STREET COMMITTEE AGENDA

Friday, January 26, 2024 at 9:00 a.m.

Adel City Hall, 301 S 10th Street, Adel, IA 50003

NEW BUSINESS

a) October 24, 2023 Minutes

b) Discussion / Possible Recommendations on HR Green's Pavement Management Program / Plan following the Council's Approved 2024-2025 Goal Setting Session Summary Report

OTHER BUSINESS

ADJOURNMENT

Street Committee
Tuesday, October 24, 2023 – Meeting Minutes

The City of Adel's Street Committee met in the council chambers at Adel City Hall. Christensen called the meeting to order at 6:00 p.m. Members present: Christensen, Miller, and Selby. Others present: Council Members McAdon and Ockerman, Deputy City Administrator/Finance Director Sandquist, Public Works Director Overton, HR Green reps. Larry Stevens and Evan Vencil, and McClure rep. Brian Sandberg.

NEW BUSINESS

a) February 1, 2022 Minutes

Selby motioned, seconded by Miller, to approve the minutes. Motion carried unanimously.

b) HR Green's Pavement Management Study

Larry Stevens with HR Green presented the Pavement Management Study. HR Green confirmed the study covered pavement & storm sewer but did not factor in water & sewer.

Council Member Ockerman commented on Rapids St and the added costs of water & sewer improvements not contained within the study.

Discussion was had regarding the use of GO bonds, revenue bonds, & special assessments to fund street projects. Staff also noted the City has the opportunity to utilize CIRTPA funding for Green St as it is deemed a farm to market road.

Deputy City Administrator/Finance Director Sandquist to consult with PFM on debt planning model to incorporate an amount for street projects.

Council Member Christensen asked that the City adopt street specifications by ordinance. Public Works Director Overton to obtain the City of Clive's specifications for reference.

c) Potential Development of Parcel 1132179019

Discussion was had regarding concerns related to ingress/egress traffic to Hwy 169. Public Works Director Overton to report traffic concerns to developer.

OTHER BUSINESS

Michael Crannell (1403 Rapids St) – Commented on deterioration of the intersection of Rapids St and N 14th St and asked about plans to improve.

Public Works Director Overton stated hot patch would be applied in the short-term at the intersection of Rapids St and N 14th St to improve its condition.

Deputy City Administrator/Finance Director Sandquist reminded all in attendance of the goal setting session to be held on Thursday, November 16th at 6:00 p.m. at Adel City Hall.

ADJOURNMENT – 7:05 p.m. Respectfully submitted: Brittany Sandquist, Deputy City Administrator/Finance Director

Resolution No. 23-82

A RESOLUTION ADOPTING THE 2024-2025 GOAL SETTING SESSION SUMMARY REPORT

WHEREAS, on January 14, 2020, the City Council of the City of Adel, Iowa approved Resolution No. 16-09, which adopted the City's current Strategic Plan; and

WHEREAS, the City Council and City Staff decided that the City would benefit from a review of the 2022-2023 Goal Setting Session Report by holding a Goal Setting Session to provide direction for the City over the next two years; and

WHEREAS, on Thursday, November 16, 2023, the City Council held a Goal Setting Session with Patrick Callahan, Callahan Municipal Consultants, LLC; and

WHEREAS, during that meeting, the City Council and City Staff identified the City's major accomplishments over the past two years; identified potential issues, concerns, and trends facing the City; developed a prioritized list of projects, programs, policies, and initiatives for the City to implement over the next two years; developed a prioritized list of capital projects and equipment purchases for the City to implement over the next two years; and reviewed the City's organizational effectiveness; and

WHEREAS, after reviewing the comments presented during the 2024-2025 Goal Setting Session, Mr. Callahan prepared a Summary Report of the session, which is attached and includes information regarding the aforementioned items.

NOW, THEREFORE, BE IT RESOLVED by the City Council of the City of Adel, Iowa, on this 12th day of December, 2023, that the City of Adel hereby adopts the attached 2024-2025 Goal Setting Summary Report as prepared by Mr. Callahan and directs City Staff to begin implementation of the items outlined in the report, with appropriate council action as necessary, including providing quarterly updates to the City Council.

Passed and approved this 12th day of December, 2023.

____
James F. Peters, Mayor

Attest: _________________________
Carrie Erickson, City Clerk

CITY OF ADEL, IOWA
MAYOR & CITY COUNCIL GOAL SETTING REPORT
2024-2025

Approved by the Adel City Council on December 12, 2023

Mayor:
James F. Peters

City Council
Rob Christensen
James West
Shirley McAdon
Bob Ockerman
Jodi Selby
Dan Miller (2023 Council)

City Clerk:
Carrie Erickson

Library Director:
Trever Jayne

Police Chief:
Gordy Shepherd

Code Compliance Officer:
Steve Nichols

Parks & Recreation Director:
Nick Schenck

City Administrator:
Anthony Brown

Public Works Director:
Kip Overton

Deputy City Administrator/Finance Director:
Brittany Sandquist

Fire Chief:
Braden Nemechek

Facilitated by:
Patrick Callahan
Callahan Municipal Consultants, LLC
November 16, 2023

THE CITY COUNCIL'S LIST OF "GIVENS"

After reviewing the list of proposed programs and policies, the Mayor and City Council Members concluded that the City was already committed to the completion of the following programs, policies, and initiatives:

1. Establish timetable and proceed with annexation efforts to east & south.
2. Develop & hire Community & Economic Development Director position.
3. Make sure water and sewer rates are sufficient to repay our debt.

Since the City Council had already committed to the completion of these items, it was agreed that the Mayor and City Council would not need to rank or prioritize these suggestions.

The City Council also reviewed the goals and objectives that were identified and started in 2021. The Council reaffirmed their commitment to continue the following programs and policies that were selected in 2021:

1. Expand/evolve staffing to better meet the needs of a growing community.
2. Create & maintain a Capital Improvement Plan (CIP).
3. Develop Continuity of Operations Plan/Continuity of Government (COOP/COG) Plan, including update to Emergency Response Plan.
4. Improve and implement technology across City departments.
5. Update Parks & Trails Master Plan.
6. Develop & implement department wide IT and security plan.

INITIATIVES AND PROGRAMS – 2024-2025

The Mayor and City Council identified the following initiatives and programs as the most urgent or important.

1. Develop a plan for the implementation of the pavement management program or streets maintenance study.
2. Water Tower Park 2 to 10 year written plan $20M +/-. The Park Board has established a fundraising group.
3. Fire Department Projects
   - Determine needs for new fire department.
   - Transition from volunteer fire department to full-time department – 5-year plan.
   - Create job description and hire full-time Fire Chief using SAFER Grant - 3 years - $100K per year.
   - Start discussion with Van Meter and DeSoto to merge fire departments.
   - Determine budgetary impacts of a new fire station operationally and whether the General Fund has the capacity.
4. Transition South Dallas County Landfill to a city department by July 2025.
5. Employee Retention and Attraction
   - Update job descriptions and wages to remain competitive.
   - Continued focus on employee attraction & retention.
   - Consideration of City "match" for employee deferred compensation plan in addition to IPERS contribution.

CAPITAL IMPROVEMENT PROJECTS – 2024-2025

The Mayor and City Council identified the following capital projects and equipment purchases as the most urgent or important.

Top Priority Capital Projects & Equipment Purchases:

1. Use the Pavement Management Plan for street construction and repair and street rehab project - $5,000,000.
2. Phase one of Water Tower Park/construct new recreation complex.
3. New fire station by 2025 - $5,000,000 +/-.
4. Rapids Street - $4,000,000 +/- - 2025.
5. Since the school bond issue passed, develop a plan to both improve Meadow Road and the feeder streets from the west side of the school property onto Meadow Road west of Highway 169.

TEAM BUILDING AGREEMENTS

The Mayor and City Council reviewed a list of ideas and suggestions relating to team building and building a better working relationship.

FUTURE PLANNING SUGGESTIONS

It is recommended that the city staff and management team prepare an "action plan" for the capital projects, and the initiatives & programs. The action plan for each goal would define the steps needed to accomplish the various tasks or objectives. This action plan could then be presented to the Mayor and City Council for review and approval and made a part of this Goal Setting Report.

It is recommended that the goals and objectives be posted in the Council Chambers at City Hall. The posting of the City Council's goals and objectives will serve as a reminder to the City Department Heads and Staff Members as to the priorities that were established by the Mayor and City Council.

It is recommended that the City Council review the lists of capital projects and equipment purchases, and initiatives, programs, and monitor the progress that is made on each item on a quarterly basis. The City could use a format that shows the project or item side by side with a comment that updates the City Council and the residents of the City on the progress that has been made on each item at the end of each quarter. The tentative dates in 2024 for the quarterly updates are: March 12, June 11, September 10, and December 10.

It is important to note that the prioritizing of all the capital projects and various initiatives is not "cast in stone." The two lists can be modified as new circumstances may dictate. Hopefully, the Mayor and City Council will repeat this process in late 2025, which may result in some additional modifications.

It is recommended that the City continue to review and update the capital improvements plan to identify the City's capital projects over the next four to six years. The plan could include cost estimates, descriptions of the projects, the justification, and sources of funding. An example of a capital improvements plan has been made available to the City Administrator.

HRGreen

MEMO

To:	City of Adel, Iowa
From:	Larry Stevens, PE, HR Green, Inc.
Subject:	Pavement Management Study – Brick Street CIP Adjustments
Project Number:	2202611
Date:	August 31, 2023

This memo details an addendum to the Adel Pavement Management Study.

Due to the difficulty of assessing and predicting distresses of brick streets, automatic data collection is not typically performed on brick-surfaced streets. As a result, brick streets were excluded from the analysis portion of Adel's Pavement Management Report, which was completed in June 2023. However, it was determined that including brick rehabilitation or reconstruction projects in the CIP (Capital Improvement Plan) would provide the City with a more accurate and realistic plan for addressing streets in the Adel.

In August 2023, visual inspection of the brick streets was completed by HR Green and City staff to supplement the distress and condition data that were collected for the non-brick streets in Adel's Road network. A subjective PCI (Pavement Condition Index) score was assigned to all brick streets in the network. As is the case with all other streets in the network, each segment of brick streets was assigned a score from 0-100 and placed in one of the five condition categories. This allowed all streets in the network to be compared using the same grading system.

Following the visual inspection, multiple brick street segments were identified to be in the "Poor Condition" category. HR Green and staff determined that these brick street segments should be considered for reconstruction within the next 10 years and should be included in the proposed Capital Improvement Plan. Since these streets were not previously considered, estimated brick reconstruction costs on a $/square yard basis were calculated to supplement the other treatment unit costs provided in the report. Unit costs for brick reconstruction were split into either full ROW reconstruction projects (including sidewalk, parking, and paving) or street only reconstruction projects to distinguish between projects with different requirements. Additionally, a unit cost for reconstruction of brick streets to PCC was also provided. These new costs are included in the addendum.

Once construction unit costs were calculated, these brick streets were then programmed into the CIP. To maintain the recommended annual budget recommended in the Pavement Management Report and used to develop the CIP, some previously recommended projects were moved out of the 10-year CIP to keep the budget consistent and achievable. To accomplish this, the dTIMS analysis was re-performed with consideration for the committed brick street reconstruction projects. This resulted in the revised CIP included in the report addendum. Following the new 3 Phase, 10-year CIP is a table of streets that were removed from the 10-year CIP, now shown as additional projects for consideration in the future.

Addendum 1: Capital Improvement Plan

Capital Improvement Plan – List of Recommended Projects (Phase 1 – FY2023-FY2025)

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
1	GREENE STREET_1	Major Rehabilitation	VISION PARKWAY	1444' From VAN FOSSEN LANE	$ 426,000	5	COM	138	45.5	2900	6497	0.43
1	NORTH 15TH STREET_1	Major Rehabilitation	LOCUST STREET	SUNSET CIRCLE	$ 611,000	5	ACC	172	46.5	1090	10175	0.67
1	NORTH 15TH STREET_1	Minor Rehabilitation	SUNSET CIRCLE	City Limits	$ 26,000	5	ACC	75	64.0	660	5172	0.40
1	GREENE STREET_1	Minor Rehabilitation	City Limits	VISION PARKWAY	$ 49,000	5	COM	89	59.8	2900	9744	0.69
1	SOUTH 4TH STREET_1	Minor Rehabilitation	OLD PORTLAND ROAD	COTTAGE STREET	$ 20,000	7	ACC	215	66.0	160	3882	0.25
1	GREENE STREET_1	Reconstruction	SOUTH 12TH STREET	SOUTH 10TH STREET	$ 380,000	5	COM	242	30.3	8500	2223	0.13
2	GREENE STREET_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 505,000	5	PCC	221	60.5	5100	2886	0.11
1	MAIN STREET_1	Reconstruction	HWY 169	SOUTH 7TH STREET	$ 607,000	7	BRK		25	700	1619	0.06
1	RAPIDS STREET_1	Reconstruction	NORTH 15TH STREET	NORTH 9TH STREET	$ 1,480,000	7	BRK		25	160	942	0.40
1	2023 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
1	2024 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
1	2025 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 4,599,000						43140	27.14

Capital Improvement Plan – List of Recommended Projects (Phase 2 – FY2026-FY2028)

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
2	CHANCE COURT_1	Major Rehabilitation	W Dead End	SOUTH 14TH STREET	$ 154,000	7	ACC	258	50.0	434	2268	0.15
2	PRAIRIE STREET_1	Major Rehabilitation	SOUTH 11TH STREET	SOUTH 12TH STREET	$ 90,000	7	ACC	228	51.9	980	1501	0.10
2	PROSPECT AVENUE_2	Minor Rehabilitation	HWY 6	288TH TRAIL	$ 92,000	6	PCC	166	55.5	880	4363	0.34
2	GREENE STREET_1	Reconstruction	SOUTH 18TH STREET	SOUTH 12TH STREET	$ 1,260,000	5	PCC	217	48.5	7600	7420	0.42
2	SOUTH 12TH STREET_2	Reconstruction	S Dead End	GREENE STREET	$ 471,000	7	PCC	324	0.0	434	2152	0.14
2	SOUTH 18TH STREET_1	Reconstruction	BRICKYARD ROAD	MAIN STREET	$ 493,000	7	PCC	232	41.0	770	2893	0.15
2	SOUTH 10TH STREET_2	Reconstruction	Bryan St	S Dead End	$ 1,028,000	7	PCC	354	35.3	270	4704	0.31
2	2026 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
2	2027 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
2	2028 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 4,083,000						25301	25.61

Capital Improvement Plan – List of Recommended Projects (Phase 3 – FY2029-FY2032)

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
3	HORSE AND BUGGY DRIVE_1	Major Rehabilitation	SOUTH 19TH STREET	SOUTH 16TH STREET	$ 205,000	7	ACC	320	40.3	434	2776	0.20
3	RAPIDS STREET_1	Major Rehabilitation	NORTH 9TH STREET	HWY 169	$ 73,000	7	ACC	206	49.5	901	922	0.06
3	NORTH 10TH STREET_1	Major Rehabilitation	RAPIDS STREET	582' From GROVE STREET	$ 173,000	7	ACC	254	48.5	712	2482	0.18
3	PLEASANT STREET_1	Major Rehabilitation	HYVUE STREET	SOUTH 16TH STREET	$ 171,000	7	COM	288	46.0	434	2447	0.15
3	COURT STREET_2	Minor Rehabilitation	NORTH 7TH STREET	NORTH 6TH STREET	$ 5,000	7	COM	179	66.5	923	922	0.06
3	COTTAGE STREET_1	Minor Rehabilitation	HWY 169	SOUTH 7TH STREET	$ 5,000	7	COM	200	67.5	1328	892	0.06
3	SOUTH 11TH STREET_1	Minor Rehabilitation	CASSIDY CURVE	SUNDANCE CIRCLE	$ 37,000	7	PCC	313	53.5	550	1570	0.10
3	SOUTH 11TH STREET_2	Minor Rehabilitation	GREENE STREET	PRAIRIE STREET	$ 56,000	7	PCC	270	67.5	510	2430	0.13
3	PRAIRIE STREET_1	Minor Rehabilitation	SOUTH 18TH STREET	SOUTH 15TH STREET	$ 78,000	7	PCC	208	54.5	270	3096	0.22
3	GREENWOOD DRIVE_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 583,000	7	PCC	326	23.8	640	2993	0.20
3	NORTH 15TH STREET_1	Reconstruction	GROVE STREET	LOCUST STREET	$ 160,000	5	ACC	241	53.1	1090	920	0.07
3	PRAIRIE STREET_1	Reconstruction	SOUTH 13TH STREET	SOUTH 12TH STREET	$ 150,000	7	ACC	228	51.9	980	880	0.07
3	SOUTH 7TH STREET_2	Reconstruction	COTTAGE STREET	PRAIRIE STREET	$ 560,000	7	ACC	335	33.3	574	2790	0.20
3	SOUTH 9TH STREET_2	Reconstruction	GREENE STREET	345' From GREENE STREET	$ 156,000	7	PCC	282	38.0	1080	920	0.07
3	GROVE STREET_1	Reconstruction	North 15th St	11th st pl	$ 680,000	5	ACC	272	29.3	2160	3606	0.26
3	COURT STREET_2	Reconstruction	NORTH 15TH STREET	NORTH 10TH STREET	$ 1,200,000	7	BRK	N/A	25.0	406	5010	0.34
3	COURT STREET_2	Reconstruction	HWY 169	NORTH 7TH STREET	$ 300,000	7	BRK	N/A	25.0	1722	920	0.06
3	2029 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2030 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2031 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2032 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 5,252,000						35576	34.43

Additional Recommended Projects for Consideration (Projects Previously Included in Recommended CIP)

Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
SOUTH 14TH STREET_1	Major Rehabilitation	LYNN DRIVE	PENOACH DRIVE	$ 213,000	7	COM	392	40.7	151	3539	0.19
OLD PORTLAND ROAD_2	Minor Rehabilitation	567' From SOUTH 4TH STREET	SOUTH 4TH STREET	$ 9,000	7	ACC	278	55.5	160	1641	0.11
BRYAN STREET_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 371,000	7	PCC	544	39.7	434	1748	0.12
NORTH 14TH STREET_1	Reconstruction	GROVE STREET	N Dead End	$ 397,000	7	PCC	238	26.3	224	1926	0.13
NORTH 17TH STREET_1	Reconstruction	COURT STREET	RAPIDS STREET	$ 151,000	7	PCC	208	17.5	101	729	0.07
NORTH 6TH STREET_1	Reconstruction	COURT STREET	RAPIDS STREET	$ 196,000	7	ACC	174	14.0	180	947	0.07
SOUTH 16TH STREET_1	Reconstruction	MAPLE DRIVE	HYVUE STREET	$ 315,000	7	PCC	359	23.0	500	1572	0.10
SOUTH 6TH STREET_2	Reconstruction	HWY 6	416' From RR Xing	$ 251,000	7	PCC	323	4.0	560	1111	0.08
GROVE STREET_1	Major Rehabilitation	NORTH 10TH STREET	HWY 169	$ 120,000	5	ACC	217	49.0	2160	1770	0.13
SOUTH 14TH STREET_1	Major Rehabilitation	GREENE STREET	CHANCE COURT	$ 130,000	7	ACC	275	57.0	1390	1921	0.14
ASPEN DRIVE_1	Minor Rehabilitation	SOUTH 16TH STREET	SOUTH 14TH STREET	$ 50,000	7	PCC	395	53.5	434	2093	0.14
GREENWOOD DRIVE_1	Minor Rehabilitation	SOUTH 11TH STREET	SOUTH 10TH STREET	$ 27,000	7	PCC	191	72.0	640	1078	0.07
GROVE STREET_1	Major Rehabilitation	NORTH 10TH STREET	11th st pl	$ 109,000	5	ACC	323	40.3	2160	1200	0.09
HYVUE STREET_1	Major Rehabilitation	SOUTH 14TH STREET	W Dead End	$ 379,000	7	COM	320	45.2	434	4840	0.31
MAIN STREET_1	Major Rehabilitation	NORTH 19TH STREET	SOUTH 18TH STREET	$ 116,000	7	PCC	243	69.5	434	1752	0.10
MAIN STREET_1	Major Rehabilitation	SOUTH 18TH STREET	SOUTH 15TH STREET	$ 293,000	7	ACC	259	45.0	320	3225	0.22
PRAIRIE STREET_1	Major Rehabilitation	SOUTH 11TH STREET	HWY 169	$ 198,000	7	ACC	224	56.7	1310	2524	0.18
SOUTH 15TH STREET_1	Major Rehabilitation	MEADOW ROAD	ANN AVENUE	$ 212,000	7	PCC	152	68.5	434	4315	0.25
ANN AVENUE_1	Minor Rehabilitation	SOUTH 15TH STREET	SOUTH 14TH STREET	$ 51,000	7	PCC	244	69.0	670	1940	0.12
MEADOW ROAD_1	Minor Rehabilitation	HWY 169	ROEBLING ROAD	$ 72,000	7	PCC	167	66.0	289	2785	0.18
SOUTH 14TH STREET_1	Minor Rehabilitation	PLEASANT STREET	GREENE STREET	$ 12,000	7	COM	133	84.8	1190	2294	0.13
SOUTH 19TH STREET_1	Minor Rehabilitation	HORSE AND BUGGY DRIVE	GREENE STREET	$ 26,000	7	PCC	139	65.0	434	922	0.07
GROVE STREET_1	Reconstruction	NORTH 17TH STREET	W Dead End	$ 255,000	7	ACC	401	34.0	434	1497	0.11
ORCHARD STREET_1	Reconstruction	SOUTH 14TH STREET	SOUTH 13TH STREET	$ 183,000	7	PCC	316	32.0	434	1068	0.08
RAPIDS STREET_1	Reconstruction	NORTH 16TH STREET	383' From NORTH 17TH STREET	$ 478,000	7	PCC	330	26.8	393	2161	0.14
				$ 4,614,000						50599	3.30

7.1.1. Proposed Brick Street Estimated Reconstruction Costs:

Table 22: Brick Reconstruction - Full ROW Cost Calculation

Reconstruction ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$8.00
Storm Sewer*	$30.00
Pavement Removal	$10.00
PCC Paver Base	$75.00
Remove and Reinstall Brick Pavers	$120.00
Driveways/Sidewalks	$30.00
Seeding/Paint Markings, etc.	$12.00
Mobilization, Traffic Control, Survey (15%)	$40.00
Contingency (10%)	$30.00
Total (Rounded Up)	**$375.00**

Table 23: Brick Reconstruction - Street Only Cost Calculation

Reconstruction ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$8.00
Storm Sewer*	$30.00
Pavement Removal	$10.00
PCC Paver Base	$75.00
Remove and Reinstall Brick Pavers	$100.00
Driveways/Sidewalks	$15.00
Seeding/Paint Markings, etc.	$7.00
Mobilization, Traffic Control, Survey (15%)	$35.00
Contingency (10%)	$25.00
Total (Rounded Up)	**$325.00**

Table 24: Brick to PCC Reconstruction Cost Calculation

Reconstruction ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$10.00
Storm Sewer*	$35.00
Pavement Removal	$12.00
Pavement (PCC)	$85.00
Driveways/Sidewalks	$20.00
Seeding/Paint Markings, etc.	$7.00
Mobilization, Traffic Control, Survey (15%)	$27.00
Contingency (10%)	$24.00
Total (Rounded Up)	**$240.00**

ADEL
THRIVE WITH US

Map 3
Pavement Condition Overview

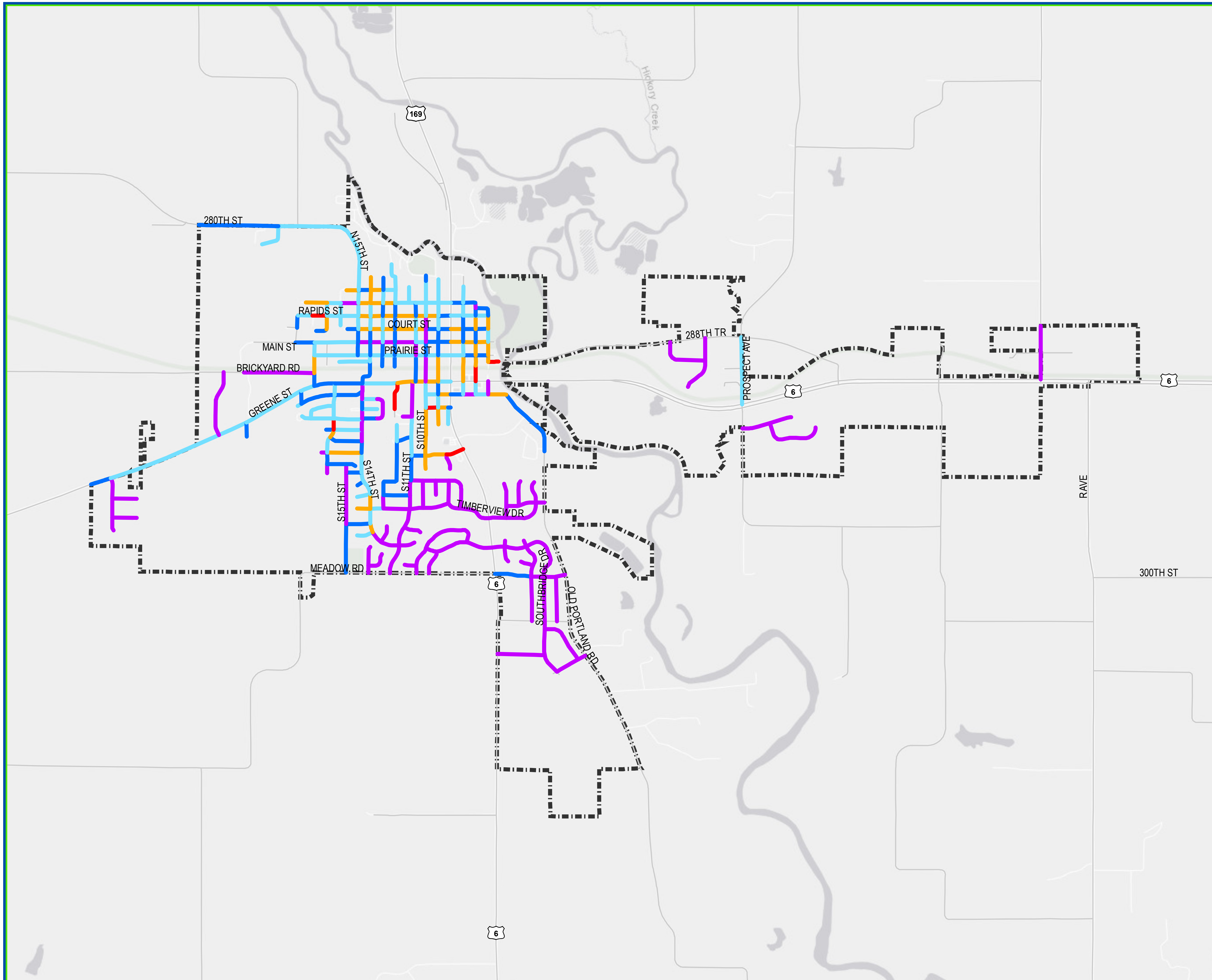
Legend

Pavement Condition *

- Very Good
- Good
- Fair
- Poor
- Very Poor
- No Data

Municipal Boundary

- Municipal Boundary



* Does not include roads not maintained by City of Adel, such as State and Federal highways

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N S E W

0 1,250 2,500 Feet

1 inch = 2,500 feet

HRGreen

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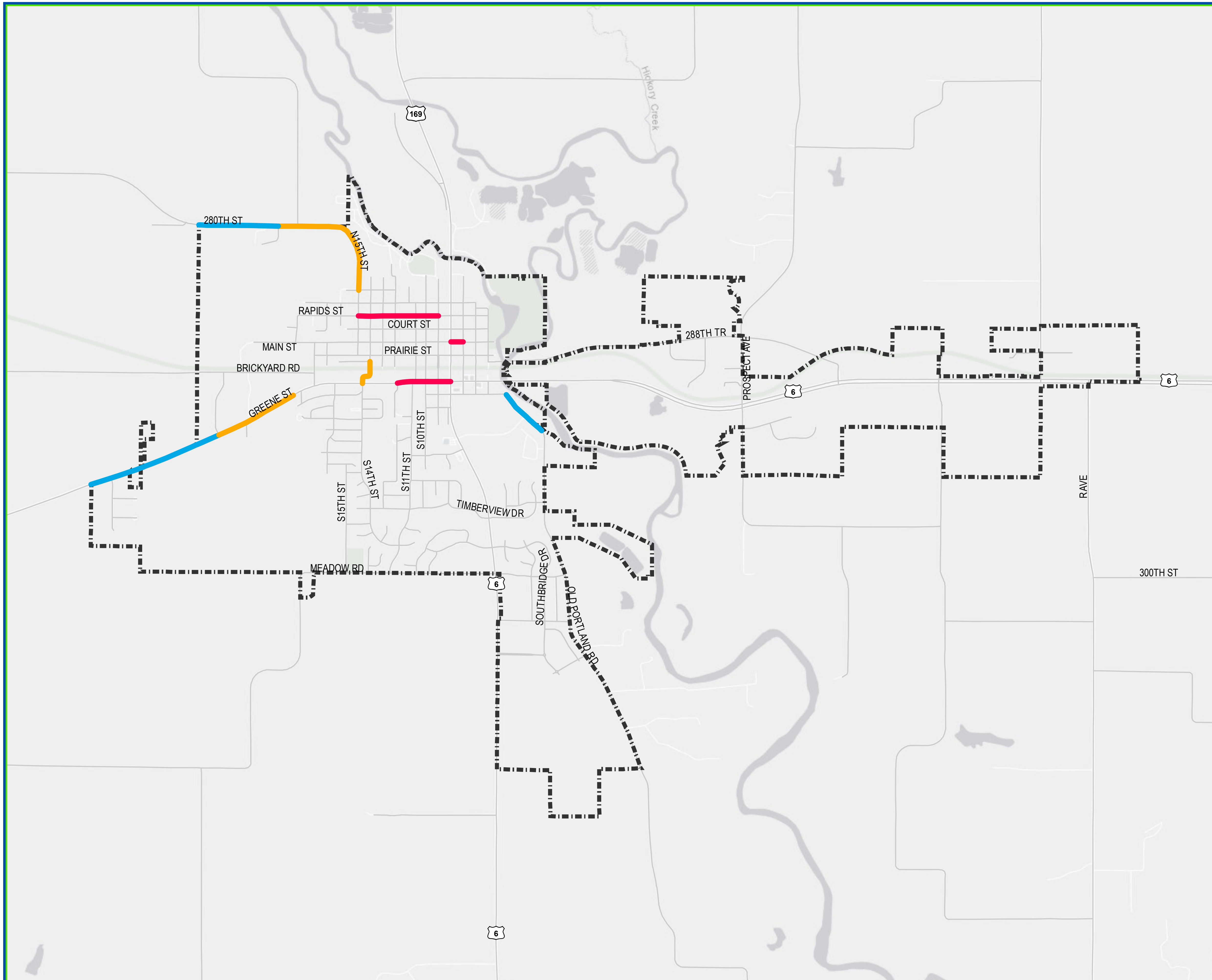
ADEL
THRIVE WITH US

Map 7
Phase 1 Projects Overview

Legend

Projects
- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

Municipal Boundary
- Municipal Boundary



* Does not include roads not maintained by City of Adel, such as State and Federal highways

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W E
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0 1,250 2,500 Feet

1 inch = 2,500 feet

HRGreen

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Map 8
Phase 2 Projects Overview

Legend

Treatment
- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

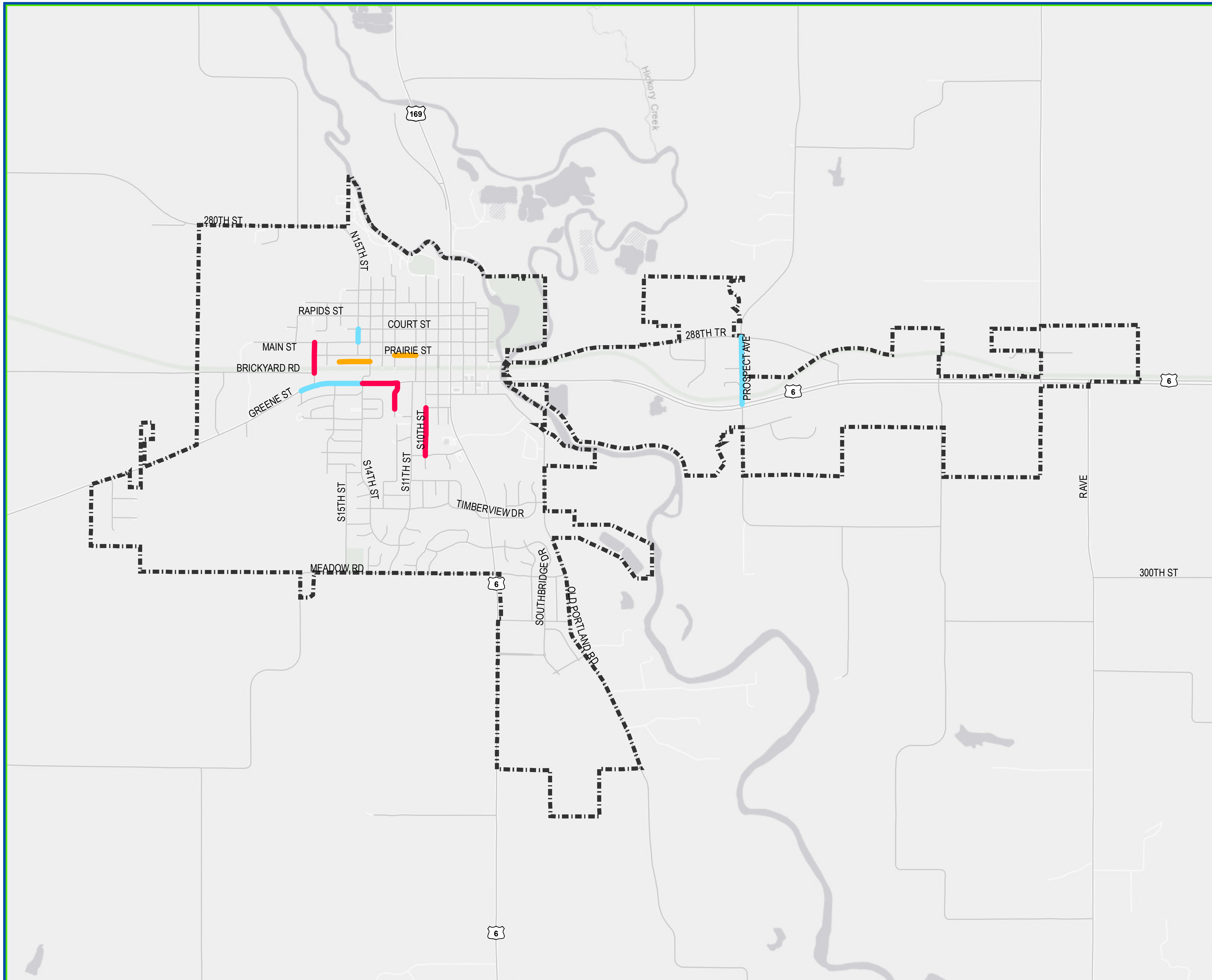
Municipal Boundary
- Municipal Boundary

* Does not include roads not maintained by City of Adel, such as State and Federal highways

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

0 1,250 2,500 Feet
1 inch = 2,500 feet

HRGreen



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Map 9
Phase 3 Projects Overview

