City of Oakes, North Dakota

Street Improvements Engineering Report Project No. 19701 July 2022

moore engineering, inc.

Contents

I. General

Purpose

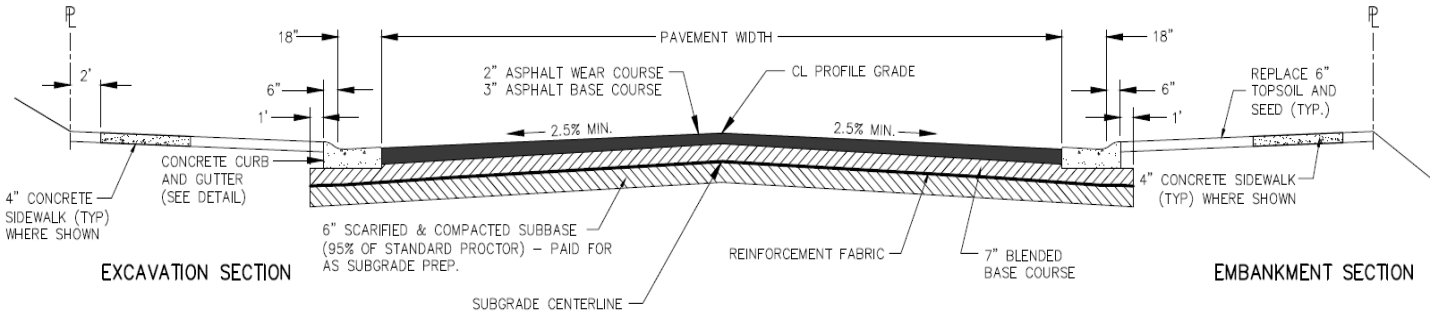
The purpose of this Engineer's Report is to provide the City of Oakes a detailed explanation of the existing conditions of the city streets and the proposed improvements.

Scope

Moore Engineering previously conducted a city wide street assessment in 2015, at that time many blocks needed work, but because funding was limited, only ½ of the streets that needed work were addressed. Moore Engineering then re-completed the street survey in 2019 with the remaining blocks that were left out of the 2015 project, but no action was taken. A follow up review was conducted in early June of 2022 and those results will be presented in this report.

Existing Street System Information

The street system in Oakes consists mainly of asphalt or gravel surfacing. Residential streets are typically 41' wide from back of curb, and have an asphalt pavement width of 37'. The residential streets are typically built with 5" of asphalt on top of 6"-9" of aggregate base, with geosynthetic fabric underneath. The length of time since the last improvements were completed to streets throughout the city varies from 7 to 27 years with the last street treatment occurring in 2015. A map showing the maintenance history of the streets can be found in Appendix A.



TYPICAL URBAN STREET SECTION – RESIDENTIAL

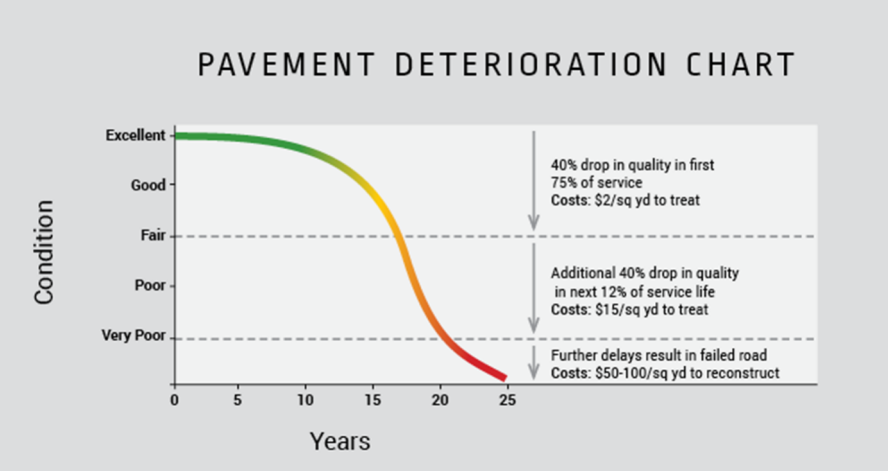
NO SCALE

Need for Project

Adequate pavement maintenance is an aspect of public infrastructure that is often overlooked. Funding options are limited for street repairs, and if the streets are not regularly maintained, they are often expensive to replace. The implementation of an asphalt pavement maintenance program will sustain the performance of the streets and maximize the useful life of the pavement.

