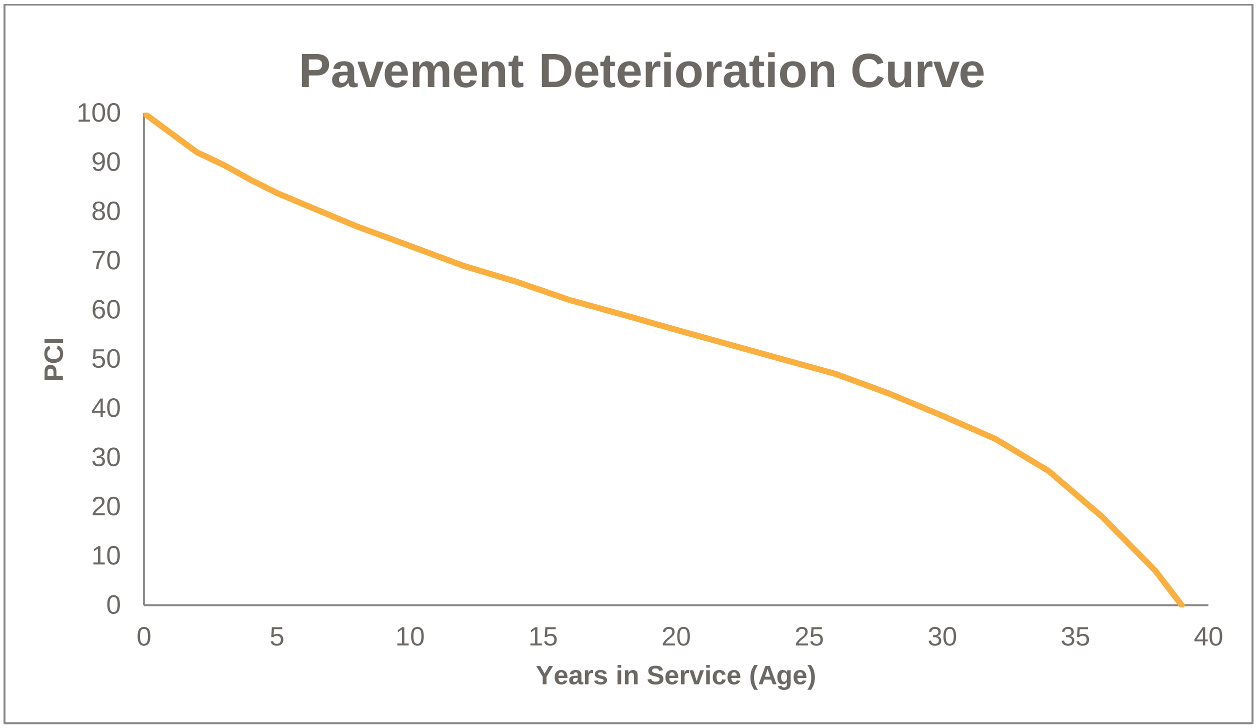


Figure III.1. Typical Pavement Deterioration Curve

This curve exhibits standard behavior when no maintenance is implemented. Each repair or preservation technique applied increases the PCI of a segment and increases its expected life by delaying degradation. The PCI values used in this report are based on a surface inspection of the City's streets. Surface inspections provide a good indication of the pavement and what riders experience when driving the road. However, they do not capture the sub-surface of a pavement structure. Pavement forensics such as pavement coring are required to analyze the entire depth of the road. Some repairs such as patching often improve the PCI of a road but fail to address underlying issues that will continue to cause deterioration. The recommendations in this report seek to keep PCI values high but also maintain the underlying layers of pavement for each segment.

Existing Pavement Conditions

PCI values are used to evaluate pavement condition on a scale from 0 to 100 with 100 being a perfect roadway that exhibits no distress. Table III.1. displays the PCI categories that the engineering staff at WSB recommended to describe the condition of bituminous roadways along with the maintenance strategy typically implemented on roads in that condition.

Table III.1. Pavement Condition Categories Based on PCI Values

Category	Pavement Condition Index (PCI)	Recommended Strategy
Excellent	90.01 – 100.00	Corrective Maintenance
Good	75.01 – 90.00	Preventative Maintenance
Fair	58.01 – 75.00	Mill/Overlay
Poor	40.01 – 58.00	Reclamation
Failed	0.00 – 40.00	Reconstruction

PAVER, an asset management software, was used to record and estimate the condition of each road segment. The software calculates PCI using deduct values that are based on the type, severity, and quantity of the visible pavement distresses on each road. Examples of asphalt pavement distresses include alligator cracking, longitudinal/transverse cracking, and potholes. Distress severity is classified as either low, moderate, or high. Depending on the type of distress, quantity is measured as the number of occurrences, length, or area.

The PCI values generated were based on a visual inspection and the corresponding recommended maintenance strategies should only be used as a guideline. In some cases, pavement forensics such as coring may be needed to supplement visual inspections and provide more information regarding roadway condition.

This report shows updated pavement conditions for all road segments requested by the City. Most bituminous roadways at the time of inspection were in Excellent or Good condition, but several are approaching a critical condition stage if no maintenance is done. Table III.2. shows how much of the City's pavement is in each condition category.

Table III.2. City Roads by Condition Category

Pavement Condition Index	Mileage	Percent of System by Area
Excellent Category (90.01 – 100.00)	2.8	27.5 %
Good Category (75.01 – 90.00)	6.0	58.8 %
Fair Category (58.01 – 75.00)	1.3	10.9 %
Poor Category (40.01 – 58.00)	0.3	2.8 %
Failed Category (0.00 – 40.00	0.0	0.0 %

Appendix A includes maps of all the inspected road segments in the City with their PCI condition categories. Appendix B displays the PCI values of every inspected segment.

Pavement Rating Examples

PCI Rating = 0.00-40.00: Failed

Fortunately, the City does not currently have any roads in Failed Condition. An explanation of typical Failed pavement is included for reference only. When a road's PCI rating is 40 or below, the pavement shows high severity distresses at multiple locations or extensive moderate and low severity distresses. The street has deteriorated to the point where the structural integrity has diminished along with the driving surface. Drivers using segments of this condition experience bumpy and rough rides. Typically, streets of this category require reconstruction. Reconstruction involves removing the pavement at full depth, through the surface layers of asphalt and into the gravel base creating a new pavement structure. Reconstruction is very costly, so every effort should be made to keep streets from entering this category.

