Standing Rock Sioux Tribe

Urban Pavement Management Plan

June 2017

FHWA Disclaimer

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CHAPTER 1 INTRODUCTION

The Standing Rock Sioux Tribe is responsible for maintaining over 220 miles of roadway, nearly half of which (109 miles) are paved roads, and 22 miles of which are included in this study. These consist almost entirely of 2-lane asphalt roads. Funding levels have not allowed for extensive regular overlays, reconstruction, seal coats, and other maintenance. Without a proactive strategy in place, roads will deteriorate faster than they can be maintained.

Understanding how road pavements age and deteriorate over time, both by environmental conditions and traffic loading, is critical in developing a sustainable roadway rehabilitation and maintenance program. Maintaining and rehabilitating infrastructure at appropriate times saves public dollars in the long term. Studies have found maintaining pavement through rehabilitation techniques has the potential to be 6 to 14 times more cost effective than rebuilding a deteriorated road.

Figure 1 - Road Maintenance Types Over Time

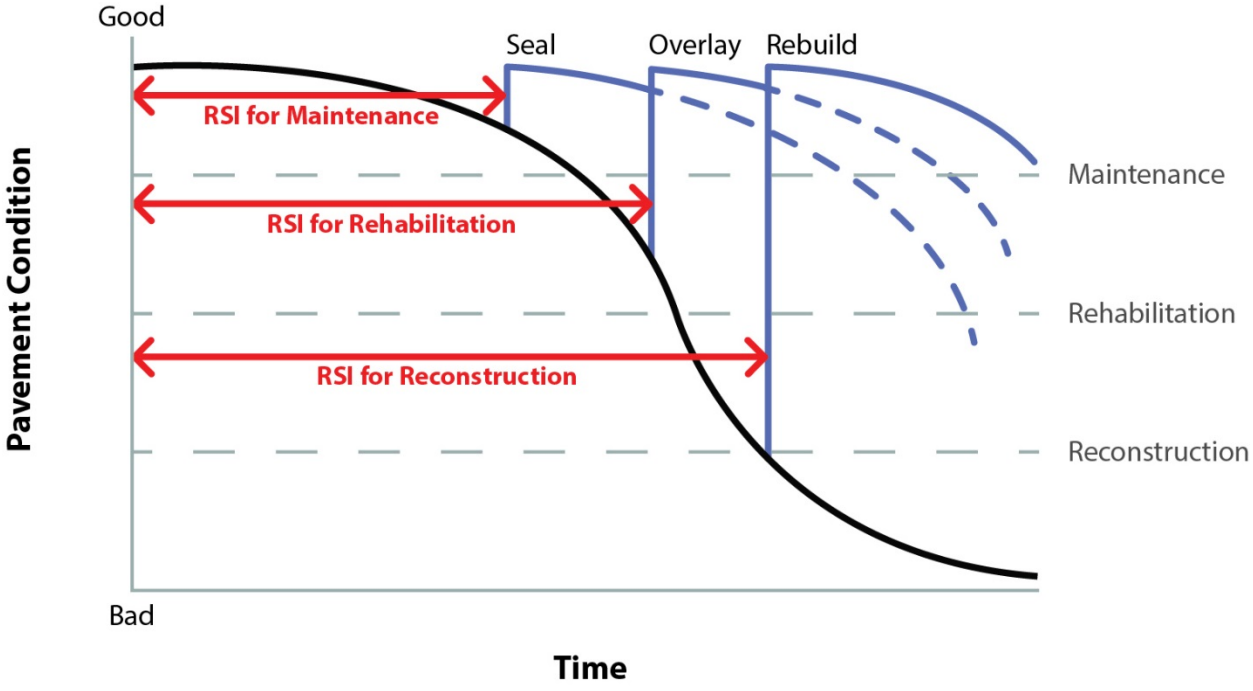


Figure 1 shows that it is easier and more cost effective to maintain good roads than it is to wait and reconstruct bad ones. Overlays or reconstruction projects have a longer Return Service Interval (RSI) and are performed less often than a chip seals. However, as the road condition deteriorates, the costs associated with restoring the road to good condition increases exponentially. See Table 1 for a comparison of cost-per-year based on RSI.

Table 1 – Treatment Cost per Year

Treatment Type	RSI (years)	Cost per Mile	Cost per Year
Seal	3	$32,500	$10,833
Overlay	12	$375,000	$31,250
Reconstruction	25	$1,125,000	$45,000

New technology and processes can streamline the maintenance scheduling process. Techniques such as Pavement Surface Evaluation and Rating (PASER) can allow a department to come up with an effective treatment plan based on the conditions of the surrounding roadways. PASER is a visual method, based on engineering principles, for evaluating paved roads in a time efficient and consistent manner. The PASER method outputs a simple 1 through 10 rating for each section of roadway studied. This provides an understandable way for an agency to communicate pavement condition to elected officials and the public, and it also allows more time to be put towards scheduling and budgeting. The ability to know the condition of all roadways under Tribal jurisdiction is an extremely useful tool. This knowledge helps to schedule all preventative maintenance to keep all roadways functioning at their current condition, instead of degrading to the point where costlier corrective and emergency maintenance treatments are required.

Photo of Pavement Condition on a Standing Rock Reservation Street

The purpose of this study is to conduct a PASER survey of all the roads in the study area and determine what maintenance strategies should be utilized by the Tribe in the short-term and longer-term time frame. This will help the Tribe effectively manage their roadways while trying to minimize the maintenance costs over time.

CHAPTER 2 EXISTING ROADWAY CONDITIONS

Methodology

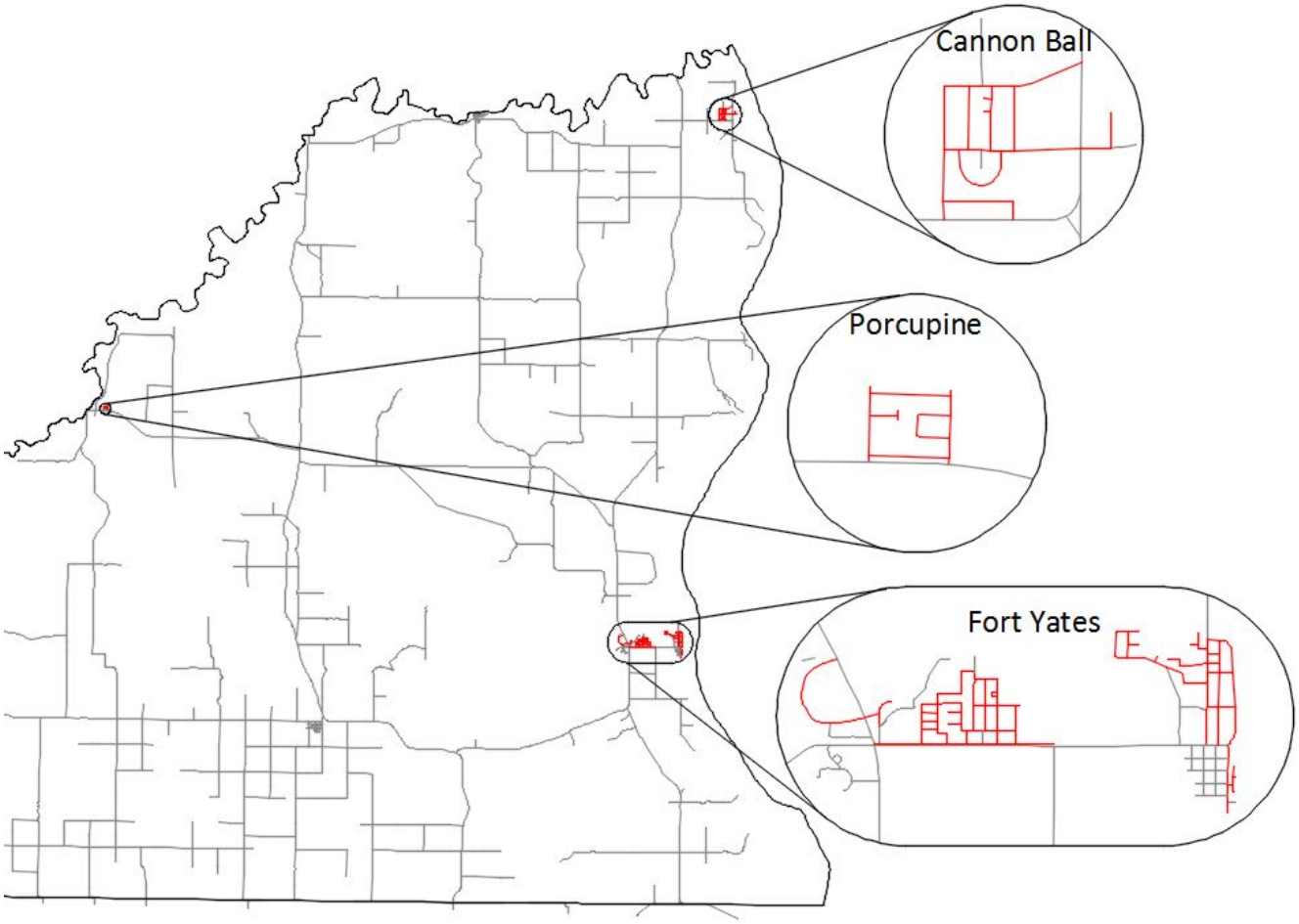
This study was focused on assessing the current condition of the streets around the reservation and developing a maintenance strategy to improve and repair them. Tribal officials identified housing streets, streets near schools, pedestrian pathways, and several other heavily travelled areas, consisting of approximately 22 miles of pavement of varying widths to be evaluated. Not all paved roads were to be evaluated; very few city owned streets were studied, and all routes included in the Rural Pavement Management Plan were excluded. Figures 2 and 3 highlight the roadways that were evaluated on the Standing Rock Reservation in this study.