- Bad Pavement Maintenance Program: Under this scenario, no routine inspections are completed, and no preventative maintenance is completed. A typical residential asphalt street will last on average 20 years until failure without any maintenance.
- Better Pavement Maintenance Program: If streets are inspected and evaluated every 10 to 20 years, pavement condition and performance is likely to have significantly deteriorated, resulting in more aggressive and expensive treatments required to restore the streets to an acceptable service level.
- Best Pavement Maintenance Program: With regular inspections (every 2 to 5 years), pavement deficiencies are noticed in the early stages and can be repaired before they are allowed to progress and cause significant performance issues.

II. Discussion of Street Deficiencies



Pavement distress generally refers to the extent of which the asphalt has cracked. As pavement ages, the first cracks appear across the roadway width (transverse) and gradually become spaced closer together. Then, cracks begin to appear in the direction of vehicle travel (longitudinal), and at first follow the original seams of the pavement. As the pavement continues to age, the longitudinal and transverse cracks become interconnected. This is referred to as block cracking, and typically presents in roughly 10' x 10' squares. Block cracking is the result of long term temperature cycling of the pavement, and is an indicator that the

asphalt cement binder is hardening and becoming more brittle. If not addressed, block cracking will eventually progress into fatigue cracking or "alligator cracking" which is defined as blocks of 1'x1' or less. While block cracking is typically associated with pavement age, fatigue cracking is most often caused by heavy or high volume traffic, or inadequate pavement thickness or subgrade support. Fatigue cracking suggests that the failure has surpassed the asphalt surface and has extended into the road base and subgrade. Each roadway is checked for the presence of pavement patches, the condition of any existing patches, and finally whether or not there are any potholes. Surface patches are square or rectangular areas of newer pavement that was replaced to correct other deformities in the road, such as a pothole. Patches, depending on the reason they were installed, often do not perfectly match the roadway profile and create bumps in the road.

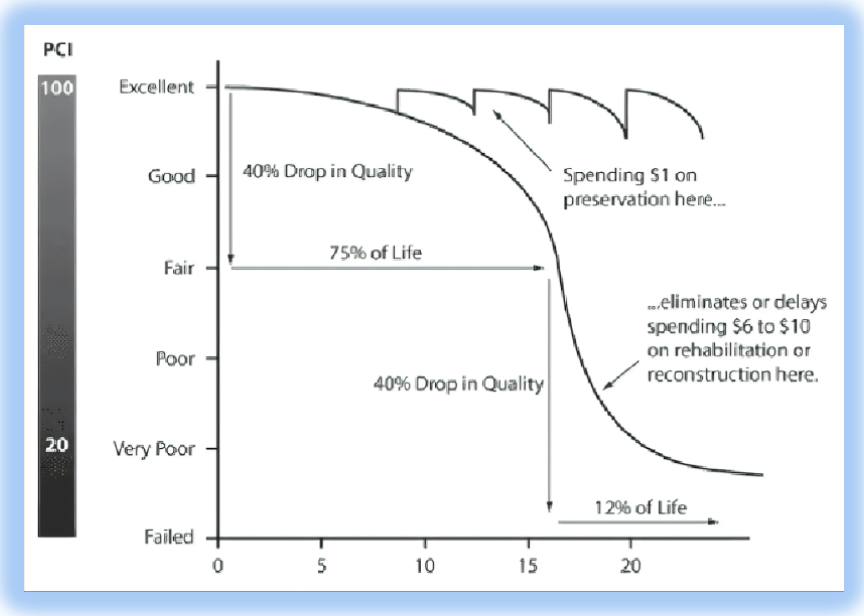
Surface deformation is generally any abnormality that changes the profile of the roadway. The evaluation considers settlement, frost heave, bumpy transverse cracks, and rutting to be surface deformities. Surface deformities begin as distortion such as settlement and frost heave. Settlement is mostly constrained to newer developments that continue to experience some degree of soil consolidation between 5 and 10 years after the installation of utilities. Frost heave is experienced seasonally during the transition from fall into winter when moisture in the underlying soil freezes and expands. Surface deformation also includes transverse cracks that have not been sealed. As transverse cracks continue to age, they erode and become wider. The widened cracks allow water to penetrate into the cracks and saturate the aggregate base. As traffic drives over the cracks, it pushes the water back out of the crack, and carries fine aggregate with it. Over time, a portion of the aggregate base under the crack is lost and the asphalt pavement settles down to fill the empty space, and the crack becomes bumpy. Rutting occurs when the pavement settles or is pushed aside in the vehicle wheel path. Rutting is usually experienced on highways with high volume or heavy truck traffic, and happens generally during the summer months when the properties of 'flexible pavement' are amplified when pavement temperatures are hot.