PCI Rating = 48: Poor

Rollingwood (Segment ID: 50)

Roads in the Poor category are at the point where the number and severity of distresses dramatically worsen. Moderate and high severity distresses become common. Drivers experience many bumps while using these streets. Maintenance tactics such as crack sealing and rejuvenators are not effective, as the pavement has deteriorated beyond the point of repair. If the damage has not yet reached the base of the road, reclamation is recommended. Reclamation is an in-place recycling method for reconstruction of flexible pavements using the existing pavement section material as the base for a new roadway-wearing surface. While reclamation projects are much cheaper than reconstructions, it is still a costly procedure.

PCI Rating = 66: Fair

Timberline (Segment ID: 37)

Segments rated as Fair may have a few moderate and severe distresses but usually only have mild widespread distresses. The road shows wear but it is still structurally sound. Drivers may experience some bumps while using these segments, but the driving surface is mostly smooth. Typically, streets in this category can be rehabilitated with a mill and overlay. This method involves milling off the top part of the pavement and replacing it with a new lift of fresh asphalt. Milling eliminates most of the distresses since they are usually mild and still only on the surface. The overlay provides a new driving surface while utilizing the existing base which is still in adequate condition. This strategy prevents the pavement from deteriorating past the point where repairing it is no longer cost-effective.

PCI Rating = 80: Good

Beecave (Segment ID: 2)

Streets with a rating of Good have experienced enough weathering and wear to show signs of distress. These distresses are usually mild with some moderate distresses also present. Drivers on these segments encounter mostly smooth rides with few bumps. While the distresses may still be relatively minor, they are prime candidates for preventative maintenance techniques. It is recommended that the City use a combination of crack sealing, rejuvenators, and fog sealing to restore segments in the Good category. These strategies are relatively inexpensive and extremely cost-effective ways to extend the life of the pavement.

PCI Rating = 92: Excellent

Almarion W (Segment ID: 34)

If a pavement section is categorized as Excellent, it will have been recently resurfaced or constructed. Distresses can be present, but they are usually mild in severity. Drivers will experience few if any bumps while traveling the segment. In most cases no maintenance is required on Excellent pavement. However, the City should be proactive by crack sealing seams and any early cracks to prevent seepage into the base of the road.

IV. Pavement Management Report

The information provided in this pavement management report is based on a systematic method of inspecting and rating the pavement condition of roads in the City's network, followed by an analysis of various cost-effective maintenance and rehabilitation strategies which can aid in making the best decisions on the use of available resources. It can also be used to provide updated data regarding the current pavement management plan.

Recommended Maintenance Action

Rollingwood has many options at their disposal for pavement rehabilitation and preventative maintenance including reconstruction, reclamation, mill and overlays, and rejuvenators that extend the life of a roadway. Each of these treatments should last several years and be cost-effective if correctly implemented at the right time.

Corrective Maintenance

Corrective maintenance is used to fix a road segment that is not performing as expected. This may be the result of improper construction or unforeseen conditions. This typically involves crack sealing or patching. Corrective maintenance is recommended for roads in Excellent condition because these segments should not need any major maintenance other than minor crack sealing unless the pavement behaves unpredictably.

Preventative Maintenance

Preventative maintenance is defined as treatment to an existing road that will help preserve and protect the pavement, while also slowing future deterioration. This type of maintenance improves the condition of the system without increasing its structural capacity.

Implementing a preventative maintenance strategy is cost-effective and important since maintenance costs increase with pavement age. Preventative maintenance actions can be done at a much lower cost than preservation actions such as mill and overlays. By applying appropriate preventative maintenance before a road deteriorates, the pavement can be kept in good condition at a much lower cost. With proper preventative maintenance techniques, the life of an average paved road increases from 20 years to 60 years.

Preventative maintenance is best performed on newer pavements prior to the appearance of significant and/or severe distresses. There are many preventative maintenance applications that seek to protect pavement from deterioration. These treatments vary in effectiveness and price. WSB would be happy to provide additional guidance on what these types of preventative maintenance include if needed. In Rollingwood, one option to consider as a preventative maintenance techinique is rejuvenating with a product called "Reclamite." Rejuvenators like Reclamite improve the durability of asphalt pavement by preventing or reversing the oxidation that causes the binder to dry out and crack. They also help seal out harmful moisture. In the PAVER model scenarios included below, Reclamite rejuvenator was used to model preventative maintenance.

Another preventative maintenance technique that could be implemented by Rollingwood is the use of a thin overlay. This repair is sometimes called a “Thinlay” and involves repaving a street with a layer of asphalt that is thinner than a traditional overlay. The thickness of a thin overlay is typically less than 2 inches. This thin layer of pavement does little to increase the structural capacity of the road or to repair existing distresses. However, it does temporarily provide a brand new driving surface for a lower cost than other repaving projects. The longevity and success of this type of project varies greatly depending on the condition of the underlying pavement. While effective in some situation, thin overlays should not completely replace other preventative maintenance or mill/overlay projects implemented in the City.

Patching can also be considered preventative maintenance, but it is usually implemented on small areas of severe distress. Additionally, patching a road to increase its PCI does not provide long term structural improvement. Patching may be necessary to keep roads in serviceable condition, but it should not be considered routine maintenance for every road.

Overlay/Mill and Overlay

An overlay involves placing a new layer of bituminous material on top of an existing asphalt surface. A mill and overlay requires grinding all or a portion of the in-place asphalt surface and topping the ground surface with a bituminous wearing course. This rehabilitation strategy provides a structural improvement to the roadway. We recommend conducting more investigation such as pavement coring to evaluate the subsurface conditions before implementing an overlay project. Information such as depths of pavement layers, signs of debonding, and distresses that are not visible from the road surface can be obtained through pavement coring. Applying an overlay to a pavement structure with inadequate subsurface conditions will cause the new surface to fail prematurely.