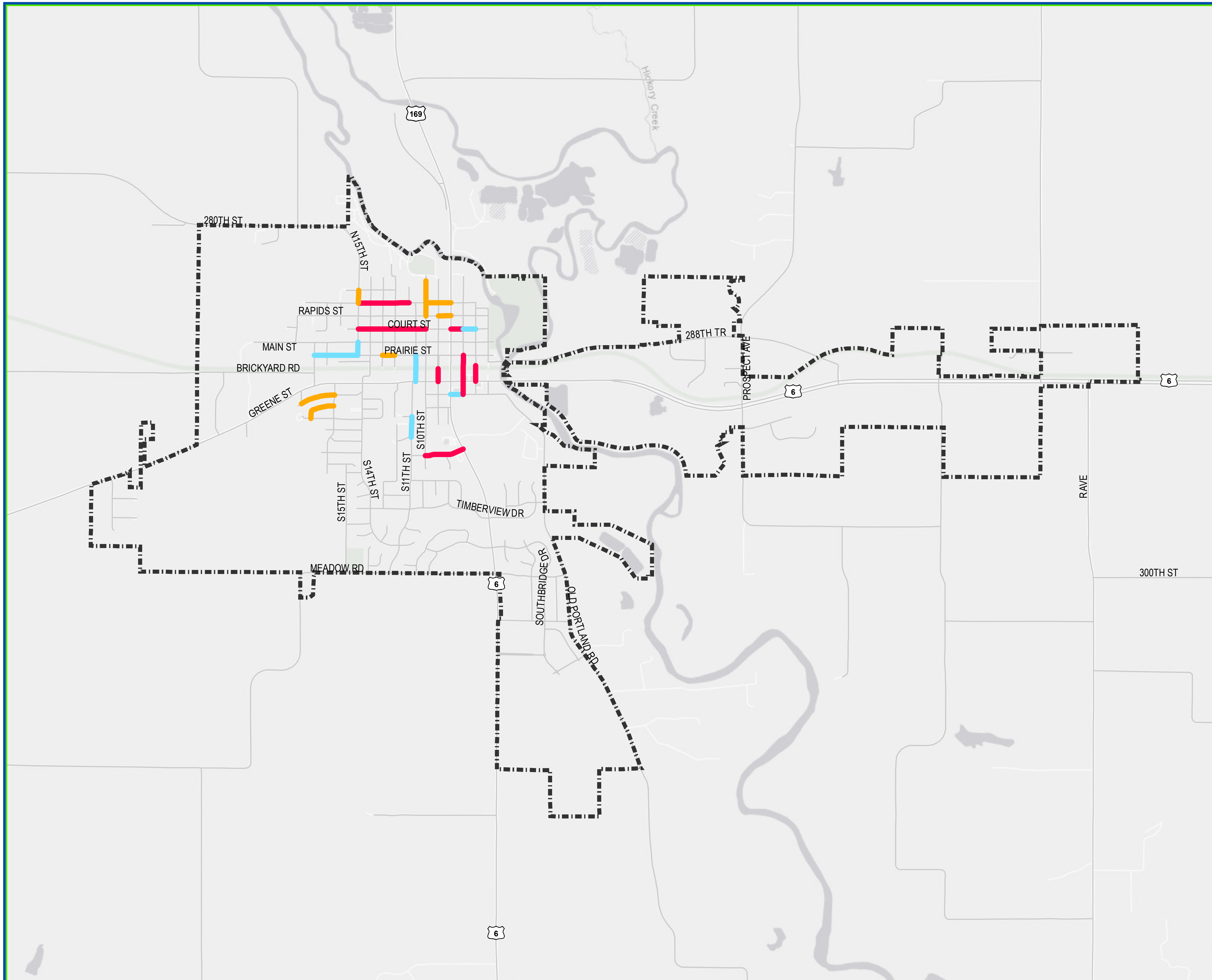
Legend

Treatment

- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

Municipal Boundary

- Municipal Boundary



* Does not include roads not maintained by City of Adel, such as State and Federal highways

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N W E S

0 1,250 2,500 Feet

1 inch = 2,500 feet

HRGreen

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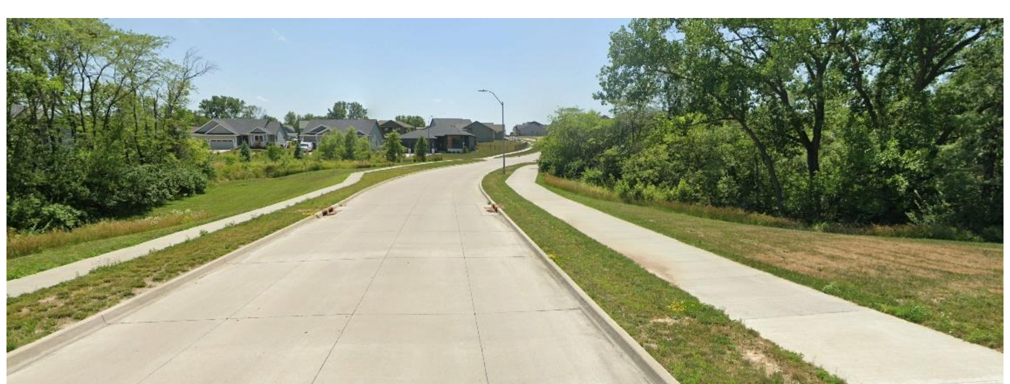
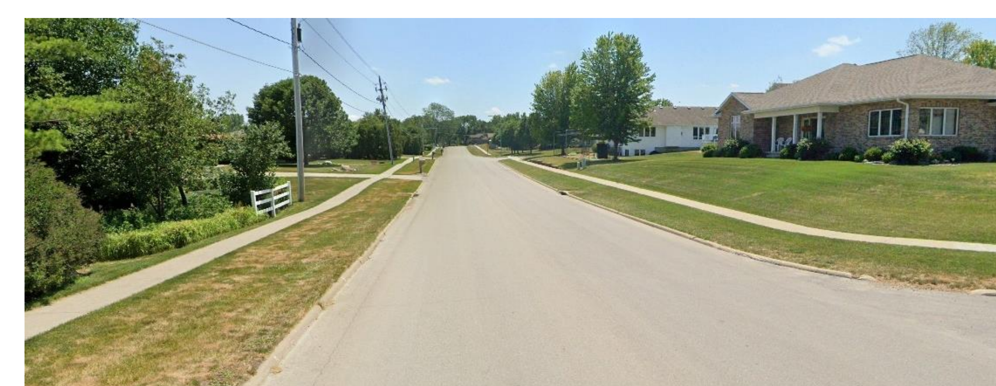
City of Adel

Pavement Management Program
FY 2023-2032

Amended September 1, 2023





Acknowledgements

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IPMP Iowa Pavement Management Program

Iowa Pavement Management Program

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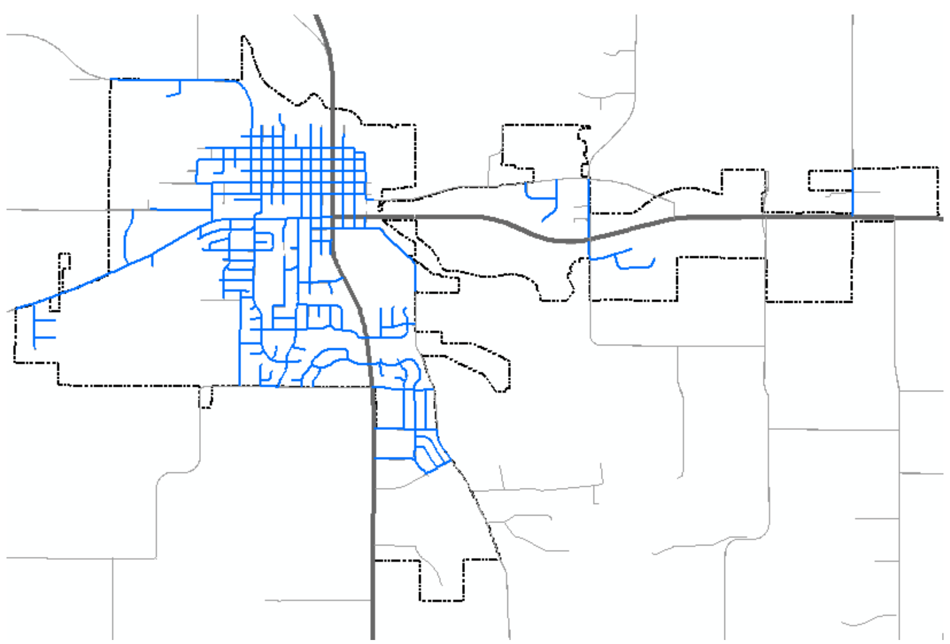
Executive Summary

The City of Adel is a city with approximately 6000 residents just west of the Des Moines metropolitan area. The county seat of Dallas County, Adel has seen multiple areas of expansion in recent years. Currently, the City maintains approximately 32 miles of paved roads, with some shared maintenance responsibility between Adel and the county of Dallas.

Of all urban areas in the state, the City of Adel ranks near the middle and is considered to have ***average pavement conditions***, based on the Iowa Pavement Management Program's (IPMP) condition assessment. Recent development and some history of rehabilitation activities have allowed the City to maintain a road network of high average quality. It is a desire to continue providing high quality infrastructure for its citizens that led Adel to contract with ***HR Green, Inc***. to improve their pavement management program.

Pavement management is a *program* that carries out an important City *policy*. The policy objective is to improve overall street conditions in an efficient manner that maximizes public benefits. This proactive approach is important for a municipality that needs to maintain its existing network while planning for further growth.



The goals of this pavement management program are to:

- Review the City's standards for street pavement design and construction/maintenance practices
- Develop an inventory of the City's street system
- Evaluate the system's current roadway conditions using data provided by the Iowa Pavement Management Program (IPMP)
- Determine major rehabilitation and reconstruction alternatives and trigger thresholds for use in the data analysis and projections.
- Create a comprehensive pavement management model using the IPMP data and the Pavement Management Software dTIMS BA™
- Develop 10-Year maintenance/replacement schedules with annualized costs for various funding levels and scenarios.

The City's pavement rehabilitation treatment alternatives and project determination process were reviewed. A set of preferred treatment alternatives and appropriate selection criteria were developed from this review, as well as City feedback.

Pavement Condition Data has been collected statewide for all public roads in Iowa, at least every 2 years, since 2013. This is done through the ***Iowa Pavement Management Program***, which is funded by the Iowa Department of Transportation and is operated by the Institute for Transportation at Iowa State University. The data collection consultant for the IPMP uses a specialized van outfitted with an array of sensors and drives every road in the state to collect information about the pavement distresses visible on the surface.

The most recent data collection for Adel was in 2021 and was very useful for assessing conditions in Adel and developing a comprehensive inventory in GIS. Each roadway segment collected had the distress data distilled into the City Pavement Condition Index (CityPCI) used throughout the state.

Based on the CityPCI results, Adel has ***an average score of 69/100***, which is considered "Good Condition". While pavement condition ratings can be considered average for a municipality the size and age of Adel, there are noticeable concentrations in the older part of town where roads are considered to be "Poor" and "Very Poor." The majority of the poorer conditions also appear to be composite (COM) as opposed to the concrete (PCC) that makes up the majority of the city's roads. Also unique to the city of Adel are the large volume of brick streets. Approximately 8% of the total street network is made up of brick streets, a much higher proportion than most other municipalities. As a part of recent construction projects in the city, multiple brick streets were preserved and improved or converted into PCC. The remaining brick streets will continue to be an important consideration for improvement plans.

Using the IPMP data, existing City resources, and input from City staff, a complex pavement management model was created using the ***dTIMS Business Analytics™ software***. This model was then used to analyze various funding and performance-based scenarios for the Adel capital improvement program. The findings of the investigation determined that the preferred annual construction budget would be ***approximately $1.4 Million*** for long-term sustainability.

Finally, the results of the scenario modelling exploration were then incorporated into the pavement management model which was used to generate an objective and computer optimized 10-Year Capital Improvement Plan (CIP). The project list is optimized for the most effective use of available funds, based on the pavement condition data. The complete list of recommended projects and maps identifying the location for the proposed treatments can be found in ***Section 7: Capital Improvement Plan*** starting on ***page 44.***

These lists and maps will serve as a tool to assist City staff during the project planning process, but they do not replace engineering judgement. Project types may change from what is in the CIP and projects will likely move between phases for various reasons. Some projects may even leave the plan entirely as new ones are added. Some reasons the program may change include field conditions not captured by the IPMP data, required utility improvements, or environmental hazards causing changes to local conditions. Consisting of ***53 Projects***, the recommended projects contained within the CIP address ***10 Miles*** of roads or approximately 31% of the City.

This document is not the end of the Pavement Management Program, however. Not only do the projects need to be constructed, but this should be considered a ***"Living Document"*** because it needs to shift and change with the conditions of the streets as well as the needs of its citizens. The City receives new IPMP data every 2 years, so this gives a good impetus for renewing the pavement management model and adjusting the plan based on new information. Expect to hear more things about this program in the future, including updated city-wide condition performance metrics and revised CIP's.

Table of Contents

List of Figures

List of Maps

List of Tables

1. Background

The City of Adel, located in Dallas County, Iowa, maintains a roadway network consisting of just over 32 centerline miles of streets.

A limited streets program budget, primarily funded through Road Use Tax funds and general obligation bonds paid via property tax revenue, requires city staff and elected officials to make difficult decisions when determining annual maintenance and reconstruction expenditures. There is not a fixed annual budget for roadway improvements in Adel, over the past 5 years the city has spent between $350,000 and $550,000, however the requested budgets appear to have been over $600,000. Other funds, in the form of grants, TIF Funds, or specific bonds, have been used in the past for large construction projects, such as the 2017 Brick Reconstruction, on an as needed basis.

Until now, the City's framework for determining which streets to repair has been normally 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 and powerful software tools to help optimize the process.

2. Introduction

The City contracted HR Green, Inc. (HRG) 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. HRG's effort involved the following actions:

- Review the City's standards for street pavement design and construction/maintenance practices.
- Develop an inventory of the City's street system.
- Evaluate the system's current roadway conditions using data provided by the Iowa Pavement Management Program (IPMP).
- Determine major rehabilitation and reconstruction alternatives and trigger thresholds for use in the data analysis and projections.
- Create a comprehensive pavement management model using the IPMP data and the Pavement Management Software dTIMS BA™
- Develop 10-Year maintenance/replacement schedules with annualized costs for various funding levels and scenarios.

Data evaluation was restricted to the previous 7 years based on the typical duration of the City's Capital Improvement Program (CIP), as well as data availability from IPMP, which began providing statewide coverage in 2013.

2.1. What is Pavement Management?

Pavement Management is a *program* that carries out an important City *policy*. The policy objective is to improve overall street conditions in an efficient manner that maximizes public benefits. This proactive approach is important for a municipality tasked with maintaining roadway infrastructure for approximately 6,000 residents.

Using Pavement Management methodology, HR Green developed recommendations using the right pavement treatment, at the right time, on the right road. Large amounts of pavement condition data were collected and analyzed with complex computer models (further described in ***Section 3 Methodology***) to determine the best use of funds to improve the overall condition of the City's road network. This report is the culmination of those efforts and includes a 10-year plan of recommended projects based on optimal annual expenditures on maintenance, rehabilitation, and reconstruction of public streets.

Figure 1: Primary Components of Pavement Management

The diagram above illustrates the six primary components of pavement management. Details of the components can be found in the methodology section

2.1.1. Pavement Life Cycles

Pavement management techniques are important as pavements do not decay at a constant rate over time. Time is a crucial factor in how much investment it takes to repair a road back to a serviceable condition. New pavement will not change drastically over the early years of its life; however, sharp declines can occur quickly with older pavements. The pavement may even reach failing status without intervention.

Small investments at appropriately-designated times can drastically improve and extend pavement life. Rehabilitating a pavement in "Fair" condition, for example, will usually cost less than 25% of reconstructing a failing pavement while extending pavement life significantly. It is important to invest wisely and early, as a consequence. This plan sets the City of Adel on a course towards this practice.

Before an ideally-maintained roadway network can be reached, however, many of the worst roadways will require reconstruction or rehabilitation. Pavements within the "Poor" condition category will, in most cases, be deferred or given light maintenance with the intent of reconstructing before reaching "Very Poor" condition. This effectively saves money and squeezes the most life out of the network while still giving the opportunity to practice ideal Pavement Management elsewhere in the community.

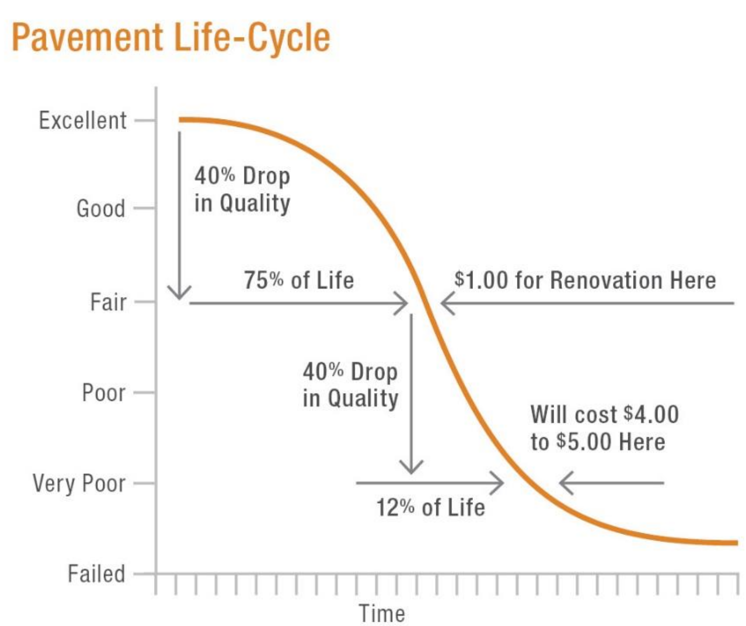


Figure 2:Performance Curve
Renovating a pavement in "Fair" condition will usually cost less than 25% of reconstructing a failing pavement.

2.2. Program Goals

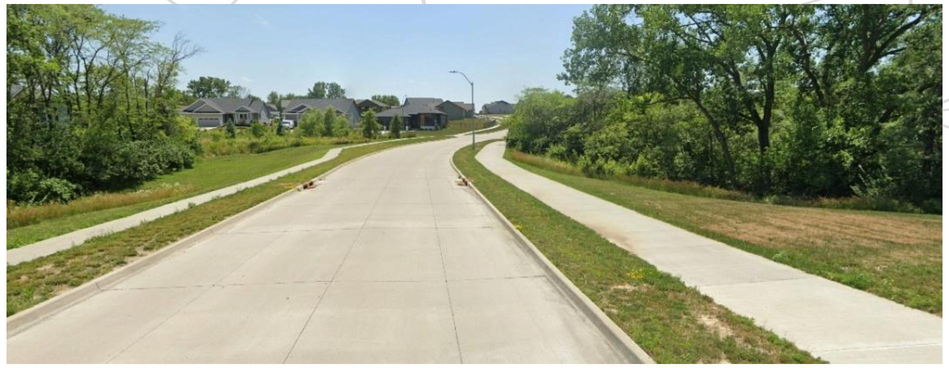
The purpose of this Pavement Management Plan is to create a sustainable program for maintaining and improving street conditions within Adel. This document provides a framework to assist the City in maximizing the impact of its expenditures in the wisest and most cost-effective manner.

The City manages its street network utilizing primarily General Obligation (GO) Bonds and Road Use Taxes (RUT), which causes the scope of pavement management in the City to be quite limited. Road use tax funds are not growing at a pace that can sustainably address the need for roadway improvements in the community, and intermittent bonding makes it more difficult to plan consistent rehabilitation programs.

With these funding limitations, it is imperative that the regularly available funds are used wisely and that other funding approaches are sufficiently explored.

Goals:

- Develop an objective and data-driven 10-year Pavement Management Plan
- Perform a full condition assessment of the existing street network
- Review City standards and maintenance practices for potential process improvements
- Select appropriate treatment alternatives and trigger conditions for the pavement management model
- Create a comprehensive inventory and pavement management model in dTIMS BA
- Identify ideal budget for maintaining the roadway conditions
- Assess feasibility of potential target condition goals



3. Methodology

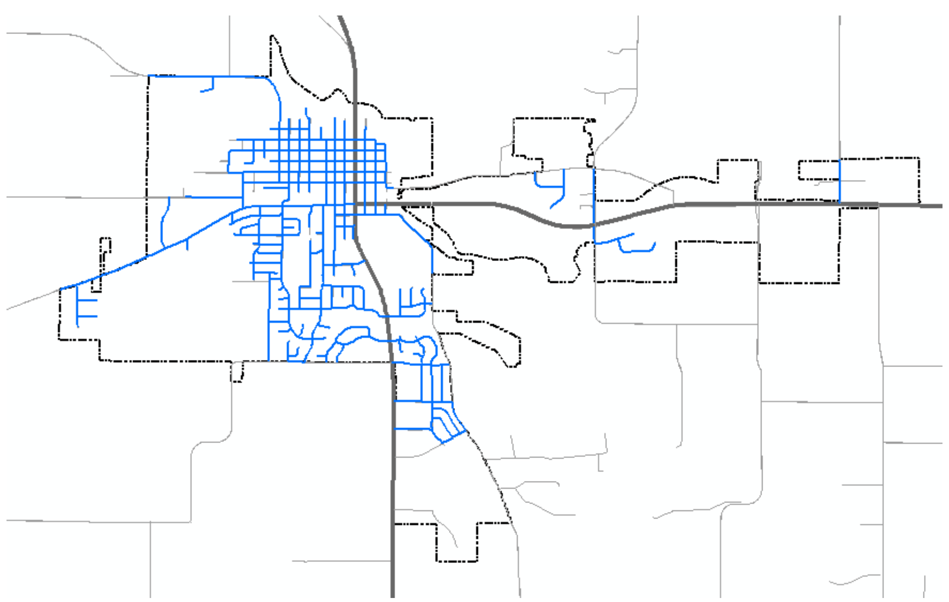
3.1. Data Collection

3.1.1. Base Inventory

The first step in any Pavement Management Program is to develop an accurate inventory of streets. HR Green collected detailed GIS information and various historical reference material outlining its current network.

The majority of this baseline inventory data came from the Iowa DOT's Roadway Asset Management System (RAMS). This database resource was substantially complete and offered a reasonable level of detail for creating this program.

Some spatial manipulation and data filtering was required to make better use of the base files for modelling purposes. This included eliminating or combining short segments, ensuring accurate intersection contiguity, and developing a linear reference model.



3.1.2. Pavement Distress Data

After the inventory was established, the condition was then determined for each asset. This assists with prioritizing roadways by their current level of serviceability as well as helping estimate their respective remaining life spans.

Roadway pavement condition data were collected by an automated data collection vehicle, like the "Pathrunner" used by Pathways Services Inc., the Iowa DOT's data vendor. This is a van outfitted with an array of sensors and cameras that automatically collect data on and around the road. These data include, but are not limited to cracking, potholes, faulting, spalling, rutting, etc. Examples of specific pavement distresses can be found in **Section 3.1.3 .**

The pavement condition data was then processed and aggregated using the existing RAMS roadway segmentation for use in ESRI ArcGIS™ (a mapping and data analytics software) by the Iowa Pavement Management Program (IPMP). IPMP's services are provided through Iowa State University's Institute for Transportation, which is the agency currently supporting Iowa DOT's pavement management data collection.

Figure 3: A "Pathrunner" Automated Data Collection Vehicle (Pathways)
This is one of the van's that a previous data collection vendor used to collect pavement condition in Iowa from 2013-2017.

The collected pavement distress data were then combined into a Pavement Condition Index (PCI) for each street. A PCI is used to help more concisely communicate a road's pavement condition by rating it on a scale from 0 to 100, with 0 representing a failed pavement that has essentially turned completely to rubble and 100 representing an excellent pavement from a freshly paved street that is only a few days old. This plan uses the CityPCI method for calculating condition indices for urban areas in Iowa, as developed by the IPMP technical subcommittee.

Using this index as a guide, each of the roads was then placed into a condition category ranging from "Very Poor" to "Very Good." All the data was then appended with additional information regarding traffic, functional class, number of lanes and the like, then stored within both GIS and dTIMS BA databases so that it could be analyzed in the pavement management models.

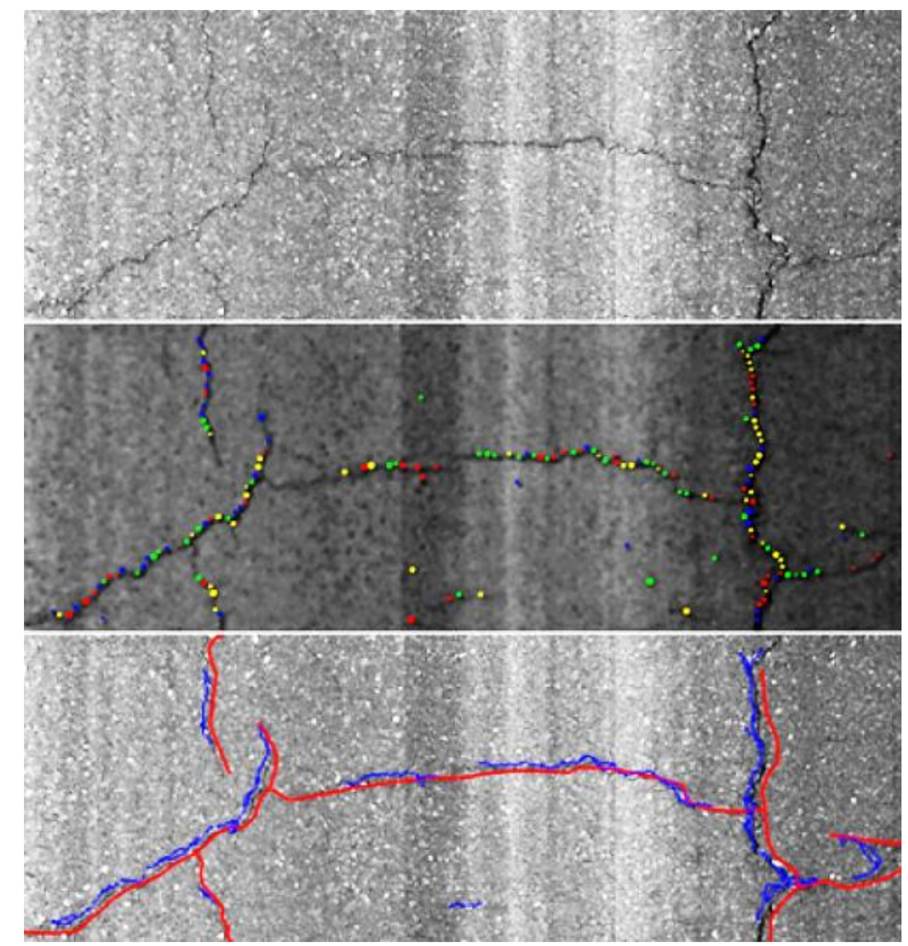


Figure 4: Automated Crack Analysis Software
This picture is a screenshot of an automated crack detection software that uses elevation information and photogrammetry to identify distresses and categorize their severity

3.1.3. Example Pavement Distresses

Figure 5: 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 6: 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 7: 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 much cracking. Typically caused by shifting or displaced underlying material.

Figure 8: 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 9: 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 are indicative of underlying issues as well as a common point of failure.

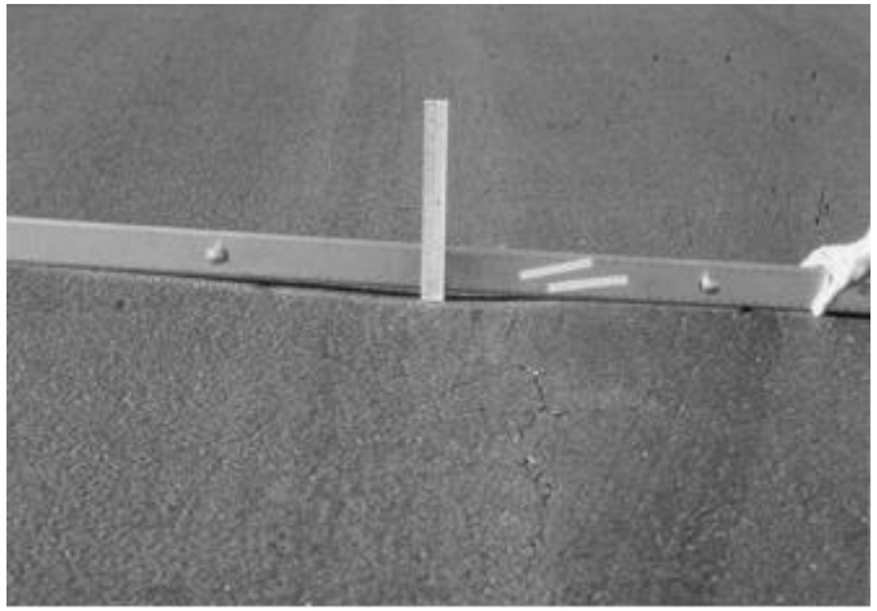


Figure 10: Example of Rutting (ASTM)
This image is from the ASTM D6433 "Standard Practice for Roads and Parking Lots Pavement Condition Index Surveys." Rutting is a depression along the wheel-path caused by traffic loads.

3.2. Condition Thresholds

The Pavement Condition Index (CityPCI) used in this plan helps differentiate and prioritize between individual streets, but due to the sampling methodology used by the data collection vendor ***it should not be interpreted as a 100% accurate,*** infallible rating. The difference between a 52/100 rating and a 55/100 could be only a few cracks. Since the data collection vehicle typically only drives one side of the street it may occasionally miss a few distresses near the middle, or the other side could be in slightly better/worse condition. A difference of a few points one way or the other should not be interpreted as a definitive ruling on one street being better than the other. ***Changes in PCI less than 10 points are, in most cases, imperceptible to the naked eye.***

Instead of using CityPCI literally, condition categories were assigned to each street based on where the value fell on the 0 to 100 scale. For example, pavements with CityPCI ratings below 20 are considered to be "Very Poor" while those above 80 would be "Very Good." This was done to help with understanding and assessment of the ratings, as well as to allow them to be used in a practical sense

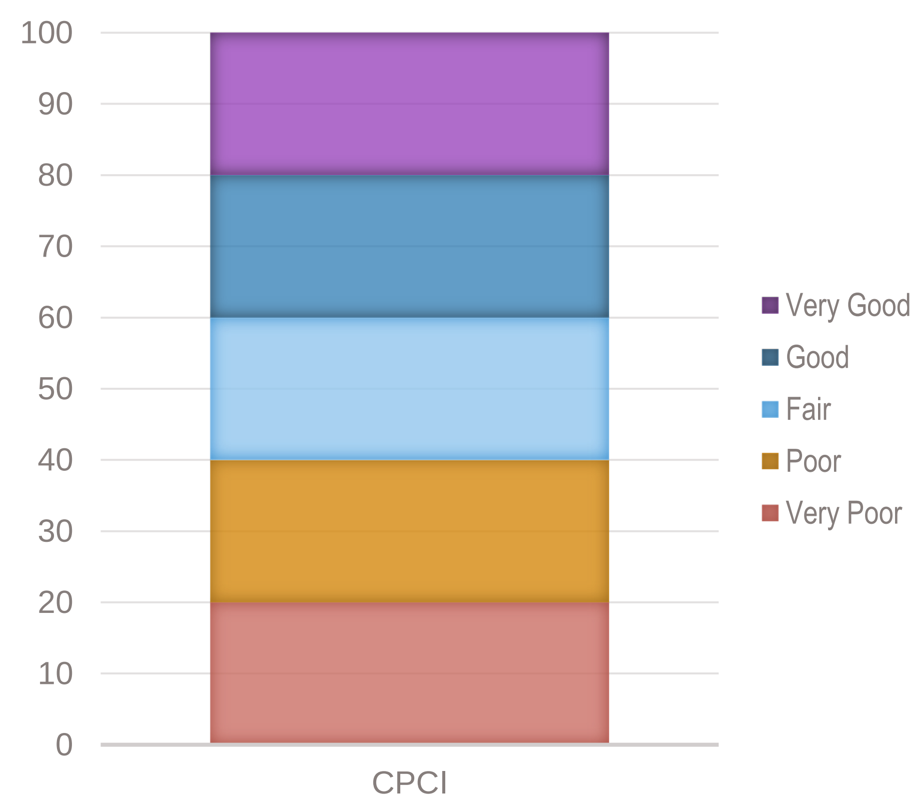


Figure 11: Condition Thresholds
This chart shows the proposed relationship between CityPCI, and the condition categories used in this plan.

Figure 12: Example of "Very Good" Condition (HMA) – South 14th Street
This picture was taken from the 2021 data collection records. South 14th St near Greene has a very high PCI of 92 /100 because it demonstrates no visible pavement distresses. Likely because it was overlayed recently.

Figure 13: Example of "Very Good" Condition (PCC) – Shelby Drive
This image from the 2021 data collection shows Shelby Dr near Meadow. It was rated as a-perfect 100/100 and would be considered "Very Good" for a PCC pavement.

A score of 80/100 or greater is considered "Very Good." Roads with pavement in "Very Good" condition exhibit very few surface distresses, if any, and those that are apparent will be very low in severity. Most often, these pavements will be relatively new. The average age of "Very Good" pavements in Adel is likely less than 15 years, meaning they were either recently constructed or rehabilitated with an overlay in the past few years. As such, it may not be feasible to expect every street in a city to be "Very Good" because it would be prohibitively expensive to resurface every street in only 15 years' time.

Pavements with CityPCI scores between 61 and 80 are considered to be in "Good" condition. The distresses on these streets are more noticeable but do not cause much concern because they are minor and infrequent. Most drivers will not even notice the few cracks and distortions. Regular maintenance activities like crack sealing can help prevent the spread of these deficiencies and preserve these pavements for quite some time for low costs. The average Adel streets would be classified in this category.

Figure 14: Example of "Good" Condition (HMA) – North 15th Street
This picture of N 15th St north of Main was rated as 68/100, which would be considered Good for an HMA pavement. Small distortions, and a few non-wheel path cracks can be found, but nothing that impacts drivers like cracks in the wheel-path or patches of failure.

Figure 15: Example of "Good" Condition (PCC) – S 15th Street
This image shows an example of a PCC pavement in "Good" condition. South 15th St was rated as 71/100, because of a few panels with cracks, and minor joint spalling.

"Fair" streets (CityPCI 41-60) have quite noticeable distresses. Either many low severity distresses, or a few high severity distresses. These will still not impact drivers very much, however.

Figure 16: Example of "Fair" Condition (HMA) – Chance Court
This image of Chance Ct is an example of HMA pavement in "Fair" condition, with a PCI of 50/100. There are very noticeable distresses but they only impact drivers slightly.

Figure 17: Example of "Fair" Condition (PCC) – Prairie Street

This picture of western Prairie St is an example of a PCC pavement that was rated as 52/100 which would be considered "Fair." It has visible distress, but they are sealed or patched.

At this point in a pavement's life, it is about 75% of the way through its expected serviceability. It will begin deteriorating much more quickly and fall into "Poor" (21-40) or "Very Poor" (1-20) in only a few years, if neglected. However, because the distresses on "Fair" streets are still minor, this is often the ideal time to Rehabilitate them affordably. On the other hand, pavements that deteriorate further, into the "Poor" and "Very Poor" categories, will likely require Reconstruction, which is very costly.

Figure 18: Example of "Poor" Condition (HMA) – Grove Street

This image shows an HMA street whose pavement is rated as 30/100 and considered to be in "Poor" condition. Grove Street east of 15th has significant alligator cracking and distortions along the wheel path and pavement edge affecting the ride.

Figure 19: Example of "Poor" Condition (PCC) – North 17th Street

This image is an example of a PCC pavement in "Poor" condition. In 2021, the section of N 17th St shown had a PCI of 26/100 due to joint failures.

