4/30/2024

PASER Inspection &

Pavement Management Plan

Eureka, KS | Project No. 231019.00

City of Eureka, Kansas

Pavement Management Plan

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1 Introduction

1.1 Background

The City of Eureka, located in Greenwood County Kansas, maintains a roadway network consisting of over 34.4 centerline miles of streets and serves as the county seat.

The streets program budget is primarily funded through the local sales tax, highway fuel taxes from the state, and general obligation bonds paid via property tax revenue. These limited revenues require city staff and elected officials to make complex decisions when determining annual maintenance and reconstruction expenditures. There is not a fixed annual budget for roadway improvements in Eureka, though annual revenues eligible specifically for general roadway improvements were typically between $350,000 and $450,000, over the past three years. A secondary sales tax is set aside specifically for River Street (US 54) and collects approximately $360,000 per year. Other funds, in the form of grants or general funds, may also be used for large construction projects, on an as needed basis.

Until now, the City's framework for determining which streets to repair has been governed by the professional judgement of City staff. Staff knowledge is critical to identifying projects and determining the appropriate treatments but, at a systematic planning level, there are better techniques to help optimize the process.

1.2 Program Goals

The City contracted JEO Consultants (JEO) to complete a Pavement Management Plan. This project will help the City develop an objective, data driven, and sustainable approach to managing its roadway assets as well as to budget for future needs. JEO's performed the following services:

- Review the City's standards for street pavement design and construction/maintenance practices.
- Develop a comprehensive inventory of the City's street system.
- Evaluate the system's current roadway conditions using Pavement Serviceability Evaluation and Rating system (PASER)
- Determine major rehabilitation and reconstruction alternatives and trigger thresholds for use in the data analysis and project considerations.
- Develop 10-Year Capital Improvement Program identifying projects and estimated costs.
- Establish Goals

1.3 Pavement Management Overview

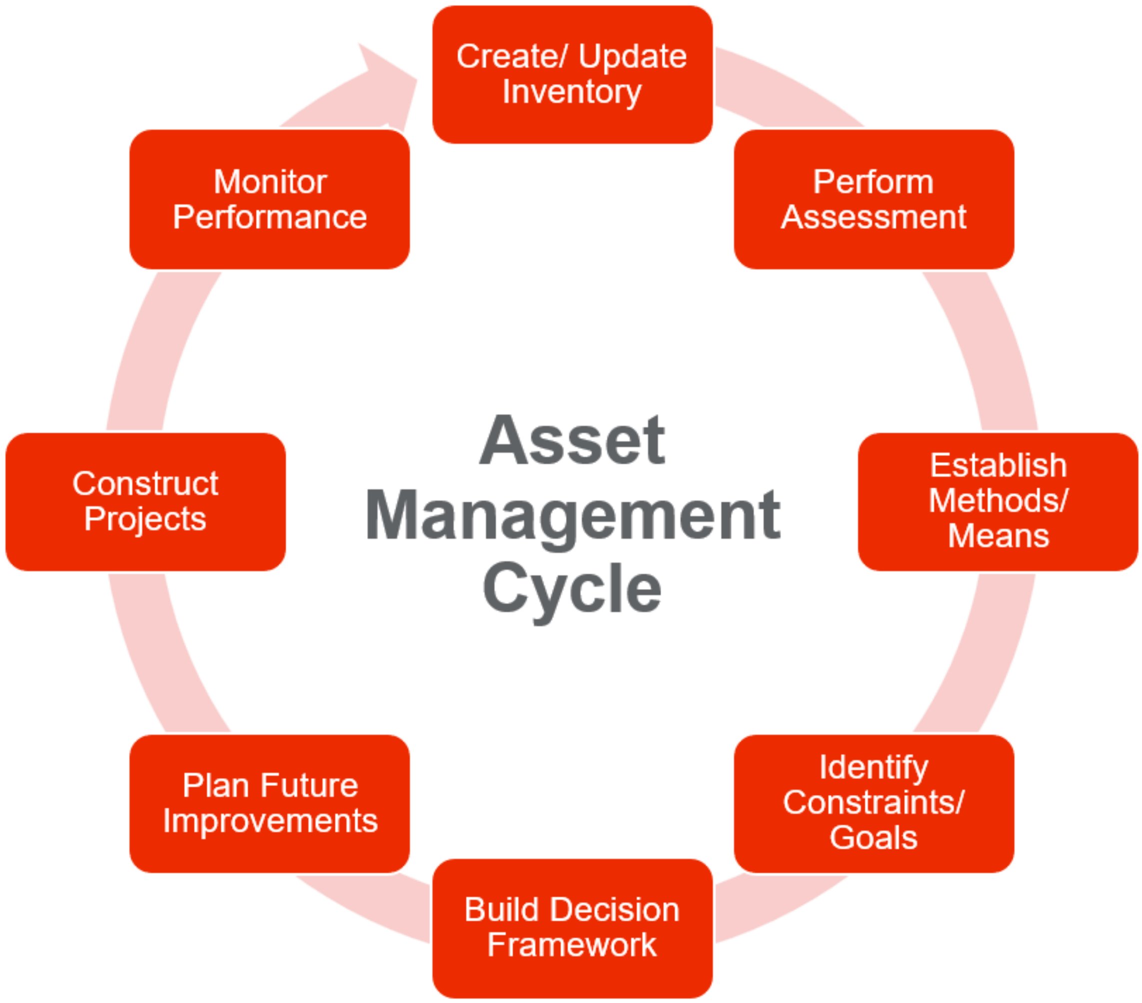
1.3.1 Defining Pavement Management

Pavement Management is a specific subset of "Asset Management." These management programs are systems that serve as tools by which agencies carry out their policies and goals. For example, the goal might be to "improve street conditions" or the policy might be "Maintain River Street to KDOT standards."

Pavement Management takes a systematic approach to proactive maintenance and efficient spending to maximize the quality of service provided to the travelling public.

All asset management is based around the core principles of understanding the needs of a community, assessing the options available to them, planning how to achieve goals, and then following through. It is not a single study, nor a software solution. It is the cyclical process by which a community optimizes its service to the community.

JEO's expert team prides themselves on understanding the ins and outs of providing safe and efficient infrastructure for communities of all sizes and can help with every step of the process by advising them how to do the right thing at the right time.



1.3.2 Pavement Life-Cycles

Pavement management techniques are all about timing. Pavement surfaces do not decay at a constant rate over time and getting the best value for money requires applying treatments at crucial periods in a pavement's life-cycle. For example, new pavement remains stable in its early years of service, but declines in condition occur quickly with older pavements. The optimal practice is to intervene with appropriate treatments while a road is at the end of its regular service life, right before the drop-off in quality happens.

This way, small investments can drastically improve and extend pavement life. The most cost-effective treatments, as such, are preventative maintenance for "Good" pavements and rehabilitation treatments for pavements in "Fair" condition. Rehabilitating a pavement in "Fair" condition often costs less than 25% of reconstructing that same road.

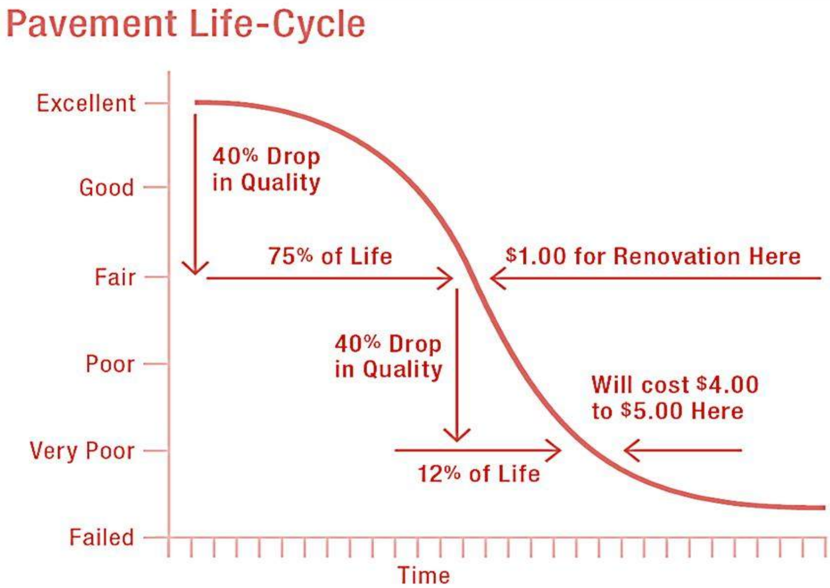


Figure 1-1: Pavement Service Life Cycle

This graph adapted from FHWA-HRT-13-038 shows how repair costs will increase over time correlated to pavement condition/age.

Ideally, each pavement would enter a cycle of preventative maintenance and regular rehabilitation to maximize the service life. Unfortunately, most communities have been unable to stay ahead of the life-cycle curve. This means that many of the pavements in the worst conditions may need to be deferred while the network condition is stabilized across the "Good" and "Fair" condition roads. As money is saved, it can be strategically applied to reconstructing roads based on their overall impact and priority within the community.

This approach effectively saves money and squeezes the most life out of the City's infrastructure by practicing ideal Pavement Management wherever it is still feasible.

2 Methodology

2.1 Streets Inventory

JEO developed a GIS inventory of streets using shapefiles taken from the US Census bureau, cross-referenced with digital maps provided by Kansas Department of Transportation (KDOT) and the Greenwood County Assessor. An additional review used aerial images along with field notes from the inspection team.

The city maintains approximately 34.4 miles of roads including major and minor collectors, local/residential streets, and alley functional classifications but no city-maintained roads meet the federal classification requirements for Arterial or Highway. The majority of streets in the city are Residential/Local in nature (83%).

Local streets typically serve houses directly, tending to have lower speed limits and traffic, which makes them economical to maintain. The other main classifications of roads in Eureka are Collectors (17%). Collectors are major streets that carry more traffic at higher speeds, aggregating the traffic towards major thoroughfares, like US 54. The primary Collector streets in Eureka are Main Street, East 7th Street, East 13th Street, Q Road, Jefferson Street, and South State Street. These higher classification streets are the most important investment for a community because they carry the majority of traffic volumes to and from any particular portion of the city as well as provide access to intercity roads.

In addition to the Federally classified routes, the City has identified portions of Poplar Street, West 7th street, and Jefferson Street as critical local routes. They may not officially be classified as Collector streets, but they are reportedly used as primary through routes and have wider typical sections with thicker pavements. As such, they are identified specifically within the plan and considered high priorities for the community alongside the federally classified routes.

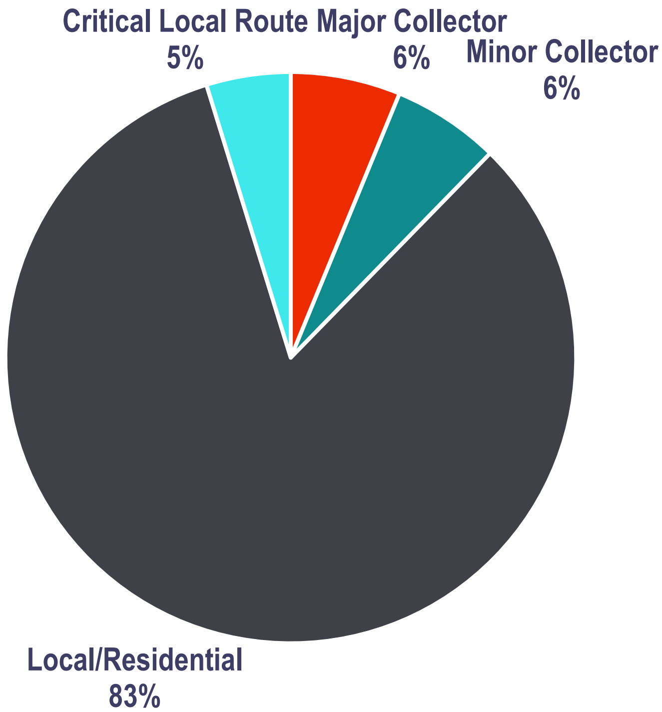


Figure 2-1: Functional Class Distribution
This figure compares the distribution of functional classifications in Eureka.

An overview of the roadway network and display of the functional classes within Eureka is found in **Map 1- Functional Class.**

The estimated value of Eureka's pavement system is $71.2 Million.

2.2 Condition Assessment (PASER)

The road network was split into 444 "management sections." Management sections identify streets by individual blocks or combinations of blocks maintained at the same time, due to their construction history and traffic patterns.

JEO mobilized two trained inspectors using a mobile collection application. The mobile application used the ArcGIS Online platform and accessed via the Field Maps app on a smartphone device. The inspectors drove every street in the city of Eureka noted the pavement type and various roadway characteristics, took a photograph of the pavement, and then rated each management section using the PASER system.

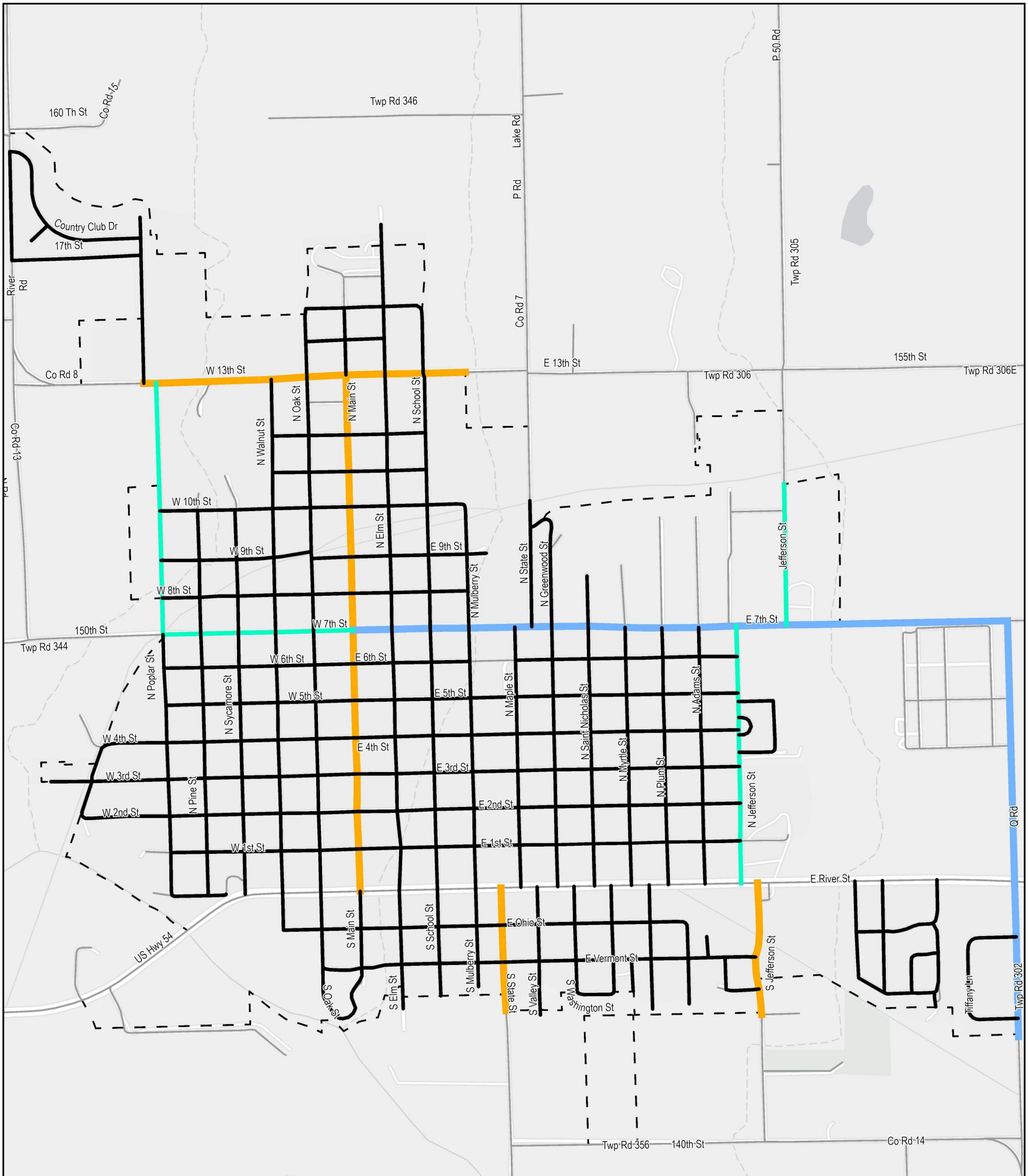
Figure 2-2: Collector App Using ArcGIS Online
Screenshot taken from the collector app.

2.2.1 PASER System

The Pavement Surface Evaluation and Rating (PASER) system is a comprehensive condition assessment protocol developed by the University of Wisconsin Madison. PASER provides a quick, standardized, way of evaluating roadways of all surface types visually, by considering the surface distresses and performance it offers to the driving public.

The visual inspection looks at the pavement distresses and it is up to the inspector to consider the cause of that issue as well as what sorts of repairs might be appropriate for addressing it.

A complete overview of the PASER rating system and the criteria used for each of the pavement types can be found in **Appendix A: PASER Rating System Overview**



Map 1 - Functional Class

- Major Collector
- Minor Collector
- Locally Critical Route
- Local/Residential
- Non-City Maintained Roads
- City Boundary

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2.3 Example Pavement Distresses

Figure 2-3: Example of Alligator Cracking (ASTM)

This image is from the ASTM D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys." Alligator Cracks are when pavement breaks into a "scaly" pattern typically caused by fatigue, either from repeated heavy loads, lack of sufficient subgrade support, or weakened material due to drainage issues.

Figure 2-4: Example of Block Cracking (ASTM)

This image is from the ASTM D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys." Block cracks are when pavement breaks into "chunks" or "blocks" that are roughly rectangular, caused by internal stress from temperature or lack of lateral support.

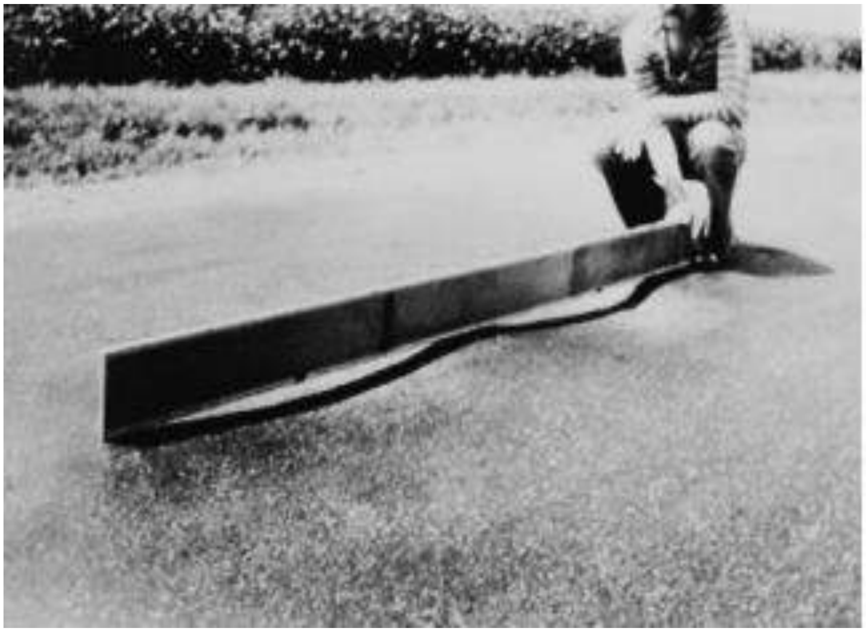


Figure 2-5: Example of Distortion (ASTM)

This image is from the ASTM D6433 “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.” Distortions are when the pavement warps its shape without significant cracking. Typically caused by shifting or displaced underlying material.

Figure 2-6: Example of Transverse Crack (ASTM)

This image is from the ASTM D6433 “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.” A common distress caused by a wide variety of issues.

Figure 2-7: Example of Patching (ASTM)

This image is from the ASTM D6433 “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.” Patching is the result of corrective actions already taken and is indicative of underlying issues as well as a common point of failure.