Pavement Surface Evaluation and Rating (PASER)

PASER ratings are performed in order to assist agencies in identifying roadway conditions and prioritizing improvements based on a range of factors including roughness (ride), surface distress (condition), surface skid characteristics, and structural characteristics (potholes, cracking, etc.). Based on the PASER rating, different maintenance tasks are required to maintain or raise the rating for a particular section of roadway. By continuing to ensure that a good roadway remains a good roadway, the life of a roadway can be extended for a far lower upfront cost than by waiting until a more intensive maintenance method is required.

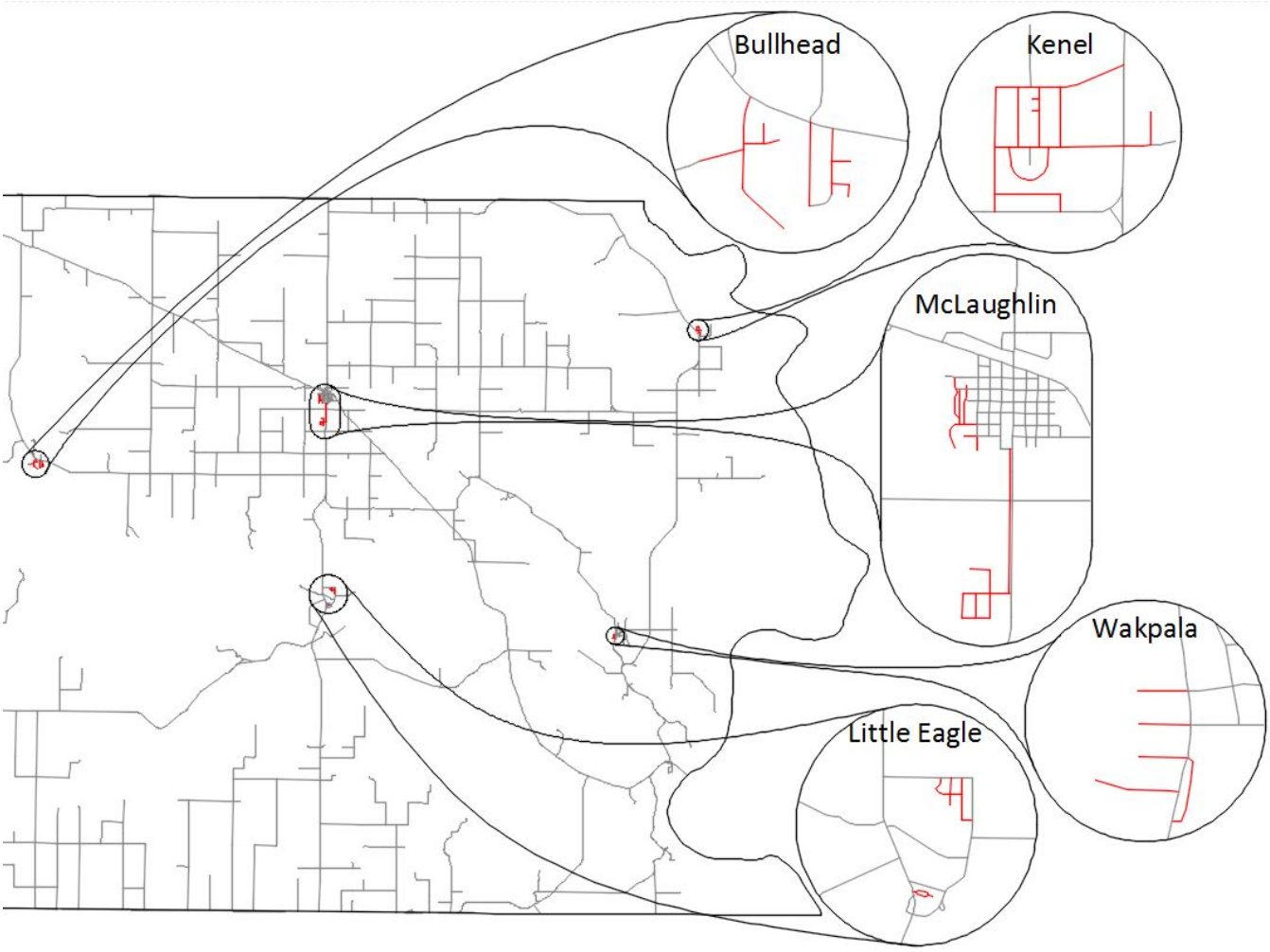
Example Photo of Road Maintenance Activities

Figure 2 - Study Area Roads: Sioux County



- The community of Cannon Ball has 3.14 miles of streets included in this study. Local roadways that were omitted from this study were included in the Rural PMP Report.
- The community of Porcupine study has 0.92 miles of streets included in this study.
- The town of Fort Yates, and surrounding areas, includes 9.54 miles of streets and 3.26 miles of pedestrian pathway. The Causeway and many city streets were excluded from this study.

Figure 3 – Study Area Roads: Corson County



- The community of Bullhead has 1.64 miles of paved streets in the study area.
- The community of Kenel has 1.00 miles of paved streets in the study area.
- The town of McLaughlin has 2.37 miles of paved streets and 0.75 miles of pedestrian pathway in the study area. Most city streets in McLaughlin were excluded from this study.
- The community of Wakpala has 0.56 miles of paved streets in the study area.
- The community of Little Eagle has 1.05 miles of paved streets in the study area. Local roadways that were excluded from this study have been included in the Rural PMP Report.

Process

In order to determine the 1 to 10 PASER rating of each segment of BIA and tribal roadway, each block of study area roadway was mapped out and driven. As each route was driven, a windshield survey of the road condition was noted and pictures were taken and geolocated in order to help document where and why each PASER rating was given. Factors such as the amount of cracking, potholes, rutting, shoulder condition, ability to drive at full speed, and the presence of gravel were all considered in rating the road segments. Consistency was important in the rating. Each of the rating values was defined and kept consistent throughout the PASER rating process. For example, severe cracking on a roadway rated it as a five and each instance of severe cracking was rated as a five consistently. As opposed to the rating process used on rural highways where a 100-foot sample segment was rated per every mile of roadway, the urban streets were rated with their entire length in consideration.

Each segment of the 22 miles in the study area was driven and rated in May 2017.

Description of PASER Ratings

The paved study area roads were all given a PASER rating between 1 and 10 based on existing conditions. None of the roads in the study area were observed to be a 1, 2, 9 or 10. The individual PASER ratings values are described below and an example photo of each is provided.

PASER Rating 1:

No pavement. A PASER rating of 1 indicates a gravel road section with virtually no visible pavement. Example: none in the study area.

Example Photo of a PASER Rating 1 Road

PASER Rating 2:

Terrible. Heavy patching with gravel patches on failed asphalt. Limited pavement intact. No striping. Shoulders are deteriorated. You cannot drive this road at the posted speed limit. Drivers need to slow down. Example: none in the study area.

Example Photo of a PASER Rating 2 Road

PASER Rating 3:

Very poor. Severe cracking and rutting with moderate visible potholes. Heavy patching with some patches on old patches. Limited striping. Shoulders are deteriorated. Areas are marked with flags. You cannot drive this road at the posted speed limit. Drivers need to slow down. Example: All Nations Street at intersection with SD Hwy 63, one mile south of McLaughlin, SD.

Photo of a PASER Rating 3 Road on the Standing Rock Reservation

PASER Rating 4:

Poor. Heavy cracking and rutting with moderate visible potholes. Heavy patching with some patches on old patches. Limited striping. Shoulders are deteriorated. Cracks are not sealed. You cannot drive this entire road at the posted speed limit. Drivers need to slow down in areas. Example: 1st Avenue, Cannon Ball, ND.