Figure 20: Example of "Very Poor" Condition (HMA) – Greene Street

This image shows an HMA street whose pavement is rated as 20/100 and considered to be in "Very Poor" condition. Greene St west of 11th is considered the worst HMA surface street in Adel due to deep ruts and large localized failures.

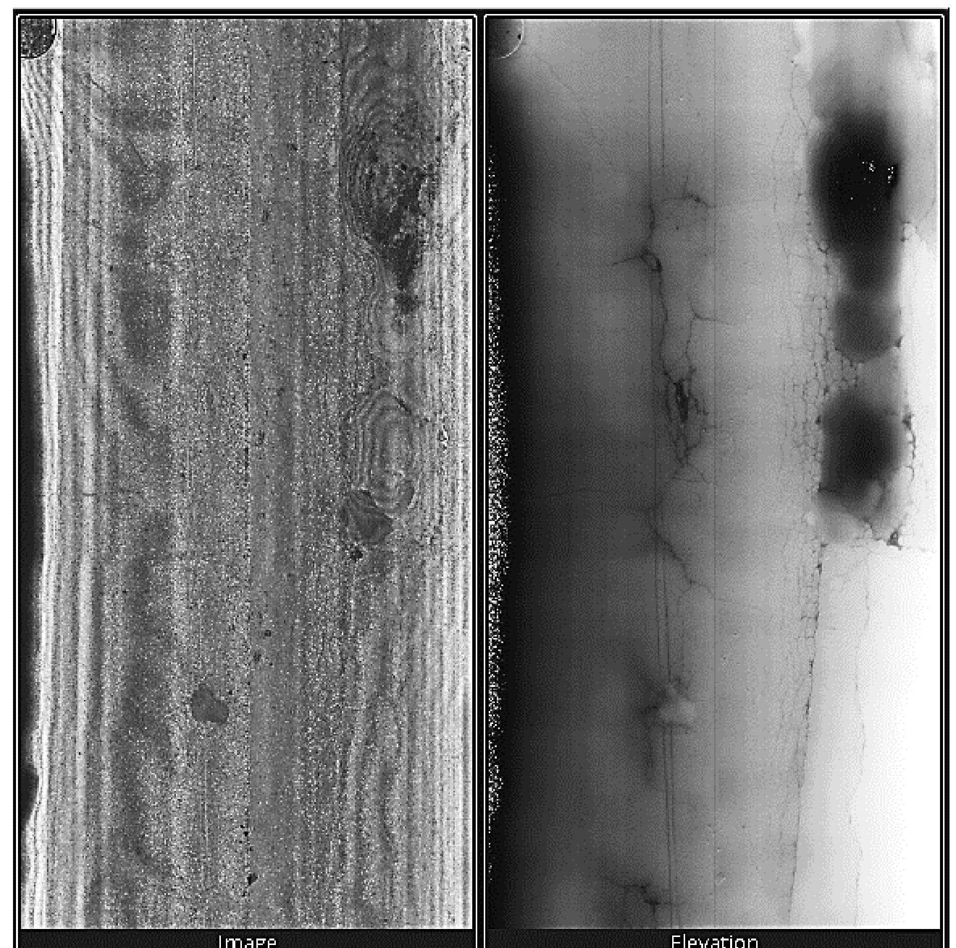


Figure 21: Roadway Imagery of a "Poor" HMA Pavement

This imagery is from the section shown in Figure 20. These were captured by the data collection vehicle's downward facing camera (left) and LIDAR array (right). These are one of the key resources used in evaluating pavement condition.

Figure 22: Example of "Very Poor" Condition (PCC) – South 16th Street

This image is an example of a PCC pavement in "Very Poor" condition. South 16th St south of Hyvue is considered the worst condition road in the system due to widespread joint spalling, d-cracking, most panels are cracked..

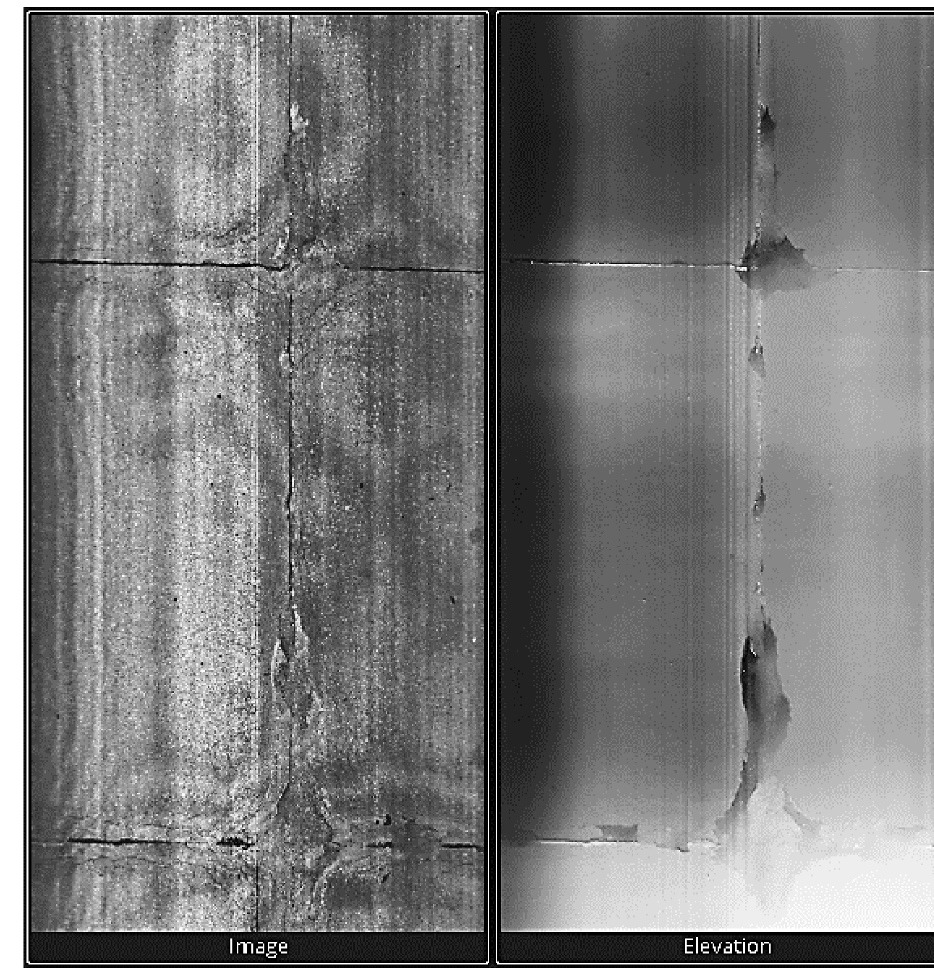


Figure 23: Roadway Imagery of a "Very Poor" PCC Pavement

This image is from the section shown in Figure 22. These were captured by the data collection vehicle's downward facing camera (left) and LIDAR array (right). These are one of the key resources used in evaluating pavement condition.

3.3. dTIMS Business Analytics (PMS)

A Pavement Management Software (PMS) is a decision-making tool that assists a City in making cost-effective decisions related to the maintenance and rehabilitation of roadway pavements. It provides a process or system for rating pavement condition, establishing a consistent maintenance and repair schedule, and evaluating the effectiveness of maintenance treatment strategies.

The PMS used by the City of Adel is called "Deighton Total Infrastructure Management System: Business Analytics" or dTIMS BA. This software was developed by Deighton Limited as an asset management software capable of storing all sorts of physical infrastructure assets and specializes in how it uses heuristic algorithms to optimize spending patterns.

dTIMS® Business Analytics

Each road is separated into pavement management sections, typically broken up by city block or by other physical features like bridges and railroads. Segments are associated to the road, as a whole, using a "Linear Reference System" where each segment would appear in sequence based on its distance from the start of the road. The pavement distress data, including the CityPCI ratings, are then imported into the web-based software and were used to develop a customized pavement management model for the City of Adel

The dTIMS BA model is a collection of the raw distress data, equations, variables, and rules for treatment applications as well as their effects. One of the most important equations used are the performance curves which dictate the behavior of pavements over time.

3.4. Performance Curves

Different types of pavements behave differently, and different classes of road have different stressors. To accommodate these factors, a pavement life cycle curve was developed for asphalt and concrete pavement types. separated further by the type of road, either Arterial, Collector, or Local/Residential.

These curves were calibrated to follow the general assumption that a pavement reaches "Fair" condition at 75% of its design life and "Very Poor" condition at the end of its design life. These curves do not necessarily represent the traditional design life-cycle curve; instead, they address the performance of the pavement and how much longer we can realistically expect it to last without having to determine the structural characteristics and history for every street in the City.

Each pavement management section has an effective "performance age" that determines its behavior. This performance age is determined based on previous data collections. Using that data, a rate of deterioration can be determined for each street individually and then fit to the appropriate family curve. The CityPCI rating is then projected along the curve and tested to see if various treatments would be appropriate at each point along the individual performance curve.

Other curves were similarly created for specific distresses, such as Alligator Cracking, Spalling/D-Cracking, and Rutting. These distresses progress in predictable ways and occasionally preclude certain types of treatments from being applied. For example, a street with severe rutting (> 0.5") would not be a good candidate for a slurry seal or thin overlay. Conversely, if these distresses progress past a certain allowable threshold, more expensive treatments, like reconstruction, will be selected as the only reasonable option even if the CityPCI would not necessarily indicate that on its own.

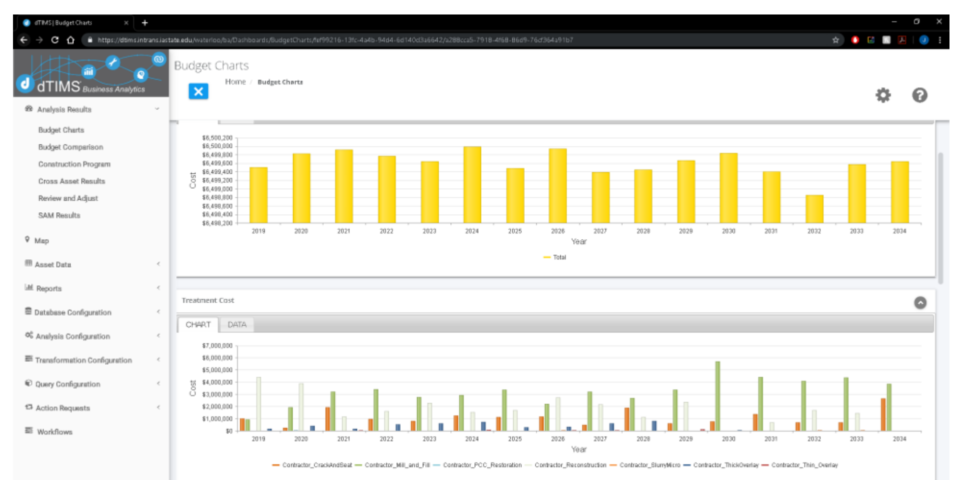


Figure 24: dTIMS BA Interface
The dTIMS BA software is accessed through normal computer browsers and operates over cloud-based technology. Calculations are performed on remote servers, meaning any computer can use it, regardless of hardware capabilities!

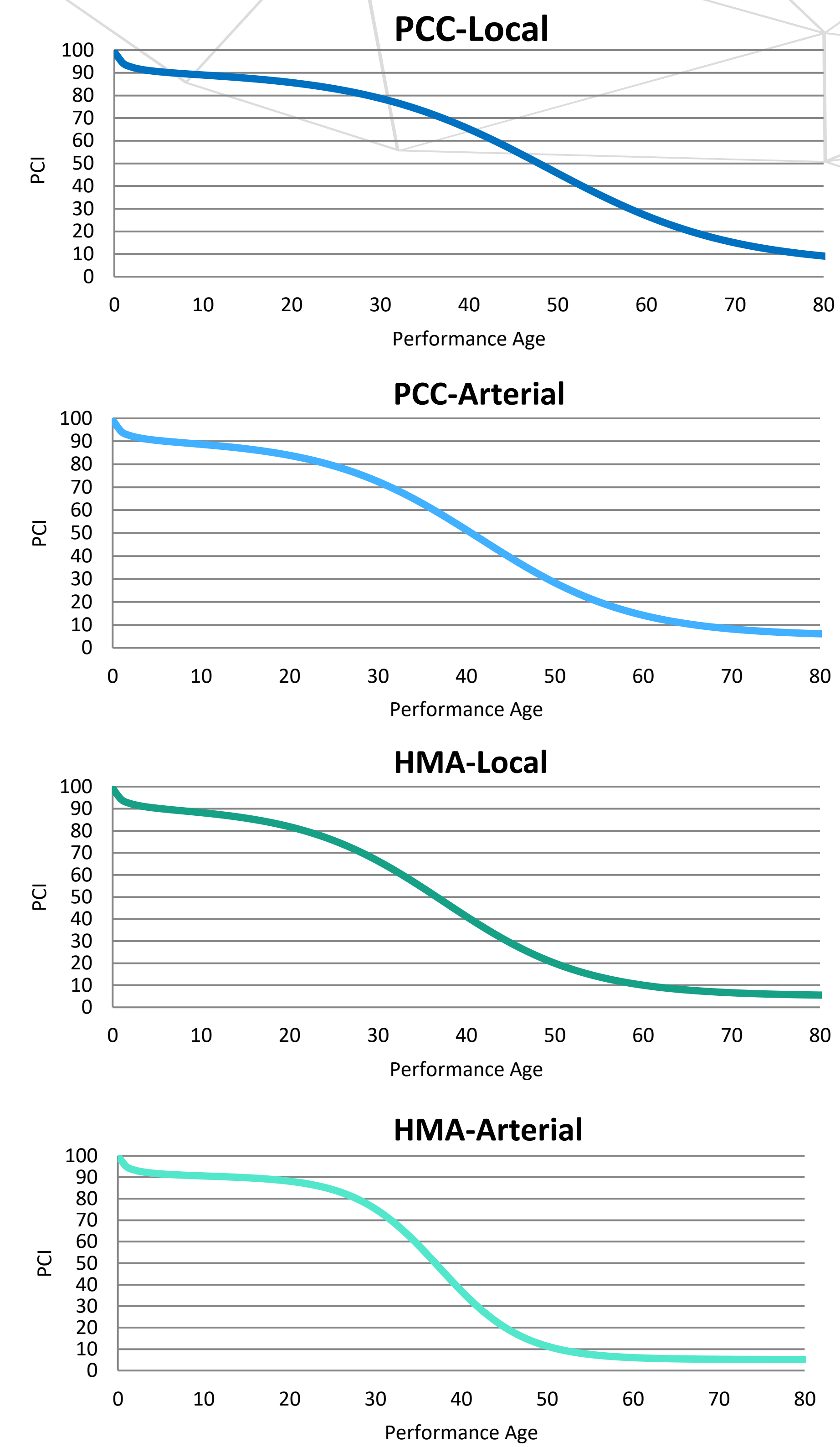


Figure 25: Pavement Performance Curves
These 4 curves are the pavement performance curves utilized in the Adel dTIMS BA model.

3.5. Treatment Alternatives

> *"The success of a pavement-preservation program is based on selecting the right treatment for the right pavement at the right time" (FHWA).*

A single pavement treatment, when properly applied, can extend the life of a roadway by as much 15 years. Before a decision on when and where a treatment can be applied, an agency must know what treatments it will consider. Dozens of potential products and techniques are available; however, not all treatment options are feasible, affordable, or effective. Climate, cost, and capability considerations must be made ahead of time.

The group of treatments available for a given municipality can be thought of as a "toolbox" filled with options appropriate for the tasks they would expect to encounter. The toolbox recommended for the **City of Adel** consists of three primary types of treatments often referred to as the 3 R's of Pavement Management: **Reconstruction**, **Rehabilitation**, and **Restoration**.

Every pavement will eventually deteriorate to a point that it cannot effectively be repaired in an economical fashion leaving reconstruction as the only viable option. Reconstructing a road from the base up is always an appropriate and effective treatment, but it is also typically the most expensive solution. As such, rehabilitation fills an important role in a pavement's life-cycle.

Rehabilitation treatments usually cost significantly less than full reconstruction and can extend a pavement's life substantially. Rehabilitation treatments in this section are split into major and minor variations. The former provides structural improvements to help a deteriorated pavement recover, whereas the latter provide relatively smaller improvements and are typically more preventative in nature.

Restoration treatments, sometimes referred to as "preservation" or "maintenance", are those applied regularly to prevent issues from developing or to prevent existing problems from spreading.

Construction standards and specifications for the following treatment alternatives should follow the Iowa ***Statewide Urban Design and Specification (SUDAS)*** manual, where applicable. These research-backed approaches to construction and pavement management techniques will extend pavement life beyond traditional methods. Often costing more, the increased performance life still makes it the cost-efficient and sustainable approach, long-term.

3.5.1. Reconstruction

- Reconstruction

Reconstruction of pavements is often the only way to save a deteriorated roadway. Unfortunately, these needs usually outstrip available funding. This treatment type should be reserved for pavements that cannot be salvaged through rehabilitation or on high-profile corridors where safety and capacity needs are paramount.

When Reconstructing a pavement, the City can use any material they wish. Most commonly for Adel, Full-depth PCC is used. However, full-depth HMA, or a composite pavement of PCC with an HMA overlay, may be considered when design constraints warrant. To provide for this option the City may want to consider using "bid-alternates," where contractors can bid based on the equivalent design of their choice.

Figure 26: Reconstruction of I-94 (NDDOT)
This photo shows the Construction of a brand-new asphalt cement concrete pavement

Figure 27: Reconstruction of Michelmore Street (Bidgee)
This photo shows a road torn out and being prepared for reconstruction

3.5.2. Major Rehabilitation

- Thick Overlay
- Mill and Overlay
- Overlay with Crack and Seat

There are few substitutes for adding new concrete on top of old to help keep it functioning and healthy. HMA is the most commonly-applied material (black-topping), but PCC (white-topping) is gaining acceptance in Iowa and is being applied in many locations as appropriate. HR Green recommends the use of HMA by default but also encourages the exploration of white-topping as a secondary option, where conditions allow and costs are comparable.

Major rehabilitations suggested herein are all variants of overlays where moderately-thick layers of HMA are placed upon existing pavements, sometimes with special preparations. ***"Thick Overlays"*** requiring a minimum of 3 inches of HMA is preferable for each treatment as any less will not provide significant structural benefit. Note, however, that amounts greater than 3 inches can become costly and sometimes may cause logistical difficulties. Overly-thick HMA overlays can affect side street elevations, drainage patterns, driveways, and fill up curbs leaving little remaining to control storm water and delineate the edge of the roadway. A thick overlay is the most common rehab used in most agencies and, for the purposes of this report, is recommended to be placed at the end of a pavement's life.

Figure 28: HMA Overlay Placed On Milled Pavement (Famartin)
This is a picture of an asphalt overlay placed on I-80 through Elko, Nevada after part of the original pavement was milled off.

When dealing with a full-depth HMA pavement, or one overlaid previously, milling off 2-3 inches of the top can provide significant benefits. It can help smooth the underlying pavement for the final surface, remove harmful defects, help create a more stable bond between pavements, and prevent the overlay from causing the referenced logistical difficulties with side streets, drainage, driveways, and curbs. ***"Mill and Overlay"*** treatments are important in keeping a pavement going strong. Once the first thick overlay is placed, it should be milled off approximately every 15 years and replaced to keep the surface from deteriorating too far.

One other major rehab treatment to consider on fairly stable and older PCC roads is called an ***"Overlay with Crack and Seat."*** This prepares an existing roadway as a suitable base for what is effectively a new HMA pavement on top of it. The PCC is cracked using a drop-hammer apparatus, or other devices, to create a flexible base of concrete before placing 3 or more inches of HMA on top of it. This process may require the reconstruction of curbs if the depth of asphalt to be placed would be problematic; however, a milled edge notch may be utilized in some cases to eliminate the need for curb replacement. The new crack and seat pavement is typically a long-lived rehabilitation treatment as it is effectively a new road altogether.

Other major rehabilitations, such as hot-in-place recycling and cold-in-place recycling, were considered but are not recommended for use in Adel due to their limited applications in urban environments and the City's limited asphalt roadways. The equipment required to perform these do not leave much flexibility in staging or timing. Even if it were feasible, it would likely be excessively disruptive to local traffic patterns.

Figure 29: Cold Milling Machine (Anthony Neff)

Cold Milling Machines like the Caterpillar PM 622 above are used to strip off the top layer of pavement. Those millings could then be used for in-place recycling, or the pavement could receive a new 3" overlay.

3.5.3. Minor Rehabilitation

- Slurry Seal
- Thin Overlay
- Microsurfacing
- Bituminous Seal Coat (Chip Seal)
- Cape Seal
- PCC Restoration
- Diamond Grinding

Minor Rehabilitations fill a different role than Major Rehabilitations. They usually are placed to prevent moisture and seasonal weather effects like rain and heat from causing too much damage. They will seal the pavement from water and provide a new "wearing surface" for vehicles to drive on instead of damaging the underlying pavement.

Slurry seals are one of the most common surface treatments used in the United States to rehabilitate asphalt pavements, though still somewhat rare in more northern climates. It is effective at sealing low-severity cracks, waterproofing the pavement, and restoring friction to surface for increased driver safety. Slurry seals also address raveling, oxidation, and hardening of asphalt. This treatment consists of a mixture of crushed, well-graded aggregate, mineral filler, and asphalt emulsion that is spread across the full width of a pavement or used as a strip application for targeted treatment of low distress areas and cracks. The thickness of the slurry seal is generally less than 1/2 inch, but it can still extend a pavement's life up to 7 years, when applied at the right time. However, the low amount of aggregate means it will not be effective at addressing anything beyond superficial distresses.

Thin Overlays are essentially the same treatment as a Thick Overlay; except they are 1-2 inches of HMA, instead of 3+ inches used for Thick Overlays. 1 ½ inches is the recommended thickness for Thin Overlay because, if it was thinner, it may be susceptible to cracking or rutting very quickly due to vehicle loads. Thin Overlays are also not appropriate on roadways with significant deformities like severe rutting and structural distresses, such as severe alligator cracking or warping, but they do have more broad uses than slurry seals. It is also common to see the use of recycled asphalt and rubber materials in Thin Overlays which can reduce costs and possibly increase durability.

Microsurfacing, on the other hand, consists of a thin application like a slurry seal but uses a polymerized binder with finer aggregate. It can smooth over minor deformities while still adding a small amount of structural durability. It also creates that same seal against water and wear that Minor Rehabilitations need. It is a versatile and relatively cheap treatment that can address a wide variety of distresses, even load-based ones. A relatively new technique, it is not very common in the state of Iowa, yet. However, the City of Des Moines has recently invested heavily into this treatment method and begun incorporating it into their regular pavement management practices.

Figure 30: Slurry Seal Being Placed by Hand (Miraflores)

This slurry seal is being placed to refresh the surface of the Villeno Rey Bridge in Miraflores, Peru.

Figure 31: Microsurfacing Crew at Work. (Eric Pulley).

This is picture shows a crew using a Microsurfacing machine to lay a new surface on this street.

Figure 32: Close-up View of Chip Seal Surface

This close-up picture of a road that has been chip sealed shows how coarse the application is and how aggregates tend to be looser on top of the new surface compared to other treatments that evenly mix the aggregate into the binder.

Bituminous Seal Coats, also known as ***Chip Seals***, are effective treatments for improving surface friction, inhibiting raveling, correcting minor roughness, and bleeding, as well as sealing the pavement surface from moisture. Bituminous Seal Coats are also used to address longitudinal, transverse, and block cracking, as well as for sealing medium severity fatigue cracks. Chip Seals can even be applied in multiple layers to address more serious problems. The application of a Chip Seal consists of an asphalt emulsion that is applied directly to the pavement surface and is followed by the laying of aggregate “chips” on top of the emulsion. Those chips are then immediately rolled into the emulsion in order to embed them. It is a cost-effective and versatile treatment but, unfortunately, often is not recommended for urban applications due to perception issues. The large amounts of loose aggregate chips that fail to bond are often kicked up or tracked elsewhere by vehicles, and since the binder tends to bleed in the few days after application, vehicles tend to leave blackened tracks on neighboring streets.

Cape Seals somewhat solve the issue of Chip Seals by using the same basic technique but then finishing it with a Slurry Seal or a layer of Microsurfacing over the top. This additional seal coat locks in the loose aggregate chips and inhibits the binder bleeding. This approach has many of the same benefits as a Thin Overlay and comes at a somewhat comparable cost.

PCC Restoration is a holistic repair to a PCC pavement street, including any or all the following actions: panel replacement, profiling, repairing utility cuts, full depth patching, and joint repair. PCC Restoration is more than simply pavement patching, it is strategic repair to existing deficiencies and can help save an otherwise stable road. A typical application removes and replaces no more than 10%-20% of the existing pavement, to address specific localized issues. This type of repair could be performed by either city forces or outside contractors.

Diamond Grinding is not a commonly applicable treatment, but due to its low cost should be considered when the conditions are ripe. Diamond Grinding is best used when a weathered pavement is beginning to show signs of aggregate polishing to add texture back to it for cars, or when settling or warping caused minor faulting. Diamond Grinding can smooth those faults and leave an otherwise stable pavement intact with its ride significantly improved. It would not, however, be appropriate for pavements with substantial cracking or signs of structural deficiencies such as severe alligator cracking, spalling, or D-cracking.

Figure 33: PCC Restoration (City of Cedar Rapids).
This is a picture of a city maintenance crew in Cedar Rapids performing a panel replacement as part of a larger concrete restoration project.

Figure 34: Pavement After Diamond Grinding (John Roberts).
This picture shows the texture of PCC pavement after diamond grinding was used on it. The image was taken on a project near Chicago Illinois.

Figure 35: Cape Seal (Michael Quinn-NPS)
This picture taken by the National Parks Service near the entrance to Grand Canyon National Park shows a loose chip seal (right) that is having a slurry seal applied (left) to effectively turn it into a cape seal.

3.5.4. Preservation

- Crack Sealing
- Pavement Patching

Restoration treatments use simple techniques to seal defects from moisture infiltration and prevent them from spreading. ***Crack Sealing***, for example, is a standard maintenance practice, recommended to be performed by city forces every 3-5 years on a road. Larger contracts for outside construction firms may be considered for crack sealing if the timing and amount of work warrant. Cracks that have slightly deteriorated edges may also need to have the loose pavement cleaned out and rough edges of the crack corrected using a concrete saw or router to improve the sealant bond. However, this is not necessarily recommended as the standard application due to increased costs and inconsistent performance.

Crack Sealing in a timely manner, and on a regular basis, is the most important tool in any pavement management program because will keep a pavement in good or fair condition much longer than it would without attention.

Figure 36: 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 is different from Crack Sealing in that it is typically done by city forces after a pavement distress has already deteriorated to the point of becoming a more substantial issue. Patching is typically done with HMA, sometimes with partial removal of the area around the defect or distress. Patching is not intended to serve as a long-term fix, but serves mostly as a way to maintain service, and act as a stop-gap until a more appropriate rehabilitation treatment can be applied.

When a surface issue is due to a structural defect, full-depth removal followed by replacement of the pavement, as well as the base material, may be appropriate. This is referred to as full-depth patching or FDP. This can be costly, but often is the only solution for addressing faulting/spalling of concrete joints or edge/corner breaks, when combined with dowel-bar replacements.

It is recommended, by default, that surface patching be performed using localized removals by cutting the pavement in a rectangular or square shape (following joints where possible) and replacing it with new HMA pavement after ensuring the base-material is suitable. When patching a PCC pavement, use of similar material is recommended as well as full removal of panels where appropriate. In cases where failures are located around joints, removals along both adjacent panels and full depth patching should be performed.

Figure 37: HMA Patching with Localized Pavement Removal (KOMU)
This is an example of an asphalt patch applied with appropriate localized removals and some base repair.

3.5.5. Preferred Treatment Alternatives

Table 1: Primary Capabilities & Functions Of HMA 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: 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 in Adel, although some are more preferred than others. The recommended CIP will not normally 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 1*** provides some simple guidance on which types of treatments are appropriate based on the distresses that a pavement presents and ***Table 2*** helps compare the effectiveness of each treatment over time.

The treatments used in the dTIMS model represent those expected to be the most common given certain conditions. These "preferred treatments" will likely comprise the majority of pavement preservation work performed in Adel. This list, however, is merely a tool to aid in budgeting and planning and not a prescriptive result. It is not designed to be interpreted as "you must do X";

rather the results from dTIMS are categorical recommendations based on severity and types of surface distresses. These recommendations will then need to be individually assessed for appropriateness against similar treatment alternatives before it is designed and constructed.

3.5.6. Estimated Treatment Costs

One of the critical components, in any financial planning endeavor, is accurately predicting costs that will be incurred. In this case, the primary costs of concern are the design, construction, and ancillary costs associated with executing a roadway improvement project. Adel has historical information about its expenditures on roadway projects throughout the years showing significant increases in project costs. This growth was accounted for via a 2.1% inflation[1,2,3,4,5] factor applied to all project costs in dTIMS BA.

Treatment types were assigned planning-level costs by analyzing local cost information and tabulations of contractor bids for past projects, which were supplied by the City, and from additional sources. Assumptions were made regarding mobilization rates, design fees, traffic control, and other ancillary costs based on percentages of the overall costs. Since the costs used in this report are planning-level, it is recommended that each project be reviewed during the annual capital improvement budgeting process, in order to assess each proposed action for ripeness and reasonableness, e.g., is this the right time? Is this the right treatment? The City may elect to move projects around, into different years, or change the treatment type.

For most practical purposes, treatments within the same category are interchangeable because they will likely be appropriate for a project of a certain condition category, regardless, and the actual treatment applied should be based on comprehensive review and engineering judgement. When determining ripeness and reasonableness it may be useful to perform Life-Cycle Cost Analysis to evaluate various treatment alternatives within the same category against each other, or even when considering leaving it to be reconstructed, at a later time.

3.5.7. Treatment Selection Criteria

With the treatment alternatives selected for the toolbox, the criteria for selecting one treatment over another needed to be determined. Cost and funding availability is regularly the deciding factor for local agencies, getting the most benefit for the least amount of investment possible. 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 3*** 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 dTIMS BA scenario modelling process, to be performed as part of the Adel Pavement Management Program.

Table 3: Treatment Alternative Details

Category	Treatment	Description	Cost	Trigger
Reconstruction	Reconstruction	The complete reconstruction of a roadway and all associated improvements. This assumes new HMA pavement, but full-depth PCC or COM may be considered based on relevant design criteria.	$200/sy	PCI =Poor OR Very Poor
Major Rehabilitation	Crack and Seat Overlay	Asphalt Overlay, of at least 3 inches thick, with preparation including breaking up existing pavement and setting it up as a good structural base for the new asphalt surface. Effectively creates a new pavement.	$65/sy	PCI =Poor, Surface = PCC, Low D Crack
	Mill and Overlay	1.5 to 3 inches of asphalt pavement is milled off and then replaced with 3 inches of asphalt. Repairs surface issues and improves structural character.	$55/sy	PCI =Poor, Surface = HMA, IRI > 250, Moderate Alligator Cracking
	Thick Overlay	Sometimes called a "Structural Overlay." 3 inches of Asphalt that adds enough thickness to increase the durability of the roadway and provides a new wearing surface. Can be done with asphalt or PCC (black-topping/white topping) May require replacing curb and gutter.	$50/sy	PCI =Poor, Low D Crack, Low Spalling, Moderate Alligator Cracking, Moderate Patching
Minor Rehabilitation	Thin Overlay	A "non-structural overlay." Laid on top of existing pavement; typically, 1-2 inches of asphalt. Improves smoothness and extends the life of roads in good to fair condition.	$35/sy	PCI =Poor or Fair, Low D Crack, Low Spalling, Low Alligator Cracking, Low Patching, Low Rutting
	Seal Coat (Various)	Slurry Seals, Chip Seals, Cape Seals, etc. Applications of finer aggregate and binder to affordably extend life of existing pavements. Type is condition and location specific.	$5/sy	PCI = Fair or Good, Surface=HMA, Low Alligator Cracking, Low Patching, Low Rutting, Local Only
	Microsurfacing	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
	PCC Restoration	Portions of the street in bad repair are torn out and replaced. This may include patching, full panel replacement, and full depth repairs at joints. Slightly improves overall condition and helps extend life by addressing problem areas before they spread	$21/sy	PCI = Fair or Good, Surface=PCC
	Diamond Grinding	Top ¼ inch to a ½ inch of PCC pavement is ground off and textured. This is only done on rough pavements with good structure to improve ride smoothness and increase vehicle traction for safety purposes.	$5/sy	PCI=Good, IRI>250, Low D Crack, Low Spalling, Low Alligator Cracking, Low Patching, Low Rutting
Restoration/ Preservation	Crack Sealing	Sealant on cracks and joints is 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.	$10,500/ Mile/Lane	Applied every time Last Work Done counter reaches a multiple of 4 years
	Pavement Patching	Asphalt placed at spot locations. Used only on good pavements with minor failures, or as a stop-gap on poor pavements until a better, more permanent, solution is applied.	$3/sy	No trigger assigned

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

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

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

[4] 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

[5] 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.

The treatment costs listed in Table 3 are considered "all-in" numbers. These costs represent not only the materials to perform the construction of the project but all the expected costs that would be associated with the given treatment type. For example, the Reconstruction treatment includes costs related to storm sewer as that will be needed as part of the new pavement system. Table 4 through Table 16 provide example calculations for each of the treatment types. Note that these are ***planning-level costs***, only, however. While based on engineering judgement and historical bid tabulations, they are not a replacement for an engineering opinion of probable cost.