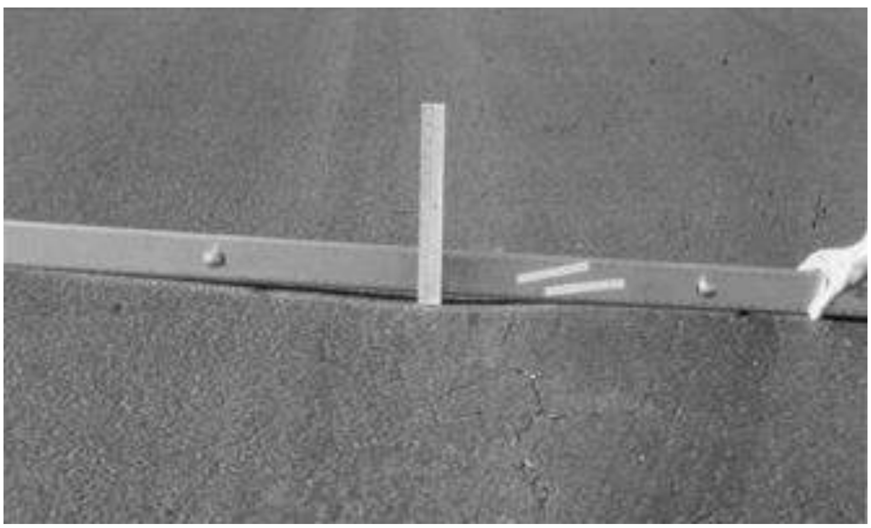


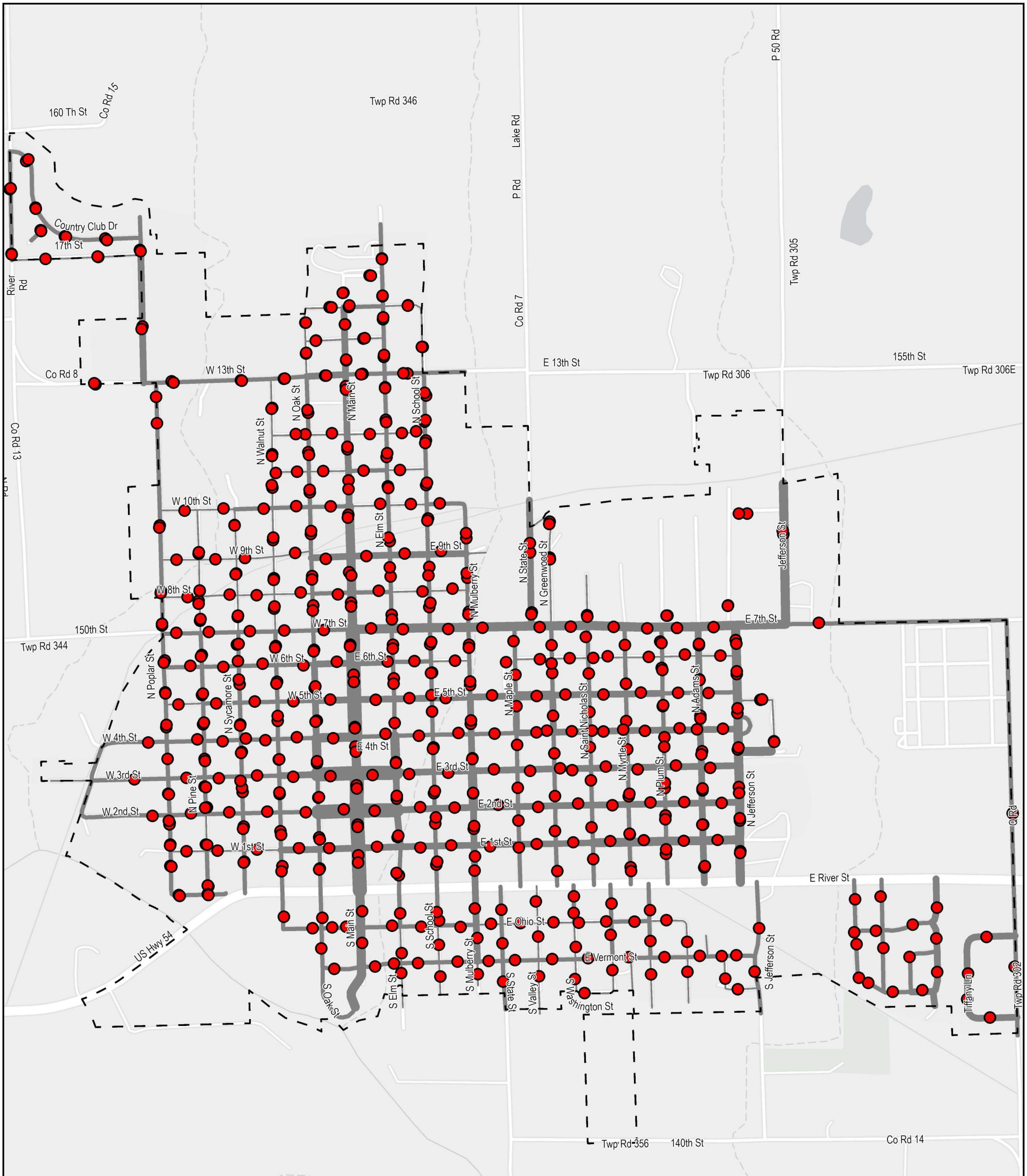
Figure 2-8: Example of Rutting (ASTM)

This image is from the ASTM D6433 “Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys.” Rutting is a depression along the wheel-path caused by traffic loads.

The score used in this plan helps differentiate and prioritize between individual streets, but due to the subjective nature of the collection each project still needs verification and a design by licensed engineers independent of this rating.

Understanding that the difference between a 6/10 rating and a 7/10 could be only a few cracks and may be influenced by time of day and weather, JEO minimized these effects by using two inspectors, working in tandem, to provide independent ratings. The raters were also encouraged to provide multiple ratings on longer sections to make sure accurate coverage. This way, the team rated each management section at least twice and each road assigned the average of all inspections combined.

An overview of the Inspection locations is found in **Map 2 -Inspections & Widths**



Map 2 - Inspections & Widths

Inspection Locations (PASER)

Non-City Maintained Roads

City Boundary

Road Widths (ft)

9 - 19

20 - 29

30 - 39

40 - 54

55 - 72

N

0 0.25 0.5

Miles

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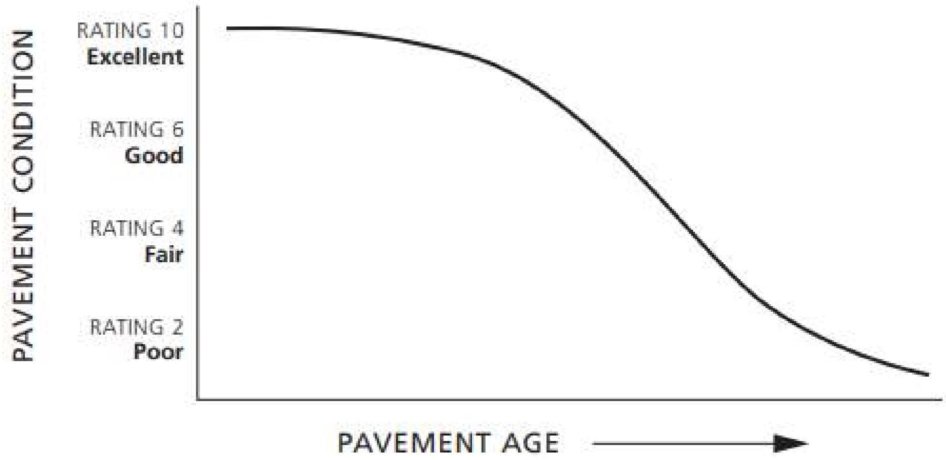
2.3.1 Interpreting Results



In addition to indicating the surface condition of a road, a given rating also includes a recommendation for needed maintenance or repair. This feature of the rating system facilitates its use and enhances its value as a tool in ongoing road maintenance.

RATINGS ARE RELATED TO NEEDED MAINTENANCE OR REPAIR

Rating 9 & 10	No maintenance required
Rating 8	Little or no maintenance
Rating 7	Routine maintenance, cracksealing and minor patching
Rating 5 & 6	Preservative treatments (sealcoating)
Rating 3 & 4	Structural improvement and leveling (overlay or recycling)
Rating 1 & 2	Reconstruction

Figure 2-9: Condition Thresholds (PASER)

This chart shows the relationship between the condition categories, pavement performance, and potential actions.

Like a simple school test, each road receives a grade on a 0 to 10 scale. Unlike those tests, however, the ratings correspond to condition categories and are a more spread out across the entire scale. For example, pavements with PASER ratings below 4 are considered to be “Poor” while those above 8 would be “Excellent.” The category name is preferred to the raw number when discussing the roadways, in order to help with understanding the assessment and to allow the results to be used in a more practical sense. The following section will describe how the ratings correspond to the condition categories.

A PASER score of 9/10 or 10/10 corresponds to an “Excellent” condition. Roads with pavement in “Excellent” condition exhibit very few surface distresses. Those distresses that are visible will be incredibly low in severity. Typically, these pavements are relatively new. The average age of “Excellent” pavement in Eureka is likely less than 15 years, meaning they were either recently constructed or rehabilitated with an overlay. As such, it may not be feasible to expect every street to be “Excellent” because it would require resurfacing every street in that 15-year period.

Figure 2-10: Example of "Excellent" Condition – Main Street

This picture is from south of Main street north of 11th scored 10/10 because it demonstrates no visible pavement distresses.

Pavements with scores of 7/10 and 8/10 are considered to be in "Good" condition. The distresses on these streets are noticeable but are minor and infrequent. Drivers are not affected by the few cracks and distortions. Simple maintenance activities, like crack sealing, will help control the spread of cracks, preserving them for quite some time.

Figure 2-11: Example of "Good" Condition – Main Street

This image is of Main Street at 2nd Street scored 8/10 and considered "Good" for an COM pavement. It exhibits longitudinal cracking and rutting but there are few issues, and each crack is sealed.

Pavement scores of 4/10 and 5/10 represent "Fair" condition roads. The cracking on these streets is more noticeable, with block-cracking up to 50% of the street and ruts up to 1/2 inch. The cracking, however, will be mostly on the surface level. This is the ideal state for most maintenance programs because the structure is still intact. Minor Rehabilitations like micro surfacing or thin overlays can provide excellent results for much cheaper investments.

This is also when a City should start paying attention to a given street and budgeting for its repair. Sometimes the budget is not currently available or other considerations like utility or drainage improvements might justify waiting on a project. Fair pavements may not stay in this state for long, and often drop out of this category quickly. Fortunately, the next category "Poor" still can provide good returns for rehabilitation treatments, but it also represents the last chance to address a deteriorating street before needing a complete reconstruction.

Figure 2-12: Example of "Fair" Condition – North Jefferson Street

This image of North Jefferson scored a 6/10. The distresses are widespread but mostly surface level. The block cracking remains mostly contained and there are no significant distortions. Simple rehabilitation methods would be effective to address these distresses.

"Poor" streets have PASER scores of 3/10 or 4/10 and have quite noticeable distresses. This may be low severity distresses over the entire surface, or a few areas exhibiting high severity distresses. These may not necessarily impact drivers very much, but deep ruts and areas of failure will begin to accelerate the deterioration as water gets into the structure.

This condition category represents the vast majority of roads in Eureka. Across multiple pavement types, rehabilitation and maintenance has been deferred to a noticeable degree.

That said, "Poor" pavements may still be salvageable without requiring excessive financial investment. The city should address these roads through Major Rehabilitations such as Mill and Overlays or localized "dig-outs" of severe distresses to provide repairs to the base material and then follow that by a surface treatment like Microsurfacing.

Figure 2-13: Example of "Poor" Condition – North Mulberry Street

This image of Mulberry street near 1st Street scored 3/10 and assigned a "Poor" rating. The block cracking is across nearly 100% of the street surface and there are significant distortions and failures along the gutter line where water gets trapped regularly.

The final category is "Very Poor" (1-2). At this point, a pavement is 75%-100% of the way through its design life. It will deteriorate quickly, if neglected, and eventually be indistinguishable from a gravel street. These pavements near complete failure are very unpleasant to drive on. In most cases, the only solution for these streets is to completely reconstruct them from the base up.

Figure 2-14: Example of "Very Poor" Condition – East 6th Street.

This picture of East 6th Street shows the portion identified as the worst street in the City. It scored a 1/10 which corresponds to "Very Poor" condition. This portion has several locations of complete failure where the pavement is washed out or obliterated.

2.4 Methods & Means

2.4.1 Pavement Design Considerations

Proper design, construction, and maintenance of the various components of the pavement system are critical to the performance of long-life pavements. For the purposes of this discussion, the pavement system consists of the elements shown in Figure 2-15.

Figure 2-15: Pavement Structure Elements

This diagram identifies the key elements to a pavement system.

2.4.1.1 Pavement Foundations

Local streets are typically constructed from PCC or HMA supported on a natural subgrade. Current research however indicates that agencies should be considering a subgrade stabilization treatment or support layers like aggregate subbases. Support layers serve to improve stability and uniformity for the pavement foundation, which can result in increased pavement service life. Aggregate subbases are particularly important because they also improve drainage beneath the pavement, mitigating common causes of pavement failure. [1]

2.4.1.2 Subgrade Soils

For concrete pavements to perform adequately long-term, its foundation needs uniform support. Historically, pavement foundations are simply natural subgrade and, occasionally, use an aggregate subbase.

If the pavement is placed directly on natural subgrade, preparation is needed to provide uniformity. At a minimum, this includes removing the topsoil or scarification of existing subgrade to a depth of one foot before compacting to a specified depth, density, and moisture content. For additional information, see American Association of State Highway and Transportation Officials (AASHTO) Mechanistic-Empirical Pavement Design Guide (MEPDG).[2] Compaction and density being the most essential elements, are often expressed by the **California Bearing Ratio** (CBR).

Typical soils found in the vicinity of Eureka are moderate to high plasticity soils high in clay and silt. These soil types may experience cycles of volume change as moisture contents vary, which can result in upward swelling in wet seasons and downward movements during dry periods which causes distortions in flexible pavements or even structural damage. The soils encountered in Eureka according to the USDA soil survey are expected to subgrade reaction capacities of 50 to 100 psi/inch, corresponding to low CBRs of 1 to 5.**Table 2-1 : Suitability of Soils for Subgrade** indicates subgrade suitability of various soils, silt and clay being the least desirable types and requiring additional subgrade preparation considerations.

[1] Gross, J., Harrington, D., Wiegand, P., and Cackler, T. Guidance for Improving Foundation Layers to Increase Pavement Performance on Local Roads, Iowa: Report No. TR-640, Iowa Department of Transportation. 2014.

[2] National Academies of Sciences, Engineering, and Medicine. 2014. *Implementation of the AASHTO Mechanistic-Empirical Pavement Design Guide and Software*. Washington, DC: The National Academies Press.

When constructing pavement (rigid or flexible) on natural subgrade exposed to poor drainage or soils, there may be soil breakdown and movement due to freeze-thaw and traffic loading.[1]

Variability in the soil affects rigid and flexible pavements differently. Rigid pavements transfer the load to the aggregate subbase and subgrade foundation less than flexible asphalt pavements because they distribute the load across a larger area. A 100-psi tire load results in less than 5 psi to the aggregate subbase for rigid pavement and is approximately 20 psi to the aggregate subbase for a flexible asphalt pavement. Therefore, asphalt pavement requires a thicker aggregate subbase or a thicker pavement to provide adequate support compared to a concrete pavement.

Table 2-1 : Suitability of Soils for Subgrade

Table 6E-1.01: Suitability of Soils for Subgrade Applications

Subgrade Soils for Design	Unified Soil Classifications	Load Support and Drainage Characteristics	Modulus of Subgrade Reaction (k), psi/inch	Resilient Modulus (M_R), psi	CBR Range
Crushed Stone	GW, GP, and GU	Excellent support and drainage characteristics with no frost potential	220 to 250	Greater than 5,700	30 to 80
Gravel	GW, GP, and GU	Excellent support and drainage characteristics with very slight frost potential	200 to 220	4,500 to 5,700	30 to 80
Silty gravel	GW-GM, GP-GM, and GM	Good support and fair drainage, characteristics with moderate frost potential	150 to 200	4,000 to 5,700	20 to 60
Sand	SW, SP, GP-GM, and GM	Good support and excellent drainage characteristics with very slight frost potential	150 to 200	4,000 to 5,700	10 to 40
Silty sand	SM, non-plastic (NP), and >35% silt (minus #200)	Poor support and poor drainage with very high frost potential	100 to 150	2,700 to 4,000	5 to 30
Silty sand	SM, Plasticity Index (PI) <10, and <35 % silt	Poor support and fair to poor drainage with moderate to high frost potential	100 to 150	2,700 to 4,000	5 to 20
Silt	ML, >50% silt, liquid limit <40, and PI <10	Poor support and impervious drainage with very high frost value	50 to 100	1,000 to 2,700	1 to 15
Clay	CL, liquid limit >40 and PI >10	Very poor support and impervious drainage with high frost potential	50 to 100	1,000 to 2,700	1 to 15

Source: American Concrete Pavement Association; Asphalt Paving Association; State of Ohio; State of Iowa; Rollings and Rollings 1996.

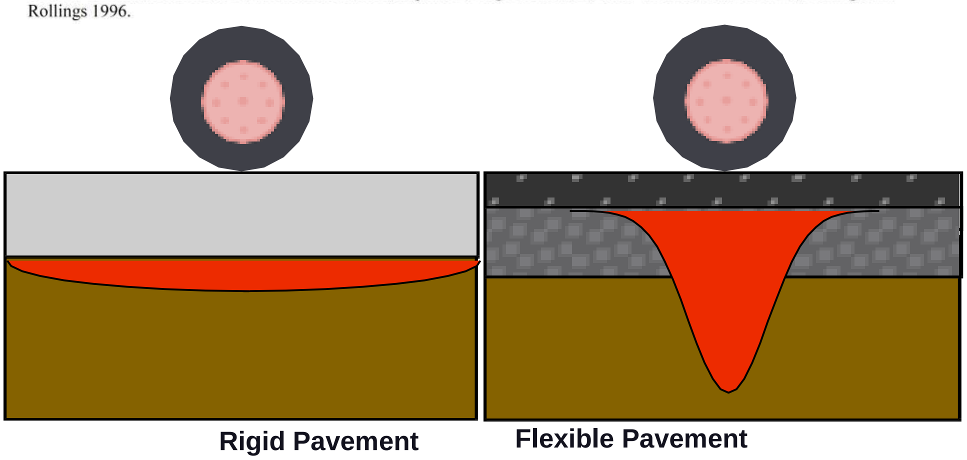


Figure 2-16: Subgrade Reaction (Gross)[1]

This diagram shows how loads are distributed differently based on surface type.

2.4.1.3 Chemical Stabilized Subgrade

Chemical Subgrade Stabilization is primarily for those situations where subsurface drainage is a concern.

High moisture soils encountered during construction from naturally high-water tables, seasonal rainfall, or changes to drainage during construction must be addressed prior to constructing an aggregate subbase or pavement. Installing subdrains or letting the soil dry out often is impractical due to construction timelines, so chemical stabilization may be prudent.[3]

Chemical subgrade stabilizers, like cement modified soils or fly ash, will dry out excessive moisture and provide more uniformity as a construction platform, thereby reducing delays to the construction process. When using chemical stabilizers, the percentage of stabilizer needs to be considered against water content, soil type and desired freeze- thaw performance. [3]

Cement Modified Soils (CMS) are soils or manufactured aggregates mixed with a small portion of Portland cement. CMS prevents soil from shifting and water from infiltrating into the aggregate subbase, as well as providing additional strength to the subgrade. CMS are most common with fine grained soils, such as silts and clays with high plasticity. Typically, cement equivalent to 3 to 5 percent of the soil's dry weight is incorporated into the mix to achieve the desired strength. [3]

Another approach to chemical stabilization is incorporating 10 to 15 percent fly ash (dry weight) into the existing subgrade. Fly ash can improve the subgrade CBR by 20 or more index points. It also improves the compressive strength by a factor of 7-8. Fly ash stabilized subgrades also reduce the shrink-swell potential of clay soils because it is such a good drying agent.[3]

2.4.1.4 Physically Reinforced Stabilized Subgrade

Where water is less of a concern but strengthening is desired for subgrades with poor bearing capacities, physical reinforcement may be desired. Reinforced subgrade treatments are best used when subgrades are unstable (soft) but not extremely high in moisture content. This may be accomplished using geosynthetics, such as geogrids and non-woven geofabrics.

Geosynthetics work by reducing the ability of subgrades and subbase layers from spreading out horizontally from the point of compression, supporting loads with the compressive strength of the material rather than its material cohesion. This means they are potentially very impactful on flexible pavements in particular. As such, these are recommended for most new HMA construction within Eureka.[3]

Figure 2-17: Geogrid (Defense Visual Information Distribution Service)

This image shows a Geotextile placed within a crater during an airfield damage repair exercise.