Photo of a PASER Rating 4 Road on the Standing Rock Reservation

PASER Rating 5:

Fair. Moderate to heavy cracking with moderate rutting. Moderate patching with some patches on old patches. Limited striping. Cracks are mostly not sealed. You can still drive this road at the posted speed limit. Example: Cedar Avenue, 1 mile south of McLaughlin, SD.

Photo of a PASER Rating 5 Road on the Standing Rock Reservation

PASER Rating 6:

Fair. Moderate to heavy cracking or some raveling and rutting exists. Moderate polishing with occasional patches visible. Cracks are mostly sealed. Example: Wolf Street in Fort Yates, ND.

Photo of a PASER Rating 6 Road on the Standing Rock Reservation

PASER Rating 7:

Good. Some cracking, no raveling and little rutting. No patches are visible. Cracks are sealed. This roadway is not in need of immediate repair. Example: Rain in the Face Avenue in Bullhead, SD.

Photo of a PASER Rating 7 Road on the Standing Rock Reservation

PASER Rating 8:

Great. No cracking, raveling or rutting present. No patches or sealed cracks are visible. This roadway is not in need of repair. Example: Wiyohiyampta Street in Porcupine, ND.

Photo of a PASER Rating 8 Road on the Standing Rock Reservation

PASER Rating 9:

Excellent. A relatively new road with new striping. This is usually a roadway that was reconstructed or overlaid recently. Example: None in the study area.

Photo of a PASER Rating 9 Road

PASER Rating 10:

Perfect. A brand new road with appropriate striping and shoulders. This is a roadway that was most likely reconstructed or overlaid in the last year. Example: None in the study area.

Example Photo of a PASER Rating 10 Road

Map of Road Conditions

Every segment of roadway and pathway was given a PASER score and the results were mapped. Figures 4 and 5 are maps that display the PASER ratings in a color coded system. Blue being the highest values or best conditions going down through the rainbow with red being the lowest values or worst conditions found in the study area. Figures 4 and 5 are included in Appendix A in 11”x17” format for reading clarity.

Figure 4 – Existing Pavement Conditions: Sioux County, 2017

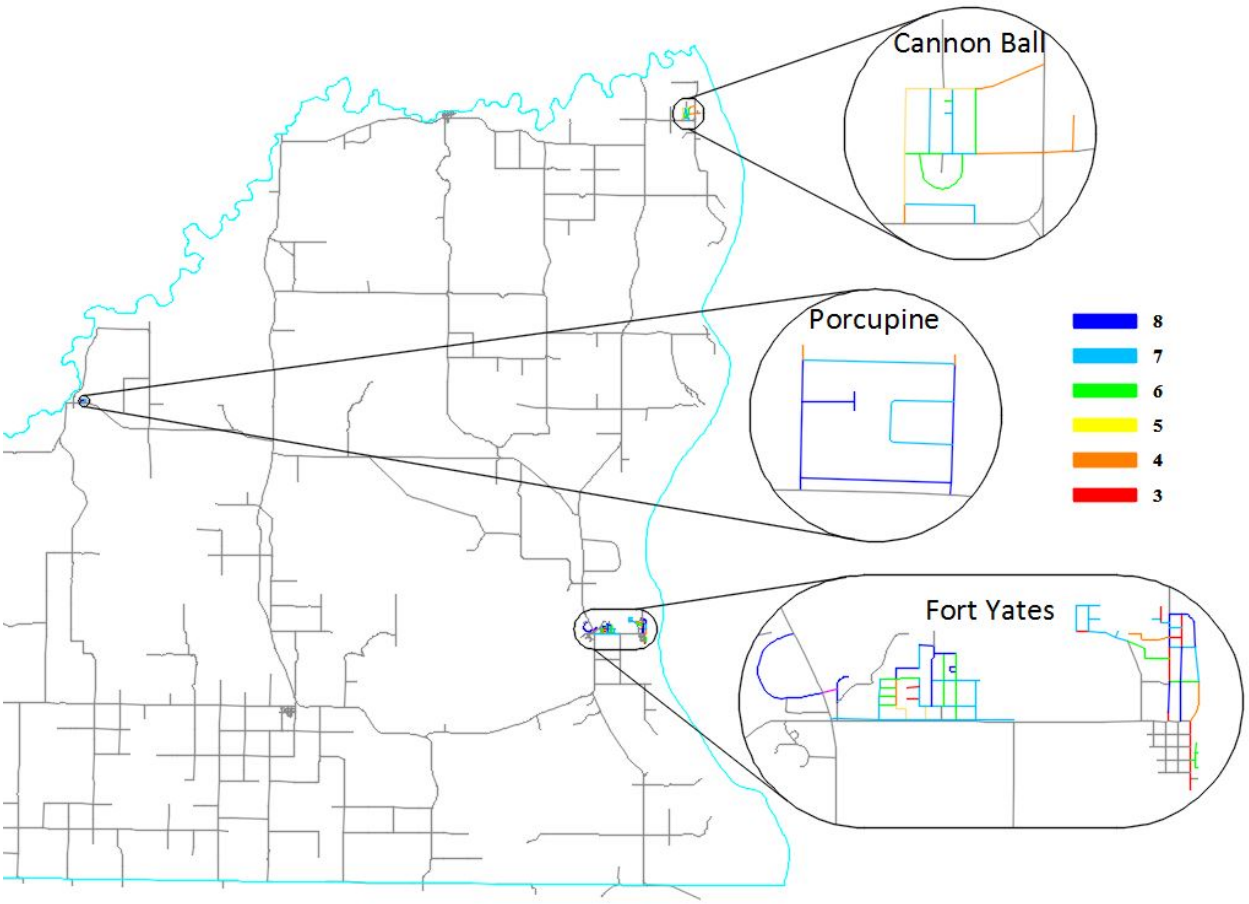
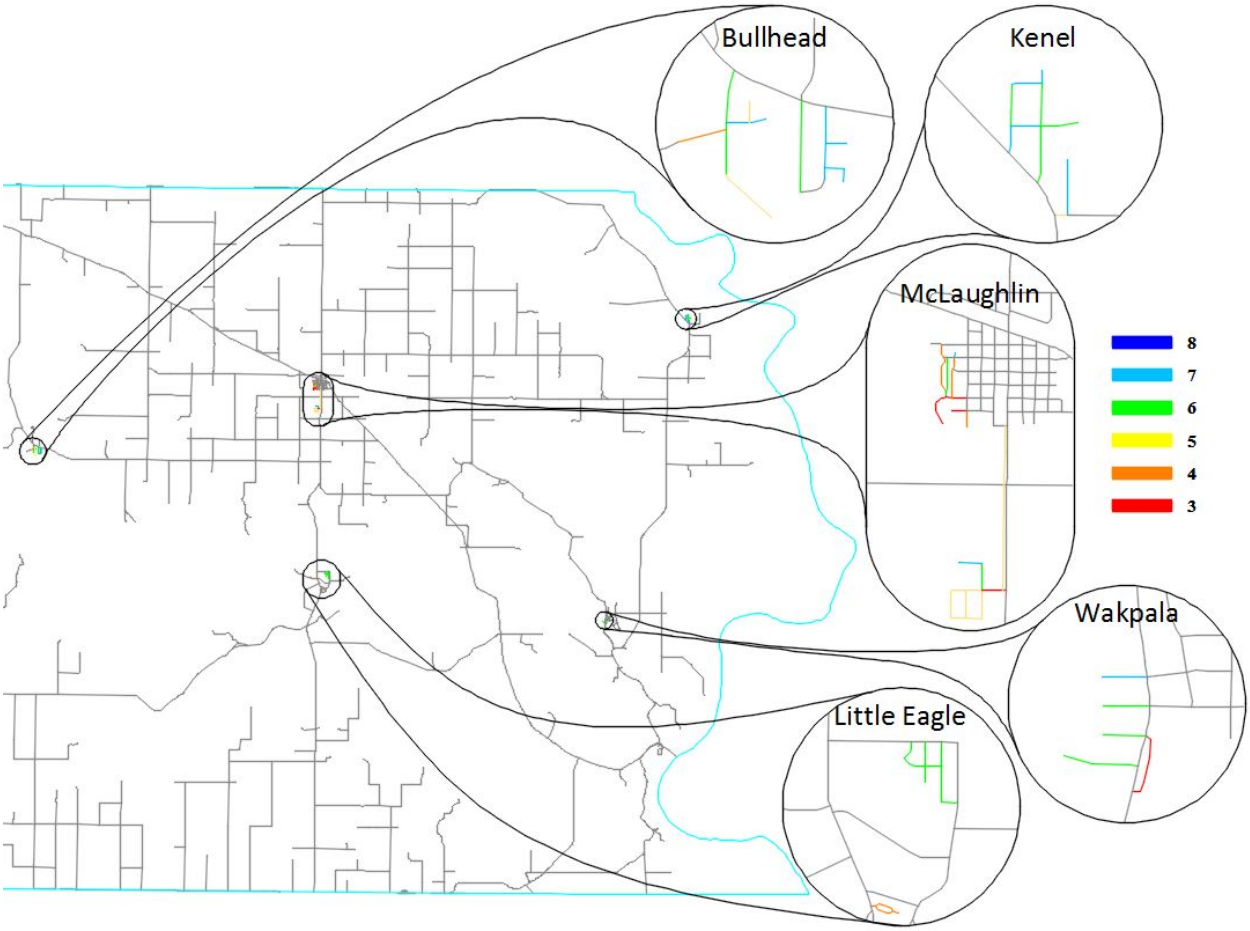