Reclamation

The most common types of reclamation are full-depth reclamations (FDR) and stabilized full-depth reclamations (SFDR). FDR involves pulverizing the full depth of bituminous and a portion of the underlying materials. That material then gets blended together and placed as a sound base for new pavement. Typically, FDR reclaim depth is 12 inches, although it can be as deep as 18 inches. Excess FDR mixture may be removed to allow 6-inch lifts compaction. Additional rock may need to be provided if the mixture is expected to be deficient in crushing or gradation. The reclaimed mixture can be topped with different types of surface course, depending on the structural requirements and anticipated traffic level. A layer of tack coat needs to be applied prior to surface treatment to provide good bonding between the FDR mixture and surface course. SFDR involves the same process but includes mechanical, chemical, or bituminous stabilization. The typical minimum depth of stabilization is 4 inches, but it can go as deep as 6 inches. Mechanical stabilization involves the addition of new aggregate or recycled materials. Chemical stabilization includes the addition of lime, cement, fly ash, calcium chloride, or other proprietary products. The asphalt additives can be foamed asphalt or asphalt emulsion. These stabilizing agents if combined with additives, can help optimizing the FDR performance.

Reconstruction

Reconstruction includes the complete replacement of the road's driving surface and pavement structure. The pavement along with its base layers are then replaced with new material. Asphalt mix type, ride specification, lift thicknesses, and compaction requirements must be in accordance with the specified standard. Selecting the specific appropriate reconstruction plan for a road requires more detailed investigation such as pavement coring. Each road segment requires a specific pavement design that considers existing subgrade materials and traffic loading to create the most effective pavement structure. Subsurface water management is a significant component of a reconstruction project. Thus, addressing roadway drainage is included in roadway reconstruction projects. When performing a reconstruction, it is important to consider the entire pavement structure that includes the base and subbase. A larger initial investment in thicker base and subbase layers along with edge drains provides the pavement with a stronger foundation that reduces damage from moisture under the surface. This produces pavement that is less susceptible to damage and has a longer expected life. WSB can provide specific reconstruction design recommendations if requested.

Pavement Forensics

The final decision on implementing a reconstruction or reclamation project should come after a pavement forensic study. Pavement forensics studies the pavement structure and condition of the base underneath the visible layer of pavement. Important information results from this analysis. Examining pavement cores can determine the depths of pavement layers, signs of bonding or de-bonding, and distresses that might not be visible from the surface. Soil borings along the roadway can be used to identify aggregate depths and soil classifications to provide a better understanding of the roadway section. This information is crucial when determining what type of rehabilitation is needed and what it will cost. Several factors should be considered when deciding the number of cores to be taken such as the pavement condition and the variability in the pavement depth as cores are being taken. A pavement forensic study should be conducted less than two years before a major maintenance project to ensure the results of the study accurately reflect the road's condition. The findings of pavement forensic studies have been proven to lead to cost savings and more appropriate maintenance strategies. WSB can perform pavement forensics for Rollingwood if requested.

5-Year Capital Improvements Program (CIP)

To develop recommendations for the City regarding their 5-year CIP, a model was created using the PAVER software. PAVER uses construction, inspection, and maintenance records along with a degradation curve to predict how each segment of pavement in the City's system will perform over time. This analysis utilized the Army Corps of Engineer's standard pavement degradation curve. Different scenarios and maintenance budgets can then be tested to see how they would perform and determine the best plan moving forward. Leveraging PAVER's ability to optimize the cost-effectiveness makes sure the City's resources have the biggest impact on the roadway system.

To build an accurate model of Rollingwood in PAVER, unit pricing for the maintenance activities were developed as follows. The unit pricing of Reclamite rejuvenator was selected as the representative cost for the preventative maintenance activity. The cost of corrective maintenance on roads in Excellent condition was considered too minimal to include in scenario modeling but is listed below for reference.

- Corrective Maintenance - $0.27/square yard
- Preventative Maintenance - $1.26/square yard
- Mill and Overlay - $31.14/square yard
- Reclamation - $55.98/square yard
- Reconstruction - $405/square yard

These cost estimates are based on previous project estimates received by the City and bids for similar work. Estimates include other costs that accompany pavement maintenance such as adjusting casings, adjusting valve boxes, striping, soft spot repairs, addressing drainage issues, and replacing curb and gutter. Contingency and indirect costs are also included to provide accurate cost projections. Figure IV.1. demonstrates how the cost of restoring pavement increases as pavement deteriorates. This shows the importance of implementing preventative maintenance because it is exponentially cheaper. It also shows the importance of repairing roads before they reach the level where a reconstruction is needed since the cost jumps significantly. Once roads reach this level, the cost no longer increases and urgency to repair the road is driven solely by the need to keep roads serviceable for the traveling public. This data is reflected in the results of each scenario modeled in PAVER.

Figure IV.1. Increasing Cost of Restoring Pavement

A main goal of this pavement management report is to determine how much funding is necessary to maintain the City's streets over the next five years and how that budget should be spent. To best determine this, three scenarios were tested and the associated impacts on the overall PCI rating of the City were recorded.

Scenario 1: No Maintenance

The No Maintenance scenario is a good starting point when comparing various funding alternatives because it shows the rate of deterioration that the City must overcome through its maintenance and rehabilitation programs. Given no pavement maintenance funding over the next 5 years, the City pavement condition would deteriorate at a rate of approximately 2-3 PCI points per year, going from a PCI of 84.4 in 2023, to 72.8 in 2028. The goal of the other scenarios tested is to find the best way to offset this natural deterioration rate. The summary of results from Scenario 1 can be found in Table IV.1. and Figure IV.2.

