NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

Infrastructure Needs: North Dakota's County, Township and Tribal Roads and Bridges: 2026-2045

Report to the North Dakota Legislative Assembly

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Executive Summary

This report is the response to the North Dakota Legislature's request for a study of the transportation infrastructure needs of all counties, townships and Tribes in the state.

In 2019, the North Dakota Legislature advanced HB 1066 which had a provision for funding distributions to non-oil producing counties based on the most recent version of this study. HB 1066 also stated: "If the data compiled by the upper great plains transportation institute includes more than one twenty-year estimate for the total needs of each county, the state treasurer shall use an average of the twenty-year estimates for each County."

In this report, the Upper Great Plains Transportation Institute (UGPTI) estimated infrastructure needs using the most current production forecasts, traffic estimates, and roadway inventory and condition data available. Agricultural- and oil-related traffic are modeled in detail at the sub-county level. Oil-related traffic is predicted for individual spacing units, whereas agricultural production is estimated at the township level.

A comprehensive data collection effort offers the most complete and up-to-date information on the condition of the state's county and township road network. UGPTI obtained a portable road profiler in 2023 to collect pavement condition data and continued to use it for this study. Traffic counts were collected on the county and township road system across the entire state since 2023. The effort was a combination of additional counts requested of NDDOT along with vehicle classifications conducted by NDSU-UGPTI students and a consultant. The data was used to calibrate a statewide travel demand model which was used to forecast future traffic levels. The GRIT (Geographic Roadway Inventory Tool) was used to gather and verify county roadway inventory information such as base thickness, pavement age, and pavement thickness, directly from local road authorities.

An enhanced county-level survey was developed to assess unpaved roadway component costs such as blading, gravel purchasing, hauling, and placement costs for each of the 53 counties in North Dakota. Training on how to accurately complete the survey was provided to counties via a live and recorded webinar. A secondary analysis of survey results was performed to identify significant variations from county to county by region within the state.

The bridge analysis underwent significant changes to accommodate the FHWA discontinuation of the bridge sufficiency rating (SR) in the 2020 study. In recent years, states have been developing a replacement index that fits their jurisdictions. The 2022 study advanced a new Bridge Needs Target (BNT) through use of a county expert panel. The analysis routine used the BNT for the first time in that study. The BNT routine was used once again in this new 2026 study. A brief new section addressing major culvert bridges has also been added. Additionally, the North Dakota Department of Transportation (NDDOT) added consultant resources to the load rating of non-state bridges which resulted in more local bridges with a reduced load rating. In addition to major structures included in the National Bridge Inventory data, UGPTI estimated the needs for minor structures (less than 20 feet in span) in the 2024 study which were not previously included due to data limitations. Minor structure needs are once again included in this current report for the 2026 – 2045 twenty-year study.

For traffic forecasting, the UGPTI developed a travel demand model (TDM) for the entire state. The TDM network includes the origins of key inputs to the oil production process (e.g., fresh water, sand, scoria, gravel, and pipe), destinations for crude oil and saltwater shipments, and the capacities of each source or destination. The origins of movements on the highway network include railroad stations where sand, pipe, and other inputs are transferred from rail to truck. The destinations of crude oil shipments include refineries and railroad and pipeline transfer facilities. In the model, the estimated capacities of transfer sites are expressed in throughput volumes per day, while the capacities of material sources are expressed in quantities of supplies available during a given time period. Similarly, an agricultural sub model was developed to model truck movements of agricultural production across the state from farms to elevators and processors. The nine largest commodities by volume were modeled explicitly as part of TDM process.

Using the TDM, inputs and products are routed to and from wells to minimize time and/or cost, subject to available supplies and capacities. A comparable model is used to predict the trips of each crop produced in each township to elevators and/or processing plants, subject to the demands of these facilities. When all trips have been routed, the individual movements over each road segment are summed to yield the total truck trips per year. Using truck characteristics and typical weights, these trips are converted to equivalent single axle loads (ESALs) and trips per day. These two factors, in conjunction with the condition ratings and structural characteristics of roads, are used to estimate the improvements and maintenance expenditures needed for the expected traffic. While the focus is on agricultural- and oil-related activities, other movements (such as farm inputs and shipments of manufactured goods) are also included in the analysis.

Unpaved Road Needs

The following types of improvements to unpaved roads are analyzed in this study: increased graveling frequency, intermediate improvements, and asphalt surfacing. On heavily impacted gravel surface roads, the graveling interval decreases and the number of bladings per month increases as traffic volumes grow. For example, a non-impacted road has an expected graveling interval of five years and a blading interval of once per month, while an impacted section has an expected gravel interval of two to five years and a blading interval of twice per month. This doubles the gravel maintenance costs over the same period.

As shown in Table A, the predicted statewide unpaved infrastructure needs estimate is $7.62 billion over the next 20 years.

Table A: Summary of Unpaved Road Investment and Maintenance Needs for Counties, Townships and Tribal Areas in North Dakota (Millions of 2026 Dollars)

Period	Statewide
2026-2027	$775.33
2028-2029	$760.31
2030-2031	$783.74
2032-2033	$785.68
2034-2035	$758.36
2036-2045	$3,764.31
2026-2045	**$7,627.73**

Paved Road Needs

The overall results of the paved road analysis show that approximately $3.587 billion in spending will be required over the next 20 years to maintain the existing paved county and Tribal road mileage in a state of repair that minimizes the need for very expensive total reconstruction projects. Table B below show higher spending in the initial 10 years, as the initial backlog of roadways in poor condition requires rehabilitation and sometimes more expensive construction projects during those years. The 2026-2027 period is lower because any 2026 projects were spread over some of those initial years. From 2036 to 2045, the total spending requirements are projected to reach approximately $1.35 billion.

Table B: Summary of Paved Road Investment and Maintenance Needs for Counties and Townships in North Dakota (Millions of 2026 Dollars)

Period	Statewide
2026-2027	$282.20
2028-2029	$541.10
2030-2031	$446.80
2032-2033	$445.80
2034-2035	$520.70
2036-2045	$1,351.00
2026-2045	**$3,587.60**

Bridge Needs

Table C shows the estimated bridge investment and maintenance needs for county, township and Tribal bridges for 2026-2045. Most of the improvement needs are determined by the study's model to be backlog needs and occur during the first study biennium. Based on past discussions with NDDOT Bridge and Local Government Divisions, these needs have been distributed evenly over the first five biennia of the study period because it would not be possible to replace all the eligible bridges in one biennium with existing construction resources.

Table C: Summary of Bridge Investment and Maintenance Needs for Counties, Townships and Tribal Areas in North Dakota (Millions of 2026 Dollars)

Period	Statewide
2026-2027	$162.23
2028-2029	$162.23
2030-2031	$162.23
2032-2033	$162.23
2034-2035	$162.23
2036-2045	$175.59
2026-2045	**$986.77**

The county, township and tribal minor structures needs are presented in Table D below. These are structures which span 20 feet or less. This study includes an analysis of these structures which range from 8 feet to 20 feet in span as directed by the UGPTI ND County Bridge Steering Committee. See the bridge section in this report for details and tables with separate and combined needs with the major structures which have a span of greater than 20 feet.

Table D: Summary of Minor Structures Investment and Maintenance Needs for Counties, Townships and Tribal Areas in North Dakota (Millions of 2026 Dollars)

Period	Statewide
2026-2027	$93.33
2028-2029	$93.33
2030-2031	$93.33
2032-2033	$93.33
2034-2035	$93.33
2036-2045	$101.03
2026-2045	**$567.65**

Total Statewide Needs

As shown in Tables E and F, the combined estimate of infrastructure needs for all county, township and tribal roads and bridges is $12.77 billion over the next 20 years. Unpaved road funding needs make up approximately 59% of the total. If averaged over the next 20 years, the annualized infrastructure need is equivalent to $638 million per year.

The values shown in Tables E and F do not include the infrastructure needs of Forest Service roads or city streets within municipal areas. The infrastructure needs of Indian reservation roads are included for the paved roads and presented separately in the report.

Table E: Summary of All Road and Bridge Investment and Maintenance Needs for Counties, Townships and Tribal Areas in North Dakota (Millions of 2026 Dollars)

Period	Unpaved	Paved	Bridges	Minor Structures	Total
2026-2027	$775.33	$282.20	$162.23	$93.33	$1,313.09
2028-2029	$760.31	$541.10	$162.23	$93.33	$1,556.97
2030-2031	$783.74	$446.80	$162.23	$93.33	$1,486.10
2032-2033	$785.68	$445.80	$162.23	$93.33	$1,487.04
2034-2035	$758.36	$520.70	$162.23	$93.33	$1,534.62
2036-2045	$3,764.31	$1,351.00	$175.59	$101.03	$5,391.93
2026-2045	**$7,627.73**	**$3,587.60**	**$986.77**	**$567.65**	**$12,769.75**

General Comparison with Recent Studies

Figure A shows that more than half of the roadway network (54%) is in fair condition. The percentage of roads in good condition increased from 23% in 2024 to 26% in 2026. The share of roads in poor condition dropped slightly from 21% to 20% between 2024 and 2026. Overall, pavement conditions across the entire system have remained relatively stable since 2024, with a small percentage of roads moving from poor or fair condition to good condition.

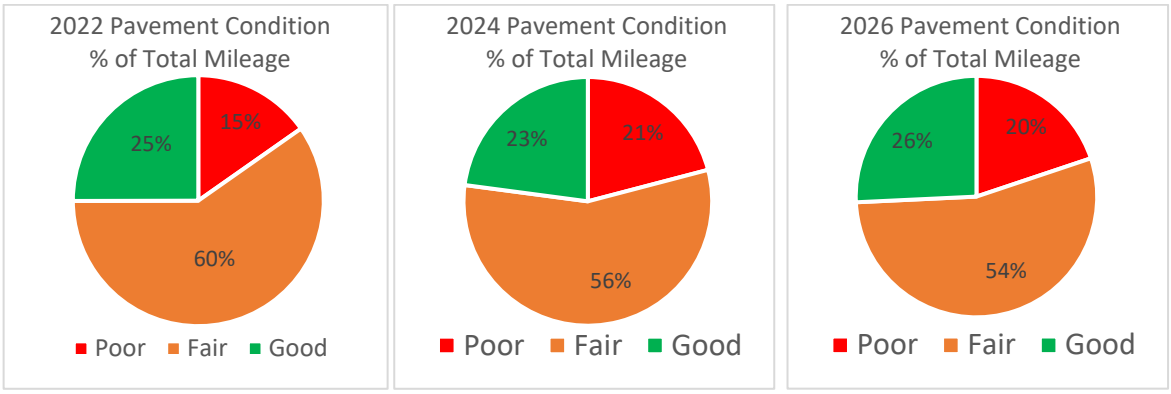


Figure A. Pavement Condition Change from 2022 to 2026

Estimates of bridge funding needs are down by 9.3% for major structures over the next 20 years compared to the last study report. The primary factor behind this decrease is the cost of construction now reflects a reduction in cost from $530 per square foot in the 2024 study to $503 in the current study. Other factors include the rapid decline of bridge conditions. There are 117 additional bridges that have decks, superstructures or substructures rated in poor condition in this study compared to the previous study. Once again, minor bridge structure needs have also been calculated with a grand total of $878 million in replacement needs for structures spanning 8 feet to 20 feet. Major and minor bridge needs totals in this report result in a 20-year grand total of $1.62 billion.

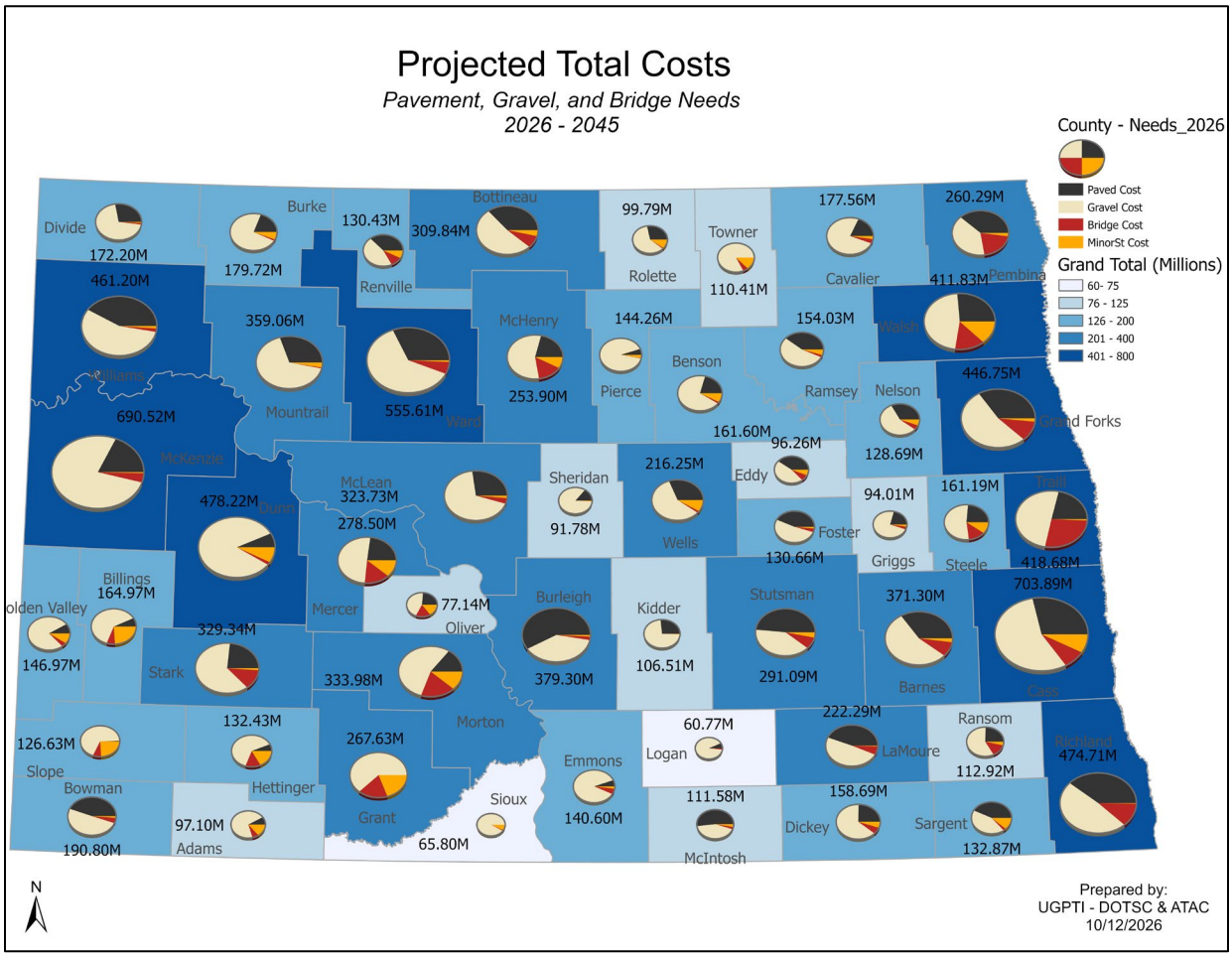


Figure B. Projected Total Costs for Pavement, Gravel and Bridges, 2026-2045

Contents

1. Introduction 1
2. Background Trends in Agriculture and Oil Development Impacting Traffic Levels on Local Roads 2
2.1. Agricultural Trends 2
2.1.1. Yield 2
2.1.2. Crop Mix 3
2.1.3. Total Production 5
2.1.4. Elevator Throughput 6
2.1.5. Combined Impact of Factors 8
2.2. Oil Production Trends 8
2.2.1. Technology 8
2.2.2. Well Productivity 9
2.2.3. Total Number of Wells 10
2.2.4. Total Production 11
3. Model Methods and Assumptions 12
3.1. Agriculture 12
3.1.1. Transportation Analysis Zones 12
3.1.2. Modeled Commodities 12
3.1.3. Crop Mix and Production 12
3.1.4. Total Acres 13
3.1.5. Yield Trends 13
3.1.6. Elevator and Processor Demands 13
3.2. Oil and Gas 14
3.2.1. Transportation Analysis Zones 14
3.2.2. Wells per Rig per Year 14
3.2.3. Well Forecasts 14
3.2.4. Spatial Forecasts 14
3.2.5. Initial Production Rates 16
3.2.6. Truck Volumes 16
3.2.7. Mode Splits 16
3.3. Road Network 16
3.4. Network Connectivity 16

3.5. Jurisdiction 17
4. Traffic Data and Model 18
4.1. Traffic Data Collection 18
4.2. Traffic Model Development 19
4.2.1. Movement Types 19
4.2.2. Distribution Networks - Agriculture 19
4.2.3. Distribution Networks – Oil Related Movements 20
4.2.4. Travel Demand Modeling Framework 21
4.2.5. Calibration Procedures 23
5. Unpaved Road Analysis 24
5.1. Costs and Practices Survey 24
5.1.1. Aggregate Description 26
5.1.2. Placement Practices 27
5.1.3. County vs. Contractor Work 27
5.1.4. Costs 28
5.1.5. Practices by Traffic Level 30
5.2. Analysis Procedures 30
5.2.1. Traffic Classification 30
5.2.2. Improvement Types 30
5.2.3. Projected Investment Needs 32
6. Paved Road Analysis 34
6.1. Truck Axle Weights 35
6.2. Trucks Used to Haul Oil Products and Inputs 35
6.3. Trucks Used to Haul Grains and Farm Products 38
6.4. Surface Conditions 38
6.5. Structural Capacity 40
6.6. Types of Roadway Improvement 41
6.7. Improvement Logic 42
6.8. Preservation Maintenance 42
6.9. Forecasted Improvement Needs 43
6.9.1. Required Overlay Thickness 43
6.9.2. Miles Improved 43

6.9.3. Improvement Costs per Mile 44
6.9.4. Indian Reservation Roads 47
7. Bridge Analysis 48
7.1. Major Structures 48
7.1.1. Data Collection 48
7.2. 7.1.1a - Major Culvert Bridges (buried structures) 49
7.2.1. Condition of County and Township Bridges 50
7.2.2. Minimum Maintenance Bridges 54
7.2.3. Methodology – Major Structures 54
7.2.4. Results – Major Structures 57
7.3. Minor Structures 60
7.3.1. Data Collection 60
7.3.2. Methodology – Minor Structures 62
7.3.3. Cost model 62
7.3.4. Results – Minor Structures 63
8. Summary and Conclusions 65
Appendix A: Cost and Practices Surveys 68
Appendix B: Flowchart for Road Improvement 73
Appendix C: Comparison of Paved Road Conditions, by County 74
Appendix D: Detailed Results by County and Funding Period 78
Appendix E: Calculation of NBI Data to Bridge Needs Target (BNT) 88
Appendix F: Bridge Improvement Flow Chart 89
Appendix G: Culvert Flow Chart and Needs 91
Appendix H: Pavement Data Collection 92
Appendix I: Minor Structures Inventory Form 94
Appendix J: Minor Structures Decision Flow Chart 95
Appendix K: List of Abbreviations 96

1. Introduction

In response to a request from the North Dakota Legislature, North Dakota State University's Upper Great Plains Transportation Institute (UGPTI) estimated county, township, and Tribal road and bridge investment needs across the state. HB 1066 of the 2019 Legislative session provided that funding to non-oil producing counties would be distributed based on the 2016 UGPTI study and, if available, the average of the 2016 study and succeeding studies. This report is the seventh in a series of such studies.

In 2010, under the direction of the North Dakota Governor, UGPTI estimated the additional county and local road investment needs in western North Dakota as a result of rapid growth in oil production. The oil study was quickly followed by an analysis of the roadway investments needed to facilitate agricultural logistics. Results of both studies were presented to the Legislature in January 2011. Beginning in 2012 a statewide study, which included all traffic generators was advanced to estimate road and bridge investments needed to maintain the current system. Subsequent updates were completed in 2014, 2016, 2020, 2022 and in this current study.

Each study iteration includes updates to underlying assumptions of oil and agricultural volumes and reflects changes to the distribution networks and marketing channels and component costs and practices utilized across the state. In addition to these changes, updates to data collection sophistication, survey instruments, and gravel, paved and bridge methodology were implemented to improve the study process, enhance the ease of response by individual jurisdictions, and improve the accuracy of the data used in the study process.

In the 2024 study update of statewide needs for county, township and Tribal road and bridge needs, investment needs for minor structures were estimated in response to comments from counties, townships and legislators. Minor structures are defined as bridges with a span of less than 20 feet. Prior bridge analyses relied on data from the National Bridge Inventory System (NBIS) which includes bridges with a span of 20 feet or greater. There is not a corresponding database of bridge conditions for minor structures, so an extensive mapping and data collection effort was undertaken to estimate the needs to maintain these structures.

This report again focuses on county, township, and Tribal roads and bridges for 2026 levels of agricultural and energy production using current road construction costs. State highway and city needs are not considered in this study. In this report, investment needs are estimated for three classes of road systems: county, township, and Tribal – referred to collectively as local roads. In some cases, distinctions are made between county major collectors and county local roads. In these instances, "local" refers to a subclassification within a county.

The material presented in this report is organized under the following headings:

- Key economic and industry trends that affect the volume of traffic on local roads
- Key assumptions and methods related to agricultural and energy production and traffic forecasts
- The geographic information system and road network model used in this study
- The statewide traffic data collection and analysis plan
- The traffic prediction model used to forecast truck trips on individual road segments
- Methods of analyzing unpaved roads and forecasts of unpaved road funding needs
- Methods of analyzing paved roads and forecasts of paved road funding needs
- Methods of analyzing bridges and forecasts of bridge investment needs

2. Background Trends in Agriculture and Oil Development Impacting Traffic Levels on Local Roads

North Dakota's, local road systems have seen significant changes in traffic patterns, not only in volumes, but also in clustering because of changing land use and the consolidation of transload locations. This section describes major trends in agriculture and oil development that have had an impact on the number, type, and pattern of truck movements within the state during the past 10 years.

2.1. Agricultural Trends

2.1.1. Yield

Per acre yields for major crops in North Dakota increased or remained flat during the past 10 years because of increases in technology, genetically modified varieties, improved farming practices, and other factors. Dry weather conditions significantly impacted yields during the 2021 growing season. Figure 1 shows yield trends for the three major crops in North Dakota: corn, wheat and soybeans.

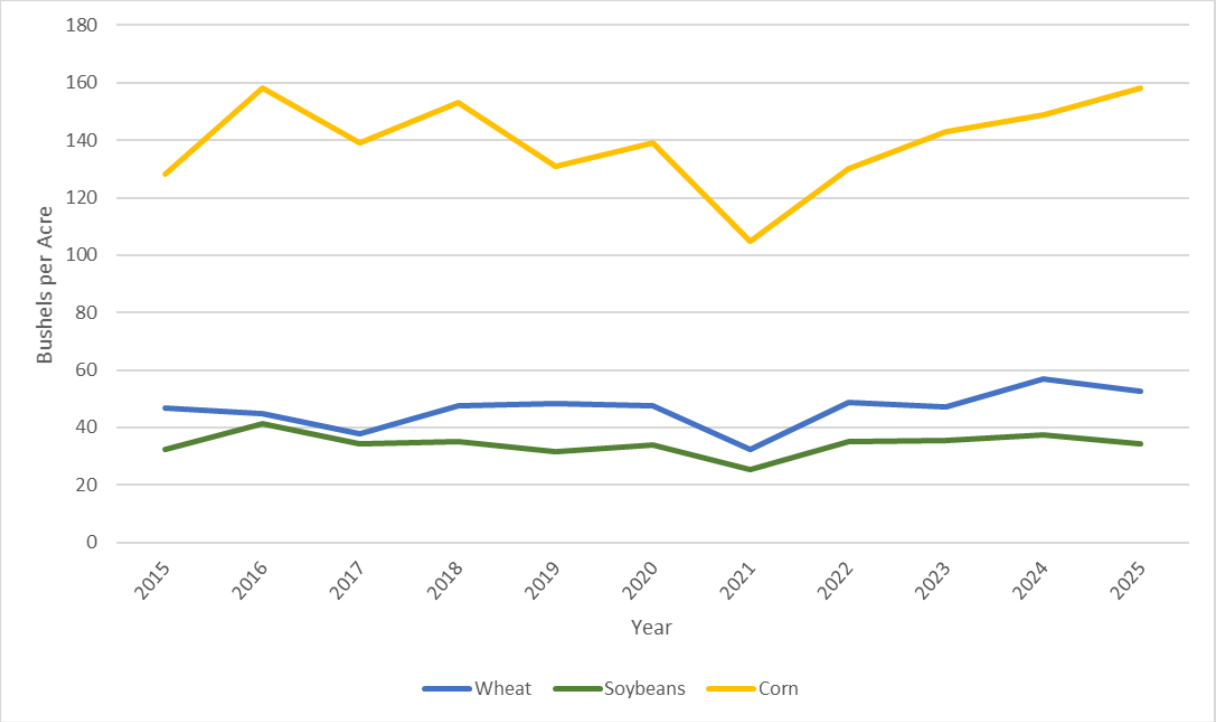


Figure 1. Average Yield for Corn, Soybeans and Wheat in North Dakota 2015-2025 (bushels per acre)

There are significant year-to-year yield variations, primarily due to changes in weather, but the overall trend is stable for wheat, corn, and soybeans. All crops demonstrated a notable decline in yield during the 2021 season due to drought conditions. In 2022, yields for all three of the major commodities increased to normal levels. Corn yields further increased from 130 bushels per acre in 2022 to 158 bushels per acre in 2025. Wheat and soybean yields remained relatively constant from 2022 to 2025.

If the acreage of each of these crops is held constant and outliers such as the 2021 growing season are removed, these yield increases will lead to a growth rate of slightly greater than 2% in the number of truck trips generated as a result of agricultural production in North Dakota. However, changes in the number of acres or to the crop mix during the last decade have also contributed to increased truck traffic.

2.1.2. Crop Mix

Crop mix refers to the percentage of land used to produce each commodity. As shown in Figure 1, the three major commodities have different yields. In 2025, the average statewide yield for wheat was 52.8 bushels/acre. For soybeans, the average yield was 34.5 bushels/acre. Statewide average corn yield was 158 bushels/acre. Any shift in wheat acreage to corn would represent a 300% increase in yield on average. A shift in soybean acreage to corn would represent a 457% increase in yield on average. These increases directly correspond to increases in truck traffic. Moreover, the fertilizer requirements for corn production versus wheat production are nearly double, so an increase in inbound input movements is expected as well.

Again, using the largest three commodities by acreage for comparative purposes, Figure 2 shows the number of planted acres by year of corn, soybeans and wheat in North Dakota from 2015 to 2025. This chart is a stacked line chart, so the difference between the top and the bottom of each of the commodity ranges is the number of acres. The sum of these ranges is the total number of acres that these three commodities comprise.

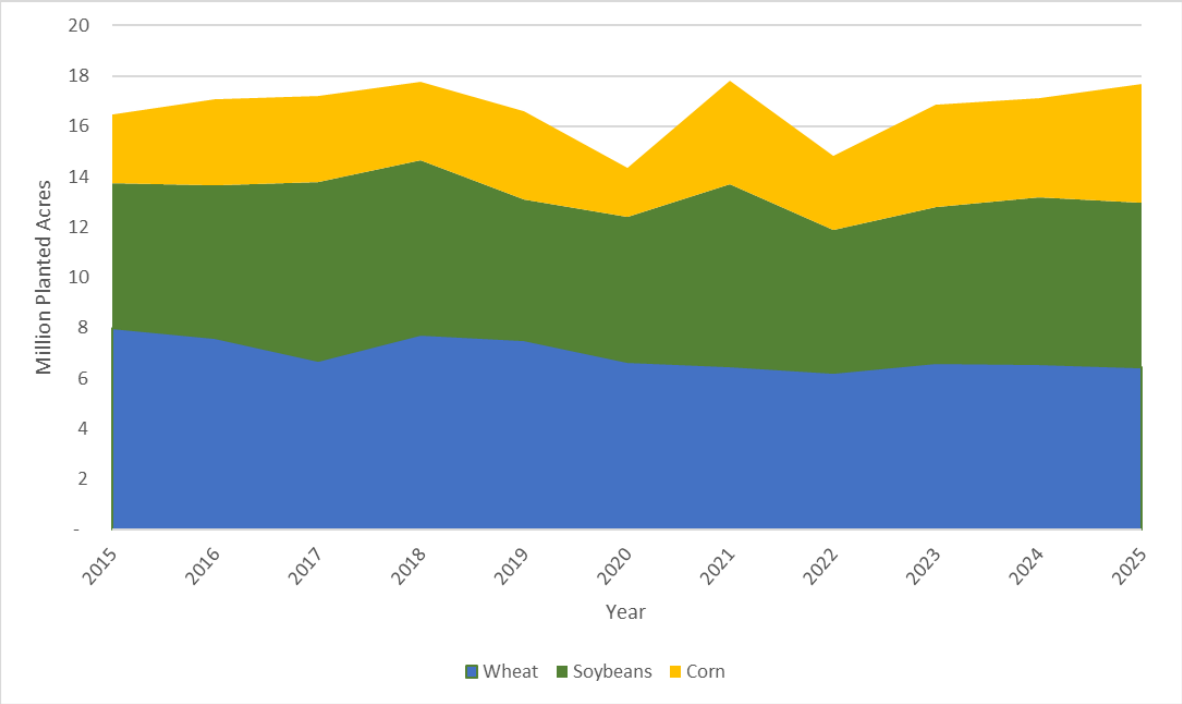


Figure 2. Planted Acres of Corn, Soybeans and Wheat in North Dakota (2015-2025)

Figure 3 breaks out the acreages by percentage. At the beginning of the period, acres of wheat planted was 44% of the total harvested acres of corn, wheat and soybeans with soybeans comprising 35%, and corn 17% of these acres. In 2025, the planted acres of wheat were 36%, soybeans 37% and corn 27%. For reference, in 2025, 17.6 million acres of corn, wheat, and soybeans were planted in North Dakota

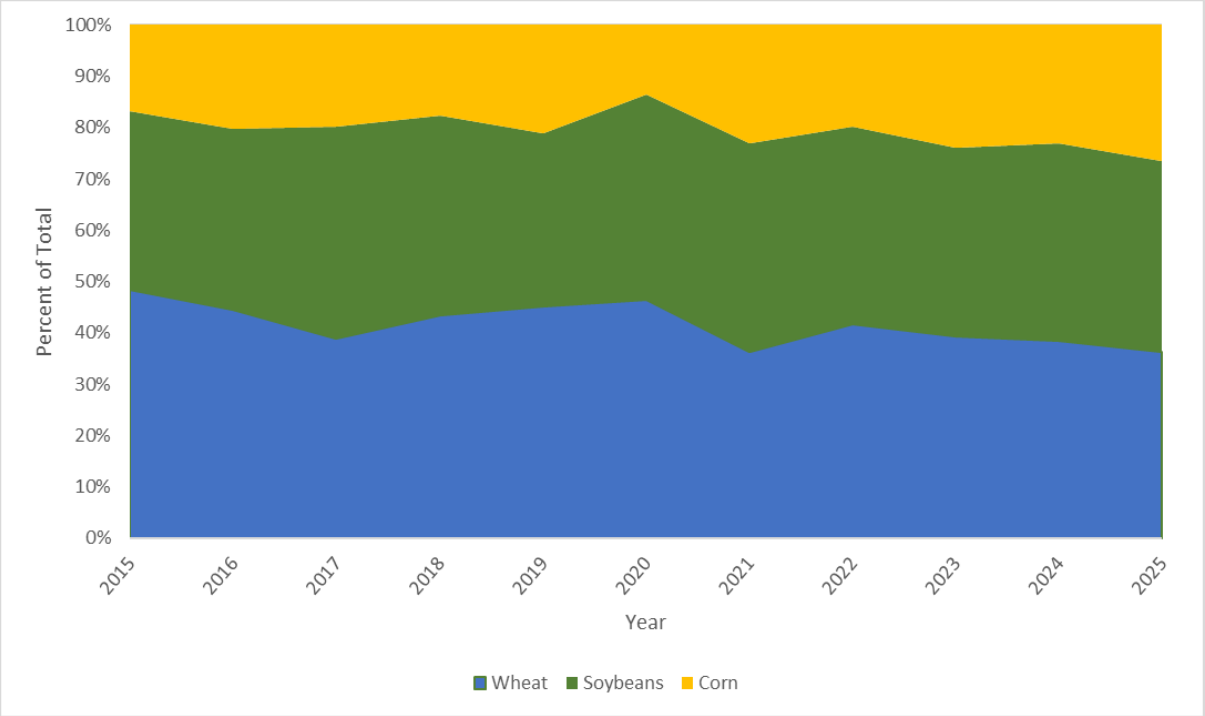


Figure 3. Percent Acres of Corn, Soybeans and Wheat in North Dakota (2014-2023)

2.1.3. Total Production

Because of the combination of increased yields and changing crop mix, total production has increased over the past decade. As shown in Figure 4, total production varied over the last decade, peaking in 2016 and 2018 with 1.098 and 1.051 billion bushels of corn, wheat and soybeans. Since 2023, combined production of corn, wheat and soybeans increased from 1.068 to 1.267 billion bushels.

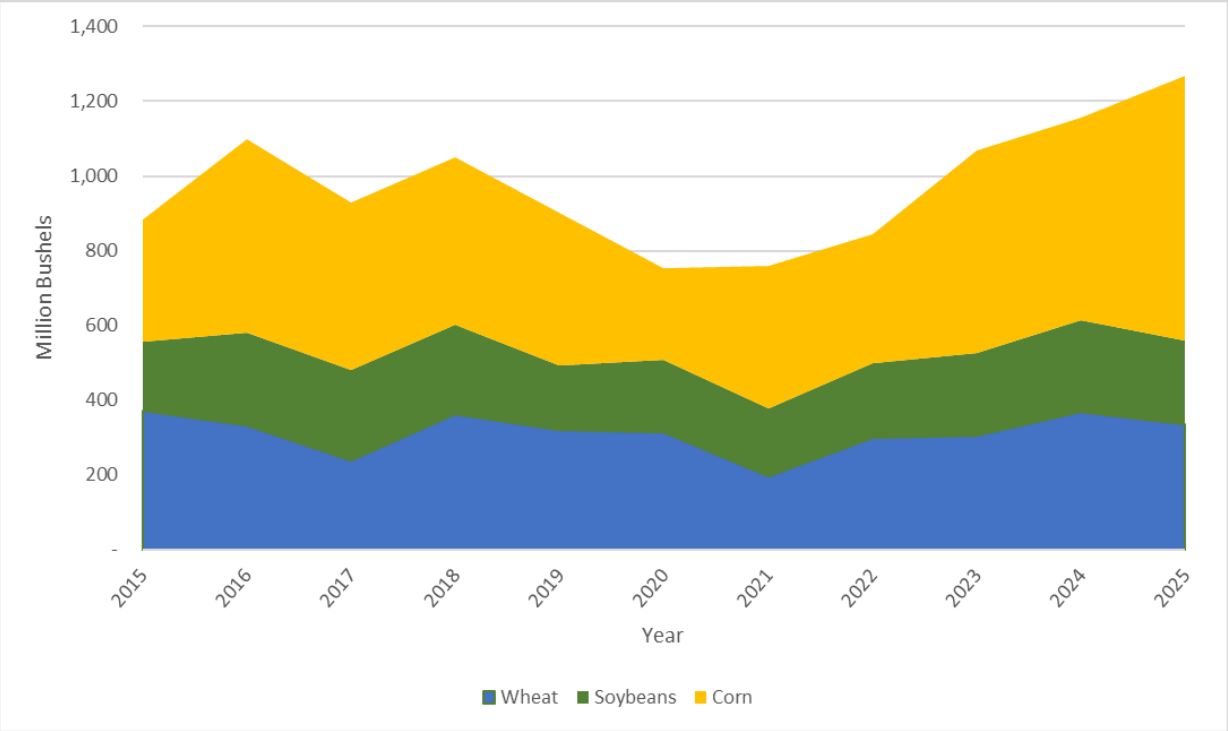


Figure 4. Total Production of Corn, Wheat and Soybeans in North Dakota, 2014-2023

2.1.4. Elevator Throughput

Since the mid-1990s there has been an increase in the number of grain elevators that can handle and load 100 or more rail cars. These shuttle elevators receive a discounted rail rate in exchange for guaranteed volumes and service times. Discounted transportation rates allow shuttle elevators to expand their draw areas through higher spot prices, thereby increasing the total volume of grain marketed at their facilities. In 2002, there were 15 shuttle elevators in North Dakota. By 2025, there were 67 shuttle elevators. A comparison of the numbers of elevators by shipment categories is shown in Table 1.

