Infrastructure Needs: North Dakota's County, Township, & Tribal Roads & Bridges 2022-2041

Draft Report Preview

Upper Great Plains Transportation Institute
North Dakota State University
Presenters: Alan Dybing, Bradley Wentz, Kelly Bengtson

NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

Purpose of Today's Presentation

- Review draft report results with jurisdictions prior to legislative presentation
- Solicit comments on study process and provide information on timelines
- 4 regional outreach meetings will be held the week of July 11

Outline of Today's Presentation

- Study Objective
- Quick History of Studies
- Traffic Forecasting
- Unpaved (Gravel) Analysis
- Paved Analysis
- Bridge Analysis
- Initial Results
- Future Timeline and Comment Process

Study Objective

- Directed by 2021 Legislative Session
- Estimate the funding needs to maintain the existing road system over the next 20 years
- Outcomes to be used for distribution of HB 1066 (Operation Prairie Dog) county funding

Study Team

- Denver Tolliver
- Alan Dybing
- Brad Wentz
- Kelly Bengtson
- Dale Heglund
- Tim Horner
- Satpal Wadhwa
- Sharijad Hasan

Quick History of Studies

- 2010 study: UGPTI estimated road investment needs for the 2011 session
  - 21,500 new wells & increased ag. production
- 2012 study: updated investment needs
  - 46,000 new wells, ag. production, & initial bridge study
- 2014 Study: more comprehensive data
  - Higher roadway costs, ag. production, & 60,000 new wells
- 2016 Study: First study with GRIT and oil scenario analysis
- 2020 study: First study with a 4-year gap between studies.
  - First study where it was known that funding distribution was partially tied to results
- 2022 study: Updated bridge analysis methods and classification counts
  - Inflationary impacts

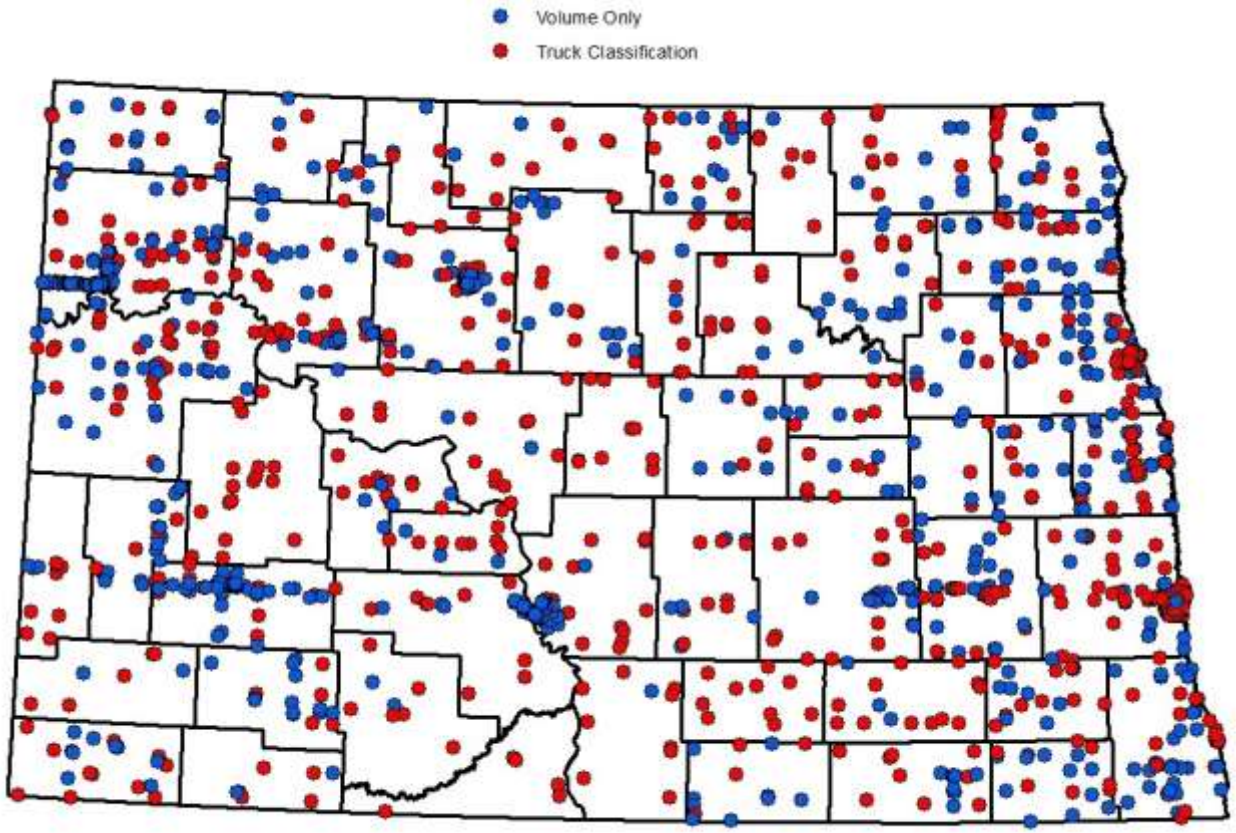
Primary Components of Study

- Traffic Model
  - Traffic is key to modeling pavement and gravel needs
- Unpaved Costing Process
  - Based upon updated survey and traffic volumes
  - Gravel is 60% of the total needs in past studies
- Pavement Model and Cost Projection
  - Dependent on good data from GRIT
- Bridge Model and Cost Projection
  - Looking at the 3 major components of bridges
    - Superstructure, substructure and deck

Traffic Forecasting

- Impacts to roadways are dependent on traffic levels
  - Unpaved
    - More frequent blading
    - More frequent and thicker gravel overlays
    - Dust suppressant and base stabilization
  - Paved
    - Design based upon projected ESALs
    - Pavement Thickness
    - Pavement Deterioration
- Travel Demand Model
  - Using agricultural and oil related data to forecast truck traffic over the next 20 years
  - Compared against observed traffic counts and adjusted