Table IV.1. Summary Results for Scenario 1

Year	2024	2025	2026	2027	2028	Totals
Total Spent ($ thousand)	0.0	0.0	0.0	0.0	0.0	0.0
Average PCI	81.6	79.2	77.0	74.9	72.8	-

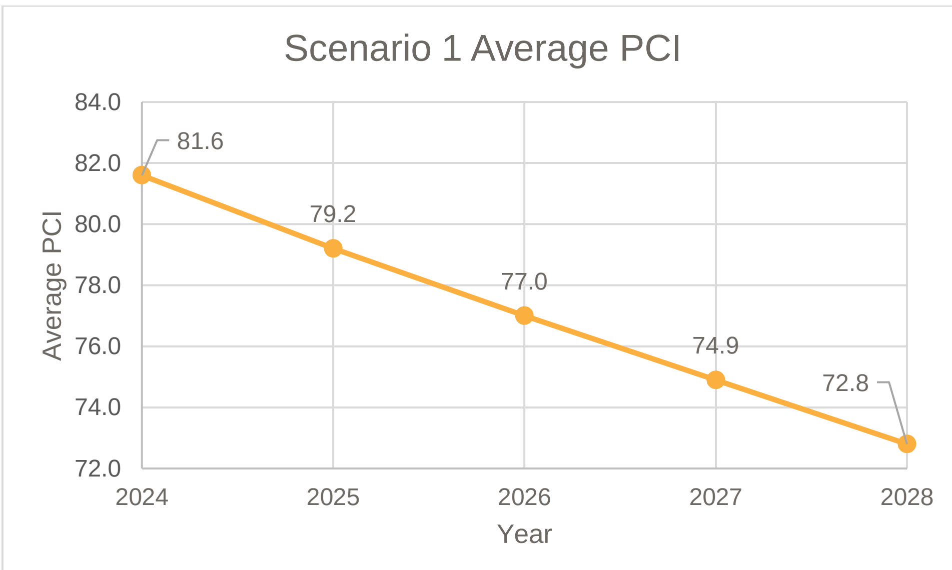


Figure IV.2. Average PCI in Scenario 1

Scenario 2: Minimum PCI of 75 on Every Segment

The second scenario was tested with the goal of getting every road in the City to have pavement in Good condition by the end of the five-year plan. Under this scenario, the model increases the minimum PCI threshold each year until a target PCI of 75 or greater is achieved at the end of 2028 on all segments. This scenario involves implementing many major rehabilitation projects on the roads currently in bad condition. To achieve this ambitious goal, an annual budget of approximately $515,000 is required for each of the next five years. While eliminating all Failed, Poor, and Fair pavement in Rollingwood, this scenario is costly and results in a slight decrease in average PCI. When funds are allocated towards only repairing the worst roads in a community, the budget is quickly used up by only a few major projects and the rest of the pavement segments are left to degrade. This shows the importance of preventative maintenance as a way to cost-effectively improve many segments and keep the average PCI in a community high.

The results show how money is initially directed towards the worst roads resulting in mostly reclamation projects. Funds then shift towards the mill & overlay projects as the worst roads get repaired. This scenario is much more costly than Scenario 3 and it is also the least cost-effective since all resources are allocated towards improving the worst roads and none are dedicated to preventative maintenance on the better segments. The summary of results from Scenario 2 can be found in Table IV.2. and Figure IV.3.

Table IV.2. Summary Results for Scenario 2

Year	2024	2025	2026	2027	2028	Totals
Spent on PM ($ thousand)	0	0	0	0	0	0
Spent on M/O ($ thousand)	215	516	495	493	563	2,283
Spent on Reclaim ($ thousand)	292	0	0	0	0	292
Spent on Recon ($ thousand)	0	0	0	0	0	0
Total Spent ($ thousand)	507	516	495	493	563	2,575
Average PCI	83.0	83.2	83.3	83.1	83.0	-

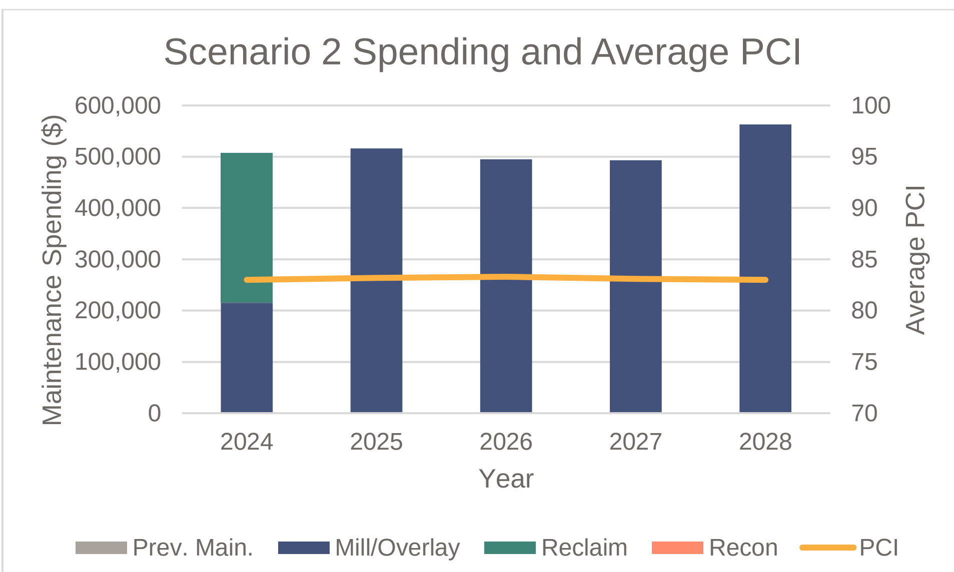


Figure IV.3. PCI vs Maintenance Budget for Scenario 2

Scenario 3: Maintain Current Average PCI

The final scenario tested examined what budget would be needed to maintain an average PCI of 84.4 over the life of the CIP. That allows this scenario to identify the budget needed to maintain the current average quality of pavement the City's residents are accustomed to. If funds are spent in the optimal way, the model showed that an annual budget of approximately $255,000 is needed to ensure an average PCI of 84.4 is achieved each year until 2028.

It is important to note that the PAVER simulation only seeks to maximize the average PCI with the least amount of money. This means that reconstruction and reclamation projects receive last priority since they are the most expensive and least cost-effective way to improve the PCI of a segment. While this approach does keep average PCI values high, it lets some roads degrade beyond an acceptable condition. No model is perfect and the decision between implementing more cost-effective maintenance projects on segments in better condition and implementing more costly repairs on roads in unacceptable condition is one City officials will need to make.