Table 1. Elevator Types in North Dakota, 2015 and 2025

Elevator Type	2015	2025	Change
No Rail (0 Car)	12	26	14
Single (1-25 Cars)	106	44	-62
Multi Car (25-52 Cars)	56	31	-25
Unit (52-100 Cars)	53	27	-26
Shuttle (100+ Cars)	59	67	8
All Types	286	195	-91

During the last decade there has been a decline in the numbers of all types of elevators, with the exception of shuttle elevators. Shuttle elevators experienced a 13 percent increase. The number of elevators by type tells only part of the story with regard to changes in agricultural marketing in North

Dakota. The Annual Elevator Marketing Report compiled by UGPTI provides total throughput by elevators in each class. Figure 5 and Figure 6 show the total throughput by elevator class in 2015 and 2025 respectively and is taken directly from the Annual Elevator Marketing Report for the corresponding years.

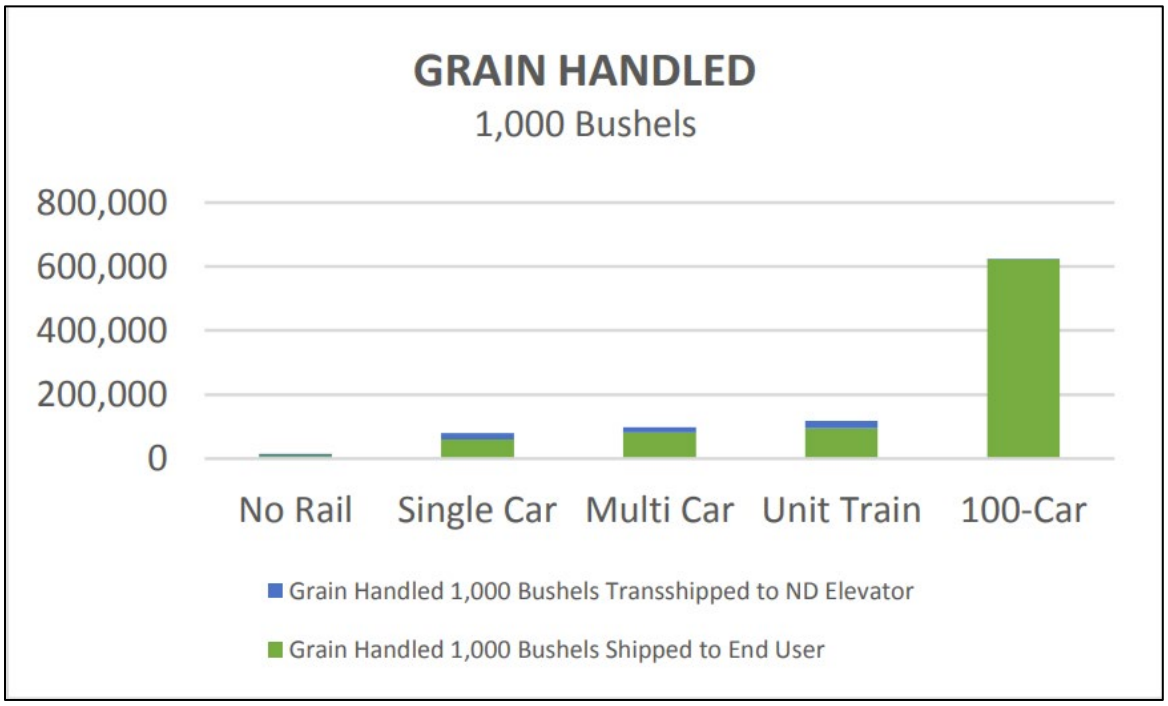


Figure 5. Elevator Throughput by Elevator Class: 2015

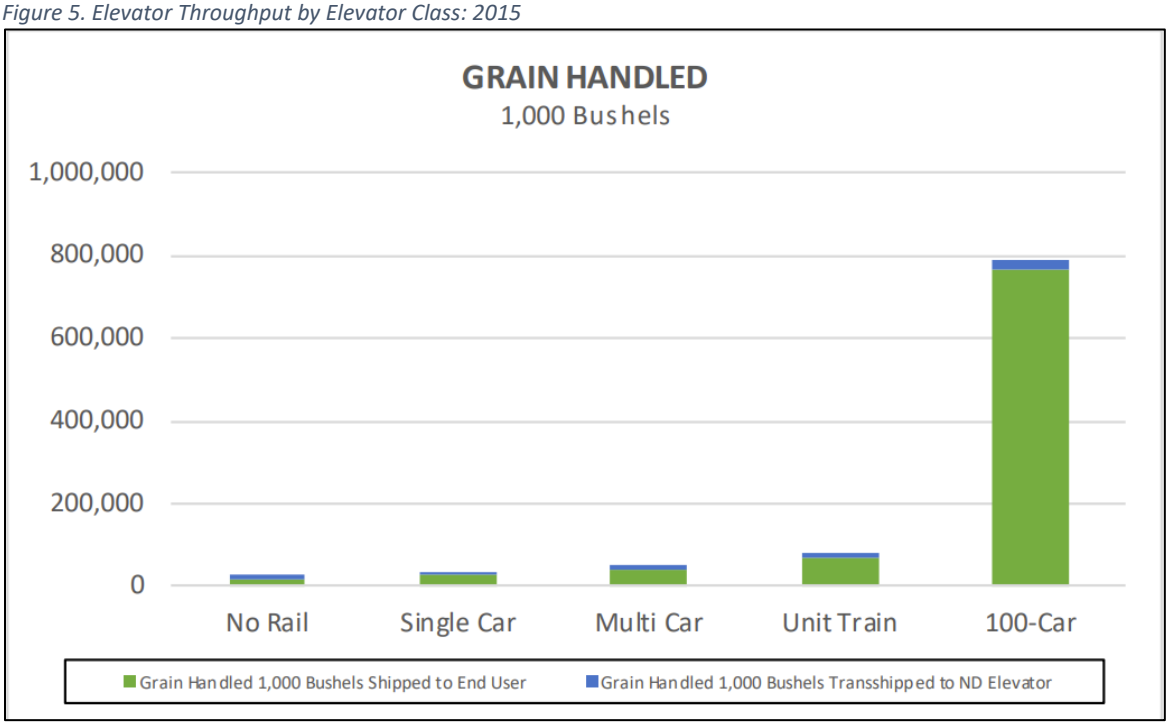


Figure 6. Elevator Throughput by Elevator Class: 2025

As these figures show, a larger percentage of grain was marketed through shuttle elevators in 2025 than in 2015. This change has an impact on the local road system throughout the state. For example, in 2015, shuttle train elevators marketed roughly 600 million bushels of grain through 59 facilities. In 2025, roughly 750 million bushels of grain were marketed through 67 shuttle facilities statewide. The result of this change is consolidation of higher levels of truck traffic at fewer destination points. Often these shuttle elevators are located on or near state highways, but the county major collector (CMC) and other county routes where traffic is consolidated also may see increased truck traffic, depending on the location and network density near these facilities.

2.1.5. Combined Impact of Factors

As discussed in the previous sections, a variety of factors are changing in the agricultural industry within North Dakota, all of which may result in increased truck traffic related to agricultural production and marketing. Increased yield for nearly every crop produced in the state, a changing crop mix favoring the highest productivity, and higher consolidation of grain volumes at elevators and ethanol facilities each contribute to increased traffic. The combination of these factors, whether total acreage increases or not, trend toward higher traffic volumes, particularly on CMC routes and state highways.

2.2. Oil Production Trends

2.2.1. Technology

The current oil boom in North Dakota came about as a result of improved technology in oil exploration and extraction. Two primary technological advances have led to increased productivity within the Bakken/Three Forks formations: horizontal drilling and hydraulic fracturing.

Horizontal drilling consists of an initial vertical wellbore which, at a specified depth, is deviated at an angle that is adjusted until the final wellbore is a horizontal lateral wellbore. Because the shale formations being explored are relatively narrow, this allows for a much larger contact area between the wellbore and the formation, which is greatly enhanced through hydraulic fracturing. Hydraulic fracturing results in multiple longitudinal fractures along the horizontal lateral. Multiple fracturing stages ensure that fractures occur along the entire horizontal alignment thereby optimizing oil recovery potential.

2.2.2. Well Productivity

As a result of the improved extraction technology, the average productivity of a North Dakota oil well has dramatically increased. From 2005-2020 average oil well production increased from 29 barrels of crude (BBL) oil/day to 69 BBL oil/day. From 2020 to 2025, the average well production decreased from 69 BBL oil/day to 56 BBL oil/day Figure 7 shows the daily average statewide oil production per well by year and daily oil production by year in North Dakota since the first well was drilled in 1951.

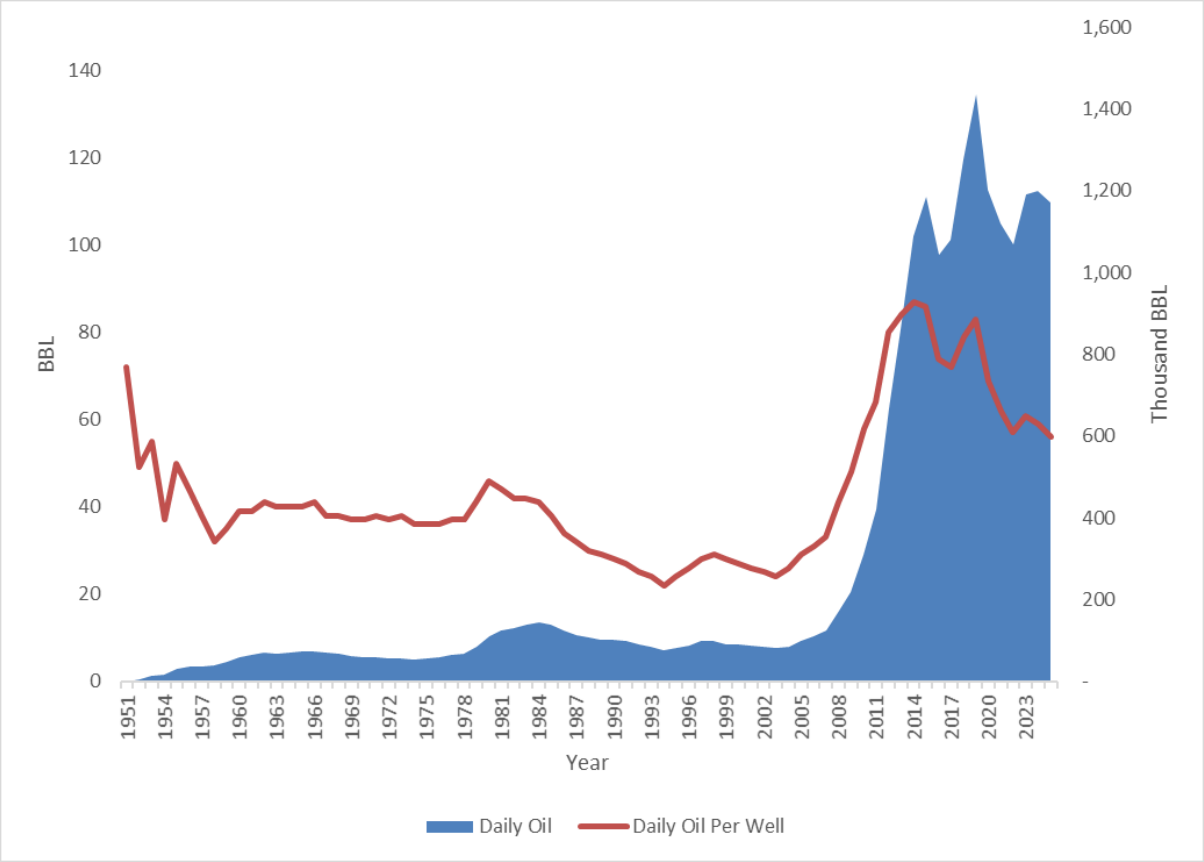


Figure 7. Daily Oil Produced in North Dakota, Total and Per Well: 1951-2025

2.2.3. Total Number of Wells

Improved extraction technology has not only increased the productivity of wells in North Dakota, but expanded the geographic area where oil can be profitably extracted. As a result, expanded drilling has occurred throughout the play, now encompassing 17 counties in western North Dakota, with the heaviest activity occurring in Dunn, McKenzie, Mountrail, and Williams counties. The total number of producing wells per year is shown in Figure 8. From the late 1970s until mid-2000s the number of producing wells remained relatively constant. With the technological advances in exploration and extraction, the number of producing wells increased exponentially.

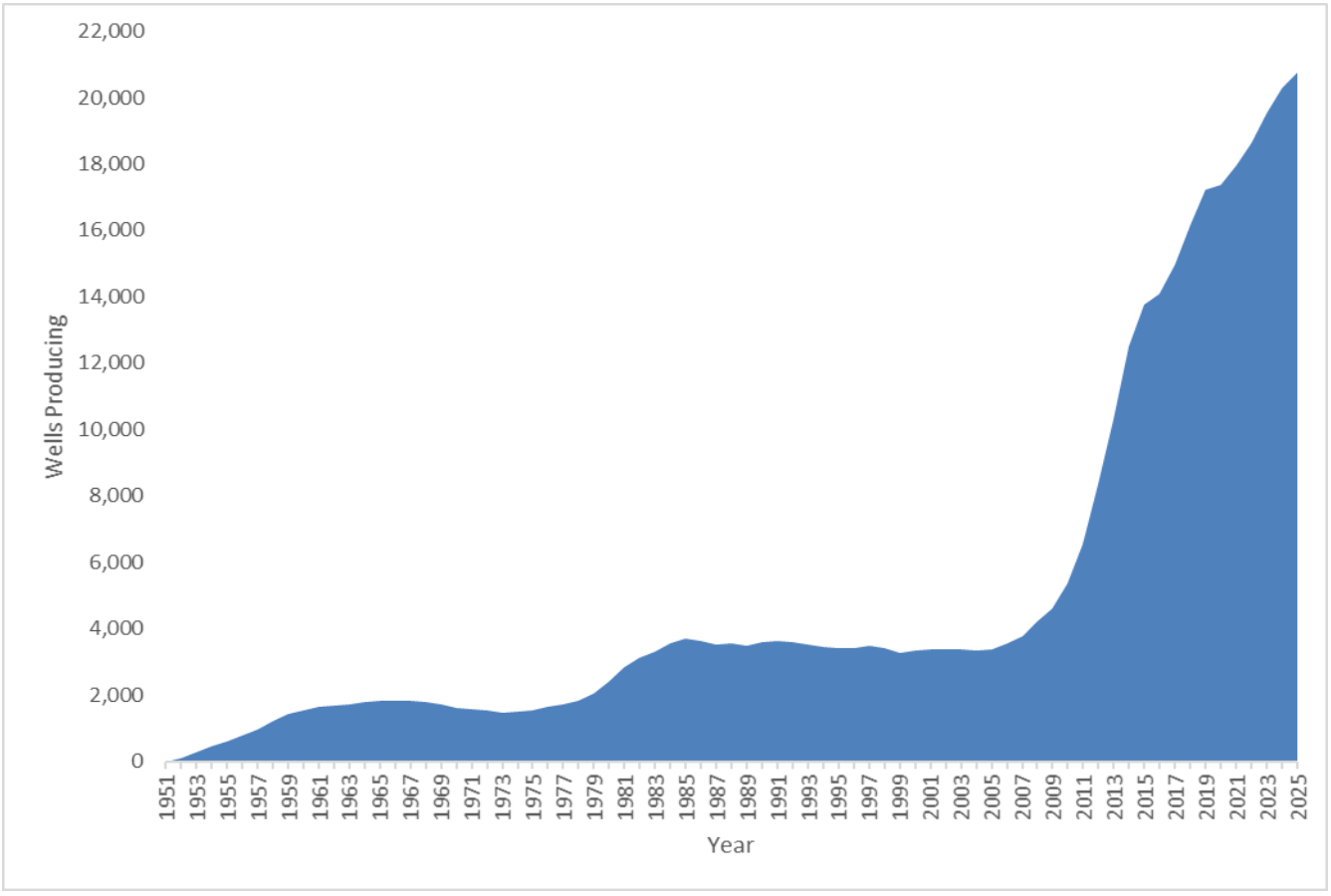


Figure 8. Total Producing Oil Wells in North Dakota: 1951-2025

2.2.4. Total Production

As outlined previously, productivity per well has increased while the total number of wells has increased as well. The combination of these two trends has resulted in a significant surge in total statewide oil production since 2007. Figure 9 shows the historical daily oil production from 1951 to 2023. From 2021 to 2023, average oil production was 1.14 million barrels per day.

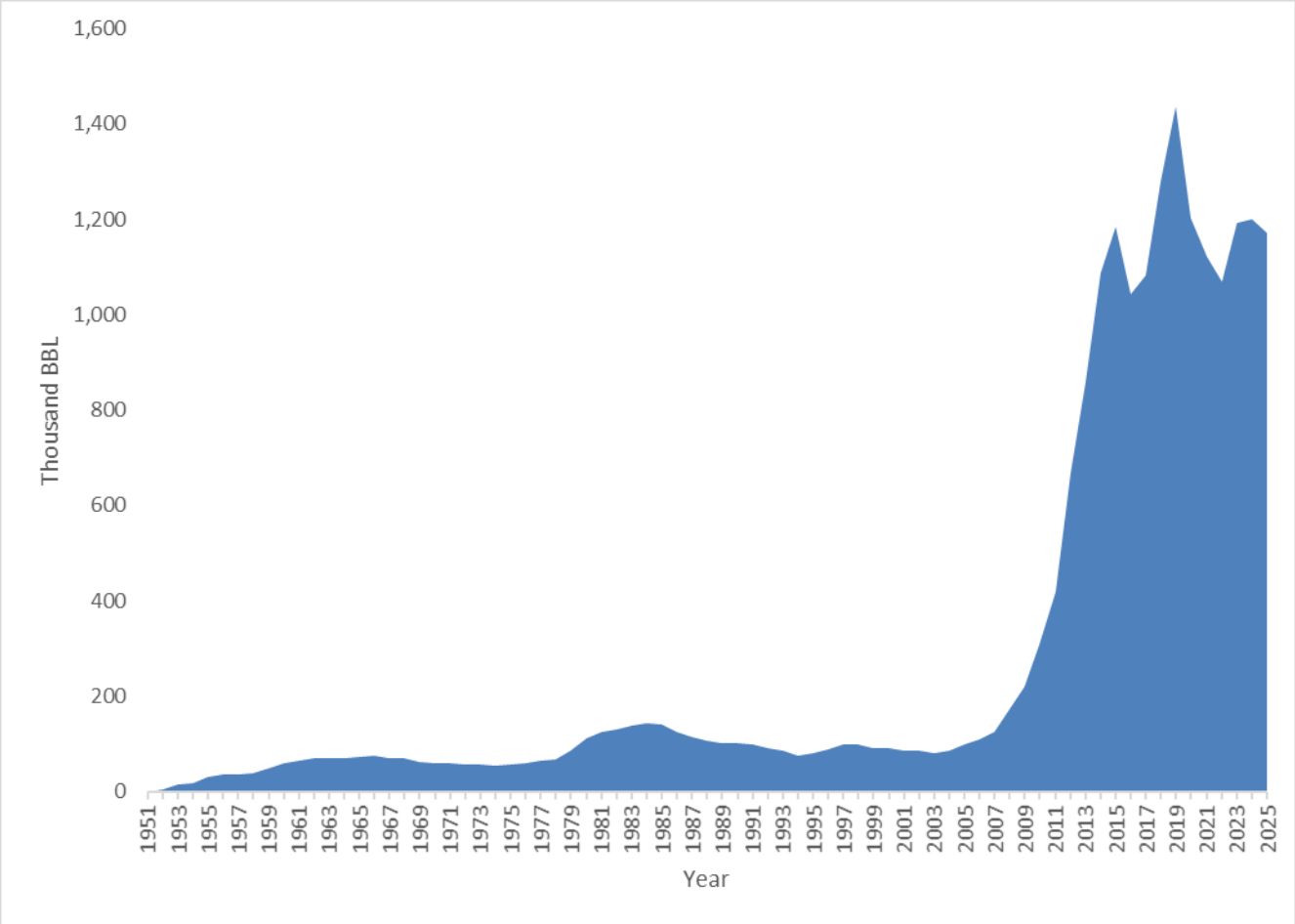


Figure 9. Historical Daily Oil Production in North Dakota: 1951-2025

3. Model Methods and Assumptions

This section of the report describes the key assumptions related to agricultural and energy production and movement patterns, including: (1) primary sources of production and travel demand data, (2) the geographic basis for production forecasts, and (3) land use patterns (such as crop and well densities) that give rise to truck trips.

3.1. Agriculture

3.1.1. Transportation Analysis Zones

The base unit of production used in the agricultural model is the township, or county subdivision. Township shapefiles were obtained from the North Dakota Geographic Information System (GIS) Hub. However, organized townships do not exist in all North Dakota counties. Townships were selected for use as a geographic and not an organizational boundary. Where unorganized townships exist, a placeholder boundary was created to represent a geographic area similar in size to a township.

3.1.2. Modeled Commodities

The discussion of agricultural production in Section 2 of this report focused on the three largest commodities in North Dakota: corn, wheat and soybeans. In addition to these commodities, truck movements were estimated for barley, canola, sunflowers, dry edible beans, sugar beets, and potatoes. Because of the truck volumes required to deliver fertilizer to fields in the spring, fertilizer requirements for each acre produced of each commodity were estimated using NDSU Extension crop budgets. Truck movements from fertilizer locations to crop production areas were modeled in a similar, but reverse direction, as those for crop shipments. Finally, because of the structure of the elevator industry in North Dakota, transshipments between elevators (i.e. satellite elevator to shuttle elevator) were also included in the traffic forecasts.

3.1.3. Crop Mix and Production

Crop production data by county was obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service (NASS) website. This data provides the number of acres planted and harvested, as well as yields and total production by county, crop, and production practice. The most current data available at the time of the analysis was from 2021. County-level data is not sufficient for use in a traffic model as it is too aggregated to accurately assign traffic to individual roadways, especially at the county level. To further disaggregate this data, the USDA's Crop Data Layer (CDL) was utilized.

The CDL is a satellite image of land use in North Dakota, with individual crop types represented by different colors. Each pixel of the image represents a 30-meter by 30-meter area. Used in conjunction with GIS software packages, the CDL provides data regarding the total number of acres of each crop produced in each county subdivision. In this study, acreage data was aggregated to the county level and compared against known NASS data for accuracy.

Analysis using the CDL is precise with respect to geographic area, but is only a snapshot of production in time and does not provide production data (e.g., bushels or pounds harvested).

In this study, NASS county-level data is used to approximate sub-county-level yield and production rates. For example, if a township is located within Barnes County, the Barnes County average wheat yield is used to approximate the actual township yield. The end result of these processes is the total production by crop for each township in the state. For use in traffic forecasting, township crop production estimates are converted to truck trips, based on each commodity's weight and density.

3.1.4. Total Acres

As presented in the previous section, annual crop acreage is relatively unchanged over the past 10 years despite 1.7 million additional acres being returned to production with the expiration of Conservation Reserve Program (CRP) contracts. With the estimated 1.16 million acres of CRP set to expire within the next 15 years, an increase in total acres is expected. However, spatial data is currently unavailable for the location of the acres set to expire by year. Consequently, the assumption made for the purpose of this study is that acres in production will remain at 2018 levels, which is the highest on record for the past 10 years.

3.1.5. Yield Trends

Following comparisons of NASS yield data trends for each of the eight crops specifically modeled in the rural road traffic model, there were variations from commodity to commodity in terms of yield growth. For the three major commodities, corn, soybeans, and wheat, there were 2%, 2%, and 4% growth rates respectively. Over the same time period, wheat acres decreased in favor of corn, so the effective level of wheat production is constant. For the purpose of forecasting increased tonnage and truck trip generation, a 2% yield growth rate was applied to all commodities for future year forecasting purposes. This is consistent with the historical yield growth rate for five of the eight modeled commodities.

3.1.6. Elevator and Processor Demands

Demand points for grain within the state include elevators, processors, and ethanol facilities. Elevator locations were obtained from a shapefile maintained by UGPTI, which was compared against the North Dakota Public Service Commission (NDPSC) licensed elevator report. Throughput information was obtained from the North Dakota Department of Agriculture Grain Movement Database, which provides the quantity of each commodity shipped through an elevator by mode and destination.

Ethanol facility demands were estimated by obtaining the output capacity of ethanol for each facility and dividing the capacity by the conversion rate of 2.78 gallons of ethanol per bushel of corn. For processing facilities, annual capacities were obtained through news releases, website publications, or phone surveys of the facilities. Individual elevator and plant demands are based upon actual data in the base year of 2023. Because there is forecasted growth in each commodity's yield over the 20-year analysis period, an equal increase in the plant and elevator demand for the commodities was implemented for future year analysis to balance the model.

3.2. Oil and Gas

3.2.1. Transportation Analysis Zones

The zone representing the geographic unit of production in this study is the spacing unit. The spacing unit defined in this study is a 1,280-acre (2-square mile) polygon that is the basis of oil development within the Bakken formation. The initial spacing unit shapefiles were obtained from the website of the North Dakota Department of Mineral Resources Oil and Gas Division. For areas within the study area that were not divided into spacing units, the fishnet procedure in ArcMap was used to construct new spacing units for the purpose of spatial forecasting of the future locations of new wells.

3.2.2. Wells per Rig per Year

Over the course of these studies, rig productivity has increased. At the outset of this study series, rig productivity was 10-12 new wells per year. Based on discussions with the Oil and Gas Division, the updated productivity rate is 20-24 new wells per year.

3.2.3. Well Forecasts

Because of uncertainty in present and future crude petroleum markets, three scenarios were estimated. Each of the scenarios forecasts the number of new wells drilled as a function of the number of active drilling rigs within the state. The baseline forecast scenario is equivalent to a 40-rig drilling level, representing 960 wells per year. As stated above, it is assumed that each rig can drill 20-24 new wells per year.

3.2.4. Spatial Forecasts

The annual forecasts and county-level forecasts provide the total number of wells expected within the oil patch and within each individual county. They do not, however, provide the locations of the wells within each county. To distribute the new wells within spacing units, a geospatial forecasting method called hot spot analysis was used. Hot spot analysis identifies geographic clustering of activities within a specified region. Hot spot analysis is also known as heat mapping, where the reference to heat refers to the concentration of the activity within any given area.

Figure 10 shows the clustering of existing wells in the base year which serves as the basis for locating future well drilling activities throughout the analysis period. Red areas represent significant clustering of existing wells, and blue areas represent a lack of clustering of oil development.

By identifying the degree of clustering of existing wells, one can forecast the location of future wells in areas where existing development has already occurred, subject to the constraint of 8-20 wells per spacing unit. Once that constraint has been reached, no additional wells may be added.

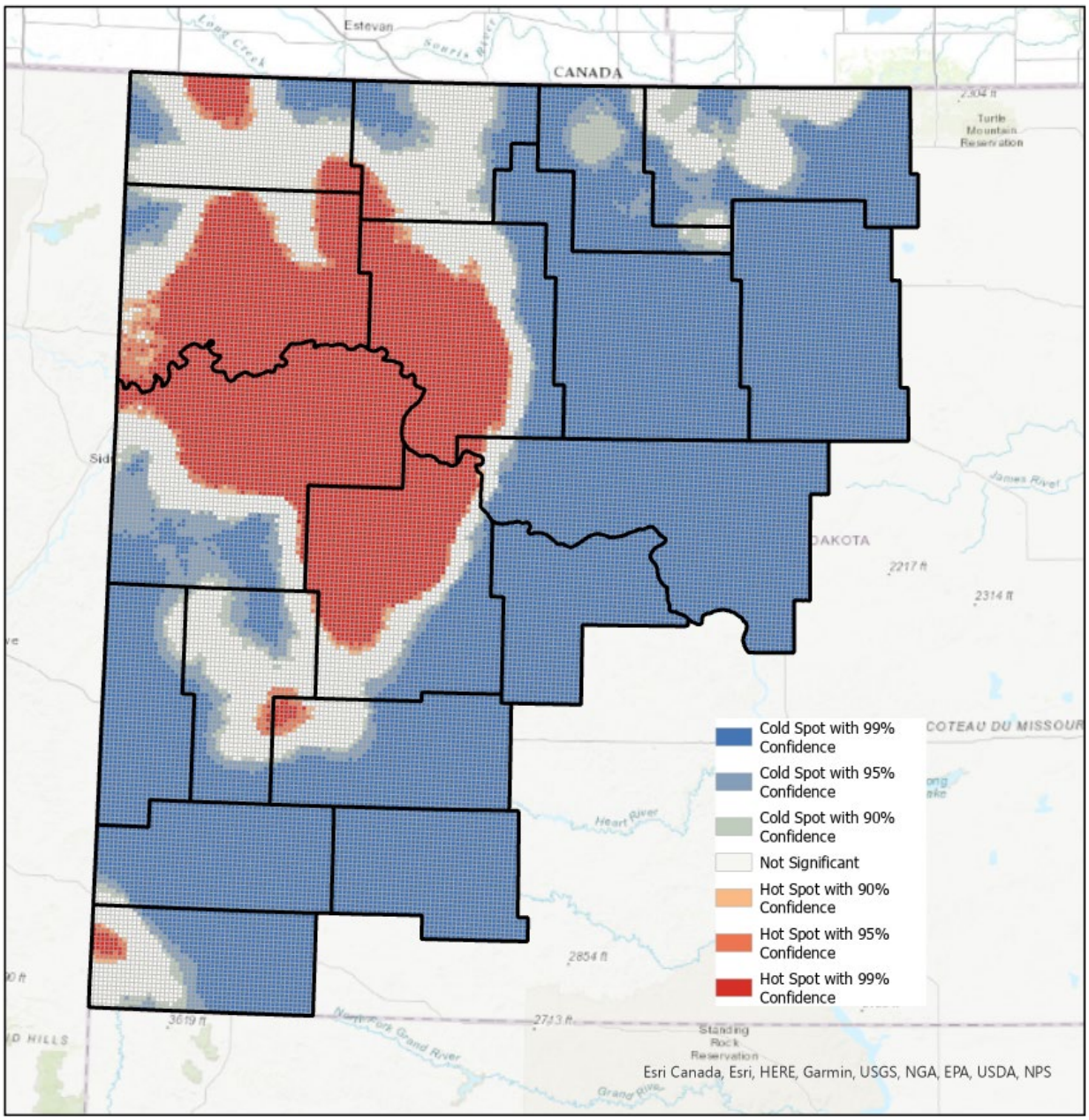


Figure 10. Hot Spot Map of Oilfield Spacing Units, 2025

All annual location forecasts are doubly constrained. That is, they are constrained by the statewide forecast of new wells and the county-level forecast of new wells per year provided by the Oil and Gas Division. These constraints ensure that, within the modeling framework, the forecasted truck trips generated cannot exceed the forecasted exploration and production limits.

3.2.5. Initial Production Rates

Once the wells have been drilled, an initial production rate must be applied to represent the starting point of production for an individual well. The Oil and Gas Division provided county average initial production rates for each oil-producing county. In addition, the Bakken well production curve is applied to this initial production rate to estimate future annual production levels. Because of the steep decline in production over the first three years of the life of a Bakken well, inclusion of this production curve is critical to avoid overestimating crude oil production and the number of truck trips generated by oil production in North Dakota.

3.2.6. Truck Volumes

Data on the number of trucks by type were compiled from input provided by the North Dakota Department of Transportation, and the Oil and Gas Division. As shown in Table 2, a total of 3,520 truck movements is estimated per well, with approximately half of them representing loaded trips.

Table 2. Drilling Related Truck Movements

Item	Number of Trucks	Inbound or Outbound
Sand	200	Inbound
Water (Fresh)	500-800*	Inbound
Water (Waste)	300	Outbound
Tanks and Equipment	460	Both
Total – Single Direction	1,760	
Total Truck Trips	3,020-3,520	

*Fresh water truck volumes decrease to nearly zero in areas with water pipeline availability

3.2.7. Mode Splits

Outbound crude is transported from well sites to either rail or pipeline transload locations via gathering pipeline or truck transportation. Recently, significant expansion in the gathering pipeline network in areas with higher-density production has greatly reduced the proportion of outbound crude hauled via truck. In this study, from 2024 onward, an estimated 80% of outbound crude is assumed to be shipped via gathering pipeline with the remaining 20% shipped to transload locations via truck.

3.3. Road Network

The primary GIS network used for this study was obtained from the North Dakota Department of Transportation GIS and Mapping website at https://www.dot.nd.gov/construction-and-planning/planning-process/gis-and-mapping. Two individual shapefiles were utilized in the creation of the network: State and Federal Roads and County Roads. Both of these shapefiles are maintained by NDDOT.

3.4. Network Connectivity

Network connectivity is required to have a routable network for use in the travel demand modeling component of this study. Initially, both the state and federal and county and city roads presented

multiple widespread connectivity errors which were repaired prior to conducting the routing analysis. In addition, certain attributes were found to be in error, particularly in areas of significant growth. These errors will likely be corrected as the network is continually updated.

3.5. Jurisdiction

The County Roads shapefile contains an attribute named RTE_SIN which represents the jurisdiction of the roads. This attribute provides accurate data on the state and federal systems as well as the Federal-aid System. However, below the CMC (County Major Collector) system there is no distinction between county-owned non-CMC routes and township roads. To distinguish township roads from county non-CMCs, UGPTI and ND-LTAP conducted surveys of all 53 counties in North Dakota. The results were then attributed to the original network for identification purposes. In addition to non-CMC identification, UGPTI and ND-LTAP staff asked for information about other jurisdictional categories, but responses were not consistent on a statewide basis aside from the non-CMC designation.

Table 3 presents the total miles by initial "RTE_SIN" designation–the base designation on the GIS Hub shapefile. These numbers represent the data that from the NDDOT roads_county geodatabase. The area most in question is the second category "Township and County Non-CMC," primarily because this category combined two jurisdictions, county and township. Because two jurisdictions were combined within a single category, separating needs by jurisdiction proved difficult without additional information. Miles represented in Table 3 and 4 represent only surfaced roads and exclude trails and unimproved miles.