Traffic Counts

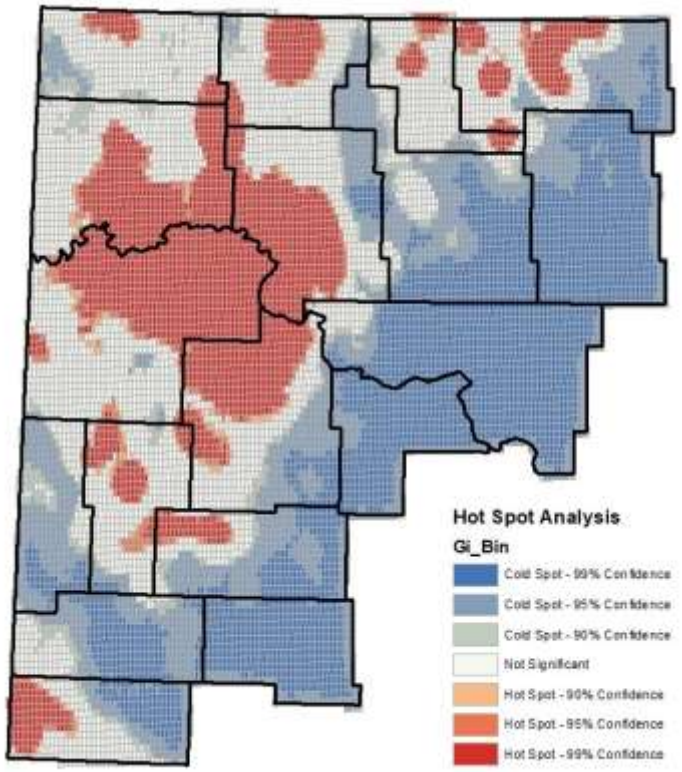


Model Groups

- Agriculture
  - Corn
  - Wheat
  - Soybeans
  - Barley
  - Canola
  - Sunflowers
  - Dry Edible Beans
  - Sugarbeets
  - Potatoes
- Oil
  - Fresh Water
  - Rigs
  - Equipment
  - Fuel
  - Mud
  - Pipe
  - Produced Water
  - Outbound Oil

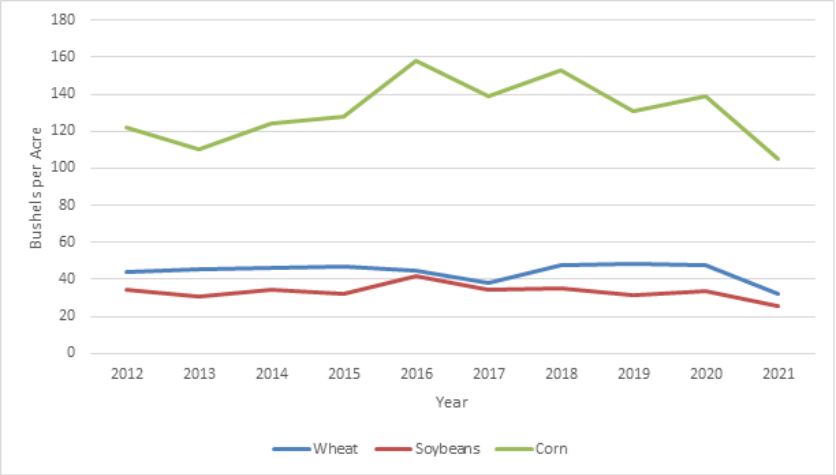
Oil Forecasts

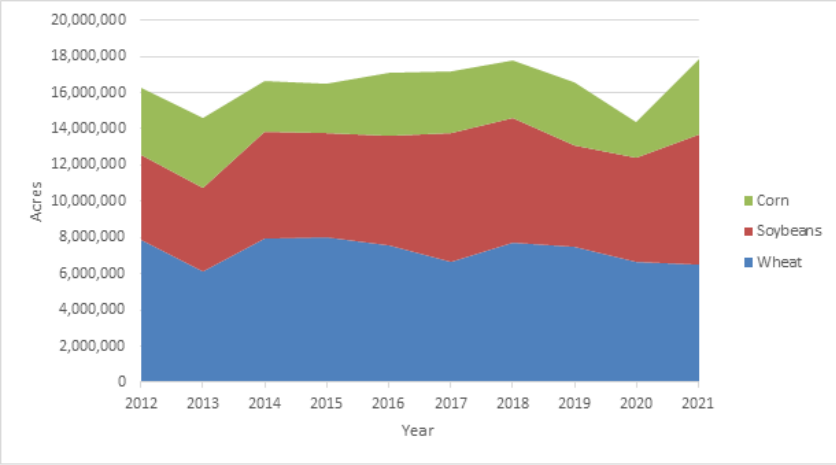
- The baseline forecast developed through discussions with Oil & Gas
- 960 new wells/year – equivalent to 40 operating rigs
- Spatial forecast of location



Agricultural Forecasts

- Historical yield and acreage data
- Trends developed from historical observations with adjustments for outliers





Unpaved Analysis

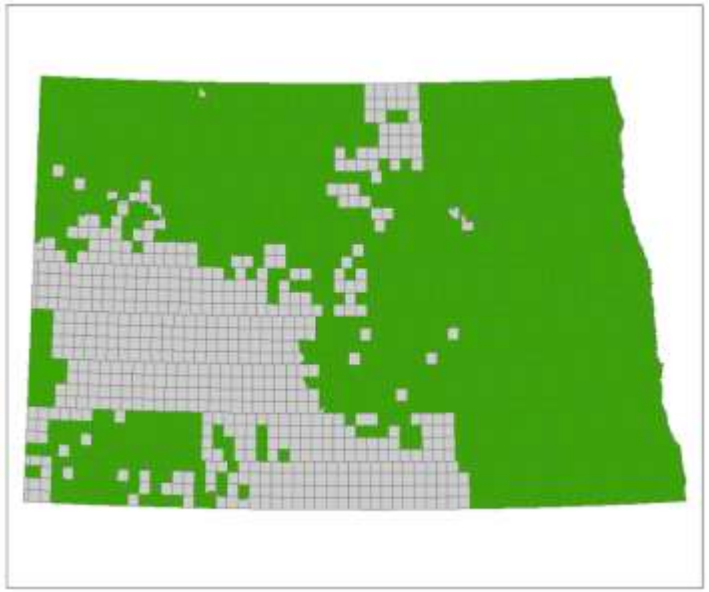
- Assigning maintenance costs based upon traffic level forecasts
- Survey of costs and practices
  - Steering Committee
  - Counties asked how roads are maintained differently based upon traffic levels