Figure 5 – Existing Pavement Conditions: Corson County, 2017

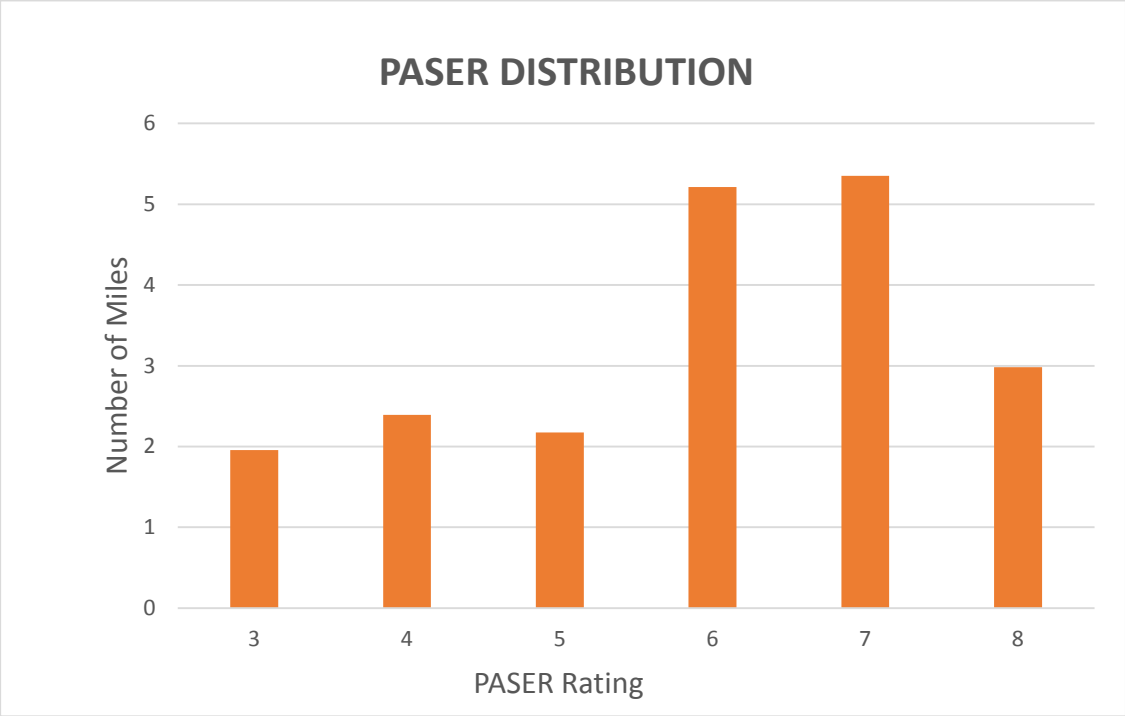


PASER Rating Distribution

Approximately 22 miles of tribal/BIA roadway were assigned PASER ratings throughout the course of the study. The average (mean) rating for the studied roadways was 5.92. That number may not signify much, but it does indicate that the Standing Rock highways scored tend to be in fair to good condition. In fact, if a rating of five is to be considered the minimum acceptable pavement condition, (able to drive at posted speed limit) then 78% of scored roads meet that standard today. This is visualized in the Figures 4 and 5 as it indicates there are more miles of green and dark/light blue than there are of red, orange, and yellow.

The number of road miles per PASER rating are broken down and illustrated in Figure 6.

Figure 6 - PASER Score Distribution



CHAPTER 3 NEEDS ASSESSMENT

Methodology

In conducting the Needs Assessment it is not as easy as simply looking at the lower scoring roads and saying that they are in the worst conditions; therefore have the most need. Other factors such as traffic volume, truck traffic, roadway safety, maintenance history, level of service needed, connections, and other factors should be considered.

Description of Pavement Preservation Strategies

Timing on treatments is particularly important in order to maintain an effective pavement management budget. Example: Crack sealing is best performed when temperatures are moderately cool, such as the spring or fall months. Cooler temperatures are generally when the cracks are fully open, allowing for the entire crack to be sealed. Crack sealing can also be performed with less labor involved, so a smaller crew can handle these in the fall and spring. More intensive maintenance methods (minor overlays, chip seals, etc.) can be done in the summer months can be done in the summer when maintenance departments typically have seasonal manpower as well. Generally, the state Departments of Transportation in northern regions prohibit chip sealing operations before May 1st and after August 31st so that minimum temperature guidelines can be followed for quality purposes. Higher temperatures also lessen the cure time required, thus allowing the roadway to be opened in a shorter time frame. Full reconstruction and structural overlays are generally more labor and equipment intensive and are much more expensive. Sealing does need to be performed in moderation. Extensive sealing operations can result in a loss of pavement friction, which would then lead to a chip seal in order for the roadway to function properly in winter months. It is also extremely important to keep weather factors in mind, as excessive moisture can prohibit primers and sealants from bonding properly.

PASER Rating of 1:

There were no roadways in the study area with a PASER rating 1. If there were, however, it would essentially be a gravel road, and the Tribe would have to determine if a full reconstruction is needed or if it is to remain gravel and the Tribe can provide maintenance as such.

PASER Rating of 2:

Due to severe deterioration, the roadway needs reconstruction with extensive base repair; or the decision can be made to pulverize any remaining asphalt and maintain it as a gravel road. As with PASER rating 1, no roads in the study area were severely deteriorated enough to receive a PASER rating of 2.

PASER Rating of 3:

Patching and repair will need to be done prior to a major structural overlay (greater than 2”). Milling and removing deteriorated areas will extend the life of the overlay. The Tribe has recently begun the process to procure an asphalt Zipper (or similar) to pulverize and recycle asphalt in-place. Owning and operating their own piece of equipment will greatly reduce the cost of rehabilitating the roads that are in the poorest condition.

PASER Rating of 4:

Because the Tribe is purchasing an asphalt zipper, several roadways with a PASER rating of 4 are shown as “Pulverize and Repave” projects. The reduced project costs associated with owning the equipment as well as the severely deteriorated pavement conditions support the rationale of a reconstructed roadway, rather than the structural overlay that would traditionally be recommended for a PASER rating of 4.

PASER Rating of 5:

Primarily consists of aging asphalt, but with sound structural conditions. The roadway can benefit from patching where necessary, followed by a non-structural overlay (less than 2”).

PASER Rating of 6:

Light signs of aging. The roadway life can be extended with routine crack sealing and a sealcoat.

PASER Rating of 7:

Roadway shows very few signs of aging and can be maintained with routine crack filling.

PASER Rating of 8 and 9:

No immediate maintenance is required on these roadways. In the future, routine crack filling and maintenance should be performed to continue to extend the life of the roadway.

PASER Rating of 10:

This roadway was recently completed and no maintenance is required.

The Standing Rock Sioux Tribe already uses all of these strategies or interventions to maintain their paved roads.

It is known that costs can vary quite a bit in the study area. Approximate contracted out costs per mile for major maintenance tasks associated with work on the Standing Rock Sioux Reservation are listed in Table 2 below. It is extremely important to keep track of all associated maintenance costs (crack sealing, seal coating, etc.). No matter how minor the task being performed, accurate and concise cost tracking will enable more accurate programming, scheduling and budgeting. Costs vary by state or region, so tracking these costs enables an accurate pavement management plan to be applied to the entire reservation.