Table 3. Initial Jurisdiction Information Using Provided RTE_SIN Designation (Excludes Trails and Unimproved)

Jurisdiction	Miles
Forest Service/Reclamation	619
Township and County Non-CMC	59,348
CMC (Federal Aid)	11,819
Tribal	490
Total	72,367

Table 4 presents the updated jurisdictional information adjusted using Highway Performance Monitoring System (HPMS) ownership and maintenance coding. The largest change is in the township and county non-CMC categories. Within the township category, only organized townships are included. In the county non-CMC, county routes and unorganized townships are included.

Table 4. Updated Jurisdiction Information Based Upon Survey Results (Excludes Trails and Unimproved)

Jurisdiction	Miles
Forest Service/Reclamation	619
Township	47,303
CMC (Federal Aid)	11,819
County Non-CMC	12,136
Tribal	490
Total	72,367

4. Traffic Data and Model

The primary objective of the traffic study was to collect traffic volume and classification data on county and township roads throughout the state. Traffic data was collected for two primary reasons: (1) to gain a better understanding of current traffic flows, and (2) enable the calibration of the traffic forecasting model used in the study.

The traffic collection plan provided for geographic coverage of the entire state, focusing on county major collector routes, higher-volume routes, and paved roads. Based on road mileage and other factors, it was determined that approximately 15 to 25 classification counts per county would provide adequate information to calibrate the traffic model.

At locations where traffic counts were taken, the raw information was turned into an estimate of the average number of vehicles traveling the road segment each day. At locations, where vehicles were classified, the raw information was used to estimate the daily trips of each type of vehicle, including single-unit, combination, and double-trailer trucks.

4.1. Traffic Data Collection

NDDOT collects traffic data on state and county major collectors on a 3-year cycle. In 2021, NDDOT counted the eastern part of the state and UGPTI requested that some additional county stations be added in that area. UGPTI students collected traffic data for 86 sites in the central portion of the state and 107 in eastern North Dakota. These sites were used in addition to the NDDOT county counts from previous years. Merging NDDOT counts with UGPTI and consultant counts, a total of 1,582 counts were used in the travel demand model development. Again, these counts were used in conjunction with, and to update, NDDOT county counts from previous years. Figure 11 depicts the locations of county and township traffic data collection.

All traffic counts were checked for quality control and processed using standard processes and procedures recommended by Federal Highway Administration. This detailed process entails the application of seasonal adjustment factors to the raw 48-hour counts to annualize them to an average annual daily traffic (AADT) volume. The seasonal adjustment factors used in the study were developed from annual traffic recorders (ATR's) located throughout the state on various road systems. For count locations involving volumes only, a seasonal axle factor was also applied to the raw counts.

All traffic data collected by UGPTI were verified and sent to NDDOT for final processing, using the same standard processes and procedures recommended by Federal Highway Administration. The joint processing of data by NDDOT and UGPTI assures consistency among the various traffic counts taken around the state.

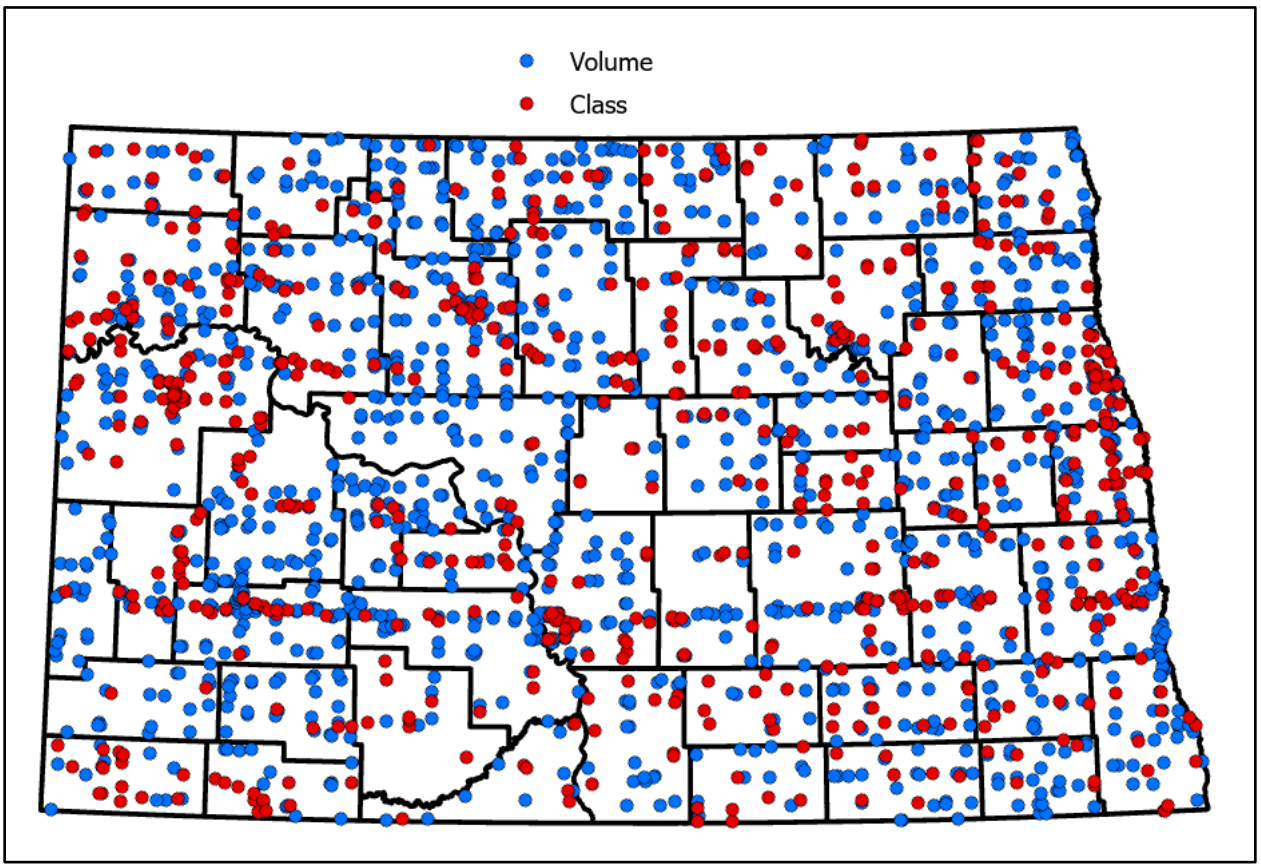


Figure 11. Traffic Data Collection Sites

4.2. Traffic Model Development

To forecast future traffic volumes on county and township roads, an effective base year traffic model must be constructed that accurately reflects existing truck traffic movements. The data collection described above provides direct observations against which the traffic model results can be compared. Only when the baseline traffic model has been shown to sufficiently model existing traffic can it be used to predict future traffic levels.

4.2.1. Movement Types

The travel demand model developed for this study consists of 18 individual sub models: 11 for agricultural movements and 7 for oil-related movements. Nine of the 11 agricultural sub models, represent individual commodities, with the remaining representing fertilizer and transshipment movements. Of the 7 oil-related sub models, five relate to inputs to the drilling process and the remaining 2 represent the movement of outbound crude oil and salt water.

4.2.2. Distribution Networks - Agriculture

For the two major sub model classes: (agriculture and oil), two different distribution networks are modeled. The traditional farm-to-market, and market-to-terminal destination network has changed

significantly within the state over the past decade, primarily because of the increase in shuttle elevators, processors and ethanol facilities.

Figure 12 provides an overview of the movements from the farm to a variety of destinations. In this simplified diagram, the farm-to-elevator movement is shown, as well as movements from farm to final destinations such as processors, ethanol facilities, or terminal destinations such as Minneapolis or Duluth. Each of these movements is effectively a truck movement because there is no rail access from individual farms.

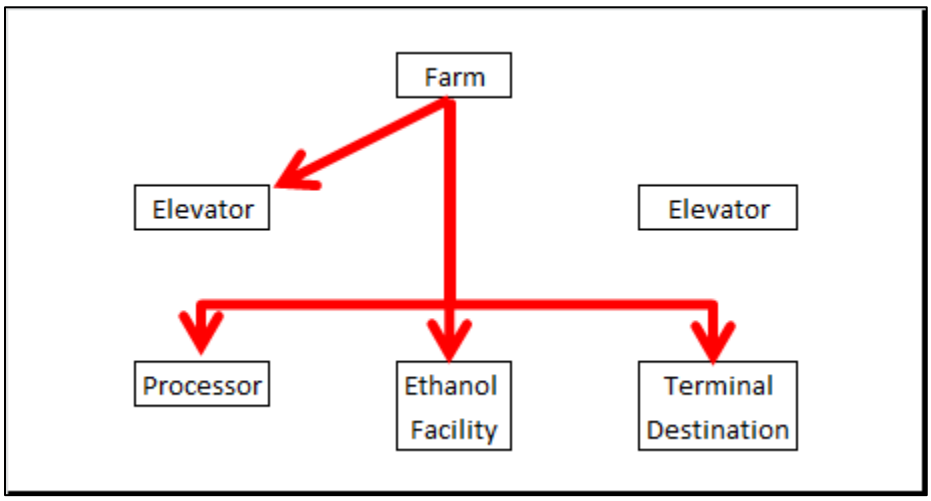


Figure 12. Agricultural Distribution Network without Transshipments

To take advantage of lower shipping rates at higher volumes, grain is commonly shipped between elevators for consolidation. Depending on the final destination of the grain from the elevator, the mode split between truck and rail varies. But as a general rule, as distance increases, truck transportation is less favored. However, almost all transshipment movements are performed via truck within the state, adding truck trips to the roadway networks.

Figure 13 shows potential movements from the elevator once the grain has been delivered from the farm. The elevator may transport grain to a processor, ethanol plant, terminal facility, or another elevator. The receiving elevator would then also have the same options as the prior elevator. As mentioned above, outbound movements from elevators have a mode choice option, as most grain elevators within the state have rail access. Numerous variables factor into mode choice at this point, but for the purposes of this study, sufficient data as to the actual mode split by elevator is available so actual observed data was used to model mode split for outbound movements.

4.2.3. Distribution Networks – Oil Related Movements

In contrast to the agricultural model where the base unit of production and related origin is the township, the oil model's base unit of production is the spacing unit, which functions as both an origin and destination as time progresses. Figure 14 provides a simplified diagram of the modeled oil-related movements. The blue arrows represent inbound drilling-related movements to the spacing unit, and

the red arrows represent outbound produced oil and water from the spacing unit to transload or injection destinations.

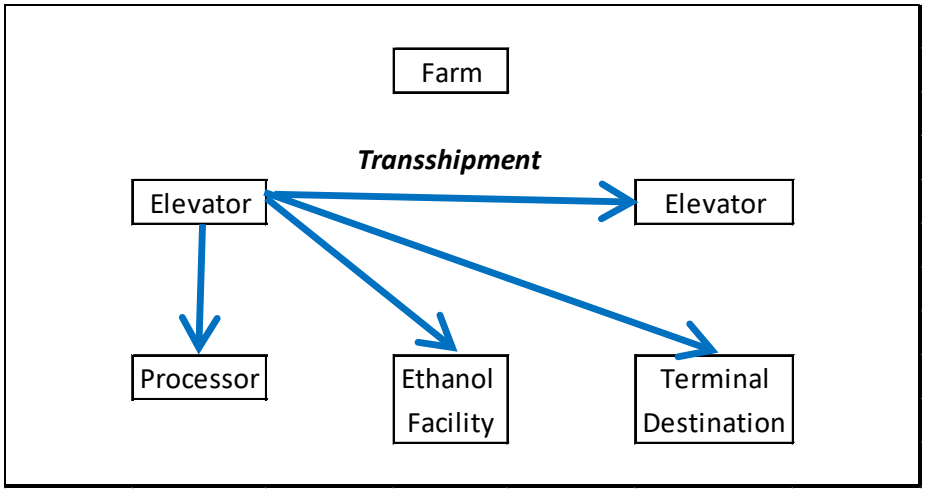


Figure 13. Transshipment Movements within an Agricultural Network

Within the model framework, both inbound and outbound movements were individually modeled. For example, frac sand, freshwater, gravel, supplies, equipment, and pipe movements were separately estimated and the results aggregated to the segment level. Similarly, both the movements from the well site to the oil collection sites and saltwater disposal locations were specifically modeled.

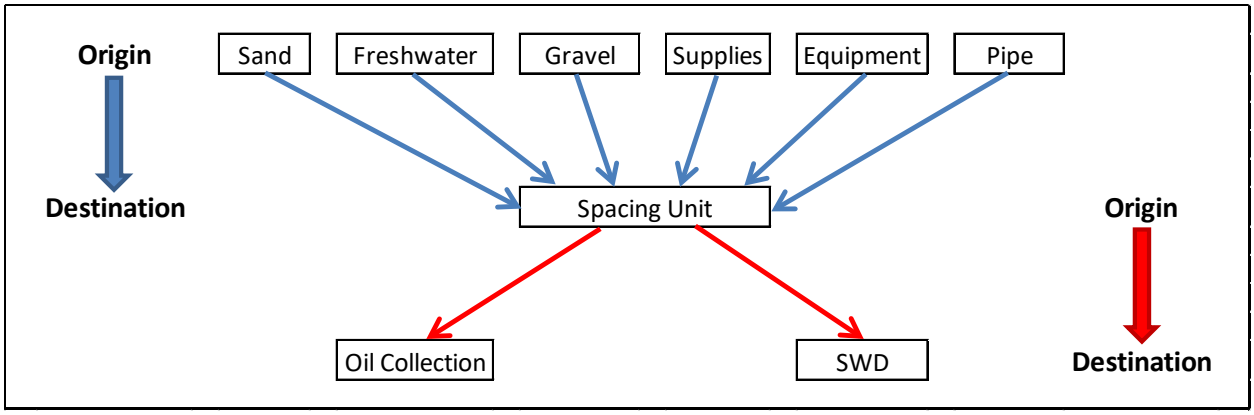


Figure 14. Oil Related Movement Network

4.2.4. Travel Demand Modeling Framework

Conventional transportation modeling utilizes the four-step model (FSM). The components of the FSM are 1) trip generation, 2) trip distribution, 3) mode split, and 4) traffic assignment. The first step in the development of a transportation model is identification of the origins and destinations of the trips to be modeled. Trip generation forecasting identifies the type and scope of movements between traffic analysis zones (TAZ). As discussed above, the TAZ for the agricultural model is a township equivalent, and the TAZ for the oil model is the spacing unit.

Trip generation focuses on trips originating as a result of activities present within some zones, and trips attracted by activities present within other zones. Once the origins, potential destinations, and number of trips have been identified, movements between areas of production (origins), and attractions (destinations) are estimated. Distribution refers to the selection of flows between origins and destinations, and is generally made using a gravity model or linear programming model. Traffic assignment occurs once movements between origins and destinations have been selected, and the minimum-cost route between them is selected. The distinction between distribution and assignment is that distribution selects the origin and destination for individual trips generated, and assignment selects the method of connecting them. This is generally the final step in the FSM, but in the case of optimization models, traffic assignment for all possible destinations from origins is completed to generate arc cost data for the model.

Trip generation is the first of the four steps and, as the name indicates, generates trips and the origin and destination points. Using the agriculture model as an example, each township represents an area of production. Each grain elevator or processor represents an area of attraction. Based on known production at the township and known throughput at the elevator, trips generated at each can be estimated. For the oil sub models, a similar approach is used, but the focus is the spacing unit, rather than the township.

Trip distribution effectively pairs the origins and destination based upon production and attraction volumes and the effective cost between them. The gravity model for trip distribution contains three primary components: zones where trips originate, zones where trips terminate, and a measure of separation between the zones. The measure of separation between the zones is a key factor, as it represents the level of attraction between the zones or repulsion between zones. In many cases, a generalized cost of traveling between the zones, often a combination of travel time, distance traveled, and actual costs, is used (Evans S. P., 1972). “It is assumed that the number of trips per unit time between pairs of zones for a particular purpose is proportional to a decreasing cost function of the cost of traveling between them” (Evans E. , 1970). The use of the gravity model for trip distribution is widespread. The end result of this type of analysis is the number of trips between each origin and each destination (trip assignment).

Mode choice is the third step in the four-step model. This step was not directly included in the travel demand model for two reasons. First, the movements modeled were specifically truck-related movements. Second, the primary factor where mode split would have a significant impact on traffic volumes relates to gathering pipelines between well sites and oil transload facilities. Because assumptions were specified by the Oil and Gas Division and the North Dakota Pipeline Authority, they were implicitly utilized in the study.

Trip assignment is the final step in the four-step model. Trip generation estimated the total number of trips generated and attracted. Trip distribution organized them into origin-destination pairs. Trip assignment selects the optimal (least cost) route between the origin and destination for each of the individual O-D pairs. This is where the individual roadway segments are selected. The precise method for selecting the paths between origin and destination is minimization of cost using Djikstra’s algorithm within the travel demand model. The cost selected for the purpose of routing is time. Each individual segment was assigned a travel speed based on posted speed or roadway class. Based on this speed,

the individual travel time was calculated for each segment. The shortest path algorithm then selects the least-cost path between the origin and destination for each pair, aggregating the movements at the segment level.

4.2.5. Calibration Procedures

The traffic data collection effort described previously was a significant effort undertaken in conjunction with NDDOT to provide an accurate, objective and detailed estimate of traffic volumes for multiple classes of roadways throughout the state. For the purposes of the travel demand model, these counts are used for calibration purposes. As discussed previously, for a travel demand model to predict future traffic flows with confidence, it must sufficiently predict existing traffic flows. Comparing modeled traffic flows to observed counts determines whether the model sufficiently predicts existing traffic flows.

As part of the travel demand model development, a critical component of the four-step model is the trip distribution step. The gravity model described above uses friction factors between zones. These friction factors encourage or penalize movements within certain specified time thresholds. In the absence of trip length distribution data for individual commodity and input movements, scenario analysis was performed on the individual sub models for calibration of the traffic model.

The final step in the calibration process was to utilize matrix estimation. This process compares actual counts on segments to the predicted assigned traffic. Initially, the software provides detailed statistical measurements as to the quality of the fit. Then, utilizing the matrix estimation procedure, the software re-estimates the trip distribution matrix in an iterative fashion to improve the statistical comparisons. The resulting matrix was then compared to the initial unadjusted matrix to identify any significant variations. Where significant variations were identified, the trip generation volume estimates at the TAZ in question and related assumptions were reevaluated and altered if deemed appropriate.

5. Unpaved Road Analysis

The unpaved road analysis has two primary components: traffic volumes and maintenance practices. Traffic volumes are estimated using the travel demand modeling process described in Section 4 of this report. Maintenance practices and corresponding costs were obtained through a survey of county road maintenance officials and commissioners.

5.1. Costs and Practices Survey

Assessment of the funding needs to maintain and preserve unpaved county and local roads focuses on traffic levels and existing practices as reported by counties and townships in survey responses. Each county was analyzed separately, which allows the study to focus on county-level needs based upon existing practices and expectations. During the input process from the 2014 study, concern was expressed by policy-makers and county officials as to the homogeneity of costs and practices within regions, as well as the varied utilization of contractors for work within the counties. The survey was enhanced in 2016, 2019, and again during this study to collect additional information about graveling practices, aggregate type, use of contractors, and reported traffic levels by county. The survey enhancements were developed with the assistance of a panel of county engineers and road superintendents. Survey training webinars were hosted to provide additional insights to all county and township survey respondents. This provided additional information about the reason for regional discrepancies and allowed for consistency within regions where costs and practices are similar.

Because of variations in dedicated staff for roadway planning, separate surveys were designed for county and township officials. The county survey was mailed to all 53 counties in North Dakota and a 90% response rate was achieved. The township survey was mailed to all 1,333 organized townships (shown in Figure 15) with a 38% response rate. Unorganized township maintenance practices were derived from responses of organized townships within the same county or through county survey responses.

The survey was designed to obtain information on maintenance practices for unpaved roads as well as the costs are faced by each county and local entity. The full survey can be found in Appendix A of this report.

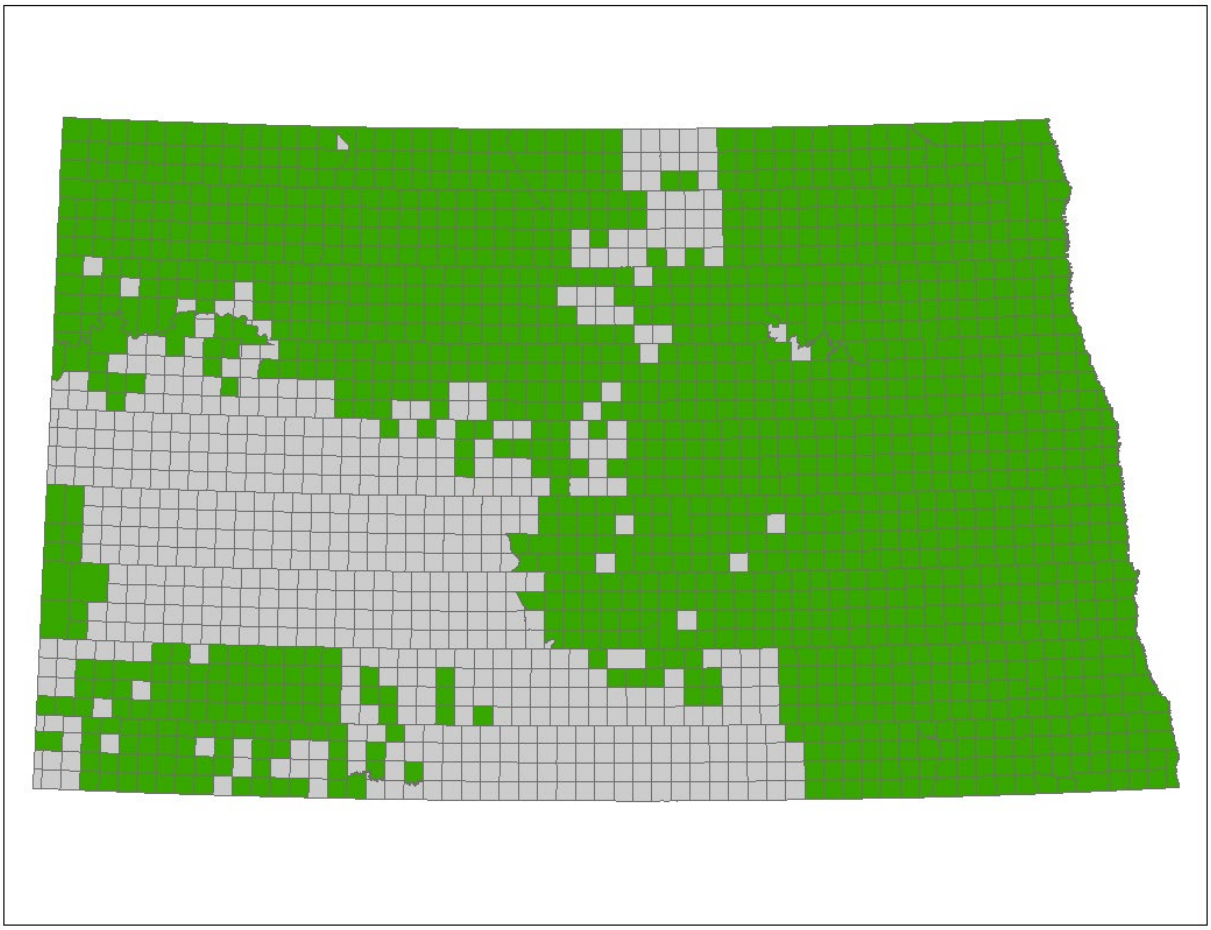


Figure 15. Organized Townships in North Dakota

Since the last study, there have been some changes in unpaved road maintenance practices that are intended to preserve the resources applied to the roads. These preservation techniques are evolving across the nation and North Dakota. The new techniques may slightly increase initial costs but will reduce costs over time through reduced blading and gravel overlay frequency. The goal of the new gravel techniques is to preserve the gravel on the roadway rather than let it be blown away as dust or have it roll into the adjacent ditches. At the time of this report, many counties were in the process of changing or had changed their gravel bidding and testing practices to ensure that higher quality and lower maintenance gravel was being purchased. The Federal Highway Administration (FHWA) and the Department of Defense (DOD) were also adding specification and testing requirements to missile road graveling projects administered by NDDOT.

5.1.1. Aggregate Description

The type and quality of aggregate used on unpaved roads has an impact on the cost and amount of maintenance required to maintain a road in acceptable condition. The survey utilized the following types of aggregate: gravel or scoria. In addition to aggregate type, respondents were asked whether their aggregate is pit run, screened, crushed material or if gravel purchases include specification and testing. Pembina Co. has all of its county roads surfaced with asphalt or concrete and therefore does not test gravel for surfacing specifications.

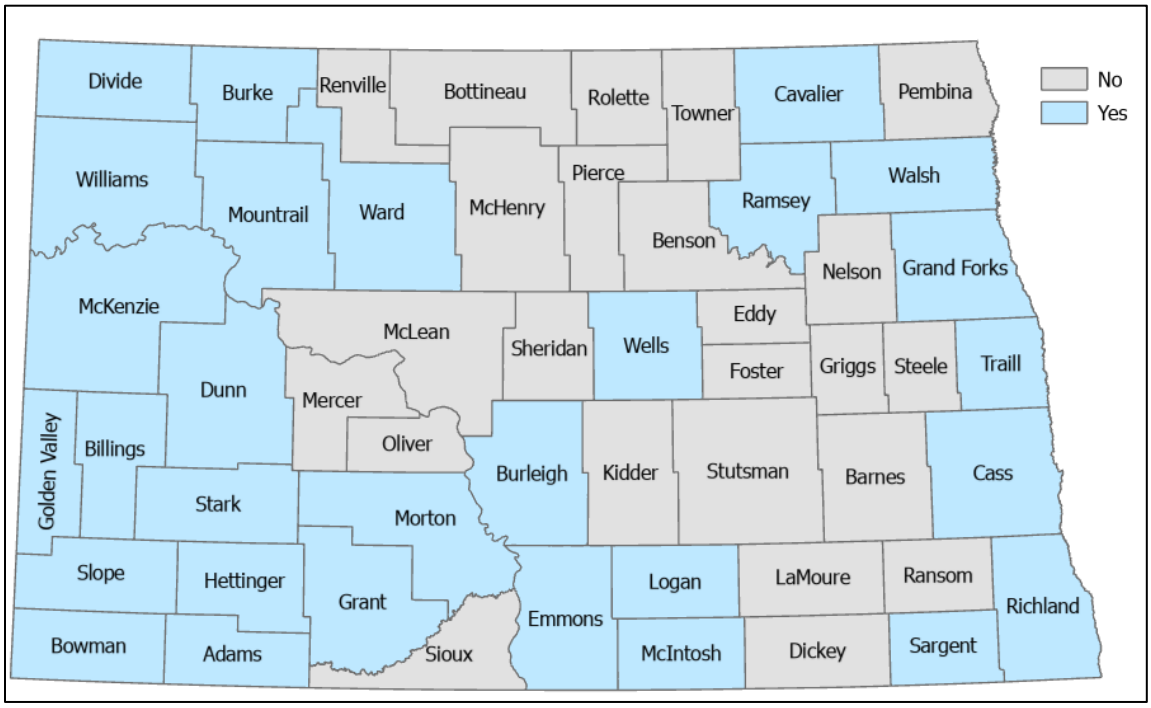


Figure 16. Survey Responses to Gravel Specifications

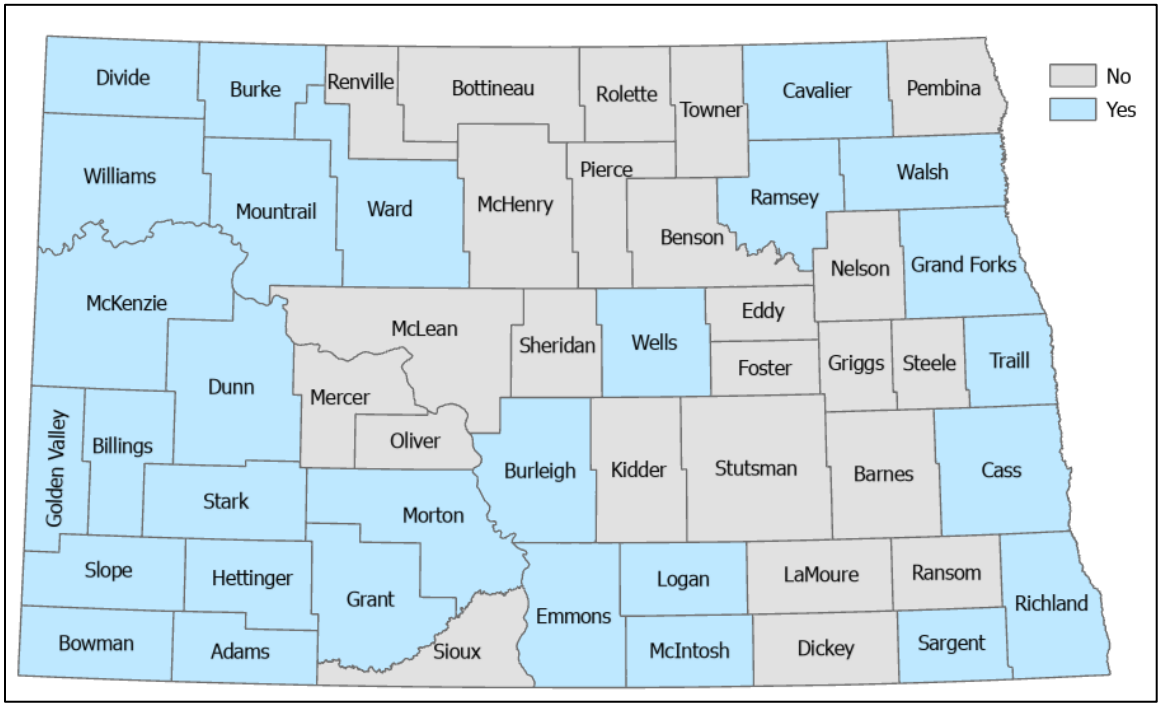


Figure 17. Survey Responses to Gravel Testing

5.1.2. Placement Practices

Common methods of applying a gravel overlay include truck drop and blading, windrowing and equalizing, watering rolling and compaction or a combination of any of the three. In addition, counties were asked for practices listed other than the most common placement techniques. Each of these techniques come at a different cost and the responses in this section of the survey help to reconcile reported placement costs in the cost section of the survey.

5.1.3. County vs. Contractor Work

In previous iterations of this study, significant variations in costs were observed and weren't readily explained by geographic aggregate and labor prices. Further conversations with county officials revealed that many of these cost differences could be explained by whether a county utilizes its own staff and equipment or uses contractors for gravel acquisition and maintenance activities. Consequently, county officials were asked whether county staff or contractors were utilized for crushing, hauling, placement, blading, dust control and base stabilization.

5.1.4. Costs

Depending on the region within the state, the survey indicated that there were significant variations in component costs. From region-to-region, aggregate availability and quality varies significantly and the resulting cost per yard and trucking cost from gravel pits to roads varies accordingly. County officials were asked for cost estimates for the following categories:

- cost per cubic yard
- trucking cost from gravel origin
- trucking distance
- truck payload
- placement costs
- blading cost
- dust suppressant cost
- base stabilization cost

To represent regional variations in aggregate price and availability, Figure 18 and Figure 19 show the unit price of aggregate per cubic yard and the average trucking distance for aggregate respectively. As Figure 18 shows, there are regional variations in aggregate prices with the highest per-yard costs in the western portion of the state and the lowest prices in the southeast and northeast part of the state. One outlier in eastern North Dakota is Traill County which reported the combined aggregate and hauling cost.

Figure 19 shows the average hauling distance from aggregate sources to improved roads. This map illustrates aggregate availability across the state. In counties having numerous sources of aggregate, the hauling distance is expected to be very short. In other counties with scarce aggregate resources, the hauling distance may be from one end of the county to the other, or even from outside of the county. The largest haul distances can be found in the Red River Valley because of low aggregate availability. As with Figure 21, Traill County is an outlier as it reported aggregate cost and hauling in one combined figure.

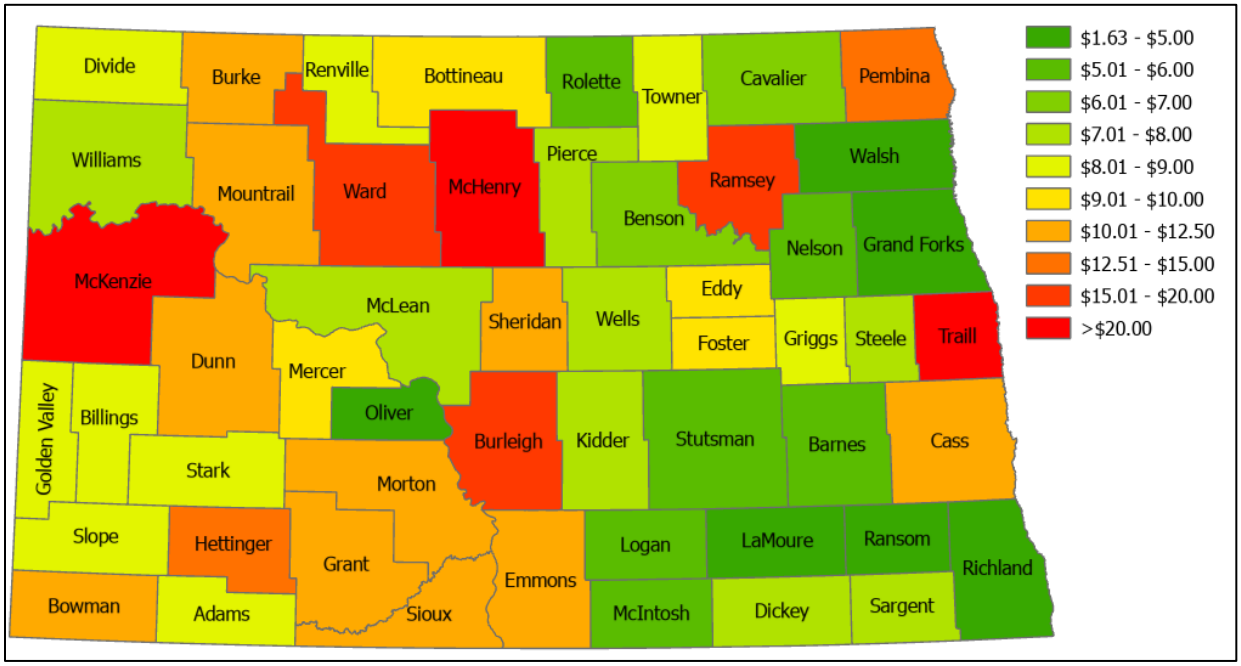


Figure 18. Aggregate Cost per Cubic Yard (2024 dollars)

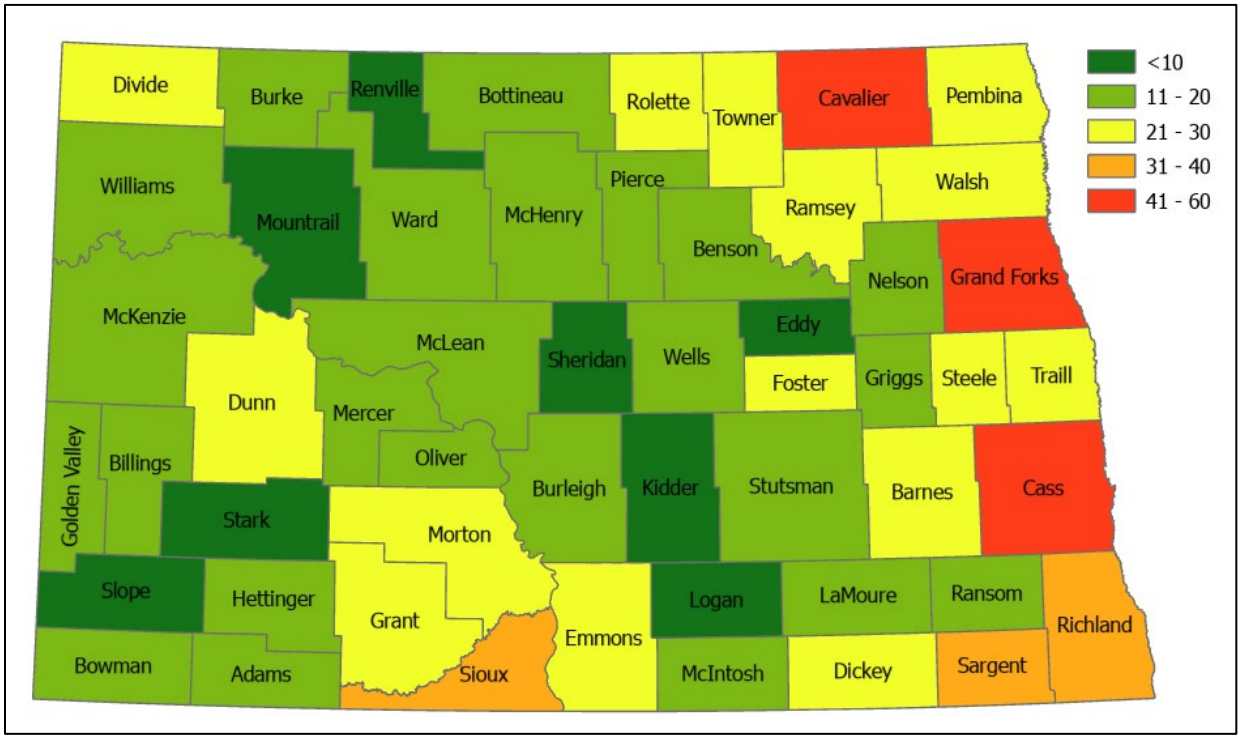


Figure 19. Aggregate Trucking One-Way Distance (Miles)

5.1.5. Practices by Traffic Level

Routine maintenance practices utilized by county and township officials for unpaved roads include blading and regraveling. The frequency and type of these practices vary based on the traffic levels on the road being maintained. For example, a high-volume gravel road requires more frequent blading and gravel overlays. Moreover, the gravel overlay would be thicker on a high-volume road than on a low-volume road. In addition to routine maintenance practices, many counties use dust suppressants or base stabilizations on high-volume roads to help preserve the road condition and mitigate impacts to citizens.