Gravel Survey

- Aggregate characteristics
  - Specifications
  - Testing
- Unit costs
  - Aggregate
  - Blading
  - Hauling
- Overlay thickness and frequency
  - How they vary at different traffic levels
- Blading frequency
  - How they vary at different traffic levels
- Dust suppressant usage
- Stabilization

Gravel Survey

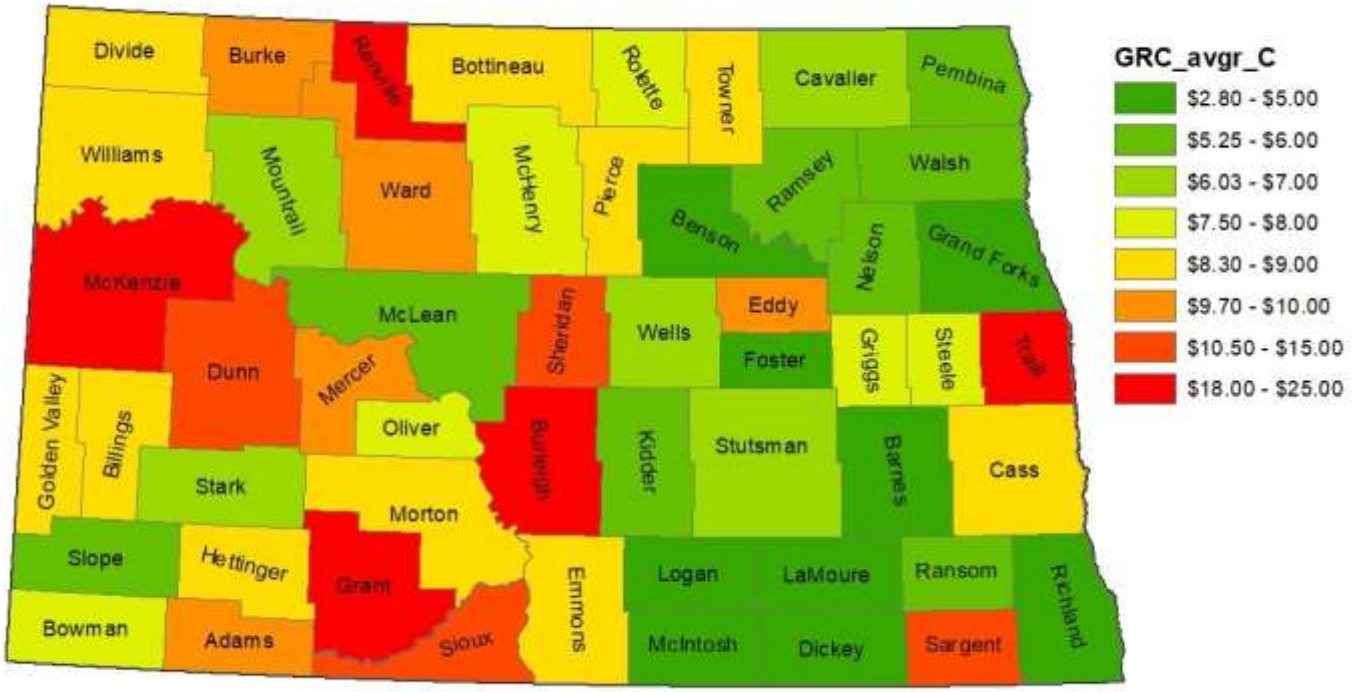
- Mailed to all 53 counties and roughly 1,300 organized townships
- Response rate:
  - Counties: 100%
  - Townships: 57%



Unpaved Analysis

- Survey results are used to calculate an average annual cost per mile by traffic level
- Survey results account for regional variations in gravel costs and maintenance practices
- Group miles by traffic levels
  - Very high, high, medium, low, very low
- Apply annualized costs to each traffic level and add up mileages across each jurisdiction

Aggregate Cost/Cu.Yd.



Paved Analysis

- Data Collection
  - Pavement condition
  - GRIT – County data
  - Existing Conditions
- Data Analysis
  - AASHTO routine
  - Costs
- Pavement results

Pavement Data Collection

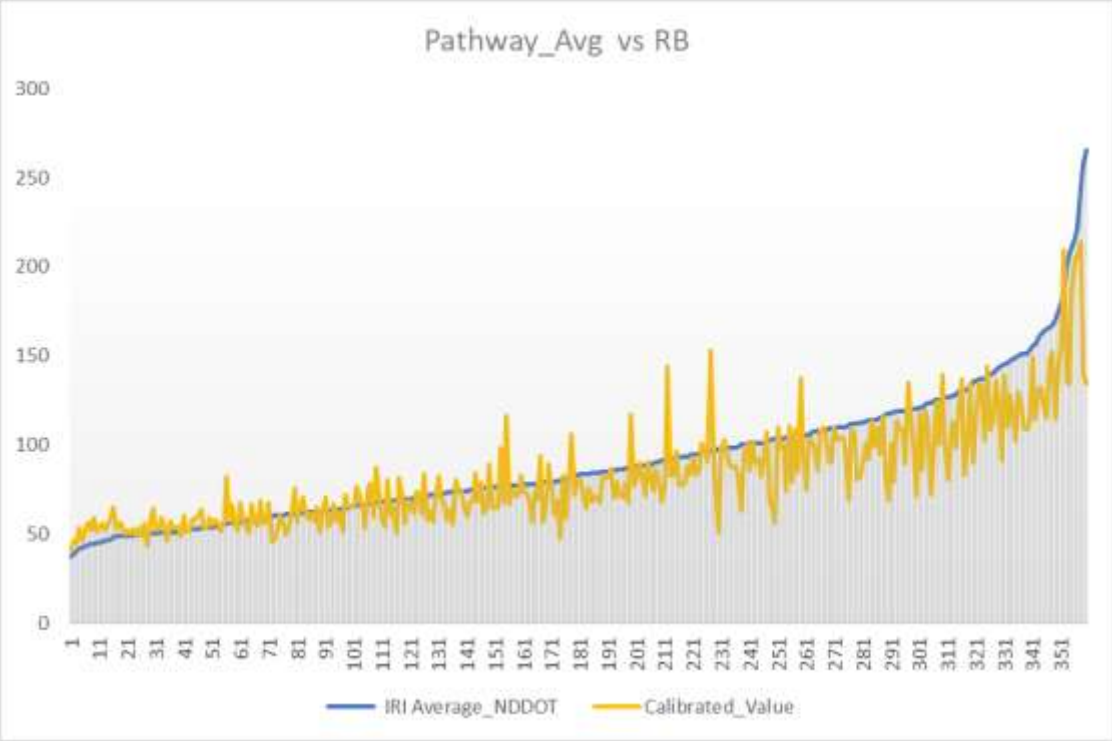
- 2021 Condition data collection
  - Roadbump - calibrated to Pathway
  - Collected south half of State in 2021.
    - Will collect north half in 2022.
    - Projected north from 2019 to 2021
  - Images every 500'
    - Evaluated for distress
  - Approx. 3,000 miles of ride and image data collected