Table 4: Reconstruction Cost Calculation

Reconstruction ($/SY)	
Excavation	$ 7.00
Subgrade	$ 3.00
Subbase	$ 10.00
Subdrain	$ 8.00
Storm Sewer*	$ 30.00
Pavement Removal	$ 12.00
Pavement (PCC)	$ 65.00
Driveways/Sidewalks	$ 15.00
Seeding/Paint Markings, etc.	$ 7.00
Mobilization, Traffic Control, Survey (15%)	$ 24.00
Contingency (10%)	$ 19.00
Total (Rounded Up)	$ 200.00

Table 5: Crack and Seat Cost Calculation

Crack and Seat w/ Overlay ($/SY)	
Crack and Seat	$ 6.00
Milling	$ 2.00
3" HMA Overlay @ $100/Ton	$ 18.00
Tack and Patch @ $200/Ton	$ 4.00
Curb and Gutter/Patching	$ 10.00
Driveways/Sidewalks	$ 10.00
Mobilization, Traffic Control, Survey (15%)	$ 8.00
Contingency (10%)	$ 7.00
Total (Rounded Up)	$ 65.00

Table 6: Mill and Overlay Cost Calculation

Mill and Overlay ($/SY)	
3" HMA Overlay @ $100/Ton	$ 18.00
Tack and Patch @ $200/Ton	$ 3.00
Milling	$ 5.00
Curb and Gutter/Patching	$ 8.00
Driveways/Sidewalks	$ 9.00
Mobilization, Traffic control, survey (15%)	$ 7.00
Contingency (10%)	$ 5.00
Total (Rounded Up)	$ 55.00

Table 7: Thick Overlay Cost Calculation

Thick (3 In.) Overlay ($/SY)	
3" HMA Overlay @ $100/Ton	$ 18.00
Tack and Patch @ $200/Ton	$ 3.00
Curb and Gutter/PCC Patching	$ 8.00
Driveways/Sidewalks	$ 10.00
Mobilization, Traffic control, survey (15%)	$ 6.00
Contingency (10%)	$ 5.00
Total (Rounded Up)	$ 50.00

Table 8: Thin Overlay Cost Calculation

Thin (1.5 In.) Overlay ($/SY)	
1.5" HMA Overlay @ $100/Ton	$ 9.00
Tack and Patch @ 200/Ton	$ 3.00
Curb and Gutter/PCC Patching	$ 8.00
Driveways/Sidewalks	$ 6.00
Mobilization, Traffic control, survey (25%)	$ 5.00
Contingency (10%)	$ 4.00
Total (Rounded Up)	$ 35.00

Table 9: PCCR Cost Calculation

PCC Restoration ($/SY)	
10% Remove and Replace	$ 10.00
Crack Fill/Seal	$ 2.00
Profiling	$ 4.00
Mobilization, Traffic control, survey (15%)	$ 2.00
Contingency (10%)	$ 2.00
Total (Rounded Up)	$ 20.00

Table 10: Microsurfacing Cost Calculation

Microsurfacing ($/SY)	
Polymerized Surface Treatment	$ 1.50
Tack and Patch @ 200/Ton	$ 3.00
Mobilization, Traffic control, survey (25%)	$ 1.00
Contingency (10%)	$ 0.50
Total (Rounded Up)	$ 6.00

Table 11: Diamond Grinding Cost Calculation

Diamond Grinding ($/SY)	
Grinding and Mobilization	$ 5.00
Total (Rounded Up)	$ 5.00

Table 12: Crack Sealing/Filling Cost Calculation

Crack Sealing/Filling ($/Lane-Mile)	
Crack Sealing (per Mile per Lane)	$10,500
Total (Rounded Up)	$10,500

Table 13: Patching Cost Calculation

Patching ($/SY)	
Patch @ 200/Ton	$ 3.00
Total (Rounded Up)	$ 3.00

Table 14: Brick Reconstruction Cost Calculation

Brick Reconstruction – Full ROW ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$8.00
Storm Sewer*	$30.00
Pavement Removal	$10.00
PCC Paver Base	$75.00
Remove and Reinstall Brick Pavers	$120.00
Driveways/Sidewalks	$30.00
Seeding/Paint Markings, etc.	$12.00
Mobilization, Traffic Control, Survey (15%)	$40.00
Contingency (10%)	$30.00
Total (Rounded Up)	$375.00

Table 15: Brick Reconstruction Cost Calculation

Brick Reconstruction – Street Only ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$8.00
Storm Sewer*	$30.00
Pavement Removal	$10.00
PCC Paver Base	$75.00
Remove and Reinstall Brick Pavers	$100.00
Driveways/Sidewalks	$15.00
Seeding/Paint Markings, etc.	$7.00
Mobilization, Traffic Control, Survey (15%)	$35.00
Contingency (10%)	$25.00
Total (Rounded Up)	$325.00

Table 16: Brick to PCC Reconstruction Cost Calculation

Brick Reconstruction – PCC Conversion ($/SY)	
Excavation	$7.00
Subgrade	$3.00
Subbase	$10.00
Subdrain	$10.00
Storm Sewer*	$35.00
Pavement Removal	$12.00
Pavement (PCC)	$85.00
Driveways/Sidewalks	$20.00
Seeding/Paint Markings, etc.	$7.00
Mobilization, Traffic Control, Survey (15%)	$27.00
Contingency (10%)	$24.00
Total (Rounded Up)	$240.00

Maintaining Brick Pavements

Adel faces a unique challenge compared to most cities within Iowa, in that a large proportion of the city's streets are comprised of brick surfaces. 7.6% of the street system by area is brick, when most cities do not have any brick and even when they due it is limited to only one or two streets in a historic area that can be easily kept as a separate consideration.

Brick presents a particular difficulty to predict and therefore maintain. The paving bricks themselves are incredibly hard and resistant to wear and weather, and because they are not the same as a rigid pavement there is little risk of load-based failures to the surface. The types of stresses that cause HMA and PCC pavements to crack hardly affect the bricks as they can move around to flex with the strain. Conversely, because bricks cannot distribute loads across each other much of the structural characteristics come from the subbase and subgrade layers.

The gaps between the bricks then present an issue; because the surface is not water-tight, infiltration of stormwater and runoff can erode the subbase and subgrade, cause the clay soils common to Iowa to swell and distort, have frost to shove and damage pavers, allow tree roots and other plants can grow beneath/between the bricks, or otherwise destabilize the area underneath the bricks. Repeated heavy loads from trucks or garbage collection vehicles can make these worse. Unfortunately, because brick pavements are so permeable many older streets have insufficient drainage capacity to get water out of the road and prevent it from infiltrating. The lack of standing water is not necessarily proof of sufficient drainage.

Figure 38: Main and 9th Street Intersection
Example of a Historic Brick Pavement in the heart of Adel next to the courthouse.

This all results in brick pavements to be quite volatile and causes it to be difficult to predict their long-term behavior. They require maintenance not unlike more standard pavement types but the practices due differ.

3.5.8. Brick Restoration

The most direct maintenance of brick or cobble streets requires keeping the bricks themselves level and in good repair. Chipped or damaged bricks can be replaced with similar pavers, ideally from a City store-yard or the historical source but oftentimes can be obtained from specialty manufacturers (perhaps at a significant cost). A cost-effective alternative is to simply remove an area of damaged bricks, re-level the subbase and replace the bricks flipped over from their original facing. Depending on brick dimensions this can be done 1-3 times.

Unlike traditional pavement maintenance it is not necessarily a practice that can be planned with regularity. There is no fixed schedule to replace or flip brick pavers, and the City will likely have to manually inspect their Brick streets every 2-4 years and perform repairs as-needed, budgeting a modest amount each year for basic repairs that can also be saved up for when larger ones are necessary.

Figure 39: Crew Manually Re-laying bricks (Godofredo A. Vasquez)
This crew in Houston is laying historic bricks in Freedmen's Town.

3.5.9. Brick Rehabilitation

The unevenness of old brick streets from worn pavers or from large distortions of the subgrade can be addressed either through replacing large areas of brick or via an overlay.

When replacing a distorted area, remove brick pavers approximately 2-3' beyond the extent of the distortion. Excavate 12-18" and prepare the subgrade and subbase to the same SUDAS standard as for HMA pavements, compacting it to a CBR of at least 9. Geofabric or geogrid is recommended. If drainage-based failures are suspected, consider running subdrain from the affected area to a nearby storm intake/manhole or local outfall to help direct water out from under the brick pavement. Replace the salvaged bricks, supplementing them with new for any pavers damaged or lost, before sealing the gaps with a dry sand-cement mixture (3:1 ratio, passing No.16 sieve, cement may be colored to match). This approach can be a labor-intensive approach but will maintain the historical character of the street, while extending the serviceability.

Figure 40: Area Distortion of Rapids Street Holding Water
This area has distorted enough to catch and hold water, which indicates it will likely continue to fail as water and frost undermine the subsurface support.

In the case of minor distortions (<1.5") or when the bricks themselves are beginning to wear down (after being flipped) an overlay can be considered. The hardness and flexibility of brick pavements make them an ideal base layer for a long-lived asphalt pavement. Typically brick streets come with tall beam curbs of 6-8" so there can be quite a lot of room to provide for a sturdy Thick Overlay, that will likely perform even better than a Crack and Seat treatment on a PCC road. This will help stabilize the subgrade and subbase as well due to sealing the pavement surface from further water infiltration, however additional drainage intakes may need to be considered to compensate for sealing up the primary drainage method. This method, unfortunately, also will take away the historical aesthetic of the roadway and can be a sore spot for communities. Ideally, this new HMA surface can be milled and re-overlayed regularly to maintain it as if it were a full-depth HMA pavement so long as the depth of the overlay was sufficient that a contractor's milling machine is unlikely to catch the pavers beneath.

Of course, the two above treatments can be used in tandem to correct for larger distortions and then seal the street up with an HMA overlay.

Figure 41: Evidence of Brick Street Under a 30-year old Overlay

This photo from Anamosa shows an older brick street underneath an asphalt overlay.

Figure 42: HMA Patch over Brick

This asphalt patches is not likely to last long into the future, as any vehicle loads will have to be supported exclusively by the patch and the already compromised subsurface region.

Some communities will use asphalt or quick-set concrete patching material to correct distortions, but this is not a recommended best practice for long-term cost-effectiveness. Not only do the results not look great, but they do not perform well either. HMA and PCC patches will not adhere well to the brick and the flexible porous nature will allow water to get under and between the patch anyways. The initial distortion cause will continue to worsen and the patch itself will likely fall apart more quickly than it would otherwise. Such methods should only be considered as stop-gap solutions until a proper area repair or overlay is performed.

3.5.10. Brick Reconstruction

Many older brick streets reach a point where they become unsalvageable. The pavers on original brick streets were often placed directly on grade, or just a simple sand bed, if anything. . If the surface becomes too distorted with areas heaved 6" above or below the normal grade it may not be possible to correct the subsurface issues without replacing the entire roadway. Cracked/chipped pavers can always be overlayed but at a certain point it becomes the area failures that drive the decision to rebuild the roadway.

Once the decision to rebuild the street is made, the City will have to decide whether to reconstruct the street using traditional materials to save costs or to maintain the character of the roadway as a brick pavement. If the City would like to keep it as brick pavement it is recommended to use a 6" PCC base with an Asphalt setting bed or adhered to the PCC using approved adhesives. The PCC base should be constructed and jointed exactly as if it were a normal PCC pavement, including with drainable subbase, properly prepared subgrade, and subdrain. Weep-holes should then be drilled at regular intervals to provide infiltration points before the pavers are adhered to the PCC and sealed with a sand-cement mixture. This method is sometimes called the "Tub" method because the tall curb and PCC base make it like filling a concrete tub with bricks. The PCC base provides rigidity to the system, distributing loads and bridging subsurface issues preventing distortions while the asphalt setting bed (or adhesive) combined with the sand-cement seal prevents the bricks moving about, being kicked up, as well as reducing the amount of water that can get between the pavers.

The "Tub" reconstruction method can cost around ***$5 to $6 Million per mile*** in Iowa (see 2017 Adel Brick Reconstruction Bid Tabulations & Iowa City Davenport St project) or ***$450-$550 per square yard***, compared to traditional pavements which cost less than half that amount.

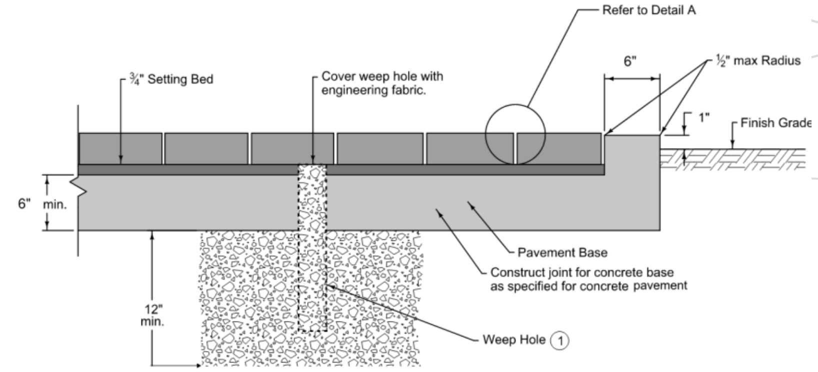


Figure 43: Standard "Tub" Cross section for Brick Pavement

Adapted from Iowa DOT guidance, this figure shows how a brick street can be constructed over a PCC base.

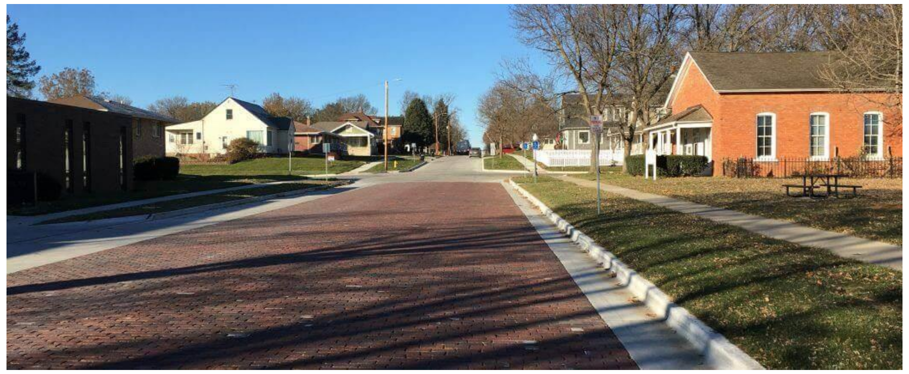


Figure 44: Roadway part of 2017 Brick Reconstruction Project

In 2017, Adel reconstructed Main Street, from North 10th Street to North 15th Street; on North 14th Street from Main Street to Prairie Street; on South 11th Street from Main Street to 180 feet south of Prairie Street.

Alternatively, Cities may consider using a traditional pavement for reconstruction and instead use the existing bricks for decoration to help bridge the historical character of the community with the practical and financial needs of City. Re-using salvaged bricks for edging behind the curb, to delineate cross walks, as part of decorative landings, or in a small monument can help connect the aesthetics of the area to the more modern street construction as well as serve as a bargaining chip for concerned political groups and citizens.

4. Existing Condition Analysis

The City of Adel maintains approximately ***32 Miles of roads*** and the transportation infrastructure network, not including bridges, is valued at ***over $99 Million.***

Network Value = $99 Million

Pavement condition information from the 2021 automated data collection vehicle run by IPMP's sub-consultant Pathways was joined to the processed baseline information from the City of Adel using the ESRI ArcGIS software. That data was analyzed to create overview statistics and investigate various trends, both over time and spatially. Detailed maps were created to illustrate the pavement characteristics and the collected condition data, which can be found starting on ***Page 25.***

4.1. Functional Class and Pavement Type

4.1.1. Functional Classification

Roads in Adel are separated into three broad categories to help differentiate their use: ***Local Streets***, ***Collector Streets***, and ***Arterial Streets***.

Local Streets, also referred to as "residential", serve low levels of traffic at the beginning or ending of vehicle trips. These streets often have many points of direct access from driveways, have lower speed limits, and sometimes have on-street parking. Local Streets make up the majority of any transportation network.

Collector Streets are those that connect Local Streets and concentrate traffic to help move vehicles efficiently between adjoining neighborhoods or provide access to the primary street network, namely Arterial Streets. These Collector Streets are generally wider and have slightly higher speed limits than Locals.

Arterial Streets carry the most traffic. These trunk roads travel at higher speeds and efficiently move traffic from one end of town to the other. They are also the gateway routes into and out of the City.

The reason for this distinction is that Arterial and Collectors are designed for higher volumes of traffic and heavier vehicles such as semi-trucks. As such, they are designed differently, costing more per square yard of pavement than Local streets. They also perform differently, by comparison. The higher traffic loads cause Arterials and Collectors to wear out faster on average than Locals, and motorists are more sensitive to surface distresses due to the higher speeds. That said, because Arterials/Collectors carry most of the vehicle-miles travelled in cities, they are more valuable to maintain in good condition. As such, for the purposes of modelling and planning using dTIMS BA, Arterial and Collector streets are considered separately from Local Streets.

Overall, Adel's transportation system has an unusual distribution of roadway Functional Classifications. Most urban systems contain 60%-75% local roads with Arterial and Collectors being split roughly even in the remainder. Adel's maintenance responsibilities, however, does not cover any roads classified as "Arterial" by the Iowa DOT. US 169 and US 6 are the only roads within the City classed higher than a collector, but those are primarily the state's jurisdiction. An argument could be made about the classification of Greene Street and Grove Street, based on volume but currently the formal classification still puts those as Collectors.

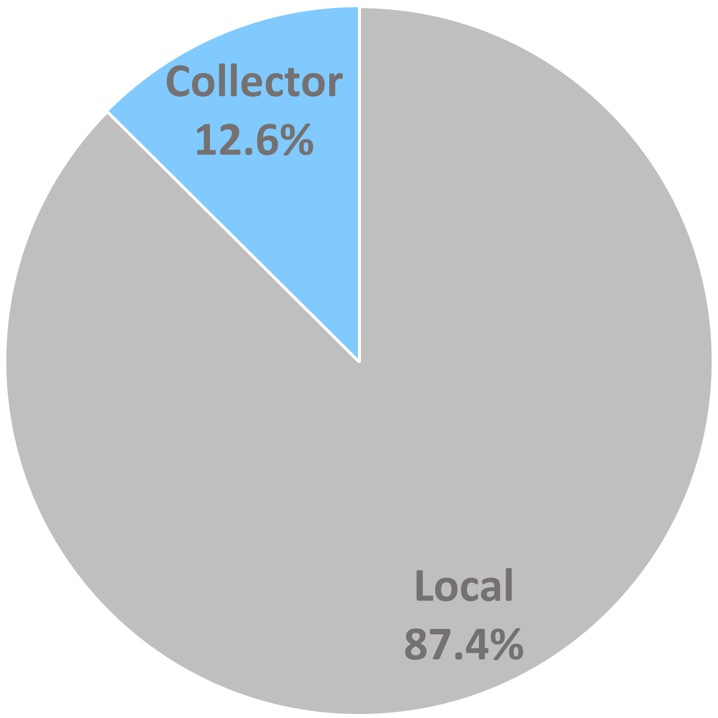


Figure 45: Functional Class Distribution (By Centerline Miles)
This figure shows the breakdown of the various street classifications in Adel, based on the official Federal Functional Classification used by Iowa DOT weighted by area.

4.1.2. Pavement Type

Roads can also be separated by their surfacing type. Different pavement surfaces perform differently, have different types of treatment alternatives, and have different initial construction costs. Each type of road was considered separately in the dTIMS BA model for the City of Adel.

The three main categories considered by this plan are Portland Cement Concrete (***PCC***), Asphalt Cement Concrete (***ACC***), and Composite Pavements with HMA over the top of PCC (***COM***). Some agencies also refer to ACC as Hot-Mix Asphalt or HMA.

The fourth surface type found in the City of Adel are Brick streets (***BRK***). The long-term behavior of these types of surfaces, and the budgeting processes used to schedule repairs, differ significantly from the previous three, so these roads are kept separate from the model and traditional condition analyses. Roads identified as having these surface types will instead need to be considered on a case-by-case basis.

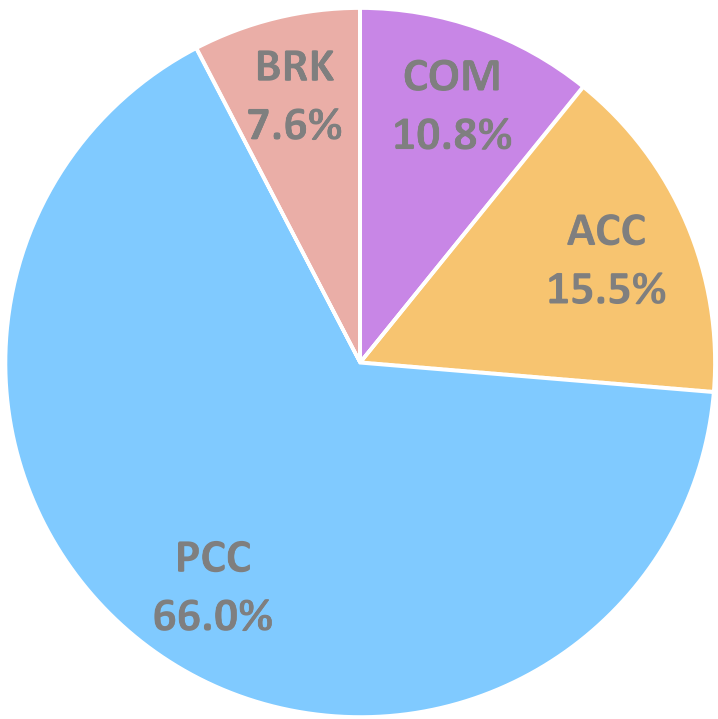


Figure 46: Pavement Type Distribution
This figure shows the distribution of pavement types in Adel. Of note is the high proportion PCC, and the relatively small proportion of ACC & COM surfaces.

4.2. Pavement Condition

Adel's history as the oldest town in Dallas County and relatively modest population growth from 1960 up until about 2010 means much of the old "core" of the city has pavements that differ significantly from many of the other residential-heavy communities within the orbit of the Des Moines Metro-area. Newer development, over the past 10 years, particularly in the southern parts of the city, keep the overall average somewhat in line with similarly sized cities within Iowa. For reference, he majority of urban areas in Iowa have average CityPCI scores around 60 which is considered "Fair" bordering on "Good."

Adel, streets are currently in "Good" condition with a network-wide CityPCI of 69/100. This number does not include Brick streets.

CityPCI = 68.6

(Good)

The current pavement conditions are not homogenous based on pavement type. Even though PCC makes up most of the pavement, it also represents the newest pavements in Adel. This means that generally the PCC pavements in Adel are in better condition than the non-PCC pavements. The non-PCC pavements are still performing adequately however, with most of the roads at a "Fair" or better condition with a well-balanced distribution.

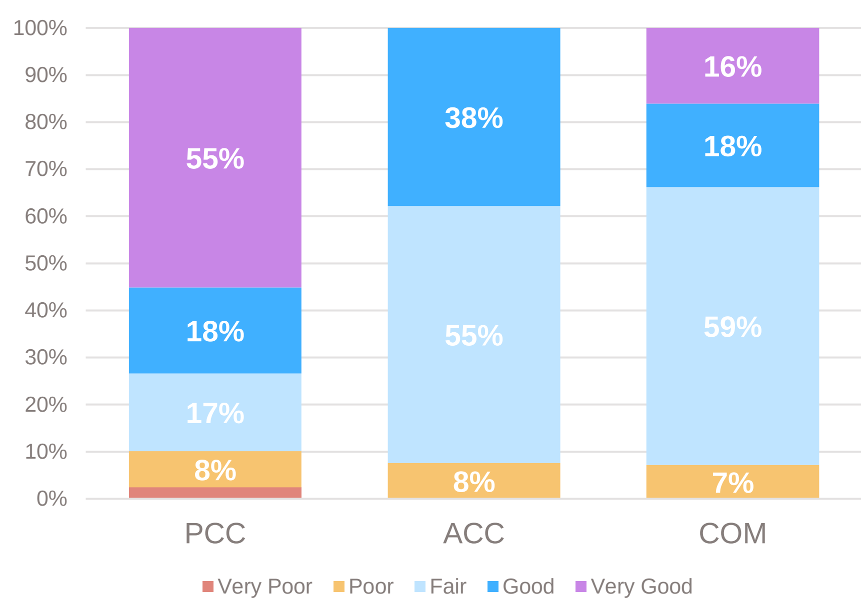


Figure 47: Condition Distribution by Pavement Type

This figure shows the distribution of pavement conditions for each of the four pavement types.

When looking at functional classification, there also a perceptible difference between Local and Non-local roads. Overall, the Collector roads are performing noticeably worse than the local roads with the local roads having an average CityPCI score of 71/100, and the non-local roads have an average CityPCI score of 55/100. The collector roads are the most heavily travelled in town, represent some of the oldest streets in the City, and 2/3rds of them are ACC or COM. Compared to low-traffic local streets more likely to be new construction, this meets expectations but may indicate that additional effort needs to be dedicated towards these Collectors.

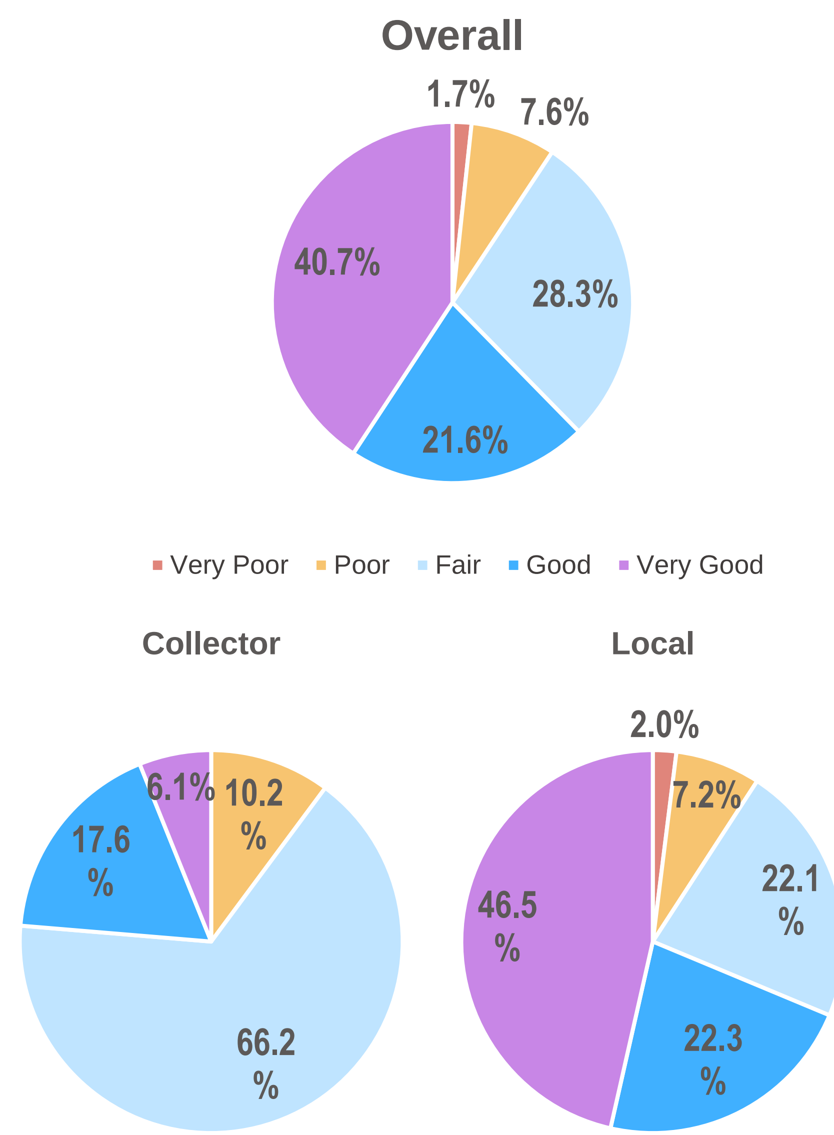


Figure 48: Condition Distribution by Functional Class

This figure shows the distribution of pavement conditions for each functional classification, as well as the network overall.

4.3. Pavement Condition Trends

One of the biggest values of the IPMP Program and the data it provides is the fact that there are multiple years of data to work with. This allows for better trend predictions, due to having an 8-year period to work with, and it increases the statistical relevance of the data due to the higher volume of data points. This volume helps refine the precision of the modelling processes and identify specific conditions that may warrant further investigation.

Every other year IPMP receives over 2,900 raw data points from the automated collection vendor, just for the city of Adel. Approximately 23,000 data points go into this analysis section.

Looking at the network over time reveals a decline in quality since 2013, steeper than most communities experience within the state. The average score dropped from 78 to 69, slightly faster than the 1 point per year typical to Iowa. This could be due to a variety of potential causes such as the inflation of construction costs, aging infrastructure, or inconsistent roadway expenditures.

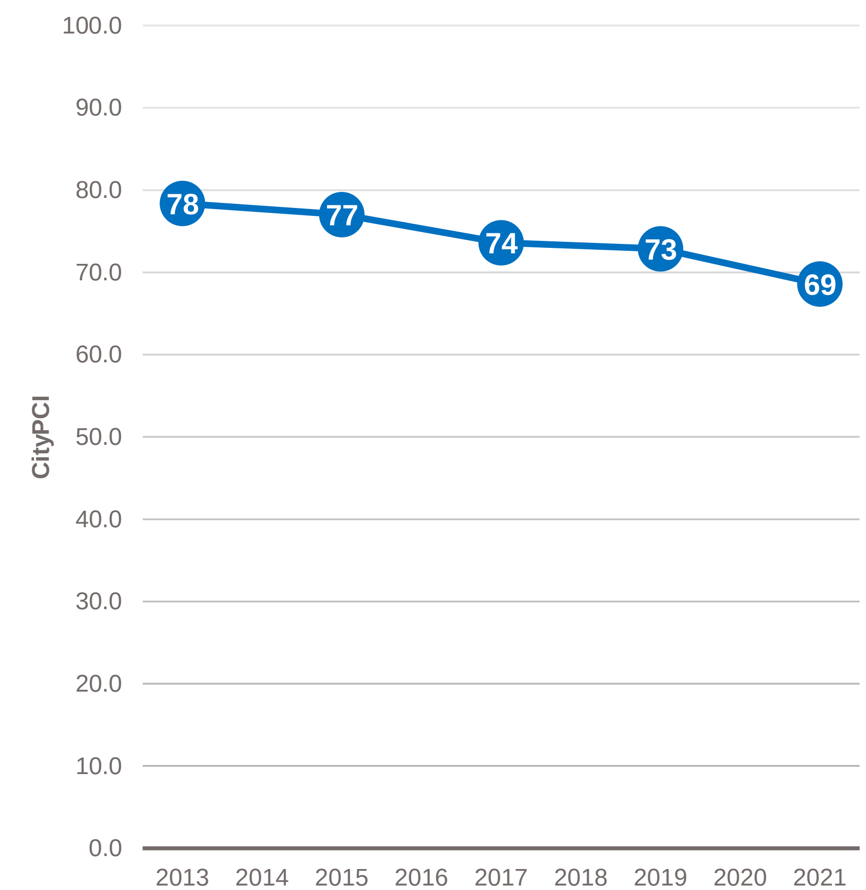


Figure 49: Network-Level Pavement Condition Trend

This figure demonstrates the slight decline the overall network has experienced since 2013

When looking at trends based on functional classification, we see that both classes of roadway, Collectors and Locals, are performing similarly, although Collectors have consistently been at a much lower condition than the locals. Overall the trends match the shape we expect based on ***Figure 49*** so there is not much need for concern. This result indicates that historical expenditures are likely insufficient, causing every class of road to drop equally, and the difference in quality between classes is easily attributed to a core attribute like age or traffic.

Comparing the pavement types did reveals the same downward trends, with the ACC and COM pavements performing less well on average. The only unexpected behavior is the levelling off and slight increase in condition amongst ACC and HMA pavements from 2017 to 2021, likely due to some more recent overlays or perhaps because the data vendor changed in 2017.

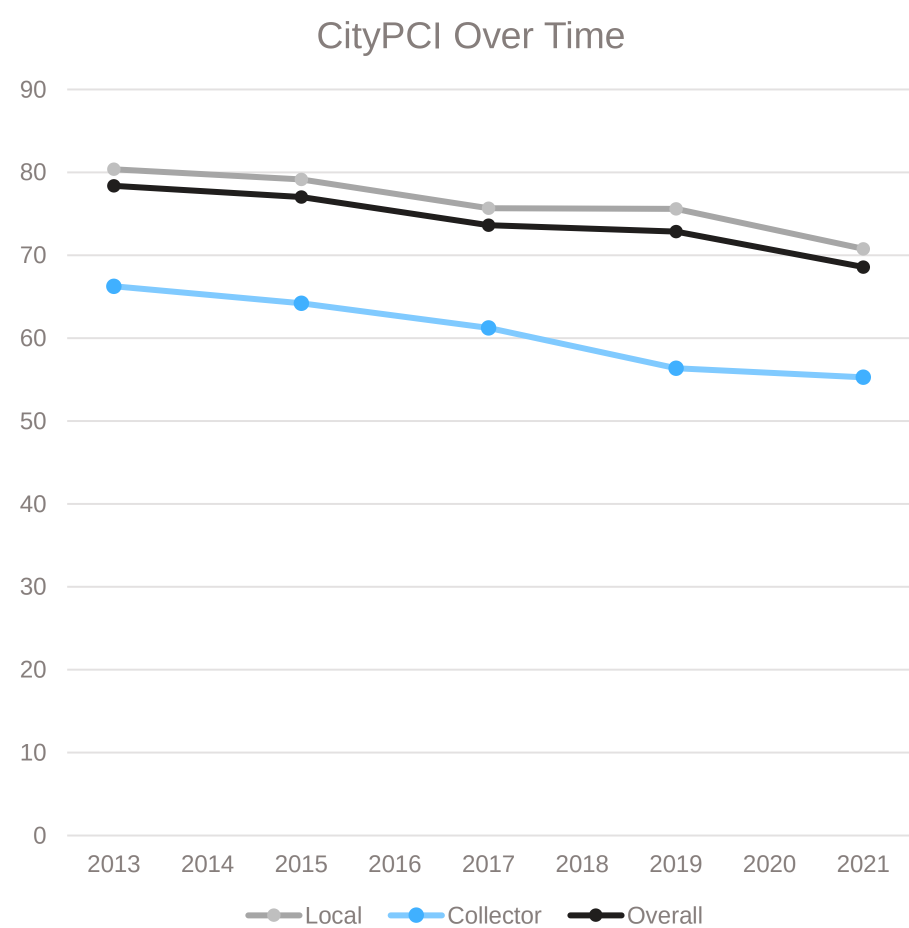


Figure 50: Condition Trend by Functional Class
This figure demonstrates the slight decline across Adel by Pavement Type

4.4. Success in Adel & Cautions

- Average CityPCI score compared to similar urban agencies in Iowa
- High proportion of "Very Good" and "Good" condition pavement
- Minimal pavement in "Very Poor" condition
- Evenly distributed conditions amongst the older parts of town.

This does not mean, however, that there is no work to be done. In fact, there are some specific weaknesses in the IPMP data that may superficially hide the true conditions of the streets in Adel. Some of those data gaps are caused by the way the data is collected, the types of data collected, and completeness of information.

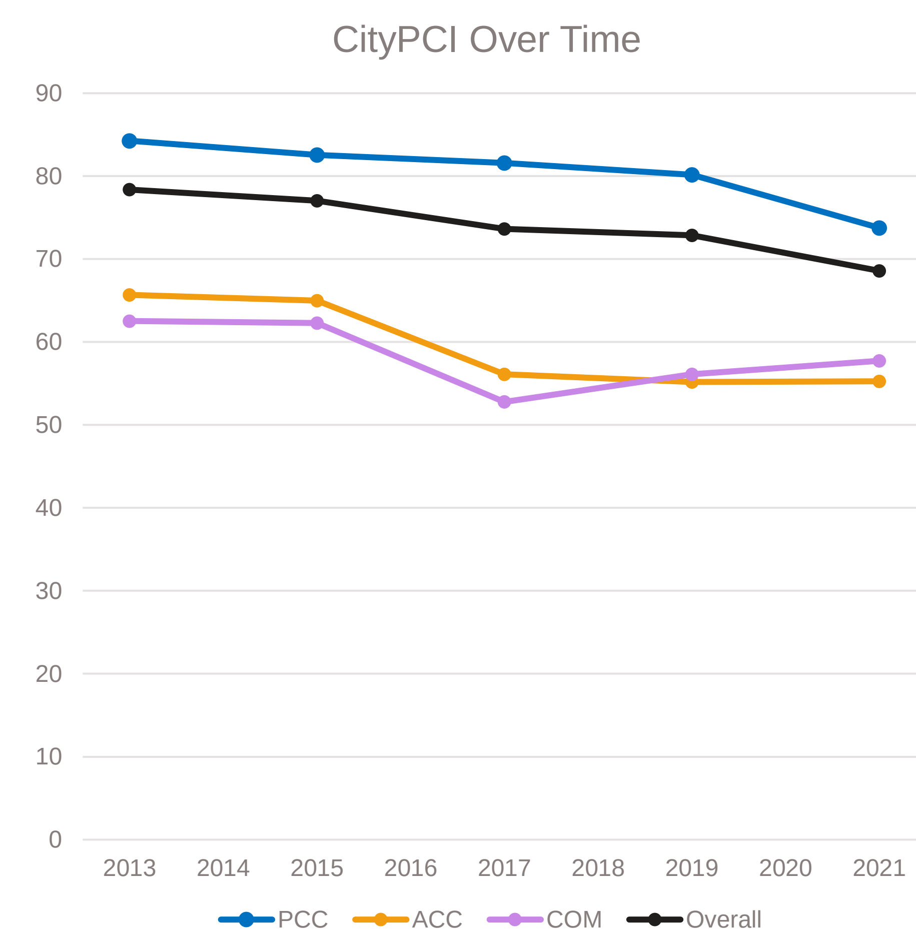


Figure 51: Condition Trend by Pavement Type
This figure demonstrates the slight decline across Adel by Pavement Type

The ***sampling methodology*** used by the IPMP data vendor consultant only addresses one direction of travel for a road and has certain restrictions. That means the data set, while extensive and significantly better than subjective manual rating, it is not fully comprehensive. In 2017, undivided roads with fewer than 5 lanes were only driven in one direction, meaning that up to 75% of pavement area may not be covered on wide streets. Similarly, on-street parking can limit the vehicle's ability to read a continuous section of road accurately due to weaving maneuvers resulting in readings based on skewed angles and in areas outside the normal driving lane.