Surface defects are irregularities in the pavement caused by wear. The three surface defects evaluated are raveling, flushing, and polishing. Raveling is the loss of surface material of the pavement, and is caused by cold weather construction, traffic wear and/or asphalt hardening

due to aging. Slight to moderate raveling includes loss of fine aggregate particles on the roadway surface that expose larger aggregate, while severe raveling includes loss of the larger surface aggregate. Flushing is defined as excess asphalt cement visible on the roadway surface, and is caused either by heavy traffic or an initial asphalt mix design containing too much asphalt cement. Polishing is the smoothing of the roadway surface caused by traffic wearing off the sharp edges of the surface aggregate. Polishing of the asphalt surface creates problems with traction, especially during wet or frozen conditions.

III. Discussion of Results and Proposed Improvement Recommendations

The results of the street survey indicated a variety of pavement issues. Many of the existing streets are in good condition and would only need minor maintenance to extend the life of the pavement. Ranging from minor to major, the proposed improvements include: 1. seal coat (chip sealing), 2. micro-surfacing, 3. mill and overlay, and 4. full reconstruction.



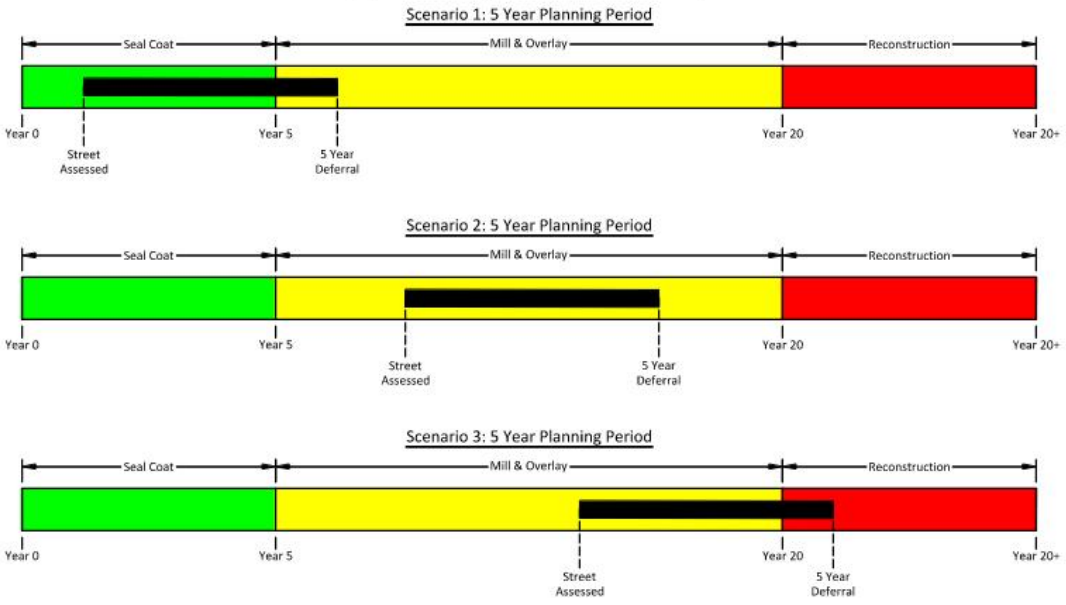
1. Seal coats are one of the most basic asphalt maintenance measures and include a thin layer of liquid with embedded rock chips. Sealing protects the asphalt from the elements.
2. Micro-sealing, which is similar to a slurry seal, consists of a mixture of asphalt emulsion, aggregate and a polymer additive. Micro-sealing is a step above a chip seal in performance and structural performance, and can achieve minor rut filling and leveling.
3. Mill and overlay is used when the surface defects are at a point where chip sealing or micro-sealing will not provide any long term benefits, the suggested method is to mill off the top 2” and place a new 2” layer of asphalt.
4. The final method proposed is a total reconstruct, this would be done on streets that have deteriorated beyond repair. The reconstruct would involve removing the existing asphalt