Table 2 - Cost Estimates

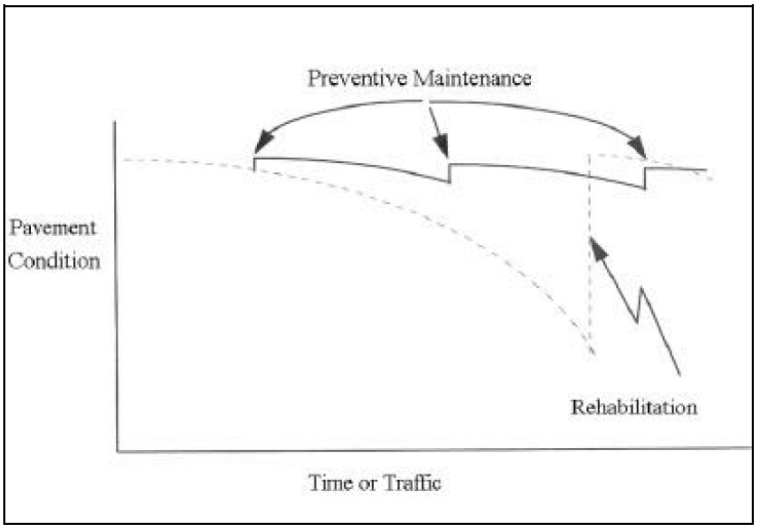
Improvement Type	Cost per Mile*
Reconstruction	$ 1,300,000.00
Pulverize and Repave	$ 800,000.00
Structural Overlay	$ 400,000.00
Non-Structural Overlay	$ 200,000.00
Chip Seal	$ 32,500.00

*Note: Costs are planning figures based on asphalt and earth materials costs only and include gross approximations for contractor mobilization costs. Dollar amounts shown do not include costs or fees for: other incidental construction costs associated with drainage, safety improvements, lighting, or signage; right-of-way acquisition; preliminary engineering; or construction management. Assumed asphalt thicknesses for non-structural overlays, structural overlays, and reconstruction are 1 ½ inches, 4 inches, and 5 inches, respectively. Costs for overlays and reconstruction include chip seal cost. Pulverize and repave cost is for Tribe performing pulverization with their own equipment.

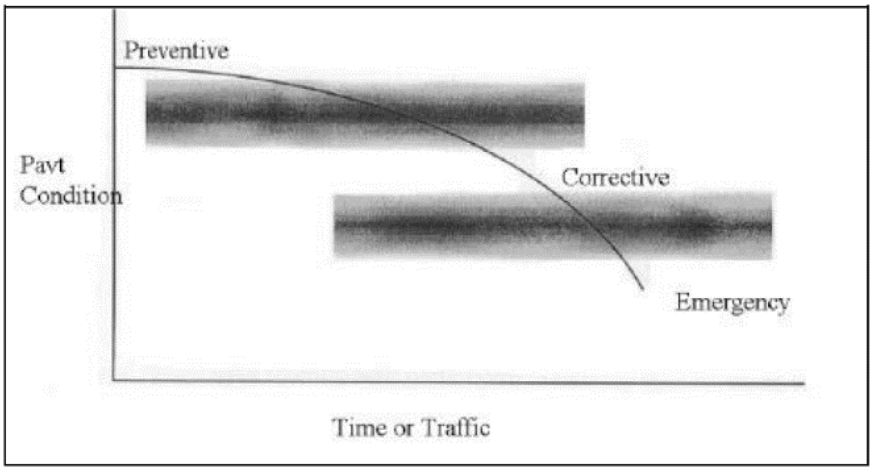
The estimated costs are assumptions in 2016 US Dollars for contracting purposes. These are estimates based on recent similar projects and NDDOT & SDDOT Average Bid Prices. For planning and budgeting purposes, construction costs should be expected to increase at a 5 to 6 percent annual inflation rate.

Feasible Strategies

There is a saying that you don't want to improve the worst roads first. This is backed up by research. It is more cost efficient to keep a good road in operating condition than to replace an aging road. By putting money upfront into seal coating, crack sealing, etc., the roadway's life can be extended far more efficiently than waiting until structural improvements are required (overlays, milling, reconstruction, etc.). Deferring repairs until a road deteriorates to poor condition costs more than double what it would cost to perform routine preventative maintenance (based on a recommended sample system preservation program published by FHWA).



Corrective and emergency repairs occur when the roads are more deteriorated or have lower PASER ratings and require costly structural improvements or reconstruction.



CHAPTER 4 RECOMMENDATIONS

The Standing Rock Sioux have contracted their road maintenance department from the BIA, and they are in the process of restarting their Tribal Transportation Program through PL93-638 contracting through the BIA as well. The Tribe has dozens of projects programmed into its Tribal Transportation Improvement Plan (TTIP) over the next 5 years, and many more projects exist on the Tribe's priority list that are not yet on the TTIP. Several projects are on the TTIP which involve pavement preservation of some form, such as: Kenel Road Rehab (ND), Kenel Road Chip Seal (SD), Bullhead East Chip Seal, and Bullhead to Walker Chip Seal. These TTIP pavement preservation projects, however, are rural in nature, and there are no projects for urban pavement preservation in the current TTIP. There are, of course, other road maintenance activities such as patching and crack-sealing that are on-going.

The TTIP also an allocates $250,000 annually to Road Maintenance; portions of this funding could be considered for chip seals and, to a lesser degree, non-structural overlays. The Tribe also has some older FHWA allocations that are tagged for road maintenance expenditures, and newer TTP allocations are ready to be contracted and released by the BIA Great Plains Regional Office.

Prioritized Projects

The focus for recommendations in this Pavement Management Plan is on pavement overlays and chip seals. Below in Table 3 is the priority project list. The Standing Rock TTP is already aggressively pursuing projects from the Rural Highways Pavement Management Plan, and it would be best left to Standing Rock TTP staff to determine how best to work the urban pavement management plan projects into the TTIP and construction schedule.

Table 3 - Priority Urban Preservation Projects

Priority	Community	Total Length (miles)	Average PASER Rating	Treatment Type	Estimated Cost (2017 Dollars)
1	Fort Yates	0.758	3.8	Reconstruction	$ 606,515
2	Fort Yates	0.937	4.2	Repave Utility Trenches	$ 187,386
3	McLaughlin	0.842	5.0	Non-Structural Overlay	$ 168,333
4	McLaughlin	0.877	4.5	Reconstruction	$ 701,515
5	Cannon Ball	0.686	5.0	Non-Structural Overlay	$ 137,121
6	Cannon Ball	0.792	4.0	Structural Overlay	$ 316,742
7	Wakpala	0.132	3.0	Reconstruction	$ 105,303
8	Little Eagle	0.249	4.0	Non-Structural Overlay	$ 49,811
9	Bullhead	0.280	5.0	Non-Structural Overlay	$ 56,061
					$ 2,328,788

Table 4 – Near Term Chip Seal Needs

Priority	Community	Total Length (miles)	Average PASER Rating	Treatment Type	Estimated Cost (2017 Dollars)
1	Little Eagle	0.798	6.0	Chip Seal	$ 25,926
2	Kenel	1.000	6.4	Chip Seal	$ 32,512
3	Cannon Ball	1.663	6.6	Chip Seal	$ 54,050
4	Bullhead	1.204	6.5	Chip Seal	$ 39,129
5	Fort Yates	4.680	6.8	Chip Seal	$ 152,085
					$ 303,703

* It should be noted that crack seals are to be performed before chip seals and non-structural overlays.

Tables 3 outlines a priority paving plan to focus efforts on maintaining the best tribal roadway system possible, for the most users.

CHAPTER 5 – SUPPLEMENTAL DATA

Below is a condensed version of the field data collected, summarizing existing conditions that contributed to the rating given and treatment recommended.

Table 5 – Field Data Summary by Project

Project	Community	Rutting (depth)	Transverse Cracks (width/spacing)	Longitudinal Cracks (width/extent)	Alligator/ Block Cracking (size/%)	Patches (extent)	Potholes (extent)	Comment
1	Fort Yates	½" – 2"	¾" @ 5' – 25'	¼" – ¾" Moderate to Severe	3" @ 10%	Severe	Severe	Several streets w/ alligator cracking and potholes
2	Fort Yates	-	½" – ¾" @ 50' – 150'	-	-	-	Backfilled util. trenches	PASER 8 without unpatched util. trenches
3	McLaughlin	-	½" – 1" @ 6' – 30'	½" – 1" Moderate to Severe	6" – 8" 10%	Very Low	Very Low	
4	McLaughlin	½" – 1½"	½" – 1" @ 3' – 15'	½" – 1" Severe	3" - 8" 60%	Moderate	Severe	Isolated bad section of the route
5	Cannon Ball	0 – ½"	¼" – ½" @ 6' – 20'	¼" – ¾" Moderate to Severe	4" – 8" 30%	Low	-	
6	Cannon Ball	½" – 2"	½" – 1" @ 3' – 20'	¼" – ¾" Severe	3" 50%	Severe	Low	Condition changes drastically at MM0.3
7	Wakpala	1" – 2"	½" – 1" @ 5' – 50'	¼" – ½" Moderate	3"x4" 15%	-	Moderate	
8	Little Eagle	½" – 1"	¼" – ¾" Severe	¼" – ¾" Severe	4"x6" 90%	-	Moderate to Severe	
9	Bullhead	¼" – ½"	½" – ¾" @ 2' – 35'	½" – ¾" Moderate	6"x6" 20%	-	Moderate to Severe	

References

Smart Growth America. (2011). *Repair Priorities - Transportation spending strategies to save.* Smarth Growth America and Taxpayers for Common Sense.

Walker, D., & Entine, L. (2002). *Asphalt Roads - Pavement Surface Evaluation and Rating.* Madison: Wisconsin Transportation Information Center.