[3] Taylor, P., Zhang, J., Wang, X. Conclusions from the Investigation of Deterioration of Joints in Concrete Pavement, Report No. TPF-5(224), Federal Highway Administration, 2016.; ACPA, Subgrades and Subbases for Concrete Pavements, EB204P, American Concrete Pavement Association, 2007.

2.4.1.5 Unstabilized Aggregate Subbases

Unstabilized Aggregate subbases are appropriate when a stable and uniform construction platform is desired. (ACPA 2007) Aggregate subbase support layers provide a working platform during construction, support through uniformity, and serve as a drainage system to direct water out from beneath the main body of pavement. If an aggregate subbase is used, subdrains and outlets are recommended to complete the drainage system where local soils have poor permeability or easily transported due to a high content of fines.

Commonly used aggregate subbase materials include modified subbase, granular subbase and special backfill. Normal specifications for modified subbase and special backfill allow for crushed stone, gravels, and recycled pavement materials meeting material with a maximum of 50 percent RAP (Reclaimed Asphalt Pavement). [4]

Benefits to aggregate subbases:

- Increase service life.
- Provide a construction platform.
- Offer uniform pavement support.
- Prevent water infiltration beneath pavement.
- Reduce shrink/swell of volume-change susceptible soils.
- Control frost heave.
- Minimizes transport of fine-grained soils.
- Prevent subgrade consolidation.
- Cut off capillary action for high water tables.

Aggregate subbases are recommended for all new pavements and full-depth repairs.

2.4.1.6 Subdrains

Drainage is critical to long-term performance of all pavements. Surface drainage should be managed through a variety of options such as properly designed ditches, intakes feeding underground pipe systems, or green infrastructure solutions. Subsurface drainage, on the other hand, needs to be addressed as part of the pavement foundation.

Subsurface drainage is best achieved through the use of an aggregate subbase with subdrain outlets. It is important to prepare the subgrade prior to the placement of the aggregate subbase to achieve the best performance.[5][6] Geotextiles such as engineering fabric wrapped around perforated subdrain or along the subgrade/subbase interface may be considered to prevent soil settlement or voiding.

[4] Gross, J., Harrington, D., Wiegand, P., and Cackler, T. Guidance for Improving Foundation Layers to Increase Pavement Performance on Local Roads, Iowa: Report No. TR-640, Iowa Department of Transportation. 2014.

[5] Taylor, P., Zhang, J., Wang, X. Conclusions from the Investigation of Deterioration of Joints in Concrete Pavement, Report No. TPF-5(224), Federal Highway Administration, 2016.; ACPA, Subgrades and Subbases for Concrete Pavements, EB204P, American Concrete Pavement Association, 2007.

[6] Schaefer, V., Stevens, L., White, D., Ceylan, H. Design Guide for Improved Quality of Roadway Subgrades and Subbases, Iowa: Report No. TR-525, Iowa Department of Transportation, 2008.

Figure 2-18: Perforated Subdrain Pipe (SnapColor)
This image shows a closeup shot of a perforated drainpipe.

2.4.1.7 Pavement Foundation Recommendations

The performance of a pavement depends heavily on its subgrade and subbase layers. These foundational layers play a key role in mitigating the effects of climate and traffic. Therefore, building a stable subgrade and a properly drained subbase is vital to an effective and long-lasting pavement system.[6]

To properly determine the appropriate approach for subgrade stabilization and subbase design, it is recommended that agencies perform a geotechnical investigation for most projects. It is important the existing subgrade conditions are understood for selecting proper treatments, when necessary, and what specifications can be made to best provide uniform support.[4, 6]

Subgrade provides support to the entire pavement system, and it is crucial that engineers develop a subgrade with a CBR value of at least 10 for best performance. Research has shown that subgrades with CBR values less than 10 will deflect the pavement or subbase under traffic loadings causing premature pavement deterioration[2]. Stabilization of on-site soil may be required to achieve this goal.

The subbase layer of aggregate material below the pavement provides drainage and stability. It is crucial that engineers provide stable, permeable subbases, preferably with longitudinal subdrains[2]. According to the MEPDG analysis for low volume roads, rigid pavement systems with aggregate subbases thicker than 5 inches do not show a significant benefit over thicker sections. Two thickness options to consider are A) 6” or more subbase to accommodate migration of soil into the aggregate, or B) 4”-5” of subbase with a separation layer of geotextile. [6]

Longitudinal subdrains are ideal for providing positive subsurface drainage. Rigid or corrugated plastic pipe, 6” in diameter, with perforations, and sufficient outlets are recommended. In areas where parallel storm sewer is present, the storm sewer piping itself along with porous backfill may serve as an alternative to longitudinal subdrains.

2.4.1.8 Pavement Thickness

- It is typical practice to use a pre-determined minimum pavement thickness for local roads. These minimum thicknesses are typically 5 to 7 inches. [5]
- Modifying the design parameters for improved foundations with geotextiles and aggregate subbases will not decrease the thickness design significantly. [5]
- HMA pavements are typically designed for 30 to 50 years of service based on a pavement thickness design. Some older pavements were designed for 20 years, if designed at all. [7]

The proposed minimum thickness for Eureka Pavements is 6" based on the AASHTO Guide for the Design of Pavement Structures, which is used throughout the industry for pavement thickness design.

For reference Kansas City Metro region uses a typical section of:

- ▷ 6" HMA (2" Surface course of Type 5-01 or Type 3-01, over Type 1 Base Course)
- ▷ 6" Aggregate Subbase
- ▷ 6" Compacted subgrade (95% standard density)

2.4.1.9 Hot-Mix Asphalt Design

HMA stability is primarily determined by the subgrade and subbase support and the asphalt mix itself.

HMA design depends on traffic volumes, using calculated equivalent single axle load (ESAL) values. Roadways with design ESAL values greater than 10,000,000 require detailed design analysis, preferably using the (AASHTO) Mechanistic-Empirical Pavement Design Guide (MEPDG) process. Local streets are often all under that threshold and can use the more standardized approach.

LIFT THICKNESS

Base courses should be 3", at minimum to prevent interim cracking. Minimum lift thicknesses should not be less than 1.5-inches for surface courses, and no less than 3/4" for Binder and Levelling courses, for structural stability related to aggregate sizes.

BINDER SELECTION

Due to low speeds on local streets, it is recommended that stiffer binder grades be used. KDOT historically has used a PG58-28 standard binder and recently is moving towards a PG64-28 or PG64-22 in southern Kansas.

Due to its wide-spread use within Kansas and nationwide as a good asphalt binder for local operations it is recommended that Eureka continue to **use the PG58-28 binder** until further literature is available to review the long-term use of the alternatives.

[7] American Association of State Highway and Transportation Officials. (1993). AASHTO guide for design of pavement structures, 1993. The Association.

2.4.2 Treatment Alternatives

A pavement treatment, when properly applied, can extend roadway service life by as much 15 years, but agencies should know what treatments to consider. Dozens of products and techniques are available though not all treatment options are feasible, affordable, or effective.

The treatments available can be thought of as a "toolbox" filled with options. The toolbox recommended by JEO consists of three primary types of treatments: **Reconstruction, Rehabilitation, and Restoration.**

Every pavement will deteriorate to a point it cannot economically be repaired leaving reconstruction as the only viable option. Reconstructing a road, base up, is always an effective treatment, but is also the most expensive option, which is why rehabilitation fills a vital role in a pavement's life-cycle.

Rehabilitation treatments cost significantly less than complete reconstruction and should still extend a pavement's life significantly. Rehabilitation treatments in this report are split into "major" and "minor" treatments based on the desired timing of when to apply them. Major Rehabilitations provide structural improvements, whereas Minor Rehabilitations are typically more preventative in nature, focused on keeping water out and providing a smooth surface.

The last category is Restoration treatments, also called "preservation" or "maintenance" treatments. These Restoration treatments are applied regularly to prevent surface distresses or contain their spread.

2.4.2.1 Reconstruction

Reconstruction is sometimes the only way to save a pavement. Due to the cost, in most communities have reconstruction needs well exceeding their available funding. This treatment type is reserved for high-profile corridors where safety and capacity needs are paramount and local routes when funding allows.

Communities can reconstruct a pavement using PCC, HMA or a composite of the two, but in Eureka it is assumed that the best approach is to use primarily HMA based on cost and availability.

The other benefit of Reconstruction is that it provides the opportunity to repair or replace underground utilities, install drainage upgrades, or reconfigure the roadway for safety and performance. One cost-saving measure to consider is narrowing wide roadway sections to a standard 24' or 29' cross section to reduce costs. If the roadway is low enough in traffic, use of a chip-seal material might be considered instead of a full depth HMA pavement, although the foundation design should remain mostly the same.

Figure 2-19: Reconstruction of I-94 (NDDOT)
This photo shows the Construction of a brand-new asphalt cement concrete pavement.

2.4.2.2 Major Rehabilitation Treatments

- Thick Overlay
- Mill and Overlay

The primary way to rehabilitate roads is adding new concrete on top of the old. HMA is the most commonly material often called black-topping. The two main Major rehabilitations to consider are each variants of black topping where thick layers of HMA are placed upon existing pavements.

"Thick Overlays" are recommended for most roads towards the end of their normal service lives and should use a minimum of 3 inches of HMA. Any less than that will not provide significant structural benefit. Amounts greater than 3 inches, however, may result in drawbacks related to cost and logistical difficulties. HMA overlays can impact side street tie-ins/slopes, change drainage patterns, require driveway modifications, and cover curb faces to the point where there is little remaining capacity to control storm water.

Figure 2-20: HMA Overlay Placed On Milled Pavement (Famartin)
This asphalt overlay was placed on I-80 in Elko, Nevada after the original asphalt pavement was milled.

For full-depth HMA pavements or a composite pavement, milling the top 2-3 inches provides significant benefits. The milling will smooth the underlying pavement surface, remove harmful surface defects, offer a more stable bond with the overlay, and prevent some of the logistical difficulties with side streets, drainage, driveways, and curbs. **"Mill and Overlay"** treatments are the quintessential way to keep HMA surfaces in good repair. After a new HMA street is constructed or once the first thick overlay is placed, it should be milled off roughly every 15 years and replaced to keep the surface in prime condition.

Other major rehabilitations, such as hot-in-place recycling and cold-in-place recycling, are not recommended for urban environments. The equipment required has strict requirements for staging and timing. Even where it is physically feasible, they can be excessively disruptive to local traffic and create a mess of adjacent properties.

2.4.2.3 Minor Rehabilitation Treatments

- Slurry Seal
- Thin Overlay
- Microsurfacing
- Bituminous Seal Coat (Chip Seal)
- Cape Seal
- Asphalt Rejuvenators

Minor Rehabilitations are placed to prevent moisture and seasonal weather effects, like rain and heat, from causing damage. They seal the pavement from water infiltration, reverse surface oxidation, and provide nice smooth surfaces for vehicles to drive on instead of the damaged underlying pavement.

Bituminous Seal Coats, also known as **Chip Seals**, are effective treatments for improving friction, inhibiting raveling, correcting roughness, and sealing the pavement surface from moisture. Bituminous Seal Coats can typically address longitudinal and transverse cracking as well as minor block cracking and medium severity fatigue cracks. Chip Seals can even be applied in multiple layers to address more serious problems.

Chip Seal applications consist of an asphalt emulsion applied directly to the existing pavement followed by placing a ½ inch to 1-inch-thick layer of aggregate "chips" atop the emulsion. Those chips are then rolled into the emulsion to embed them. Some approaches may follow this up with an additional pass of binder, or "pre-coat" the chips with binder prior to spreading them out.

Ship seals are a cost-effective and versatile treatment but in many urban environments they are not well liked. Loose aggregate chips that fail to bond to the surface can be kicked up by tires and some of the binder and chips can get tracked onto neighboring streets leaving black tread-marks and dark debris.

Figure 2-21: Close-up View of Chip Seal Surface

This picture is a close-up of a chip seal showing the coarseness and loose aggregates of the new surface, compared to other treatments that evenly mix the aggregate into the binder.

Slurry Seals are one of the most common surface treatments in the United States for rehabilitating asphalt pavements, though rare in more northern and midwestern regions. Slurry Seals can address low-severity cracks, waterproof the pavement, and restore surface friction for driver safety. Slurry seals primarily address surface distresses like raveling, oxidation, and polishing.

The treatment is performed by spreading a mixture of crushed, well-graded aggregate, mineral filler, and asphalt emulsion across the pavement or sometimes as a strip for targeted spot treatments. The thickness of slurry seals is normally less than 1/2 inch. In ideal cases it can extend an HMA pavement's life by up to 7 years, however, the minimal aggregate means it is not capable of providing structural support or addressing anything beyond superficial distresses.

Figure 2-22: Slurry Seal Being Placed (NAVFAC)

This slurry seal machine is shown being used during a Naval facility training session to highlight how the cost-effective maintenance treatment can benefit the Public Works Department Joint Base Pearl Harbor-Hickam.

Thin Overlays are the same as a Thick Overlay. The main difference is the thickness. Thin overlays are only 1-2 inches of HMA. Some thin overlays use a special high-performance binder modified with polymers for greater stiffness. The recommended thickness for normal us 1 ½ inches because thinner applications may be susceptible to cracking or rutting, particularly due to vehicle loads. Thin Overlays are of more broad use than Chip Seals and Slurry Seals but are still of limited use on roadways with significant surface deformities like rutting and warping or structural distresses such as severe alligator cracking. Commonly recycled asphalt and rubber materials are used in Thin Overlays to reduce costs and potentially increase durability.

Microsurfacing is gaining more popularity throughout the country and is many agencies' go-to option for pavement rehabilitation these days. It consists of a thin layer of asphaltic material, like a slurry seal, but instead uses a polymerized binder with finer aggregates. This treatment is capable of smoothing over minor deformities and adding a small amount of structural durability. It can be a versatile and relatively cheap treatment that still seals the pavement from water intrusion while doubling as a way to address a wide variety of minor distresses.

Figure 2-23: Microsurfacing Crew at Work. (Eric Pulley).
This picture shows a crew using a Microsurfacing machine to lay a new surface on this street.

Cape Seals are a powerful and affordable alternative to overlays that use a Chip Seal as a base but then is finished it with a Slurry Seal or a layer of Microsurfacing over the top. By using the second treatment, the loose aggregate is locked in, and surface is both smoother and more durable. The secondary coat also inhibits the binder bleeding. This approach has many of the same benefits as Thin Overlays but often at a decreased cost.

Figure 2-24: Cape Seal (Michael Quinn-NPS)
This picture taken by the National Parks Service in Grand Canyon National Park shows a loose chip seal (right) that is being sealed with a slurry treatment (left) as part of a cape seal.

Asphalt Rejuvenators are a growing sector of pavement maintenance products that claim to restore asphalt conditions via simple surface treatments. These treatments use special proprietary emulsions of asphaltic materials that theoretically penetrate into the pavement structure and seal the upper pavement layers and supposedly replaces binder material lost to oxidation. Many manufacturers recommend applying these products every 3-5 years as a preventative treatment. Further long-term cost-benefit analysis is still needed but there are products readily available within the region and are being used by agencies like El Dorado.

Figure 2-25 : Proprietary Asphalt Rejuvenator (Tricor Refining)
Figure shows a machine spreading the Reclamite product to rejuvenate the asphalt.

2.4.2.4 Restoration Treatments

- Crack Sealing
- Pavement Patching

Restoration treatments use simple techniques to seal pavements from moisture infiltration and prevent the spread of minor defects.

The most cost-effective and universal treatments is **Crack Sealing**. Crack sealing is recommended to be performed on individual roads every 3-5 years. This is often done by city staff but bid packages for contractors may be considered if the timing and amount of work are warranted.

Cracks that have rough or loose edges may need the opening cleaned out corrected using a concrete saw or router to improve the sealant bond. The sawing or routing approach is not recommended as the standard approach, however, due to inconsistent cost-benefit performance in scientific studies.

Crack Sealing, on a regular schedule, is the most valuable tool in any pavement management program. It really keeps fair or good condition pavement lasting much longer than they otherwise would unattended.

Figure 2-26: Crack Sealing Performed W/ Routing (USAF/Kenna Jackson)
This is an example of crack sealing being performed with special preparation in the form of using a router to clean up the crack profile, as being performed by 35th Civil Engineer Squadron

Pavement Patching differs from Crack Sealing based on the proper timing window. Patching normally is performed *after* a pavement distress has appeared rather than as a preventative measure.

Patching is typically performed with HMA, sometimes with partial removals. Critically, patching is not a long-term fix and should not be used as such. It serves as a way to maintain service, acting as a stopgap, until a more permanent solution can be applied.

When a surface defect is due to a structural failure it is recommended that the full depth of the pavement is removed followed by the base material as appropriate. This full-depth patching (or FDP) can be costly, but often is the only way to address recurrent potholes, faulting/spalling, or edge/corner breaks.

By default, surface patching should be performed using localized removals, cutting a rectangular or square shape into the pavement, and replacing it with new HMA pavement after ensuring the base-material is sound.

When patching accounts for 20% of a pavement area, or the existing patches are older than 5 years, that is an indication greater intervention is warranted. Patching beyond that point will no longer be cost-effective. Major Rehabilitations or Reconstructions ought to be considered and patching limited solely to keeping the roadway safely passable.

Figure 2-27: HMA Patching with Localized Pavement Removal (KOMU)
This is an example of an asphalt patch applied with appropriate localized removals and some base repair.

2.4.2.5 Preferred Treatment Alternatives

Table 2-2: Primary Capabilities & Functions Of HMA Pavement Preservation Treatments

Source: Adapted from Johnson, Best Practices Handbook on Asphalt Pavement Maintenance, 2000.

Treatment	Reasons for Use						
	Friction	Raveling	Rutting	Potholes	Cracking		
					Low	Med	High
Crack Treatments							
Crack Repair with Sealing							
Clean and Seal					X	X	
Saw and Seal							
Rout and Seal					X	X	
Crack Filling						X	X
Full Depth Crack Repair							X
Surface Treatments							
Fog Seal		X					
Seal Coat	X	X					
Double Chip Seal	X	X					
Slurry Seal	X	X					
Microsurfacing	X	X	X				
Thin Overlay		X	X				
Pothole and Patching Repair							
Cold Mix Asphalt				X			
Spray Injection Patching				X			
Hot Mix Asphalt				X			X
Patching with Slurring or Microsurfacing Material				X			X

Table 2-3: General Expected Performance of Maintenance Treatments

Source: Adapted from Iowa Statewide Urban Design and Specification guide.

Treatment	Expected Performance (Treatment Life), Years
PCC	
Crack Sealing	4 to 8
Joint Resealing	4 to 8
Partial Depth Patches	5 to 15
Full Depth Patches	10 to 15
Diamond Grinding	5 to 15
Pavement Undersealing/Stabilization	5 to 10
HMA	
Crack Filling	2 to 4
Crack Sealing	2 to 8
Pothole Patching	1 to 3
Full/Partial Depth Patches	3 to 15
Fog Seals	1 to 3
Slurry Seals	3 to 6
Microsurfacing	4 to 7
Bituminous Seal Coats	4 to 6
Double Chip Seal	7 to 10
Thin Overlays	7 to 10

All the treatments in this section may be considered for projects, although some are more preferred than others. The recommended CIP will not differentiate between types of projects within the same treatment category, as the actual treatment selection should be performed on a project-by-project basis and reviewed by a Professional Engineer. **Table 2-2** provides some simple guidance on which types of treatments are appropriate based on the distresses that a pavement presents and **Table 2-3** helps compare the effectiveness of each treatment over time.

The treatments used in the project selection model represent those expected to be the most common given certain conditions. These “preferred treatments” comprise the most likely pavement options, but this is merely a tool to aid budgeting/planning and is not a prescriptive result. These recommendations still need individual assessment for appropriateness against similar treatment alternatives during design prior to construction.

2.4.2.6 Estimated Treatment Costs

One of the critical considerations for financial planning is accurate cost predictions. For pavement management the primary costs are design, construction, and tertiary costs associated with typical roadway improvement projects. Historical costs from KDOT circulars were used to estimate unit costs within the region. A 2.1% growth factor was used to account for cost inflation[8,9,10,11,12] and applied to all projected costs.

Each treatment type was assigned planning-level costs using local cost information and the tabulations from KDOT. Assumptions were made regarding mobilization rates, design fees, traffic control, and other costs based on percentages of the overall costs of similar projects. The resultant costs used in this report are intended as planning-level only. It is still recommended that each project be reviewed during the annual capital improvement budgeting process and each proposed project be examined by a licensed engineer for ripeness and reasonableness. The City may then elect to move projects around, change budgets, or change from the suggested treatment.