To assess how counties are maintaining their roads under different traffic categories, respondents were first asked to define what comprises a high-, medium- or low-volume road. There is also significant variation in traffic levels across the state; one county's high-volume road may be another county's low-volume road at the same traffic level. Following the question regarding the definition of traffic volumes, the county representatives were asked to provide blading and overlay frequencies at each traffic level. In addition, the overlay thickness and utilization of dust suppressant and base stabilization were established.

5.2. Analysis Procedures

5.2.1. Traffic Classification

Within each county, unpaved roads were classified by daily truck estimates. Classification ranges are shown in Table 5. Each category represents a differing traffic level leading to differing maintenance needs. Note that the 25-50 range represents the baseline traffic level. A 2007 survey conducted prior to significant oil development reported an average of 20 trucks per day on local roads and 22 on CMC routes. Traffic counts taken across the state for the purpose of this study indicate that these estimates have increased slightly statewide, and greatly in areas of oil development or in proximity to new shuttle train facilities. In the UGPTI conditions and practices questionnaire, counties were asked to provide information on maintenance practices on an average mile of gravel road classified by three traffic ranges (low, medium, high). Counties were asked to define their own range thresholds for these classifications. The surveys are presented in Appendix A.

Table 5. Unpaved Road Traffic Classification

Traffic Range (Truck ADT)	Category
0-25	Low
25-50	Baseline
50-100	Elevated
100-150	Moderate
150-200	High
200+	Very High

5.2.2. Improvement Types

Survey questions asked county and township officials to provide the improvement and maintenance cycles for gravel roads within their jurisdictions. The county surveys asked officials to provide these

cycles separately for each of the three traffic volume categories. Improvement types included: increased regraveling frequency, intermediate improvements, and asphalt surfacing. The first and the last improvement types are the most straight forward; as traffic increases, the application of gravel increases. Once traffic reaches a very high level, lifecycle costs deem that an asphalt surface is the most cost-effective improvement type. The intermediate category of improvements includes base stabilization and armor coat treatments. There is no single intermediate improvement which can be applied to each county in North Dakota because of differing soil types, moisture levels, and skill and equipment availability. Types of intermediate improvements include the use of stabilizers such as Base 1 from Team Labs, Permazyme from Pacific Enzymes, and asphalt and cement stabilization. According to interviews with county road supervisors, stabilization has been used on a few county roads in North Dakota. Recent trials have yielded mixed results, with some positive cases resulting in reduced maintenance costs. However, the longevity of these types of treatments are unknown, particularly with regard to performance under North Dakota's freeze/thaw cycles.

Maintenance types by traffic category are shown in Table 6. The consensus from the survey responses was that on roads with higher traffic volumes, the graveling interval decreases and the number of bladings per month increases. For example, a road considered in the medium category has a graveling interval of three to five years and a blading interval of once per month. A high-traffic road has a graveling interval of one to three years and a blading interval of three-four times per month. The difference doubles the gravel maintenance costs over the same time period. The other important takeaway is that counties located in the oil patch tend to have shorter improvement cycles and higher standards for overlay thickness than the rest of the state. Most of these counties use advanced stabilization methods. The unit costs of gravel supply and transportation are generally higher in the western part of the state.

Table 6. Improvement Types for Unpaved Roads by Traffic Category

Traffic Category	Improvement
Low	Low Volume Average
Baseline	County Average
Elevated	County Reported
Moderate-High	County Reported and Indexed

It is entirely possible that at the very high and potentially high categories of traffic on gravel roads, counties may choose to convert the surfaces to an asphalt surface. This study does not explicitly model upgrading gravel pavements on a statewide basis, as it is expected that the decision to convert surface type is part of a county-level planning program. The estimates of maintenance costs in the very high and the potentially high categories may equal or exceed the annual equivalent improvement and maintenance costs for an asphalt surface, depending on an individual county's cost characteristics.

5.2.3. Projected Investment Needs

The projected costs by time period, region, and functional class are summarized in Table 7, Table 8, and Table 9. The total projected statewide need during the 20-year analysis period is $6.97 billion.

Table 7. Statewide Unpaved Road Investment and Maintenance Needs for Counties, Townships and Tribal Areas in North Dakota (Millions of 2026 Dollars)

Period	Statewide
2026-2027	$775.33
2028-2029	$760.31
2030-2031	$783.74
2032-2033	$785.68
2034-2035	$758.36
2036-2045	$3,764.31
2026-2045	**$7,627.73**

The estimated needs are shown by jurisdiction for the 2026-2027 biennium in Table 8. Similarly, the investment needs are shown by jurisdiction for the entire analysis period in Table 9.

Table 8. Unpaved Road Investment Needs, by Jurisdiction: 2026-2045

Jurisdiction and/or Maintenance Resp.	Needs (Millions)	Percent of Needs
County	$472.95	61%
Township	$286.87	37%
Tribal	$15.51	2%
Total	$775.33	100%

Table 9. Unpaved Road Investment Needs, by Jurisdiction: 2026-2045

Jurisdiction and/or Maintenance Resp.	Needs (Millions)	Percent of Needs
County	$4,652.91	61%
Township	$2,822.26	37%
Tribal	$152.55	2%
Total	$7,627.73	100%

Table 10 presents the unpaved road needs by county for the analysis period by biennium for each of the first 10 years, as well in total for as the last 10 years of the study period. Tribal roads not maintained by the counties are excluded from Table 10.

Table 10. Unpaved Road Needs by County (2026 Million)

County	2026-2027	2028-2029	2030-2031	2032-2033	2034-2035	2036-45
Adams	$6.94	$6.96	$6.96	$6.96	$6.97	$35.07
Barnes	$20.36	$20.36	$20.37	$20.37	$20.37	$101.84
Benson	$11.44	$11.44	$11.44	$11.44	$11.44	$57.18
Billings	$10.76	$9.92	$11.90	$11.14	$9.83	$48.93
Bottineau	$16.18	$16.13	$16.13	$16.21	$16.21	$80.99
Bowman	$9.57	$9.65	$9.67	$9.63	$9.56	$47.83
Burke	$13.45	$13.32	$13.30	$13.31	$13.35	$66.54
Burleigh	$15.18	$15.18	$15.18	$15.18	$15.18	$75.50
Cass	$39.33	$39.40	$39.62	$39.72	$39.99	$198.88
Cavalier	$13.53	$13.53	$13.57	$13.58	$13.58	$67.78
Dickey	$10.31	$10.31	$10.31	$10.31	$10.31	$51.53
Divide	$12.12	$12.04	$12.09	$12.11	$12.07	$60.28
Dunn	$45.11	$41.11	$48.64	$51.21	$36.47	$183.88
Eddy	$4.49	$4.50	$4.50	$4.50	$4.50	$22.46
Emmons	$12.37	$12.37	$12.37	$12.37	$12.37	$61.86
Foster	$6.76	$6.76	$6.76	$6.76	$6.76	$33.79
Golden Valley	$11.62	$12.16	$11.76	$11.70	$11.54	$57.63
Grand Forks	$23.80	$23.88	$23.88	$23.88	$23.90	$119.33
Grant	$16.52	$16.52	$16.52	$16.52	$16.52	$82.60
Griggs	$6.95	$6.95	$6.95	$6.95	$6.99	$34.88
Hettinger	$8.35	$8.35	$8.35	$8.35	$8.35	$41.73
Kidder	$7.74	$7.74	$7.74	$7.74	$7.74	$39.09
LaMoure	$10.94	$10.94	$10.94	$10.94	$10.94	$54.72
Logan	$5.57	$5.57	$5.57	$5.57	$5.57	$27.83
McHenry	$14.41	$14.42	$14.42	$14.42	$14.45	$72.12
McIntosh	$4.84	$4.84	$4.84	$4.84	$4.84	$24.20
McKenzie	$60.36	$52.97	$61.09	$61.17	$55.05	$252.31
McLean	$22.08	$22.08	$22.08	$22.10	$22.11	$110.61
Mercer	$14.13	$14.13	$14.13	$14.06	$14.06	$70.30
Morton	$18.49	$18.49	$18.49	$18.49	$18.49	$92.43
Mountrail	$25.08	$22.80	$26.29	$26.38	$23.25	$114.53
Nelson	$7.32	$7.32	$7.32	$7.33	$7.33	$36.62
Oliver	$3.41	$3.38	$3.38	$3.38	$3.38	$16.60
Pembina	$10.09	$10.10	$10.10	$10.10	$10.10	$50.51
Pierce	$13.29	$13.29	$13.29	$13.29	$13.29	$66.46
Ramsey	$8.25	$8.26	$8.26	$8.26	$8.26	$41.25
Ransom	$6.67	$6.69	$6.69	$6.69	$6.70	$33.42
Renville	$5.94	$5.94	$5.94	$5.94	$5.94	$29.71
Richland	$23.08	$23.08	$23.08	$23.10	$23.10	$115.49
Rolette	$6.10	$6.10	$6.10	$6.10	$6.10	$30.51
Sargent	$5.76	$5.76	$5.76	$5.76	$5.76	$28.81
Sheridan	$7.83	$7.83	$7.83	$7.83	$7.83	$39.13

County	2026-2027	2028-2029	2030-2031	2032-2033	2034-2035	2036-45
Sioux	$6.05	$6.05	$6.05	$6.05	$6.05	$30.26
Slope	$8.61	$8.61	$8.61	$8.49	$8.49	$42.46
Stark	$21.11	$21.06	$21.26	$21.03	$20.98	$105.40
Steele	$8.59	$8.59	$8.60	$8.60	$8.60	$42.97
Stutsman	$11.96	$11.96	$11.97	$11.98	$11.99	$59.89
Towner	$9.12	$9.12	$9.12	$9.12	$9.12	$45.62
Traill	$20.98	$21.01	$21.13	$21.16	$21.18	$105.42
Walsh	$18.93	$18.93	$19.06	$19.07	$19.07	$95.10
Ward	$34.13	$34.52	$34.75	$34.87	$34.68	$171.34
Wells	$12.79	$12.79	$12.79	$12.79	$12.79	$63.96
Williams	$26.55	$25.11	$26.80	$26.84	$24.87	$124.74
Total	$775.33	$760.31	$783.74	$785.68	$758.36	$3,764.31

6. Paved Road Analysis

The paved road analysis follows a similar approach to the methods used in the previous study. For the most part, the same methods and models were used, but expanded data collection reduced uncertainty and improved the accuracy of this study's county and township paved road needs forecasts.

A major part of the expanded data collection includes the use of the UGPTI/DOTSC-developed asset inventory tool, the Geographic Roadway Inventory Tool (GRIT). This online tool has allowed county roadway managers to input roadway data based on past improvement projects, providing a practical view of the roadway age and past construction practices. For the study, construction project data was taken from the inventory and input into the model to forecast future projects.

More than 6,000 miles of paved county and local roads (exclusive of city streets) are traveled by agricultural- and oil-related traffic and other highway users. Some of these roads are under the jurisdiction of governments or agencies other than counties, such as townships, municipal governments, the Bureau of Indian Affairs (BIA), and the Forest Service. City streets and Forest Service roads are excluded from the study.[1] BIA and tribal roads are included, but the results are presented separately from county and township roads.

In addition to miles of road and forecasted traffic levels, key factors that influence paved road investments are the number of trucks that travel the road, the types of trucks and axle configurations used to haul inputs and products, the structural characteristics of the road, the width of the road, and the current surface condition. The primary indicator of a truck's impact is its composite axle load –

[1] Investments in city streets primarily reflect access to commercial and residential properties and include the costs of parking and traffic control devices. This does not mean that city streets are unaffected by truck traffic. However, the specific focus of this study is county and township roads.

which, in turn, is a function of the number of axles, the type of axle (e.g. single, double, or triple), and the weight distribution to the axle units.

6.1. Truck Axle Weights

American Association of State Highway Transportation Officials (AASHTO) pavement design equations were used to analyze paved road impacts. These same equations are used by most state transportation departments. The equations are expressed in equivalent single axle loads (ESALs). In this form of measurement, the weights of various axle configurations (e.g., single, tandem, and tridem axles) are converted to a uniform measure of pavement impact. With this concept, the service life of a road can be expressed in ESALs instead of truck trips.

An ESAL factor for a specific axle represents the impact of that axle in comparison to an 18,000-pound single axle. The effects are nonlinear. For example, a 16,000-pound single axle followed by a 20,000-pound single axle generates a total of 2.19 ESALs, as compared to 2.0 ESALs for the passage of two 18,000-pound single axles.[2] An increase in a single-axle load from 18,000 to 22,000 pounds more than doubles the pavement impact, increasing the ESAL factor from 1.0 to 2.44. These nonlinear relationships result in exponential increases to ESALs & contribute to road damages. Even modestly illegal overloads (e.g. 22,000 pounds on a single axle) can significantly reduce pavement life.

6.2. Trucks Used to Haul Oil Products and Inputs

The forecasted trips for each type of load moving to and from well sites were shown in Table 2. The characteristics of these trips are depicted in Table 13. Specifically, the number of axles in the truck, the weight per axle group (in kilo pounds or kips), and the ESALs are shown.

For example, the truck used to transport a derrick has six axles positioned in three distinct groups, plus a single steering axle, for a total of seven axles. The first axle group (other than the steering axle) is a tandem set weighing 45,000 pounds. The second group is a three-axle set weighing 60,000 pounds. The third group is a tandem axle weighing 42,000 pounds. The ESAL factors for the three axle groups are 3.58, 2.48, and 2.49, respectively. The ESAL factor of the steering axle (which weighs 12,000 pounds) is 0.23. In total, the truck weighs 159,000 pounds with an ESAL factor of 8.78.

The heaviest weights and highest ESAL factors are generated by the indivisible loads listed in the first part of Table 11. These vehicles (which exceed the maximum vehicle weight limit) travel under special permits. In comparison, a truck used to transport sand while complying with Bridge Formula B weighs 76,000 pounds and generates an ESAL factor of 2.24. Nevertheless, based on enforcement data from the North Dakota Highway Patrol and results of special studies at truck weigh stations, it has been estimated that 25% of these trucks are overloaded. The typical overloaded vehicle weighs 90,000 pounds with an ESAL factor of 3.78 (instead of 2.24).

In the analysis, 75% of the trips for this type of truck are assumed to be legally loaded and 25% are assumed to be overloaded. A similar assumption is made for movements of fresh water. The estimated

[2] These calculations reflect a light pavement section with a structural number of 2.0 and a terminal serviceability (PSR) of 2.0.

ESAL factor for movements of crude oil in 5-axle tanker trucks is 2.42. These tank trailers are designed for transporting oil at the 80,000-pound weight limit.

Table 11. Axle and Vehicle Weights and Equivalent Single Axle Loads for Drilling-Related Truck Movements to and from Oil Wells

	Steering Axle			Axle Group 1			Axle Group 2			Axle Group 3			Axle Group 4			Vehicle Total	
Load Type	**Axles**	**Kips**	**ESALs**	**Axles**	**Kips**	**ESALs**	**Axles**	**Kips**	**ESALs**	**Axles**	**Kips**	**ESALs**	**Axles**	**Kips**	**ESALs**	**Kips**	**ESALs**
Generator House	1	12.7	0.40	3	54.7	1.90	4	59.4	6.08	2	33.4	1.11				160.2	9.49
Crown Section	1	15.0	0.65	2	45.0	3.58	2	45.0	3.58	2	35.0	1.38				140.0	9.19
Shaker Tank/Pit	1	14.1	0.65	3	51.6	1.44	4	54.0	4.00	2	23.0	0.32				142.7	6.40
Derrick	1	12.0	0.23	2	45.0	3.58	3	60.0	2.48	2	42.0	2.49				159.0	8.78
Suction Tank	1	11.8	0.23	3	42.1	0.78	3	49.6	1.24	1	17.1	1.00				120.6	3.25
VFD House	1	13.9	0.40	3	54.7	1.90	3	45.8	0.92	2	27.8	0.55	1	12.7	0.40	154.9	4.16
Mud Pump	1	12.9	0.40	3	54.3	1.90	3	56.5	2.17	2	37.2	1.69	1	5.0	0.02	165.9	6.18
Mud Boat	1	16.0	0.65	2	40.0	2.06	3	60.0	2.48	0	0.0					116.0	5.19
Shaker Skid	1	12.0	0.23	2	45.0	3.58	3	54.8	1.90	0	0.0					111.8	5.71
Substructure, Centerpiece, etc.	1	14.0	0.40	3	43.4	0.78	2	45.3	3.58	2	32.6	1.11	1	25.3	4.31	160.6	10.18
Draw Works	1	14.4	0.40	3	58.0	2.17	3	59.0	2.48	2	36.0	1.38				167.4	6.43
Hydraulic Unit	1	16.0	0.65	2	28.0	0.55	2	26.0	0.42	3	60.0	2.48				130.0	4.09
Choke Manifold	1	14.0	0.40	2	41.8	2.49	2	39.5	2.06	1	19.8	1.49	1	4.0	0.00	119.1	6.44
MCC House	1	18.0	1.00	3	58.5	2.48	3	58.5	2.48	2	39.0	2.06				174.0	8.02
Tool Room, Junk Box, etc.	1	12.0	0.23	2	45.0	3.58	3	60.0	2.48	0	0.0					117.0	6.29
Screen House	1	13.0	0.40	4	56.0	4.98	4	56.5	4.98	2	33.0	1.11				158.5	11.46
Light Plant	1	14.0	0.40	4	58.0	6.08	4	66.0	8.83	2	32.0	0.89				170.0	16.20
Mud Tank	1	13.0	0.40	3	47.5	1.07	4	58.8	6.08	1	19.5	1.49				138.8	9.04
Workover Rigs	2	45.0	3.58	3	60.0	2.48										105.0	6.06
Fresh Water Unpermitted Overloads[1]	1	14.0	0.40	3	38.0	0.46	2	19.0	0.16	2	19.0	0.16				90.0	1.18
Fresh Water Legal Loads [2]	1	10.0	0.12	3	33.0	0.31	2	16.5	0.11	2	16.5	0.11				76.0	0.64
Fresh Water Empty Return Loads	1	6.0	0.02	3	14.0	0.01	2	9.0	0.01	2	9.0	0.01				38.0	0.05
Sand Unpermitted Overloads[1]	1	14.0	0.40	2	38.0	1.69	2	38.0	1.69							90.0	3.78
Sand Legal Loads[2]	1	10.0	0.02	2	33.0	1.11	2	33.0	1.11							76.0	2.24
Sand Empty Return Loads	1	6.0	0.00	2	16.0	0.07	2	16.0	0.07							38.0	0.14

1. 25% of Loads @ 90 kips
2. 75% of Loads @ 76 kips

6.3. Trucks Used to Haul Grains and Farm Products

A previous survey of elevators revealed the types of trucks used to haul grains and oilseeds and the frequencies of use. As shown in Table 12, approximately 56% of the inbound volume is transported to elevators in five-axle tractor-semitrailer trucks. Another 4% arrives in double trailer trucks—e.g. Rocky Mountain doubles. Another 12% to 13% arrives in four-axle trucks equipped with triple or tridem rear axles.

Table 12. Types of Trucks Used to Transport Grain to Elevators in North Dakota

Truck Type	Percentage of Inbound Volume
Single unit three-axle truck (with tandem axle)	25.15%
Single unit four-axle truck (with tridem axle)	12.55%
Five-axle tractor-semitrailer	54.96%
Tractor-semitrailer with pup (7 axles)	3.62%
Other	3.72%

After considering entries in the "other" category, the following assumptions have been made. 62% of the grains and oilseeds delivered to elevators in North Dakota are expected to arrive in combination trucks, as typified by the five-axle tractor-semitrailer. The remaining 38% are expected to arrive in single-unit trucks, typified by the three-axle truck. The impact factor for grain movements in tractor-semitrailers is 2.7 ESAL per front-haul mile, which includes the loaded and empty trips. In comparison, the impact factor for a single-unit truck is 1.5 ESALs per mile. Nevertheless, the ESAL factors per ton-mile are roughly the same for both trucks, given the differences in payload.

6.4. Surface Conditions

Since 2023, the UGPTI has used a portable road-survey profiler system to collect pavement condition information on paved county roads statewide. For this study report, researchers collected pavement condition data on approximately 6,058 miles of paved county roads. This extensive dataset provides a detailed understanding of roadway conditions and helps identify where maintenance, preservation, and rehabilitation investments are most needed.

As part of the data collection process, 360-degree roadway images are captured and stored in the GRIT image database. These images provide a visual record of roadway conditions and allow researchers to verify pavement performance and assess visible signs of deterioration, such as cracking, raveling, and surface wear. The imagery complements the field measurements and strengthens the overall reliability of the condition assessment.

Road conditions were evaluated using a combination of measured pavement smoothness and visual condition assessments. Pavement smoothness was measured using the International Roughness Index (IRI), a widely used indicator of ride quality. Lower roughness values generally indicate a smoother and more comfortable ride, while higher values indicate rougher pavement conditions.

To make the results easier to interpret and more closely aligned with the traveling public's experience, roughness measurements were converted to the Present Serviceability Rating (PSR) scale. The PSR scale ranges from 0 (very poor) to 5 (very good) and reflects how road users perceive pavement quality. The conversion is based on research conducted by the Minnesota Department of Transportation (MnDOT) that linked measured pavement conditions to ratings provided by motorists. IRI is converted to PSR using the Minnesota survey panel equation (MnDOT, 2003):

In addition to the ride quality, researchers conducted a comprehensive evaluation of pavement surface conditions by analyzing 360-degree roadway images. They reviewed about 5,500 miles of paved roads to assess surface distress and deterioration. This visual assessment complemented existing ride quality and roughness measurements, providing a more thorough understanding of roadway performance than roughness measurements alone, as guided by the same MnDOT study. The combined PSR value is calculated using the ride and condition values of PSR.

The condition PSR value used in the equation is the subjective 0 to 5 scale rating of cracking and surface deterioration of the road sections. For roadway segments with detailed pavement structure information, both ride quality and visual condition ratings were combined to produce a final PSR value. For segments without sufficient pavement structure data, the ride quality rating was used as the final pavement condition measure.

The current condition of paved roadways shown in Figure 20 is predominantly fair, a trend that has remained consistent over the past study years. About one-quarter of these roads are rated good, while about one-fifth are classified as poor. Looking ahead to 2025, 1,560 miles, or 26% of the total 6,058 miles of roadway, are projected to be in good condition. In contrast, 3,295 miles (54%) are expected to remain in fair condition, and 1,203 miles (20%) will be rated as poor.

The pavement condition trends indicate that the overall network gradually deteriorated between 2019 and 2024. During this period, the percentage of roads in good condition declined, while the share of roads in poor condition increased. This pattern suggests roadway deterioration was outpacing preservation and rehabilitation efforts, causing more road segments to shift from good to fair and poor condition categories.

Recent data from 2024 to 2026 indicates a stabilization in road-condition trends, with modest improvements. The percentage of roads classified as in good condition has increased by 3%, while the percentage in poor condition has declined. This progress largely reflects increased legislative focus and state funding for local transportation infrastructure. The additional financial resources allowed counties to undertake more preservation, rehabilitation, and reconstruction projects, which slowed road deterioration and improved pavement conditions across the road system.

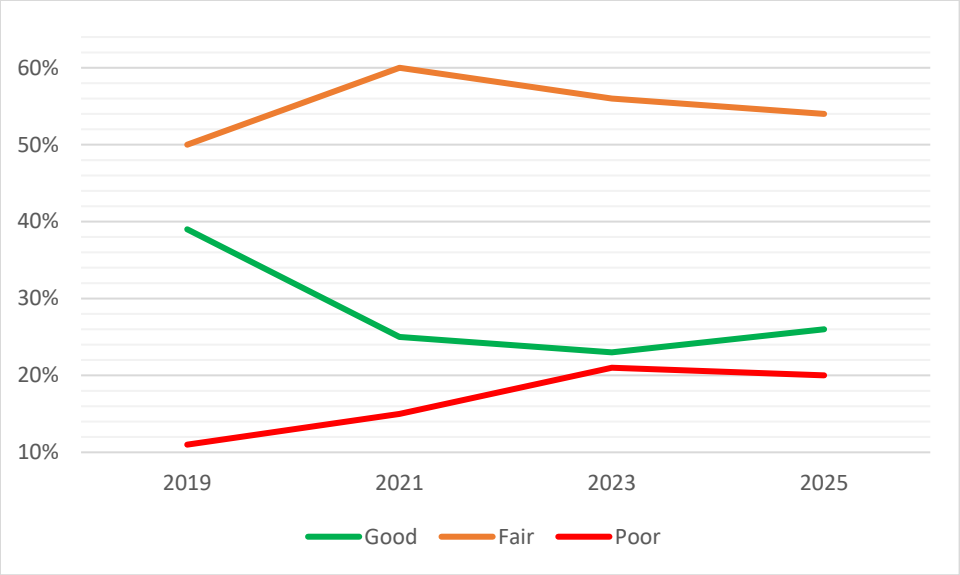


Figure 20: Comparison of Paved County and Township Roads in North Dakota in 2026 Condition Miles

6.5. Structural Capacity

A road's ability to carry traffic, particularly heavy trucks, depends not only on its surface condition but also on the strength of the layers beneath the pavement. This underlying strength, referred to as the road's structural capacity and measured through the Structural Number (SN), reflects the thickness and quality of the pavement, base materials, and supporting ground.

County officials utilize the GRIT system, which categorizes updates into three distinct layers. The top layer, or surface layer, is mainly asphalt. Beneath it, the bottom layer, known as the sub-base, consists of aggregate materials. The intermediate layer, or base layer, consists of various grades of aggregates along with reclaimed pavement and base materials. To evaluate structural capacity, this study uses information maintained in the GRIT roadway inventory, including pavement and base layer thicknesses. Where current local data are unavailable, the study uses historical testing data (non-destructive testing) and regional default values to ensure a complete statewide assessment.

For this study, structural information is used to determine:

- The remaining capacity in an existing roadway when improvements are needed.
- The type and extent of improvement required to provide an expected service life of approximately 20 years.
- The most cost-effective investment strategy for each roadway segment.

This approach helps ensure improvement recommendations are based not only on current pavement conditions but also on the roadway's long-term ability to support traffic demands.

6.6. Types of Roadway Improvement

The study evaluates five improvement strategies that vary in cost, expected life, and rehabilitation level.

1) Resurfacing

Resurfacing is typically the most cost-effective treatment for roads that remain structurally sound but are showing signs of minor distress. A new asphalt layer is placed over the existing pavement (with or without milling) to restore ride quality and extend pavement life. The amount of work required depends on the road's current structural capacity and the expected future volume of heavy traffic. Because resurfacing maintains much of the existing roadway structure, it is typically less expensive than major rehabilitation or reconstruction.

2) Reconstruction

Reconstruction involves removing and replacing the entire roadway structure. This is the most extensive and costly improvement option. A roadway may require reconstruction when:

- Pavement deterioration has become too severe for resurfacing.
- The underlying base or subgrade no longer provides adequate support.
- The roadway geometry or width no longer meets operational needs.

Although reconstruction requires a substantial investment, it restores the roadway to like-new condition and provides the longest service life.

3) Mine and Blend (Reclamation)

For lower-volume roads, full reconstruction may not always provide the best return on investment. The mine-and-blend process reuses existing pavement and base materials to create a new roadway intermediate layer, reducing the need for costly imported materials. This treatment can significantly lower rehabilitation costs while still restoring structural performance. As a result, mine and blend is often a cost-effective alternative for rural roads where traffic volumes do not justify full reconstruction.

4) Sliver Widening with Resurfacing

Repeated resurfacing can maintain the overall depth required for traffic movement on the pavement. However, it can gradually reduce usable lane and shoulder width particularly for narrow roads. Sliver widening addresses this issue by modestly widening the roadway within the existing right-of-way while resurfacing is performed. Although this treatment may not create full-width modern lanes or shoulders, it helps maintain roadway function and improves safety while avoiding the higher costs associated with full reconstruction and widening projects.

5) Concrete Break and Seat with Overlay

Several concrete pavements built during the oil embargo crisis of the 1970s remain on roads within North Dakota. Such older concrete pavements require specialized rehabilitation methods. In these cases, crews break and stabilize the existing concrete pavement before applying a new asphalt overlay. This treatment improves ride quality and structural performance at a cost substantially lower than complete reconstruction.

6.7. Improvement Logic

The study uses a forecasting model to estimate how roadway conditions will change over time based on factors such as:

- Current pavement condition
- Traffic volumes and projected truck traffic
- Structural strength of the roadway
- Width deficiencies
- Condition of the base and subgrade

Road conditions are projected year by year. When a roadway is expected to fall below acceptable performance levels, the system identifies an appropriate improvement strategy. Roads with seriously weakened foundations are automatically prioritized for major rehabilitation or reconstruction because surface treatments alone will not provide a lasting solution. When a roadway is still in fair condition, resurfacing can often restore performance at a much lower cost than waiting until reconstruction becomes necessary. This is a key principle of asset management: investing at the right time can significantly reduce long-term costs. The study also evaluates roadway width. When narrow roads require thicker overlays, widening treatments may be recommended to maintain roadway function and safety standards. Regional practices vary across the state, and recommendations account for local construction approaches and operating conditions.

6.8. Preservation Maintenance

Pavement preservation techniques include timely crack sealing, seal coats, and patching. When combined with timely overlay projects, these methods aim to extend pavement life and minimize the need for costly reconstruction which can be up to six times more expensive than an overlay. Although pavement preservation is generally accepted, it is not always implemented uniformly due to budget constraints.

This study outlines the costs associated with timely pavement preservation techniques, even if they are not consistently applied across the jurisdictions examined. Preservation maintenance costs for paved roads include periodic activities such as crack sealing and chip seals, as well as annual activities like patching. The cost relationships presented in Table 13 have been updated to 2026 levels and annualized according to the North Dakota Department of Transportation (NDDOT) price sheet, factoring in changes from the FHWA National Highway Construction Cost Index (NHCCI) since 2024.

Annual road maintenance cost rises substantially as truck traffic volumes increase. For roads carrying 500 or fewer trucks per day, total annualized maintenance costs are about $13,115 per mile, with chip sealing accounting for the largest share of expenditures. For roads carrying more than 500 trucks per day, total annualized maintenance costs rise to about $32,160 per mile, more than twice the cost of lower-volume truck routes. Microsurfacing contributes most to this increase, followed by higher costs for contract patching and crack sealing.

Table 13. Routine Maintenance Cost for Paved Roads by Traffic Level (Million 2026 Dollars)

AADTT Truck Traffic	Region	Annualized Cost of Road Maintenance Activities				
		Chip	Crack	Contract	Chip Seal	Total
0-500	All	$7,343	0-500	All	$7,343	0-500
>500	All	$4,892	>500	All	$4,892	>500

6.9. Forecasted Improvement Needs

6.9.1. Required Overlay Thickness

As noted earlier, the projected overlay thickness depends on truck traffic and the existing pavement structure and condition. Based on the estimated ESAL demand for the next 20 years, a new structural number is computed that considers the effective structural number of the existing layers at the time of resurfacing.

Overlay thicknesses may be classified as thin (≤ 2 inches), medium (between 2 and 4 inches), and thick (≥ 4 inches). As shown in Figure 27, 29% of the state's paved road miles are expected to need thick overlays or major rehabilitation. Another 11% will require medium overlays, and thin overlays will suffice for the remaining 60%.

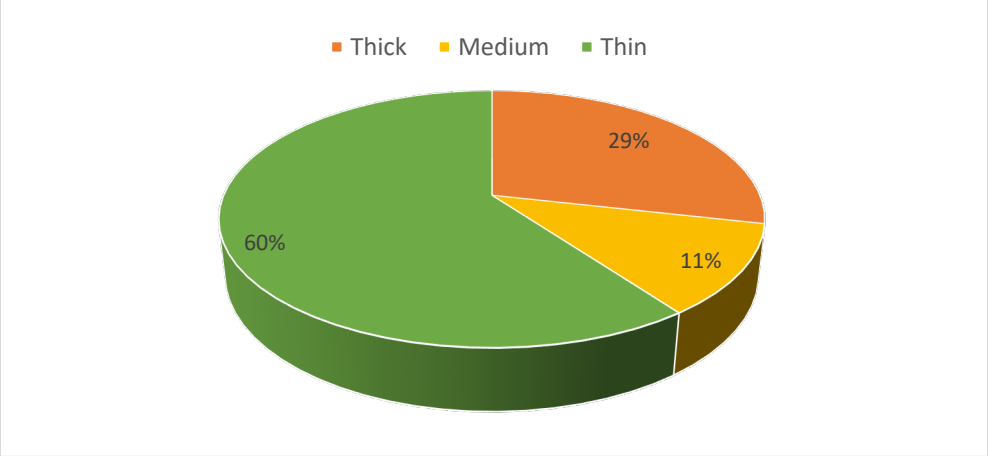


Figure 20. Statewide Projected Overlay Thickness

6.9.2. Miles Improved

As shown in Figure 22, approximately 10% of the county paved road miles in the state must receive major rehabilitation (reconstruction or mine-and-blend treatment) because of poor condition and heavy traffic, which will cause existing pavements to deteriorate quickly. This is 6% higher than the requirement from the last need study. About 2% of road miles must be widened when resurfacing, while 1% need a break-and-seat project.