The model also does not account for important factors such as keeping heavily trafficked roads in better condition than lesser trafficked routes or public opinion about which roads should be repaired. The judgement of the City is needed to decide when a road has reached the end of its serviceable life and should receive a reconstruction or reclamation. When these additional variables are included, resources need to get spent in less cost-effective ways which means the weighted average PCI will likely perform worse than projected.

The results from Scenario 3 show most of the budget being allocated towards mill and overlay projects. The City has many roads in Fair condition so PAVER is trying to improve these segments, especially before they reach the point where they will need a much more expensive repair. The model also allocated significant funding towards preventative maintenance. While the amount spent on preventative maintenance is much lower, that amount can improve many more segments. Implementing cost-effective preventative maintenance is important when trying to maximize a budget. Additionally, some funds are allocated towards reclamation projects to help repair a few of the worst segments in the City. The summary of results from Scenario 3 can be found in Table IV.3. and Figure IV.4.

Table IV.3. Summary Results for Scenario 3

Year	2024	2025	2026	2027	2028	Totals
Spent on PM ($ thousand)	184	4	0	0	0	187
Spent on M/O ($ thousand)	79	260	263	252	0	854
Spent on Reclaim ($ thousand)	0	0	0	0	213	213
Spent on Recon ($ thousand)	0	0	0	0	0	0
Total Spent ($ thousand)	262	264	263	252	213	1,254
Average PCI	87.0	89.6	87.8	86.3	84.7	-

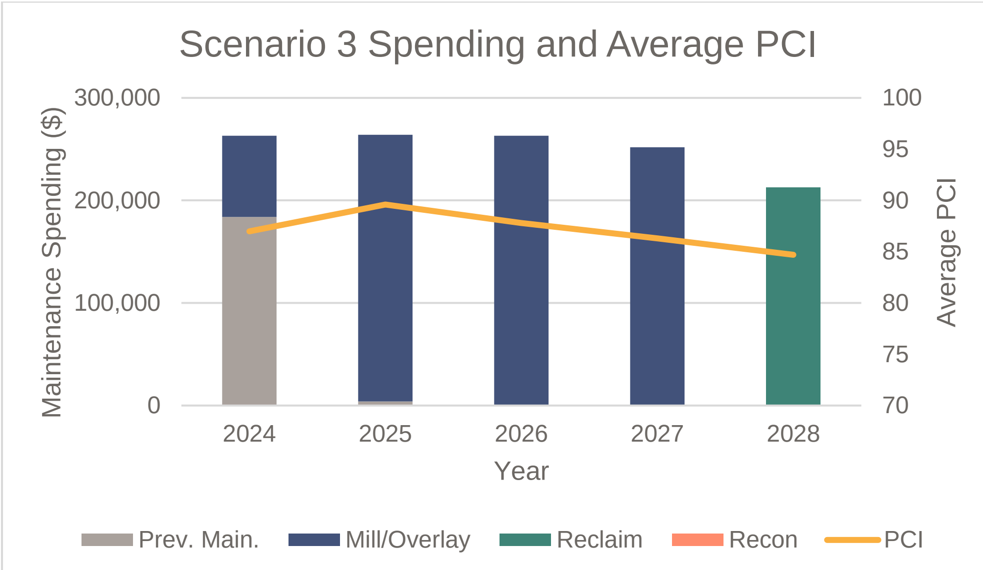


Figure IV.4. PCI vs Maintenance Budget for Scenario 3

Spending and Maintenance Recommendations

Figure IV.5. compares the three scenarios tested in PAVER. The results were used to notice trends and develop recommendations for the City.

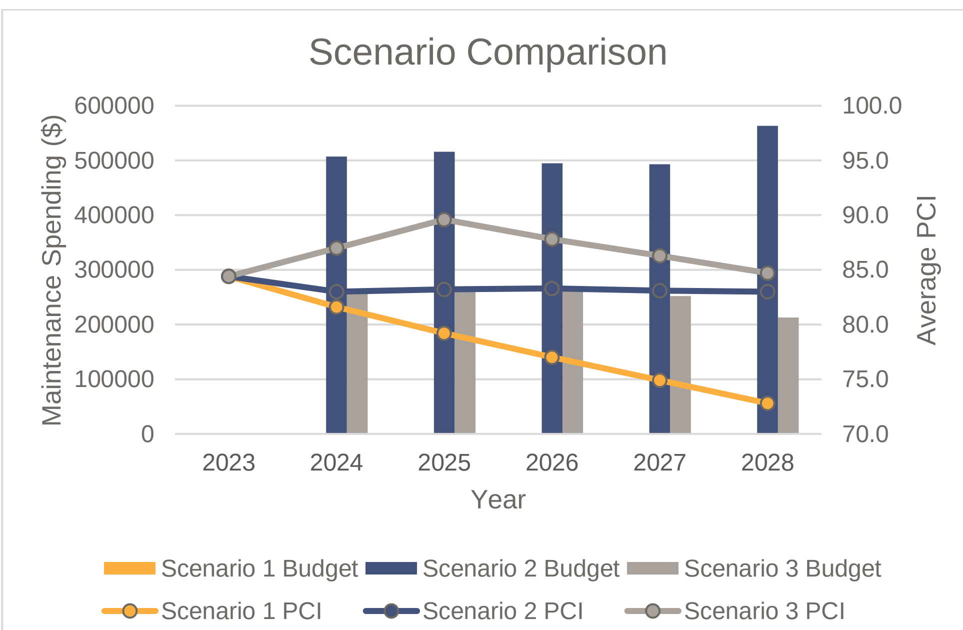


Figure IV.5. Scenario Summary Comparison

Budget Recommendations

If Rollingwood's goal is to maintain the current quality of pavement in the City, WSB recommends an annual budget based on the results from the PAVER scenarios. The exact amount needed to maintain the current average pavement condition will depend on the type and effectiveness of the implemented maintenance techniques (see Maintenance Recommendations below for more details). However, with proper budgeting and maintenance selection, the City should expect to be able to maintain its network for approximately $275,000 to $300,000 each year. When determining long-term budget needs, it is important to consider the effects of inflation. Each year the buying power of a constant budget will decrease and allow for repairs of less roads. PAVER considered standard inflation when modeling the listed scenarios, but WSB encourages communities to consider a budget that increases slightly each year to account for inflation. Lastly, as the PCI of a system falls, it becomes increasingly expensive to maintain or repair. Rollingwood's current pavement network currently has a high average PCI. However, neglecting current maintenance needs will require a much larger maintenance budget in the future.