APPENDIX A – EXISTING PAVEMENT CONDITIONS

Figure 7 – Existing Pavement Conditions: Sioux County, 2017

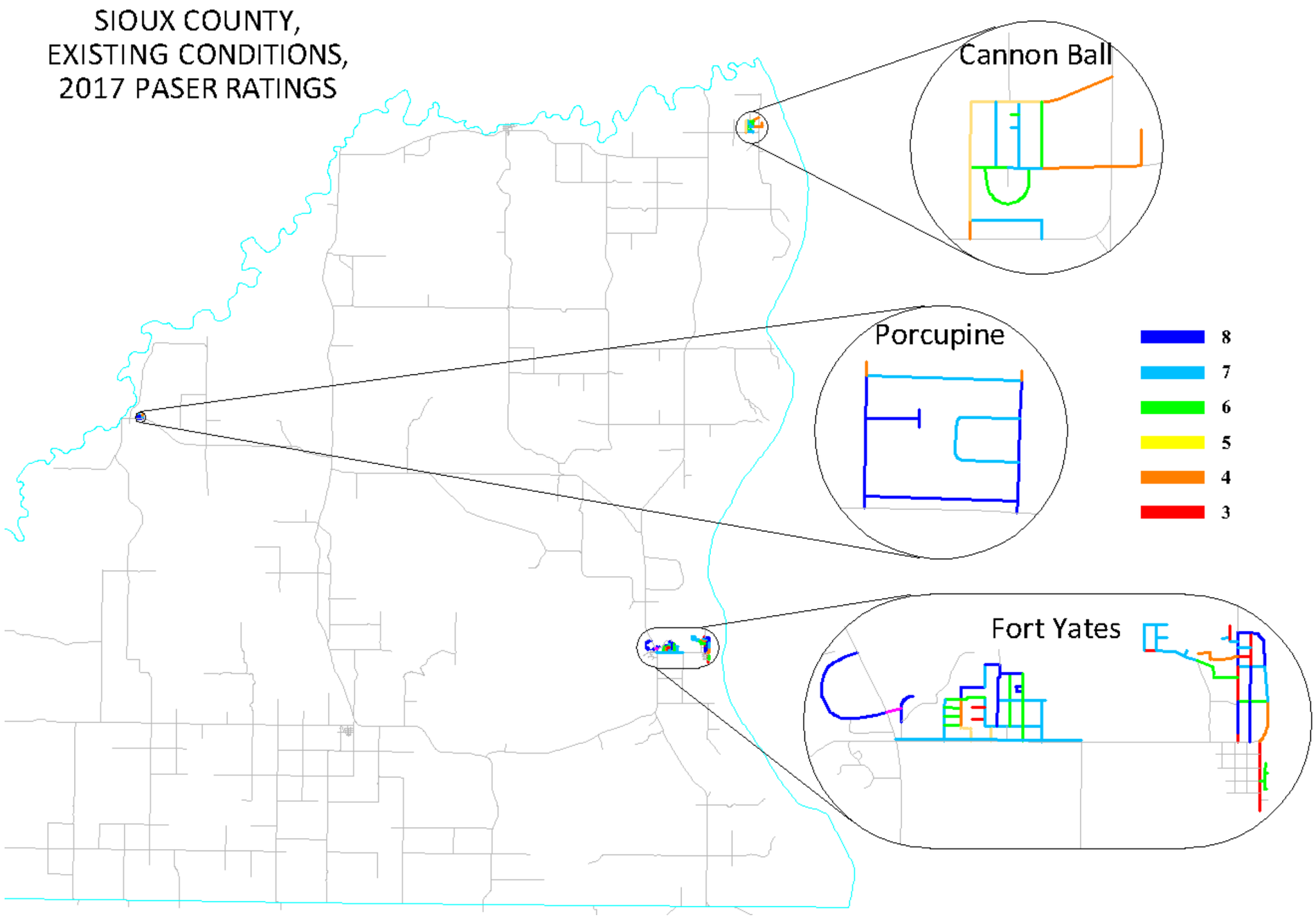
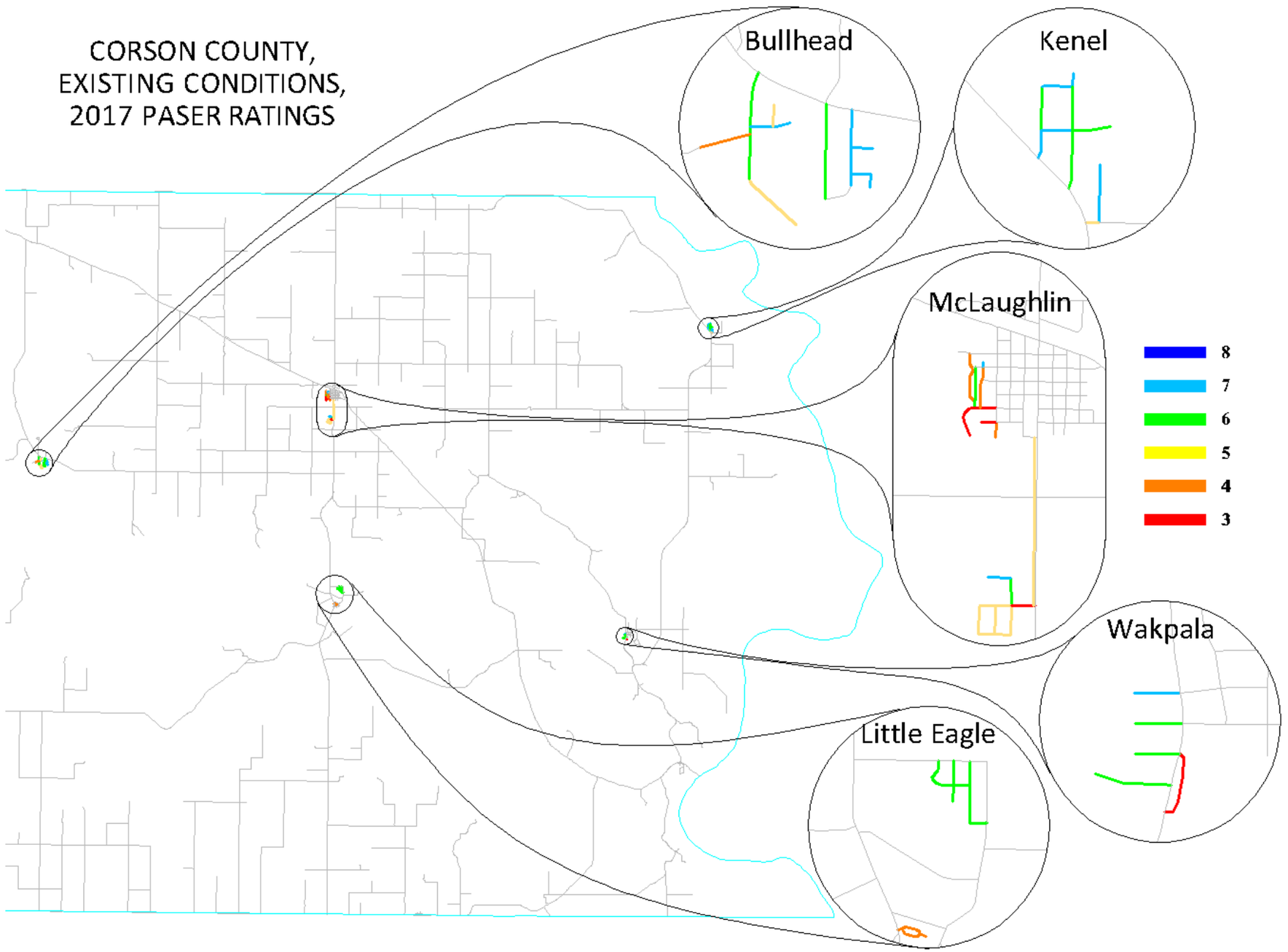