Overall, the analysis shows that most of the miles in the state can be resurfaced without major rehabilitation or widening. However, many road segments that can be improved in the near term with thin overlays may need widening in future projects beyond this study.

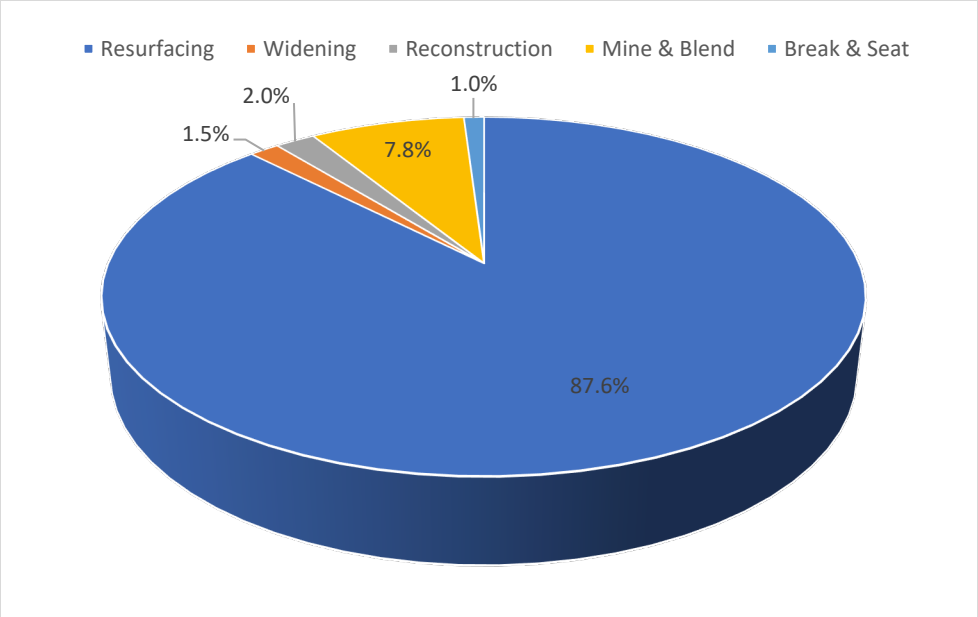


Figure 21. Percent of Paved Road Miles by Improvement Type

6.9.3. Improvement Costs per Mile

Recent evaluations of county and NDDOT construction projects reveal a moderate upward trend in roadway construction costs. Between 2024 and 2026, the Federal Highway Administration's National Highway Construction Cost Index (NHCCI) rose by approximately 2%. However, some resurfacing and rehabilitation projects saw cost increases that surpassed general construction inflation. This cost rise can be attributed to several factors, including escalating material prices, higher equipment and fuel expenses, increased borrowing costs, and ongoing difficulties recruiting and retaining a skilled transportation workforce. Additionally, market volatility and uncertainty concerning material availability have complicated project budgeting for local agencies. To address these trends, a review of statewide and local projects was conducted to identify necessary adjustments to project unit costs that reflect current market conditions and ensure consistency across different types of improvements. The previous study relied on NDDOT bid data and project plans for developing improvement costs across different roadway categories. For this analysis, recent construction projects from local governments and the NDDOT were compared with unit costs established in the previous study. This review indicated the need for a modest adjustment, prompting a 5% increase to the unit costs for resurfacing and rehabilitation in the analysis.

Using this adjustment, as shown in Figure 22, the statewide resurfacing cost is estimated at approximately $5,125 per inch-foot of roadway width. For a 24-foot-wide roadway, this equates to approximately $246,000 per mile for a 2-inch overlay, $492,000 per mile for a 4-inch overlay, and $738,000 per mile for a 6-inch overlay. A similar 5% adjustment was applied to break-and-seat treatments for concrete pavements and other applicable roadway improvement categories.

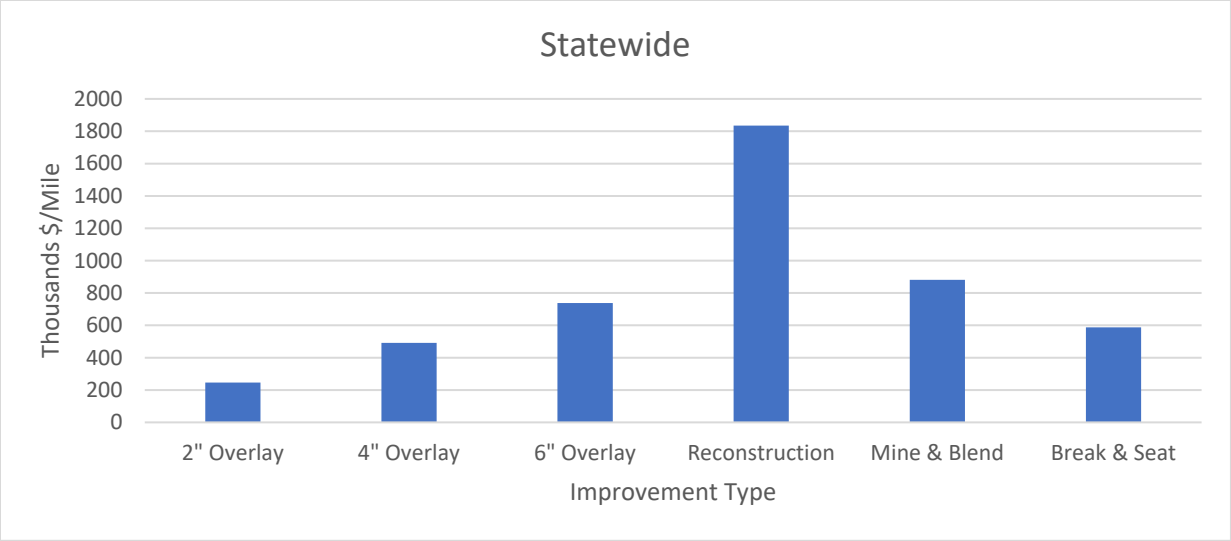


Figure 22. Average Cost per Mile for Different Improvement Types

Major rehabilitation costs are estimated using normalized unit cost data from the NDDOT statewide. The cost of reconstruction due to weak or failed subgrade is estimated at $1,835,370 per mile statewide. A mine-and-blend treatment is expected to cost about $880,975 per mile, while break-and-seat treatments are estimated at about $587,135 per mile. For segments selected for sliver widening, the cost is $113,795 per additional foot of width, in addition to the overlay cost.

Table 14 summarizes the analysis results, presenting projected improvements and costs (including maintenance) for each biennium over the next ten years, along with subtotals for 2026-2035 and 2036-2045. Table 15 summarizes total statewide pavement preservation costs. Appendix D.2 details the total paved road needs by county.

As shown in Table 14, most future pavement investment needs on paved county and township roads are associated with resurfacing projects, which account for approximately 5,309 miles of roadway over the 20-year analysis period, including 3,429 miles between 2026 and 2035 and an additional 1,880 miles between 2036 and 2045. A smaller portion of the network will require more extensive improvements, including approximately 123 miles of reconstruction, 473 miles of mine-and-blend rehabilitation, and 62 miles of concrete break-and-seat treatments. In addition, about 92 miles of roadway are projected to require widening improvements to address width deficiencies and maintain roadway functionality.

The analysis indicates that preservation-oriented treatments, particularly resurfacing, represent the most cost-effective strategy for maintaining much of the network. However, a subset of roads will require major rehabilitation or reconstruction due to advanced deterioration, structural deficiencies, traffic demands, or geometric limitations. Reconstruction needs remain relatively stable throughout the study period. The forecast indicates that major rehabilitation needs are concentrated during the first decade of the analysis period. Mine-and-blend treatments account for the largest share of these needs, particularly between 2028 and 2035, while reconstruction requirements remain relatively consistent throughout the 20-year period. Combined major rehabilitation costs are projected to peak during 2028-2029 at approximately $112 million and remain elevated through 2035 before declining in the later years of the analysis. These results suggest that sustained investment over the next 10 years will be

critical to addressing roads nearing the end of their useful life and preventing a significant increase in future reconstruction needs.

In this study, each roadway segment is assigned a single primary improvement strategy, ensuring needs are not double-counted across treatment categories. Over the 20-year study period, these capital improvements, together with ongoing maintenance activities, result in an estimated statewide investment need of approximately $3,587 million or $179.39 million annually. The weighted average cost for the predicted resurfacing improvements is roughly $232,600 per mile. The average routine maintenance cost is approximately $12,730 per mile per year. The annualized cost per mile is approximately $14,40 per year for roads that do not require major rehabilitation or widening. Once deferred investment needs are addressed and regular preservation maintenance is practiced on all segments, annualized costs should stabilize near this level.

Table 14. Summary of Statewide Forecasted Improvements and Costs for Paved County and Township Roads (Million 2026 Dollars)

Period	Resurfacing		Widening		Reconstruction		Mine & Blend		Break & Seat		Maintenance Cost	Total Cost
	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost	Miles	Cost		
2026-2027	294.3	$102.20	29.5	$21.20	19.5	$35.70	64.8	$42.40	0	$0.00	$80.70	$282.20
2028-2029	749.4	$227.20	52.2	$40.10	17.9	$32.90	108.3	$72.50	11.8	$7.00	$161.60	$541.20
2030-2031	680.1	$184.50	4.7	$4.40	19.7	$36.20	79.4	$52.90	11.9	$7.00	$161.80	$446.80
2032-2033	680.3	$175.10	2.1	$2.30	22.3	$40.90	101.7	$61.70	6.1	$3.60	$162.20	$445.80
2034-2035	1,024.8	$263.50	0	$0.00	21.9	$40.10	77.2	$50.60	9.8	$3.90	$162.50	$520.70
2026-2035	3,428.9	$952.50	88.5	$68.00	101.3	$185.80	431.4	$280.10	39.6	$21.50	$728.80	$2,236.70
2036-2045	1,880.4	$456.60	3.3	$1.90	21.5	$39.40	41.1	$26.20	22.4	$13.20	$813.70	$1,351.00

The cost distribution shown in Figure 23 further illustrates the importance of preserving the existing roadway network before major rehabilitation becomes necessary. Over the 20-year analysis period, maintenance activities account for the largest share of total investment needs at approximately 43%, followed by resurfacing projects at 39%. Together, these two categories represent roughly 82% of all projected expenditures, highlighting the critical role that routine maintenance and timely preservation treatments play in extending pavement life and delaying more costly repairs.

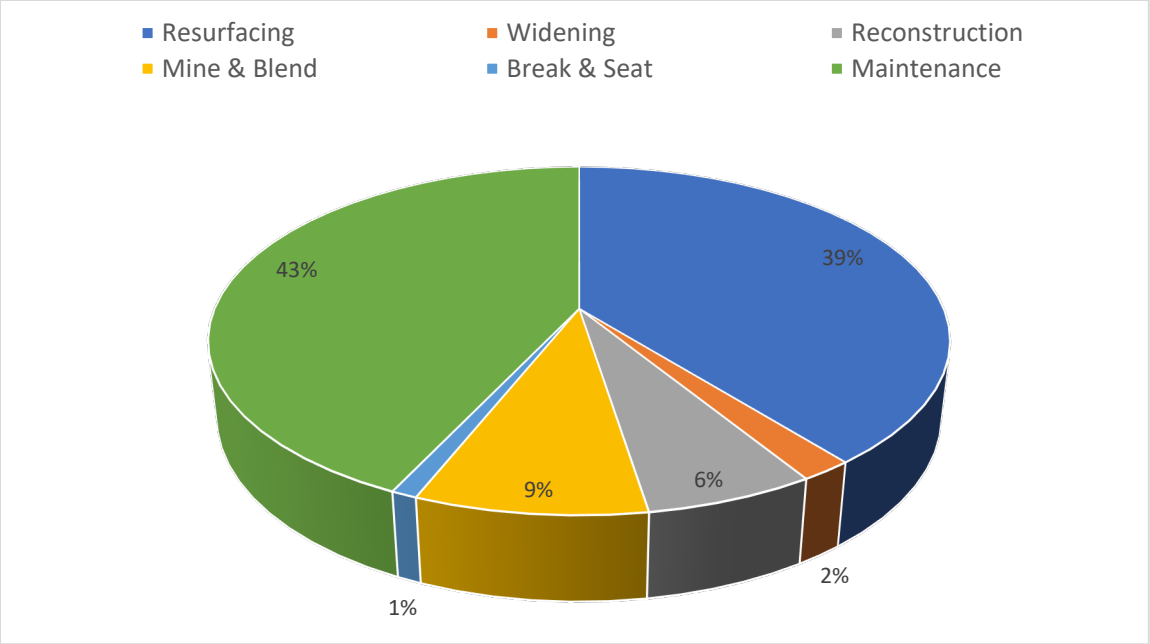


Figure 23. Percent of Cost for Different Improvement Types for All Statewide Roads

In contrast, the more intensive rehabilitation treatments make up a much smaller share of total costs. Mine-and-blend projects account for approximately 9% of projected expenditures, while reconstruction projects represent about 6%. Widening improvements (2%) and break-and-seat treatments (1%) constitute relatively small portions of the overall investment need.

Table 15. Statewide Pavement Investment Needs for County and Township Roads (Million 2026 Dollars)

Period	Statewide
2026-2027	$282.20
2028-2029	$541.10
2030-2031	$446.80
2032-2033	$445.80
2034-2035	$520.70
2036-2045	**$1,351.00**

6.9.4. Indian Reservation Roads

Several paved roads accessed by agricultural and oil industry traffic fall under the jurisdiction of the Bureau of Indian Affairs (BIA) and various Native American tribal governments. These roads are incorporated into the traffic modeling framework, data collection initiatives, and the GRIT; consequently, investment forecasts have been generated for these segments as well. This analysis is incorporated into the total needs tables presented earlier in this report and is also presented separately in this section.

The analytical methodologies and assumptions used to assess county and township roads were similarly applied to evaluate tribal roads. Table 16 summarizes the findings from this paved road analysis, including the anticipated enhancements and associated costs for all tribal road segments cataloged within the GRIT program.

Table 16. Paved Indian Reservation Road Needs (Million 2026 Dollars)

Reservations	2026-2027	2028-2029	2030-2031	2032-2033	2034-2035	2036-2045
Fort Berthold	$1.05	$11.79	$7.92	$7.09	$5.55	$11.80
Spirit Lake	$2.14	$2.89	$2.97	$2.47	$1.37	$12.13
Standing Rock	$3.47	$4.99	$0.83	$0.83	$0.83	$4.16
Turtle	$0.93	$2.33	$9.51	$14.32	$5.41	$21.76

7. Bridge Analysis

7.1. Major Structures

Ideally, bridges allow the highway network to meet the needs of the traveling public. However, bridge inadequacies can restrict the capacity of the transportation system in two ways. First, if the width of a bridge is insufficient to carry a modern truck fleet and serve current traffic demand, the bridge will restrict traffic flows and trucks may need to be rerouted. Second, if the strength of a bridge is unable to carry legal loads, then load limits must be posted and truck traffic again must be rerouted. These detours mean lost time and money for road users, including the agricultural- and energy-related traffic which are key drivers of the North Dakota economy. Therefore, a network of modern and structurally adequate bridges is critical to the state's transportation network. A total of 2,951 local government major bridge structures that were analyzed for this report. Of those, 736 (24%) local bridges are posted for load based on the ND DOT bridge dashboard. An additional 110 local bridges are closed to traffic because of critical findings that have not or cannot be repaired. This is a combined 28.6% of local government major bridges resulting in transportation issues for the oil and agricultural industries in North Dakota. Bridges have the highest cost per linear foot of roadway compared to paved or gravel roads. Therefore, an adequate source of funding for their maintenance, repair, and replacement is important to maintain safety on public roads. Stutsman and Barnes Counties have city bridges under their jurisdiction, and these have been included in the data and analysis in this year's report. Two city bridges in each of these counties are showing the need for replacement.

This study expands upon the bridge needs forecasting methodology used in the previous UGPTI investment needs study. The forecast is based upon the goal of maintaining a bridge network that serves modern traffic demand.

7.1.1. Data Collection

Bridge inventory, condition, and appraisal data were collected from two resources: The National Bridge Inventory (NBI) database (comma delimited file) and the NDDOT's bridge inventory database (shapefile of county/urban bridges). These databases were combined and spatially merged with a shapefile of the county and local road centerlines which are the focus of this study. Each bridge was individually calibrated with regard to their spatial location and relationship to road segment.

The combined and spatially located data set includes a total of 2,175 (NBI 2025) rural non-culvert structures which are owned by counties, townships, parks or forest reserves, other local agencies, tribal governments, the Bureau of Indian Affairs, or the U.S. Forest Service and are currently open to traffic. There were 776 buried structures or culvert bridges and minimum maintenance road bridges that were

excluded from the SAS run analysis. Culvert bridges owned by counties were added as separate analysis with these needs included in the final total replacement projects. This dataset represents the basis for this study's needs analysis.

Bridges and culverts or buried structures with total span length of less than 20 feet are not included in the NBI database. However, this study includes a separate analysis of minor structure data which has been obtained from a 1985 NDDOT inventory that has been imported to GRIT. Counties were asked to review, update and approve these locations and at the time of this writing more than 75% of these structures had been approved. In addition, these locations were compared to the NBI to prevent overlaps and 632 of the original structures are now in the NBI so they are not included in the new minor structure analysis.

7.2. 7.1.1a - Major Culvert Bridges (buried structures)

Major bridges which are culverts that have bridge numbers and are included in the NBI data have been added to the total bridge needs. These structures have spans of 20 feet or greater and may consist of more than one main unit. If the structure material is steel or timber, the culverts that qualify have a culvert condition code of 5 or less. If the material is concrete, the qualifier is 4 or less. Only one timber culvert was found in the NBI data on a county road and this structure was in fair condition, so it was not included. The decision tree flow chart is included in the Appendix F. The table of the qualifying culvert bridge structures is shown here below in Table 17a. Qualifying structures must have an ADT of at least 50. There are 25 major culvert bridges that qualify for replacement needs. These needs dollars are included in tables 23 and 24 which summarize the total bridge needs by biennium and by county.

Table 17a: Major Bridge Culvert Replacement Needs (2026 Dollars)

County	**Number of**	**Additional**
Benson	1	$737,000
Burleigh	2	$1,474,000
Cass	2	$1,474,000
Golden Valley	1	$737,000
Grand Forks	4	$2,948,000
Mercer	1	$1,231,000
Morton	4	$3,442,000
Pembina	1	$737,000
Richland	1	$737,000
Stark	2	$1,474,000
Traill	3	$2,211,000
Walsh	2	$1,474,000
Ward	1	$737,000
Totals	**25**	**$19,413,000**

To support statistical significance, a complete NBI North Dakota bridge population dataset was used to develop the bridge condition forecasting models which will be explained in greater detail later.

7.2.1. Condition of County and Township Bridges

Table 17 summarizes the age distribution of county, township, and tribal-owned bridges in North Dakota based on the 2025 NBI, which was the most recent data available at the time of this report. Nearly 20% of bridges in the data set are older than 50 years. Another 33% are between 30 and 50 years of age. A total of 509 bridges (20.83%) were built more than 75 years ago. Although 50 years was historically considered the design life of many bridges, service lives can be extended through diligent maintenance. However, many of the bridges are obsolete and beyond repair.

Table 17. Age Distribution of County, Township and Tribal Bridges in North Dakota

Age (Years)	Number of Bridges	Percent	Cumulative Frequency	Cumulative Percent
<= 20	500	17.68%	500	17.68%
> 20 and <= 30	253	8.94%	753	26.63%
> 30 and <= 40	394	13.93%	1147	40.57%
> 40 and <= 50	553	19.56%	1700	60.13%
> 50 and <= 75	538	19.03%	2238	79.16%
> 75	589	20.83%	2,827	100.00%

The condition assessment scale used in the National Bridge Inventory is shown in Table 18. In this scale, a brand-new bridge component deteriorates from excellent condition to failure via eight interim steps or levels. Independent ratings are developed for each of the three major components which comprise a bridge structure – deck, superstructure and substructure. The latest recorded component ratings are shown in Table 19, and in an alternative format in Table 20.

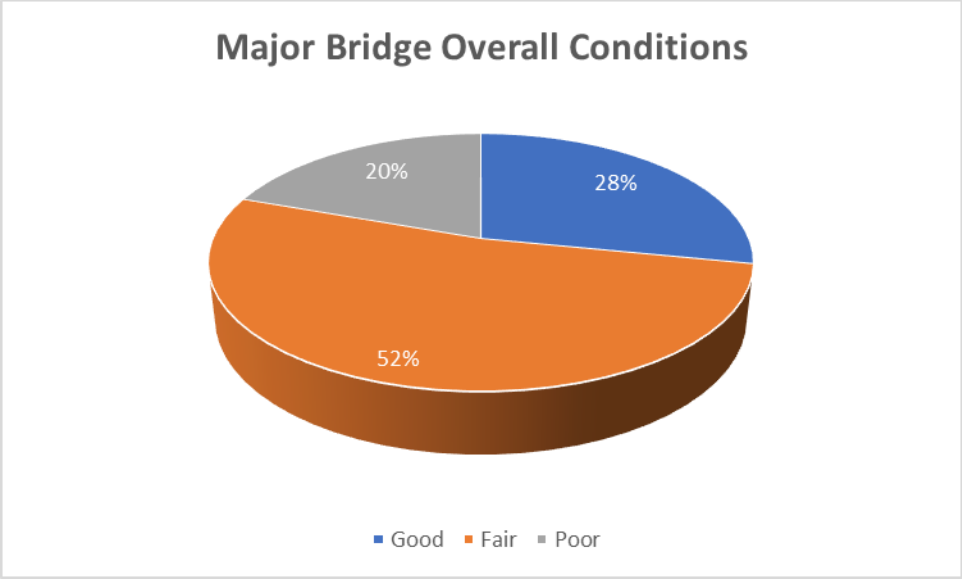


Figure 24. Major Bridge Overall Condition

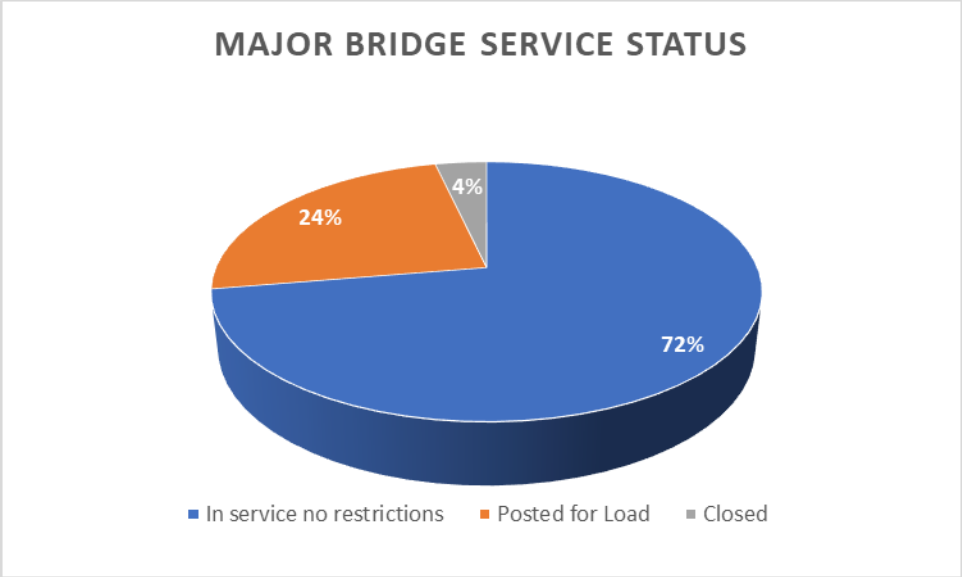


Figure 25. Major Bridge Service Status

Table 18. Component Rating Scales

Code	Meaning	Description
9	Excellent	
8	Very Good	No problems noted
7	Good	Some minor problems
6	Satisfactory	Structural elements show some minor deterioration
5	Fair	All primary structural elements are sound but may have minor section loss, cracking, spalling or scour
4	Poor	Advanced section loss, deterioration, spalling or scour
3	Serious	Loss of section, deterioration, spalling or scour has seriously affected primary structural components. Local failures are possible. Fatigue cracks in steel or shear cracks in concrete may be present.
2	Critical	Advanced deterioration of primary structural elements. Fatigue cracks in steel or shear cracks in concrete may be present or scour may have removed substructure support. Unless closely monitored it may be necessary to close the bridge until corrective action is taken.
1	Imminent Failure	Major deterioration or section loss present in critical structural components or obvious vertical or horizontal movement affecting structure stability. Bridge is closed to traffic; corrective action may put it back in light service.
0	Failed	Out of service – beyond corrective action.

Table 19. Deck, Superstructure and Substructure Component Condition Ratings

Component Rating	Deck		Superstructure		Substructure	
	Bridges	Percent	Bridges	Percent	Bridges	Percent
9	18	0.83%	31	1.43%	24	1.11%
8	243	11.22%	426	19.68%	257	11.85%
7	964	44.54%	624	28.83%	499	23.01%
6	645	29.80%	618	28.55%	572	26.37%
5	225	10.35%	315	14.55%	460	21.21%
4	53	1.54%	91	4.20%	223	10.28%
3	12	0.55%	47	2.17%	108	4.98%
2	1	0.04%	9	0.41%	18	0.83%
No component rating of 0 or 1 reported.						

Table 20. Compound Ratings, Alternative Format

Component Rating	Deck		Superstructure		Substructure	
	Bridges	Percent	Bridges	Percent	Bridges	Percent
Good (7-9)	1225	56.61%	1,081	49.95%	780	35.96%
Fair (5-6)	870	40.20%	933	43.11%	1,032	47.58%
Poor (3-4)	65	3.00%	138	6.38%	331	15.26%
Critical (0-2)	4	0.18%	12	0.55%	26	1.20%

With the elimination of the Sufficiency Rating (SR) tracking by FHWA in its NBI data in 2015 which was used in the previous studies done by UGPTI, a new rating system was developed. This new calculator called Bridge Needs Target (BNT) was vetted through several meetings with UGPTI staff and county road superintendents and county engineers from across North Dakota during the summer of 2021. The 2022 study implemented this modified SR calculator which now includes special reduction factors for scour, fracture critical, timber and load ratings. These factors were implemented to provide a stronger focus on bridge elements and condition codes that generally result in bridge closures or failures. The new total bridge rating, referred to as the BNT, is solely used for the purpose of this needs study report. The previous internally developed SAS calculator was used as a basic framework for the BNT. This study continues using a trigger of 75 for the BNT in the decision flow charts. Trial runs of bridge inspection data resulted in an acceptable correlation with the old SR method and results and was approved by the ND County Bridge Steering Committee. Elements included in the BNT equation are shown in Table 21. The detailed BNT model components and calculations are shown in Appendix E.

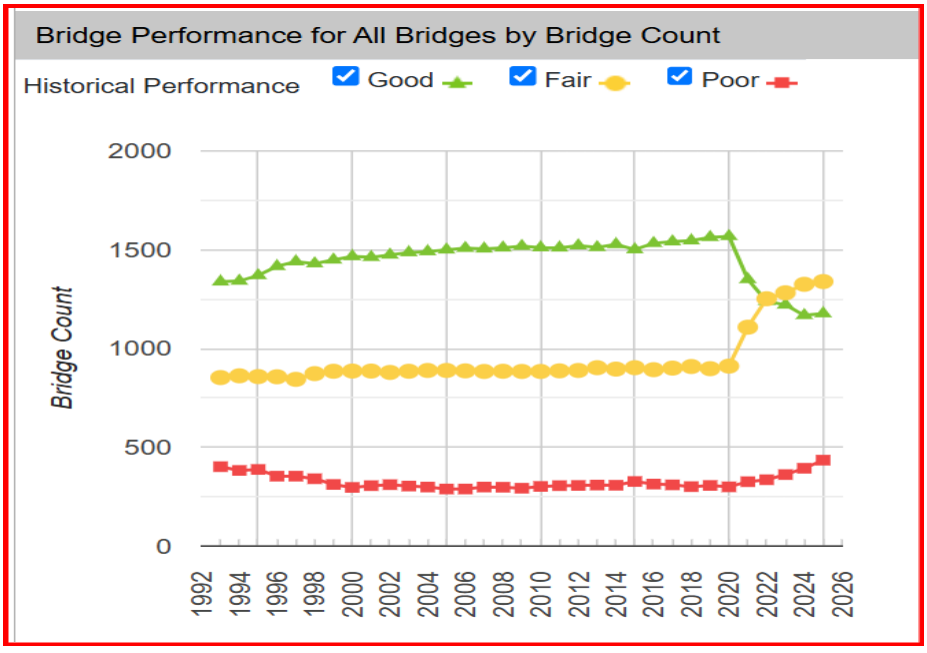


Figure 26. Historical Bridge Performance for Local Bridges (NBIS) (2026 study report)

Table 21. NBIS Factors Used for Bridge Needs Target

NBI Item - Description
Deck NBI rating
Superstructure NBI rating
Substructure NBI rating
Culvert NBI rating
Fracture Critical NBI Y/N
Timber Structure Age starting > 30 years
Load Rating
Approach Road Alignment
Scour Code
Channel Protection Condition

Approximately 54% of bridges in North Dakota have a BNT of greater than 85%. About 20% of the bridges have a BNT rating of less than 60%.

7.2.2. Minimum Maintenance Bridges

Many of the state's county- and township-owned bridges exist on low- or minimum-maintenance roads. These bridges may be located on closed or unimproved roads and serve very low traffic demand. The user cost-benefit ratios of replacement typically do not justify the high investment cost. Based on discussion with NDDOT's Bridge and Local Government Divisions, this study assumes that structures on low-maintenance roads will not receive maintenance, rehabilitation, or replacement. The study's road network data did not include a designation for minimum maintenance roads, so an effort had to be made to identify these roads based on existing road data and recent satellite photography. This effort identified 182 bridges as existing on minimum maintenance roads.

7.2.3. Methodology – Major Structures

7.2.3.1. Deterioration Model

In prior studies, UGPTI developed a set of empirical models to forecast component (deck, superstructure, and substructure) deterioration rates for bridges nationwide. UGPTI also developed regional empirical regression models with a focus on North Dakota. In the prior studies, a sufficiency rating was predicted for each year of the 20-year study period. These past models were based heavily on the sufficiency rating and are of less value now that FHWA has dropped the sufficiency rating since the 2022 study and the study team has moved to a BNT bridge condition concept.

7.2.3.2. Improvement Selection Model

The analysis considered three treatment types for each bridge: preventive maintenance, replacement, and no action. Bridge replacement is separated into three subcategories based on the type of structure which will replace the existing bridge:

1. New bridge with 32-foot width for CMC routes and 28 foot for non-CMC routes.
2. Double barrel reinforced concrete box culvert
3. Multiple barrels reinforced concrete box culvert

An improvement selection model was developed based on current practice and discussions with NDDOT personnel. The decision criteria include, but are not limited to, bridge status, BNT, operating rating, bridge geometry, and component condition ratings. The full improvement selection model is detailed in Appendix F.

The AASHTO and Federal Highway Administration (FHWA) have defined bridge preventive maintenance as "a planned strategy of cost-effective treatments to an existing roadway system and its appurtenances that preserves the system, retards future deterioration, and maintains or improves the functional condition of the system (without substantially increasing structural capacity)" (FHWA 2011). This can include cyclical activities such as deck washing or condition-based activities such as scour mitigation or concrete patching. FHWA notes that effective bridge preventive maintenance activities can extend the useful life of bridges and reduce lifetime cost.

Preventive maintenance can encompass a wide variety of activities, but this study's improvement model was limited to the selection of a generalized annual "preventive maintenance" treatment category. It is assumed that each bridge owner will determine the maintenance treatments and intervals most appropriate for their bridges.

An additional forecasted preventive maintenance need was included for deck washing on maintenance-eligible bridges that exist on major collectors. This deck washing allocation recognizes the need for maintenance to combat chloride-induced corrosion of reinforcement (and resulting loss of service life) for concrete bridge decks.

Bridge replacement represents the final and most cost-intensive type of bridge treatment. It involves a complete replacement of the existing structure, either with a new bridge or another structure. This study assumes short-span bridges will be replaced by reinforced concrete box culverts (RCBC), per current state of practice. Structures less than 40 feet in length will be replaced by a double-barrel RCBC, while structures between 40 and 50 feet in length will be replaced by multiple-barrel RCBC. Structures with total length greater than 50 feet are replaced by new bridges.

Typically, when older substandard bridges are replaced by modern ones, the lengths and widths of the structures increase. Based on recent North Dakota bridge replacement project data, a new structure is generally 80% longer than the original one. Replacement widths of 32 feet are used for bridges on the CMC system and 28 feet for non-CMC routes, respectively, to allow clearance for modern trucks and agricultural equipment.

Several criteria were used to qualify bridges for replacement. These are described in detail in Appendix F. In general, bridges qualified for replacement if they had low BNT (<75), or if they included a narrow deck (≤20 feet). Removal of load postings was a priority, so bridges on CMC routes with operating ratings of less than a standard HS-20 load were sent to replacement state regardless of other condition criteria. Special hauling vehicles can also result in the need for bridges to be posted for load maximums.

Functionally obsolete bridges are no longer tracked by the NBI. However, this classification referred to bridges that did not meet design standards for number of lanes, lane width, shoulder width and other safety factors for today's standards. Structurally deficient bridges are those with any parts of the deck, superstructure or substructure that have a condition rating of 4 out of 10 or less. For modeling purposes, functionally obsolete and structurally deficient ratings are still calculated based on the NBI data dictionary to produce a more detailed analysis of the bridge condition codes.

For the purpose of this study's 20-year analysis period, it is assumed that a bridge that receives a replacement will not be considered for another major improvement for the remainder of the study period and will instead be assigned preventive maintenance. Culvert structures require comparatively little preventive maintenance and are not considered eligible for preventive maintenance treatment in this study. If a bridge was replaced with a box culvert, no preventative maintenance costs would be modeled for the bridge.

For the first time, this study does include culvert bridges built from steel with a condition code of 5 or less and those built from concrete with a condition code of 4 or less. A total of 14 culvert bridges are included in the total bridge needs using these criteria. A table of the existing culverts and resulting improvements with a decision flow chart is shown in Appendix G.

7.2.3.3. Cost Model

This study includes the cost of timely bridge preservation techniques even if the techniques are not uniformly applied across the jurisdictions of this study. Preventive maintenance cost estimates used an annual unit cost of $0.35 per square foot of deck area for off-system bridges and $0.40 per square foot for on-system bridges. These costs were derived from input obtained at the December 2021 Midwestern & Western Bridge Preservation Conference with an added inflation factor from the NHCCI of 16%. These values represent a typical annualized cost of maintenance as derived from other state DOT preventive maintenance expenditures outlined in individual state needs studies and in NCHRP 20-68A Scan 07-05 Best Practices in Bridge Management Decision-Making (2009). A new length factor of 1.8 was used for this study to address the likelihood that a new bridge would be longer than the original bridge in order to accommodate current flood frequency requirements. The previous study used a factor of 1.7. This change was based on the average increase in length for new local bridge contracts awarded between February 2024 and March 2026.