and any gravel below, performing subgrade work to obtain a stable base, placing fabric and 6” of aggregate base then paving 5” of asphalt to finished elevations.

IV. Maintenance and Life Expectancy

Asphalt streets will continue to deteriorate as they age, regardless of the frequency of maintenance. As such, it is helpful to consider the difference in relative life cycle costs between a seal coat and a mill and overlay, which are the two most common treatments for streets with the same average age as those found in the City of Oakes. On average, the cost of a mill and overlay is between 4 and 5 times higher than that of a seal coat. A seal coat can be reasonably expected to last between 7 and 10 years. A mill and overlay is expected to last between 10 and 15 years. It is also beneficial to consider the range of street conditions for which a given treatment is compatible. For example, a seal coat is effective mainly as a regularly scheduled preventative measure, extending the life of the pavement, and can remedy slight to moderate surface defects as well as hairline cracks. Essentially, seal coats are an effective treatment for the earliest signs of street deficiencies. A seal coat is much like an oil change for a vehicle. It is not advisable to wait until defects start showing up, but rather schedule maintenance regularly regardless of condition. Similar to a vehicle, it is not advisable to wait to change the oil until the engine starts having issues. That is the intent of “preventative maintenance”. Mill and overlay,

Figure A: Example Treatment Windows



however, is an improvement to the pavement, and is an effective treatment for a much broader range of street conditions, up to the point of addressing fatigue cracking. Because a mill and overlay can treat a wider range of street conditions, if a street requiring a mill and overlay is put off for a period of 5 years, it may still be that a mill and overlay is still the correct treatment. On the other hand, if a street requiring a seal coat is put off for 5 years, there is a significant chance that the street condition will degrade to the point where a mill and overlay is now required. In Scenario 1, the street was assessed as a seal coat, but was deferred for 5 years. After the 5 year deferral, the same street now needs a mill and overlay. In Scenario 2, the street was assessed as a mill and overlay, but was deferred for 5 years. After the 5 year deferral, a mill and overlay is still the correct treatment. In Scenario 3, the street was assessed as a mill and overlay, but was deferred for 5 years. After the 5 year deferral, the street now needs reconstructing.
While a mill and overlay can treat a broader range of street conditions, it is still possible that deferring a mill and overlay could result in a street that needs reconstructing. Then, it becomes important to note that streets are best addressed and treated before the "tipping point" from seal coat to mill and overlay, or from mill and overlay to reconstruction. However, in practice there is not a clearly defined "line" between the need for one improvement to the other, but more so a range or spectrum. For this reason it is recommended that seal coating streets be considered as part of regularly scheduled preventative maintenance.

V. Proposed Improvements

The proposed improvements include treatment recommendations to all asphalt streets. The attached maps show the most recent history of improvements, with no work being completed since 2015. By next construction season, the minimum street age will be 8 years.