Detailed information on how the typical treatment costs were calculated can be found in **Appendix B:Treatment Cost Estimation**

For most practical purposes, treatments within the same category may be considered interchangeable. The actual treatment applied should be based on a field review and engineering judgement. When determining the actual project scope, prior to design, a Life-Cycle Cost Analysis may be useful to evaluate treatment alternative, or when deciding to leave the street it to be reconstructed, later on.

2.4.2.7 Treatment Selection Criteria (Toolbox)

For each treatment alternative selected for the toolbox, the selection criteria and costs needed to be considered. Funding is regularly the deciding factor for local agencies when deciding on projects, so it is important to get the most benefit for the least investment. Therefore, cost estimates for each treatment were developed using bid tabulations and project histories from various cities' pavement management programs.

The other main factors in treatment selection are condition and distresses. The overall condition of a pavement should determine when it needs work and what type of work. The types of distresses should then be considered when evaluating equivalent treatments based on appropriateness. **Table 2-4** includes a full overview of the treatment toolbox with descriptions, cost estimates, triggers, and the expected effects of each individual treatment alternative. This information is what will be used in the modelling process.

[8] HDR and CH2M Hill, Memo to Lucia Ramirez of Oregon department of Transportation; Discounting Recommendations for Least Cost Planning in Oregon, March 15, 2011

[9] Office of Management and Budget. (October 2022). Advisory Circular A-94. DISCOUNT RATES FOR COST-EFFECTIVENESS, LEASE PURCHASE, AND RELATED ANALYSES Appendix C

[10] Mack, J. W. Accounting for Inflation in Life Cycle Cost Analysis for Pavement Type Selection. Transportation Research Board, Vol. 12, No. 2686, 2011.

[11] Life-Cycle Cost Analysis in Pavement Design. Pavement Division Interim Technical Bulletin. Publication FHWA-SA-98-079. FHWA, U.S. Department of Transportation, Sept. 1998

[12] Mack, James W. "Accounting for material-specific inflation rates in life-cycle cost analysis for pavement type selection." Transportation research record 2304.1 (2012): 86-96.

Table 2-4: Treatment Alternative Details

Category	Treatment	Description	Cost	Trigger
Reconstruction	HMA Reconstruction	Complete reconstruction. Assumes new 6" pavement, 6" subbase, geofabric, and subgrade prep.	$149/sy	Poor OR Very Poor
	Double Chip Seal	Pulverize and shape existing chip seal pavement, improve drainage with edge drains or ditch cleaning, followed by double chip seal.	$30/sy	Very Poor, Surface = SEAL
Major Rehabilitation	Mill & Overlay	1.5 to 3 inches of HMA milled off followed by 3-inch HMA overlay. Repairs surface issues and improves structural character.	$41/sy	Poor, Surface = HMA/COM, Moderate Alligator Cracking
	Thick Overlay	3-inch HMA "structural" overlay. Increases durability and provides a new wearing surface. May require replacing curb and gutter.	$47/sy	Poor, Moderate Alligator Cracking, Moderate Patching
Minor Rehabilitation	Thin Overlay	1.5 inch "non-structural overlay." Improves smoothness and extends the life of roads in good to fair condition.	$20/sy	Poor or Fair, Low Alligator Cracking, Low Patching, Low Rutting
	Cape Seal	½-inch Chip Seal followed by Microsurfacing layer. Corrects minor structural defects.	$22/sy	Fair or Good, Surface=HMA, Low Alligator Cracking, Low Patching, Low Rutting
	Microsurfacing	A thin asphalt polymer that seals the pavement from weather effects and corrects for minor irregularities. Typically used as a preventative measure, rather than a corrective one.	$6/sy	PCI = Fair or Good, Low D Crack, Low Alligator Cracking, Low Patching, Moderate Rutting
	Slurry Seal	¼-inch slurry treatment. Addresses low-severity cracks, waterproofs the pavement, and restores surface friction.	$6/sy	Fair or Good, Surface=HMA, Low Alligator Cracking, Low Patching, Low Rutting
	Asphalt Rejuvenator	Special emulsion to restore surface and seal from water.	$2/sy	Good, Surface=HMA, No Alligator Cracking, Low Patching, No Rutting
	Chip Seal	½-inch Chip Seal treatment. Improves friction, inhibits raveling, corrects roughness, and seals the pavement surface.	$14/sy	Fair or Good, Surface=SEAL/HMA, Low Alligator Cracking, Low Patching, Low Rutting, Local Only.
	Gravel Resurfacing	3" Granular Material placed and shaped, potential drainage improvements or edge drains.	$5/sy	Very Poor to Fair, Surface=Gravel.
Restoration/ Preservation	Crack Sealing	Sealant on cracks used to prevent spreading and moisture from getting into the pavement structure. Deteriorated cracks may be routed or sawed out to provide better seal and bond.	$2/sy	Applied every 3-5 years.
	Pavement Patching	HMA repairs at spot locations. Stop-gap on poor pavements until a better, more permanent, solution is applied.	$3.5/sy	Good w/ Minor-Severity Defects or Poor w/ Small High-Severity Defects

The treatment costs listed in Table 2-4 are "all-in" numbers. These costs represent the materials as well as all other costs associated with the given treatment type. For example: Thick Overlays include driveway and sidewalk repairs, and the Reconstruction treatment includes storm sewer. Please note, however, that these are **planning-level costs**. While based on engineering judgement and historical bid tabulations, they are not a replacement for a licensed engineer's opinion of probable cost.

2.4.2.8 Maintaining Chip Seal Roadways

The City has roadways constructed via certain methods called “seal coat roads” or “chip seal roads.” These streets were constructed using a few layers of bituminous seal coats over compacted dirt subgrade, or sometimes a rock base.

The technique has fallen out of favor though they are still common throughout rural regions in the US, particularly the Mid-West. Once thought of as a cost saving measure due to low construction costs, this method made it affordable for cities and developers to construct new roads, but they have short life-spans, only 4-7 years. They can also be relatively cheap to maintain, given a single chip seal coat will improve the surface to “like-new.”

Figure 2-28: Chip Seal Road (laggnugg)

Photo of a chip seal road built on natural subgrade at a Naval Support Facility in Kamiseya.

Unfortunately, many municipalities are learning that the long-term cost of re-paving streets on such a frequent basis is nearly as expensive as a traditional pavement. It also increases the average annual workload for City staff. There are also some considerable issues endemic to Chip Seal construction. Often these streets are constructed without drainage improvements, nor do they have sufficient structural integrity. Severe weather or unexpectedly heavy loads can cause seal coat streets to fail. Even the most well-kept seal coat streets will have loose aggregate, edge failures, and binder bleeding.

Many communities are now dedicating portions of their budgets to rebuilding these streets using modern standards to escape the cycle of rapid decline and catch-up. Their main motivator is to reduce costs, long-term, by building them as traditional HMA or PCC pavements alongside curbs and storm sewer systems.

When determining how to best maintain seal coat streets, it is important to understand they do not function like traditional pavements. Patching and crack sealing are ineffective, nor is there enough structural stability to place overlays over-top. The only improvement options are reconstruction, “re-sealing," or minor drainage improvements.

National Cooperative Highway Research Program (NCHRP) Synthesis 342 and the **FHWA Guide to Preventative Maintenance Treatments** highlight key design components and recommended best practices related to Chip Seals. Aggregate quality and weather conditions when laid are the most impactful factors in chip seal design, but there are secondary considerations within the City’s control.

For example: to prevent reflective cracking from deeper existing distresses, geotextile fabric or interlayer tack coats can be used. Another example is polymer-modified binders can provide better structural support to mitigate rutting or distortions.

To extend the life of chip seal pavements three main improvements are recommended:

- Where subgrade or base material are insufficient structurally, consider using double chip seal coats.
- Roads carrying heavier loads should consider using slurry, or Microsurfacing seal coats over the chip seal to convert it to a Cape Seal.
- Where alligator cracking and potholing are present, add edge drains and grade ditches to stabilize the pavement by preventing drainage problems. Ensure the pavement slopes are sufficient to drain.
- When edge cracking is occurring, stabilize the pavement edge or bank. Grind down the pavement center to flatten the street's peak to better distribute vehicle loads.

2.4.2.9 Design Comparisons

To assist the City in determining when and where to deploy the proposed construction standards or whether Seal Coat is the right pavement type for certain roadways a long-term cost comparison was performed to compare the apparent design characteristics for local HMA roads, typical Seal Coat roads, and the proposed design. The analysis used the treatment cost calculations for a 27-foot-wide road that is 1320-feet long (1/4 Mile). The treatments were assigned at the prescribed frequencies over a 50-year period. This period is the standard Life-Cycle Cost-Analysis period as well as the expected service life of the proposed HMA standard.

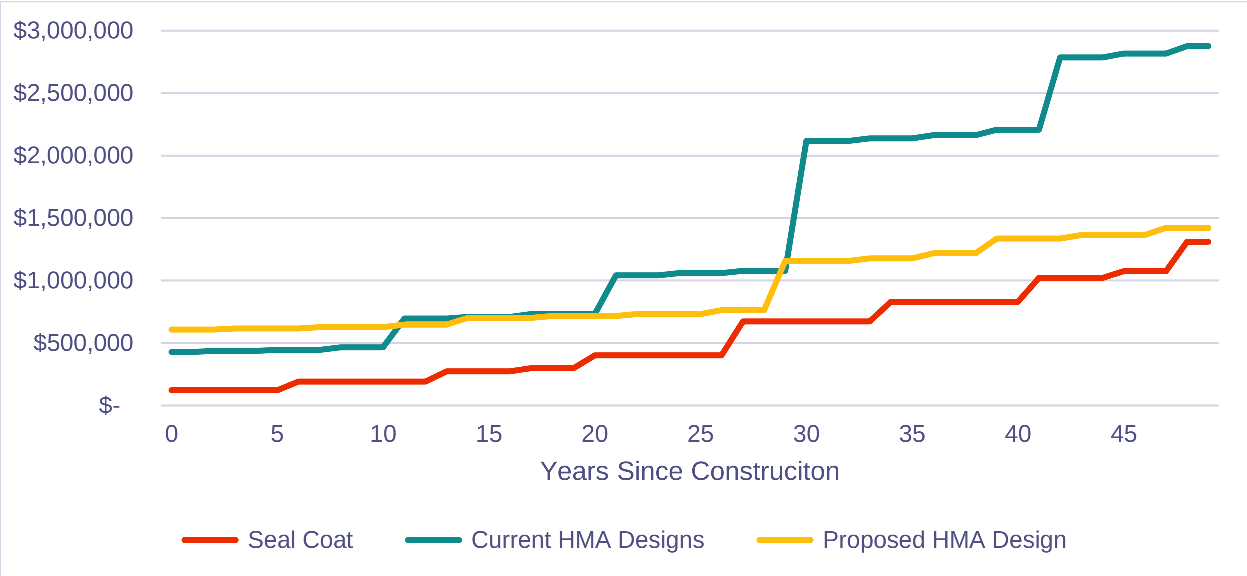


Figure 2-29: Life-Cycle Cost Comparison of Pavement Designs

The graph shows the life-cycle costs for Seal Coat pavements, the existing apparent residential standard, and the proposed design characteristics explored previously in this section.

Surprisingly, the long-term costs of Seal Coat streets are very similar to the proposed 50-year design-life HMA pavement. The high initial cost 50-year HMA design combined with very reasonable bid prices for Seal Coating in this region of Kansas and are what drive the competition here. This does not mean that all roads should be considered for Seal Coating, but for low volume streets without high traffic loads or particularly heavy vehicles using them, Seal Coating can be an option. This still assumes proper subgrade preparation, subbase construction, and drainage improvements are included to maximize the Seal Coat life.

For the particularly thin or damaged HMA roads, it may be preferable "downgrade" to Seal Coat, but the HMA design will still provide better service and be more reliable, while requiring less frequent or intensive interventions.

2.5 Constraints/Goals

2.5.1 Budget Constraints

The primary constraint to Eureka's proposed pavement management program is, like most communities, the budget. Roadway infrastructure repairs are primarily funded via a 1-cent local sales tax. Additional funding typically comes from highway fuel taxes or from general obligation bonds paid via property tax revenue. Other funds, in the form of grants, may occasionally be used for larger construction projects.

These limited revenues require city staff and elected officials to make complex decisions when determining annual maintenance and reconstruction expenditures especially since there is not a fixed annual budget.

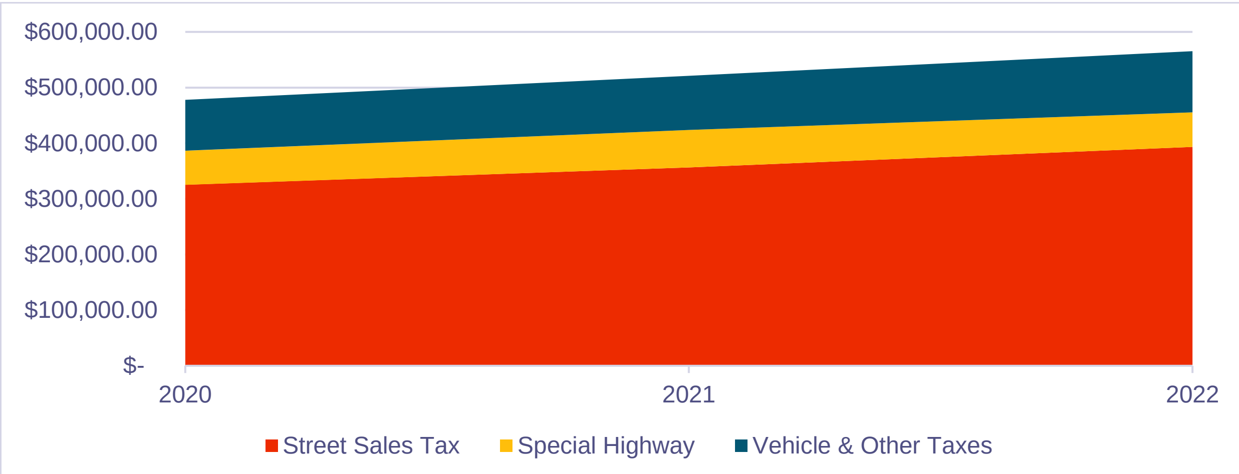


Figure 2-30: Transportation Revenues 2020-2022

This graph tracks transportation-related revenues the City received over the past 3 years according to their annual audits. This does not include the River street Tax.

A review of the annual financial statements from the City over the past 3 years indicates that revenues from Transportation-related sources average around $525,000 per year and are growing 8-10% each year. This amount is fairly good for a community of this size and the growth rate is greater than typical inflation impacts. However, for a network of this size and make-up it is still likely a bit shy of ideal. Particularly, given the amount of pavement determined to be in "Very Poor" conditions.

In the future additional funding may need to be diverted from the River Street tax fund or more allocated from the general fund for high-priority projects. Some revenues from the water or sewer funds may likewise be reasonably diverted towards street repairs in places where the roadway repairs are driven by utility upgrades such as those identified in the recent water study. In the meantime, aggressive applications for grant funding will be the best way to make up the deficit.

2.5.2 Goals

The primary goals of this pavement management plan are simply to address the growing backlog of streets and maximize the use of public funds. As such a list of priorities were created.

1. Collector Routes and Critical Local Roads should be in "Good" or better condition.
2. Regular Crack Sealing should be applied on all roads using a rotating 3–5-year plan.
3. Chip seal surfaces should be renewed every 8 years.
4. Coordinate with Water Main replacement program.
5. Gravel roads should be refreshed every 10 years.
6. Rehabilitate all "Fair" condition streets prior to reconstructing low volume local streets.

2.6 Decision Framework

Given the constraints and the goals set forward the following priorities were implemented to determine projects:

Phased Approach

- Each roadway was evaluated for the optimal treatment in 3 phases, short (1-3 years), medium (4-6 years), and longer terms (7-10 years) and costs assigned.

Conversions

- Very Poor HMA pavements on low volume local roads were assumed to be converted to Chip Seal when reconstructing.

Prioritize High Volume Roads

- Collectors and Critical Local Routes were given highest priority during project selection.

Coordiante w/ Water Main Replacements

- In the medium- and long-term periods preference was given to projects associated with Water Main replacements.

Maximize Pavement Life

- Preventative maintenance for “Fair” and “Good” pavements was given next priority.

Strategic Programs

- The remaining budget will then be allocated first to strategic rehabilitations, the Chip Seal Program, and Gravel resurfacing.

Cost/Benefit Results

- Similar projects will be assessed by cost and adjacent property information.

Reconstructions when Necesessary

- Final consideration is then given to reconstructing pavements that have completely failed.

3 Condition Assessment

3.1 Pavement Information

The inspectors recorded information on pavement widths, types, and presence of curb. The majority of the system is Hot-Mix Asphalt (HMA) or Chip Seal surfaces (SEAL). The remaining roads are Gravel and Composite pavements that were PCC and then overlaid with asphalt. As such, over 95% of the roads have some form of asphalt surface. The pavement type results along with curb information is found in **Map 3 – Pavement Types & Curb Presence**

One caveat to these investigation results is that a considerable proportion of the HMA pavements in “Poor” and “Very Poor” condition were difficult to distinguish from Chip Seal due to inadequate pavement thickness, poor drainage, and insufficient base materials. These roads are broken into a myriad of small fragments and when determining appropriate rehabilitation techniques, the analysis will treat them as Chip Seal rather than HMA.

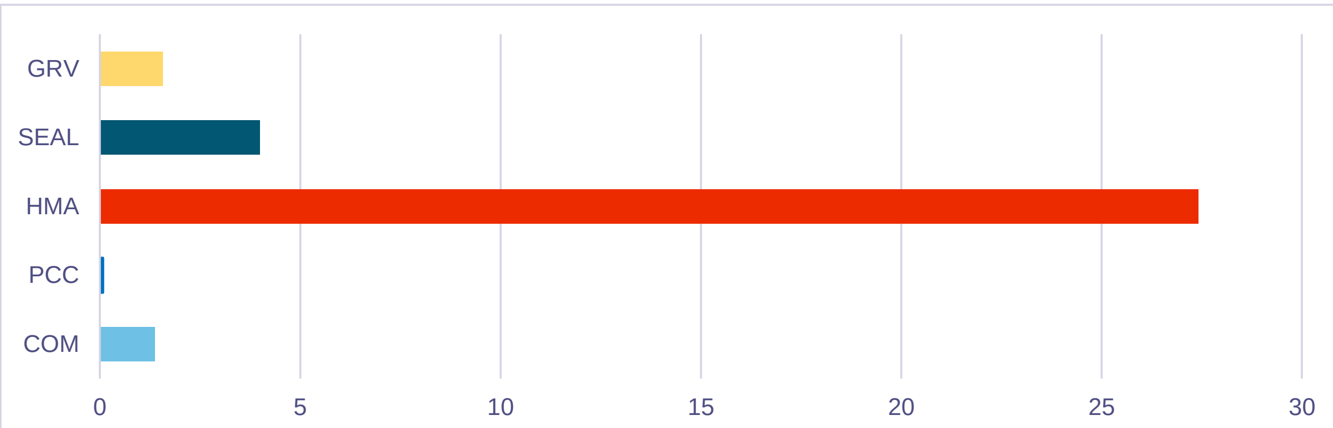


Figure 3-1 : Pavement Types in Eureka
This graphic displays the various pavement types inspected in Eureka, based on centerline length.