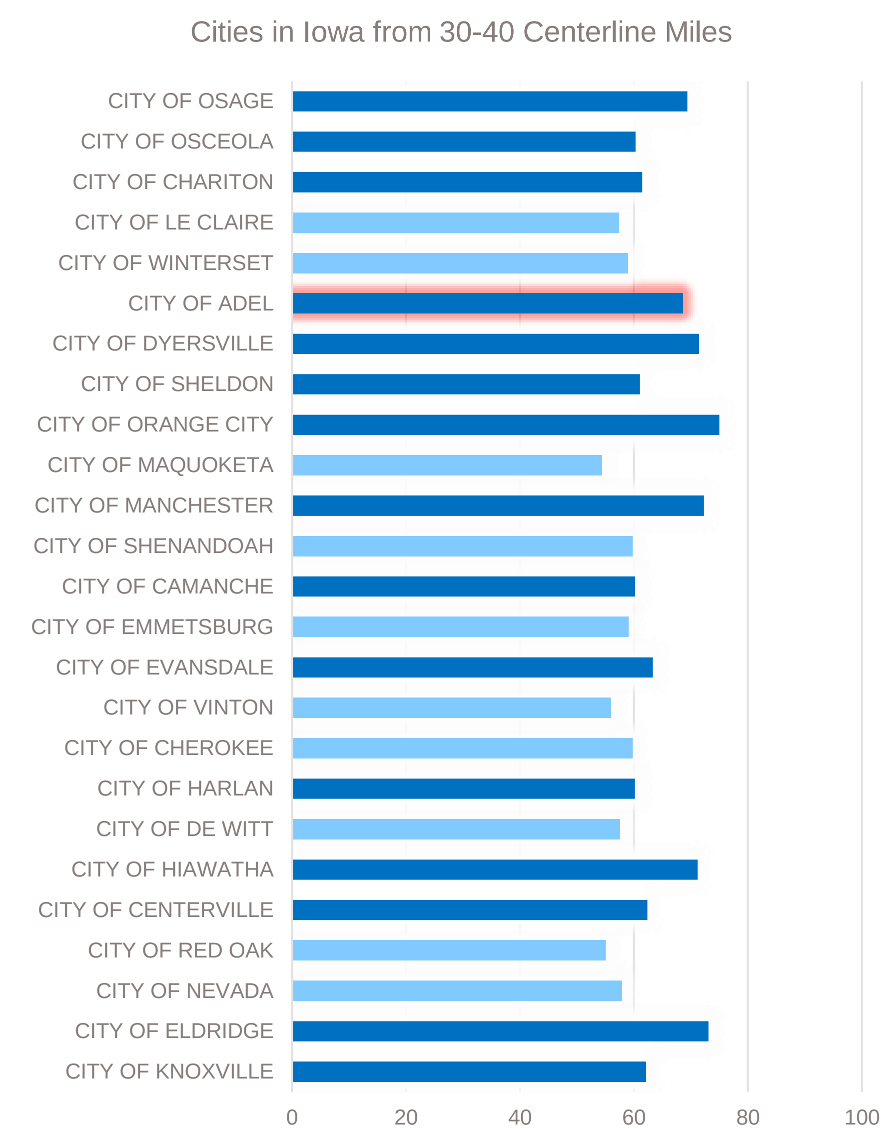


Figure 52: Comparison of 22 Jurisdictions
This figure compares Adel's current performance amongst its peer cities within the state.

Roughness data can only be collected when travelling at 20 mph or more and requires a steady speed for at least 200 feet. Short street segments, dead-end roads, on-street parking, pedestrian crossings, and stop sign–controlled intersections can be very disruptive to the roughness measuring equipment, meaning that an urban area with many local streets will likely have low coverage for roughness data. Over 2.7 miles of streets in Adel did not collect any roughness data, in 2021, and the data that was collected may not be reliable. Each collection cycle, 1%-5% do not have roughness data available. For those roads, roughness needs to be assumed based on other distress data. Luckily, the effect of roughness on CityPCI scores is minor.

Figure 53: Roughness Profile Affected by Local Driving Conditions

This Image was taken from Iowa DOT Pathweb showing a road where the collection vehicle was trailing a delivery van and weaving around parked cars causing a sudden change in roughness.

Other distresses, even though they were collected, may not factor at all into the CityPCI rating. Prime examples include punch-outs and failures. ***Failures*** are potholes and potholes that have been filled, identified as irregularly shaped asphalt patches. Failures are a critical distress both in pavement performance as well as driver perception of road quality. Unfortunately, these distresses are treated the same as other patches, if included at all. The CityPCI rating system for full-depth asphalt does not formally include failure as a distress and is inconsistent in whether it should be considered at all, because the failure is not always indicative of the rest of the roadway conditions.

Punch-outs are another failure completely ignored by the CityPCI rating. Punch-outs are when the edge of road breaks off, typically in conditions where there is no curb, or the curb was constructed separately. Pavement edges may continue sinking due to erosion of the base material. The condition is commonly caused by poor bank stability on roads with ditches, and erosion prone subbase materials in urban areas where subsurface drainage issues are not addressed. Punch-outs were only captured by the data collection services a handful of times in Adel, since collection started, but where it was present, it was not included as a contributing distress.

The final caveat to this data collection system is that it can only address ***SURFACE*** distresses. Underlying problems such as voiding, eroding subgrade/subbase, and structural deficiencies cannot be identified, only the symptoms. High priority is paid to alligator cracking, spalling, and patching because of their associations with these problems, but evidence of these major deficiencies is not possible to collect directly without ground penetrating radar or pavement cores (both of which are comparatively expensive).

Figure 54: Unaccounted for Failure

These images are of a failure are not included in the pavement rating for the associated road.

Underlying pavement ages are similarly important from a deterioration standpoint. Older, more distressed, bases mean new surfaces will deteriorate faster, due to a lack of stable support. Construction history is not as readily available so base age was assumed, in many cases. This report's methodology uses a "performance age" to group pavements that are deteriorating at similar rates, in order to estimate future behaviors.

Figure 55: Unaccounted for Punchout

These images are of a punch-out that was not included in the pavement rating for the section

ADEL
THRIVE WITH US

Map 1
Functional Classification Overview

Legend

Functional Class *

- Collector
- Local

No Data

- No Data

Municipal Boundary

- Municipal Boundary

* Does not include roads not maintained by City of Adel, such as State and Federal highways

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

N W E S

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1 inch = 2,500 feet

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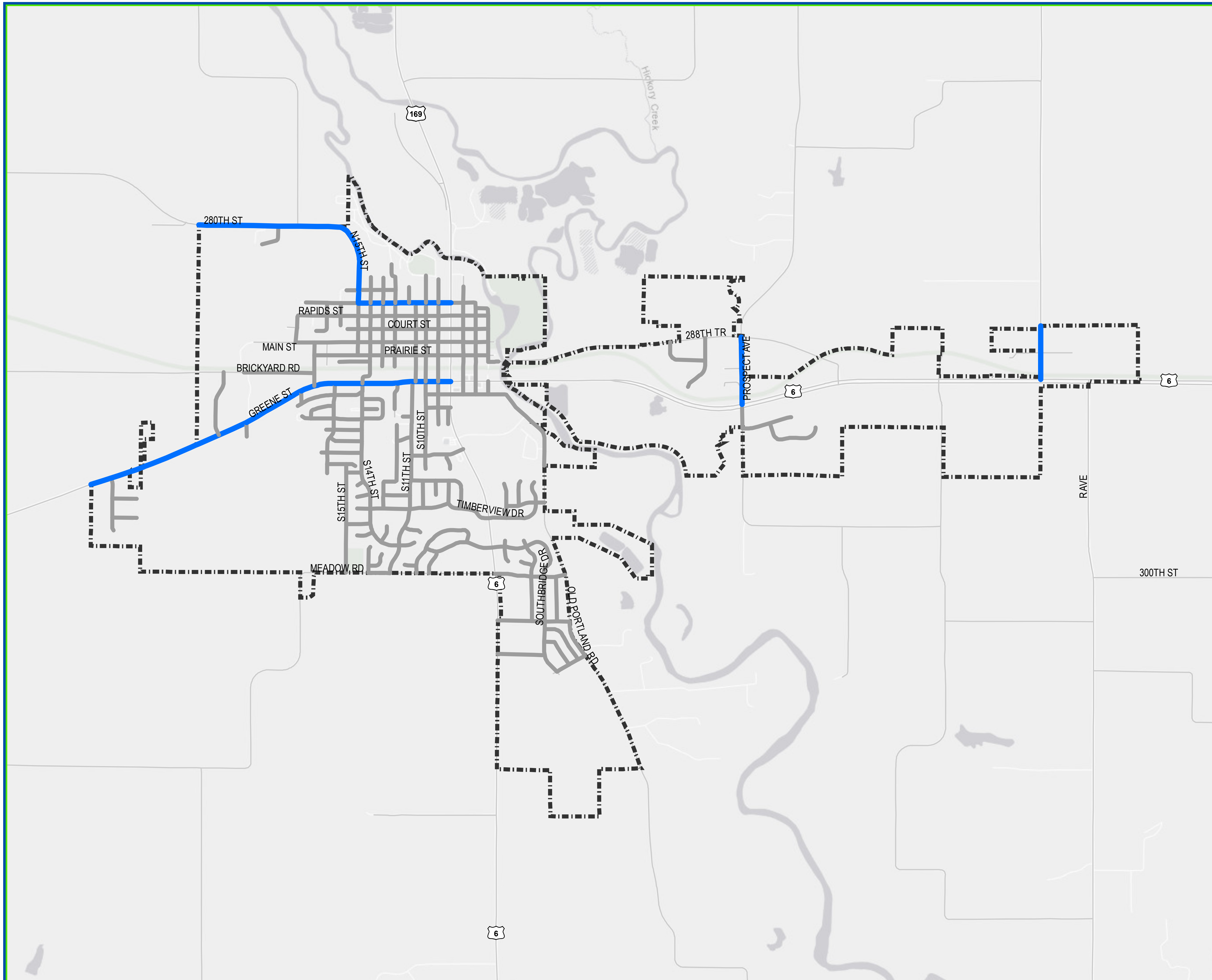

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ADEL
THRIVE WITH US

Map 2
Pavement Type Overview

Legend

Functional Class *

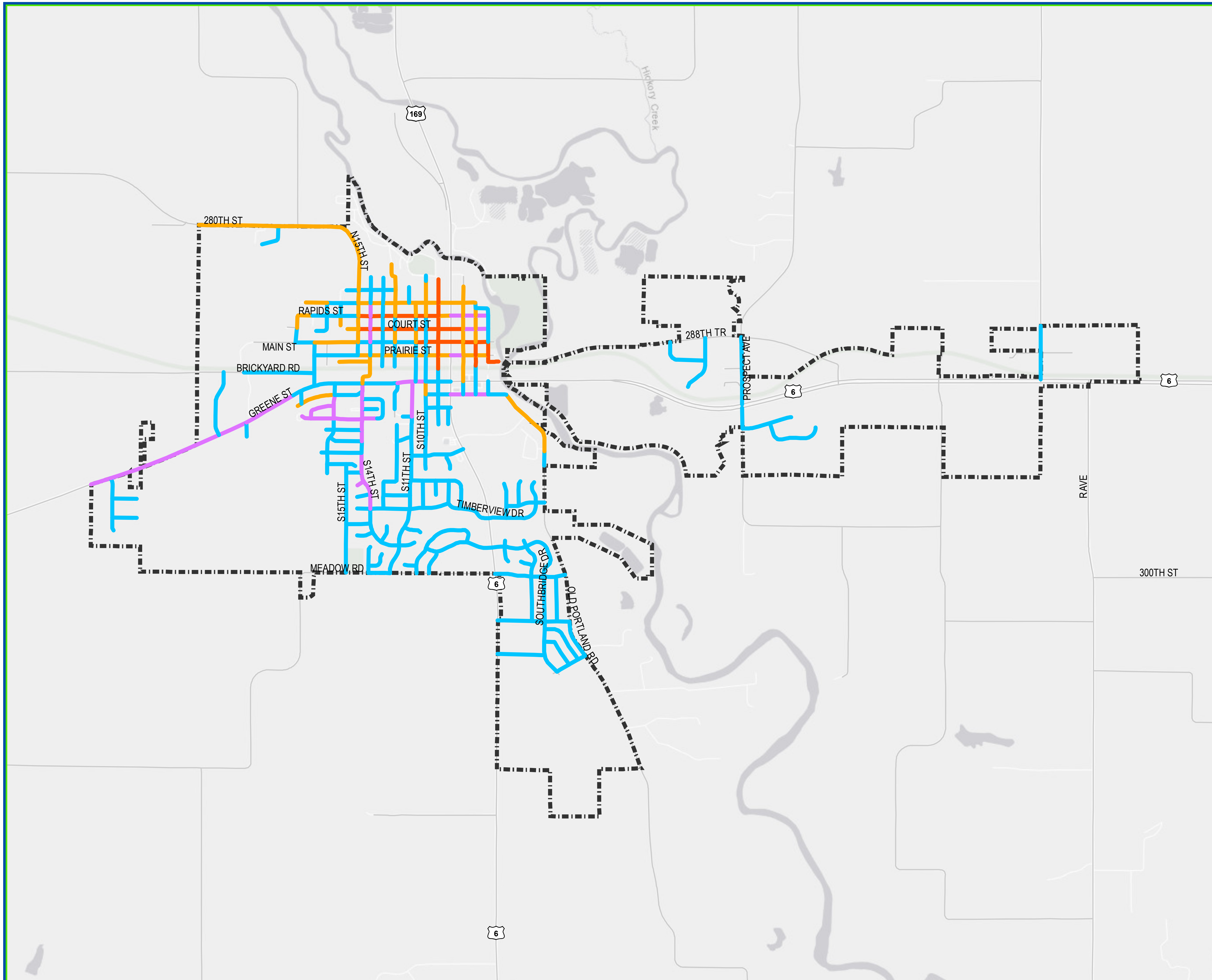
- ACC
- BRK
- COM
- PCC

Municipal Boundary

- Municipal Boundary

No Data

- No Data



* Does not include roads not maintained by City of Adel, such as State and Federal highways

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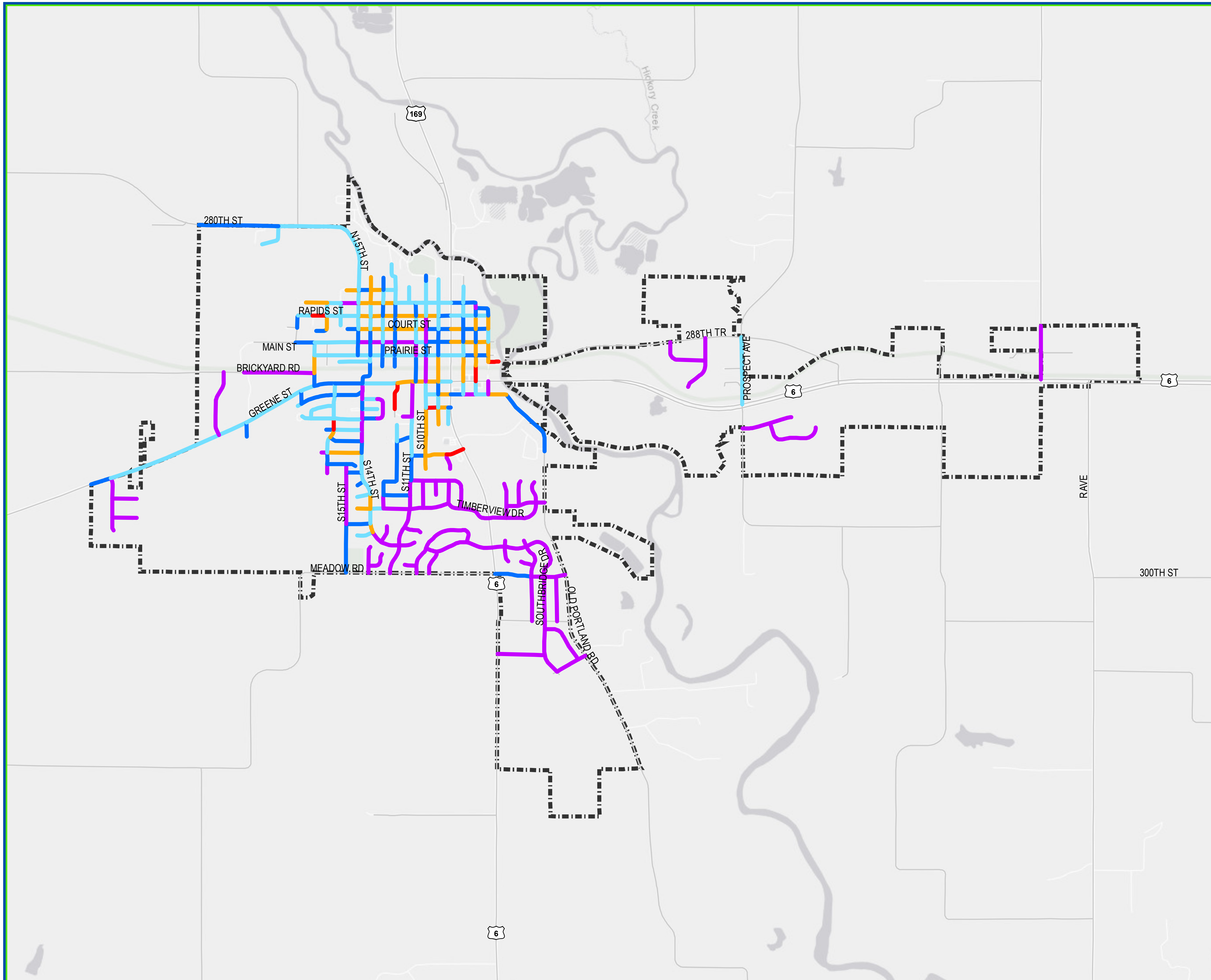
ADEL
THRIVE WITH US

Map 3
Pavement Condition Overview

Legend

Pavement Condition *
- Very Good
- Good
- Fair
- Poor
- Very Poor
- No Data

Municipal Boundary
- Municipal Boundary



* Revised with Addendum 1

* Does not include roads not maintained by City of Adel, such as State and Federal highways

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1 inch = 2,500 feet

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ADEL
THRIVE WITH US

Map 4
Deterioration Rate Overview

Legend

Deterioration Rate* (PCI per Year)

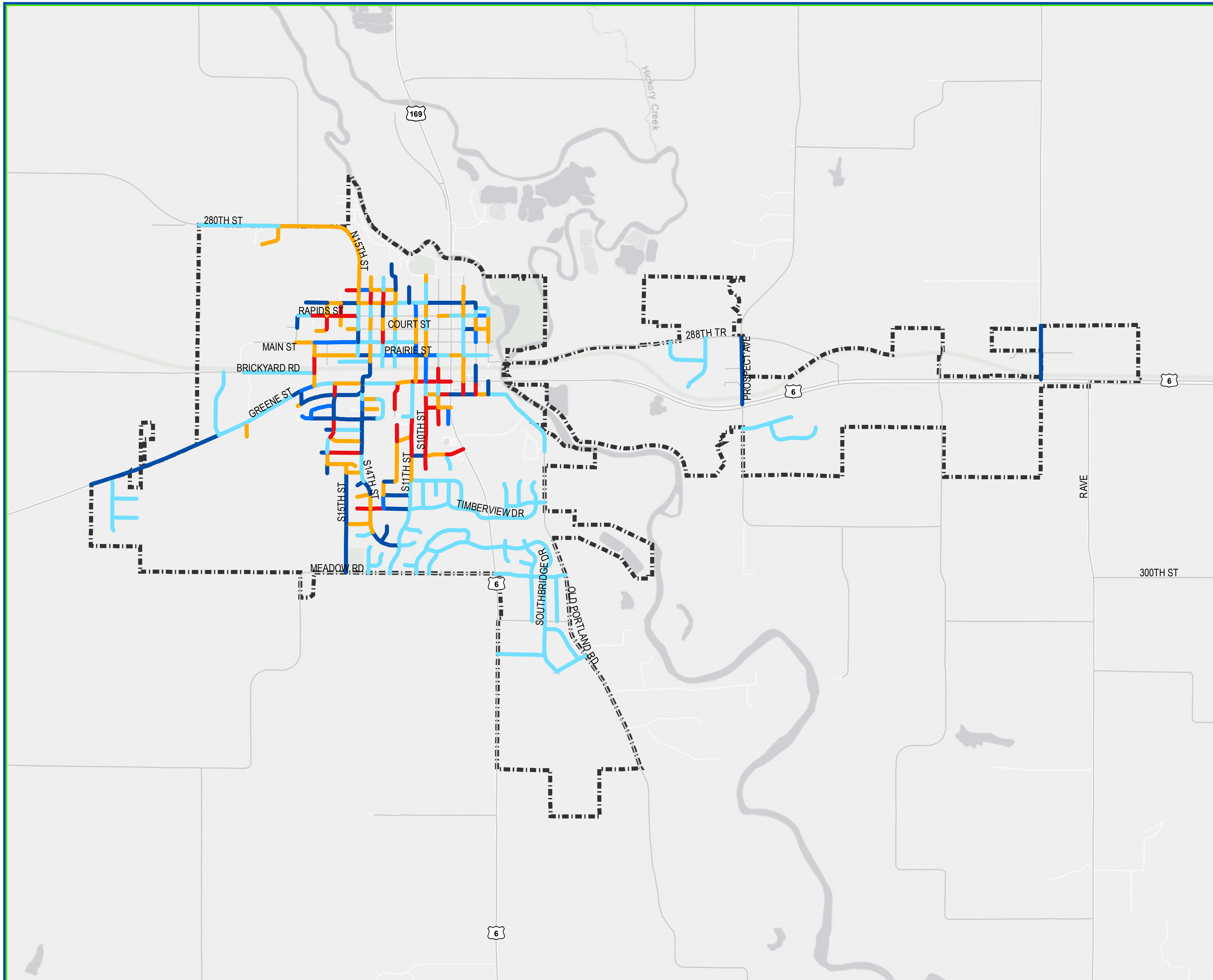
- Stable (0.00-0.25)
- Slow (0.25-0.50)
- Normal (0.5-2.0)
- Fast (2.00-5.00)
- Extreme (>5.00)

No Data

- No Data

Municipal Boundary

- Municipal Boundary



* Does not include roads not maintained by City of Adel, such as State and Federal highways

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1 inch = 2,500 feet

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ADEL
THRIVE WITH US

Map 5
Ride Quality Overview

Legend

International Roughness Index (Inches of Deflection per Mile)

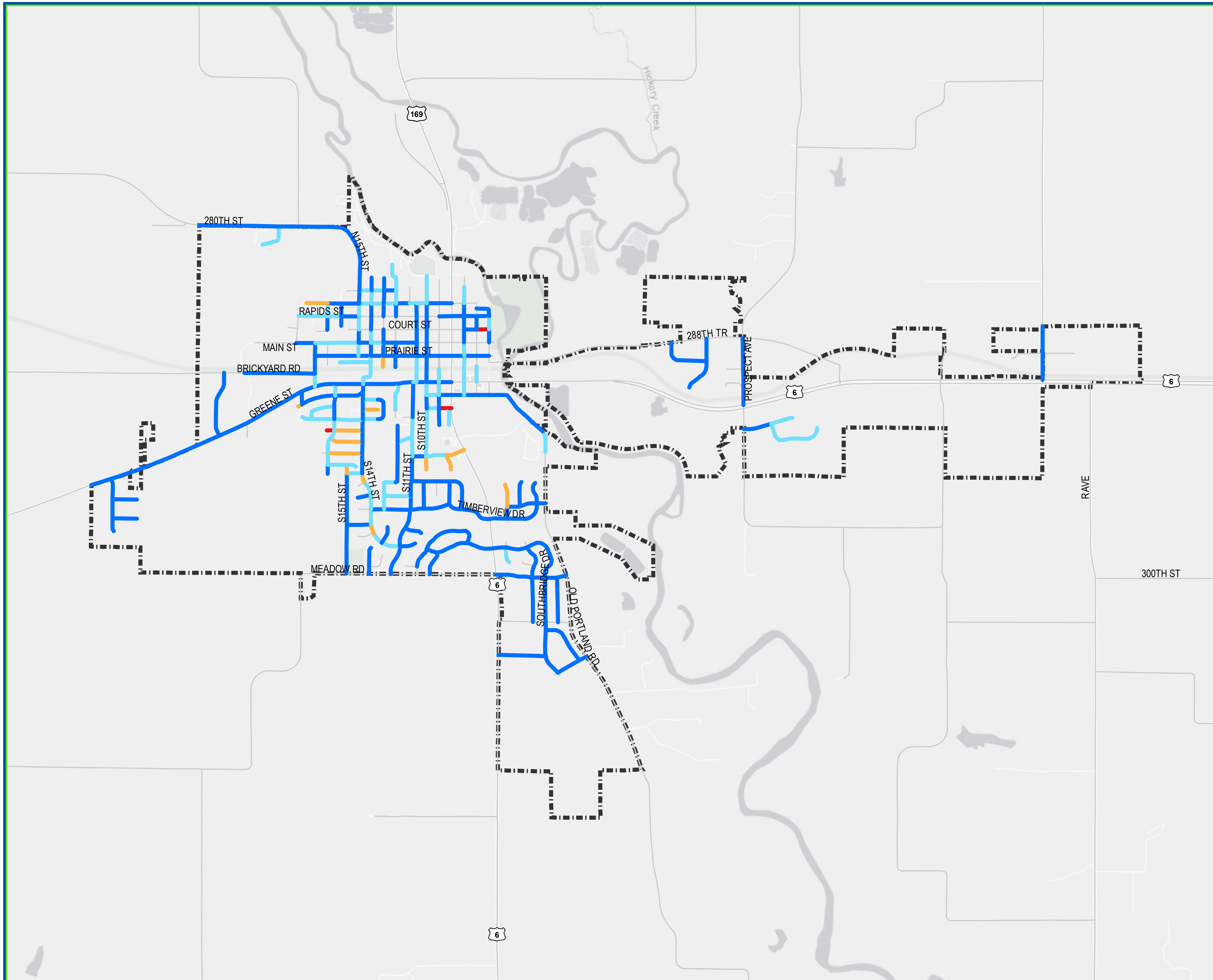
- Very Rough (>450 in/mi)
- Moderately Rough (>380 in/mi)
- Slightly Rough (>250 in/mi)
- Smooth (<250 in/mi)

No Data

- No Data

Municipal Boundary

- Municipal Boundary



* Does not include roads not maintained by City of Adel, such as State and Federal highways

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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1 inch = 2,500 feet

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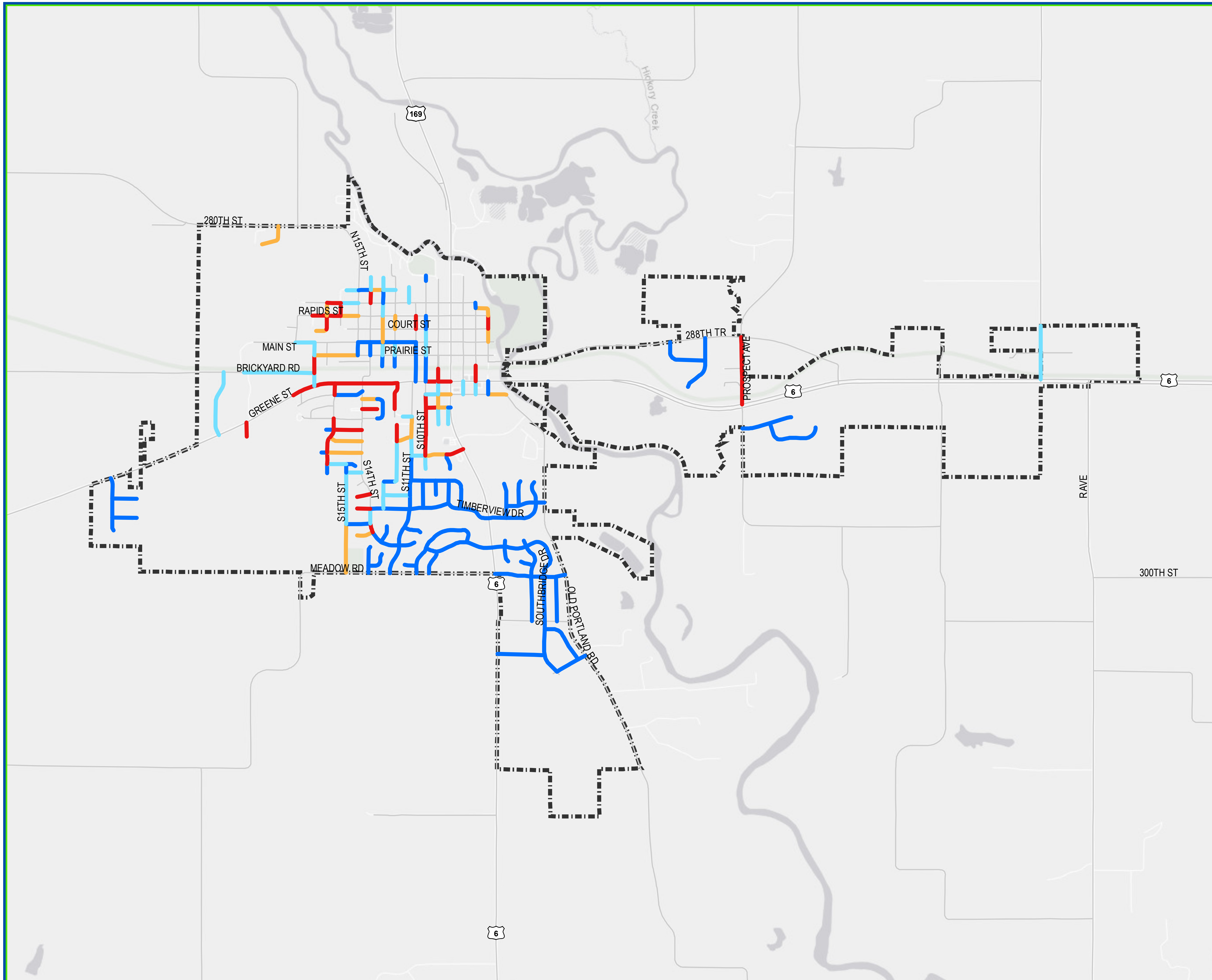
Map 6

PCC Joint Health Overview



Legend

PCC Joint Deterioration (Distressed Joints per Mile)

- Low Joint Deterioration (<10/mi)
- Minor Joint Deterioration (>10/mi)
- Moderate Joint Deterioration (>50/mi)
- Major Joint Deterioration (>100/mi)

No Data

- No Data

Municipal Boundary

- Municipal Boundary

* Does not include roads not maintained by City of Adel, such as State and Federal highways

Service Layer Credits: Esri, HERE, Garmin, (c) OpenStreetMap contributors, and the GIS user community

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1 inch = 2,500 feet

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5. Urban Pavement System Design

For the purposes of this discussion, the pavement system consists of the elements shown in ***Figure 56***

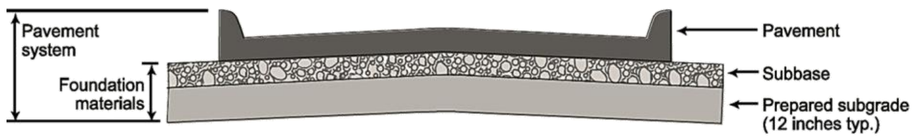


Figure 56: Illustration Pavement System Elements
This diagram identifies the key elements to a pavement system

Proper design, construction, and maintenance of the various components of the pavement system are critical to the performance of long-life pavements.

5.1. Pavement Foundation

It is common for local street and highway pavements to be constructed from PCC or HMA supported on a natural subgrade without considering or using a subgrade stabilized treatment or support layer such as an aggregate subbase. When support layers are considered, they typically serve as a construction platform and improve the level of stability and uniformity for the pavement foundation which can result in increased performance and thus increased pavement life. An aggregate subbase can also improve the drainage under the pavement, minimizing the deterioration caused by water entrapment. The question is how much do aggregate subbases benefit the pavement and is the benefit worth the costs, particularly if the pavement is meeting the design life. [6]

The pavement design life for local roadways (not including heavily traveled arterials or trunk highways) is normally based on the pavement thickness and less concern is typically given to the support system. Unless there are material related distress failures in concrete pavement (i.e., freeze-thaw damage, ASR, D-cracking) the normal mode of failure is the vertical distortions of the pavement surface from subgrade movement. The degradation is normally faulting, slab movement, joint failures, cracking, etc. and is represented by the dropping of the pavement condition index (PCI). [6]

5.1.1. Subgrade Soils

Concrete pavement is relied upon for its durability and strength. For a concrete pavement to provide long term performance, its foundation needs to have uniform support. Typically, in Iowa, the foundation includes the natural subgrade and, in some instances, an aggregate subbase.

If the pavement is placed directly on the natural subgrade, preparation is needed to provide uniformity. At a minimum this includes, topsoil removal, scarification of the underlying subgrade to a depth of one foot and compaction to a specified depth, density, and moisture content. For additional information, see Iowa Statewide Urban Design and Specifications (SUDAS) Chapter 6.[7] Compaction and density being the most important elements, are expressed by the ***California Bearing Ratio*** (CBR).

Typical soils found in the vicinity of Adel are moderate to high plasticity soils (fat clays and lean clays with liquid limits greater than 45 and/or plasticity indices greater than 23). These soil types can experience cycles of volume change as moisture contents vary, which can result in upward and downward movement of supported pavements that could cause distortion or structural damage. The soils encountered in Adel can be expected to have low k values of 50 to 100 psi/inch and corresponding low CBRs of 1 to 3, as shown in the ***Table 17*** which indicates subgrade suitability of various soils.

When constructing any pavement (rigid or flexible) on natural subgrade that is subject to poor drainage and/or has poor soils, there will likely be measurable soil breakdown and movement due to freeze-thaw conditions and/or traffic loading.[6]

It should be noted that variability in the soil affects both rigid and flexible pavements. Rigid concrete pavements transfer the traffic load to the aggregate subbase and subgrade foundation at a smaller value then flexible asphalt pavements because they are able to distribute the load to a larger area. For example, a 100-psi tire load typically results in less than 5 psi to the aggregate subbase for concrete pavement and is approximately 20 psi for the aggregate subbase for asphalt pavement. Therefore, asphalt pavement requires a thicker aggregate subbase and/or a thicker pavement to provide additional support and strength as compared to a concrete pavement. Although concrete pavements can perform better than asphalt pavements when subjected to poor support characteristics, they are more rigid and are subject to more tensile cracking.

Figure 57 illustrates the subgrade reactions for rigid and flexible pavements.