Figure 8 – Existing Pavement Conditions: Corson County, 2017

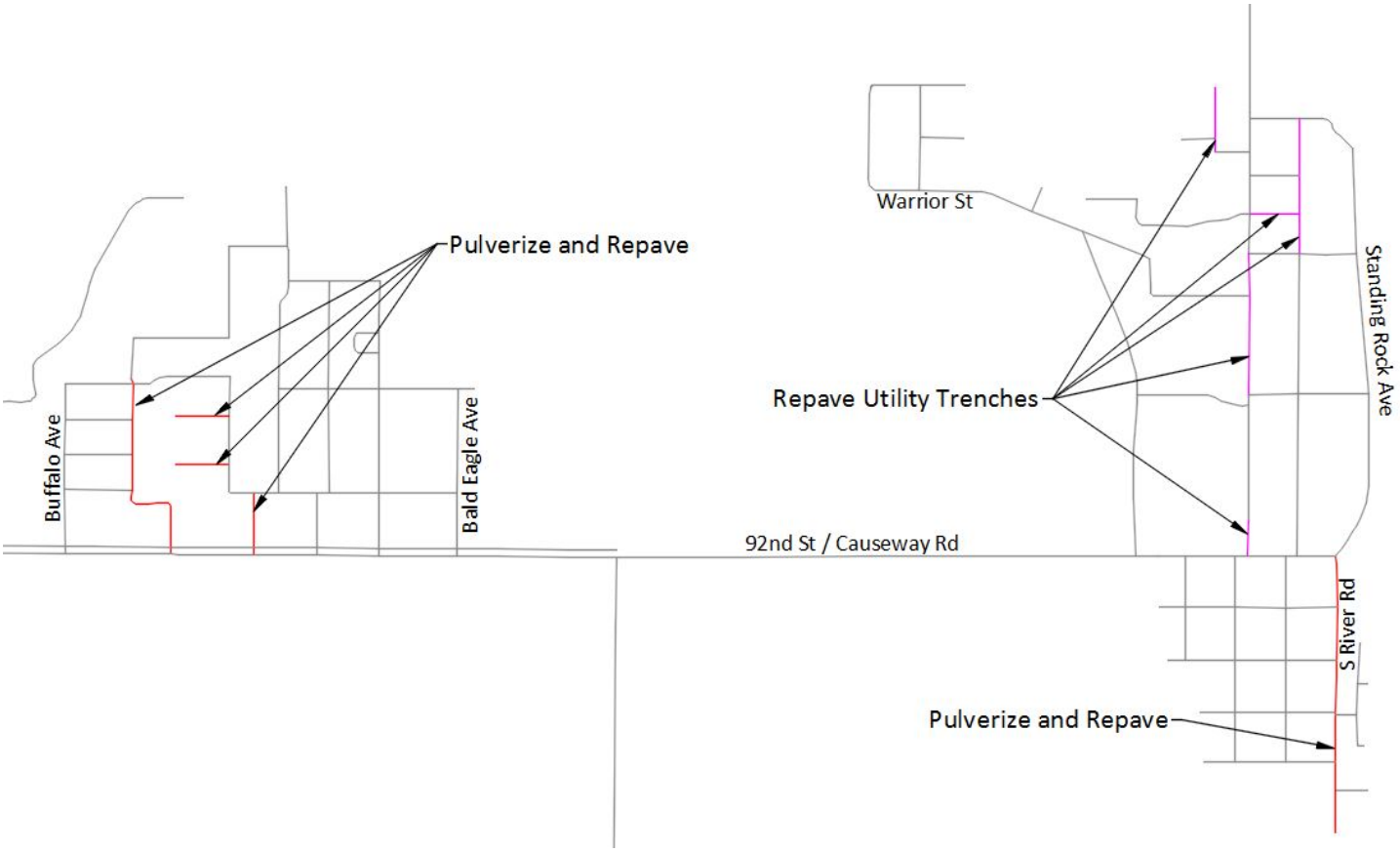


APPENDIX B – PROJECT LOCATION MAPS

Figures in Appendix A have been included show the routes included in the pavement preservation projects in Table 3. The locations of the chip seal projects in Table 4 have been purposefully omitted from these figures. The chip seal routes can generally be assumed to be the remainder of the study area routes, with the exception of those with a PASER rating of 7 or 8, as shown in Figures 4, 5, 7 and 8. All strip maps are oriented with north at the top of the page.