Replacement costs were estimated by developing unit costs from recent (2026) NDDOT bid reports and plan documents for local government projects. Unit costs were adjusted for county projects based on NDLTAP and County input. The type of replacement structure was based on the criteria described in the Improvement Selection Model section of this chapter.

A deficient bridge less than 40 feet long is assumed to be replaced by a double box culvert structure at a cost of $737,000. A deficient bridge between 40 and 50 feet in length is assumed to be replaced by a

multiple box culvert structure costing $1,231,000. Costs for bridges longer than 50 feet are calculated using the square footage of the deck and an average replacement unit cost. Unit replacement costs were $503 per square foot of deck area. Costs were down from the previous study by 5.08% for bridges and 6.9% for box culverts. All costs include approach grading, preliminary engineering and construction engineering costs. Preliminary engineering costs are assumed to add an additional 10% to the bid price, while construction engineering adds another 10% to the total price.

7.2.4. Results – Major Structures

Estimated statewide bridge improvement and preventive maintenance needs for the study period, 2026-2045, are $986.774 million. Statewide bridge needs by biennium are shown in Table 22 with needs for individual counties presented in Table 23.

Table 22. Statewide Major Bridge Needs: 2026-2045 (2026 Dollars)

Period	Replacement		Maintenance Cost (million)	Total Cost (million)
	Number	Cost (million)		
2026-2027	135	$160.38	$1.85	$162.23
2028-2029	135	$160.38	$1.85	$162.23
2030-2031	135	$160.38	$1.85	$162.23
2032-2033	135	$160.38	$1.85	$162.23
2034-2035	135	$160.38	$1.85	$162.23
2036-2045	140	$166.32	$9.27	$175.59

Table 23. County and Township Major Bridge Needs by County: 2026-2045 (2026 Dollars)

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Adams	6	$6,265,677	$281,726	$6,547,402
Barnes	8	$28,713,167	$726,365	$29,439,532
Benson	4	$2,258,301	$84,734	$2,343,035
Billings	7	$11,558,437	$175,752	$11,734,188
Bottineau	29	$22,671,269	$366,242	$23,037,511
Bowman	12	$7,134,190	$152,189	$7,286,379
Burke	4	$1,992,000	$41,537	$2,033,537
Burleigh	10	$6,023,417	$430,712	$6,454,129
Cass	35	$52,287,056	$2,488,721	$54,775,777
Cavalier	8	$5,749,133	$98,951	$5,848,084
Dickey	3	$8,381,055	$515,219	$8,896,274
Divide	4	$1,992,000	$66,096	$2,058,096
Dunn	4	$6,528,185	$356,721	$6,884,907
Eddy	3	$6,386,421	$246,622	$6,633,044
Emmons	8	$6,286,980	$317,254	$6,604,234
Foster	3	$3,997,186	$107,633	$4,104,819
Golden Valley	5	$5,625,232	$106,377	$5,731,609
Grand Forks	61	$42,729,323	$1,519,924	$44,249,247
Grant	23	$51,209,794	$198,248	$51,408,043
Griggs	1	$2,585,249	$178,237	$2,763,486

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Hettinger	26	$18,821,995	$270,892	$19,092,887
Kidder	0	$0	$0	$0
LaMoure	10	$12,373,057	$292,155	$12,665,212
Logan	3	$996,000	$75,214	$1,071,214
McHenry	39	$38,142,357	$231,217	$38,373,574
McIntosh	2	$2,475,885	$0	$2,475,885
McKenzie	14	$23,700,116	$437,013	$24,137,129
McLean	7	$9,797,744	$322,842	$10,120,586
Mercer	21	$43,970,586	$306,424	$44,277,010
Morton	72	$66,002,011	$878,500	$66,880,511
Mountrail	1	$1,521,301	$216,550	$1,737,852
Nelson	3	$5,428,188	$262,719	$5,690,906
Oliver	7	$14,071,410	$92,051	$14,163,461
Pembina	60	$52,151,260	$508,322	$52,659,582
Pierce	1	$498,000	$0	$498,000
Ramsey	3	$2,856,134	$188,068	$3,044,202
Ransom	4	$14,282,980	$316,179	$14,599,159
Renville	6	$12,721,654	$128,672	$12,850,326
Richland	48	$51,835,755	$1,356,462	$53,192,217
Rolette	2	$996,000	$51,342	$1,047,342
Sargent	6	$2,988,000	$14,655	$3,002,655
Sheridan	0	$0	$0	$0
Sioux	1	$498,000	$154,888	$652,888
Slope	3	$10,102,402	$171,719	$10,274,120
Stark	23	$37,325,343	$542,409	$37,867,752
Steele	28	$21,494,841	$455,453	$21,950,294
Stutsman	11	$20,580,149	$406,055	$20,986,204
Towner	10	$5,458,000	$48,336	$5,506,336
Traill	57	$115,784,460	$607,596	$116,392,056
Walsh	69	$63,289,736	$908,709	$64,198,445
Ward	21	$28,006,504	$353,487	$2,835,991
Wells	4	$2,734,885	$316,106	$3,050,991
Williams	15	$6,952,000	$170,544	$7,122,544
Statewide	815	$968,230,827	$18,543,842	$986,774,669

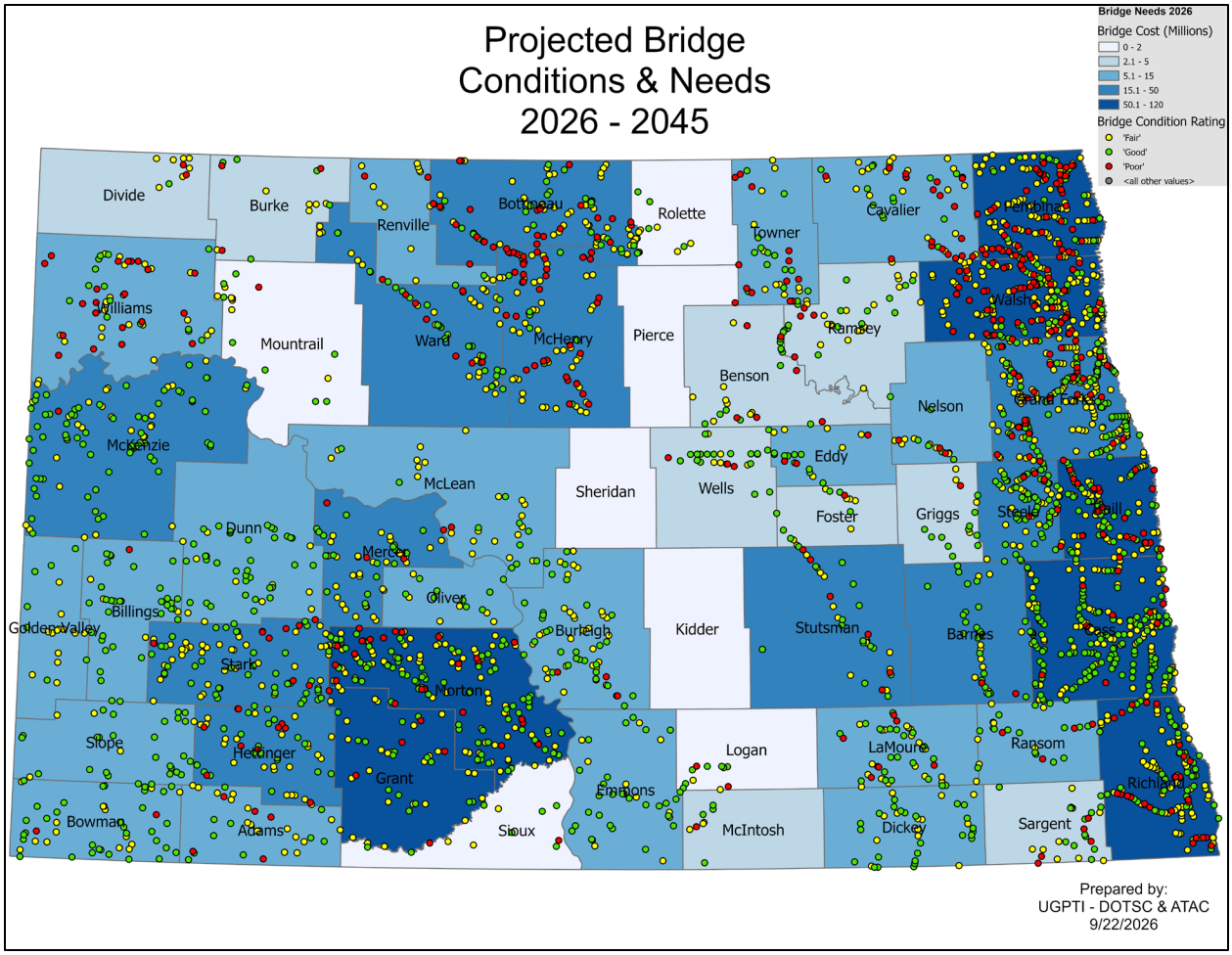


Figure 27. Projected Bridge Needs and Current Conditions

7.3. Minor Structures

Previous needs studies did not include bridge needs for smaller structures that are not included in the National Bridge Inventory which is only for bridges with spans of greater than 20 feet. However, there had been a lot of discussion about adding minor structures to this study for several years. The main issue was that no up-to-date inventory was available for each of the 53 counties in North Dakota. The UGPTI Geographic Road Inventory Tool has a minor structure layer but it was not being utilized by all of the counties. In the summer of 2023, a 1985 inventory of minor structures from the ND DOT was digitized and imported into the GRIT layer. After a meeting with the ND County Bridge Needs Steering Committee in July of 2023, support was overwhelming to move forward with a needs analysis for minor structures which had a span range of 8 to 20 feet. Discussions on the size range had actually begun in the fall of 2021 when the previous report's analysis began. The study team and the steering committee agree that of the failure of these structures can cause severe injury or death to the traveling public. Failures of these structures can also impact the agricultural and oil economies on a local, regional and statewide basis by increasing detour lengths for deliveries of inputs and of the affiliated products produced in North Dakota. Counties have been updating these minor structures in GRIT with assistance from UGPTI and ND LTAP staff. Therefore, this report has a much higher level of confidence on needs for minor structures.

7.3.1. Data Collection

Counties were asked to go into their GRIT editor maps and review, edit and approve each minor structure that was imported from the 1985 inventory. UGPTI staff created a recorded webinar on how to review and approve the imported data for counties. Culvert size and shape diagrams were also distributed to the counties as a helpful tool. A minor structure inventory/inspection form was created and distributed for counties to use as an in-the-field document. Some of these bridges were still in service, some had been replaced and some were closed.

The exported minor structures were compared with the NBI to avoid possible duplications. As a result, for the 3,324 exported structures with spans of 8 to 20 feet, 220 were eliminated to clean up the data. The resulting data was the basis for the minor structures analysis. There is no current traffic data for these structures. However, counties were asked to only approve structures that are in service and open to traffic.

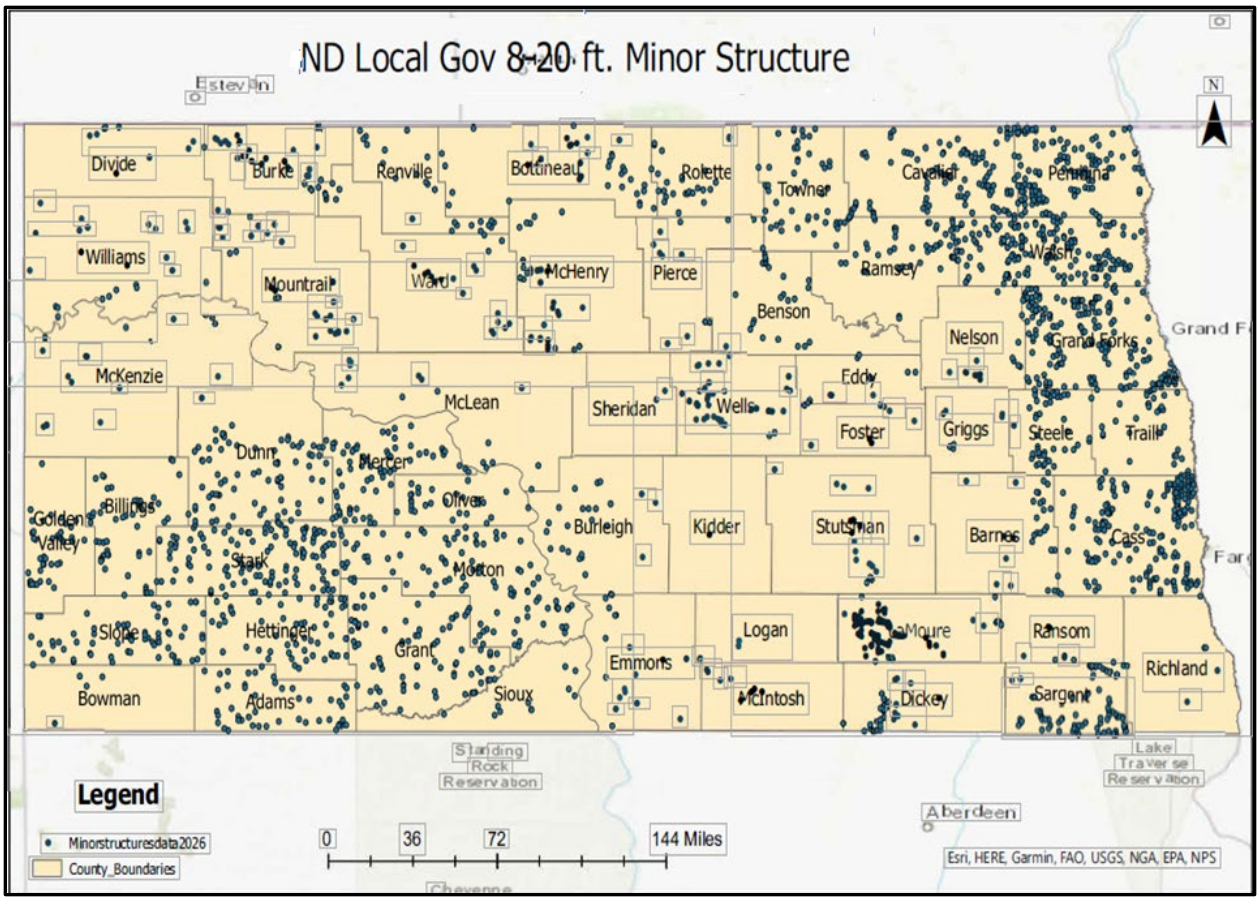


Figure 28. Locations of Minor Structures on County and Township Systems

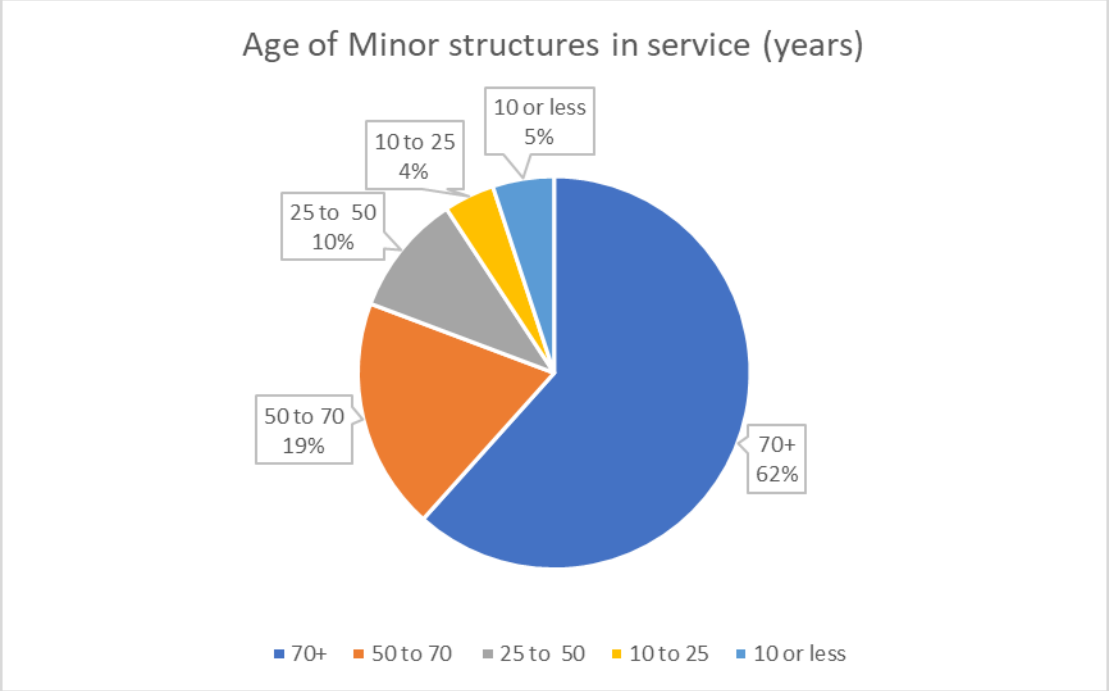


Figure 29. Age of Minor Structures in Service

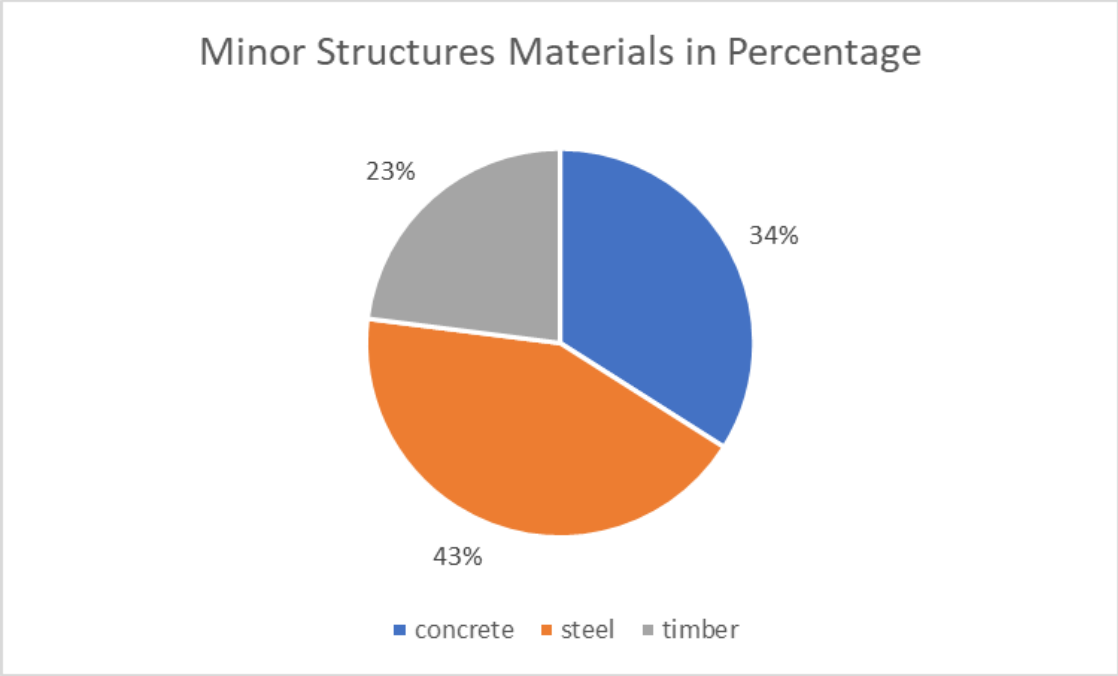


Figure 30. Percentage of Minor Structures by Material Type

7.3.2. Methodology – Minor Structures

The data file was exported from GRIT after counties had been given a period of time (July 2023 to March 2024) to review the structures in their counties. This file included minor structures that ranged from 8 to 20 feet in length as directed by the UGPTI ND County Bridge Steering Group consisting of members from various counties around the state. The structures were then sorted into 3 groups of span lengths. These groups were structures with spans of 8 to 11 feet, 11.1 to 15 feet, and 15.1 to 20 feet. They were also sorted into three groups of materials including timber, steel and concrete. Structures that were rated in very poor, poor, and fair conditions were designated as replacement needs. Structures that did not have a condition rating were evaluated based on age. The age of 40 years for timber, 50 years for steel and 70 years for concrete were used as the qualifier for replacement. For structures in good or excellent condition or that did not meet the age requirements were designated as maintenance needs. Table 25 shows the number of structures needing replacement or maintenance for each county. The decision flow chart for the analysis is shown in Appendix J. There is no deterioration model used in the analysis for minor structures. The output shows a current needs total vs. a 20-year total. This total could be spread out over a 20-year delivery period for budgetary reasons.

7.3.3. Cost model

The cost model was created using the ND DOT Price Sheet List as the basis for construction items most commonly used for replacement of minor structures. Culverts with a minimum waterway opening of 50 square feet or greater were selected as recommended by the steering committee. Average prices for the construction items were adjusted to be more in line with typical county projects based on input from steering committee members and ND LTAP staff. For group A, with spans of 8 to 11 feet, a cost of

$305,000 was used. For group B, with spans of 11.1 to 15 feet, a cost of $456,000 was used and for group C, with spans of 15.1 to 20 feet, a cost of $601,000 was used. These costs are also shown in the decision flow chart located in Appendix J.

For minor structures in the output data file which were in good to excellent condition, it was decided to include a maintenance needs cost. This cost was assigned as an annual cost of $1000 for up to 2 years as this will be the period before the next needs study planned for 2028. At that time, some of the structures in good condition have deteriorated to the point where they will be rated in fair to poor condition which would then qualify them for replacement.

7.3.4. Results – Minor Structures

The total estimated replacement investment need for minor structures is $620.954 million. This amount is 63% of the amount needed for the major structures in this report. This is an decrease of 23% since the last study and indicates updated data reflecting minor structures that are still in operation. There are 1,228 minor structures that qualify for replacement beginning in 2026. There are 586 qualified minor structures that require maintenance at a cost of $547,000 per year or $1,172,000 for the 2 years until the 2028 study report is generated. Table 24 outlines each county's minor structures investment needs for the next 20 years. Counties have been actively updating their minor structures data in GRIT since they were added to the system and a needs analysis started in the summer of 2023. Counties not listed did not have any qualifying minor structures in the output data to be analyzed.

Table 24. County and Township Minor Structures Needs (2026 Dollars)

County	Replacement	Replacement	Preventative	Total Cost
Adams	31	$13,055,000	$0	$13,055,000
Barnes	18	$7,139,000	$14,000	$7,153,000
Benson	23	$11,636,000	$0	$11,636,000
Billings	32	$19,232,000	$25,000	$19,257,000
Bottineau	15	$8,284,000	$12,000	$8,296,000
Bowman	3	$1,803,000	$0	$1,803,000
Burke	24	$10,153,000	$0	$10,153,000
Burleigh	8	$2,887,000	$11,000	$2,898,000
Cass	105	$44,728,000	$28,000	$44,756,000
Cavalier	6	$3,026,000	$53,000	$3,079,000
Dickey	16	$7,574,000	$0	$7,574,000
Divide	1	$601,000	$7,000	$608,000
Dunn	74	$33,878,000	$1,000	$33,879,000
Eddy	12	$5,605,000	$1,000	$5,606,000
Emmons	9	$3,639,000	$5,000	$3,644,000
Foster	5	$1,978,000	$0	$1,978,000
Golden Valley	29	$12,868,000	$0	$12,868,000
Grand Forks	16	$6,082,000	$34,000	$6,116,000

County	Replacement	Replacement	Preventative	Total Cost
Grant	81	$41,347,000	$3,000	$41,350,000
Griggs	4	$2,114,000	$0	$2,114,000
Hettinger	43	$21,306,000	$0	$21,306,000
Kidder	1	$456,000	$0	$456,000
LaMoure	4	$1,818,000	$0	$1,818,000
McHenry	33	$18,232,000	$0	$18,232,000
McIntosh	6	$2,875,000	$0	$2,875,000
McKenzie	7	$3,023,000	$13,000	$3,036,000
McLean	8	$4,373,000	$0	$4,373,000
Mercer	65	$29,653,000	$0	$29,653,000
Morton	88	$35,937,000	$0	$35,937,000
Mountrail	24	$9,410,000	$0	$9,410,000
Nelson	17	$6,828,000	$0	$6,828,000
Oliver	30	$11,107,000	$0	$11,107,000
Pembina	9	$3,941,000	$69,000	$4,010,000
Pierce	10	$3,654,000	$0	$3,654,000
Ramsey	8	$3,932,000	$43,000	$3,975,000
Ransom	8	$3,781,000	$0	$3,781,000
Renville	17	$9,045,000	$0	$9,045,000
Richland	3	$1,362,000	$1,000	$1,363,000
Rolette	20	$9,386,000	$0	$9,386,000
Sargent	27	$13,617,000	$48,000	$13,665,000
Sheridan	2	$761,000	$0	$761,000
Sioux	8	$4,663,000	$0	$4,663,000
Slope	66	$30,435,000	$0	$30,435,000
Stark	2	$906,000	$98,000	$1,004,000
Steele	20	$9,821,000	$21,000	$9,842,000
Stutsman	21	$9,105,000	$0 -	$9,105,000
Towner	30	$13,650,000	$1,000	$13,651,000
Traill	3	$1,362,000	$30,000	$1,392,000
Walsh	95	$44,922,000	$29,000	$44,951,000
Ward	7	$4,062,000	$0	$4,062,000
Wells	34	$16,054,000	$0	$16,054,000
Statewide	**1,228**	**$567,106,000**	**$547,000**	**$567,653,000**

8. Summary and Conclusions

This report outlines the study to estimate the needs for maintaining and improving North Dakota's network of county, township and tribal roads and bridges during the next 20 years. The needs estimates presented in this report have been developed at a network planning level. Project-specific costs may vary either above or below the estimated cost of a specific road segment for a number of reasons. Factors such as wetlands mitigation, geometric corrections, and high right-of-way acquisition costs, among others may influence the actual project-specific costs. In addition, because this is a network planning study, project-specific enhancements such as turning lanes and climbing lanes were not modeled. These enhancements are typically included in a project as a result of a project-specific analysis. The combined needs estimates by biennium are presented in Table 25.

Table 25. Combined Statewide Road and Bridge Needs, 2026-2045

Period	Unpaved	Paved	Bridges	Minor Structures	Total
2026-2027	$775.33	$282.20	$162.23	$93.33	$1,313.09
2028-2029	$760.31	$541.10	$162.23	$93.33	$1,556.97
2030-2031	$783.74	$446.80	$162.23	$93.33	$1,486.10
2032-2033	$785.68	$445.80	$162.23	$93.33	$1,487.04
2034-2035	$758.36	$520.70	$162.23	$93.33	$1,534.62
2036-2045	$3,764.31	$1,351	$175.59	$101.03	$5,391.93
2026-2045	**$7,627.73**	**$3,587.60**	**$986.77**	**$567.65**	**$12,769.75**

All estimates presented in this report are based upon the best available data at the time of the writing of the report and assumptions used to arrive at these estimates are based upon the most recent forecasts of traffic within North Dakota. Any significant changes in costs, forecasts, practices or highway technology may require re-estimation of the needs for county, township, and tribal roads.

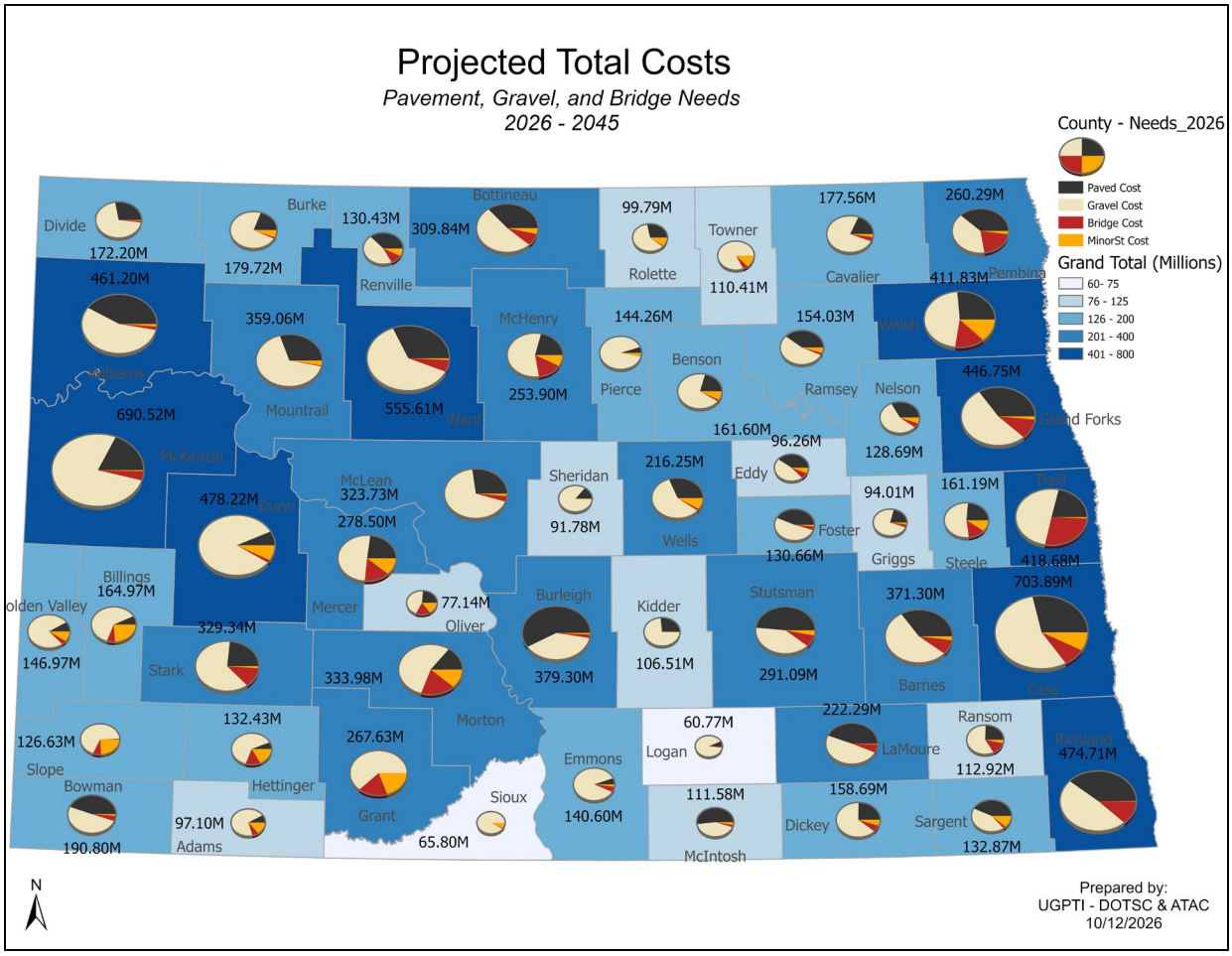


Figure 31. Projected Total Costs for Pavement, Gravel and Bridges, 2024-2043

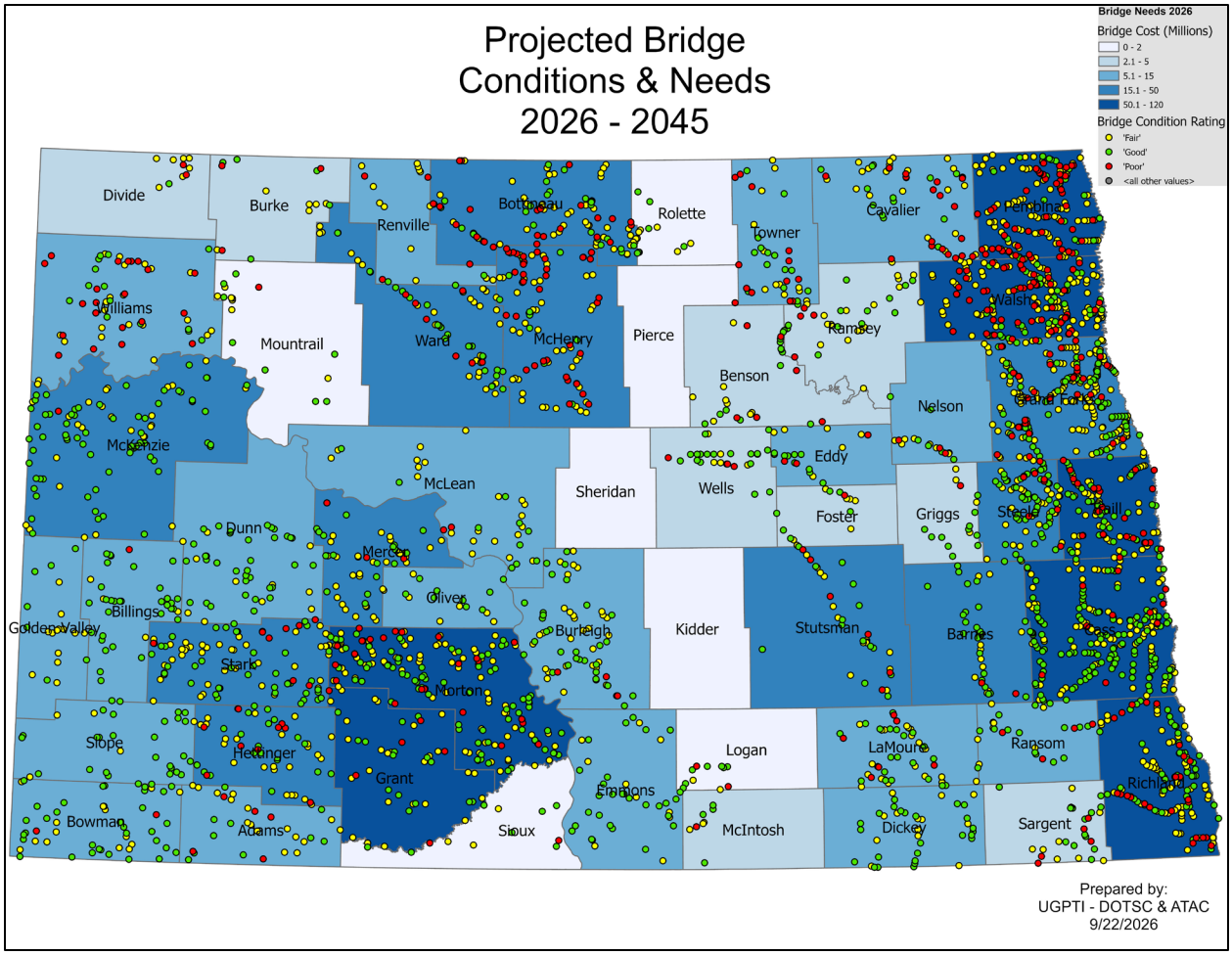


Figure 32. Projected Bridge Needs and Current Conditions, 2026-2045

Appendix A: Cost and Practices Surveys

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

2025 COUNTY ROAD NEEDS STUDY

County: _____

Contact: _____ _____ _____
Name Phone Email

Preparer: _____ Date Prepared: _____

Aggregate Description

To determine the type and quality of aggregate used in your county, please check all boxes that apply. For example, if your county uses crushed, specification base gravel – select gravel, crushed material and specifications.