Table 17: Suitability of soils for subgrade applications

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.

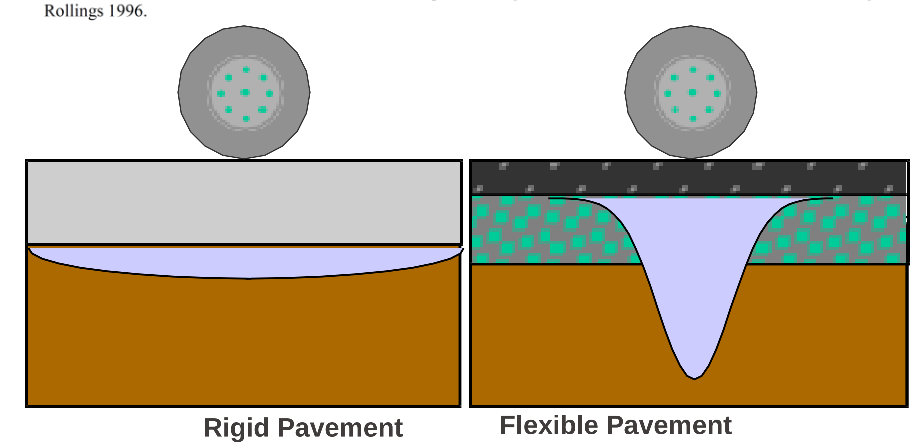


Figure 57: Subgrade Reaction (Gross)[6]
This diagram shows how loads are distributed differently based on surface type.

[6] 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.

[7] Institute for Transportation, Iowa State University, Statewide Urban Design and Specifications, Design Manual, Rev. 2022

5.1.2. Stabilized Subgrades

The need to stabilize subgrades is primarily due to excessive moisture in the subgrade itself.

High moisture in soils may be encountered during construction for reasons ranging from a naturally high-water table to seasonal rainfall and even to changes in drainage conditions during construction. Regardless of the cause, in situ wet soils must be addressed before constructing an aggregate subbase or placement of the pavement on the subgrade. Placing subdrains before construction or letting the soil dry out through a natural process is not normally a practical approach because of time constraints. The two most used methods are chemical modification of the soils, particularly in high moisture conditions, and reinforcement/separation.[8]

5.1.3. Chemical Stabilized Subgrade

A stabilized subgrade, such as soil cement or fly ash stabilization, will help to dry out excessive moisture soils and develop the uniformity needed to provide a construction platform and reduce delays during construction. When using chemical stabilizers, the percent of the stabilizer needs to be stipulated when the water content, soil type and freeze- thaw performance are considered. [8]

Cement Modified Soils (CMS) are soils and/or manufactured aggregates mixed with a small portion of Portland cement. CMS are normally used to improve material properties in the subgrade. Also, CMS helps prevent migration of subgrade soil and water into the aggregate subbase and provides some additional strength to the subgrade. CMS are principally used to modify fine grained soils such as silts and clays having high plasticity content. Some specifications require enough cement content to reduce the Plastic Index (PI) within a range of 12 to 15. Typically, a CMS amount equivalent to 3 to 5 percent of the soil's dry weight is incorporated into the mix to achieve the desired strength. This combination allows for the reduction of plasticity, minimization of moisture related volumetric changes, an increase in bearing strength and an improvement in stability. This also provides a weather resistant construction platform.

A successful chemical stabilization can be achieved by incorporating approximately 10 to 15 percent fly ash (measured by dry weight of the native soil) into the existing subgrade. Fly ash can improve the subgrade CBR from 2 to 3 to as much as 25 to 30. It can also improve the unconfined compressive strength from 50 psi to 400 psi. Fly ash stabilized subgrades can also reduce the shrink-swell potential of clay soils and upgrade the condition of marginal soils. It is also a good drying agent for wet soils and provides a working platform during construction.

5.1.4. Reinforced Stabilized Subgrade

Reinforced subgrade treatment is typically used when subgrades have an unstable (soft) but not extremely high moisture content. This may be accomplished using geosynthetics, such as geogrids and woven geotextiles. [8]

5.1.5. Unstabilized Aggregate Subbases

Unstabilized Aggregate subbases are appropriate when a stable and uniform construction platform will benefit construction. (ACPA 2007) An aggregate subbase support layer can provide a working platform during construction as well as provide uniformity as a support layer. A granular support layer will also serve as a drainage system to help drain surface water away from the pavement as well as provide a cutoff layer from subsurface moisture. If an aggregate subbase is used, a subdrain and outlet will be needed to complete the drainage system due to the poor drainage properties of local soils. [8]

Premature deterioration of PCC pavement joints may be attributed to poorly draining joints, and subsurface drainage will help alleviate the problem (Taylor et al. 2016)[8].

Commonly used Iowa DOT and SUDAS aggregate subbase materials include modified subbase, granular subbase and special backfill. The Iowa DOT and SUDAS specifications for modified subbase and special backfill allow for crushed stone, gravels, and recycled pavement materials meeting material IM210 requirements or uniformly blended combinations of these materials with a maximum of 50 percent RAP (Reclaimed Asphalt Pavement). [9]

The target permeability of approximately 150 feet per day provides the adequate drainage necessary for a pavement foundation layer. Although materials as coarse and open-graded as ASTM No. 57 stone have been used as draining layers, they are not recommended for concrete pavements due to their lack of adequate stability for construction operations and their susceptibility to long-term settlement under heavy truck traffic. It is better to design the gradation of the unstabilized aggregate subbase to include more fines for the sake of stability than to omit the fines for the sake of drainage (ACPA 2007); therefore, modified subbase is the preferred subbase material for local roadways.

In summary, the benefits of aggregate subbases and a drainage system include the following: [8]

- Increases performance and service life
- Provides a construction platform
- Maintains uniform support
- Provides drainage from water infiltration
- Helps reduce shrink and swell of high volume-change soils
- Controls excessive or differential frost heave
- Minimizes mud-pumping of fine-grained soils
- Prevents consolidation of subgrade
- Provides capillary cut off for high water table

5.1.6. Subdrains

Drainage is also critical to the long-term performance of concrete pavement.

Drainage can be achieved with the use of an aggregate subbase with subdrain outlets. It is important to prepare the natural subgrade prior to the placement of the aggregate subbase to achieve the best performance. [8][10]

5.1.7. Pavement Foundation Recommendations

The performance of a pavement depends on the quality of its subgrade and subbase layers. These foundational layers play a key role in mitigating the detrimental effects of climate and the static and dynamic stresses generated by traffic. Therefore, building a stable subgrade and a properly drained subbase is vital for constructing an effective and long-lasting pavement system. [8, 10]

To determine what soils are present and understand their characteristics, it is essential to complete a geotechnical investigation. It is very important that the conditions of the subgrade are known prior to design for selecting various treatments, if necessary, and specify

[8] 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.

[9] 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.

[10] 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.

various materials and preparation to provide uniformity and support for the pavement section. [11]

The subgrade, the layer of soil on which the subbase or pavement is built, provides support to the remainder of the pavement system. It is crucial for highway engineers to develop a subgrade with a CBR value of at least 10. Research has shown that if a subgrade has a CBR value less than 10, the subbase material will deflect under traffic loadings in the same manner as the subgrade and cause pavement deterioration[2]. Manipulation, and possibly stabilization, of the on-site soils will be required to achieve this level of support.

The subbase, the layer of aggregate material immediately below the pavement, provides drainage and stability to the pavement. Undrained water in the pavement supporting layers can freeze and expand, creating high internal pressures on the pavement structure. Moreover, flowing water can carry soil particles that clog drains and, in combination with traffic, pump fines from the subbase or subgrade. It is therefore crucial that highway engineers develop a stable, permeable subbase with longitudinal subdrains[2]. According to the MEPDG analysis for low volume roads, PCC pavement systems with aggregate subbase thickness above 5 inches do not show a significant benefit over thicker sections. Two thickness options to consider include 1) 6" or more to accommodate migration of soil into the aggregate, or 2) 4"-5" with a separation layer of geotextile or stabilized subgrade. [10,11]

Longitudinal subdrains are essential with subbases to provide positive subsurface drainage. Rigid or corrugated plastic pipe meeting IDOT specifications, minimum 6" in diameter, with perforations, and sufficient outlets to storm sewer structures or day-lighted are recommended. In areas, where parallel storm sewer is present, it may be possible to utilize the storm sewer piping, along with porous rock backfill and open joints covered with engineering fabric, to serve as longitudinal subdrains. Also, if sized adequately, the subdrains could also serve as a footing drain collector line for adjacent private properties.

5.2. Pavement

5.2.1. Pavement Thickness

- It is typical and current practice to use a pre-determined minimum pavement thickness for local roads. These minimum thicknesses are typically 6 or 7 inches. [11]
- Some current thickness design methodologies were developed for facilities with more traffic and may not be applicable for local roads with lower traffic volumes. [11]
- Because local roads do not carry significant levels of heavy traffic and because some thickness design methodologies revert to predetermined minimums, modifying the design parameters for improved foundations with geotextiles and aggregate subbases will not decrease the thickness design significantly. [11]
- It is common for PCC pavements to be designed for 40 to 50 years of service based on a pavement thickness design. Some older pavements were designed for only 20 years. Although pavements are reaching the specified design life, the last 15 to 20 percent of its design life may be at a low level of service including poor ride-ability. On a PCI scale this may include the lower end of the fair category and possibly the poor category. [11]

The SUDAS pavement thickness tables, SUDAS Design Section 5F-1, provide recommended pavement thicknesses for various calculated ESALs, subgrade conditions, roadway types, and pavement types. The calculated thicknesses are based on the AASHTO *Guide for the Design of Pavement Structures,* which is used throughout the industry for pavement thickness design. Due to established policies in many jurisdictions across the state, the minimum pavement thickness for streets on natural subgrade was set at 7 inches for rigid pavement and 8 inches for flexible pavement. For pavements with a granular subbase, the minimum thickness was set at 6 inches for both pavement types. As noted in the thickness tables, whenever a thickness was calculated that was less than the minimum, the minimum was used. [11]

5.2.2. PCC Pavement Jointing

Proper jointing is critical to the performance of PCC pavements. A well-designed jointing system will:

- Control cracking
- Divide the pavement into practical construction increments
- Accommodate slab movement
- Provide load transfer

Load Transfer[12]

For jointed concrete pavements to perform adequately, traffic loadings must be transferred effectively from one side of the joint to the other. This is called load transfer. When load transfer is adequate, it results in lower pavement deflection which, in turn, reduces faulting, spalling, and corner breaks; thereby increasing a pavement's life. Load transfer across joints for street pavements is developed either by aggregate inter-lock or dowel bars.

Aggregate interlock is the interlocking action between aggregate particles at the face of the joint. It relies on the shear interaction between aggregate particles at the irregular crack faces that form below the saw cut. This form of load transfer has been found to be most effective on roadways with short joint spacing and low truck volumes. Studies have found that aggregate interlock load transfer provides acceptable pavement performance when truck semi-trailer volumes are fewer than 80 to 120 trucks per day per lane. Laboratory and field studies have shown that aggregate interlock load transfer is improved with subgrade strength; size, angularity, and durability of the aggregate; joint face roughness; and slab thickness. Furthermore, these studies found that shorter slabs increase aggregate interlock effectiveness by reducing the movement and opening at each joint.

[11] 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.

[12] ACPA, Design and Construction of Joints for Concrete Streets, American Concrete Pavement Association, 1992.

Dowel Bars[12]

Dowel bars are round, smooth, steel bars placed across transverse joints to transfer loads without restricting horizontal joint movements due to thermal and moisture contractions and expansions. They also keep slabs in horizontal and vertical alignment. Dowels reduce deflections and stresses due to traffic loads. This in turn prevents or reduces faulting, pumping, and corner breaking on roadways that carry a large number of trucks and/or have longer joint spacing. The use of dowel bars for minimizing faulting and pumping should be considered when the slabs are longer than 20 ft (6.0 m), when truck semi-trailer traffic exceeds 80 to 120 per day per lane, or when the accumulated design traffic exceeds four to five million AASHTO ESAL's per lane. Typically, this truck traffic level requires an 8-in.-thick slab or greater. Since most residential City streets do not experience these truck traffic levels and the recommended joint spacing is not greater than 15 ft., dowels are generally not necessary.

Transverse Contraction Joints[12]

Table 18: Transverse Joint Requirements (SUDAS 5G-2.01)

Pavement Thickness	Transverse Joint Type	Transverse Joint Spacing
6”	C	12’
7”	C	15’
8”	CD[1]	15’
9”	CD[1]	15’
≥ 10”	CD[1]	17’

[1] No dowels within 24” of the back of curb

Contraction joints constructed transversely across pavement lanes are spaced to control natural initial and mature cracking of the concrete pavement. The joint interval is designed so that random transverse cracks do not form in the intermediate areas.

Joint spacing for jointed plain (unreinforced) concrete pavements (JPCP) depends on slab thickness, concrete aggregate, subgrade/subbase support, and environmental conditions. Transverse joint spacing should be limited to 24T (T is slab thickness) for pavements on subgrades and granular subbases or 21T if the pavement is placed on stabilized subbases, existing concrete, or asphalt. Transverse joint spacing is 12 feet for pavements less than 6 inches thick, 15 feet for pavements 7-9 inches thick, and 20 feet for pavements over 9 inches thick. Longitudinal joint spacing for two lane streets, where lane delineation is not necessary, should be limited to a maximum of 10 feet. Generally, transverse joint spacing should not exceed 150% of the longitudinal joint spacing.

Longitudinal Contraction Joints[12]

Longitudinal contraction joints release stresses from restrained warping and dynamic loading. A longitudinal joint is usually placed at the center of the pavement to allow the pavement to hinge due to lane loading and help delineate separation of opposing traffic. Controlling cracking and proper constructability are the primary functions of longitudinal contraction joints. Lane delineation is a secondary function.

An important consideration when establishing the distance between longitudinal joints for jointed plain concrete pavements is the prevention of random longitudinal cracking at the quarter point, which is the midpoint between the centerline and the back of the curb. Pavements less than 9 inches thick may not crack through a longitudinal joint placed close to the gutter, which could cause longitudinal cracks at the quarter point. Quarter point jointing will address this concern. Gutter-line jointing, with a longitudinal joint closer than five feet from the edge of pavement, is discouraged unless widening is imminent in the future and the pavement thickness is at least 9 inches.

If the city does not have joint deterioration concerns, the City should continue using their default Class C mix. SUDAS Section 7010 refers to Iowa DOT IM 529 and simply indicates that cities should use Iowa DOT Class C (or M) mix as described.

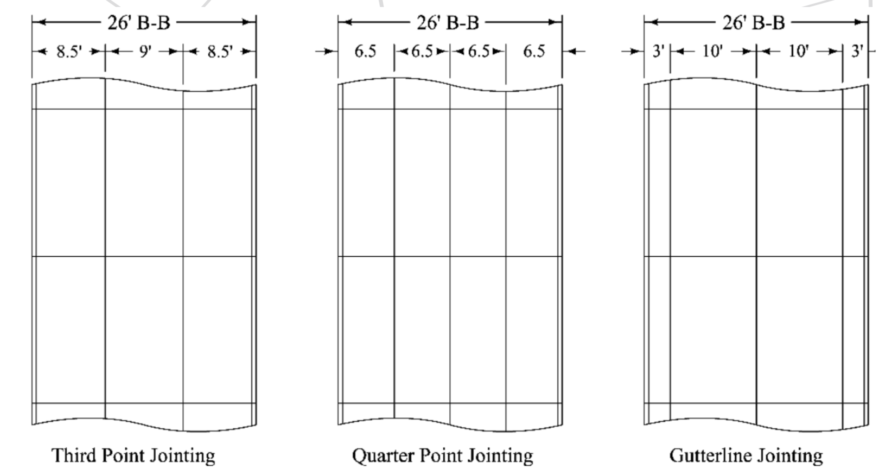


Figure 58: 26 Foot B-B Pavement (SUDAS 5G-2.04)

Jointing options for a 26' wide pavement

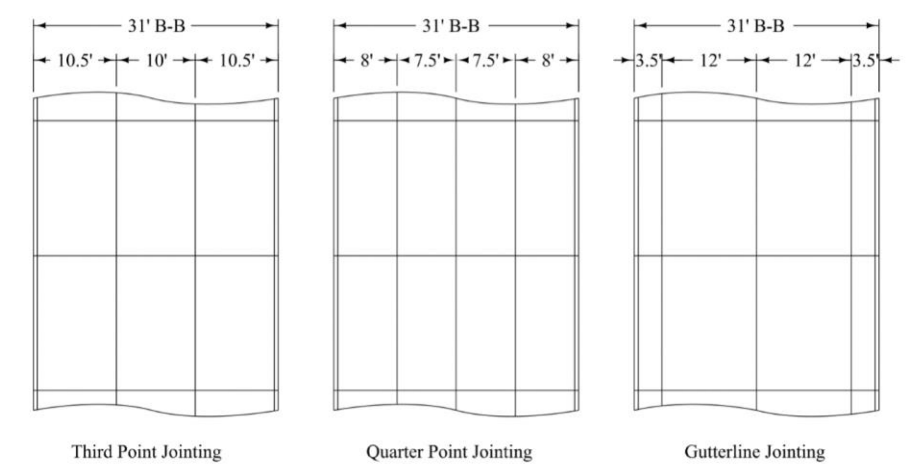


Figure 59: 31 Foot B-B Pavements (SUDAS 5G-2.05)

Jointing options for a 31' wide pavement

5.2.3. PCC Pavement Mix[13]

If the city has concerns with joint deterioration, then they should consider one of two high-durability mixes: C-SUD or CV-SUD. These mixes are identified in Iowa DOT IM 529. The C-SUD and CV-SUD mixes have the SUD designation for SUDAS. The "V" designation refers to the use of a Class V aggregate as specified in Iowa DOT Section 4117. While a conventional Class C concrete has a target w/c ratio of 0.43 and max of 0.488, the C-SUD mix has a target of 0.40 and max of 0.45. As a result, a C-SUD mix provides a more durable concrete pavement with lower permeability than conventional Class C mix due to its lower w/c ratio. With slip-form paving operations, however, the w/c ratio will typically be lower than the target w/c ratio during production with any mix design. The higher durability is desired to reduce joint deterioration due to the use of deicing chemicals. A joint saturated with de-icing salts limits the ability to allow the joint to dry out. To maintain the lower w/c ratio, a low- or mid-range water reducer may be necessary. For even greater durability, the use of ternary mixes should also be considered. Further references for mix proportioning in C-SUD and CV-SUD can be found in the Proportion Table 4 of Iowa DOT Materials IM 529. Note that these mixtures assume a basic w/c ratio of 0.40 and a maximum w/c ratio of 0.45.

The aforementioned mixture is based on Type I or Type II cements (Sp. G. = 3.14). Mixes using blended cements (Type IP or IS) must be adjusted for cement gravities listed in IM 401. Use proportions listed above if not utilizing three aggregates. The above mixture is based on Type IP cements.

[13] Weiss, J., Ley, M.T., Sutter, L. Harrington, D., Gross, J. Guide to the Prevention and Restoration of Early Joint Deterioration in Concrete Pavements, Iowa: Report No. TR-697, Iowa Department of Transportation, 2016.

5.2.4. Hot-Mix Asphalt Design

Hot-Mix Asphalt pavements require fewer considerations as flexible pavements, as there are no rigid interactions causing the need for joints, dowels, or reinforcing. HMA stability is primarily determined by the subgrade and subbase support and the asphalt mix itself.

HMA design depends on traffic volumes, using calculated ESAL values. Roadways with calculated ESAL values greater 1,000,000 require detailed design analysis, preferably using the method outlined in SUDAS Section 5D-1. Local streets are generally under that threshold, however, and can use the more standardized LT or ST Low-ESAL mixes.

Lift Thickness

Base and Surface courses should each 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 in Adel. The SUDAS manual recommends that City streets use the "Stop" condition unless the speed is posted over 25mph or on street parking is not allowed, at which point the "Slow" condition applies.

Table 19: HMA Binder Recommendations (SUDAS)

Asphalt Mixture		Criteria			
Design Traffic (1 x 10⁶ ESALs)	Mix Designation	Design Traffic (1 x 10⁶ ESALs)		Design Speed (MPH)	PG Binder
≤ 0.3 M	LT	≤ 0.3 M	and	≤ 45	58-28S
0.3 M to 1 M	ST	0.3 M to 1 M	and	> 45	58-28S
0.3 M to 1 M	ST	0.3 M to 1 M	and	15 to 45	58-28S[1]
1 to 10 M	HT	1 to 10 M	and	15 to 45	58-28H
Overlays	LT/ST/HT	≤ 10M	and	15 to 45	64-22S[2] or 58-28S or H

L = Low S = Standard H = High

5.2.5. Using Bid-Alternatives

The difference in performance and cost between properly designed pavements in the Central Iowa marketplace are very competitive price-wise and while projected life-cycles for asphalt include more regular maintenance, those maintenance activities tend to be low-cost. As such, it is not necessarily best practice to choose only one type as "standard." They both have their strengths for certain uses.

For example: the lower frequency and types of maintenance for PCC pavement makes it ideal for local roadways. The high proportion of local roads and the low-frequency maintenance minimizes City effort. Arterials, in the other case, are often ideal candidates for HMA because they benefit from more regular rehabilitation, plus HMA provides better smoothness for comfort at higher speeds.

Arguments for both options are quite strong, and with properly prepared subgrade and subbase in accordance with the design guidelines outlined in ***Section 5.1*** and ***SUDAS Chapters 6E-6F*** they will both generally perform well in Iowa's climate. The driving factor for agencies, then, should be cost.

As already stated, costs in Central Iowa are typically competitive between the two alternatives, so Cities may consider using "***Bid Alternatives***." This approach to design and bid documents provides enough information for bidders to choose which pavement type they believe will be the cheapest or easiest to implement for a given project.

The benefit of using bid-alternatives is twofold:

- **Increase pool of bidders for project, providing greater competition.**
- **Provide options so bidders can optimize costs, passing cost savings on to the agency.**

Contractors know how to optimize their own costs and will select whichever they believe will be the cheapest, and by broadening the pool of applicants to contractors experienced in both HMA & PCC, it encourages them to keep margins low. The intended result being lower average bid prices for the City. Of course, developing the alternatives takes additional resources, and should be reserved for larger or more critical projects unless the city chooses to allow bidders to submit their own equivalent pavement designs as part of the bid.

5.3. Current Design Standards

The City of Adel does not have a formally adopted design standard for pavements. However, guidance provided to designers includes the following:

- Pavement width for residential streets is generally 29' B-B with integral curb.
- Jointed plain concrete pavement (JPCP), 7" thick.
- Gutterline longitudinal joints are allowed, with a centerline joint.
- The required pavement foundation consists of prepared subgrade utilizing on-site soils.
- The typical cross-section of the current design standard as shown in ***Figure 60*** .

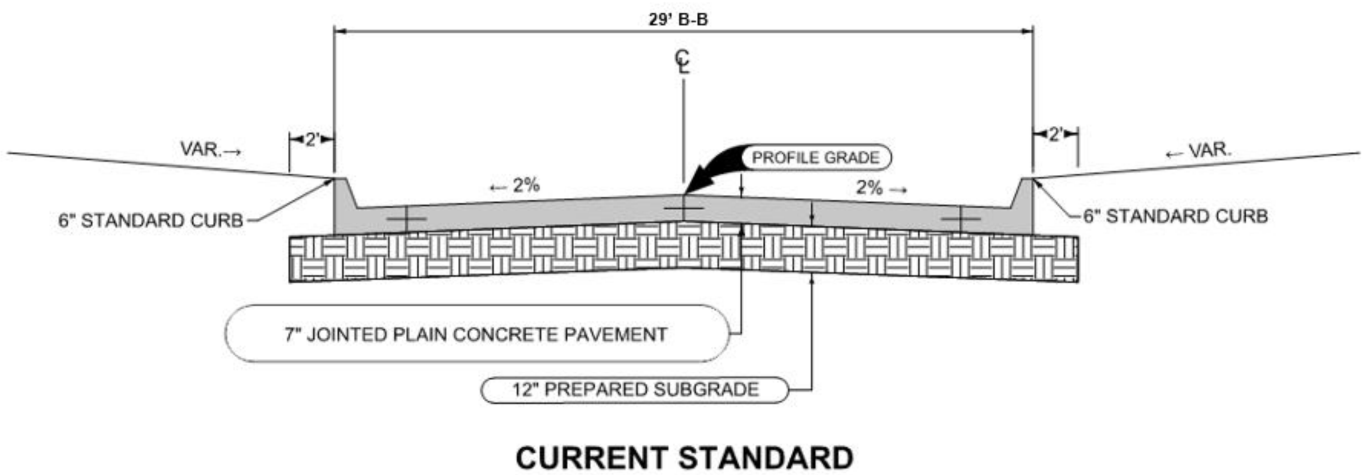


Figure 60: Current Design Standard
This diagram identifies the elements of the standard Grimes pavement. A simple slab placed directly on a prepared subgrade.

This approach presents a critical issue. Subdrain and aggregate is meant to convey water away from the pavement system without causing damage due to erosion or settlement, as well as minimize freeze-thaw effects. The natural voids and stability of aggregate bases allows water to pass easily to the subdrains, flowing along the top of the subgrade and through the voids of the granular material making up the subbase. When the aggregate base is omitted, the water cannot pass easily through the compacted subgrade and instead flows along the path of least resistance, in this case the interface between the bottom of the pavement and top of the subgrade.

Such an approach may result in environmentally caused deterioration (from water sitting in the pavement joints/cracks or freeze thaw of the base). It may even cause voiding beneath the pavement because water will naturally erode the subgrade to flow out of the pavement system more easily. Without use of an aggregate subbase the resultant pavement has significant structural vulnerabilities.

- ***HRG estimates that a pavement of this design would have a functional life cycle of only 35-40 years.***

5.4. Pavement Foundation Recommendations

- *Geotechnical Investigation:* Conduct geotechnical investigations in all development projects to determine the suitability of soils to be used for pavement subgrade.
- *Subgrade:* Improve subgrade support to provide a CBR of 10, unless the geotechnical investigation determines subgrade soils are adequate.
- *Subbase and Subdrain:* Construct drainable subbases, using material requirements of SUDAS modified subbase and install longitudinal subdrains (unless the geotechnical investigation determines the subgrade soil is free draining). The depth of the subbase should be 6" on the prepared subgrade or 4" with an appropriate geotextile between the prepared subgrade and the subbase material.

Figure 61: Under Pavement Voiding (Chen)
This photo shows a pavement void that has formed along the bottom of a pavement due to subgrade issues.

5.5. Pavement Recommendations

For the purposes of this discussion, the recommendations are for typical low-volume local streets, which have little truck traffic, not exceeding 85 trucks per day.

Pavement Thickness: The SUDAS pavement thickness design table for local low volume streets indicates a 6"-thick JPCP with an adequate foundation will perform satisfactorily and provide a 50-year life, according to the AASHTO design guide. However, experience across Iowa has shown 7" pavement will outperform the thinner pavement and is the standard thickness for most jurisdictions and is the recommended thickness of JPCP.

Pavement Jointing: Transverse joint spacing for 7"-thick JPCP paving should not exceed 15 feet, and 'C' Joints, without dowels because of the low truck volumes expected. Either quarter-point or third-point longitudinal jointing is recommended for 26'-wide pavements. Quarter-point jointing is recommended for 31'-wide pavements.

Figure 62 shows the typical cross-section of the recommended design standard.

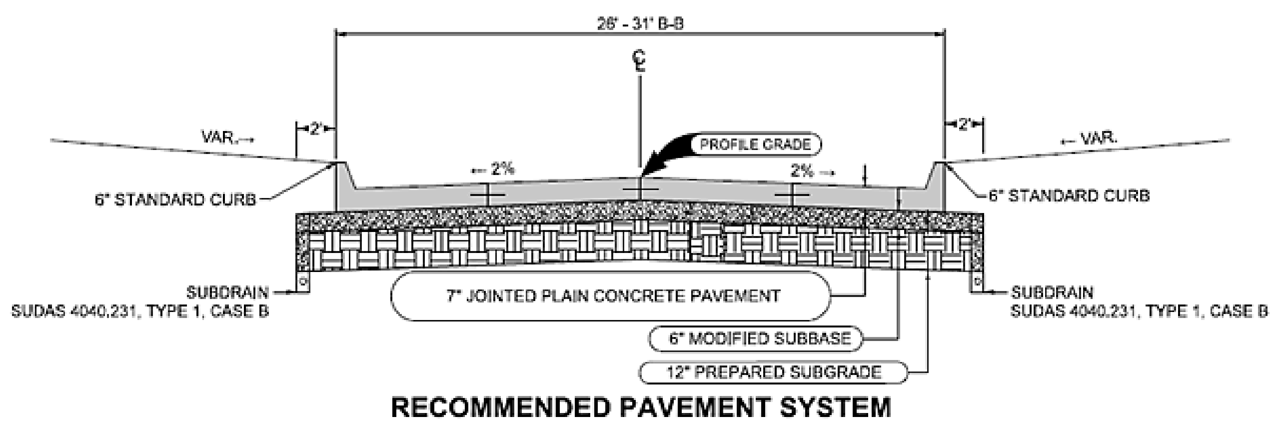


Figure 62: Recommended Design Standard (SUDAS)

This diagram identifies the elements of the proposed SUDAS pavement standard. Prepared subgrade, aggregate subbase, subdrain, and a slab designed for the conditions.

5.6. Recommended Vs. Current Standards Benefit/Cost Comparison

The following cost comparison and the benefits of the recommended higher standard of design will focus only on the costs associated with the pavement system, as previously defined, and will not include all other development infrastructure costs, such as site grading, storm sewer, water main, sanitary sewer, etc. In addition, no cost benefit has been determined for other benefits of long-lasting pavements, such as prolonged periods of higher service levels, less inconvenience to the adjoining properties and travelling public, or reduced vehicle damage from driving over deteriorated pavements.

5.6.1. Additional Costs Due to Recommended Pavement System Standards

To determine the relative costs of the pavement system using the current Adel pavement design standards and the recommended standards, two representative residential street segments were used.

- A two-block segment of 26'-wide street paving, 900'-long from center of intersection to center of intersection
- A one-block segment of 26'-wide street paving, 870'-long from center of intersection to center of intersection

Table 20 Current Standard Cost Comparison – Two-Block 900' segment

Item No.	Item	Unit	Unit Price	Quantity	Total Cost
1	Excavation, Class 10	CY	$10.00	1250	$12,500.00
2	Subgrade Preparation	SY	$4.00	3748	$14,992.00
3	Subbase, Modified, 6"	SY	$9.00	0	$0.00
4	PCC Pavement, 7"	SY	$65.00	3356	$218,140.00
5	Subdrains, PVC, 6"	LF	$15.00	0	$0.00
6	Subdrain Cleanout	EA	$500.00	0	$0.00
7	Subdrain Outlets and Connections	EA	$200.00	0	$0.00
				Total	$245,632.00
				Cost/SY	**$73.19**

Table 21: Recommended Standard Cost Comparison – Two-Block 900' segment

Item No.	Item	Unit	Unit Price	Quantity	Total Cost
1	Excavation, Class 10	CY	$10.00	1874	$18,740.00
2	Subgrade Preparation	SY	$4.00	3748	$14,992.00
3	Subbase, Modified, 6"	SY	$9.00	3748	$33,732.00
4	PCC Pavement, 7"	SY	$65.00	3356	$218,140.00
5	Subdrains, PVC, 6" *	LF	$15.00	1112	$16,680.00
6	Subdrain Cleanout	EA	$500.00	3	$1,500.00
7	Subdrain Outlets and Connections	EA	$200.00	3	$600.00
				Total	$304,384.00
				Cost/SY	**$90.70**

Table 22: Current Standard Cost Comparison– One-Block 870' segment

Item No.	Item	Unit	Unit Price	Quantity	Total Cost
1	Excavation, Class 10	CY	$10.00	1138	$11,380.00
2	Subgrade Preparation	SY	$4.00	3414	$13,656.00
3	Subbase, Modified, 6"	SY	$9.00	0	$0.00
4	PCC Pavement, 7"	SY	$65.00	3032	$197,080.00
5	Subdrains, PVC, 6"	LF	$15.00	0	$0.00
6	Subdrain Cleanout	EA	$500.00	0	$0.00
7	Subdrain Outlets and Connections	EA	$200.00	0	$0.00
				Total	$222,116.00
				Cost/SY	**$73.26**

Table 23: Recommended Standard Cost Comparison– One-Block 870' segment

Item No.	Item	Unit	Unit Price	Quantity	Total Cost
1	Excavation, Class 10	CY	$10.00	1707	$17,070.00
2	Subgrade Preparation	SY	$4.00	3414	$13,656.00
3	Subbase, Modified, 6"	SY	$9.00	3414	$30,726.00
4	PCC Pavement, 7"	SY	$65.00	3032	$197,080.00
5	Subdrains, PVC, 6" *	LF	$15.00	1187	$17,805.00
6	Subdrain Cleanout	EA	$500.00	2	$1000.00
7	Subdrain Outlets and Connections	EA	$200.00	4	$800.00
				Total	$278,137.00
				Cost/SY	**$91.73**

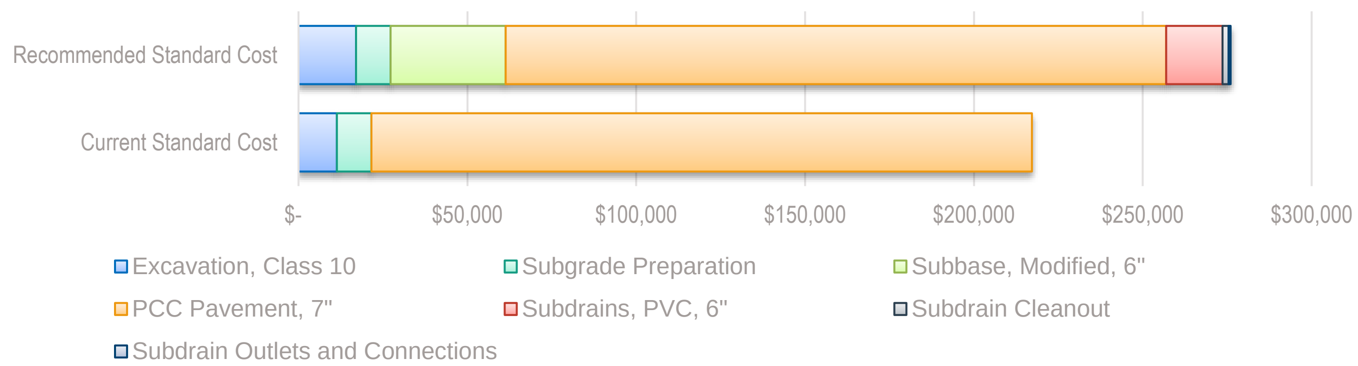


Figure 63: Recommended Vs. Current Standard Cost Comparison – Two Block 900' Segment
This diagram shows the breakdown of the costs incurred by the different design standards

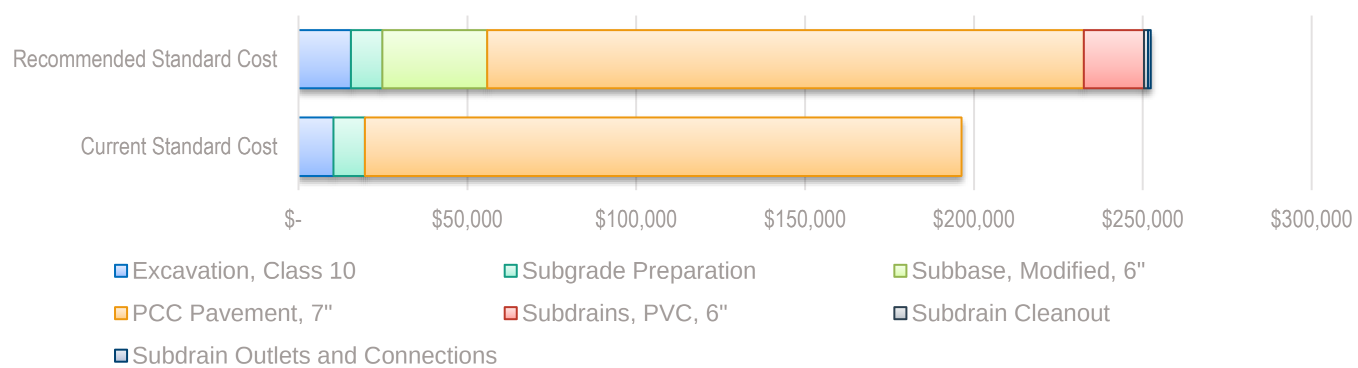


Figure 64: Recommended Vs. Current Standard Cost Comparison – One Block 870' Segment
This diagram shows the breakdown of the costs incurred by the different design standards

5.7. Cost Comparison

5.7.1. Cost of Pavement Systems

The following is a comparison of the costs of the current design standards and the recommended design standards for two similar sections of pavement in a residential area, as previously described:

Example 1: Two-block 900' Segment
Additional pavement system cost due to recommended design standards
$90.70 - $73.19 = +$17.51/SY
Percent increase in pavement system cost due to recommended design standards
$17.51 / $73.19 = +23.9%

Example 2: One-block 870' Segment
Additional pavement system cost due to recommended design standards
$ 91.73- $73.26 = +$18.47/SY
Percent increase in pavement cost due to recommended design standards
$18.47 / $73.26 = +25.2%

Averages of the two examples yield the following results due to the recommended design standards:
Additional pavement system cost +$17.99
Percent increase in pavement system cost +24.6%

5.7.2. Cost of Residential Lots

Another way to look at this additional cost is how it might affect the cost of each residential development lot. As an illustration, a normal residential lot is presumed to be 70'± wide and 140'± deep and corner lots are 90' wide. Using the two street pavement examples illustrated in Section 6.1, the following costs are calculated:

Example 1: Two-block 900' segment
As many as 20 lots or as few as 12 lots could front on the street segment, depending on orientation. Assuming an average of 16 lots, the additional cost per lot for the improved standards would be $58,752.00 / 16 lots = $3,672.00/lot.