The older streets that have not been addressed since 2009 vary in age from 14-27 years old and are intended to receive the more significant treatment methods of micro-surfacing, mill and overlay and full reconstruction. The streets that have been done since 2009 are between 8-14 years old and are generally scheduled for more minor treatment methods such as seal coating. There are some gravel streets in town that are scheduled to receive asphalt paving as well.

The total cost for the city wide street improvements recommended in this report are estimated to be $4.7 million. A map showing proposed improvements can be found in Appendix A with a detailed cost estimate to be found in Appendix B.

Planning for the Future

Even with a sound pavement improvement plan, pavement maintenance such as crack sealing and crack rehabilitation remain a top priority for street integrity. Moisture ingress is the most frequent cause of premature road failure. As such, an aggressive approach to crack sealing can significantly reduce moisture ingress and prolong the useful life of the pavement. If no other serious pavement issues are present, it is recommended that any open cracks in the fall are sealed every 1-2 years. Additionally, seal coats should be applied every 7 to 10 years to keep the asphalt surface sealed, unless pavement conditions warrant a more aggressive improvement such as a mill and overlay.

VI. Funding and Repayment Scenarios

As funding options are very limited for street projects, cities are typically required to finance street projects either through cash on hand, loans, or improvement bonds. Seal coats which are classified as maintenance improvements are intended to be funded with cash on hand through the General Fund. These improvements would be completed without direct financial contribution from the residents. Major improvements such as mill and overlays and reconstructs would be financed through improvement bonds or infrastructure loans and repaid through special assessments. The city council will make a final decision on financing that best suits the needs of the city and balances the contribution required from the residents.

Legend

Paving Projects

- 1995
- 2003
- 2005
- 2009
- 2012
- 2013
- 2015

87TH ST SE
87TH ST
8TH ST N
DAKOTA AVE
15TH ST N
INDUSTRIAL PARK A AVE
14TH ST N
INDUSTRIAL PARK B AVE
ASPEN DR
BURLWOOD DR
CHESTNUT CR
INDUSTRIAL PARK C AVE
DOGWOOD AVE
DOGWOOD AVE N
6TH ST N
ST CHARLES CT N
9TH ST N
ELM AVE N
EVERGREEN AVE
GLENWOOD AVE N
11TH ST
FIR AVE N
GRAPE AVE N
4TH ST N
5TH ST N
6TH ST N
8TH ST N
9TH ST N
10TH ST N
11TH ST N
12TH ST N
13TH ST N
HICKORY AVE N
15TH ST N
16TH ST N
17TH ST N
MAIN AVE
IVY AVE S
FIRST ST S
JUNIPER AVE S
2ND ST S
3RD ST S
4TH ST S
6TH ST S
8TH ST S
9TH ST S
10TH ST S
11TH ST S
12TH ST S
13TH ST N
14TH ST N
JUNIPER AVE
KOLA AVE S
LILAC AVE S
5TH ST S
MAPLE AVE S
NECTARINE AVE S
OAK AVE S
PINE AVE S
QUINCE AVE S
REDWOOD AVE S
SPRUCE AVE S
SCOTCH AVE S
ZEE LN