- Gravel ☐
- Scoria ☐
- Pit Run ☐
- Screened ☐
- Crushed Material ☐
- Specifications ☐
  - Fractured Faces ☐
  - PI ☐
  - Other _____ ☐
- Tested ☐
- Other_____ ☐

Placement Practices

When aggregate overlays are placed in your county, please select the all practices that are used to apply an aggregate overlay.

- Truck Drop and Blade ☐
- Windrow/Equalize ☐
- Water/Rolling/Compaction ☐
- Reshaping ☐
- Pulling in Shoulders ☐
- Soft Spot Repair ☐
- Other_____ ☐

Operational Tasks

In this section, please provide a percentage of tasks that are done using county resources versus the percentage of work done by a contractor. For example, if your county owns the pit and does all of the crushing using county labor, 100% would be entered into the first column, and 0% in the second column.

	Performed by:	
Task	**County**	**Contractor**
Crushing		
Hauling		
Placement		
Blading		
Dust Control		
Base Stabilization		

Gravel Road Costs

Please report costs for gravel for county roads in the table below. The table asks for unit costs for graveling, maintaining, and operating gravel roads. If you are quoting contractor prices, please circle "yes" in the right-hand column.

Gravel/Scoria Cost			Is this Contractor Price?
Average Gravel/Scoria Cost (crushing & royalties at the pit)		❑ Per cu. yard ❑ Per Ton	❑ Yes ❑ No
Average Transportation Cost from Gravel Origin		❑ Per loaded mile ❑ Per cu. yard ❑ Per Ton	❑ Yes ❑ No
Average trucking distance for aggregate		❑ Miles one-way ❑ Miles roundtrip	
Truck Payload		❑ Cu. Yards ❑ Tons	
Placement Cost		Per Mile	❑ Yes ❑ No
Blading Cost		Annual cost per mile	❑ Yes ❑ No
Dust Suppressant Cost		Per mile	❑ Yes ❑ No
Base Stabilization Cost		Per mile	❑ Yes ❑ No

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Gravel Road Condition

This section asks for information regarding gravel road conditions and is broken into two separate categories: Federal Aid, and Non-Federal Aid. Please provide a rough estimate of the percentage of unpaved roads by condition for these two categories.

Condition	% Federal Aid Roads (CMC)	% Non-Federal Aid Roads (non-CMC)
Very Good		
Good		
Fair		
Poor		
Total	**100%**	**100%**

Gravel Materials Specifications

If available, please attach a sample specification and sample gradation, or state materials specification number. If materials used on CMC routes differ from non-CMC routes, please provide sample specifications and gradation by system type, if available.

Comments or Suggestions (please attach additional sheets if needed):

Please complete this survey and email a copy to alan.dybing@ndsu.edu, or via US Mail to: UGPTI ATTN: Alan Dybing, NDSU Dept 2880, PO Box 6050, Fargo, ND 58108-6050 by **November 24, 2025**. Please direct any questions to Alan Dybing at 701.231.5988 or the email address above.

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NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

2025 TOWNSHIP ROAD NEEDS STUDY SURVEY

Please return this survey by November 24 to alan.dybing@ndsu.edu or mail to UGPTI, NDSU Dept 2880, PO BOX 6050, Fargo, ND 58108-6050.

Township:_____ County:_____

Contact: _____ _____ _____

Name Phone Email

Preparer:_____ Date Prepared: _____

Gravel Costs

Please report costs for gravel for township roads in either of the tables below. If information on cost breakouts is available, please use Table 1. If breakouts are not known, enter the information in the Table 2.

1. Cost Breakouts (If known)		
Average Gravel/Scoria Cost (crushing & royalties)		❑ Per cu. yard ❑ Per Ton
Average Transportation Cost from Gravel Origin		❑ Per loaded mile ❑ Per cu. yard
Average Placement Costs		Per mile
Blading Cost		Annual cost per mile
Dust Suppressant Costs (If applicable)		Per mile

2. Total Cost (if cost breakouts are not known)		
Total Cost	$	❑ Per cu. yard ❑ Per Ton ❑ Annual cost per mile
Number of Miles Maintained		Miles

Average Gravel/Scoria OverlayThickness _____ ❑ Cu. Yard/mile ❑ Inches ❑ Tons/mile

Survey Continued on the Reverse of this Page

Road Maintenance Practices

Who performs road maintenance in your township?

- ❑ County Maintained
- ❑ Township Contracted
- ❑ Township Staff

Please report blading and graveling frequency for gravel roads.

Blading Frequency

- ❑ Every other month
- ❑ 1 per month
- ❑ 2 per month
- ❑ 1 per week
- ❑ other (please explain) _____

Graveling Frequency

- ❑ Every year
- ❑ Every 2-3 years
- ❑ Every 3-4 years
- ❑ 5 or more years
- ❑ other (please explain) _____

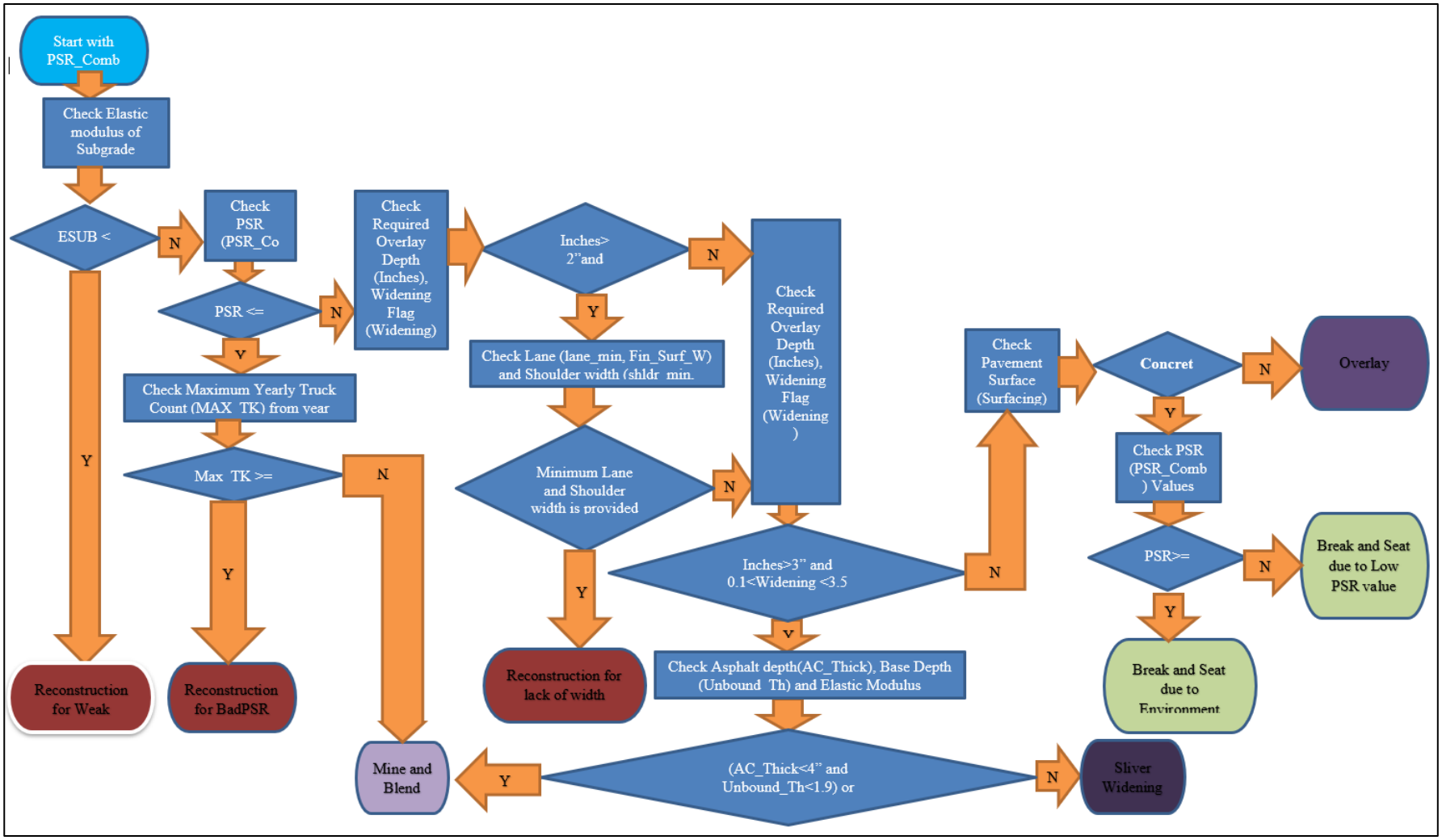
Aside from routine maintenance and improvements, what other challenges are facing roadway maintenance in your township? (flooding, high traffic generators etc.).

Does your township have an emergency road fund account? ☐ Yes ☐ No

Comments or Suggestions:

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Appendix B: Flowchart for Road Improvement



Appendix C: Comparison of Paved Road Conditions, by County

County	Condition	2025		2023	
		Miles	Percent	Miles	Percent
Adams	Good	0.0	0%	0.0	0%
	Fair	7.4	70%	5.9	55%
	Poor	3.1	30%	4.7	45%
Barnes	Good	41.1	19%	0.0	0%
	Fair	102.2	47%	149.2	67%
	Poor	73.0	34%	71.9	33%
Benson	Good	25.6	39%	0.5	1%
	Fair	40.7	61%	36.5	58%
	Poor	0.0	0%	25.4	41%
Billings	Good	11.9	61%	13.4	52%
	Fair	3.4	18%	8.3	32%
	Poor	4.2	21%	4.2	16%
Bottineau	Good	76.5	37%	84	41%
	Fair	125.3	60%	109.7	53%
	Poor	7.1	3%	13.5	7%
Bowman	Good	26.0	18%	23.8	17%
	Fair	68.8	47%	87.3	63%
	Poor	51.3	35%	27.4	20%
Burke	Good	23.5	49%	37.3	78%
	Fair	4.9	10%	9.9	21%
	Poor	19.3	41%	0.6	1%
Burleigh	Good	200.5	59%	90.1	32%
	Fair	63.4	19%	76.3	27%
	Poor	74.8	22%	113.3	41%
Cass	Good	102.6	29%	110.5	32%
	Fair	181.7	52%	222.4	64%
	Poor	67.0	19%	13.6	4%
Cavalier	Good	19.8	31%	0.9	1%
	Fair	30.7	48%	54.5	84%
	Poor	14.0	22%	9.1	14%
Dickey	Good	10.1	13%	4.3	6%
	Fair	56.1	73%	47.8	62%
	Poor	11.1	14%	25.2	33%
Divide	Good	32.2	40%	50.4	63%
	Fair	47.0	58%	30.2	37%
	Poor	1.4	2%	0.0	0%

County	Condition	2025		2023	
		Miles	Percent	Miles	Percent
Dunn	Good	14.7	24%	12.1	22%
	Fair	45.6	76%	43.5	78%
	Poor	0.0	0%	0.0	0%
Eddy	Good	0.0	0%	0.0	0%
	Fair	30.7	50%	41.6	68%
	Poor	30.1	50%	19.2	32%
Emmons	Good	1.6	12%	1.5	12%
	Fair	12.1	86%	11.3	88%
	Poor	0.3	2%	0.0	0%
Fort Berthold	Good	16.1	20%	34.1	43%
	Fair	52.7	66%	18.1	23%
	Poor	10.8	14%	27.5	35%
Foster	Good	23.1	27%	12.2	14%
	Fair	47.5	55%	58.2	64%
	Poor	16.0	18%	20.3	22%
Golden Valley	Good	0.0	0%	0.0	0%
	Fair	20.8	90%	7.0	30%
	Poor	2.3	10%	16.1	70%
Grand Forks	Good	63.3	23%	32.5	12%
	Fair	136.2	49%	184.1	66%
	Poor	81.0	29%	64.1	23%
Griggs	Good	1.0	3%	0.0	0%
	Fair	29.8	78%	33.1	87%
	Poor	7.3	19%	5.0	13%
Hettinger	Good	0.0	0%	0.7	4%
	Fair	15.4	95%	0.0	0%
	Poor	0.8	5%	16.1	96%
Kidder	Good	11.6	23%	13.8	28%
	Fair	30.1	58%	26.6	54%
	Poor	9.8	19%	9.1	18%
LaMoure	Good	17.9	12%	8.3	6%
	Fair	58.7	40%	74.9	51%
	Poor	68.5	47%	63.6	43%
Logan	Good	0.0	0%	0.0	0%
	Fair	1.7	21%	1.7	21%
	Poor	6.7	79%	6.7	79%
McHenry	Good	8.7	10%	0.0	0%
	Fair	71.8	79%	61.7	68%

County	Condition	2025		2023	
		Miles	Percent	Miles	Percent
	Poor	10.6	12%	29.4	32%
McIntosh	Good	0.0	0%	4.1	5%
	Fair	43.9	52%	44.8	53%
	Poor	41.1	48%	36.1	42%
McKenzie	Good	113.1	46%	106.4	43%
	Fair	104.6	42%	123.7	50%
	Poor	29.0	12%	16.7	7%
McLean	Good	57.2	42%	40.3	28%
	Fair	51.1	38%	49.8	34%
	Poor	27.1	20%	56.1	38%
Mercer	Good	4.7	5%	4.5	4%
	Fair	69.6	68%	94.2	93%
	Poor	27.4	27%	3.0	3%
Morton	Good	0.0	0%	0.4	1%
	Fair	53.4	65%	75.8	92%
	Poor	29.1	35%	6.4	8%
Mountrail	Good	76.9	36%	119.3	69%
	Fair	128.7	61%	46.1	27%
	Poor	7.0	3%	8.4	5%
Nelson	Good	0.0	0%	16.5	20%
	Fair	66.4	81%	40.5	49%
	Poor	15.7	19%	25.2	31%
Oliver	Good	0.0	0%	0.0	0%
	Fair	14.1	59%	5.6	23%
	Poor	9.9	41%	18.4	77%
Pembina	Good	37.0	22%	34.0	20%
	Fair	72.5	42%	123.6	72%
	Poor	62.0	36%	14.0	8%
Pierce	Good	2.2	20%	5.2	43%
	Fair	8.8	80%	6.9	57%
	Poor	0.0	0%	0.0	0%
Ramsey	Good	19.2	16%	65.6	56%
	Fair	98.5	84%	52.0	44%
	Poor	0.0	0%	0.1	0%
Ransom	Good	8.4	15%	9.4	17%
	Fair	28.7	51%	37.1	66%
	Poor	19.3	34%	9.9	18%

County	Condition	2025		2023	
		Miles	Percent	Miles	Percent
Renville	Good	25.7	33%	18.0	23%
	Fair	50.0	65%	58.4	76%
	Poor	1.0	1%	0.3	0%
Richland	Good	51.7	21%	58.7	24%
	Fair	136.6	57%	150.6	63%
	Poor	52.3	22%	31.3	13%
Rolette	Good	4.8	11%	21.9	48%
	Fair	40.5	89%	23.4	52%
	Poor	0.0	0%	0.0	0%
Sargent	Good	8.0	9%	13.8	16%
	Fair	65.1	74%	50.3	58%
	Poor	14.3	16%	23.2	27%
Sheridan	Good	6.8	31%	0.1	0%
	Fair	14.8	68%	20.3	97%
	Poor	0.1	0%	0.6	3%
Slope	Good	1.3	100%	1.3	100%
	Fair	0.0	0%	0.0	0%
	Poor	0.0	0%	0.0	0%
Spirit Lake	Good	1.4	3%	2.2	5%
	Fair	19.3	45%	23.8	55%
	Poor	22.2	52%	17.2	40%
Standing Rock	Good	0.0	0%	0.0	0%
	Fair	10.7	34%	2.0	6%
	Poor	21.0	66%	29.7	94%
Stark	Good	22.2	17%	46.0	34%
	Fair	89.8	69%	73.9	55%
	Poor	17.9	14%	14.3	11%
Steele	Good	22.3	31%	12.4	17%
	Fair	43.5	60%	43.8	60%
	Poor	7.1	10%	16.7	23%
Stutsman	Good	17.8	8%	6.1	3%
	Fair	158.4	67%	173.5	73%
	Poor	60.4	26%	57.0	24%
Traill	Good	61.5	41%	10.7	7%
	Fair	67.4	44%	89.9	59%
	Poor	22.6	15%	52.7	34%
Turtle Mountain	Good	22.3	31%	0.0	0%
	Fair	19.1	27%	24.9	35%

County	Condition	2025		2023	
		Miles	Percent	Miles	Percent
	Poor	29.8	42%	46.3	65%
Walsh	Good	25.1	15%	10.6	6%
	Fair	120.5	70%	130.6	76%
	Poor	27.4	16%	31.7	18%
Ward	Good	103.7	31%	113.3	35%
	Fair	193.3	58%	188.8	58%
	Poor	34.2	10%	22.0	7%
Wells	Good	0.0	0%	4.0	4%
	Fair	82.3	79%	49.1	47%
	Poor	21.6	21%	50.8	49%
Williams	Good	139.1	42%	104.9	34%
	Fair	158.6	48%	133.9	44%
	Poor	33.6	10%	68.3	22%

Appendix D: Detailed Results by County and Funding Period

Table D.1. County and Township Unpaved Road Investment Needs by County and Period (Million 2024 Dollars)

County	2026-27	2028-29	2030-31	2032-33	2034-35	2036-45	2026-45
Adams	$6.94	$6.96	$6.96	$6.96	$6.97	$35.07	$69.87
Barnes	$20.36	$20.36	$20.37	$20.37	$20.37	$101.84	$203.66
Benson	$11.44	$11.44	$11.44	$11.44	$11.44	$57.18	$114.38
Billings	$10.76	$9.92	$11.90	$11.14	$9.83	$48.93	$102.48
Bottineau	$16.18	$16.13	$16.13	$16.21	$16.21	$80.99	$161.83
Bowman	$9.57	$9.65	$9.67	$9.63	$9.56	$47.83	$95.91
Burke	$13.45	$13.32	$13.30	$13.31	$13.35	$66.54	$133.26
Burleigh	$15.18	$15.18	$15.18	$15.18	$15.18	$75.50	$151.40
Cass	$39.33	$39.40	$39.62	$39.72	$39.99	$198.88	$396.94
Cavalier	$13.53	$13.53	$13.57	$13.58	$13.58	$67.78	$135.56
Dickey	$10.31	$10.31	$10.31	$10.31	$10.31	$51.53	$103.06
Divide	$12.12	$12.04	$12.09	$12.11	$12.07	$60.28	$120.71
Dunn	$45.11	$41.11	$48.64	$51.21	$36.47	$183.88	$406.42
Eddy	$4.49	$4.50	$4.50	$4.50	$4.50	$22.46	$44.93
Emmons	$12.37	$12.37	$12.37	$12.37	$12.37	$61.86	$123.72
Foster	$6.76	$6.76	$6.76	$6.76	$6.76	$33.79	$67.59
Golden Valley	$11.62	$12.16	$11.76	$11.70	$11.54	$57.63	$116.41
Grand Forks	$23.80	$23.88	$23.88	$23.88	$23.90	$119.33	$238.68
Grant	$16.52	$16.52	$16.52	$16.52	$16.52	$82.60	$165.19
Griggs	$6.95	$6.95	$6.95	$6.95	$6.99	$34.88	$69.67
Hettinger	$8.35	$8.35	$8.35	$8.35	$8.35	$41.73	$83.46
Kidder	$7.74	$7.74	$7.74	$7.74	$7.74	$39.09	$77.78

County	2026-27	2028-29	2030-31	2032-33	2034-35	2036-45	2026-45
LaMoure	$10.94	$10.94	$10.94	$10.94	$10.94	$54.72	$109.43
Logan	$5.57	$5.57	$5.57	$5.57	$5.57	$27.83	$55.66
McHenry	$14.41	$14.42	$14.42	$14.42	$14.45	$72.12	$144.24
McIntosh	$4.84	$4.84	$4.84	$4.84	$4.84	$24.20	$48.40
McKenzie	$60.36	$52.97	$61.09	$61.17	$55.05	$252.31	$542.95
McLean	$22.08	$22.08	$22.08	$22.10	$22.11	$110.61	$221.05
Mercer	$14.13	$14.13	$14.13	$14.06	$14.06	$70.30	$140.81
Morton	$18.49	$18.49	$18.49	$18.49	$18.49	$92.43	$184.86
Mountrail	$25.08	$22.80	$26.29	$26.38	$23.25	$114.53	$238.34
Nelson	$7.32	$7.32	$7.32	$7.33	$7.33	$36.62	$73.23
Oliver	$3.41	$3.38	$3.38	$3.38	$3.38	$16.60	$33.54
Pembina	$10.09	$10.10	$10.10	$10.10	$10.10	$50.51	$101.01
Pierce	$13.29	$13.29	$13.29	$13.29	$13.29	$66.46	$132.91
Ramsey	$8.25	$8.26	$8.26	$8.26	$8.26	$41.25	$82.53
Ransom	$6.67	$6.69	$6.69	$6.69	$6.70	$33.42	$66.87
Renville	$5.94	$5.94	$5.94	$5.94	$5.94	$29.71	$59.43
Richland	$23.08	$23.08	$23.08	$23.10	$23.10	$115.49	$230.94
Rolette	$6.10	$6.10	$6.10	$6.10	$6.10	$30.51	$61.03
Sargent	$5.76	$5.76	$5.76	$5.76	$5.76	$28.81	$57.62
Sheridan	$7.83	$7.83	$7.83	$7.83	$7.83	$39.13	$78.26
Sioux	$6.05	$6.05	$6.05	$6.05	$6.05	$30.26	$60.49
Slope	$8.61	$8.61	$8.61	$8.49	$8.49	$42.46	$85.27
Stark	$21.11	$21.06	$21.26	$21.03	$20.98	$105.40	$210.84
Steele	$8.59	$8.59	$8.60	$8.60	$8.60	$42.97	$85.94
Stutsman	$11.96	$11.96	$11.97	$11.98	$11.99	$59.89	$119.75
Towner	$9.12	$9.12	$9.12	$9.12	$9.12	$45.62	$91.24
Traill	$20.98	$21.01	$21.13	$21.16	$21.18	$105.42	$210.89
Walsh	$18.93	$18.93	$19.06	$19.07	$19.07	$95.10	$190.17
Ward	$34.13	$34.52	$34.75	$34.87	$34.68	$171.34	$344.28
Wells	$12.79	$12.79	$12.79	$12.79	$12.79	$63.96	$127.92
Williams	$26.55	$25.11	$26.80	$26.84	$24.87	$124.74	$254.92
Total	**$775.33**	**$760.31**	**$783.74**	**$785.68**	**$758.36**	**$3,764.31**	**$7,627.73**

Table D.2: County and Township Paved Road Investment Needs by County and Period (Millions of 2026 Dollars)

County	Resurface	Widen	Recon.	Mine & Blend	Break & Seat	Total Miles	Total Cost (Millions$)	Annual Cost per Mile
Adams	9.0	0.0	1.6	0.0	0.0	10.6	$7.63	$36,081.47
Barnes	170.3	14.1	0.0	31.8	0.0	216.3	$130.78	$30,234.51
Benson	66.3	0.0	0.0	0.0	0.0	66.3	$33.24	$25,072.12
Billings	17.1	0.0	0.0	2.3	0.0	19.4	$11.20	$28,785.02
Bottineau	202.7	0.0	0.0	6.1	0.0	208.8	$114.65	$27,447.57
Bowman	119.7	0.0	0.0	26.3	0.0	146.0	$85.21	$29,179.65
Burke	40.5	0.0	6.6	0.6	0.0	47.7	$34.27	$35,950.81
Burleigh	259.3	43.5	7.4	27.9	0.5	338.7	$218.12	$32,200.96
Cass	316.9	0.0	0.0	16.3	18.0	351.3	$202.39	$28,808.07
Cavalier	64.5	0.0	0.0	0.0	0.0	64.5	$32.06	$24,837.52
Dickey	72.7	0.0	0.0	4.6	0.0	77.3	$39.16	$25,321.66
Divide	74.9	0.0	4.3	1.4	0.0	80.6	$48.08	$29,838.32
Dunn	60.4	0.0	0.0	0.0	0.0	60.4	$31.01	$25,683.51
Eddy	50.8	0.0	0.0	10.0	0.0	60.8	$39.07	$32,125.99
Emmons	14.1	0.0	0.0	0.0	0.0	14.1	$7.43	$26,438.40
Fort Berthold	79.7	0.0	0.0	0.0	0.0	79.7	$45.19	$28,359.75
Foster	78.4	0.0	4.0	4.3	0.0	86.6	$56.99	$32,897.93
Golden Valley	20.8	0.0	0.0	2.3	0.0	23.1	$11.96	$25,906.37
Grand Forks	257.5	0.0	6.6	16.3	0.0	280.4	$157.06	$28,003.05
Griggs	38.1	0.0	0.0	0.0	0.0	38.1	$19.46	$25,552.92
Hettinger	15.6	0.0	0.0	0.5	0.0	16.1	$7.97	$24,674.80
Kidder	42.9	0.0	0.0	8.6	0.0	51.5	$28.28	$27,446.68
LaMoure	104.1	0.0	5.2	35.9	0.0	145.2	$98.97	$34,075.11
Logan	8.4	0.0	0.0	0.0	0.0	8.4	$4.04	$24,075.92
McHenry	81.2	0.0	0.0	9.9	0.0	91.1	$53.05	$29,122.78
McIntosh	45.3	0.0	0.0	39.6	0.0	84.9	$57.82	$34,035.21
McKenzie	244.7	0.0	0.0	2.0	0.0	246.7	$120.75	$24,471.25
McLean	118.6	3.3	12.8	0.9	0.0	135.5	$88.18	$32,533.92
Mercer	94.1	0.0	0.0	7.5	0.0	101.6	$63.76	$31,374.14
Morton	77.2	0.0	0.0	5.3	0.0	82.6	$46.31	$28,050.14
Mountrail	207.7	0.0	0.0	4.9	0.0	212.6	$109.58	$25,770.47
Nelson	76.4	0.0	0.0	5.7	0.0	82.1	$42.94	$26,146.17
Oliver	18.6	0.0	0.0	5.4	0.0	24.0	$18.33	$38,178.50
Pembina	147.3	0.0	0.0	24.3	0.0	171.5	$101.30	$29,525.38
Pierce	9.3	1.7	0.0	0.0	0.0	11.0	$7.20	$32,637.16
Ramsey	110.1	7.6	0.0	0.0	0.0	117.7	$61.56	$26,148.34
Ransom	56.1	0.0	0.0	0.2	0.0	56.4	$27.67	$24,539.33
Renville	70.6	0.0	6.1	0.0	0.0	76.7	$49.11	$32,030.71
Richland	184.6	11.5	30.0	14.6	0.0	240.5	$189.20	$39,327.58
Rolette	37.0	8.3	0.0	0.0	0.0	45.3	$28.33	$31,276.26
Sargent	76.1	0.0	6.0	5.3	0.0	87.4	$57.66	$32,995.39
Sheridan	21.7	0.0	0.0	0.0	0.0	21.7	$12.76	$29,451.38
Slope	1.3	0.0	0.0	0.0	0.0	1.3	$0.65	$24,075.92

County	Resurface	Widen	Recon.	Mine & Blend	Break & Seat	Total Miles	Total Cost (Millions$)	Annual Cost per Mile
Spirit Lake	33.9	0.0	0.0	9.0	0.0	42.9	$23.97	$27,931.58
Standing Rock	31.7	0.0	0.0	0.0	0.0	31.7	$15.12	$23,822.56
Stark	117.6	1.3	1.5	9.5	0.0	129.9	$76.86	$29,587.18
Steele	65.4	0.4	0.0	7.1	0.0	72.9	$38.25	$26,242.26
Stutsman	195.6	0.0	0.0	38.5	2.5	236.6	$141.25	$29,852.93
Traill	140.5	0.0	6.4	4.7	0.0	151.5	$88.53	$29,219.12
Turtle Mountain	15.0	0.0	0.0	22.2	33.9	71.2	$54.26	$38,129.25
Walsh	149.8	0.0	5.0	18.1	0.0	172.9	$108.35	$31,332.93
Ward	318.4	0.0	0.0	11.9	0.9	331.2	$178.91	$27,010.05
Wells	82.6	0.0	6.0	15.3	0.0	103.8	$68.02	$32,750.86
Williams	296.4	0.0	13.3	15.4	6.1	331.2	$193.75	$29,247.23

Table D.3. County and Township Paved Road Investment Needs by County and Period (Million 2026 Dollars)

County	2026-27	2028-29	2030-31	2032-33	2034-35	2036-45	2026-45
Adams	$0.86	$0.28	$0.28	$0.28	$1.64	$4.29	$7.63
Barnes	$6.44	$29.24	$11.03	$15.84	$33.27	$34.96	$130.78
Benson	$0.87	$3.45	$3.78	$9.06	$3.13	$12.95	$33.24
Billings	$1.80	$0.51	$0.51	$0.94	$0.51	$6.93	$11.20
Bottineau	$10.61	$8.89	$19.81	$9.43	$14.87	$51.02	$114.65
Bowman	$6.77	$3.83	$7.64	$13.86	$16.39	$36.72	$85.21
Burke	$0.96	$1.25	$14.65	$1.25	$2.55	$13.60	$34.27
Burleigh	$29.76	$39.70	$27.66	$15.82	$11.75	$93.42	$218.12
Cass	$10.74	$38.45	$14.27	$21	$23.64	$94.29	$202.39
Cavalier	$0.85	$1.69	$8.03	$4.79	$3.57	$13.14	$32.06
Dickey	$1.23	$8.77	$9.28	$3.45	$6	$10.43	$39.16
Divide	$1.06	$5.07	$12.65	$2.81	$4.82	$21.67	$48.08
Dunn	$0.79	$2.82	$6.57	$1.58	$6.54	$12.71	$31.01
Eddy	$8.18	$11.96	$3.50	$4.23	$3.22	$7.97	$39.06
Emmons	$2.11	$0.72	$0.37	$0.37	$1.65	$2.22	$7.43
Fort	$1.05	$11.79	$7.92	$7.09	$5.55	$11.80	$45.19
Foster	$9.71	$20.42	$2.61	$4.70	$2.39	$17.16	$56.99
Golden	$0.30	$0.97	$0.67	$0.99	$5.99	$3.03	$11.96
Grand Forks	$8.67	$12.10	$14.04	$20.93	$41.86	$59.47	$157.06
Griggs	$0.50	$6.52	$1.90	$1.87	$2.34	$6.33	$19.46
Hettinger	$0.21	$0.42	$4.37	$0.42	$0.42	$2.12	$7.97
Kidder	$0.84	$2.86	$5.12	$3.84	$5.25	$10.38	$28.28
LaMoure	$16.69	$16.63	$18.82	$7.13	$15.05	$24.65	$98.97
Logan	$0.11	$0.22	$1.77	$0.62	$0.22	$1.10	$4.04
McHenry	$7.83	$17.55	$6.73	$6.61	$2.39	$11.95	$53.05

County	2026-27	2028-29	2030-31	2032-33	2034-35	2036-45	2026-45
McIntosh	$6.99	$10.21	$17.83	$4.78	$6.87	$11.14	$57.82
McKenzie	$5.12	$8.23	$10.47	$12.15	$16.32	$68.47	$120.75
McLean	$2.11	$10.33	$7.06	$5.16	$5.54	$57.99	$88.18
Mercer	$2.60	$16.71	$3.37	$4.33	$11.08	$25.67	$63.76
Morton	$7.27	$6.92	$3.33	$10.47	$6.40	$11.93	$46.31
Mountrail	$2.79	$6.66	$6.17	$10.17	$27.37	$56.41	$109.58
Nelson	$3.91	$2.96	$2.15	$7.89	$15.26	$10.77	$42.94
Oliver	$1.55	$6.41	$1.03	$2.32	$1.86	$5.16	$18.33
Pembina	$7.20	$18.37	$5.89	$21.45	$14.65	$33.74	$101.30
Pierce	$0.18	$1.96	$0.35	$1.05	$1.31	$2.34	$7.20
Ramsey	$1.54	$8.89	$9.28	$5.81	$10.22	$25.82	$61.56
Ransom	$0.74	$3.40	$4.05	$1.48	$6.42	$11.58	$27.67
Renville	$1.15	$4.71	$12.09	$13.46	$2.75	$14.94	$49.11
Richland	$21.15	$47.15	$20.58	$22.97	$14.15	$63.21	$189.20
Rolette	$0.59	$6.91	$7.37	$4.73	$2.78	$5.94	$28.33
Sargent	$2.55	$8.30	$7.20	$9.11	$18.22	$12.29	$57.66
Sheridan	$0.37	$3.13	$1.63	$0.57	$0.57	$6.49	$12.76
Slope	$0.02	$0.04	$0.04	$0.04	$0.04	$0.49	$0.65
Spirit Lake	$2.14	$2.89	$2.97	$2.47	$1.37	$12.13	$23.97
Standing	$3.47	$4.99	$0.83	$0.83	$0.83	$4.16	$15.12
Stark	$7.99	$5.08	$9.42	$10.29	$14.19	$29.89	$76.86
Steele	$0.96	$2.05	$5.81	$6.15	$4.23	$19.05	$38.25
Stutsman	$16.38	$34.70	$17.67	$12.47	$21.86	$38.18	$141.25
Traill	$8.29	$5.99	$7.56	$20.29	$12.55	$33.87	$88.53
Turtle	$0.93	$2.33	$9.51	$14.32	$5.41	$21.76	$54.26
Walsh	$17.28	$14.68	$19.01	$12.80	$17.60	$26.98	$108.35
Ward	$4.41	$22.90	$25.37	$28.23	$21.88	$76.13	$178.91
Wells	$19.14	$11.32	$4.35	$13.59	$5.99	$13.62	$68.02
Williams	$4.42	$16.88	$20.48	$27.48	$37.99	$86.50	$193.75
Total	$282.18	$541.21	$446.85	$445.77	$520.72	$1,350.96	$3,587.64

Table D.4. Estimated Improvement Needs for Unpaved Indian Reservation Roads (Thousand 2026 Dollars)

Tribal Area	2026-27	2028-29	2030-31	2032-33	2034-35	2036-45	2026-45
Fort Berthold	$7,914.01	$5,323.61	$7,688.33	$6,760.11	$5,303.81	$30,417.06	$63,406.93
Spirit Lake	$268.45	$268.45	$268.45	$268.45	$268.45	$1,342.23	$2,684.47
Standing Rock	$6,655.97	$6,655.97	$6,655.97	$6,655.97	$6,655.97	$33,279.84	$66,559.69
Turtle Mountain	$668.18	$668.18	$668.18	$668.18	$668.18	$3,340.87	$6,681.74

Table D.5. Estimated Improvement Needs for Paved Indian Reservation Roads (Million 2026 Dollars)

Tribal Area	2026-2027	2028-2029	2030-2031	2032-2033	2034-2035	2036-2045
Fort Berthold	$1.05	$11.79	$7.92	$7.09	$5.55	$11.80
Spirit Lake	$2.14	$2.89	$2.97	$2.47	$1.37	$12.13
Standing Rock	$3.47	$4.99	$0.83	$0.83	$0.83	$4.16
Turtle Mountain	$0.93	$2.33	$9.51	$14.32	$5.41	$21.76

Table D.6. County and Township Major Bridge Needs by County: 2026-2045 (Million 2026 Dollars)