Example 2: One-block 870' segment
As many as 22 lots or as few as 18 lots could front on the street segment, depending on orientation. Assuming an average of 20 lots, the additional cost per lot for the improved standards would be $56,021.00 / 20 lots = $2,801.05/lot.

An estimated per lot additional cost due to the recommended standards ranges from $2,801.05 to $3,672.00, or an average of $3,236.52.

5.7.3. Life Benefit of Recommended Standards

As indicated in previous discussions, improved pavement foundations and subsurface drainage will substantially increase the expected life of a pavement. It is also expected that improved jointing and concrete mixtures with provide additional longevity and improved service. Properly designed and maintained PCC pavements should be expected to provide at least 50 years of good service, as opposed to the expected life of 30 to 35 years for the current design standards. Therefore, a conservative estimate of the additional pavement life for the recommended pavement system standards is 15 years.

Additional pavement life due to recommended design standards:
50 years – 35 years = +15 years

Percent increase in pavement life due to recommended design standards:
15 years / 35 years = +42.8%

Benefit/Cost Ratio:
Life Benefit Increase % / Additional Cost % = 42.8% / 24.6% = 1.74:1

5.8. Future Reconstruction

As would be anticipated with additional expected life, pavements constructed at the higher recommended design standards should require reconstruction less frequently. As an illustration, over a period of 100 years, it would be expected that pavement constructed with the recommended design standards would require only one pavement reconstruction to last that period of time. On the other hand, pavement constructed at the current design standard would require two reconstructions to serve for a similar length of time.

Based on present costs and the cost of removing and replacing only the pavement in the future, and not including other associated work, such as excavation, intakes, drives, design, and other associated costs, the following assumptions using an average of the two previous pavement examples of similar length are made:

- Number of residential lots: 18
- Total area of pavement: 3,194 SY
- Area of pavement per lot: 177 SY
- Initial cost of pavement with current design: $73.22/SY
- Initial cost of pavement with recommended design: $91.21/SY
- Cost to remove and replace pavement = $12 + $65 = $77/SY

The following conservative costs could be expected:

Costs for pavement constructed with current design standards to serve for 100 years

Initial pavement system cost:	
3,194 SY @ $73.22 =	$233,865
Initial pavement system cost per residential lot:	
$233,865 / 18 lots =	$12,992
Pavement reconstruction cost at 35 years:	
3,194 SY @ $77.00 =	$245,938
Pavement reconstruction cost per residential lot at 35 years:	
$245,938 / 18 lots =	$13,663
Pavement reconstruction cost at 70 years:	
3,194 SY @ $77.00 =	$245,938
Pavement reconstruction cost per residential lot at 70 years:	
$245,938 / 18 lots =	$13,663

Total pavement costs with current design standards for 100 years:

Pavement system initial cost and pavement reconstruction costs	$725,741
Pavement system initial cost and pavement reconstruction costs per lot	$40,318

Cost for pavement constructed with recommended design standards to serve for 100 years

Initial pavement system cost:	
3,194 SY @ $91.22 =	$291,356
Initial pavement system cost per residential lot:	
$291,356 / 18 lots =	$16,186
Pavement reconstruction cost at 50 years:	
3,194 SY @ $77 =	$245,938
Pavement reconstruction cost per residential lot at 50 years:	
$245,938/ 18 lots =	$13,663

Total pavement costs with recommended design standards for 100 years:

Pavement system initial cost and pavement reconstruction costs	$537,294
Pavement system initial cost and pavement reconstruction costs per lot	$29,849

For each residential lot, an initial investment of approximately $3,194.00 more for longer lasting pavement using the recommended design standards will reduce future reconstruction costs by an estimated $10,469, in present day dollars.

Figure 65: Projected Pavement Construction & Reconstruction Timeline -100-Year Cycle (870' Block)

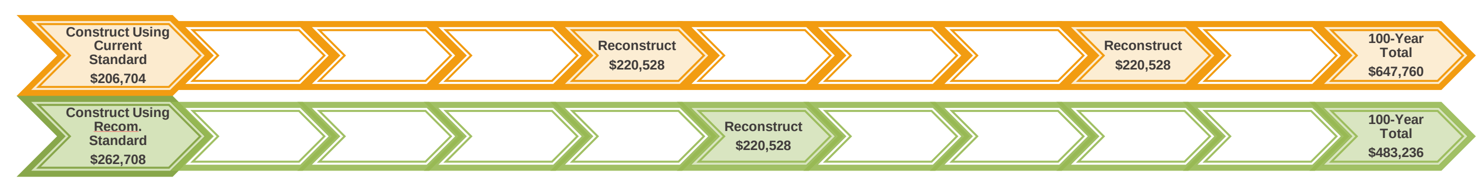
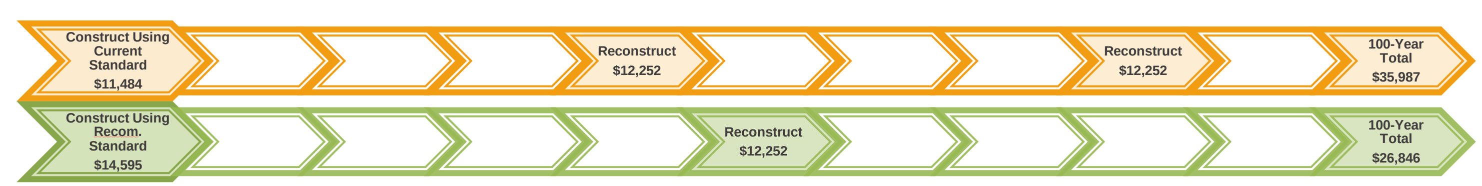


Figure 66: Projected Pavement Construction & Reconstruction Timeline -100-Year Cycle (per Lot)



6. Scenarios/Recommendations

In order to create recommendations on spending strategies and setting performance goals, a number of budget-based scenarios were created. These scenarios were designed to address "what-if?" type questions. Each scenario used a set budget and projected the effects on the overall condition of the network. The projections were performed using Deighton Limited's dTIMS BA, for a 15-year period, from 2023 to 2037.

Once all the data was processed, it was put into a dTIMS model to develop long term performance projections and to run a number of scenarios to determine optimal budgeting and assess the impact of using the recommended standards herein.

6.1. Modelling

dTIMS BA (Deighton's Total Infrastructure Asset Management Software – Business Analytics) is a computer program developed by Deighton Associates Limited for use in storing infrastructure asset data, developing projections of infrastructure asset performance, estimating remaining life in various infrastructure assets, determining when they need to be replaced or repaired, and estimating how much the treatment will cost. It allows for any and all asset data to be entered, there is no limit to what information can be stored within the program and considered during the modelling process. However, the user must manually program how all the data relates to each other, assign costs, develop the treatment triggers and effects, create funding pools that each treatment will pull from, and develop their own life-cycle curves for the infrastructure assets. Once this is accomplished, dTIMS' primary feature goes to work; it runs a heuristic algorithm (a series of tests using general rules and guessing approaches for determining optimal solutions) to identify an optimal "Strategy" for maintenance and replacement of the infrastructure assets in question, given the budget, treatments, and life-cycle information supplied by the user.

Some manipulation through GIS was required to combine the IPMP data with outside data sources from the City and State before it could be imported into dTIMS. After the data were compiled in GIS, it was imported to dTIMS, and the models were run.

6.2. Determining Need

6.2.1. Defining Need

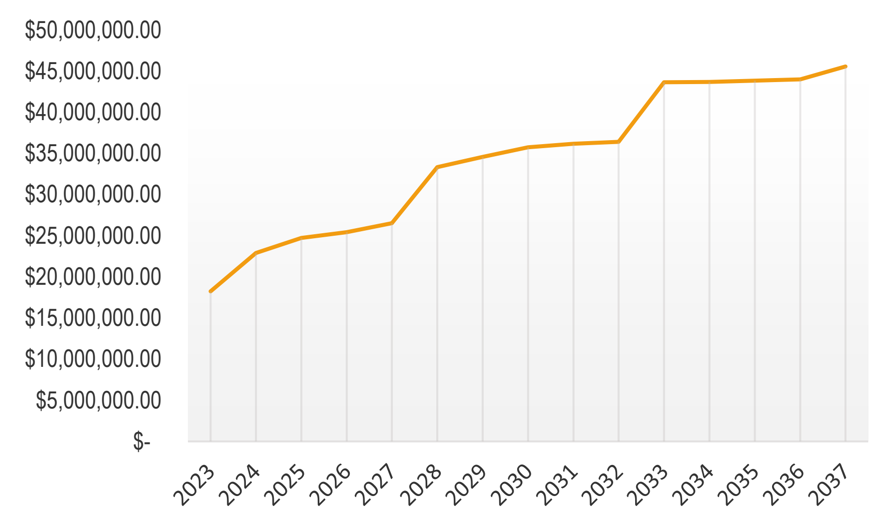
The first step in running various scenarios in dTIMS BA is to determine the "Need." Need is defined as all outstanding work and forthcoming work in the analysis period. Some agencies may consider this as a "Backlog" projection.

Essentially, dTIMS BA analyzes the current conditions and creates condition projections for every management section in the database, after which it chooses the default treatment alternative for each segment, in every year, regardless of budget. This acts as a baseline scenario which could be considered as a Pavement Management Program operating at 100% efficiency with complete funding.

6.2.2. Needs in Adel

Using the pavement condition data collected by Pathways and distributed by IPMP, dTIMS BA analyzed the existing conditions of the roadway network in Adel, and an overall Need was determined.

The current Need for pavement repairs, the total cost to address every single roadway distress in the City, bringing the network to "Very Good" condition, is approximately $46 Million. That Need is projected to grow to $102 Million by 2037.



Current Need (2023) = 46 Million
Projected Need by 2037 = $102 Million

Figure 67: Projected "Need"

This figure displays the existing funding required to bring every pavement up to "Very Good" condition, i.e., "Need" as well as its projected Growth over the next 15 Years.

6.3. Scenarios

To address the existing backlog (Need), the City will need to commit a substantial amount of funding to improve, and possibly just to maintain its roadways. A number of budget options were tested to determine a theoretical budget for the City of Adel.

Fiscally Constrained, or Budget-based Scenarios, take a fixed annual budget and attempt to optimize pavement management spending on major treatments (see ***Table 3 on page 16***).

The funding comparisons keep all the proposed work within the assigned budget, while maximizing the "Benefit" provided to the public. Benefit was determined as the difference between the conditions of the road network if nothing was done and the selected treatment effect (measured by difference in CityPCI scores). This method is standard practice when determining optimal treatments. The model used in this plan also factored in the amount of traffic (based on annual average daily traffic or AADT) on the affected roads. The final result represents both the number of people who will receive the benefit of driving on a newly reconstructed road and the magnitude/duration of the improvement. With these constraints of maximizing benefits while adhering to a strict budget the program determined how the overall condition of Adel would perform over a 15-year period.

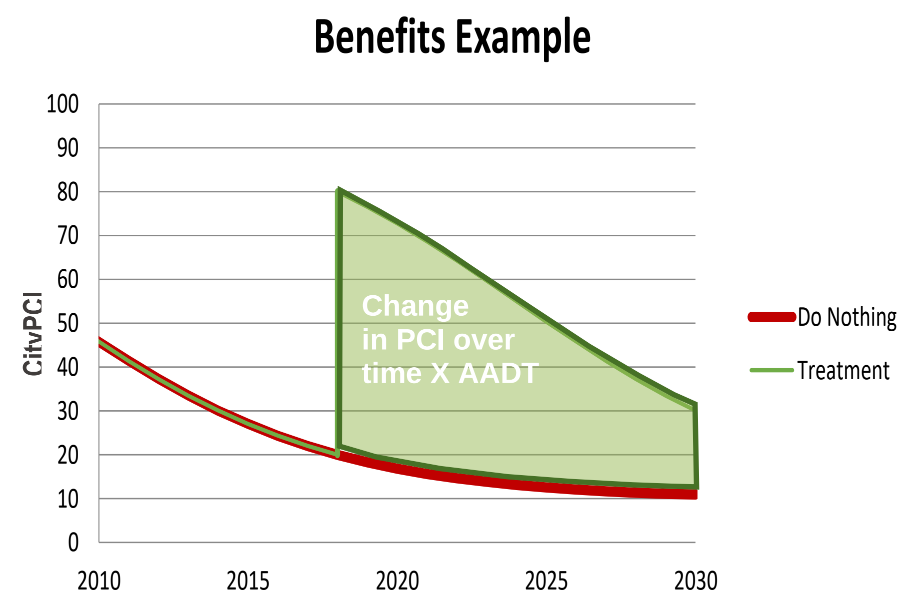


Figure 68: What The Benefits Calculation Looks Like

The red line is the "baseline" scenario, the green area is the "Benefit" the public experiences, calculated as the difference between the base-line and the new improved condition, factored by the number of people who drive on that road (Annual average daily traffic, AADT) dTIMS BA checks each individual roadway segment to see if it triggers a specific treatment type, then calculates the "Benefit" of performing that treatment. Afterwards, dTIMS BA will then compare each treatment option and determine the one that gives the best ratio of benefit to cost. It then goes out further and sees if any treatments would trigger in future years that would give better benefit-cost returns (such as waiting to reconstruct a pavement rather than overlaying it). After comparing all the initial treatment selections across all the years, the program also considers subsequent treatments and their effects. Complex dTIMS models might look at dozens of treatments in sequence before picking the best choices, which are called "treatment strategies".

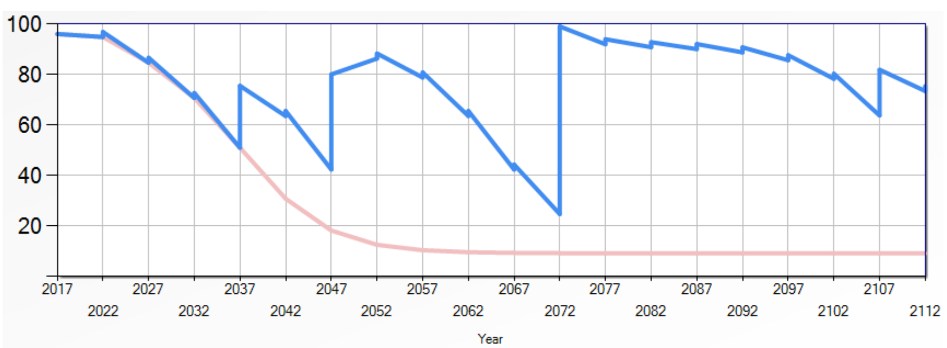


Figure 69: Example of a Treatment Strategy Executed by dTIMS.

The blue line is the effect, pink is what would happen if nothing were done. The jaggedness is from regular maintenance activities, the first peak is a PCC restoration, the second is a crack and seat overlay, the jump in 2072 is a reconstruction, and the final peak is another PCC restoration.

Of course, the best choice of treatment may not always be the one that can be afforded within the City's budget. The program then ranks each treatment strategy based on their benefit-cost ratio and picks those that it can afford, deferring those it cannot, and occasionally picking less optimal treatments because it would allow the program to use more of its budget in a timely manner.

The funding scenarios used were designed to hone in results that enable actionable changes in the existing pavement management program in Adel. Questions were asked at a high level, and the dTIMS BA model was adjusted to address those questions. The results were then interpreted to clarify what the numbers truly mean.

The funding scenarios performed looked at following questions:

- What happens if the City does nothing?
- What happens if funding increases?
- What happens if funding decreases?
- How much money to maintain a network average PCI of 60?
- How much money to maintain a network average PCI of 70?
- How much money to maintain a network average PCI of 80?
- What is the proper distribution of funds across Reconstruction/ Rehabilitation/ Restoration?

6.4. Results

6.4.1. Budget Projections

The City of Adel is currently in "Good" condition, and it is easier to maintain a network than it is to improve a network. As such, the City is well positioned to keep operations going on a limited budget while still ensuring a high quality of infrastructure.

The "Do Nothing" scenario option points out the value of Pavement Management. Network condition would drop out of the "Good" category in 10 years without it. It also shows the general trend the City can expect. The line shows that pavement deterioration in Adel is accelerating already; the line begins its turn downward immediately when treatments stop being applied.

In order to determine an ideal budget for the City, budget scenarios were first explored ranging from $300,000 up to $3 Million annual funding, with $300,000 intervals. *Figure 72 on page 41* shows only the scenarios based on million-dollar increments. The results showed that there are only marginal benefits to budgets over $3 Million per year; any expenditure over that level is mostly wasted and are just done to use up the budget, not out of need. Budgets under $1.5 Million per year showed a decline in condition, though the condition drop for $1.2 Million was quite minor and the backlog only increased slightly. This indicated that the optimal budget would likely be one between $1.2 Million and $1.5 Million and would maintain a network average PCI score very near to 70/100 or "Good" on average.

Additional scenarios were developed to refine the results and establish a preferred expenditure strategy. In the end, it was determined that the recommended budget would be approximately $1,400,000 per year. This budget level allowed the City to maintain the current average PCI level of 70/100 with very little variance over the 15-year analysis period. It neither wasted money nor short-changed the program. It also maintained the current pavement condition distribution, as seen in ***Figure 69***, so that it did not just sink money into increasing the amount of "Very Good" while ignoring "Poor" and "Very Poor" roads.

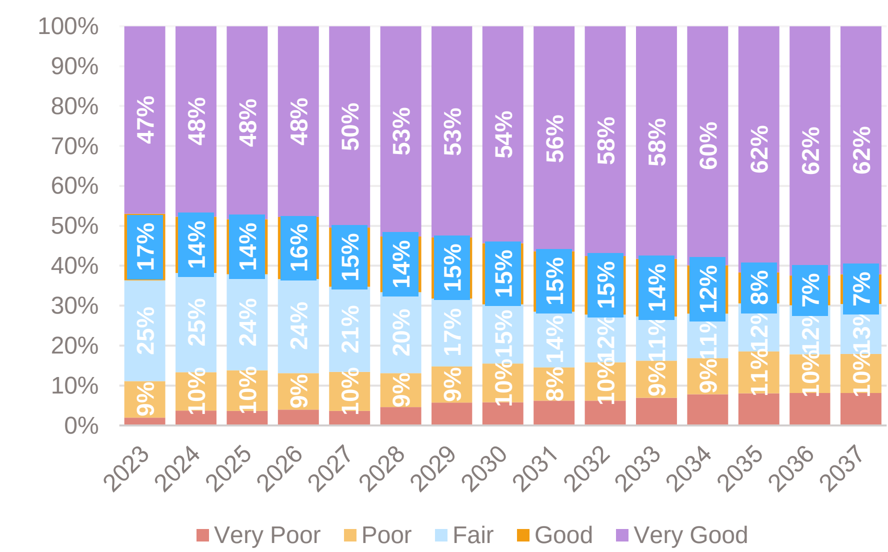


Figure 70: Condition Distribution Projection –Preferred Budget ($1.4M)

This graph is from the dTIMS BA results for the preferred budget over the next 15 years.

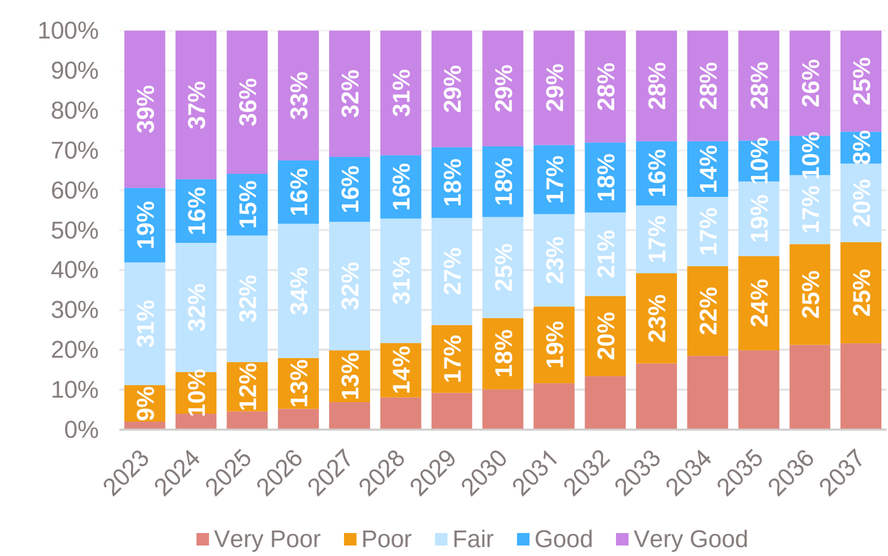


Figure 71: Condition Distribution Projection – Do Nothing ($0)

This graph is from the dTIMS BA results for the Do-Nothing Scenario over the next 15 years. Compared to the preferred budget the difference is pronounced

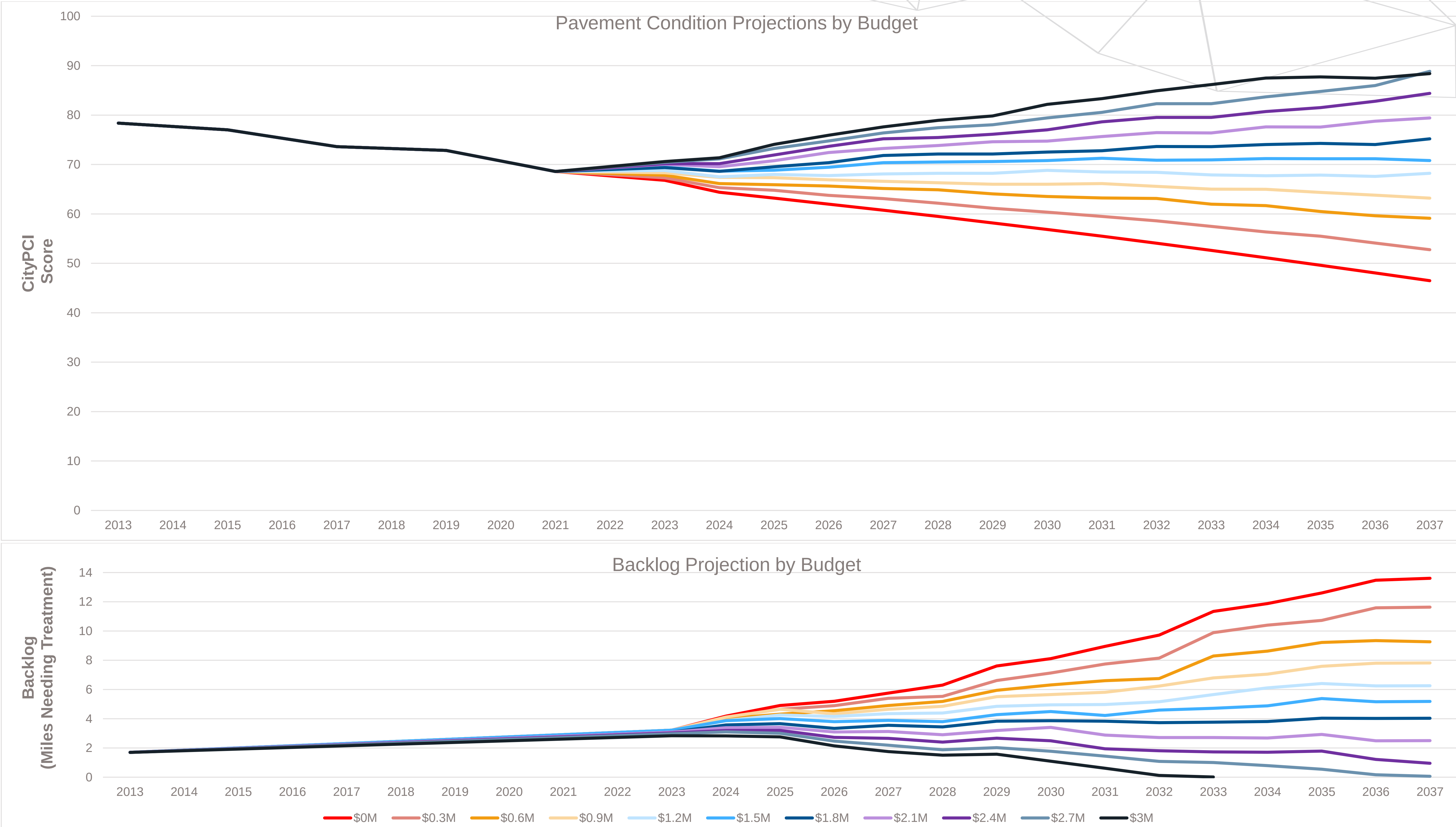


Figure 72: CityPCI and Backlog Projections by Budget

The results of the dTIMS BA modelling. These graphs represent the effects of adopting various budget and what happens over the next 15 years. Changes to the network level Pavement Condition Index is on top and the bottom represents the miles of road that will need to be deferred for future treatment

6.4.2. Ideal Spending Proportions

When looking at the types of treatments applied there is an optimal balance, unique to each city. Too much reconstruction can eat up your budget quickly and not leave anything to maintain older pavements, meaning more early failures. Too much rehabilitation means maintaining the ideal candidates really well but end up ignoring the "lost-causes" for extended periods while you try to carve out funds for reconstruction only occasionally. Both cases can result in a lopsided distribution of pavement conditions that is heavy on the two extremes.

Research performed by HR Green has indicated that cities in Iowa tend to perform best with 60/40 split or 55/35 with the remaining 10% focused on restoration treatments like crack sealing and patching. Not every city has the capabilities for such large programs, however.

The dTIMS BA model provided insight for splitting the funding, indicating an ***ideal funding distribution of 75/20/5*** between Reconstruction, Rehabilitation, and Restoration. This result is slightly atypical but is a clear result of Adel's characteristics as an older city. There are a number of roads that need major work, but also some relatively newer, low-risk, pavements that do not yet need rehabilitation. The budget therefore is focused more towards rehabilitating the "Poor" pavements and recovering the failed ones, but not ignoring restoration treatments. Over time, however, this may need to shift more towards Restoration and Minor rehabilitation.

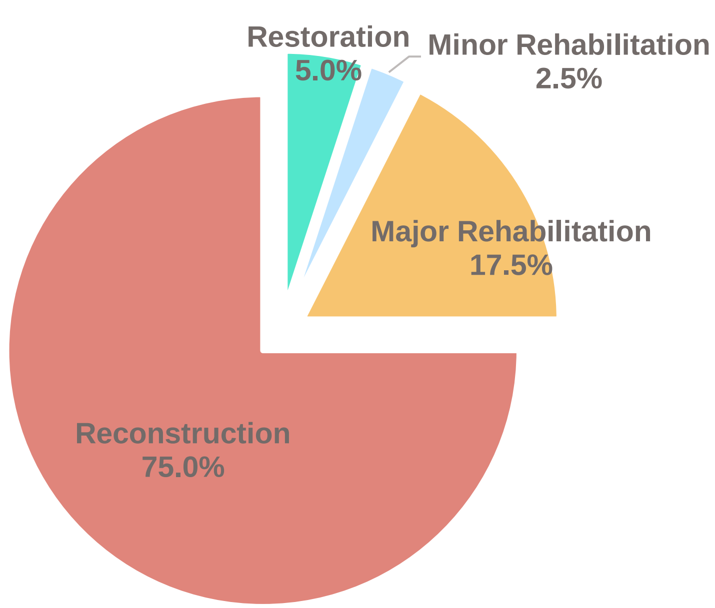


Figure 73: dTIMS BA Recommended Budget Proportions
This figure shows the results returned by dTIMS BA when developing the construction program.

6.4.3. Target-Driven Scenarios

If the City wants to consider the cost implications of maintaining a level of service other than the one they currently have, a range of options was explored within dTIMS BA. This was done using the "Strategic Analysis Module" or SAM. A range of budgets was programmed to test which ones would result with a given average PCI at the end of the analysis period. This approach is more realistic than immediately jumping to the target and holding it, and actually reduces costs for both the higher and the lower goals.

PCI targets were tested ranging from 55 to 85 in 5 PCI increments and the average annual costs were rounded to the nearest $100,000 for simplicity. Most of these targets fall within the "Good" condition.

Each jump in 5 PCI points yielded about a $300,000 cost difference, with the preferred budget falling around the Target for PCI=70. These costs are only the average for the analysis period. For lower targets it takes nearly the whole 15 years to drop to 55 so the model only puts forth minimal maintenance. Beyond the immediate future, that budget may end up rising back near to the projected budget of $1.4 Million.

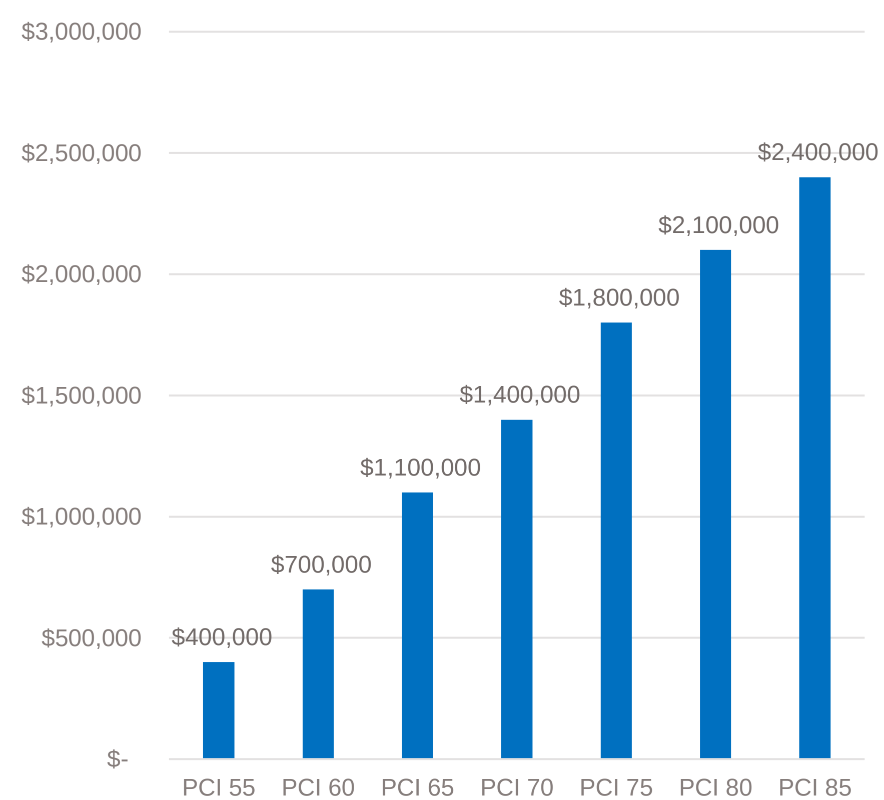


Figure 74: Est. Costs to Maintain Average Condition Levels
This figure shows the dTIMS cost results rounded to the nearest $100k in order to maintain a certain average condition level. To determine total cost.

6.4.4. "Hybrid" Goal Scenario

Different functional classifications typically are used by vastly different amounts of traffic and are traveled at different speeds, meaning that the effects of pavement distresses on drivers may not be equal. As such, setting a "hybrid" goal where local streets are held to a different standard than arterials may present a cost savings opportunity.

Local roads make up the majority of Adel's pavement network and the target performance level of the local roads are driving the majority of costs to maintain the overall network PCI. As such, exploring alternatives for local road performance will give the City more tools to optimize their budget.

If the target goal for local roads could be lowered from maintaining current conditions (69/100) down to just barely in the "Good" category (60/100), it would save the City around $650,000 per year.

Collectors are the more important streets, so a higher goal of "Very Good" (80/100) might be more suitable. Raising the costs $350,000, this option seems feasible if combined with the lowered goal for locals.

The Hybrid goal, compared to trying to maintain the current conditions, might save the City over $400,000 per year.

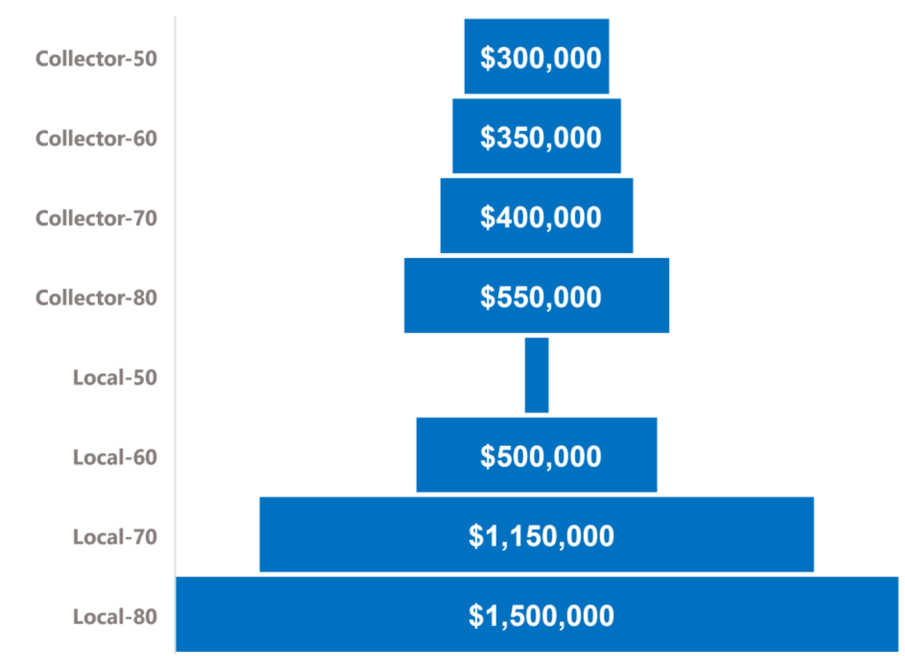


Figure 75: Est. Costs to Maintain Certain Condition Levels by Class
This figure shows the dTIMS cost results rounded to the nearest $50k in order to maintain a certain average condition level based on the functional class. To determine total cost, add 1 Local option to 1 Collector option.