PREVIOUS PAVING PROJECTS - 2015 & OLDER
ASPHALT STREET REHABILITATION
CITY OF OAKES, NORTH DAKOTA

N
W
E
S

0 350 700 1,400 Feet

1 in = 700 feet

Created By: TJS Date Created: 07/07/22 Date Saved: 07/07/22 Date Plotted: 08/25/16 Date Exported: 07/07/22
Plotted By: Tanner.Schmidt Parcel Date: N/A Aerial Image: 2021 County NAIP SIDS Elevation Data: Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
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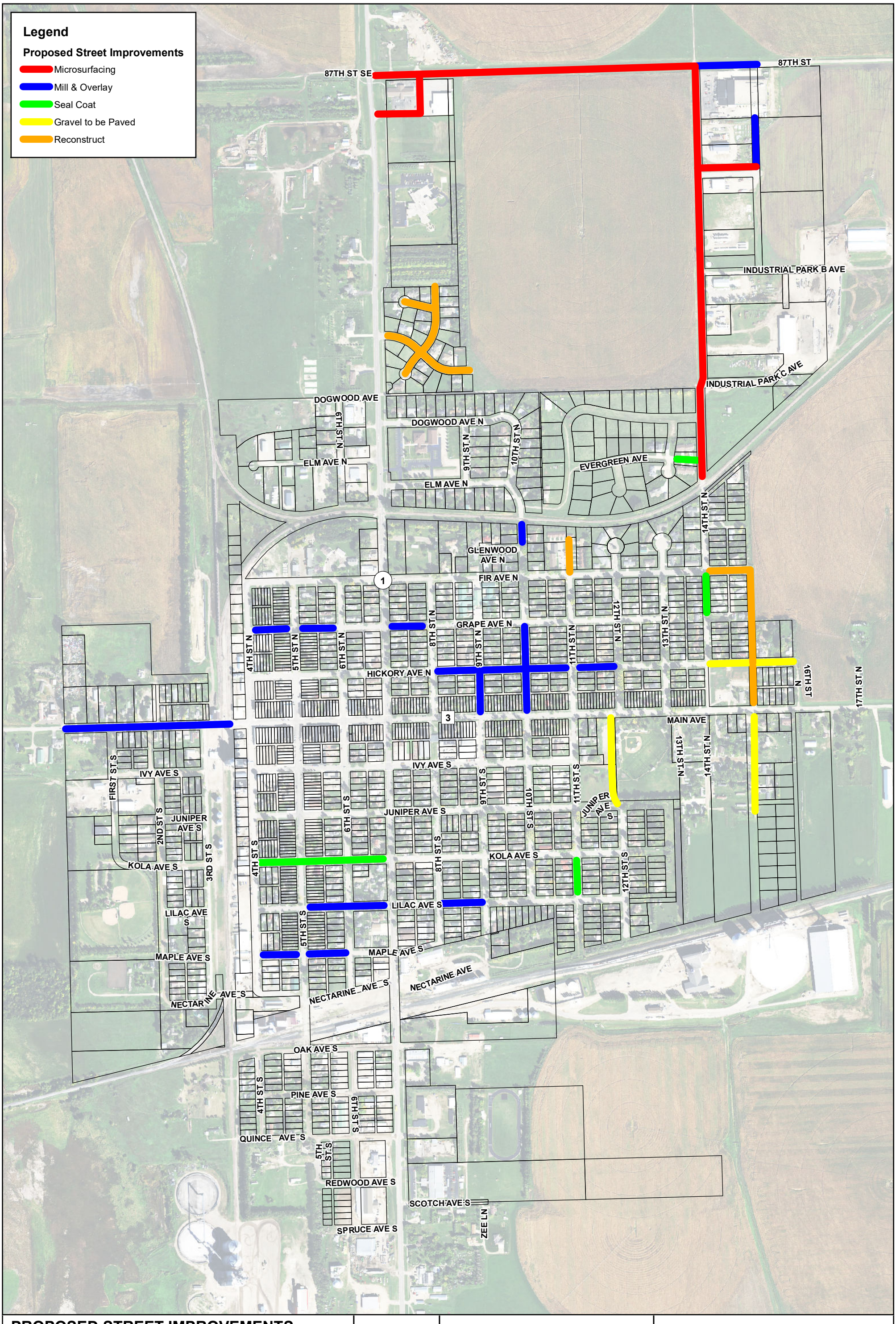

PROPOSED STREET IMPROVEMENTS
ASPHALT STREET REHABILITATION
CITY OF OAKES, NORTH DAKOTA

Created By: TJS Date Created: 06/29/2022 Date Saved: 06/29/22 Date Plotted: 08/25/16 Date Exported: 06/29/22
Plotted By: Tanner.Schmidt Parcel Date: N/A Aerial Image: 2021 County NAIP SIDS Elevation Data: Lidar
Horizontal Datum: NAD 1983 StatePlane North Dakota South FIPS 3302 Feet Vertical Datum: NAVD1988
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N
W E
S

0 350 700 1,400 Feet

1 in = 700 feet

moore engineering, inc.