Pavement Acronyms

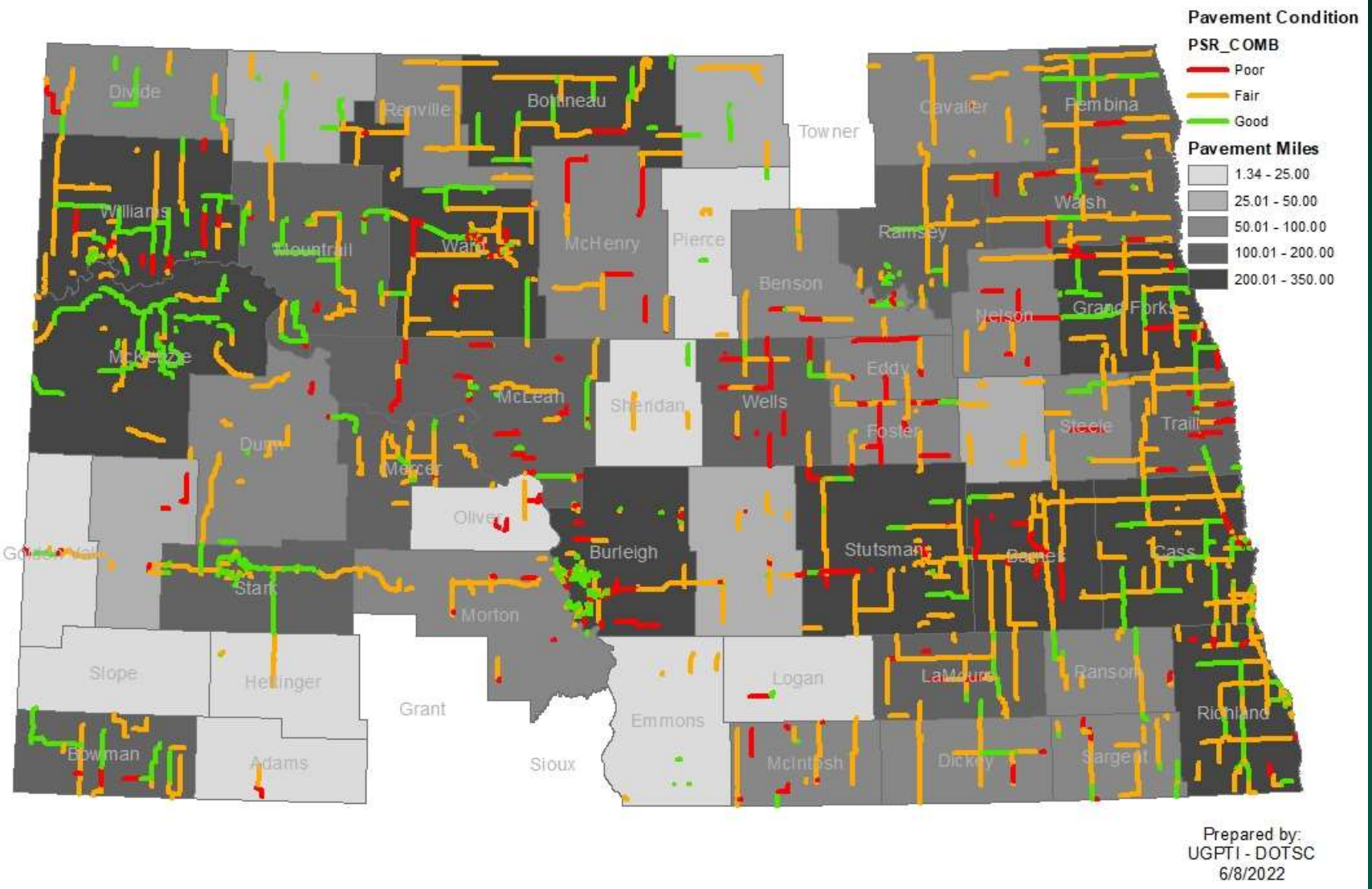
- IRI – International Ride Index
- PSR – Pavement serviceability rating
- RM – Resilient Modulus
- PCI – Pavement Condition Index
- SN – Structural number (subgrade strength)

Pavement Data Collection

- Roadbump accelerometer based IRI was calibrated to NDDOT Pathway Laser based IRI.
  - Good results after development of regression models