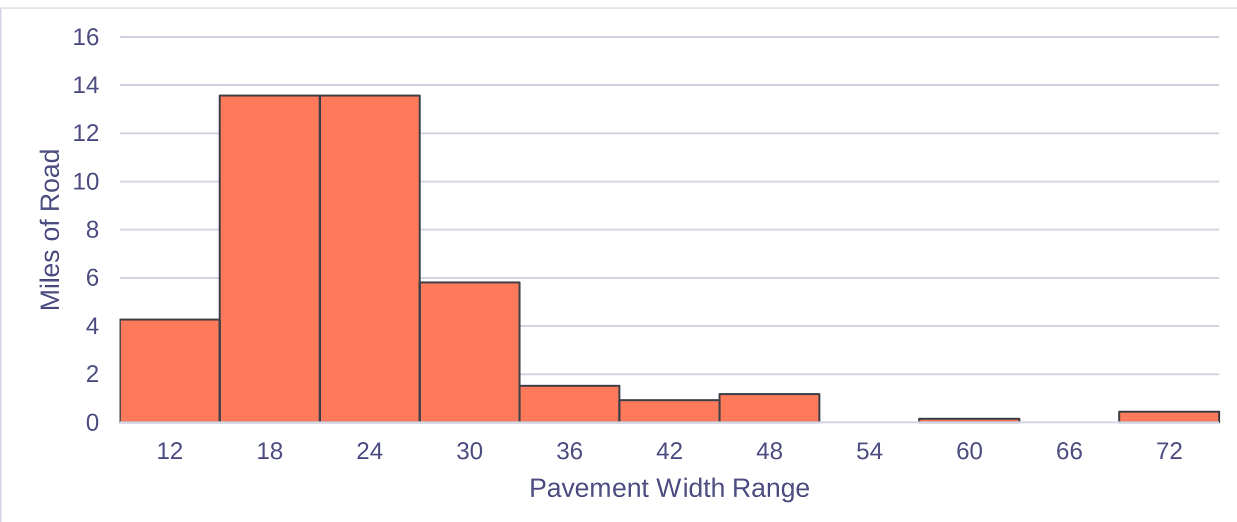
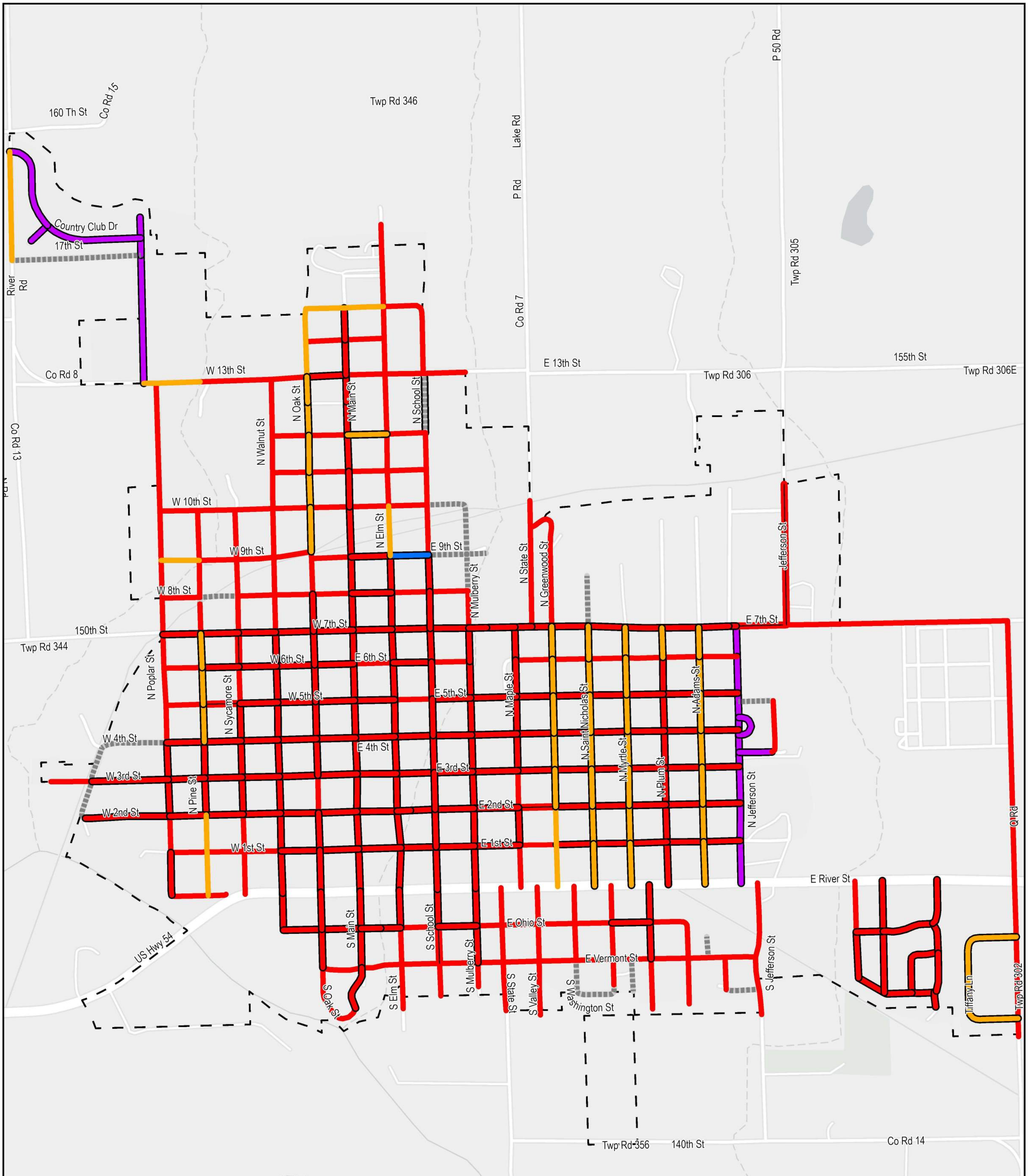


Figure 3-2: Pavement Widths in Eureka
This Histogram shows a sum of pavements by width. The number below each bar represents the lower limit of each range.



Map 3 - Pavement Type & Curb Presence

Surface Type
- GRV
- SEAL
- HMA
- PCC
- COM

Curb Presence
- None
- 1 Side
- 2 Sides

City Boundary

N

0 0.25 0.5
Miles

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3.2 Condition Assessment Results

The average pavement condition (PASER) rating for the City, was 3.9/10, which would fall in the "Poor" condition Category. This score indicates there are significant investments required to bring the overall quality of pavements in Eureka up to its community standards. An overview of the pavement inspection results is found in **Map 4 – Roadway Conditions.**

Rating = 3.9/10

(PASER)

It should be noted that the Collector Streets and Critical Local Routes are in much better shape, on average, than the Local streets. This is expected, because those streets are more likely to be designed better and have received more maintenance attention over time. About 75% of the Local streets are in Poor or Very Poor condition. Because the Local streets make up the majority of the network, it will be important to balance recovering these roads without neglecting the pavements still in Fair or better condition.

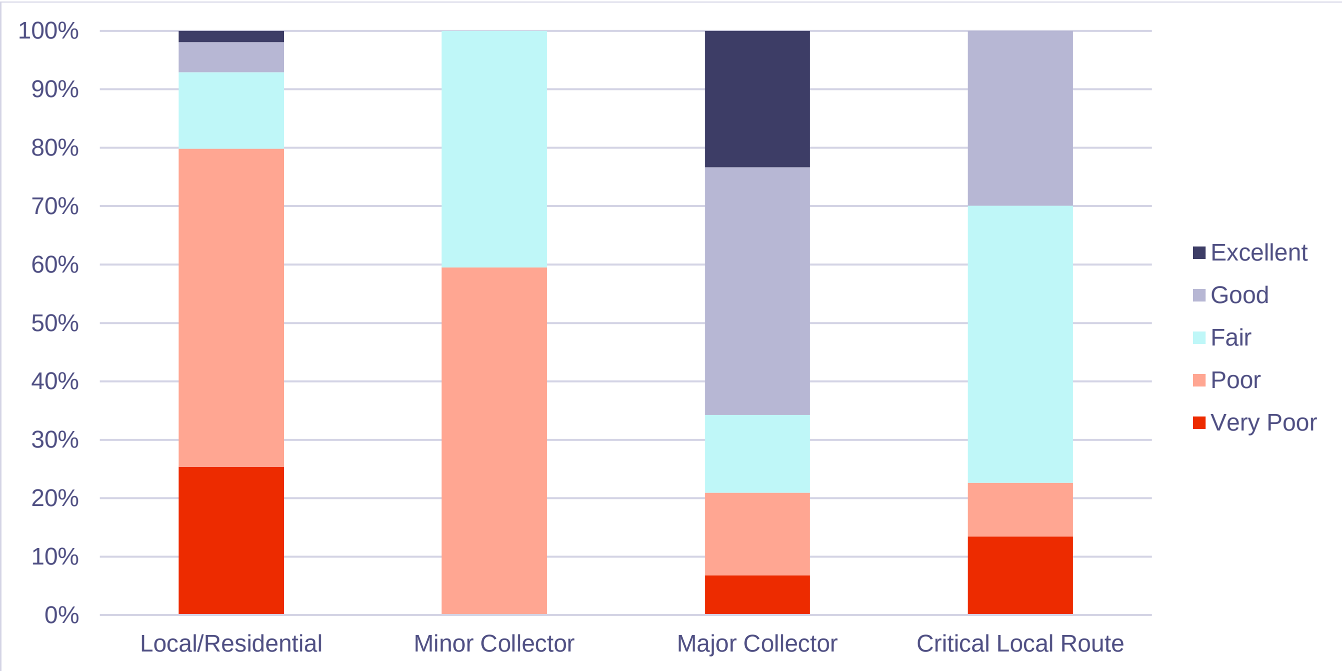
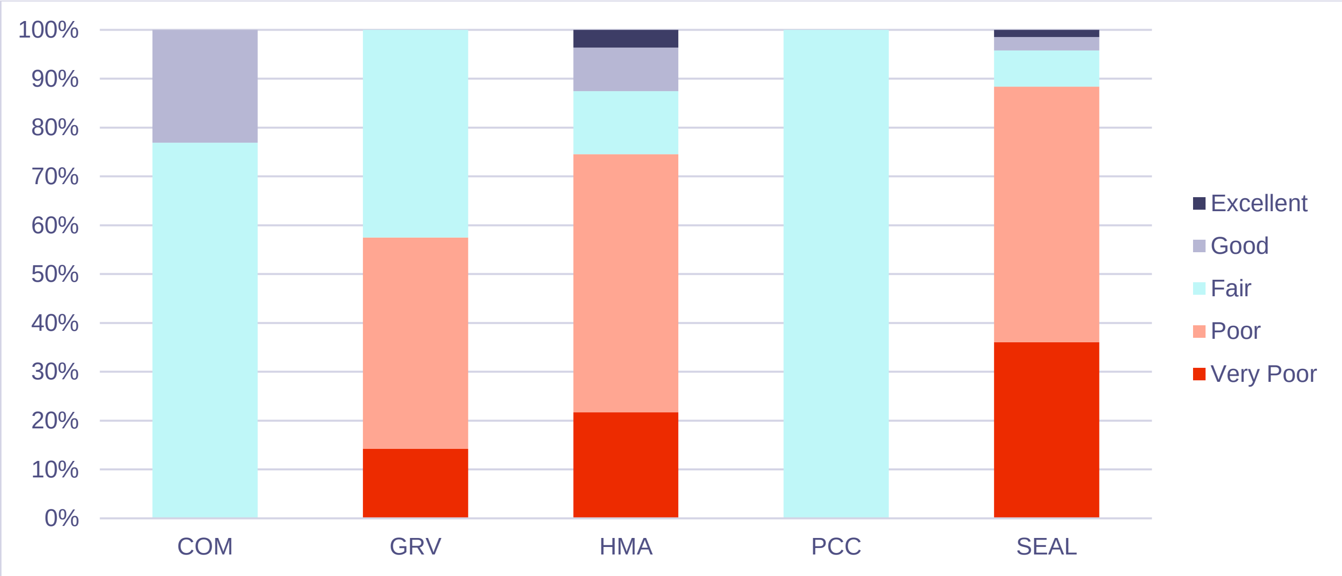


Figure 3-3 : Condition Summary by Functional Class
This figure demonstrates how the condition varies by functional class.

When looking at the various pavement types, the composite and concrete (PCC) pavements seem in decent shape, with HMA showing a more spread-out condition distribution. Chip Seal roads, however, are nearly 90% in Poor or Very Poor condition. Also due to the issue regarding pavement type determination for the worst roads, it may well be that a portion of HMA in the worst conditions is in fact Chip Seal.

The condition of the Chip Seal roads may be alarming at first look but note that these pavements have truly short service lives. The expected service life for a brand-new Chip Seal Pavement is 7-10 years, but repeated Chip Seal coats on top of that only last 5-7 years. As such, it is easy to fall behind in maintaining them.



The pavement inspections identified a number of design considerations that appear to be driving much of the pavement distresses in Eureka.

- Lack of Drainage Infrastructure (Intakes/Ditches)
- Poor On-street Drainage (Grades)
- Insufficient Pavement Thickness
- Poor subgrade/subbase

These factors are most noticeable on the east side of town particularly around intersections. Many intersections were identified as having ponding issues. The way the grades come together and the lack of intakes is leading to water getting trapped at the curb returns. This standing water then results in freeze-thaw damage and causes the underlying subbase/subgrade to deteriorate. It is common to see these issues cause sinking/heaving or the pavement crumbling into small pieces, both of which exacerbate the ponding problem

Figure 3-4: Ponding Issue

This photo shows the intersection of Plum and 2nd where water is ponding to a significant depth because it has nowhere to go.

Figure 3-5: Results of Ponding

This photo shows the intersection of Plum and 2nd where repeated ponding has caused the curb return to obliterate and settle.

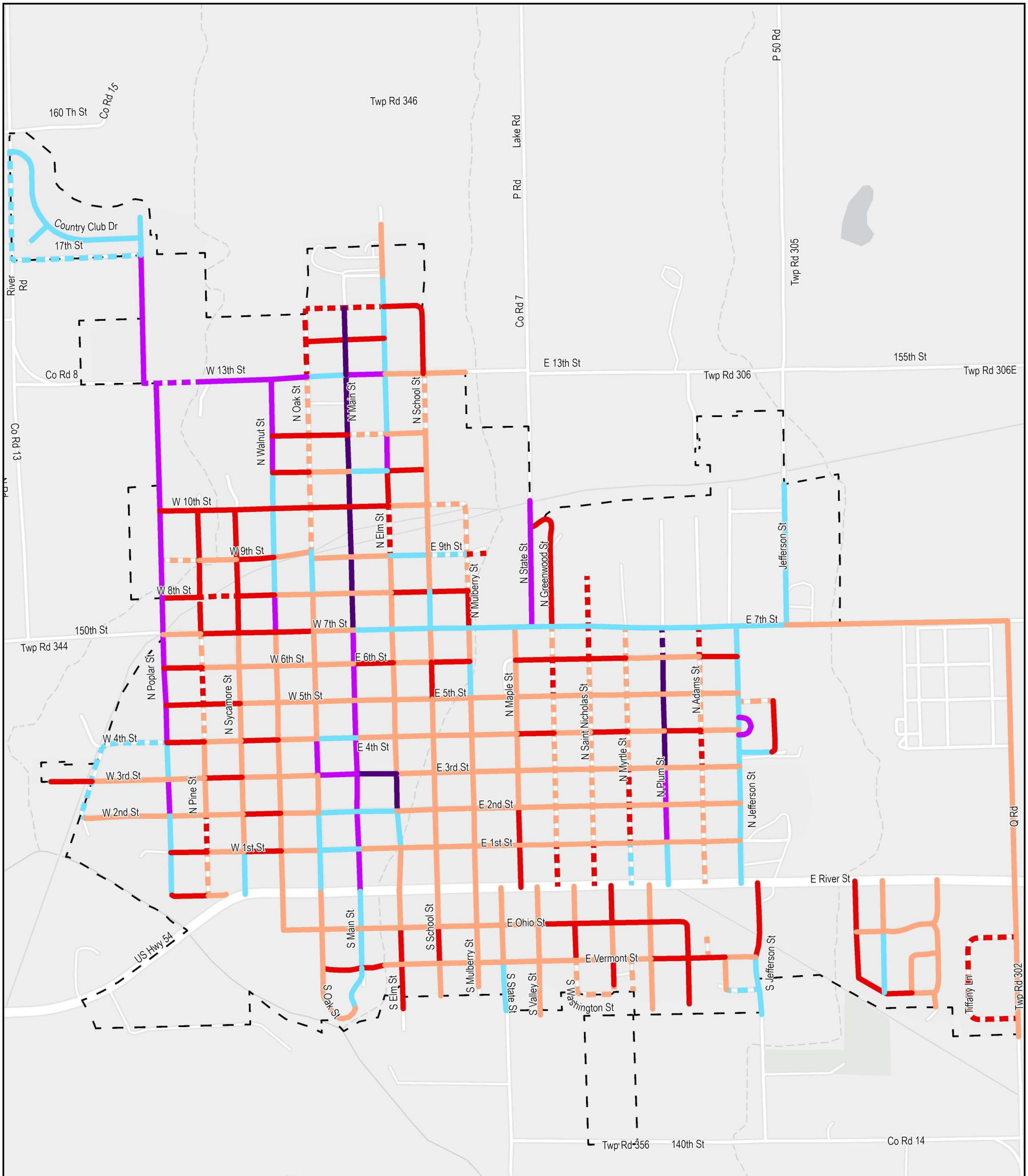
3

Figure 3-6: Insufficient Pavement Thickness

This photo shows North Greenwood Street. The bituminous material seems too thick to be Chip Seal and it does not exhibit the kind of raveling and loose material that might indicate Chip Seal.

The pavements noted as HMA in Very Poor condition often appear to be 2-3" of asphalt placed directly on unprepared subgrade. As such, they are crumbling into pieces and have pop-outs or areas where vehicle wheels have punched through to the dirt beneath. These roads are likely not salvageable but may reasonably be replaced by a Chip Seal or Gravel.

An overview of point failures and drainage issues can be found in **Map 5 – Noted Concerns.**



Map 4 - Roadway Conditions

Condition (PASER)
- 9 - 10 (Excellent)
- 7 - 8 (Good)
- 5 - 6 (Fair)
- 3 - 4 (Poor)
- 1 - 2 (Very Poor)

Pavement Type
- Traditional Pavement
- Non-Traditional Pavement

City Boundary

N

0 0.25 0.5
Miles

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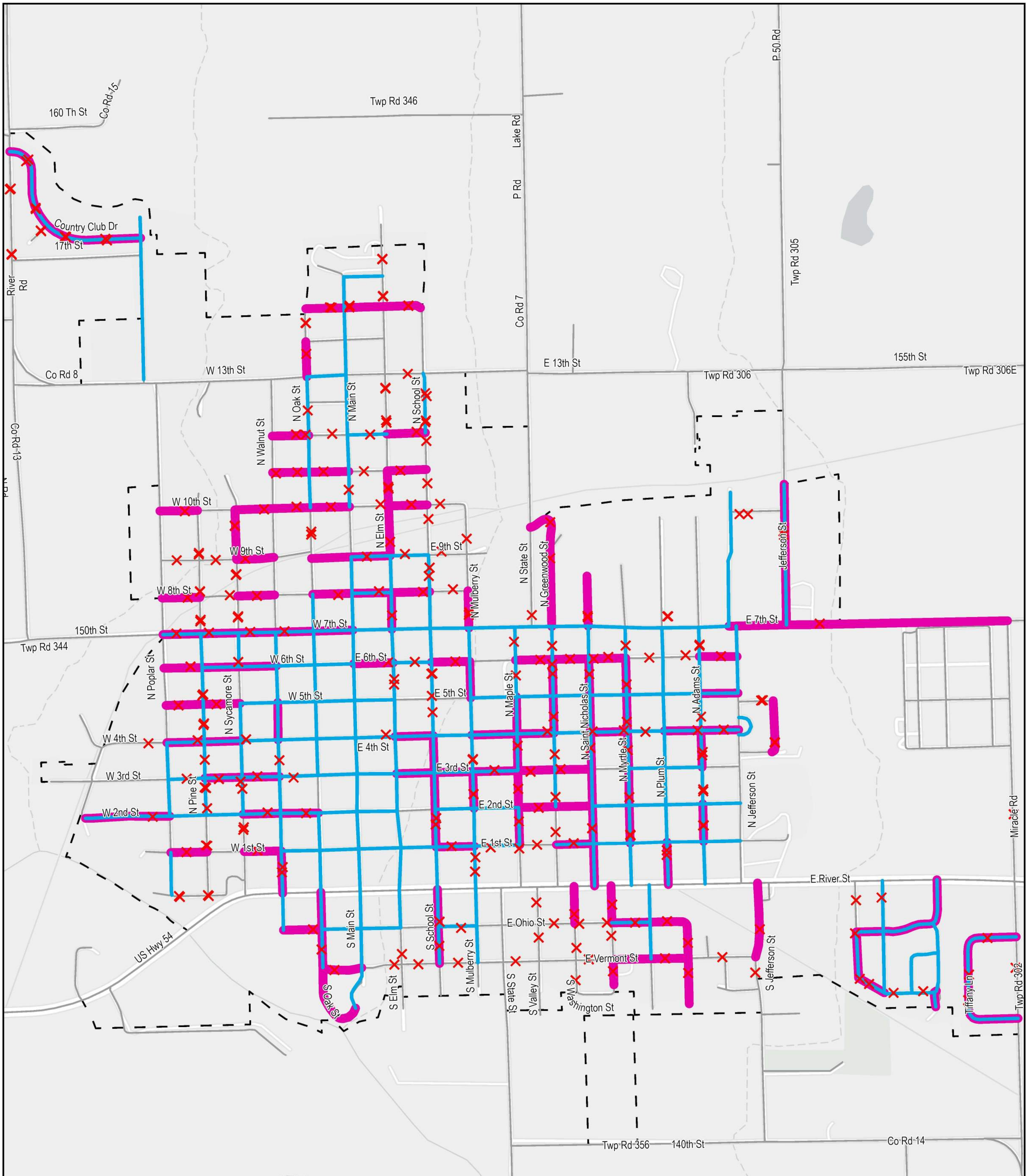

Map 5 - Noted Concerns

- Inspections Noting Point Failures
- Curbed w/o Intakes
- Noted Drainage Concerns
- Other Roads
- City Boundary

N

0 0.25 0.5
Miles

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4 Analysis & Predictions

4.1 Current Needs

The first step for identifying potential projects is assessing the existing “Need.” Need is a term intended to encompass all outstanding and expected work through the analysis period. This can be thought of as a “Backlog” of maintenance activities.