Project #: 19701
Date Created: 6/23/2022

CITY-WIDE STREET REHABILITATION
STREET IMPROVEMENT DISTRICT NO. 2020-1
OAKES, ND

Engineer's Preliminary Opinion of Probable Cost

BID ITEM NO. & DESCRIPTION		*UNIT*	*QUANTITY*	*UNIT PRICE*	*TOTAL*
BASE BID					
1.	Mobilization	LS	1	$200,000.00	$200,000.00
2.	Removal of Concrete Pavement	SY	70	$25.00	$1,750.00
3.	Removal of Bituminous Surfacing	SY	500	$11.00	$5,500.00
4.	Full Depth Reclamation	SY	13,650	$6.50	$88,725.00
5.	Topsoil Stripping	SY	5,650	$1.50	$8,475.00
6.	Aggregate - Salvage Existing	SY	6,150	$4.25	$26,137.50
7.	Milling Pavement Surface	SY	37,850	$2.00	$75,700.00
8.	Subgrade Preparation-Type A-12In	SY	21,850	$3.75	$81,937.50
9.	Geosynthetic Material Type R1	SY	21,850	$3.50	$76,475.00
10.	Blended Base Course	SY	21,830	$12.00	$261,960.00
11.	Aggregate Base Course Cl 5	CY	1,500	$35.00	$52,500.00
12.	Superpave FAA 42	TON	9,800	$115.00	$1,127,000.00
13.	Driveway Concrete	SY	1,800	$110.00	$198,000.00
14.	Curb & Gutter-Type I	LF	6,450	$50.00	$322,500.00
15.	Sidewalk Concrete 4In	SY	100	$100.00	$10,000.00
16.	ADA Ramp	SY	150	$125.00	$18,750.00
17.	Detectable Warning Panels	SF	50	$55.00	$2,750.00
18.	Asphalt Crack Repair	LF	7,900	$1.50	$11,850.00
19.	Micro-Surfacing	SY	28,850	$4.00	$115,400.00
20.	Patching	SY	1,000	$125.00	$125,000.00
21.	Seal Coat	SY	8,500	$2.80	$23,800.00
22.	Striping	LF	330	$8.00	$2,640.00
23.	Topsoil Replacement	SY	5,750	$2.00	$11,500.00
24.	Seeding Class III	SY	5,750	$2.00	$11,500.00
25.	Hydraulic Mulch	SY	5,750	$1.80	$10,350.00
26.	Stormwater Management	LS	1	$18,000.00	$18,000.00
27.	Traffic Control	LS	1	$20,000.00	$20,000.00
28.	Testing Allowance	ALL	1	$25,000.00	$25,000.00
				Total - Base Bid	*$2,933,200.00*
ALTERNATE NO. 1					
1.	Seal Coat	SY	166,600	$2.10	$349,860.00
				Total - Alternate No. 1	*$349,860.00*
				Construction Subtotal	$3,283,060.00
				Contingencies (~20%)	$656,940.00
					$3,940,000.00
				Prelim Engineering	$60,000.00
				Design Engineering	$275,000.00
				Construction Engineering	$375,000.00
				Advertising & Publishing	$3,000.00
				Legal and Bond Counsel	$25,000.00
				Special Assessments (Attorney, Eng & Publishing)	$30,000.00
				TOTAL PROJECT COST	**$4,708,000.00**

Note:
The Engineer's Opinion of Probable Cost is based on average unit prices of similar scope and quantity of work in a similar region. The quantities are estimated until final plans are prepared. The figures above will be revised to include the actual quantities after final bidding plans and specifications have been prepared and actual unit prices based on the lowest responsible and responsive bidder .