County Pavement Condition
2021 Combined ride and condition



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UGPTI - DOTSC
6/8/2022

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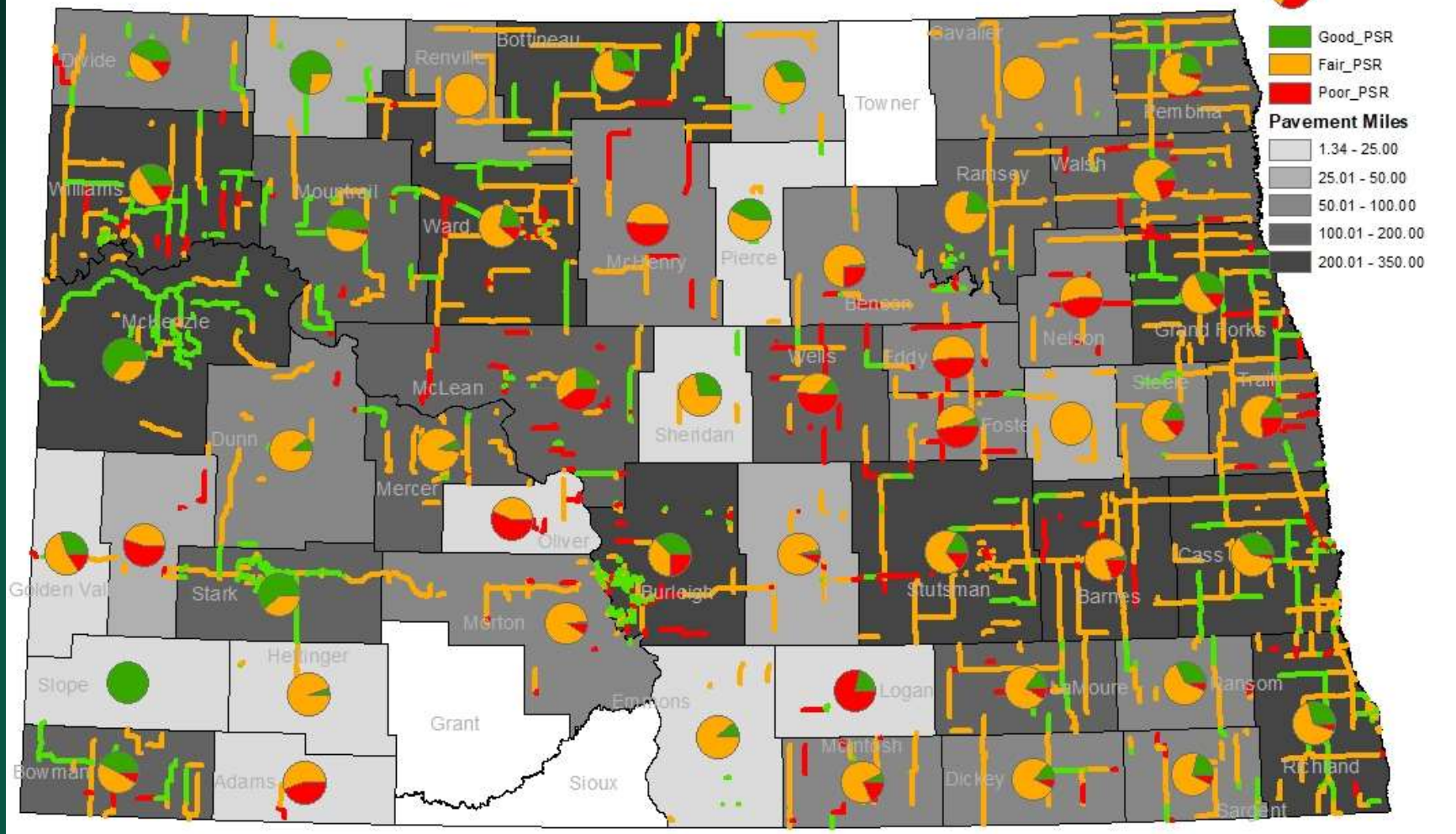

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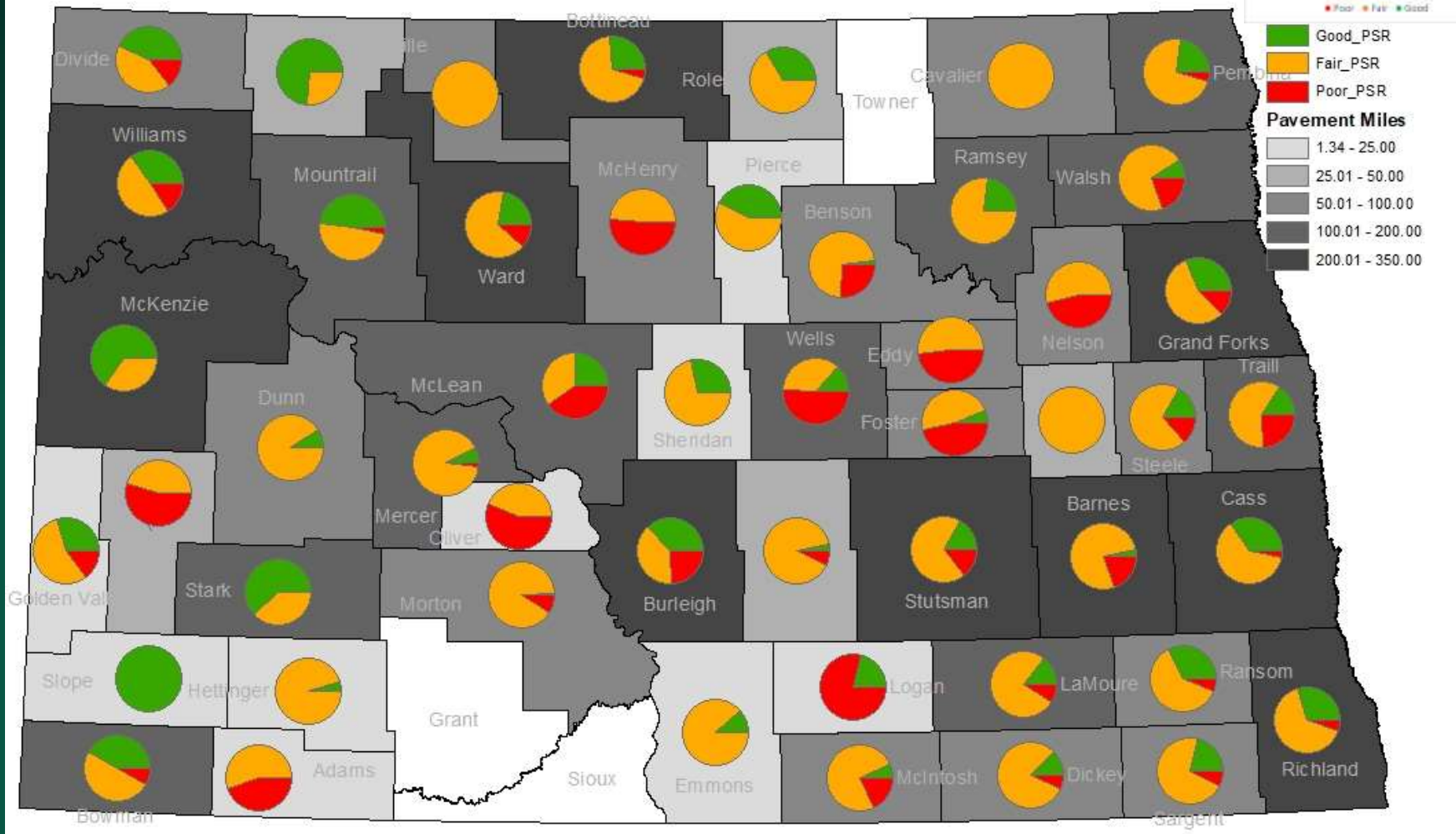