Maintenance Recommendations

While the maintenance repair recommended for a segment typically aligns with its PCI score and the corresponding condition category noted above, there are a few other factors to consider when deciding which roads should receive a specific treatment. Anytime a major rehabilitation projects is needed (PCI less than 75), it is wise to do more investigation before moving ahead with a project. Spending resources investigating the pavement and base condition adds value by making sure the most cost-effective solution is applied. This is especially true when deciding between a reclamation or a reconstruction. The cost difference between these alternatives is substantial enough that pavement coring should always be implemented before moving forward with a project that has a PCI score lower than 58.

As mentioned earlier, the actual performance of the roads in the City's system will depend on how cost-effective its maintenance is. There are several strategies that can be used to protect the roads in good condition and to stretch the impact of the City's resources. To maximize the effectiveness of the available funding, we recommend prioritizing preventative maintenance. While it seems counterintuitive to focus on roads in the best condition, their preventative maintenance is relatively cheap and retaining segments with high PCI values is necessary to avoid high maintenance costs in the future. While roads will inevitably need more expensive repairs at some point, delaying those expenses and keeping roads in good condition is a best practice. Figure IV.6. illustrates this point.

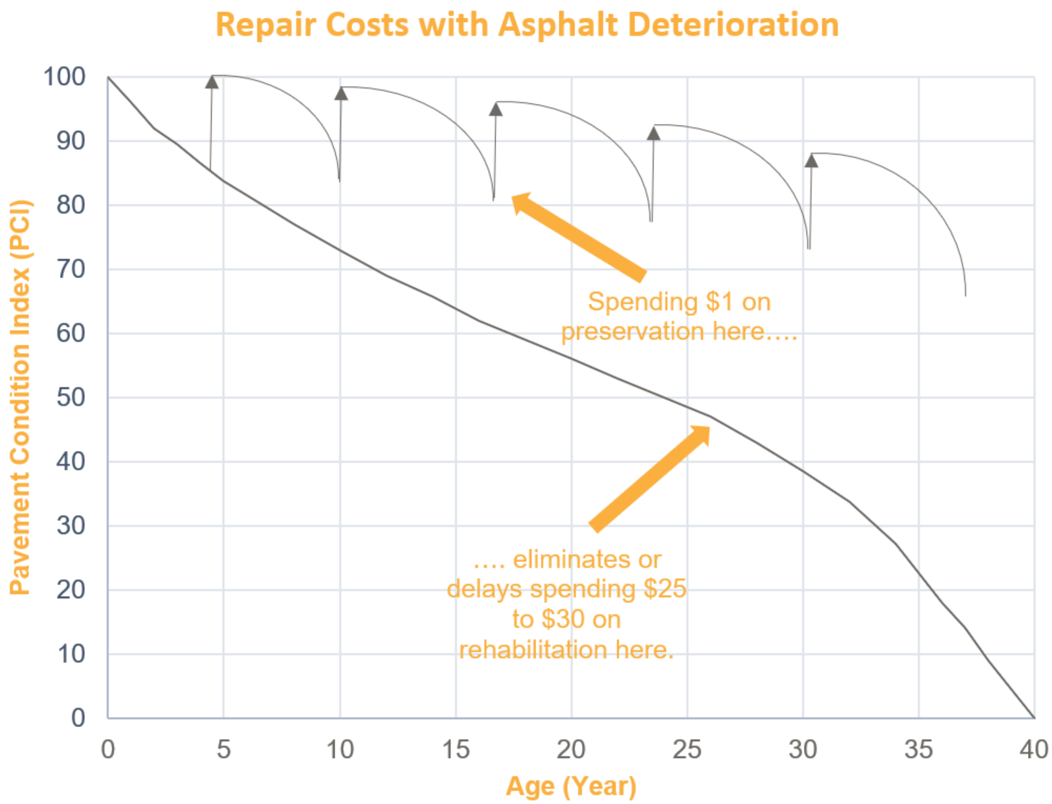


Figure IV.6. Cost-Effectiveness of Preventative Maintenance Example

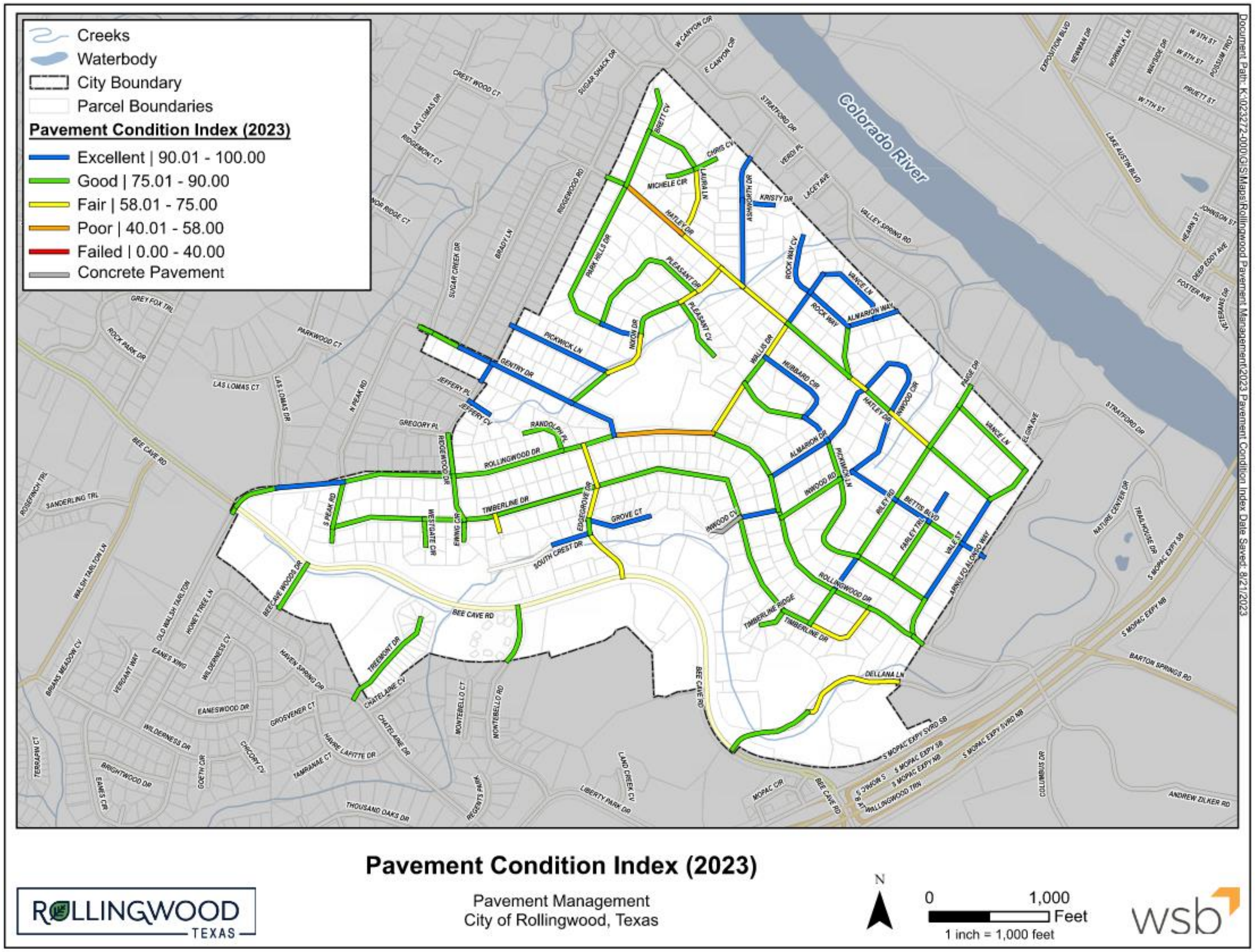
Similarly, taking advantage of the lower cost of mill and overlay projects compared to other major rehabilitation projects allows the budget to improve more road segments in the City. This same logic applies to not letting a road deteriorate to the point where it will need to be reconstructed. Reconstructions consume many resources which is why most of the PAVER scenarios tested tried to implement reclamation projects before reconstruction would be necessary. When reconstruction is necessary, we recommend investing in base and subbase layers with adequate thickness. Paying extra to make sure the new road is built on a sturdy and dry foundation will extend the life of the pavement and reduce the amount of resources needed for maintenance. When constructed properly, aggregate bases and subbases should not need to be replaced, even when the pavement fails.