Existing conditions were analyzed against the treatment selection criteria for each roadway section and a treatment was assigned, including an estimated cost. If the City were fully funded and operating at 100% efficiency, they would be able to address every single road needing work, bringing the overall score up to a perfect 10/10 or “Very Good” condition. It should be noted that this does not stop the growth of the Need/backlog only the current problems. Need/backlog will always exist, and an optimal pavement management program is one that can keep pace with the growth.

The current Need for Eureka is Estimated to be $16 Million.

85% of the City’s pavements currently need Rehabilitation or Reconstruction. This is a burdensome proportion. The Needs of the City make up approximately 22% of the system’s value. In an ideal case, the proportion of Need to overall value would be 100 divided by the average expected pavement service (2-5%). Even the most conservative pavement life (5 years for inadequate Chip Seal) results in a proportion smaller than that (20%).

It will be critical for the community to strategically invest in its streets to reduce its burden, and it needs to do so soon. These marginal pavements deteriorate more quickly and cause the Need to grow more exponentially, making it more difficult to catch up later.

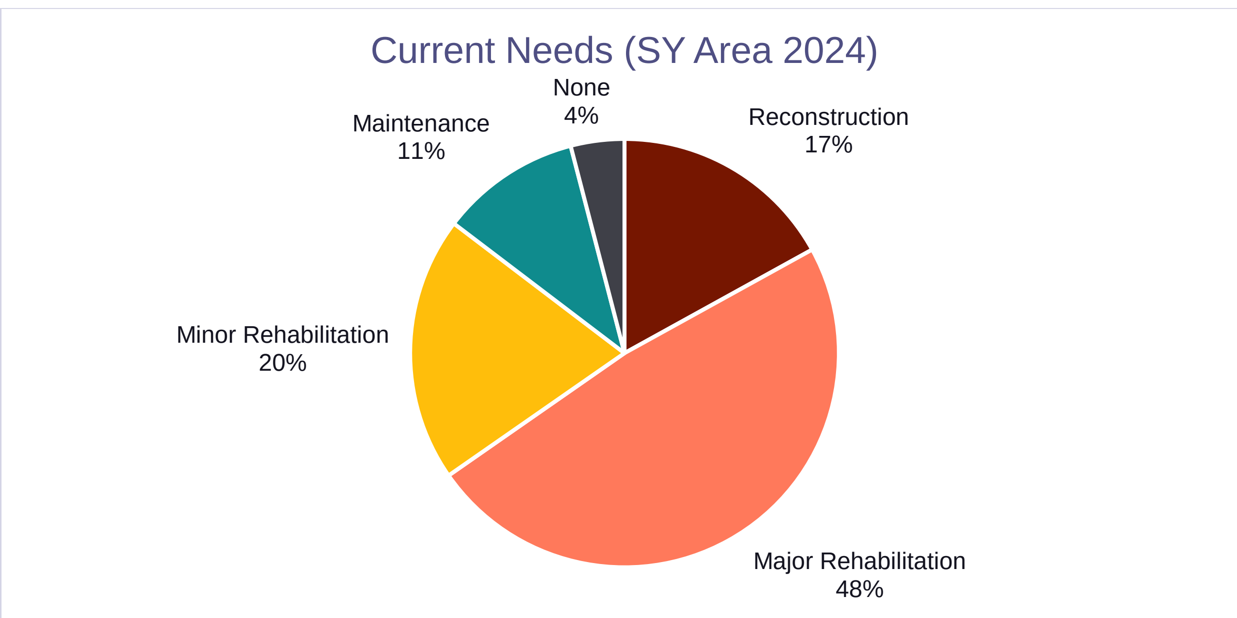


Figure 4-1: Current Needs Based on Area (SY)
This graph shows the distribution of Current Needs based on treatment category.

At the current rate of expenditure, it will take 30 Years to clear the backlog. Which would be reasonable, but for the projected rate of deterioration.

Figure 4-2: Est. Cost of Current Needs
This graph shows the estimated investment required to clear the various current needs of the community.

4.2 Projected Needs

Chip Seal pavements last 5-10 years, with an average life-cycle of 7 years. HMA and Composite pavements will last 20-50 years, with an average around 35. Gravel Roads will need resurfacing typically within 10 years' time. Based on these expected service lives, each roadway in the system received a condition projection over the 10-year analysis period.

The deterioration rate does rely on the current condition, falling in PASER score faster in the middle of the spectrum than on the ends. This was accounted for within the projections, but on average it was expected that an HMA pavement would drop 2-5 points over the analysis period, Chip Seal and Gravel Roads would drop by 6 points. Without intervention the average PASER score would also fall to 1.8/10.

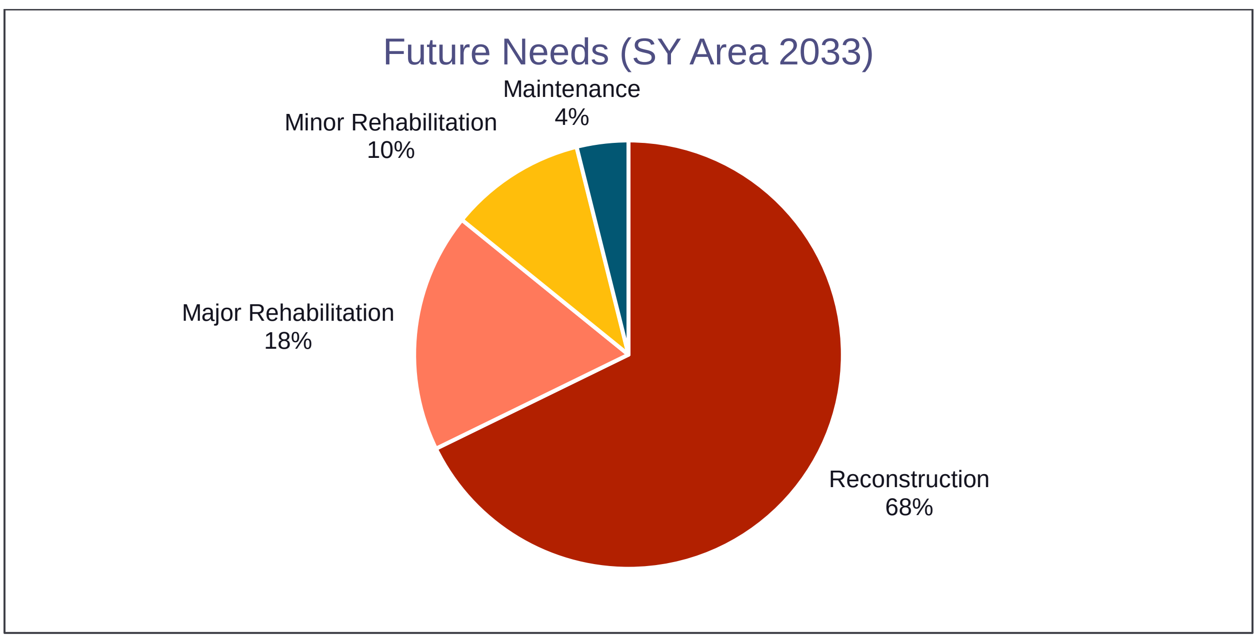


Figure 4-3: Future Needs Based on Area (SY)
This graph shows the distribution of Future Needs based on treatment category.

Using these projected conditions, an assessment was conducted on the future Needs, should the City not intervene. Based on no work being performed over the 10-year period the revised treatment plan and estimated costs suggest that the Need double to **$32.7 Million, with 96% of the system needing Rehabilitation or Reconstruction.**

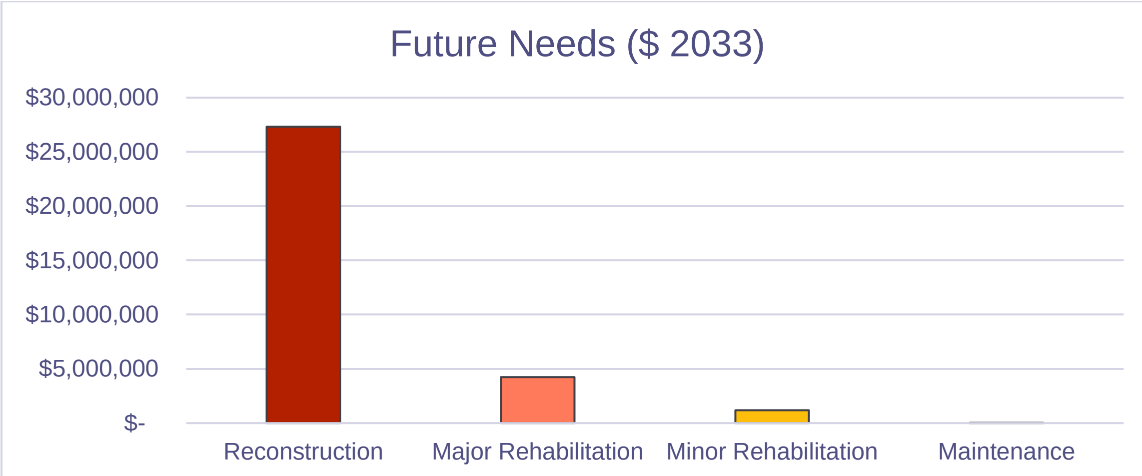


Figure 4-4: Est. Cost of Future Needs

This graph shows the estimated investment required to clear the various future needs of the community.

The growth of the Need averages approximately $1.7 Million per year. That does not necessarily mean that the spending target needs to be that, as there is an acceleration factor. Smartly applying work to slow the system's deterioration should be able to significantly reduce that liability. That $1.7 Million figure is still useful as a benchmark of what kind of magnitude annual expenditures ought to be for a community of this size with its pavement condition distribution.

4.2.1 Spending Targets

The optimal spending targets for a community like Eureka will depend highly on its regular maintenance programs. Assuming normal service lives for each of its pavement types and timely applications of preventative maintenance treatments, a distribution of annual costs can be estimated.

The analysis results indicate a mix of treatments heavy on Rehabilitation and Reconstruction, cost-wise. Which is fairly typical, due to their high unit costs. Many agencies in the Midwest United States have Reconstruction proportions around 60%, however, so the low percentage here is fortunate. This is a result of good bid prices in the region for HMA pavements and the fact that most of the network can rely primarily on regular Mill & Overlay or Seal Coat treatments.

Notably the ideal spending rate is approximately $1.7 Million, almost exactly the predicted growth rate of the construction Needs.

The key to these results is that 10% of the budget should be for preventative maintenance. Crack Sealing and Patching are high-value activities that maximize pavement life and reduce the need for more expensive options. In the first few years of this program, it is recommended that this be reduced, as the "very Poor" and "Poor" roads are not good candidates. However, as more roadways are rehabilitated and reconstructed the City should seek to increase its spending proportions to meet that 10% goal and keep those new surfaces in good repair as long as possible.

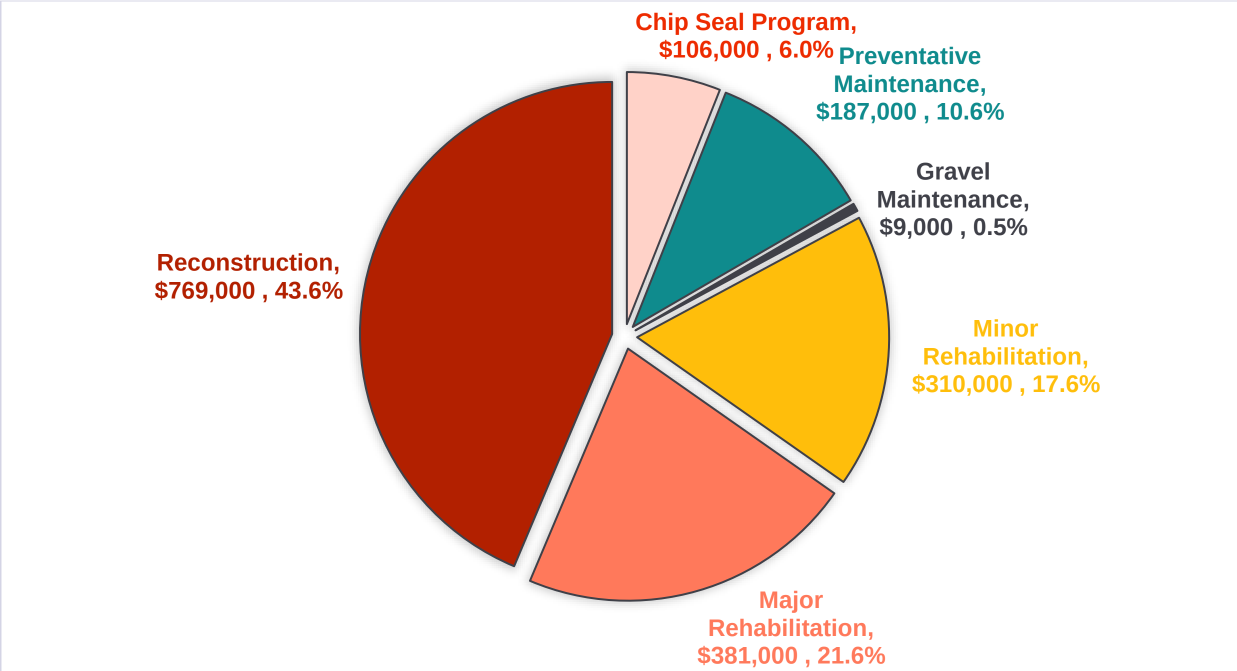


Figure 4-5: Ideal Spending Rates

This graph shows how the City might spend its roadway dollars under ideal circumstances to maximize their impact.

4.2.2 Budgets

Three budget scenarios were analyzed to provide additional guidance in determining future funding needs.

Current

- Current average annual budget of $525,000 per year.
- **Ending PASER score was 4.1/10 and Backlog grew to $25 Million**

Growth

- A Growth Scenario Budget that increases 5% annually.
- **Ending PASER score was 4.6/10 and Backlog grew to $23 Million**

Infusion

- 50% Increase, applied immediately to the budget.
- **Ending PASER score was 5.2/10 and Backlog grew to $20 Million**

5 Proposed Capital Improvement Plan

5.1 Projects

The Capital Improvement Plan (CIP) is a list of recommended projects for Eureka to complete over the next 10 years. This list of projects was generated using the prescribed Decision Framework and the project list is optimized for the most effective use of currently available funds, based on the pavement condition data and planning-level information provided by the City.

Projects are sorted into three phases, Phase 1 (FY2025-FY2027), Phase 2 (2028-2030), and Phase 3 (FY2031-2034). Complete lists and maps can be found on the following pages.

These lists and maps are a tool to assist City staff during the project planning process, but do not replace engineering judgement. Project types may change from what is in the CIP and projects will move between phases for assorted reasons. Some projects may need to leave the plan entirely as new ones are added. Common reasons the program should be changed include field conditions not captured by the inspection data, utility improvements, or weather disasters.

Consisting of **114 Blocks of Road**, the recommended projects would improve approximately **10 Miles** of roads and include every Chip Seal and Gravel road, as well as ensures each of the Collectors or Critical Local routes is kept in the highest service condition.

5.2 Performance Metrics & Goal Setting

Pavement Management Programs are always ongoing processes. Studies and budgets are not enough. These programs need actionable goals and clear performance measures.

With the Scenario results in mind, Eureka needs to set some measurable performance goals, which will be addressed by said Capital Improvement Program. This allows a City to track its performance, ensuring that it remains on track and is actually effective.

5.2.1.1 Recommended Performance Metrics

- Reach 10% Maintenance budget by 2033, Crack Seal on at least 5-year basis.
- Resurface every gravel road over the next 10 years, and then put on a regular rotation.
- Resurface every Chip Seal roadway not in “Very Poor” condition over the next 5 years and rebuild the remainder by 2033. Put on regular 7–10-year resurfacing rotation.
- Aim for PASER score of 4.5/10.

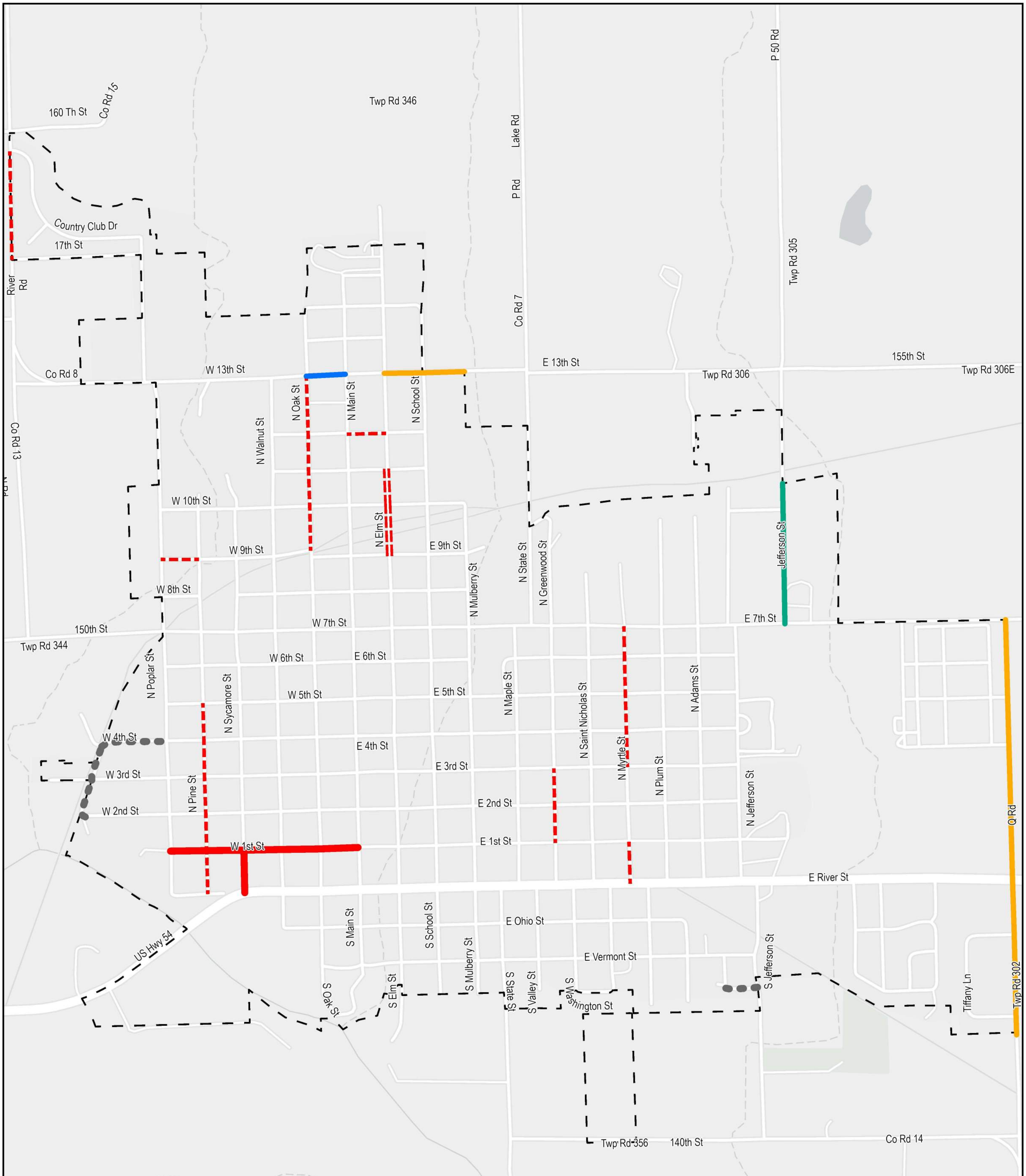
5.2.1.2 “Living Documents”

The final recommendation of this report is to renew this plan as physical, fiscal, and political conditions change. JEO recommends that City’s view Pavement Management Plans as “Living Documents” that should grow with communities and adapt to their needs through regular updates and changes. The next inspection and program update should be performed in 3-5 years after the first phase of construction projects is completed.