6.4.5. Land Development and Increasing Liabilities

The recommended budget solutions assume that the amount of maintenance, rehabilitation, and reconstruction needs in Adel will be static and unchanging. The size of the network, and its characteristics are fixed in time. However, the reality is that Adel is still a growing City.

In 2010, Adel's population was 3682. Since then, the population of Adel has grown to 6,153 according to the 2020 census, a nearly 100% increase in population. This is not simply families having more kids, this kind of population change is driven by new development and housing opportunities.

Along with the expansion of housing and population comes increased demand for infrastructure. In order to provide for the future needs, either the City or Developers will need to ensure they are providing adequate funding for road reconstruction.

Expanding the street network, however, means increasing the City's maintenance liabilities. More roads equal more money. HRG estimates that for each mile of new roadway built, the City will need to spend approximately ***$91,000 more a year*** on maintenance and rehabilitation, not accounting for inflation.

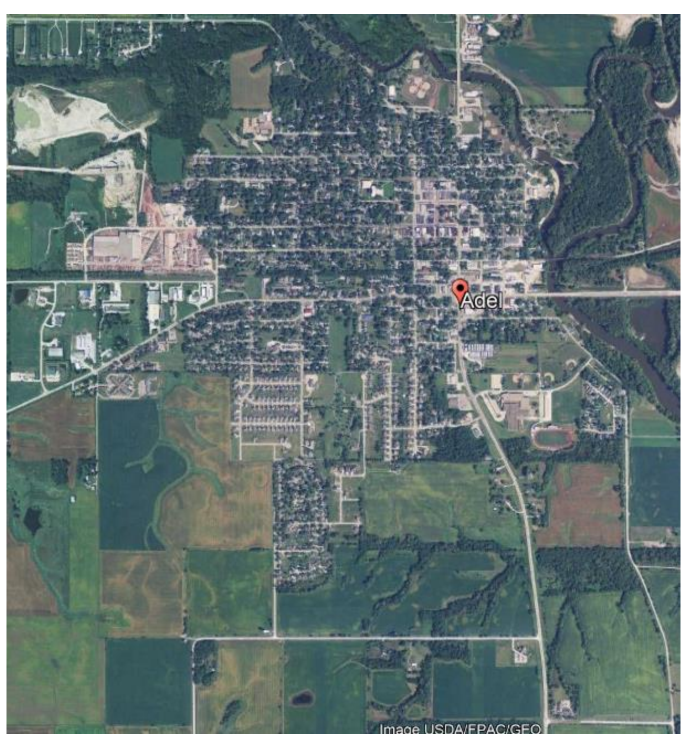


Figure 76: 2010 Aerial Imagery (USDA)
Aerial imagery from 2010 shows the historical core of the community's infrastructure and serves as a reference for how much it has expanded in the past 10 years.

Looked at another way, using the assumptions from ***Section 5.7***, the cost increase is approximately ***$778 to $835 per lot.***

Table 24: Additional Costs of Maintaining 1 Mile of New Road

Year	Action	Cost (PV)	Annual Cost (PV)
1	Construction	By Developer	By Developer
5	Seal	$21,000	$4,200
9	Seal	$21,000	$2,333
12	Seal & Patch	$54,560	$4,547
15	Rehab (PCC Restoration)	$ 400,107	$26,674
18	Seal	$21,000	$1,167
21	Seal	$21,000	$1,000
24	Seal & Patch	$54,560	$2,273
27	Seal & Patch	$54,560	$2,021
30	Rehab (Overlay)	$ 909,333	$30,311
33	Seal	$21,000	$636
36	Seal	$21,000	$583
39	Seal & Patch	$54,560	$1,399
42	Seal & Patch	$54,560	$1,299
45	Rehab (Mill & Overlay)	$1,000,267	$22,228
48	Seal	$21,000	$438
51	Seal	$21,000	$412
54	Seal & Patch	$54,560	$1,010
57	Seal & Patch	$54,560	$957
60	Seal & Patch	$54,560	$909
65	Reconstruct	$3,000,800	$46,166
	Total	**$5,914,987**	**$91,000**

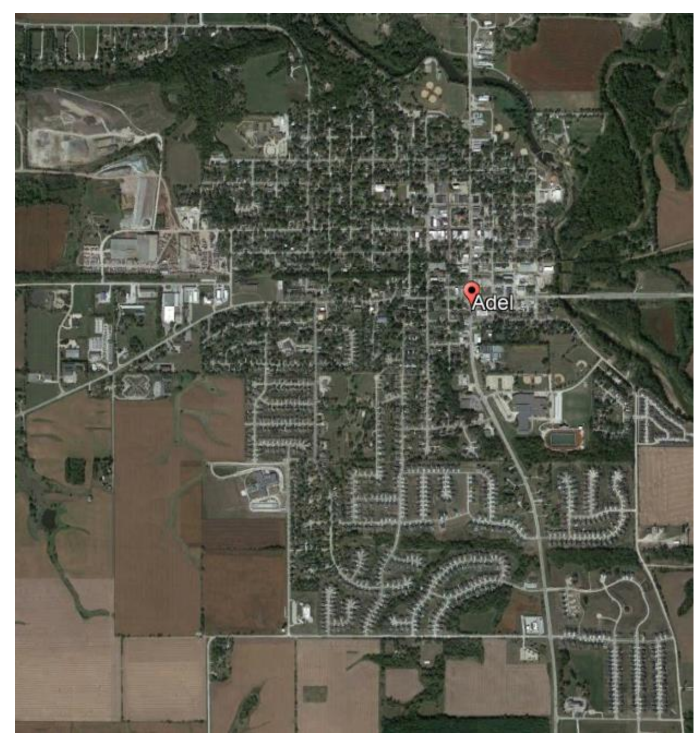


Figure 77: 2022 Aerial Imagery (Maxar)
Aerial imagery from 2022 can show the extent of growth that has taken place over the past 10 years.

6.5. Performance Metrics and Goal Setting

Pavement Management Programs are ongoing processes. Adopting a plan and analyzing potential budgets are not enough. They need to be actionable and have clear, measurable performance goals.

The first steps in moving forward are to approve the findings of this pavement management plan, identify a funding strategy, and then develop an objective, data-driven Capital Improvement Plan. The Capital Improvement Plan will assist decision makers in determining the most cost-effective actions are to use the funding they have available to improve or maintain conditions in Adel.

With the Scenario results in mind, Adel needs to set some measurable performance goals for the near future, that 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.

6.5.1. Recommended Performance Metrics

- Maintain an ideal Reconstruction budget share of around 75% and Restoration share of at least 5%. Aim for a Rehabilitation budget of about 20%
- Clearly establish a dedicated budget for Pavement Management activities, with a recommended annual budget of $1.4 Million
- Maintain Overall Network Average CityPCI above 70/100 or consider a Hybrid goal of 60 for Local Streets and 80 for Collectors

6.5.2. "Living Documents"

Another important part of this performance tracking and goal-setting is to renew this plan as physical, fiscal, and political conditions change. HRG recommends that Pavement Management Plans act as "Living Documents" that grow with cities and adapt to their needs by regular updates and changes. By default, for most agencies this will mean renewing the plan every 2-4 years, complete with new pavement condition data.

7. Capital Improvement Plan

The Capital Improvement Plan (CIP) is a list of recommended projects for Adel to complete over the next 10 years. This list of projects was generated using the results of the dTIMS BA model, as well as several other factors. The project list is optimized for the most effective use of available funds, based on the pavement condition data and planning-level information provided by the City.

The complete list of recommended projects identifying the location for the proposed treatments can be found in ***Appendix A: Capital Improvement Plan,*** followed by illustrative maps. Projects are sorted into three phases, Phase 1 (FY2023-FY2025), Phase 2 (2026-2028), and Phase 3 (FY2029-2032)

.These lists and maps will serve as a tool to assist City staff during the project planning process, but they do not replace engineering judgement. Project types may change from what is in the CIP and projects will likely move between phases for various reasons. Some projects may even leave the plan entirely as new ones are added. Some reasons the program may change include field conditions not captured by the IPMP data, required utility improvements, or environmental hazards causing changes to local conditions.

Consisting of ***53 Projects***, the recommended projects contained within the CIP will address over ***10 Miles*** of roads, approximately 1/3rd of the entire Adel network. The treatments are weighted primarily towards addressing the worst pavements in Adel as well as rehabilitating many of the older Composite roads, with a 60/40 split between Local and Collector roads improved, by length.

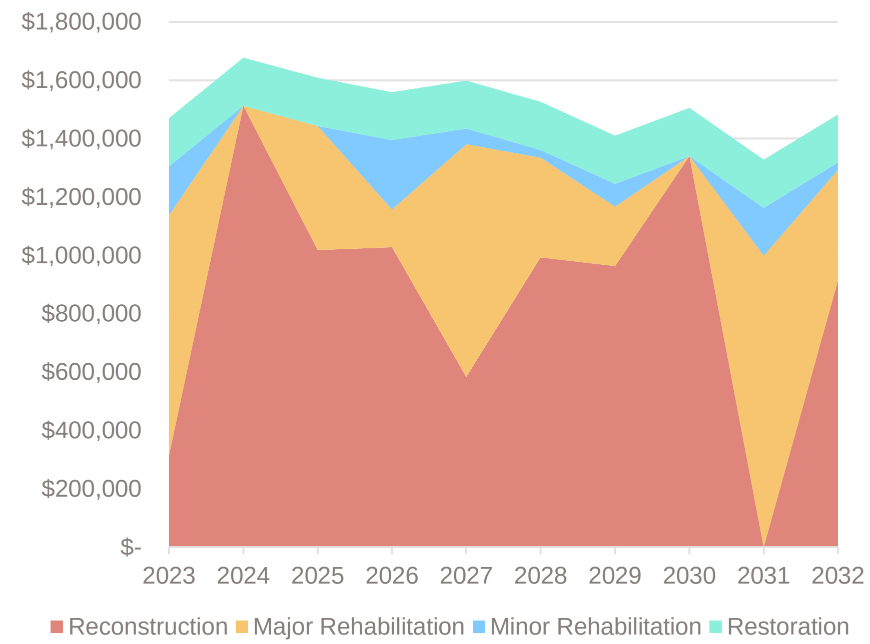


Figure 78: Treatment Type Over Time
This area graph shows the treatment distribution for each year of the CIP.

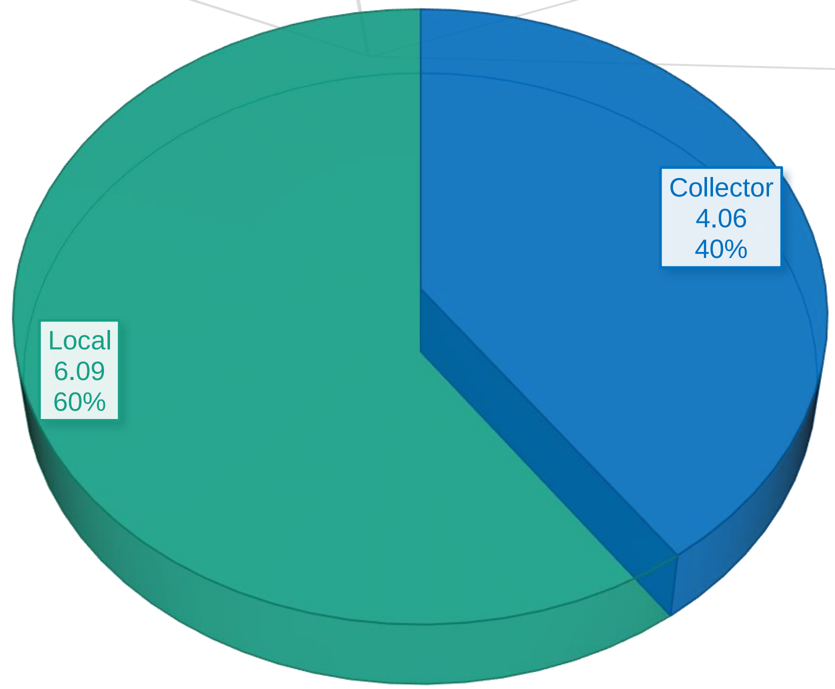


Figure 79: CIP Functional Classification by Length
This area graph shows the treatment distribution for each year of the CIP.

Appendix A: Capital Improvement Plan

Capital Improvement Plan – List of Recommended Projects (Phase 1 – FY2023-FY2025)

Revised with Addendum 1

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
1	GREENE STREET_1	Major Rehabilitation	VISION PARKWAY	1444' From VAN FOSSEN LANE	$ 426,000	5	COM	138	45.5	2900	6497	0.43
1	NORTH 15TH STREET_1	Major Rehabilitation	LOCUST STREET	SUNSET CIRCLE	$ 611,000	5	ACC	172	46.5	1090	10175	0.67
1	NORTH 15TH STREET_1	Minor Rehabilitation	SUNSET CIRCLE	City Limits	$ 26,000	5	ACC	75	64.0	660	5172	0.40
1	GREENE STREET_1	Minor Rehabilitation	City Limits	VISION PARKWAY	$ 49,000	5	COM	89	59.8	2900	9744	0.69
1	SOUTH 4TH STREET_1	Minor Rehabilitation	OLD PORTLAND ROAD	COTTAGE STREET	$ 20,000	7	ACC	215	66.0	160	3882	0.25
1	GREENE STREET_1	Reconstruction	SOUTH 12TH STREET	SOUTH 10TH STREET	$ 380,000	5	COM	242	30.3	8500	2223	0.13
2	GREENE STREET_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 505,000	5	PCC	221	60.5	5100	2886	0.11
1	MAIN STREET_1	Reconstruction	HWY 169	SOUTH 7TH STREET	$ 607,000	7	BRK		25	700	1619	0.06
1	RAPIDS STREET_1	Reconstruction	NORTH 15TH STREET	NORTH 9TH STREET	$ 1,480,000	7	BRK		25	160	942	0.40
1	2023 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
1	2024 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
1	2025 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 4,599,000						43140	27.14

Capital Improvement Plan – List of Recommended Projects (Phase 2 – FY2026-FY2028)

Revised with Addendum 1

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
2	CHANCE COURT_1	Major Rehabilitation	W Dead End	SOUTH 14TH STREET	$ 154,000	7	ACC	258	50.0	434	2268	0.15
2	PRAIRIE STREET_1	Major Rehabilitation	SOUTH 11TH STREET	SOUTH 12TH STREET	$ 90,000	7	ACC	228	51.9	980	1501	0.10
2	PROSPECT AVENUE_2	Minor Rehabilitation	HWY 6	288TH TRAIL	$ 92,000	6	PCC	166	55.5	880	4363	0.34
2	GREENE STREET_1	Reconstruction	SOUTH 18TH STREET	SOUTH 12TH STREET	$ 1,260,000	5	PCC	217	48.5	7600	7420	0.42
2	SOUTH 12TH STREET_2	Reconstruction	S Dead End	GREENE STREET	$ 471,000	7	PCC	324	0.0	434	2152	0.14
2	SOUTH 18TH STREET_1	Reconstruction	BRICKYARD ROAD	MAIN STREET	$ 493,000	7	PCC	232	41.0	770	2893	0.15
2	SOUTH 10TH STREET_2	Reconstruction	Bryan St	S Dead End	$ 1,028,000	7	PCC	354	35.3	270	4704	0.31
2	2026 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
2	2027 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
2	2028 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 4,083,000						25301	25.61

Capital Improvement Plan – List of Recommended Projects (Phase 3 – FY2029-FY2032)

Revised with Addendum 1

Project Phase	Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
3	HORSE AND BUGGY DRIVE_1	Major Rehabilitation	SOUTH 19TH STREET	SOUTH 16TH STREET	$ 205,000	7	ACC	320	40.3	434	2776	0.20
3	RAPIDS STREET_1	Major Rehabilitation	NORTH 9TH STREET	HWY 169	$ 73,000	7	ACC	206	49.5	901	922	0.06
3	NORTH 10TH STREET_1	Major Rehabilitation	RAPIDS STREET	582' From GROVE STREET	$ 173,000	7	ACC	254	48.5	712	2482	0.18
3	PLEASANT STREET_1	Major Rehabilitation	HYVUE STREET	SOUTH 16TH STREET	$ 171,000	7	COM	288	46.0	434	2447	0.15
3	COURT STREET_2	Minor Rehabilitation	NORTH 7TH STREET	NORTH 6TH STREET	$ 5,000	7	COM	179	66.5	923	922	0.06
3	COTTAGE STREET_1	Minor Rehabilitation	HWY 169	SOUTH 7TH STREET	$ 5,000	7	COM	200	67.5	1328	892	0.06
3	SOUTH 11TH STREET_1	Minor Rehabilitation	CASSIDY CURVE	SUNDANCE CIRCLE	$ 37,000	7	PCC	313	53.5	550	1570	0.10
3	SOUTH 11TH STREET_2	Minor Rehabilitation	GREENE STREET	PRAIRIE STREET	$ 56,000	7	PCC	270	67.5	510	2430	0.13
3	PRAIRIE STREET_1	Minor Rehabilitation	SOUTH 18TH STREET	SOUTH 15TH STREET	$ 78,000	7	PCC	208	54.5	270	3096	0.22
3	GREENWOOD DRIVE_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 583,000	7	PCC	326	23.8	640	2993	0.20
3	NORTH 15TH STREET_1	Reconstruction	GROVE STREET	LOCUST STREET	$ 160,000	5	ACC	241	53.1	1090	920	0.07
3	PRAIRIE STREET_1	Reconstruction	SOUTH 13TH STREET	SOUTH 12TH STREET	$ 150,000	7	ACC	228	51.9	980	880	0.07
3	SOUTH 7TH STREET_2	Reconstruction	COTTAGE STREET	PRAIRIE STREET	$ 560,000	7	ACC	335	33.3	574	2790	0.20
3	SOUTH 9TH STREET_2	Reconstruction	GREENE STREET	345' From GREENE STREET	$ 156,000	7	PCC	282	38.0	1080	920	0.07
3	GROVE STREET_1	Reconstruction	North 15th St	11th st pl	$ 680,000	5	ACC	272	29.3	2160	3606	0.26
3	COURT STREET_2	Reconstruction	NORTH 15TH STREET	NORTH 10TH STREET	$ 1,200,000	7	BRK	N/A	25.0	406	5010	0.34
3	COURT STREET_2	Reconstruction	HWY 169	NORTH 7TH STREET	$ 300,000	7	BRK	N/A	25.0	1722	920	0.06
3	2029 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2030 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2031 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
3	2032 Annual Maintenance Program	Restoration	Location	Varies	$ 165,000	N/A	Varies	N/A	N/A	N/A		8.00
Total					$ 5,252,000						35576	34.43

Additional Recommended Projects for Consideration (Projects Previously Included in Recommended CIP)

Revised with Addendum 1

Branch	Recommended Treatment Type	From	To	Est. Cost	Functional Class	Surface	IRI	CityPCI	AADT	Area (Sy)	Length (Miles)
SOUTH 14TH STREET_1	Major Rehabilitation	LYNN DRIVE	PENOACH DRIVE	$ 213,000	7	COM	392	40.7	151	3539	0.19
OLD PORTLAND ROAD_2	Minor Rehabilitation	567' From SOUTH 4TH STREET	SOUTH 4TH STREET	$ 9,000	7	ACC	278	55.5	160	1641	0.11
BRYAN STREET_1	Reconstruction	SOUTH 10TH STREET	HWY 169	$ 371,000	7	PCC	544	39.7	434	1748	0.12
NORTH 14TH STREET_1	Reconstruction	GROVE STREET	N Dead End	$ 397,000	7	PCC	238	26.3	224	1926	0.13
NORTH 17TH STREET_1	Reconstruction	COURT STREET	RAPIDS STREET	$ 151,000	7	PCC	208	17.5	101	729	0.07
NORTH 6TH STREET_1	Reconstruction	COURT STREET	RAPIDS STREET	$ 196,000	7	ACC	174	14.0	180	947	0.07
SOUTH 16TH STREET_1	Reconstruction	MAPLE DRIVE	HYVUE STREET	$ 315,000	7	PCC	359	23.0	500	1572	0.10
SOUTH 6TH STREET_2	Reconstruction	HWY 6	416' From RR Xing	$ 251,000	7	PCC	323	4.0	560	1111	0.08
GROVE STREET_1	Major Rehabilitation	NORTH 10TH STREET	HWY 169	$ 120,000	5	ACC	217	49.0	2160	1770	0.13
SOUTH 14TH STREET_1	Major Rehabilitation	GREENE STREET	CHANCE COURT	$ 130,000	7	ACC	275	57.0	1390	1921	0.14
ASPEN DRIVE_1	Minor Rehabilitation	SOUTH 16TH STREET	SOUTH 14TH STREET	$ 50,000	7	PCC	395	53.5	434	2093	0.14
GREENWOOD DRIVE_1	Minor Rehabilitation	SOUTH 11TH STREET	SOUTH 10TH STREET	$ 27,000	7	PCC	191	72.0	640	1078	0.07
GROVE STREET_1	Major Rehabilitation	NORTH 10TH STREET	11th st pl	$ 109,000	5	ACC	323	40.3	2160	1200	0.09
HYVUE STREET_1	Major Rehabilitation	SOUTH 14TH STREET	W Dead End	$ 379,000	7	COM	320	45.2	434	4840	0.31
MAIN STREET_1	Major Rehabilitation	NORTH 19TH STREET	SOUTH 18TH STREET	$ 116,000	7	PCC	243	69.5	434	1752	0.10
MAIN STREET_1	Major Rehabilitation	SOUTH 18TH STREET	SOUTH 15TH STREET	$ 293,000	7	ACC	259	45.0	320	3225	0.22
PRAIRIE STREET_1	Major Rehabilitation	SOUTH 11TH STREET	HWY 169	$ 198,000	7	ACC	224	56.7	1310	2524	0.18
SOUTH 15TH STREET_1	Major Rehabilitation	MEADOW ROAD	ANN AVENUE	$ 212,000	7	PCC	152	68.5	434	4315	0.25
ANN AVENUE_1	Minor Rehabilitation	SOUTH 15TH STREET	SOUTH 14TH STREET	$ 51,000	7	PCC	244	69.0	670	1940	0.12
MEADOW ROAD_1	Minor Rehabilitation	HWY 169	ROEBLING ROAD	$ 72,000	7	PCC	167	66.0	289	2785	0.18
SOUTH 14TH STREET_1	Minor Rehabilitation	PLEASANT STREET	GREENE STREET	$ 12,000	7	COM	133	84.8	1190	2294	0.13
SOUTH 19TH STREET_1	Minor Rehabilitation	HORSE AND BUGGY DRIVE	GREENE STREET	$ 26,000	7	PCC	139	65.0	434	922	0.07
GROVE STREET_1	Reconstruction	NORTH 17TH STREET	W Dead End	$ 255,000	7	ACC	401	34.0	434	1497	0.11
ORCHARD STREET_1	Reconstruction	SOUTH 14TH STREET	SOUTH 13TH STREET	$ 183,000	7	PCC	316	32.0	434	1068	0.08
RAPIDS STREET_1	Reconstruction	NORTH 16TH STREET	383' From NORTH 17TH STREET	$ 478,000	7	PCC	330	26.8	393	2161	0.14
				$ 4,614,000						50599	3.30

Map 7

Phase 1 Projects Overview

Legend

Projects

- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

Municipal Boundary

- Municipal Boundary

* Revised with Addendum 1

* Does not include roads not maintained by City of Adel, such as State and Federal highways

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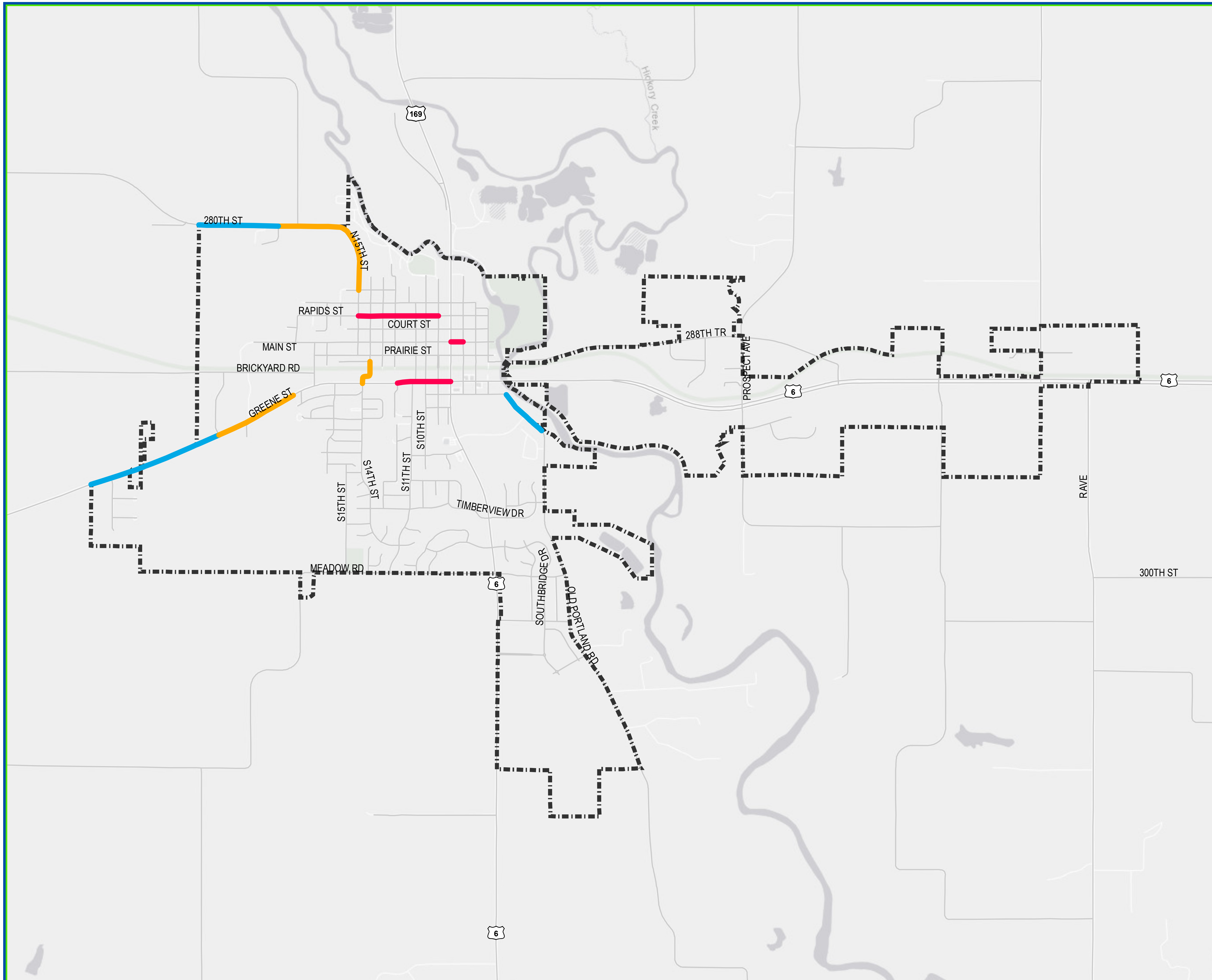
0 1,250 2,500 Feet

1 inch = 2,500 feet

HRGreen



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ADEL
THRIVE WITH US

Map 8
Phase 2 Projects Overview

Legend

Treatment
- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

Municipal Boundary
- Municipal Boundary

* Revised with Addendum 1

* Does not include roads not maintained by City of Adel, such as State and Federal highways

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0 1,250 2,500 Feet
1 inch = 2,500 feet

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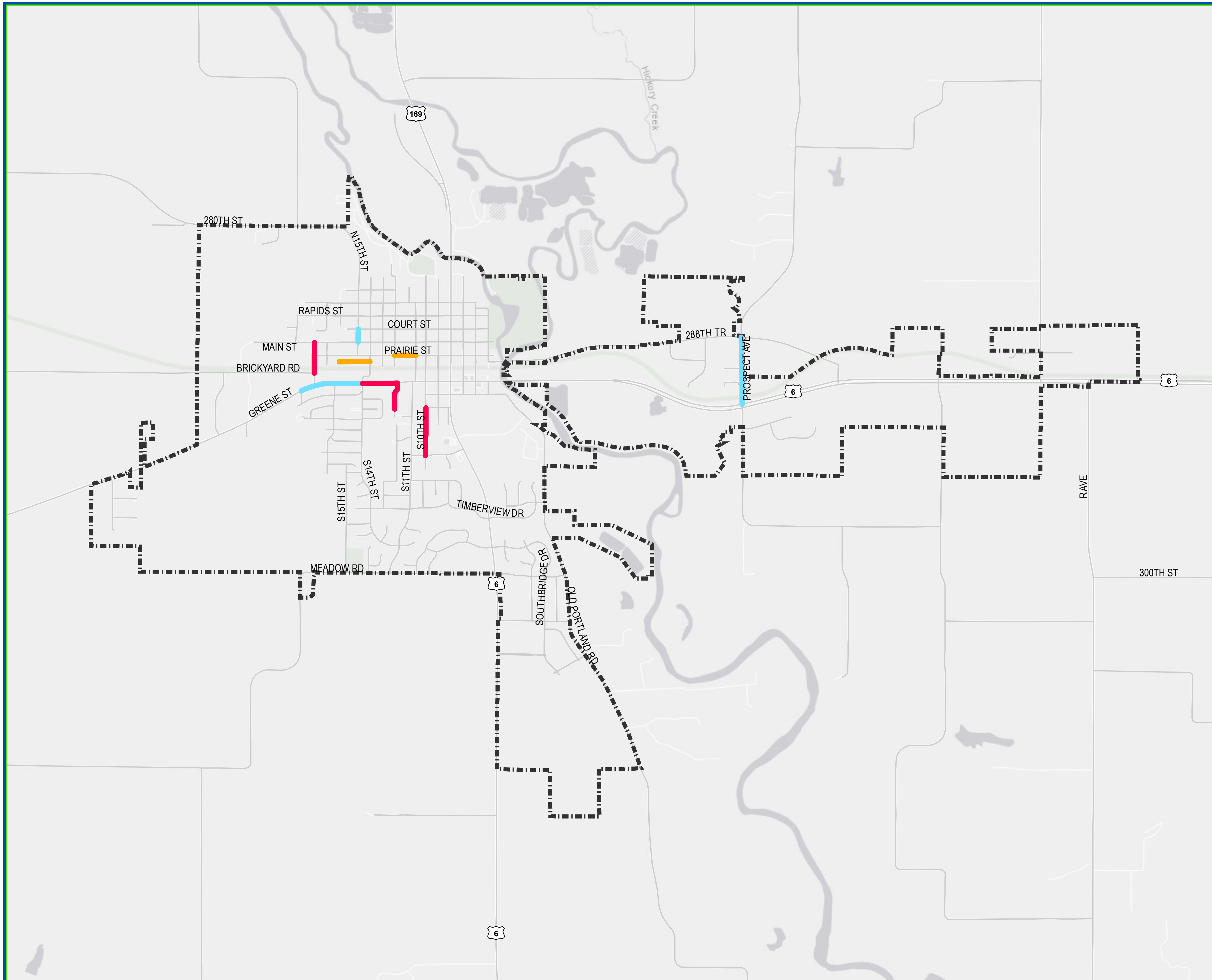

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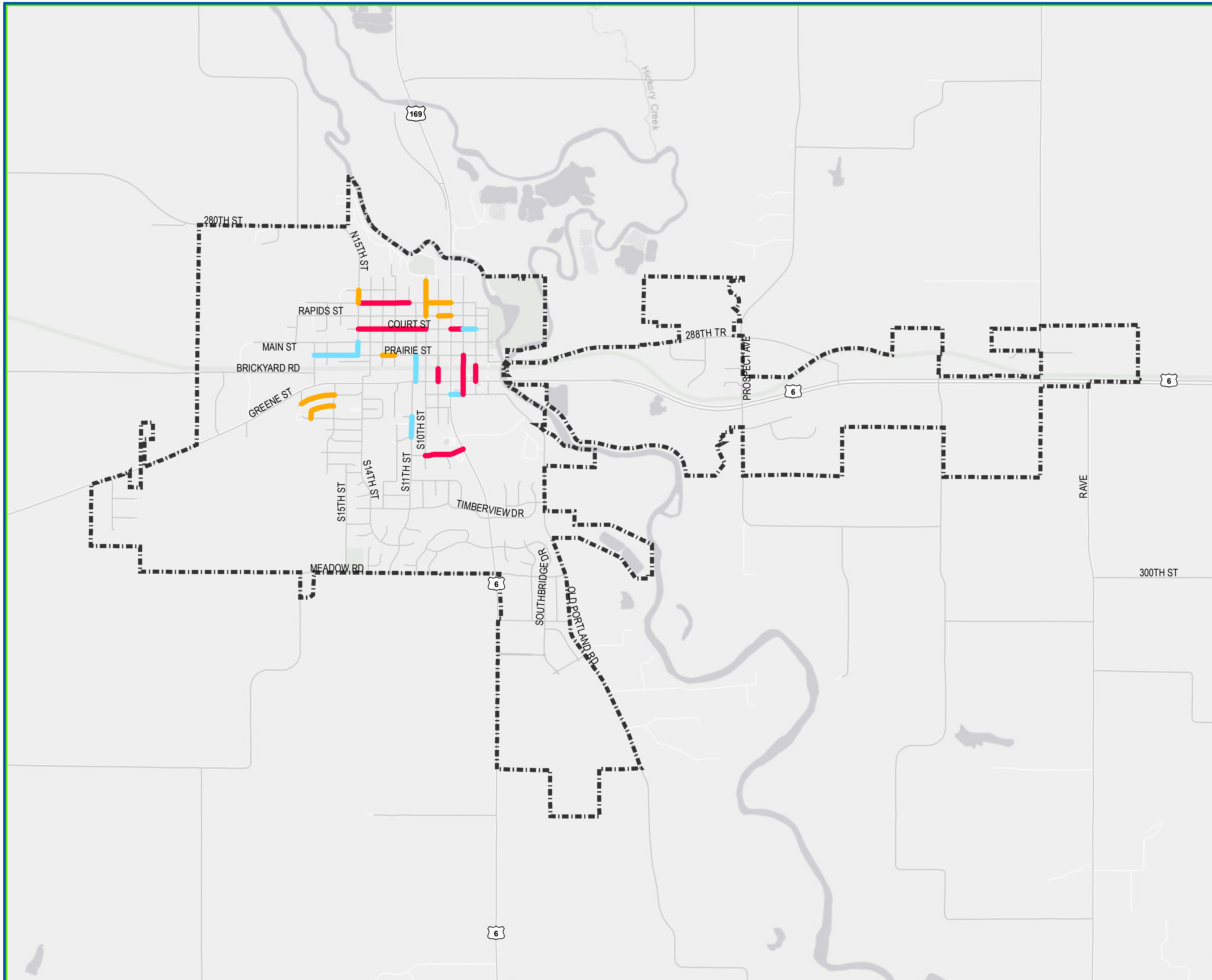
ADEL
THRIVE WITH US

Map 9
Phase 3 Projects Overview

Legend

Treatment
- Minor Rehabilitation
- Major Rehabilitation
- Reconstruction
- No Data

Municipal Boundary
- Municipal Boundary



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1 inch = 2,500 feet

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