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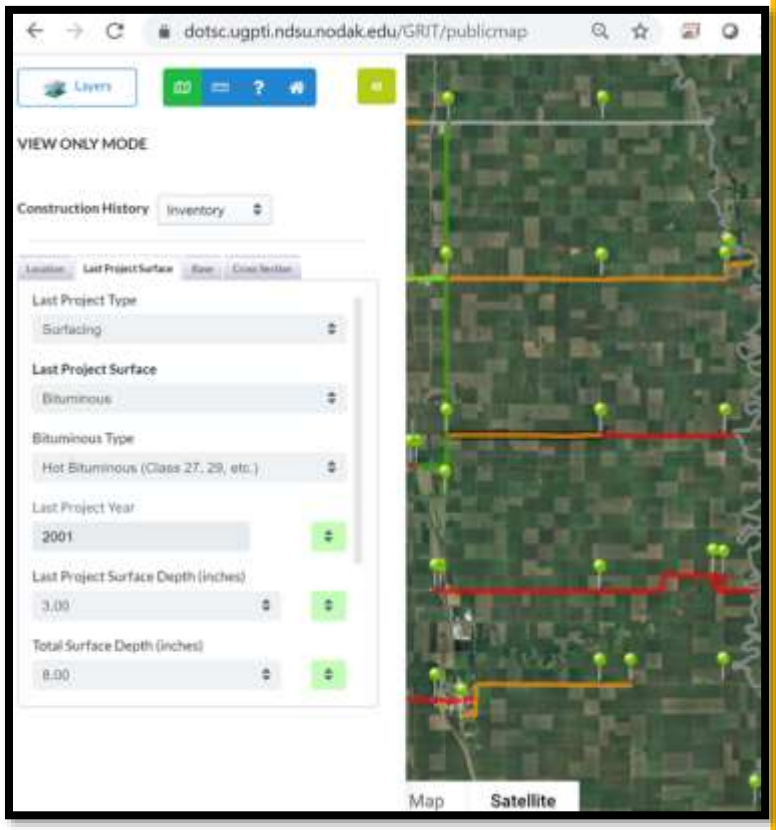
Data Collection (Cont.)

- Pavement/subgrade strength and depth
  - Falling Weight Deflectometer and Ground Penetrating Radar
  - Sampling on all county paved segments > 2 miles in length
  - Completed October 28, 2015
  - **Updated with GRIT Data**

Pavement Data Collection

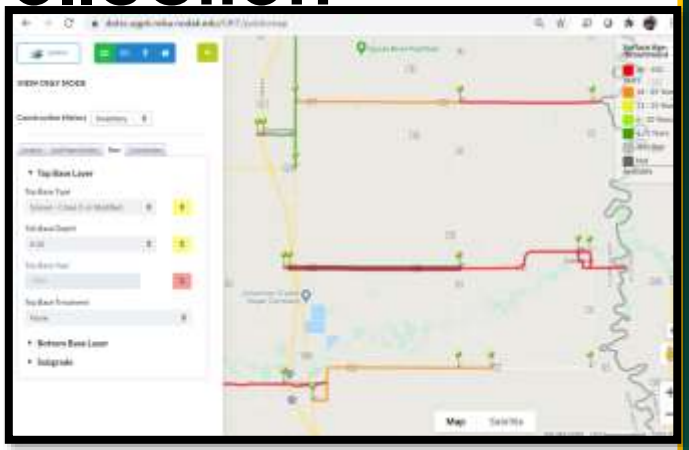
- **Geographic Roadway Inventory Tool (GRIT)**
  - Easy to use web-map based inventory tool
  - Available and in use by all ND Counties
  - Four Layers of Information
    - Construction History
    - Construction Planning
    - Minor Structures
    - Load Restrictions



https://www.ugpti.org/resources/asset-inventory/

Pavement Data Collection

- **Geographic Roadway Inventory Tool (GRIT)**
  - Construction History – SN
    - Pavement thickness and type
    - Base thickness and type
    - Subgrade strength
    - Pavement Age
  - Shoulder type and width