Table 5-1: Phase 1 (2025-2027) Projects

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
PHASE 1 PREVENTATIVE MAINTENANCE	Various	Locations													Preventative Maintenance	$79,000
N JEFFERSON ST	E 7th St	N City Limits	Critical Local Route	0.28	40	6461	1	5	Fair	HMA	None	Y	Y	N	Cape Seal	$129,500
E 12TH ST	N Main St	N Elm St	Local/ Residential	0.08	16	725	2	4	Poor	SEAL	None	N	Y	N	Chip Seal	$10,500
N GREENWOOD ST	E 1st St	E 2nd St	Local/ Residential	0.07	22	966	0	3	Poor	SEAL	None	N	Y	N	Chip Seal	$14,000
N GREENWOOD ST	E 2nd St	E 3rd St	Local/ Residential	0.07	24	1020	2	3	Poor	SEAL	None	N	Y	N	Chip Seal	$14,500
N MYRTLE ST	E 3rd St	E 4th St	Local/ Residential	0.07	28	1195	2	4	Poor	SEAL	None	Y	Y	N	Chip Seal	$17,000
N MYRTLE ST	E 4th St	E 5th St	Local/ Residential	0.07	28	1175	2	3	Poor	SEAL	None	Y	Y	N	Chip Seal	$16,500
N MYRTLE ST	E 5th St	E 6th St	Local/ Residential	0.07	28	1182	2	4	Poor	SEAL	None	Y	Y	N	Chip Seal	$17,000
N MYRTLE ST	E 6th St	E 7th St	Local/ Residential	0.06	28	989	2	3	Poor	SEAL	None	N	Y	N	Chip Seal	$14,000
N OAK ST	Alley	W 13th St	Local/ Residential	0.05	25	735	2	4	Poor	SEAL	None	N	N	N	Chip Seal	$10,500
N OAK ST	W 10th St	W 11th St	Local/ Residential	0.07	25	1018	2	4	Poor	SEAL	None	N	N	N	Chip Seal	$14,500
N OAK ST	W 11th St	W 12th St	Local/ Residential	0.07	25	1055	2	4	Poor	SEAL	None	N	N	N	Chip Seal	$15,000
N OAK ST	W 12th St	Alley	Local/ Residential	0.06	25	948	2	4	Poor	SEAL	None	N	N	N	Chip Seal	$13,500
N OAK ST	W 9th St	W 10th St	Local/ Residential	0.09	25	1265	2	3	Poor	SEAL	Yes	N	Y	N	Chip Seal	$18,000
N PINE ST	W 1st St	W 2nd St	Local/ Residential	0.07	18	771	0	1	Very Poor	SEAL	None	N	Y	N	Chip Seal	$11,000
N PINE ST	W 2nd St	W 3rd St	Local/ Residential	0.07	24	1019	2	4	Poor	HMA	None	N	Y	Y	Chip Seal	$14,500
N PINE ST	W 3rd St	W 4th St	Local/ Residential	0.07	24	999	2	4	Poor	HMA	None	N	Y	Y	Chip Seal	$14,000
N PINE ST	W 4th St	W 5th St	Local/ Residential	0.07	25	1080	2	3	Poor	SEAL	None	N	Y	Y	Chip Seal	$15,500
RIVER RD	17th St	Country Club Dr	Local/ Residential	0.21	21	2628	0	5	Fair	SEAL	None	N	Y	N	Chip Seal	$37,000
S MYRTLE ST	US Hwy 54	E 1st St	Local/ Residential	0.08	28	1358	2	5	Fair	SEAL	None	N	N	N	Chip Seal	$19,500
S PINE ST	W River St	W 1st St	Local/ Residential	0.09	20	1003	0	3	Poor	SEAL	None	N	N	N	Chip Seal	$14,500
W 9TH ST	Culvert	N Pine St	Local/ Residential	0.02	14	203	0	4	Poor	SEAL	None	N	Y	N	Chip Seal	$3,000
W 9TH ST	N Poplar St	Culvert	Local/ Residential	0.05	14	410	0	4	Poor	SEAL	None	N	Y	N	Chip Seal	$6,000

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
N ELM ST	E 10th St	E 11th St	Local/ Residential	0.07	24	969	0	2	Very Poor	HMA	None	Y	Y	Y	Double Chip Seal Reconstruct	$29,500
N ELM ST	E 9th St	E 10th St	Local/ Residential	0.10	24	1375	0	2	Very Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$41,500
W 13TH ST	Culvert	N Poplar St	Major Collector	0.11	28	1815	0	8	Good	SEAL	None	N	N	Y	Double Chip Seal Reconstruct	$54,500
ORANGE AVE	S Kansas St	S Jefferson St	Local/ Residential	0.06	12	455	0	5	Fair	GRV	None	N	N	N	Gravel Resurfacing	$2,500
W 4TH ST	N Pine St	N Sycamore St	Local/ Residential	0.13	24	1816	0	5	Fair	GRV	None	N	Y	N	Gravel Resurfacing	$9,000
W 4TH ST	N Sycamore St	N Walnut St	Local/ Residential	0.07	24	974	0	5	Fair	GRV	None	N	N	N	Gravel Resurfacing	$5,000
W 4TH ST	W 2nd St	W 3rd St	Local/ Residential	0.08	24	1113	0	6	Fair	GRV	None	N	N	N	Gravel Resurfacing	$6,000
Q RD	Central Ave	E 7th St	Minor Collector	0.15	24	2149	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$88,500
Q RD	Central Ave	9th St	Minor Collector	0.09	24	1294	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$53,500
Q RD	E River St	9th St	Minor Collector	0.27	24	3756	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$154,500
Q RD	N Tiffany Ln	S Tiffany Ln	Minor Collector	0.16	22	2060	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$84,500
Q RD	S City Limits	Tiffany Ln	Minor Collector	0.04	22	462	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$19,000
Q RD	Tiffany Ln	US HWY 54	Minor Collector	0.11	22	1399	0	3	Poor	HMA	None	N	Y	N	Mill & Overlay	$57,500
W 1ST ST	N Pine St	N Poplar St	Local/ Residential	0.07	18	748	0	2	Very Poor	HMA	None	Y	Y	N	Reconstruction	$111,500
W 1ST ST	N Sycamore St	N Pine St	Local/ Residential	0.07	18	772	0	3	Poor	HMA	None	N	N	N	Reconstruction	$115,500
S SYCAMORE ST	US HWY 54	River St	Local/ Residential	0.03	26	422	0	5	Fair	HMA	None	N	N	N	Reconstruction (Grant Match)	$16,000
S SYCAMORE ST	W River St	W 1st St	Local/ Residential	0.06	26	851	0	5	Fair	HMA	None	N	N	N	Reconstruction (Grant Match)	$32,000
W 1ST ST	N Main St	N Oak St	Local/ Residential	0.08	36	1607	2	5	Fair	HMA	None	N	N	N	Reconstruction (Grant Match)	$60,000
W 1ST ST	N Oak St	N Walnut St	Local/ Residential	0.08	36	1599	2	3	Poor	HMA	None	N	N	N	Reconstruction (Grant Match)	$60,000
W 1ST ST	N Walnut St	N Sycamore St	Local/ Residential	0.07	18	762	0	2	Very Poor	HMA	None	Y	Y	N	Reconstruction (Grant Match)	$28,500
W 13TH ST	N Main St	N Oak St	Major Collector	0.08	32	1438	2	5	Fair	HMA	None	N	N	Y	Thin Overlay	$32,000



Map 6 - Phase 1 Projects

Proposed Treatment

- Cape Seal
- Chip Seal
- Double Chip Seal Reconstruct
- Gravel Resurfacing
- Mill & Overlay
- Reconstruction
- Thin Overlay
- City Boundary

N

0 0.25 0.5
Miles

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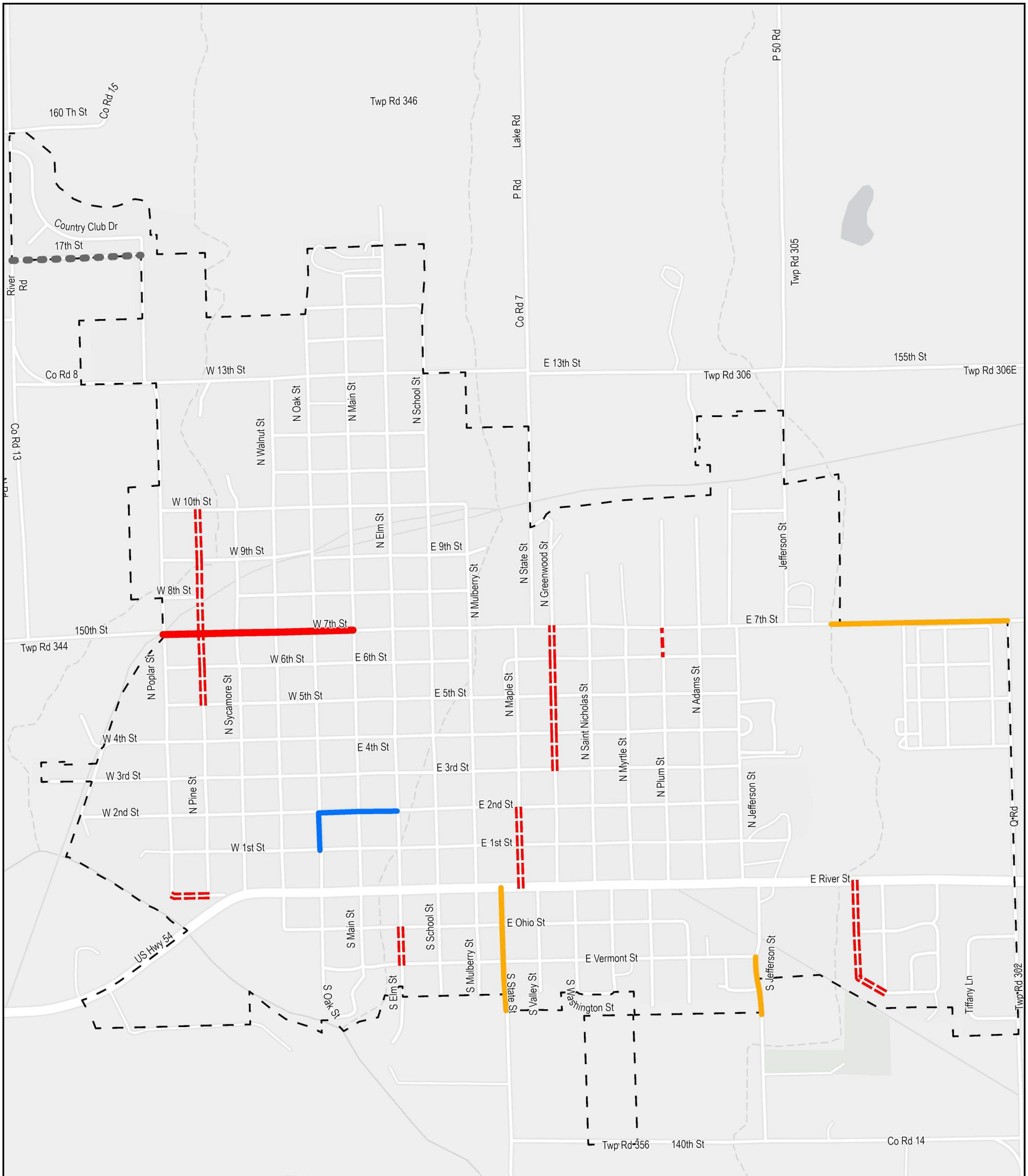
Table 5-2: Phase 2 (2028-2030) Projects

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
PHASE 2 PREVENTATIVE MAINTENANCE	Various	Locations													Preventative Maintenance	$117,500
N PLUM ST	E 6th St	E 7th St	Local/ Residential	0.06	24	814	2	9	Excellent	SEAL	None	N	N	Y	Chip Seal	$12,500
MARRIOTT DR	Quincy St	Madison St	Local/ Residential	0.09	24	1270	2	2	Very Poor	HMA	None	Y	Y	Y	Double Chip Seal Reconstruct	$41,000
MARRIOTT DR	US HWY 54	Madison St	Local/ Residential	0.10	24	1400	0	2	Very Poor	HMA	Yes	N	Y	Y	Double Chip Seal Reconstruct	$45,000
N GREENWOOD ST	E 3rd St	E 4th St	Local/ Residential	0.07	24	1009	2	4	Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$32,500
N GREENWOOD ST	E 4th St	E 5th St	Local/ Residential	0.07	32	1365	2	3	Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$44,000
N GREENWOOD ST	E 5th St	E 6th St	Local/ Residential	0.07	24	1008	2	2	Very Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$32,500
N GREENWOOD ST	E 6th St	E 7th St	Local/ Residential	0.06	24	907	2	3	Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$29,000
N MAPLE ST	E 1st St	E 2nd St	Local/ Residential	0.07	24	1042	2	2	Very Poor	HMA	None	Y	Y	Y	Double Chip Seal Reconstruct	$33,500
N PINE ST	W 5th St	W 6th St	Local/ Residential	0.07	25	1054	2	2	Very Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$34,000
N PINE ST	W 6th St	W 7th St	Local/ Residential	0.07	25	972	2	4	Poor	SEAL	None	N	N	Y	Double Chip Seal Reconstruct	$31,500
N PINE ST	W 7th St	W 8th St	Local/ Residential	0.06	18	615	0	2	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$20,000
N PINE ST	W 8th St	W 9th St	Local/ Residential	0.07	18	765	0	1	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$24,500
N PINE ST	W 9th St	W 10th St	Local/ Residential	0.10	18	1031	0	2	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$33,000
QUINCY ST	Mission Rd	Marriott Dr	Local/ Residential	0.06	24	819	2	2	Very Poor	HMA	None	Y	Y	Y	Double Chip Seal Reconstruct	$26,500
S ELM ST	E Ohio St	E Vermont St	Local/ Residential	0.07	18	755	0	2	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$24,500
S MAPLE ST	US Hwy 54	E 1st St	Local/ Residential	0.08	24	1167	0	2	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$37,500
W RIVER ST	S Pine St	S Poplar St	Local/ Residential	0.07	22	926	0	2	Very Poor	HMA	None	N	Y	Y	Double Chip Seal Reconstruct	$30,000
17TH ST	River Rd	N Poplar St	Local/ Residential	0.25	12	1780	0	6	Fair	GRV	None	N	N	N	Gravel Resurfacing	$9,500
W 7TH ST	N Main St	N Oak St	Critical Local Route	0.08	24	1089	2	3	Poor	HMA	None	Y	N	N	Reconstruction	$153,569
W 7TH ST	N Oak St	N Walnut St	Critical Local Route	0.07	24	1047	2	2	Very Poor	HMA	None	Y	Y	N	Reconstruction	$166,500

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
W 7TH ST	N Pine St	150th St	Critical Local Route	0.07	24	1042	2	3	Poor	HMA	None	Y	Y	N	Reconstruction	$146,944
W 7TH ST	N Sycamore St	N Pine St	Critical Local Route	0.07	24	1038	2	2	Very Poor	HMA	None	Y	Y	N	Reconstruction	$165,000
W 7TH ST	N Walnut St	N Sycamore St	Critical Local Route	0.07	24	1026	2	2	Very Poor	HMA	None	Y	Y	N	Reconstruction	$163,000
E 2ND ST	N Main St	N Elm St	Local/ Residential	0.08	60	2769	2	5	Fair	HMA	None	N	N	N	Thin Overlay	$65,000
N OAK ST	W 1st St	W 2nd St	Local/ Residential	0.07	25	1084	2	6	Fair	HMA	None	N	N	N	Thin Overlay	$25,500
W 2ND ST	N Oak St	N Main St	Local/ Residential	0.08	60	2650	2	5	Fair	HMA	None	N	N	N	Thin Overlay	$62,500

Map 7 - Phase 2 Projects



Proposed Treatment

- Chip Seal
- Double Chip Seal Reconstruct
- Gravel Resurfacing
- Mill & Overlay
- Reconstruction
- Thin Overlay
- City Boundary

N

0 0.25 0.5
Miles

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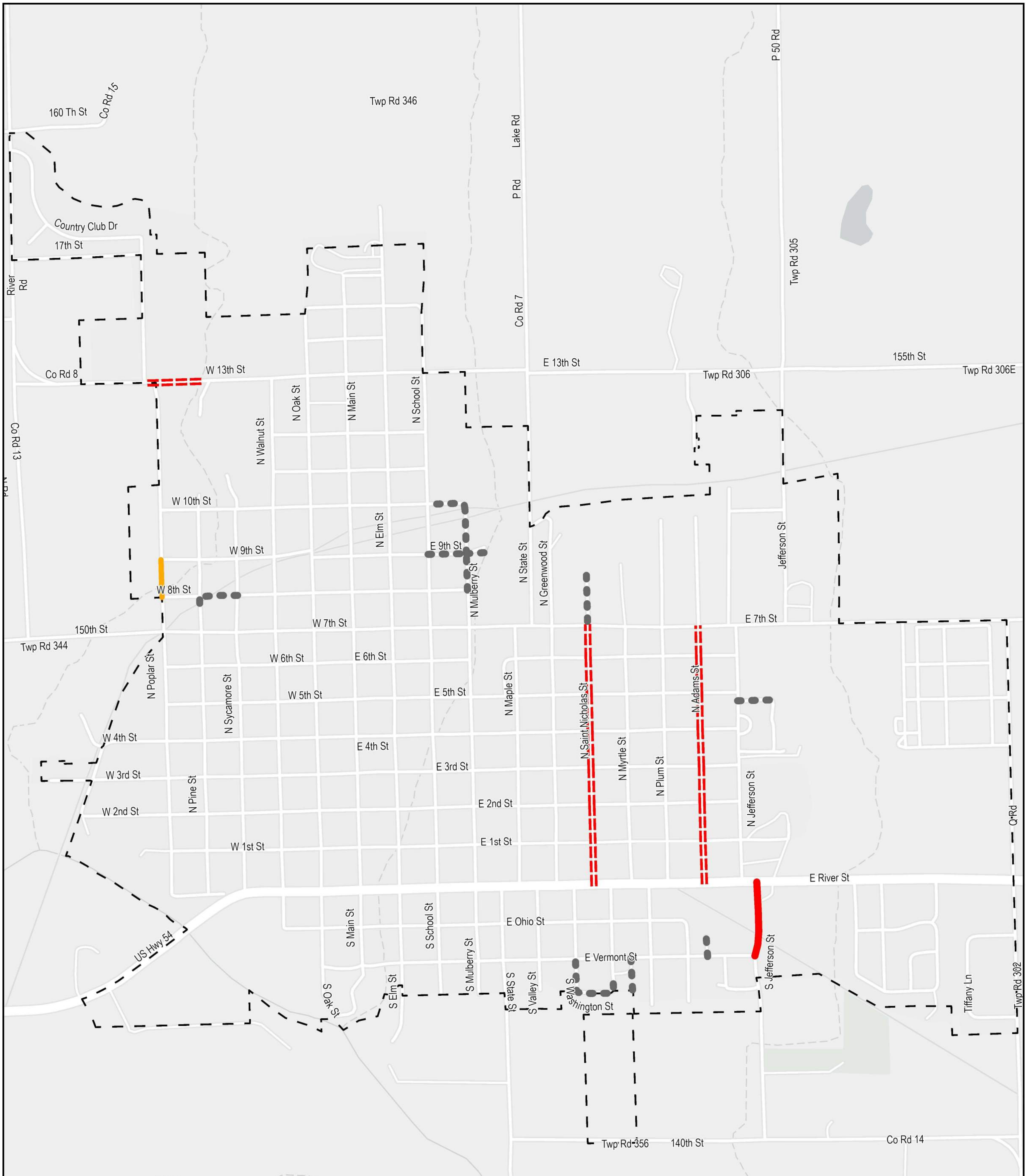
Table 5-3: Phase 3 (2031-2034) Projects