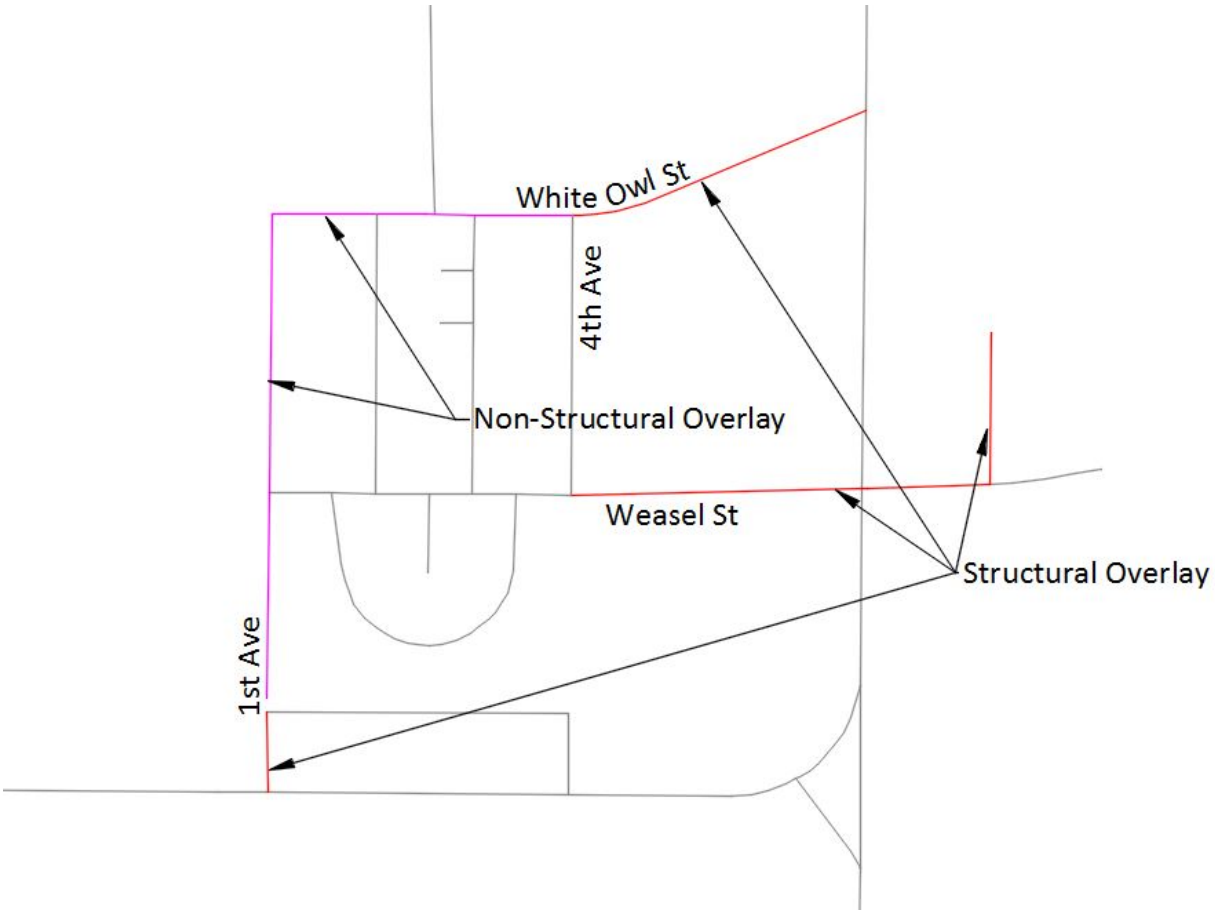
Fort Yates

Figure 9 – Fort Yates Pavement Preservation Projects



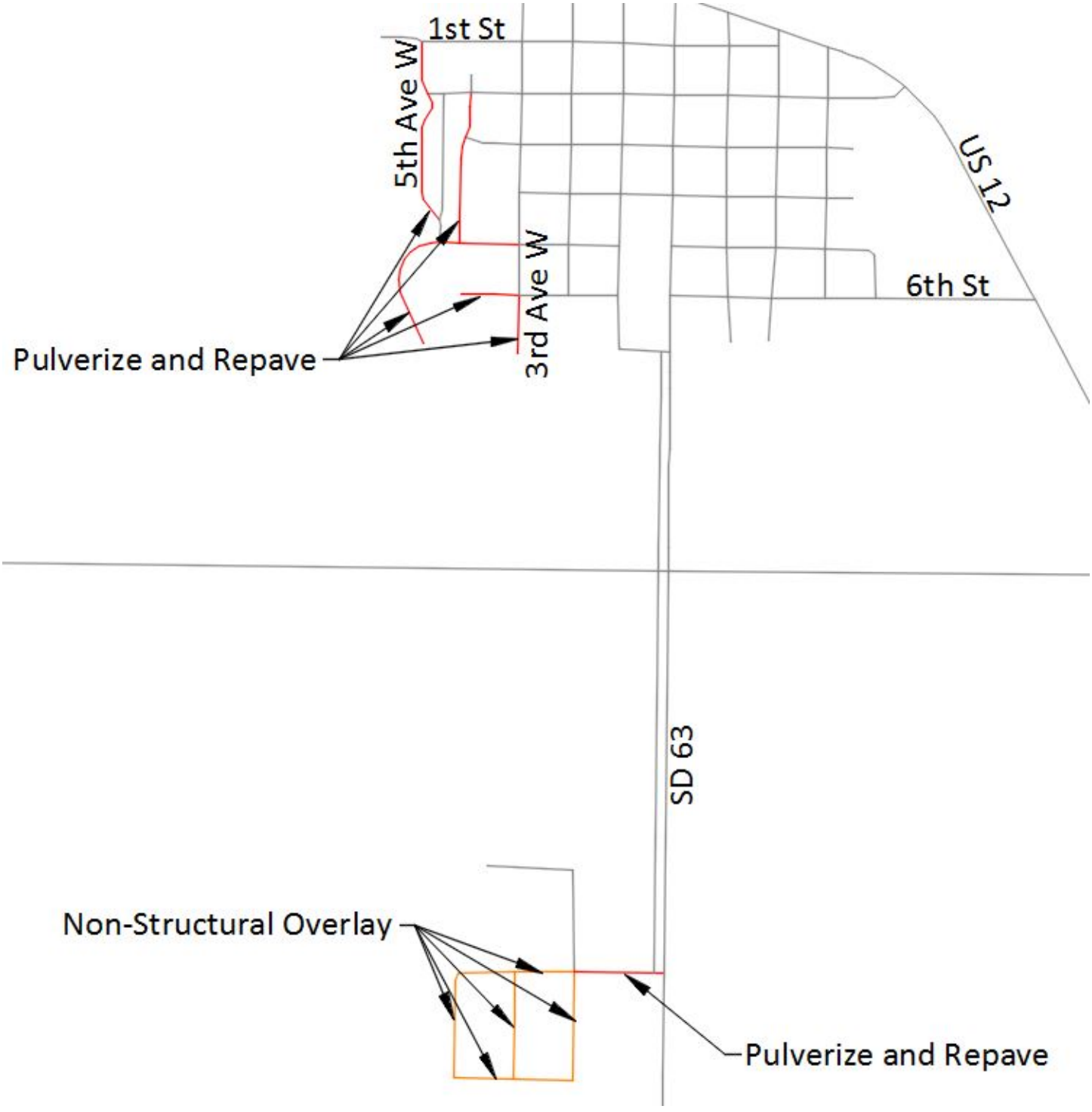
Cannon Ball

Figure 10 – Cannon Ball Pavement Preservation Projects



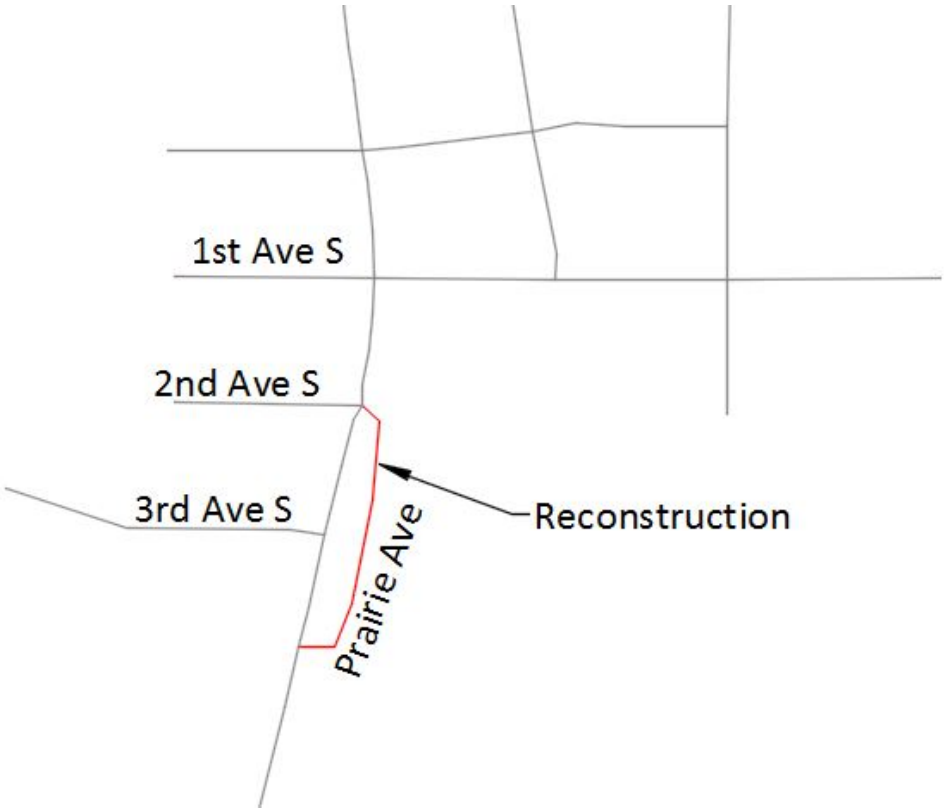
McLaughlin

Figure 11 – McLaughlin Pavement Preservation Projects



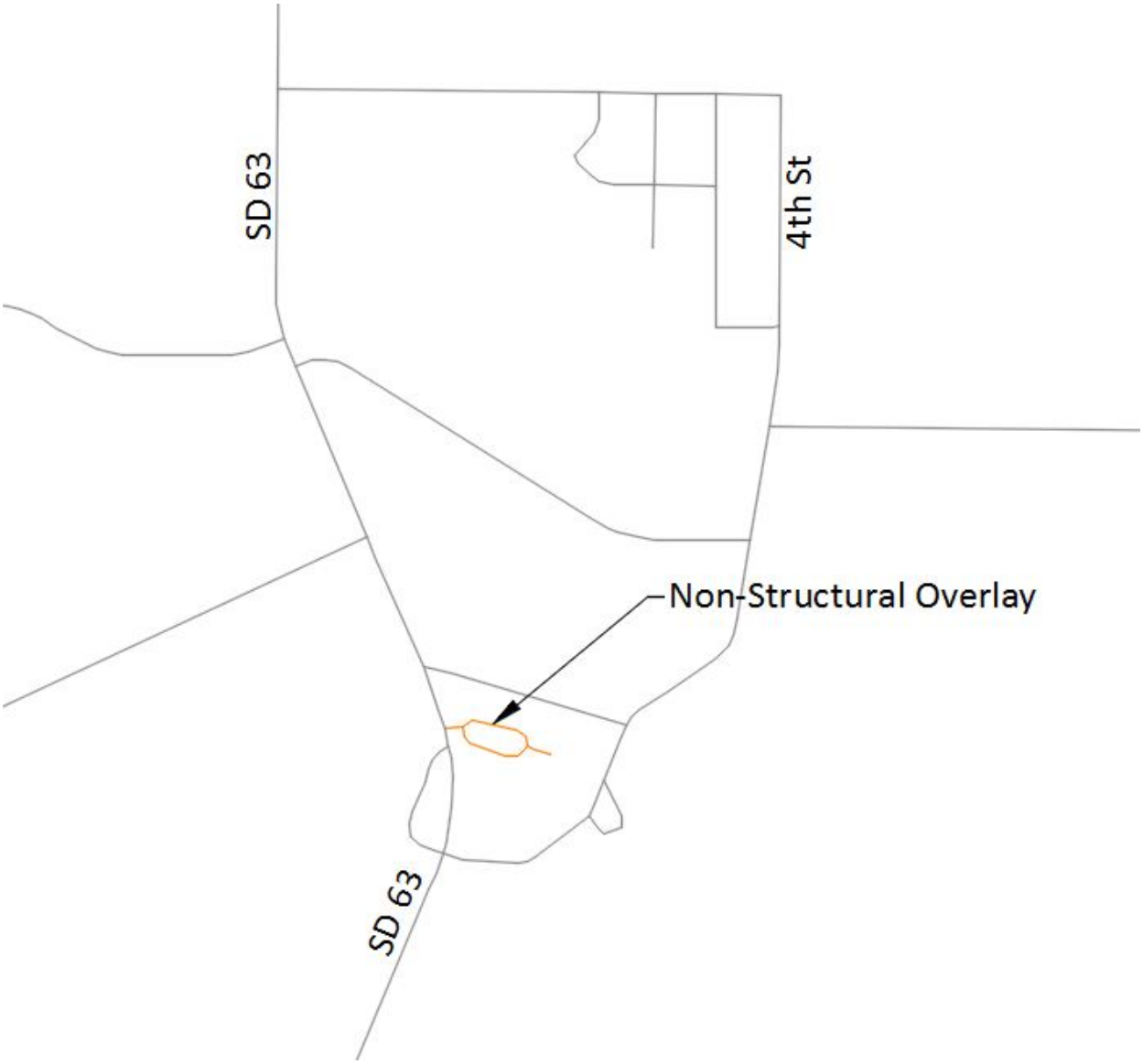
Wakpala

Figure 12 – Wakpala Pavement Preservation Project



Little Eagle

Figure 13 – Little Eagle Pavement Preservation Project



Bullhead

Figure 14 – Bullhead Pavement Preservation Project