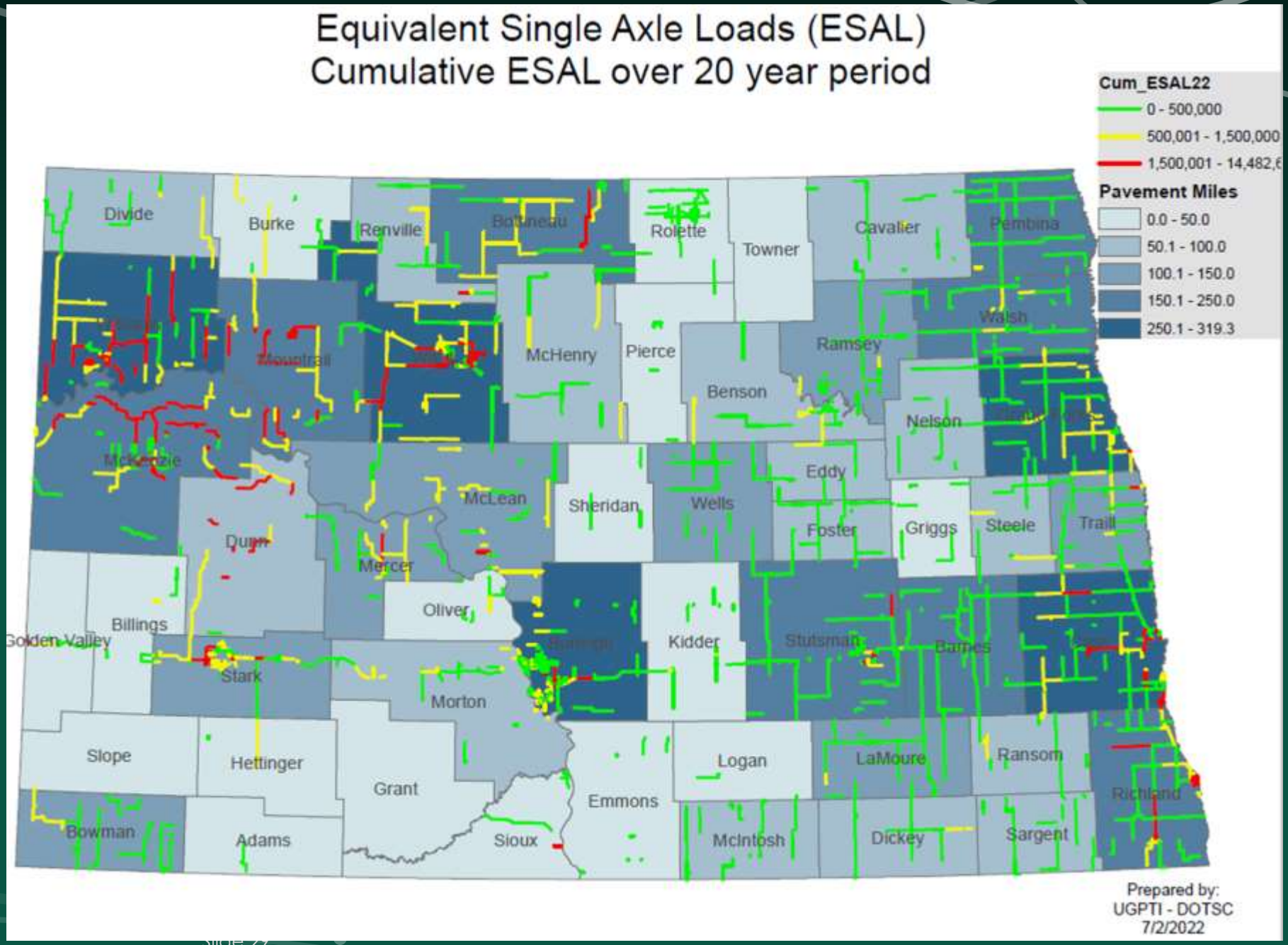


https://www.ugpti.org/resources/asset-inventory/

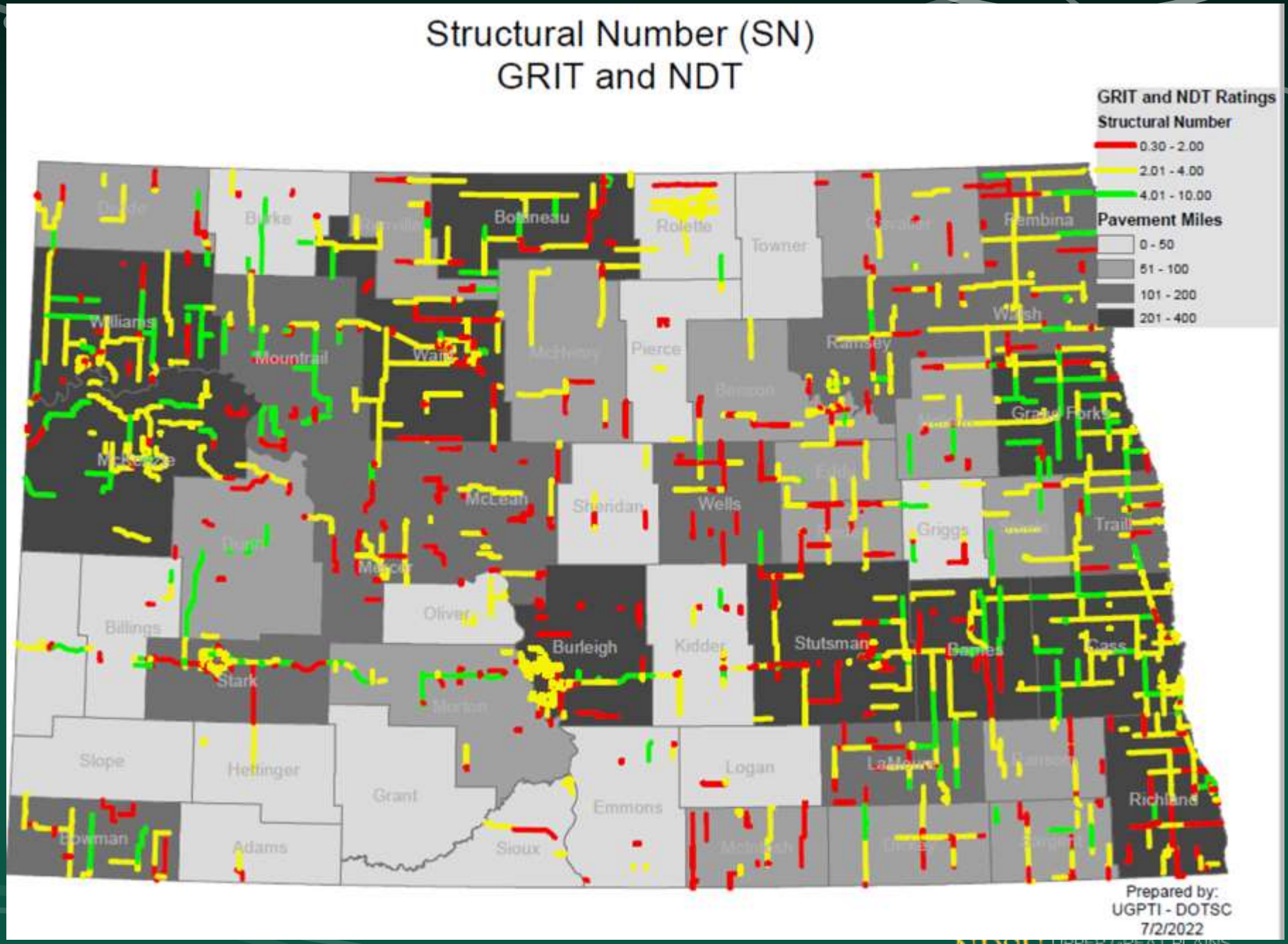
Paved Data Analysis

- AASHTO pavement design model
  - Design Inputs
    - PSR – initial pavement condition
    - Cumulative ESAL's – truck traffic
    - Structural Number SN – roadway strength
    - Subgrade strength – Resilient Modulus
- Other Inputs
  - Shoulder width