Another important methodology to adopt is to not implement a less expensive repair on a road that requires a more expensive fix. It is tempting to try and apply cheaper fixes when facing expensive cost estimates. However, this will result in wasting precious funds. For example, applying a rejuvenator as preventative maintenance on a road that is in Fair, Poor, or Bad condition is not effective. Instead of providing years or protection as intended, it will deteriorate quickly and not result in long-term results.

Finally, we recommend keeping a detailed log of all street maintenance implemented in the City. Recording information such as the type of maintenance activity, when it was implemented, how much it cost, the materials used, the age of the road during implementation, and any other testing results on that segment can prove helpful in the future. Maintenance logs can help determine what is working well for a City and what is not. Similarly, if a recommended maintenance strategy is not working well, reviewing details of the activity can help reveal why. This detailed information can also be used to improve the assumptions used by the PAVER model. This will ensure future recommendations will be based on accurate scenarios.

Appendices

Appendix A: PCI Condition Category Maps



Appendix B: PCI Values by Segment

Network ID	Branch ID	Section ID	Length (ft)	Width (ft)	Area (sqft)	2023 PCI
STREETS	ALMARION D	23	545	30	16,340	91
STREETS	ALMARION D	53	562	36	20,233	91
STREETS	ALMARION W	34	237	28	6,627	92
STREETS	ALMARION W	89	430	28	12,031	89
STREETS	ALMARION W	99	185	28	5,187	91
STREETS	ASHWORTH D	49	366	28	10,251	92
STREETS	ASHWORTH D	73	719	28	20,144	92
STREETS	BEECAVE WO	2	429	40	17,153	80
STREETS	BETTIS BLV	42	333	36	11,982	90
STREETS	BETTIS BLV	54	334	36	12,042	92
STREETS	BETTIS BLV	91	430	36	15,477	92
STREETS	BETTIS BLV	106	208	36	7,483	91
STREETS	BRETT CV	83	359	28	10,063	85
STREETS	CHRIS CV	70	180	28	5,045	81
STREETS	DELLANA LN	43	891	16	14,253	74
STREETS	DELLANA LN	121	725	28	20,287	87
STREETS	EDGEGROVE	4	469	28	13,135	74
STREETS	EDGEGROVE	69	293	28	8,194	65
STREETS	EDGEGROVE	97	359	28	10,041	63
STREETS	EDGEGROVE	117	111	28	3,097	89
STREETS	EWING CIR	7	170	28	4,761	85
STREETS	FARLEY TRL	24	560	28	15,687	88
STREETS	FARLEY TRL	107	267	28	7,473	91
STREETS	GENTRY DR	22	276	28	7,716	89
STREETS	GENTRY DR	28	300	28	8,390	95
STREETS	GENTRY DR	57	100	28	2,790	81
STREETS	GENTRY DR	62	484	28	13,553	93
STREETS	GENTRY DR	118	740	28	20,724	91
STREETS	GROVE CT	26	526	28	14,732	91
STREETS	HATLEY DR	12	290	28	8,108	79
STREETS	HATLEY DR	15	671	28	18,775	86
STREETS	HATLEY DR	30	171	28	4,783	78
STREETS	HATLEY DR	32	433	28	12,122	65
STREETS	HATLEY DR	33	488	28	13,670	67
STREETS	HATLEY DR	76	435	28	12,180	69
STREETS	HATLEY DR	95	617	28	17,277	57
STREETS	HATLEY DR	100	165	28	4,627	74
STREETS	HATLEY DR	109	237	28	6,623	69
STREETS	HATLEY DR	115	681	28	19,060	77