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Adams	6	$6.27	$0.28	$6.55
Barnes	8	$28.71	$0.73	$29.44
Benson	4	$2.26	$0.08	$2.34
Billings	7	$11.56	$0.18	$11.73
Bottineau	29	$22.67	$0.37	$23.04
Bowman	12	$7.13	$0.15	$7.29
Burke	4	$1.99	$0.04	$2.03
Burleigh	10	$6.02	$0.43	$6.45
Cass	35	$52.29	$2.49	$54.78
Cavalier	8	$5.75	$0.10	$5.85
Dickey	3	$8.38	$0.52	$8.90
Divide	4	$1.99	$0.07	$2.06
Dunn	4	$6.53	$0.36	$6.88
Eddy	3	$6.39	$0.25	$6.63
Emmons	8	$6.29	$0.32	$6.60
Foster	3	$4	$0.11	$4.10
Golden Valley	5	$5.63	$0.11	$5.73
Grand Forks	61	$42.73	$1.52	$44.25
Grant	23	$51.21	$0.20	$51.41
Griggs	1	$2.59	$0.18	$2.76
Hettinger	26	$18.82	$0.27	$19.09
Kidder	0	$0	$0	$0
LaMoure	10	$12.37	$0.29	$12.67
Logan	3	$1	$0.08	$1.07
McHenry	39	$38.14	$0.23	$38.37
McIntosh	2	$2.48	$0	$2.48
McKenzie	14	$23.70	$0.44	$24.14
McLean	7	$9.80	$0.32	$10.12
Mercer	21	$43.97	$0.31	$44.28
Morton	72	$66	$0.88	$66.88
Mountrail	1	$1.52	$0.22	$1.74
Nelson	3	$5.43	$0.26	$5.69
Oliver	7	$14.07	$0.09	$14.16
Pembina	60	$52.15	$0.51	$52.66

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Pierce	1	$0.50	$0	$0.50
Ramsey	3	$2.86	$0.19	$3.04
Ransom	4	$14.28	$0.32	$14.60
Renville	6	$12.72	$0.13	$12.85
Richland	48	$51.84	$1.36	$53.19
Rolette	2	$1	$0.05	$1.05
Sargent	6	$2.99	$0.01	$3
Sheridan	0	$0	$0	$0
Sioux	1	$0.50	$0.15	$0.65
Slope	3	$10.10	$0.17	$10.27
Stark	23	$37.33	$0.54	$37.87
Steele	28	$21.49	$0.46	$21.95
Stutsman	11	$20.58	$0.41	$20.99
Towner	10	$5.46	$0.05	$5.51
Traill	57	$115.78	$0.61	$116.39
Walsh	69	$63.29	$0.91	$64.20
Ward	21	$28.01	$0.35	$2.84
Wells	4	$2.73	$0.32	$3.05
Williams	15	$6.95	$0.17	$7.12
Statewide	815	$968.23	$18.54	$986.77

Table D.7. County and Township Minor Structures Needs (Million 2026 Dollars)

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Adams	31	$13.06	$0.00	$13.06
Barnes	18	$7.14	$0.01	$7.15
Benson	23	$11.64	$0.00	$11.64
Billings	65	$39.07	$0.03	$39.09
Bottineau	18	$10.09	$0.01	$10.10
Bowman	4	$2.40	$0.00	$2.40
Burke	24	$10.15	$0.00	$10.15
Burleigh	8	$2.89	$0.02	$2.91
Cass	115	$48.67	$0.06	$48.72
Cavalier	6	$3.03	$0.05	$3.08
Dickey	16	$7.57	$0.00	$7.57
Divide	2	$1.20	$0.01	$1.21
Dunn	74	$33.88	$0.00	$33.88
Eddy	12	$5.61	$0.00	$5.61
Emmons	8	$2.74	$0.01	$2.75
Foster	5	$1.98	$0.00	$1.98
Golden	29	$12.87	$0.00	$12.87
Grand Forks	16	$6.08	$0.03	$6.12

County	Replacement Bridges	Replacement Cost	Preventive Maintenance Cost	Total Cost
Grant	98	$50.97	$0.00	$50.98
Griggs	4	$2.11	$0.00	$2.11
Hettinger	44	$21.91	$0.00	$21.91
Kidder	1	$0.46	$0.00	$0.46
LaMoure	3	$1.22	$0.00	$1.22
Logan	33	$18.23	$0.00	$18.23
McHenry	6	$2.88	$0.00	$2.88
McIntosh	6	$2.42	$0.01	$2.44
McKenzie	8	$4.37	$0.00	$4.37
McLean	65	$29.65	$0.00	$29.65
Mercer	88	$35.94	$0.00	$35.94
Morton	24	$9.41	$0.00	$9.41
Mountrail	17	$6.83	$0.00	$6.83
Nelson	30	$11.11	$0.00	$11.11
Oliver	9	$3.94	$0.07	$4.01
Pembina	10	$3.65	$0.00	$3.65
Pierce	12	$6.04	$0.04	$6.08
Ramsey	8	$3.78	$0.00	$3.78
Ransom	17	$9.05	$0.00	$9.05
Renville	3	$1.36	$0.00	$1.36
Richland	20	$9.39	$0.00	$9.39
Rolette	27	$13.62	$0.05	$13.67
Sargent	2	$0.76	$0.00	$0.76
Sheridan	8	$4.66	$0.00	$4.66
Sioux	66	$30.44	$0.00	$30.44
Slope	4	$1.81	$0.10	$1.91
Stark	28	$14.63	$0.02	$14.65
Steele	21	$9.11	$0.00	$9.11
Stutsman	30	$13.65	$0.00	$13.65
Towner	5	$2.27	$0.03	$2.30
Traill	101	$48.53	$0.03	$48.56
Walsh	7	$4.06	$0.00	$4.06
Ward	36	$17.26	$0.00	$17.26
Wells	9	$5.41	$0.00	$5.41
Williams	1,324	$620.95	$0.59	$621.54
Statewide	31	$13.06	$0.00	$13.06

Table D.8. Total Road and Bridge Investment Needs, 2026-2045 (Million 2026 Dollars)

Period	Unpaved	Paved	Bridges	Minor Structures	Total
2026-2027	$775.33	$282.20	$162.23	$101.23	$1,319.11
2028-2029	$760.31	$541.10	$162.23	$101.23	$1,562.99
2030-2031	$783.74	$446.80	$162.23	$101.23	$1,492.12

2032-2033	$785.68	$445.80	$162.23	$101.23	$1,493.06
2034-2035	$758.36	$520.70	$162.23	$101.23	$1,540.64
2036-2045	$3,764.31	$1,351	$175.59	$126.54	$5,415.10
2026-2045	**$7,627.73**	**$3,587.60**	**$986.77**	**$632.67**	**$12,823.05**

Table D.9. Total Road and Bridge Investment Needs by County, 2026-2045 (Million 2026 Dollars)

County	Unpaved	Paved	Bridges	Minor Structures	Total Needs
Adams	$69.87	$7.63	$6.55	$13.06	$97.11
Barnes	$203.66	$130.78	$29.44	$7.15	$371.03
Benson	$114.38	$33.24	$2.34	$11.64	$161.60
Billings	$102.48	$11.20	$11.73	$39.09	$164.50
Bottineau	$161.83	$114.65	$23.04	$10.10	$309.62
Bowman	$95.91	$85.21	$7.29	$2.40	$190.81
Burke	$133.26	$34.27	$2.03	$10.15	$179.71
Burleigh	$151.40	$218.12	$6.45	$2.91	$378.88
Cass	$396.94	$202.39	$54.78	$48.72	$702.83
Cavalier	$135.56	$32.06	$5.85	$3.08	$176.55
Dickey	$103.06	$39.16	$8.90	$7.57	$158.69
Divide	$120.71	$48.08	$2.06	$1.21	$172.06
Dunn	$406.42	$31.01	$6.88	$33.88	$478.19
Eddy	$44.93	$39.06	$6.63	$5.61	$96.23
Emmons	$123.72	$7.43	$6.60	$2.75	$140.50
Foster	$67.59	$56.99	$4.10	$1.98	$130.66
Golden Valley	$116.41	$11.96	$5.73	$12.87	$146.97
Grand Forks	$238.68	$157.06	$44.25	$6.12	$446.11
Grant	$165.19	$0.00	$51.41	$50.98	$267.58
Griggs	$69.67	$19.46	$2.76	$2.11	$94.00
Hettinger	$83.46	$7.97	$19.09	$21.91	$132.43
Kidder	$77.78	$28.28	$0.00	$0.46	$106.52
LaMoure	$109.43	$98.97	$12.67	$1.22	$222.29
Logan	$55.66	$4.04	$1.07	$0.00	$60.77
McHenry	$144.24	$53.05	$38.37	$18.23	$253.89
McIntosh	$48.40	$57.82	$2.48	$2.88	$111.58
McKenzie	$542.95	$120.75	$24.14	$2.44	$690.28
McLean	$221.05	$88.18	$10.12	$4.37	$323.72
Mercer	$140.81	$63.76	$44.28	$29.65	$278.50
Morton	$184.86	$46.31	$66.88	$35.94	$333.99
Mountrail	$238.34	$109.58	$1.74	$9.41	$359.07
Nelson	$73.23	$42.94	$5.69	$6.83	$128.69
Oliver	$33.54	$18.33	$14.16	$11.11	$77.14
Pembina	$101.01	$101.30	$52.66	$4.01	$258.98
Pierce	$132.91	$7.20	$0.50	$3.65	$144.26
Ramsey	$82.53	$61.56	$3.04	$6.08	$153.21

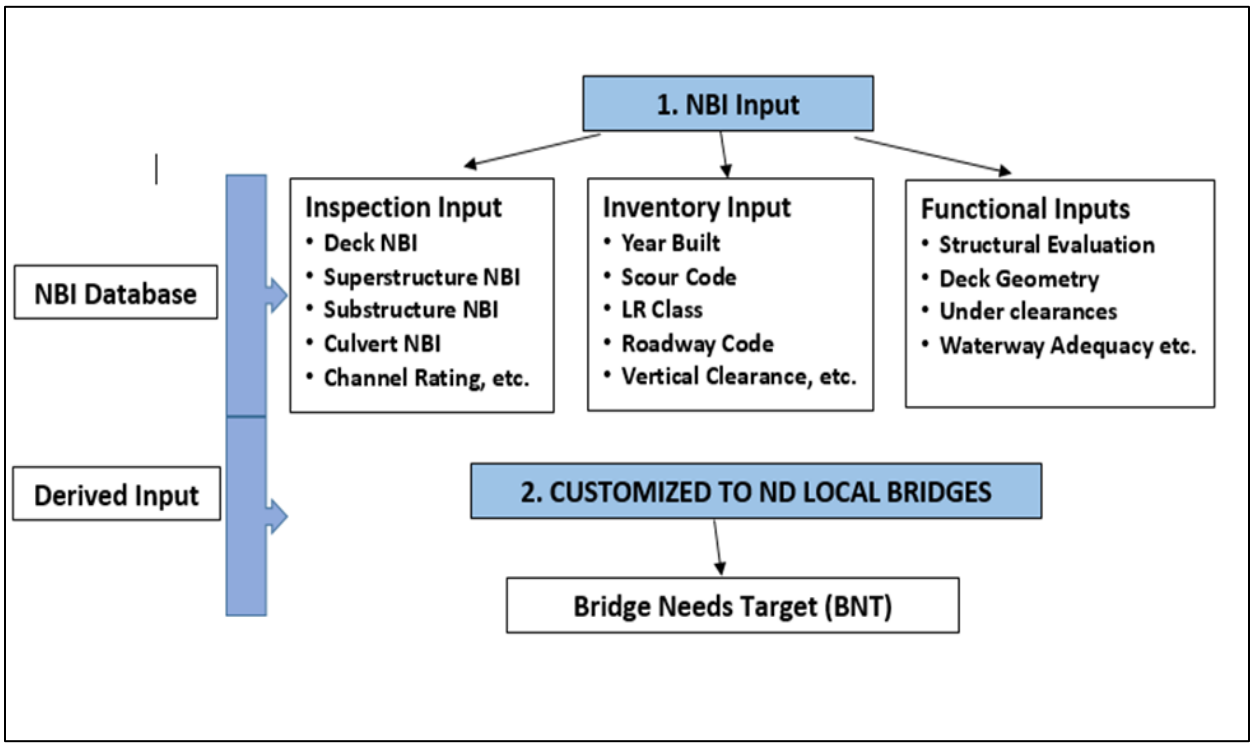
County	Unpaved	Paved	Bridges	Minor Structures	Total Needs
Ransom	$66.87	$27.67	$14.60	$3.78	$112.92
Renville	$59.43	$49.11	$12.85	$9.05	$130.44
Richland	$230.94	$189.20	$53.19	$1.36	$474.69
Rolette	$61.03	$28.33	$1.05	$9.39	$99.80
Sargent	$57.62	$57.66	$3.00	$13.67	$131.95
Sheridan	$78.26	$12.76	$0.00	$0.76	$91.78
Sioux	$60.49	$0.00	$0.65	$4.66	$65.80
Slope	$85.27	$0.65	$10.27	$30.44	$126.63
Stark	$210.84	$76.86	$37.87	$1.91	$327.48
Steele	$85.94	$38.25	$21.95	$14.65	$160.79
Stutsman	$119.75	$141.25	$20.99	$9.11	$291.10
Towner	$91.24	$0.00	$5.51	$13.65	$110.40
Traill	$210.89	$88.53	$116.39	$2.30	$418.11
Walsh	$190.17	$108.35	$64.20	$48.56	$411.28
Ward	$344.28	$178.91	$2.84	$4.06	$530.09
Wells	$127.92	$68.02	$3.05	$17.26	$216.25
Williams	$254.92	$193.75	$7.12	$5.41	$461.20
Total	**$7,627.73**	**$3,449.10**	**$986.77**	**$621.54**	**$12,685.14**

Appendix E: Calculation of NBI Data to Bridge Needs Target (BNT)

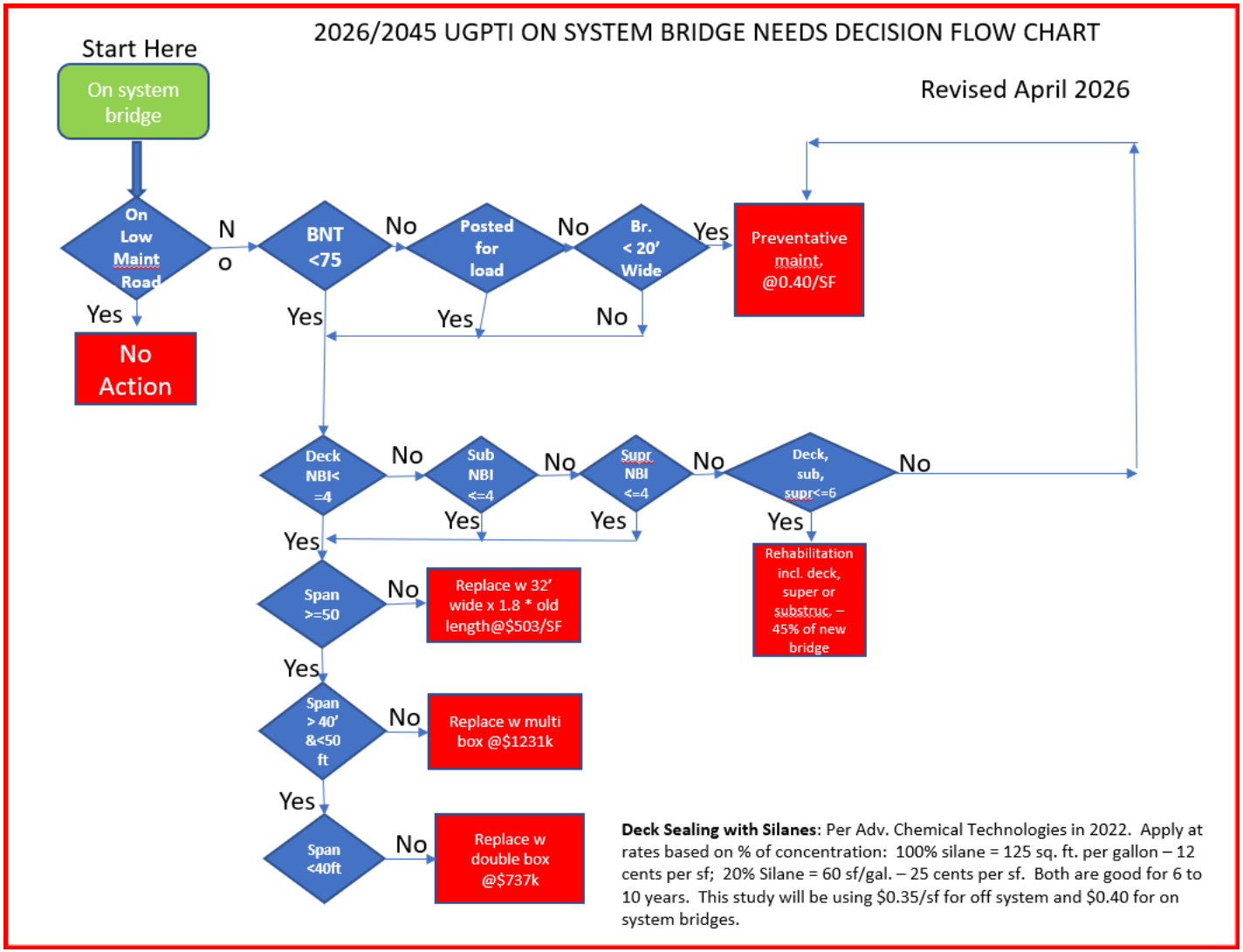
Introduction

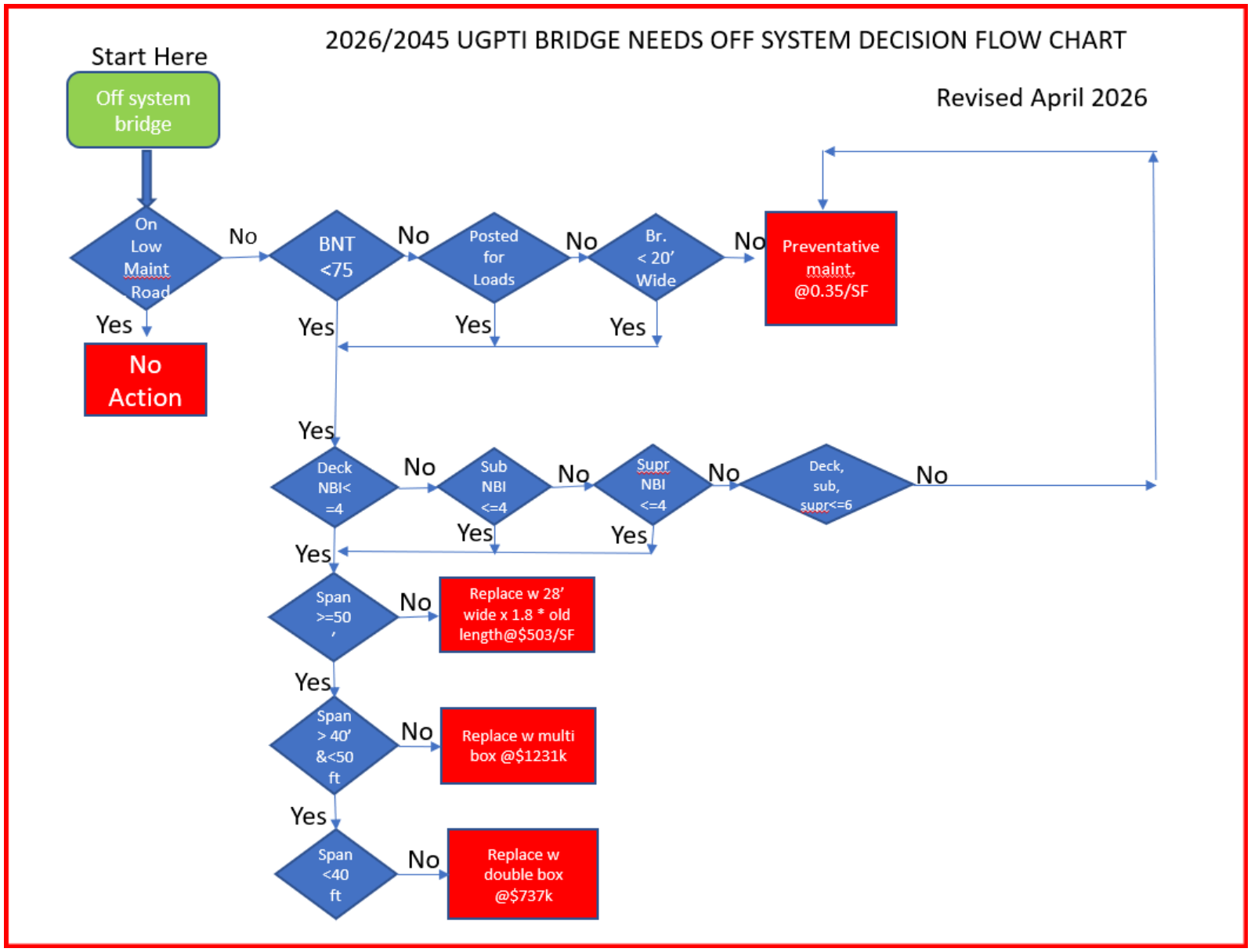
The BNT includes special reduction factors for the following ratings in addition to those ratings already included in the obsolete sufficiency rating method. A scour reduction factor is determined by utilizing Channel Protection (61) and Scour Critical (113) condition codes from the NBI. The fracture critical reduction factor is based on code 92 A, B & C. The reduction factor for load capacity is based on Inventory Rating (66) and finally the reduction factor for timber materials in the main span which would be a maximum deduction of 5%.

Bridge Modeling Framework Chart



Appendix F: Bridge Improvement Flow Chart




2026/2045 UGPTI BRIDGE NEEDS OFF SYSTEM DECISION FLOW CHART
Revised April 2026
Start Here
Off system bridge
On Low Maint Road
No
Yes
No Action
BNT <75
No
Yes
Posted for Loads
No
Yes
Br. < 20' Wide
No
Yes
Preventative maint. @0.35/SF
Deck NBI<=4
No
Yes
Sub NBI <=4
No
Yes
Supr NBI <=4
No
Yes
Deck, sub, supr<=6
No
Span >=50'
No
Yes
Replace w 28' wide x 1.8 * old length@$503/SF
Span > 40' &<50 ft
No
Yes
Replace w multi box @$1231k
Span <40 ft
No
Yes
Replace w double box @$737k

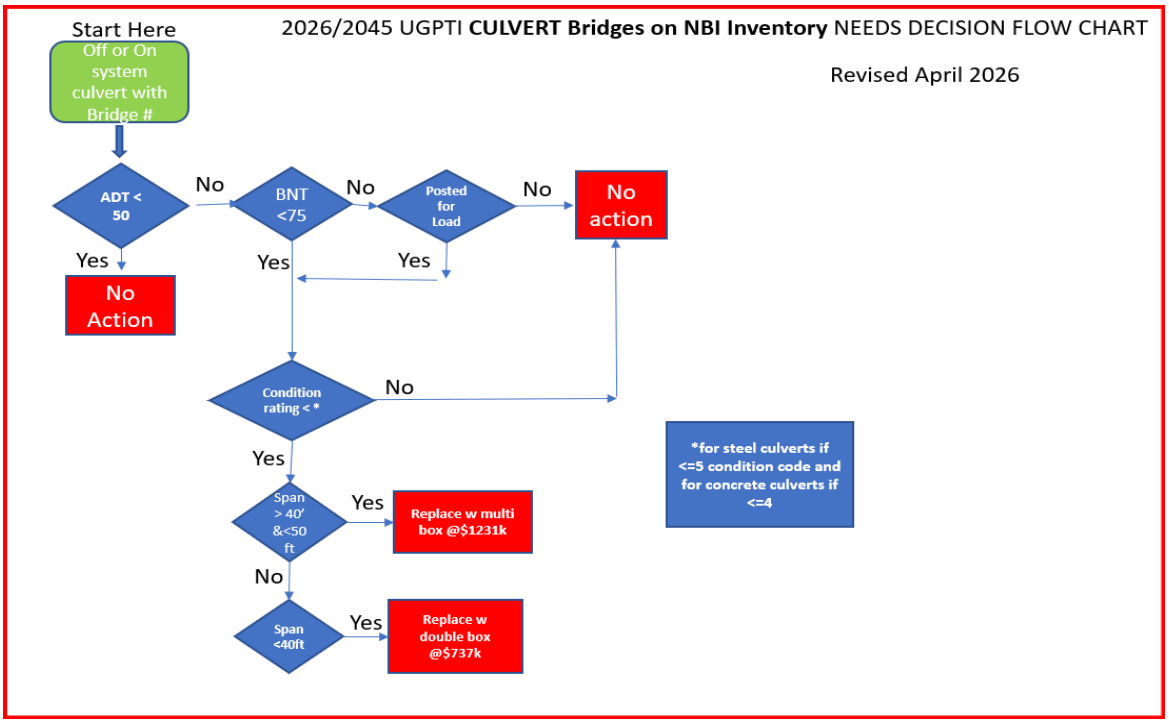
Appendix G: Culvert Flow Chart and Needs

Table G.1. Counties with Culverts 20-foot Span or Greater Drawing Replacement Needs 2026

County	Number of Qualifying Culverts	Additional Needs
Benson	1	$737,000
Burleigh	2	$1,474,000
Cass	2	$1,474,000
Golden Valley	1	$737,000
Grand Forks	4	$2,948,000
Mercer	1	$1,231,000
Morton	4	$3,442,000
Pembina	1	$737,000
Richland	1	$737,000
Stark	2	$1,474,000
Traill	3	$2,211,000
Walsh	2	$1,474,000
Ward	1	$737,000
Totals	**25**	**$19,413,000**

(ADT >= 50)

Note: Qualifying culvert NBI Structures had condition codes of 5 or less for steel or timber and 4 or less for concrete.



Appendix H: Pavement Data Collection

IRISgo Portable Profiler

The portable profiler which mounts to the receiver hitch of a state motor pool vehicle is equipped with several advanced features like an accelerometer that measures acceleration using the relative motion between a proof mass and a mounting substrate, a reflective target detection system for distance measurement, two spot lasers to measure the longitudinal profile in each wheel path, and a Garmin GPS to integrate the system with precise geolocation. The profiler can collect data at speeds as low as 25 mph. The laser readings on the longitudinal profile can be translated into International Roughness Index (IRI) values for every 500 feet of pavement, providing a detailed analysis of road smoothness.

Before data collection, various calibrations are performed to ensure accuracy: accelerometer, distance, block check, bounce test, etc. Accelerometer calibration needs to be done daily, which cancels out the effect of vehicle motion on sensor readings. Distance calibration and block check are other calibrations that need to be done every week. Distance calibration is used to calibrate the distance measurement instrument on a course with pre-measured distance. Block checks are conducted with different height blocks to ensure the elevation accuracy measured by each laser. Another calibration that is performed monthly is the bounce test, which is essentially a verification that the laser and processed initial reference height cancel out.



Figure H.1. UGPTI Utilized a Portable Profiler for Pavement Data Collection



Figure H.2. IRISgo Portable Profiler for Pavement Data Collection

Appendix I: Minor Structures Inventory Form

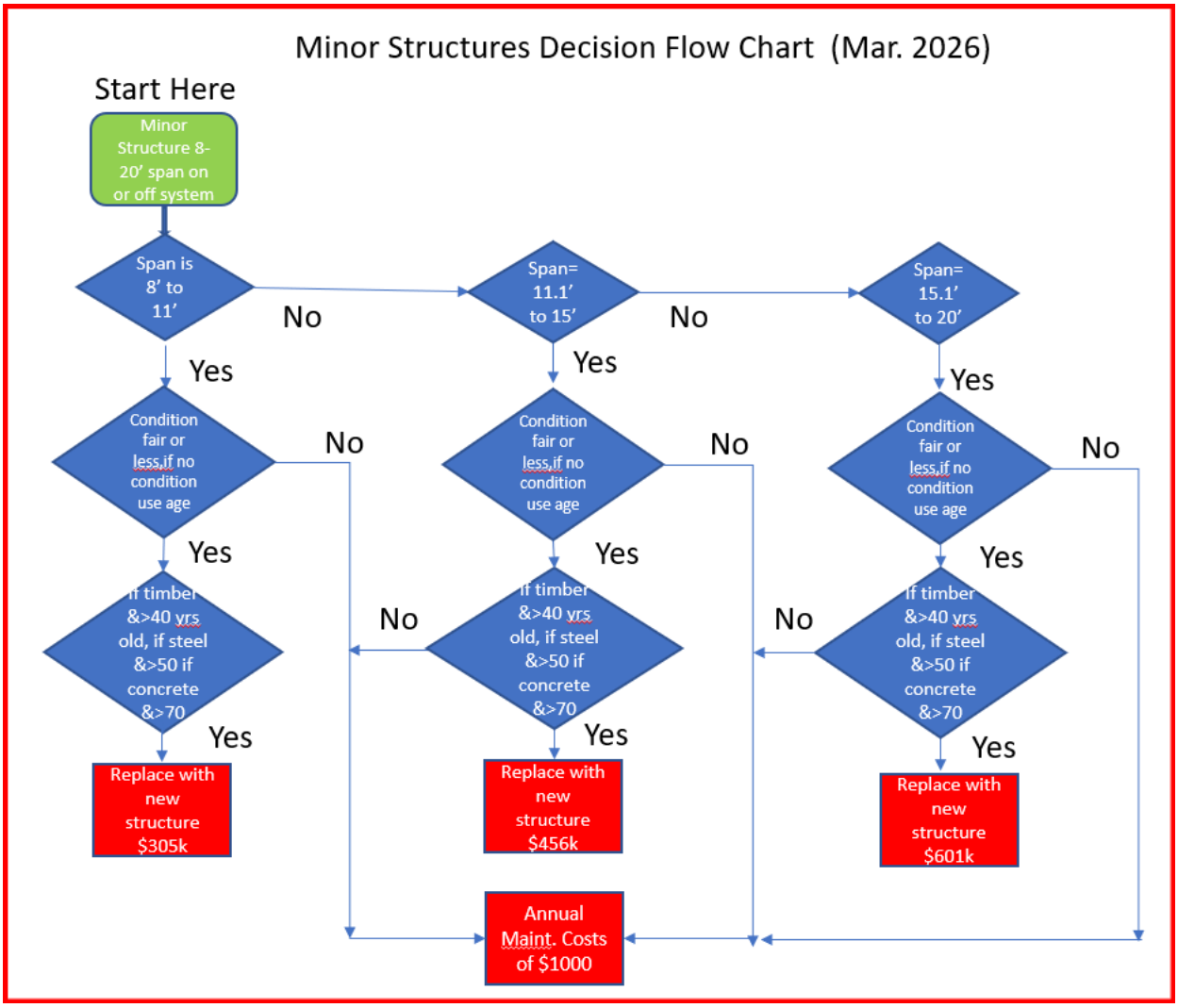
North Dakota Minor Structure Inventory Form **Bridge Inventory Form (Page 1 of 2)** **Revised 04/04/2023**

COMMON INVENTORY ITEMS		
Location		
Item 1	County Name	
Item 2	Town or Township Name	
Item 3	Road System	☐ Township ☐ County ☐ County Secondary ☐ Other
Item 4	Small Structure Local Identifier	
Item 5	Sequence Number	
Item 6	Inventoried By	
Item 7	Inventory Date	____ / ____ / 20____
Item 8	Latitude	_____._____ decimal degrees
Item 9	Longitude	_____._____ decimal degrees
Item 10	Small Structure Number	____ - _____ - _____ (to be assigned later)
Road Attributes		
Item 11	Road Name	
Item 12	Road Maintenance Level	☐ Full Maintenance ☐ No Maintenance ☐ Minimum Maintenance
Item 13	Road Surface	☐ Dirt ☐ Asphalt Mat ☐ Gravel ☐ Concrete ☐ Blotter ☐ Other
Item 14	Number Served	☐ Not a Dead End ☐ No homes, farms, ranches ☐ 1 home, farm, or ranch ☐ More than 1 home, farm, or ranch
Item 15	Detour Length	_____ miles
(Items 16 – 49 are used only for Box and Pipe Culverts)		

SMALL BRIDGE INVENTORY ITEMS		
Bridge Attributes		
Item 50	Structure Design Type	☐ Slab ☐ Through Truss ☐ Girder ☐ Deck Arch ☐ Box Beam ☐ Through Arch ☐ Channel Beam ☐ Rigid Frame ☐ Tee Beam ☐ Combination ☐ Deck Truss ☐ Other
Item 51	Structure Material	☐ Concrete ☐ Wood ☐ Steel ☐ Masonry ☐ Prestressed Concrete ☐ Other
Bridge Dimensions		
Item 52	Overall Length	_____ feet
Item 53	NBIS Length	_____ feet
Item 54	Number of Spans	_____ spans
Item 55	Traffic Lanes	_____ lanes
Item 56	Deck Width	_____ feet
Item 57	Roadway Width	_____ feet
Item 58	Skew Angle	_____ degrees
Bridge Condition		
Item 59	Deck Condition	☐ Good ☐ Poor ☐ Fair ☐ Critical
Item 60	Superstructure Condition	☐ Good ☐ Poor ☐ Fair ☐ Critical
Item 61	Substructure Condition	☐ Good ☐ Poor ☐ Fair ☐ Critical
Item 62	Channel Condition	☐ Good ☐ Poor ☐ Fair ☐ Critical
Item 63	Bridge Rail Condition	☐ Railing runs full bridge length in sound condition ☐ Railing is partially missing or needs repair ☐ No functional railing is present
Item 64	Approach Rail	☐ Railing is present and in sound condition ☐ Railing is partially missing or needs repair ☐ No functional railing is present

Instructions: Use this form with the Small Structure Inventory Handbook. Use a separate form for each Small Bridge inventoried. Information on this form must be entered into the GRIT Minor Structure Database.

Appendix J: Minor Structures Decision Flow Chart



Appendix K: List of Abbreviations

ATR- Annual Traffic Recorders
AADT- Average Annual Daily Traffic
BBL- Barrel of Oil
BIA- Bureau of Indian Affairs
CDL- Crop Data Layer
CMC- County Major Collector
CRP- Conservation Reserve Program
DOD- Department of Defense
DOTSC- Department of Transportation Support Center
ESAL- Equivalent Single Axle Loads
FHWA- Federal Highway Administration
FO- Functionally Obsolete
FSM- Four Step Model
FWD- Falling Weight Deflectometer
GIS- Geographic Information System
GPR- Ground Penetrating Radar
GRIT- Geographic Roadway Inventory Tool
HB- House Bill
IRI- International Roughness Index
KIPS- Kilopounds
NASS- National Agricultural Statistics Service
NBI- National Bridge Inventory
NDDOT- North Dakota Department of Transportation
NDPSC- North Dakota Public Service Commission
NDT- Non-Destructive Testing
PAVVET- Performance Analysis Via Vehicle Electronic Telemetry
PSR- Present Serviceability Index
R-Sq- Coefficient of Determination
RCBC- Reinforced Concrete Box Culverts
RIC- Roadway Image Capture
RIF- Road Impact Factor
RMS- Root Mean Square
SD- Standard Deviation/ Structurally Deficient
SN- Structural Number
SR- Sufficiency Rating
TAZ- Traffic Analysis Zones
TDM- Travel Demand Model
TWP- Township
UGPTI- Upper Great Plains Transportation Institute
USDA- United States Department of Agriculture