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
PHASE 3 PREVENTATIVE MAINTENANCE	Various	Locations													Preventative Maintenance	$238,000
N ADAMS ST	E 1st St	E 2nd St	Local/ Residential	0.07	32	1392	2	3	Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$47,500
N ADAMS ST	E 2nd St	E 3rd St	Local/ Residential	0.07	32	1350	2	3	Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$46,000
N ADAMS ST	E 3rd St	E 4th St	Local/ Residential	0.07	32	1352	2	2	Very Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$46,000
N ADAMS ST	E 4th St	E 5th St	Local/ Residential	0.07	32	1358	2	3	Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$46,500
N ADAMS ST	E 5th St	E 6th St	Local/ Residential	0.07	32	1359	2	4	Poor	SEAL	None	N	N	Y	Double Chip Seal Reconstruct	$46,500
N ADAMS ST	E 6th St	E 7th St	Local/ Residential	0.06	32	1069	2	2	Very Poor	SEAL	None	N	Y	Y	Double Chip Seal Reconstruct	$36,500
N SAINT NICHOLAS ST	E 1st St	E 2nd St	Local/ Residential	0.07	24	1043	2	3	Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$35,500
N SAINT NICHOLAS ST	E 2nd St	E 3rd St	Local/ Residential	0.07	24	1015	2	4	Poor	SEAL	None	Y	N	Y	Double Chip Seal Reconstruct	$34,500
N SAINT NICHOLAS ST	E 3rd St	E 4th St	Local/ Residential	0.07	24	1019	2	4	Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$35,000
N SAINT NICHOLAS ST	E 4th St	E 5th St	Local/ Residential	0.07	24	1023	2	4	Poor	SEAL	None	Y	N	Y	Double Chip Seal Reconstruct	$35,000
N SAINT NICHOLAS ST	E 5th St	E 6th St	Local/ Residential	0.07	24	1003	2	3	Poor	SEAL	None	Y	Y	Y	Double Chip Seal Reconstruct	$34,500
N SAINT NICHOLAS ST	E 6th St	E 7th St	Local/ Residential	0.06	24	900	2	2	Very Poor	SEAL	None	n	n	Y	Double Chip Seal Reconstruct	$31,000
S ADAMS ST	US Hwy 54	W 1st St	Local/ Residential	0.08	32	1562	2	4	Poor	SEAL	None	N	N	Y	Double Chip Seal Reconstruct	$53,500
S SAINT NICHOLAS ST	US Hwy 54	E 1st St	Local/ Residential	0.08	24	1171	2	2	Very Poor	SEAL	None	Y	N	Y	Double Chip Seal Reconstruct	$40,000
5TH ST	E 5th St	Ash St	Local/ Residential	0.07	14	561	0	4	Poor	GRV	None	N	Y	N	Gravel Resurfacing	$3,500
E 10TH ST	N Mulberry St	N School St	Local/ Residential	0.08	20	963	0	4	Poor	GRV	None	N	Y	N	Gravel Resurfacing	$5,500
E 9TH ST	N Mulberry St	East End	Local/ Residential	0.04	18	403	0	1	Very Poor	GRV	None	N	Y	Y	Gravel Resurfacing	$2,500
E 9TH ST	N School St	N Mulberry St	Local/ Residential	0.08	30	1322	0	5	Fair	GRV	None	N	Y	Y	Gravel Resurfacing	$7,500
N MULBERRY ST	E 8th St	E 9th St	Local/ Residential	0.07	26	1094	0	3	Poor	GRV	None	N	N	N	Gravel Resurfacing	$6,500
N MULBERRY ST	E 9th St	E 10th St	Local/ Residential	0.09	26	1339	0	3	Poor	GRV	None	N	Y	N	Gravel Resurfacing	$8,000
N PINE ST	W 7th St	W 8th St	Local/ Residential	0.01	18	137	0	2	Very Poor	GRV	None	N	Y	N	Gravel Resurfacing	$1,000

Name	Start	End	Functional Class	Length (Miles)	Width (ft)	Area (SY)	Curbs	PASER Rating	Condition	Pavement Type	Intakes	Drainage Issues	Point Failures	Water Main Needs	Action	Est Cost
N SAINT NICHOLAS ST	North End	E 7th St	Local/ Residential	0.10	18	1037	0	1	Very Poor	GRV	None	Y	Y	N	Gravel Resurfacing	$6,000
S WASHINGTON ST	S High St	E Vermont St	Local/ Residential	0.15	18	1594	0	3	Poor	GRV	None	N	N	N	Gravel Resurfacing	$9,500
VERMONT ALLEY	E Vermont St	South End	Local/ Residential	0.06	9	332	0	4	Poor	GRV	None	N	N	N	Gravel Resurfacing	$2,000
VERMONT ALLEY NORTH	E Vermont St	North End	Local/ Residential	0.04	9	218	0	3	Poor	GRV	None	N	N	N	Gravel Resurfacing	$1,500
W 8TH ST	N Sycamore St	N Pine St	Local/ Residential	0.07	12	526	0	2	Very Poor	GRV	None	N	Y	N	Gravel Resurfacing	$3,000
E 7TH ST	N Adams St	N Plum St	Minor Collector	0.07	44	1860	2	5	Fair	HMA	None	N	N	Y	Mill & Overlay	$86,500
E 7TH ST	N Greenwood St	N State St	Minor Collector	0.04	44	1008	2	6	Fair	HMA	None	N	N	Y	Mill & Overlay	$47,000
E 7TH ST	N Jefferson St	Culvert	Minor Collector	0.09	24	1235	0	4	Poor	HMA	None	Y	Y	N	Mill & Overlay	$57,500
E 7TH ST	N Jefferson St	N Jefferson St	Minor Collector	0.10	44	2540	1	5	Fair	HMA	Yes	Y	Y	N	Mill & Overlay	$118,000
E 7TH ST	N Jefferson St	N Adams St	Minor Collector	0.06	44	1522	2	5	Fair	HMA	None	N	N	N	Mill & Overlay	$71,000
E 7TH ST	N Myrtle St	N Saint Nicholas St	Minor Collector	0.07	44	1867	2	5	Fair	HMA	None	N	N	Y	Mill & Overlay	$87,000
E 7TH ST	N Plum St	N Myrtle St	Minor Collector	0.07	44	1859	2	5	Fair	HMA	None	N	N	N	Mill & Overlay	$86,500
E 7TH ST	N Saint Nicholas St	N Greenwood St	Minor Collector	0.07	44	1843	2	5	Fair	HMA	None	N	N	Y	Mill & Overlay	$86,000
E 7TH ST	Q Rd	Culvert	Minor Collector	0.35	24	4866	0	4	Poor	HMA	None	Y	Y	N	Mill & Overlay	$226,500
E 7TH ST	School Access Rd	N Jefferson St	Minor Collector	0.01	44	376	2	5	Fair	HMA	Yes	Y	Y	N	Mill & Overlay	$17,500
N POPLAR ST	Culvert	W 9th St	Critical Local Route	0.04	20	517	0	7	Good	HMA	None	n	n	N	Mill & Overlay	$24,500
N POPLAR ST	W 8th St	Culvert	Critical Local Route	0.03	20	349	0	7	Good	HMA	None	N	N	N	Mill & Overlay	$16,500
S JEFFERSON ST	Orange Ave	E Vermont St	Major Collector	0.06	22	813	0	5	Fair	HMA	None	N	Y	N	Mill & Overlay	$38,000
S JEFFERSON ST	South City Limits	Orange Ave	Major Collector	0.05	22	649	0	5	Fair	HMA	None	N	Y	N	Mill & Overlay	$30,500
S STATE ST	E Ohio St	US Hwy 54	Major Collector	0.07	20	858	0	4	Poor	HMA	None	N	N	Y	Mill & Overlay	$40,000
S STATE ST	E Vermont St	E Ohio St	Major Collector	0.07	20	851	0	4	Poor	HMA	None	N	N	Y	Mill & Overlay	$40,000
S STATE ST	South City Limits	E Vermont St	Major Collector	0.10	20	1116	0	5	Fair	HMA	None	N	N	N	Mill & Overlay	$52,000
S JEFFERSON ST	E Vermont St	US Hwy 54	Major Collector	0.15	22	1883	0	2	Very Poor	HMA	None	Y	Y	N	Reconstruction	$301,000



Map 8 - Phase 3 Projects

Proposed Treatment

Double Chip Seal Reconstruct

Gravel Resurfacing

Mill & Overlay

Reconstruction

City Boundary

N

0 0.25 0.5

Miles

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Appendices

Appendix A: PASER Rating System Overview

Score		HMA		PCC		SEAL		Gravel	
		Distress	Action	Distress	Action	Distress	Action	Distress	Action
Excellent	10	None	None	None	None	None	None	None	None
Excellent	9	None	None	Traffic Wear, small pop-outs.	None	1-Year Old	None	None	None
Very Good	8	No longitudinal cracks. Occasional transverse cracks widely spaced (40' or greater). All cracks sealed or tight (open less than 1/4").	None	Pop-outs, map cracking, or minor surface defects. Partial loss of joint sealant. Isolated meander cracks, tight or well-sealed. Isolated cracks at manholes, tight or well-sealed.	Joint sealing	2-4 Years. Slight surface wear from traffic. Slight loss of surface aggregate. Minor flushing or tracking.	None	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	None
Good	7	Surface shows some traffic wear. Transverse cracks (open 1/4") spaced 10' or more apart, little, or slight crack raveling. No patching.	Crack Sealing	Some open joints. Isolated transverse or longitudinal cracks, tight or well-sealed. Some manhole displacement and cracking. First noticeable settlement or heave area.	Crack sealing	2-4 Years. Slight surface wear from traffic. Slight loss of surface aggregate. Minor flushing or tracking.	Crack Sealing	Dust under dry conditions. Moderate loose aggregate. Slight washboarding.	Grading
Fair	6	Traffic wear. Longitudinal cracks (open 1/4"–1/2"). Transverse cracks (open 1/4"– 1/2"), some spaced less than 10'. First sign of block cracking. Occasional patching in good condition.	Crack sealing or seal coat	A few isolated surface spalls. Several corner cracks, tight or well-sealed. Open (1/4" wide) longitudinal or transverse joints and more frequent transverse cracks (some open 1/4").	Crack sealing	3-5 Years. Moderate surface wear and/or flushing. Slight edge cracking. Occasional patch or loss of top layer of sealcoat.	Patching	Good crown (3"-6"). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate. Moderate washboarding (1"-2" deep) over 10%-25% of the area. Moderate dust, partial obstruction of vision. Slight rutting (less than 1" deep). An occasional small pothole (less than 2" deep). Some loose aggregate (2" deep).	Grading & Ditch Maintenance
Fair	5	Loss of fine and coarse aggregate. Longitudinal and transverse cracks (open 1/2" or more) show first signs of slight raveling and secondary cracks. First signs of longitudinal cracks near pavement edge. Block cracking up to 50% of surface. Some patching in good condition.	Seal Coat or Thin Overlay	Moderate to severe polishing or scaling over 25% of the surface. Some joints and cracks have begun spalling. First signs of joint or crack faulting (1/4"). Multiple corner cracks with broken pieces. Moderate settlement or frost heave areas. Patching showing distress.	Partial Depth patching or localized repairs	3-5 Years. Moderate surface wear and/or flushing. Slight edge cracking. Occasional patch or loss of top layer of sealcoat.	Single seal coat	Good crown (3"-6"). Adequate ditches on more than 50% of roadway. Gravel layer mostly adequate. Moderate washboarding (1"-2" deep) over 10%-25% of the area. Moderate dust, partial obstruction of vision. Slight rutting (less than 1" deep). An occasional small pothole (less than 2" deep). Some loose aggregate (2" deep).	Grading & Ditch Maintenance, refresh some aggregate.
Poor	4	Severe surface raveling. Longitudinal cracking in wheel path. Block cracking (over 50% of surface). Patching in fair condition. Slight rutting or distortions (1/2" deep or less).	Structural Overlay	Joints and cracks show moderate to severe spalling. Pumping and faulting of joints (1/2") with fair ride. Several slabs have multiple transverse or meander cracks with moderate spalling. Spalled area broken into several pieces. Corner cracks with missing pieces or patches.	Panel Replacements or Thin Overlay	5+ Years. Severe wear or flushing. Moderate to severe edge cracking or patching. Potholes or significant loss of surface sealcoat. Alligator cracking.	Drainage improvements & single seal coat	Little or no roadway crown (less than 3"). Adequate ditches on less than 50% of roadway. Portions of the ditches filled in, overgrown and/or show erosion. Some areas (25%) with little or no aggregate. Moderate to severe washboarding (over 3" deep) over 25% of area. Moderate rutting (1"-3"), over 10%-25% of area. Moderate potholes (2"-4") over 10%-25% of area. Severe loose aggregate (over 4").	New Aggregate
Poor	3	Closely spaced longitudinal and transverse cracks often showing raveling and crack erosion. Severe block cracking. Some alligator cracking (less than 25% of surface). Patches in fair to poor condition. Moderate rutting or distortion (greater than 1/2" but less than 2" deep). Occasional potholes.	Mill & Overlay	Most joints and cracks are open, with multiple parallel cracks, severe spalling, or faulting. D-cracking is evident. Severe faulting (1") giving poor ride. Extensive patching in fair to poor condition. Many transverse and meander cracks, open and severely spalled.	Full-Depth Repairs & Overlay	5+ Years. Severe wear or flushing. Moderate to severe edge cracking or patching. Potholes or significant loss of surface sealcoat. Alligator cracking.	Drainage improvements & single seal coat	Little or no roadway crown (less than 3"). Adequate ditches on less than 50% of roadway. Portions of the ditches filled in, overgrown and/or show erosion. Some areas (25%) with little or no aggregate. Moderate to severe washboarding (over 3" deep) over 25% of area. Moderate rutting (1"-3"), over 10%-25% of area. Moderate potholes (2"-4") over 10%-25% of area. Severe loose aggregate (over 4").	New Aggregate & Drainage Improvements
Very Poor	2	Alligator cracking (over 25% of surface). Severe rutting or distortions (2" or deeper). Extensive patching in poor condition. Potholes.	Reconstruction or Full-Depth Reclamation	Extensive slab cracking severely spalled and patched. Joints failed. Patching in very poor condition. Severe and extensive settlements or frost heaves.	Crack & Seat or Reconstruction	7+ Years. Extensive loss of surface sealcoat. Severe edge cracking and/or alligator cracking. Extensive patching in poor condition and/or rutting.	Base Repairs & Double Seal Coat	No roadway crown or road is bowl shaped with extensive ponding. Little if any ditching. Filled or damaged culverts. Severe rutting (over 3" deep), over 25% of the area. Severe potholes (over 4" deep), over 25% of area. Many areas (over 25%) with little or no aggregate.	Reconstruct or Close
Failed	1	Severe distress with extensive loss of surface integrity	Reconstruction	Restricted speed. Extensive potholes. Almost total loss of pavement integrity	Reconstruction	7+ Years. Severe distress with extensive loss of surface integrity	Pulverize & Double Seal coat.	No roadway crown or road is bowl shaped with extensive ponding. Ditches filled in. Severe rutting (over 3" deep) and Severe potholes (over 4" deep). 50% exposed dirt.	Reconstruct or Close

Appendix B: Treatment Cost Estimation

Reconstruction (HMA)												
Excavation	$/CY	$9		Assumed Average Excavation Depth	12	in						
Subgrade Prep	$/SY	$3										
Engineering Fabric	$/SY	$2										
Subbase (4")	$/SY	$13		Subbase Density	135	Lb /cf						
Pavement Removal	$/SY	$13										
HMA Pavement (6")	$/Ton	$150		HMA Density	145	Lb /cf	Assumed HMA Thickness	6	in			
Subdrain (4" HDPE)	$/LF	$20		Assumed Road Width	32	ft						
Storm Sewer	% Cost	15%		Subtotal	$88.56							
Driveways/Sidewalks	% Cost	7%			$13.28							
Seeding/Paint Markings, etc.	% Cost	5%			$6.20							
Mobilization, Traffic Control, Survey	% Cost	10%			$4.43							
Contingency	% Cost	20%			$11.25							
					$24.74							
Sum		$149	/SY									
Reconstruct Double Chip Seal												
Chip Seal	$/Ton	$750		Density of Chip Seal (1/2")	22	Lb /sy	Density of Emulsified Asphalt	8.4	Lbs /gal	application rate	0.46	Gal /sy
Pulverization & Shaping	$/SY	$7										
Subdrain (4" HDPE)	$/LF	$20		Assumed Road Width	32	ft						
Mobilization, Traffic Control, Survey	% Cost	10%		Subtotal	$22.32							
Contingency	% Cost	20%			$2.23							
					$4.91							
Sum		$30	/SY									
Mill & Overlay (3")												
Milling	$/SY	$1.80										
HMA Pavement (3")	$/Ton	$150		HMA Density	145	Lb /cf	Assumed HMA Thickness	3	in			
Patching	% Cost	5%		Subtotal	$26.27							
Curb & Gutter Repair	% Cost	5%			$1.31							
Driveways/Sidewalks	% Cost	7%			$1.31							
Mobilization, Traffic Control, Survey	% Cost	10%			$1.84							
Contingency	% Cost	20%			$3.07							
					$6.76							
Sum		$41	/SY									

Thick Overlay (3")

HMA Pavement (3")	$/Ton	$150		HMA Density	145	Lb /cf			Assumed HMA Thickness	3	inches	
Subdrain (4" HDPE)	$/LF	$20		Assumed Road Width	32	ft						
Patching	% Cost	5%		Subtotal	$30.09							
Curb & Gutter Repair	% Cost	5%			$1.50							
Driveways/Sidewalks	% Cost	7%			$1.50							
Mobilization, Traffic Control, Survey	% Cost	10%			$2.11							
Contingency	% Cost	20%			$3.52							
					$7.75							
Sum		$47	/SY									

Thin Overlay (1.5")

HMA Pavement (1.5")	$/Ton	$150		HMA Density	150	Lb /cy	High Pro		Assumed HMA Thickness	1.5	inches	
Patching	% Cost	5%		Subtotal	$12.66							
Curb & Gutter Repair	% Cost	5%			$0.63							
Driveways/Sidewalks	% Cost	7%			$0.63							
Mobilization, Traffic Control, Survey	% Cost	10%			$0.89							
Contingency	% Cost	20%			$1.48							
					$3.26							
Sum		$20	/SY									

Single Chip Seal (1/2")

Chip Seal	$/Ton	$750		Density of Chip Seal (1/2")	22	Lb /sy	Density of Emulsified Asphalt	8.4	Lbs /gal	application rate	0.46	Gal /sy
Patching	% Cost	5%		Subtotal	$9.70							
Mobilization, Traffic Control, Survey	% Cost	10%			$0.48							
Contingency	% Cost	20%			$1.02							
					$2.24							
Sum		$14	/SY									

Microsurfacing (1/2")

Microsurfacing	$/Ton	$750		Micro Density	16	Lb /sy	$6					
Patching	% Cost	5%		Subtotal	$6							
Mobilization, Traffic Control, Survey	% Cost	10%			$0.30							
Contingency	% Cost	20%			$0.63							
					$1.39							
Sum		$9	/SY									

Cape Seal

Chip Seal (1/2")	$/Ton	$750		Density of Chip Seal (1/2")	22	Lb /sy	Density of Emulsified Asphalt	8.4	Lbs /gal	application rate	0.46	Gal /sy
Microsurfacing	$/Ton	$750		Micro Density	16	Lb /sy	$6					
Patching	% Cost	5%		Subtotal	$15.70							
Mobilization, Traffic Control, Survey	% Cost	10%			$0.30							
Contingency	% Cost	20%			$1.60							
					$3.52							
Sum		$22	/SY									

Asphalt Rejuvenators													
Rejuvenator Product	$/Ton	$850		Application Rate	0.05	Gal /sy	Density of Emulsified Asphalt	8.4	Lbs /gal	Screening	1.5	Lb /sy
Patching	% Cost	5%		Subtotal	$0.82							
Mobilization, Traffic Control, Survey	% Cost	10%			$0.30							
Contingency	% Cost	20%			$0.11							
					$0.25							
Sum		$2	/SY									
Edge Drain Retrofit				Assumes City does this								
Subdrain (4" HDPE)	$/LF	$20		Assumed Road Width	32	ft						
				Generalized to SY of WHOLE road								
Sum		$6	/SY									
Crack Sealing/Filling				Assumes City does this								
Crack Sealing/Filling	$/LF	$0.85		Assumed Road Width	24	ft	Assumed avg. cracks per width	1				
				Generalized to SY of WHOLE road								
Sum		$2.50	/SY									
Full-Depth HMA Patching				Assume City does this								
Patching	$/SY	$175		Assumed Road Width	27	ft	Assumed % area	5%				
				Generalized to SY of WHOLE road								
Sum		$8.75	/SY									
Gravel Resurfacing												
Granular Material (3")	$/TON	$30		Density	140	pcf	Assumed Thickness	3	inches			
Sum		$4.75	/SY									

THIS CONCLUDES THE

Eureka Pavement Management Report

JEO Consulting, Inc.

Eureka, KS

4/30/2024