Network ID	Branch ID	Section ID	Length (ft)	Width (ft)	Area (sqft)	2023 PCI
STREETS	HUBBARD CI	90	746	28	20,881	92
STREETS	INWOOD CIR	17	859	28	24,042	93
STREETS	INWOOD CV	11	298	28	8,338	79
STREETS	INWOOD RD	9	619	30	18,569	91
STREETS	INWOOD RD	18	120	36	4,305	93
STREETS	INWOOD RD	48	327	28	9,165	91
STREETS	INWOOD RD	102	584	30	17,523	90
STREETS	JEFFERY CV	103	193	40	7,710	94
STREETS	KRISTY DR	3	262	40	10,463	91
STREETS	LAURA LN	14	517	28	14,489	83
STREETS	LAURA LN	41	576	28	16,138	71
STREETS	MICHELE CI	5	238	28	6,656	83
STREETS	MONTEBELLO	98	474	48	22,743	77
STREETS	NIXON DR	45	307	28	8,601	73
STREETS	NIXON DR	58	396	28	11,083	90
STREETS	NIXON DR	101	486	30	14,588	83
STREETS	NIXON DR	105	140	30	4,195	74
STREETS	NIXON DR	108	460	28	12,891	75
STREETS	OLD WALSH	6	57	36	2,062	87
STREETS	PARK HILLS	82	1,412	28	39,526	81
STREETS	PARK HILLS	94	342	28	9,574	92
STREETS	PARK HILLS	113	487	28	13,640	84
STREETS	PICKWICK L	10	333	28	9,335	89
STREETS	PICKWICK L	13	337	30	10,114	89
STREETS	PICKWICK L	38	899	28	25,164	91
STREETS	PICKWICK L	72	332	28	9,308	90
STREETS	PICKWICK L	74	610	28	17,076	89
STREETS	PICKWICK L	92	280	28	7,833	91
STREETS	PICKWICK L	93	885	28	24,768	90
STREETS	PLEASANT C	65	535	30	16,060	87
STREETS	PLEASANT D	87	1,165	28	32,613	88
STREETS	PRIVATE DR	120	133	14	1,858	69
STREETS	RANDOLPH P	46	430	28	12,052	84
STREETS	RIDGEWOOD	80	172	28	4,812	93
STREETS	RIDGEWOOD	96	347	32	11,100	84
STREETS	RIDGEWOOD	119	383	32	12,252	86
STREETS	RILEY RD	1	347	28	9,713	93
STREETS	RILEY RD	16	567	28	15,881	87
STREETS	RILEY RD	36	528	28	14,795	89
STREETS	RILEY RD	59	421	28	11,780	85

Network ID	Branch ID	Section ID	Length (ft)	Width (ft)	Area (sqft)	2023 PCI
STREETS	RILEY RD	60	185	28	5,167	84
STREETS	RILEY RD	111	343	36	12,340	86
STREETS	ROCK WAY	104	424	28	11,878	93
STREETS	ROCK WAY C	77	527	28	14,753	93
STREETS	ROLLINGWOO	19	628	36	22,613	77
STREETS	ROLLINGWOO	47	388	36	13,974	87
STREETS	ROLLINGWOO	50	826	36	29,722	48
STREETS	ROLLINGWOO	51	70	36	2,515	84
STREETS	ROLLINGWOO	52	340	36	12,236	77
STREETS	ROLLINGWOO	56	187	36	6,723	90
STREETS	ROLLINGWOO	61	267	36	9,609	87
STREETS	ROLLINGWOO	79	436	36	15,693	89
STREETS	ROLLINGWOO	84	927	36	33,362	89
STREETS	ROLLINGWOO	85	935	36	33,656	88
STREETS	ROLLINGWOO	86	788	36	28,358	78
STREETS	ROLLINGWOO	88	89	40	3,567	90
STREETS	ROLLINGWOO	112	554	36	19,932	92
STREETS	ROLLINGWOO	116	283	36	10,176	82
STREETS	S PEAK RD	64	114	36	4,111	90
STREETS	S PEAK RD	67	390	36	14,054	90
STREETS	SOUTH CRES	81	315	24	7,551	91
STREETS	TIMBERLINE	27	778	28	21,779	86
STREETS	TIMBERLINE	37	647	28	18,123	66
STREETS	TIMBERLINE	39	1,446	28	40,482	79
STREETS	TIMBERLINE	40	1,149	28	32,169	81
STREETS	TIMBERLINE	68	875	36	31,484	90
STREETS	TIMBERLINE	71	238	30	7,147	86
STREETS	TIMBERLINE	78	334	28	9,353	89
STREETS	TIMBERLINE	110	243	36	8,742	90
STREETS	TREEMONT D	63	885	24	21,244	89
STREETS	VALE ST	21	565	36	20,329	92
STREETS	VALE ST	25	438	36	15,769	92
STREETS	VALE ST	44	386	28	10,809	89
STREETS	VALE ST	66	333	40	13,310	84
STREETS	VANCE LN	29	773	28	21,648	89
STREETS	VANCE LN	35	633	28	17,731	91
STREETS	WALLIS DR	8	337	28	9,428	75
STREETS	WALLIS DR	20	278	28	7,793	77
STREETS	WALLIS DR	31	494	28	13,826	73
STREETS	WALLIS DR	75	322	28	9,006	94

Network ID	Branch ID	Section ID	Length (ft)	Width (ft)	Area (sqft)	2023 PCI
STREETS	WALLIS DR	114	184	28	5,150	93
STREETS	WESTGATE C	55	218	28	6,112	85