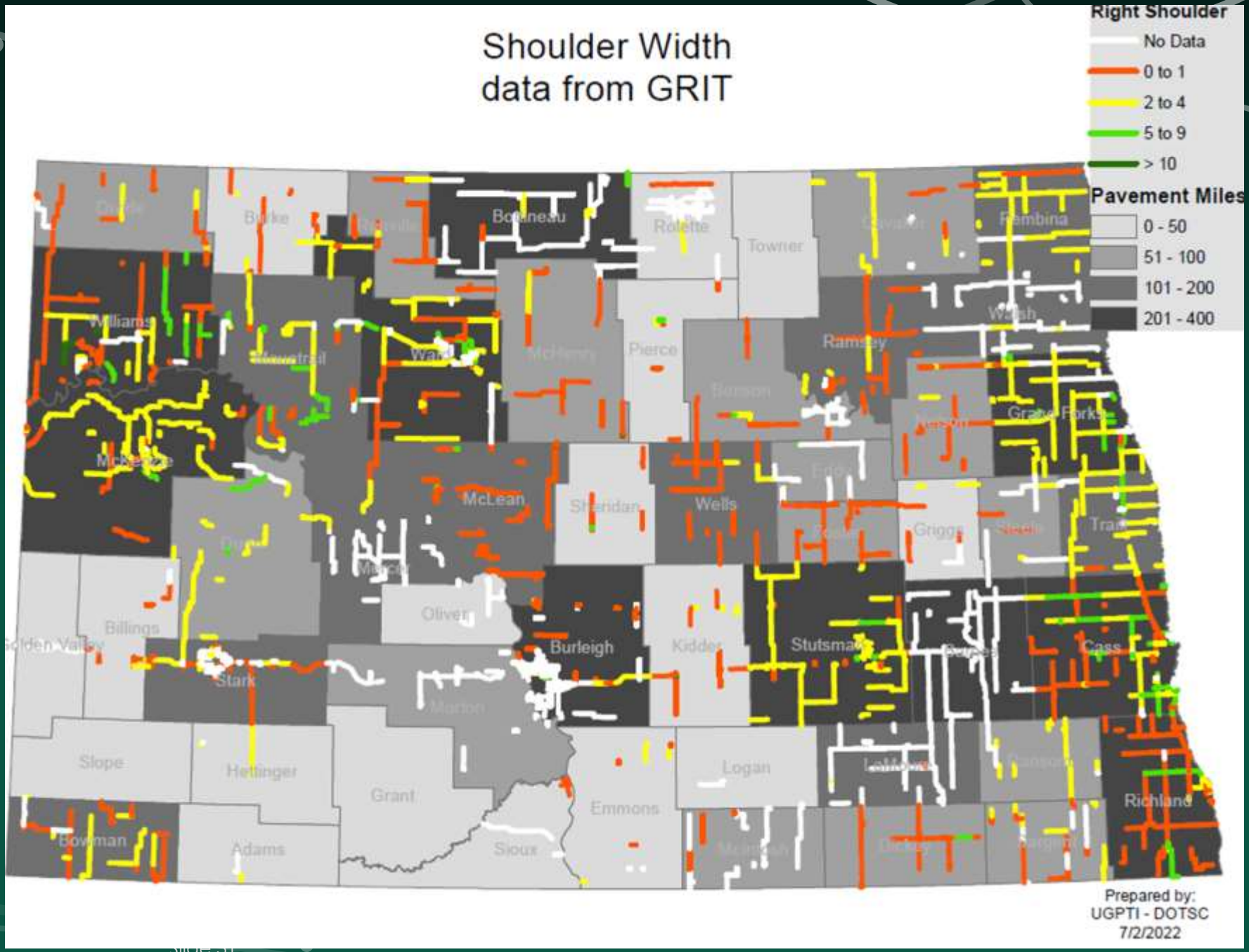
Equivalent Single Axle Loads (ESAL)
Cumulative ESAL over 20 year period



Structural Number (SN)
GRIT and NDT

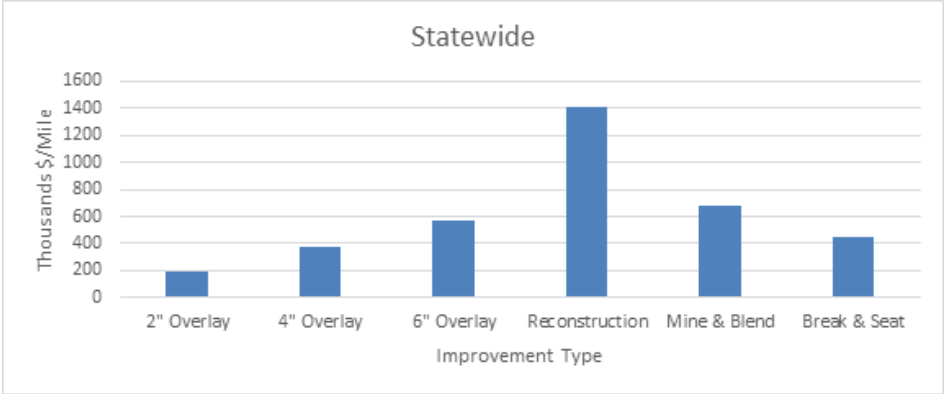


Shoulder Width
data from GRIT



Paved Data Analysis

- **Project Selection and Costs**
  - Bituminous Overlay
    - $200,000 to $550,000/mile
  - Total Reconstruction
    - $1.4 Million/mile
  - Mine & Blend / Reclamation
    - $678,000/mile
  - Widening with Overlay
    - Add $87,000 per foot width to overlay
  - Concrete Pavement Repair (CPR)
    - $450,000/mile



Since Last Study NHCCI is up 12%

Q1 2020

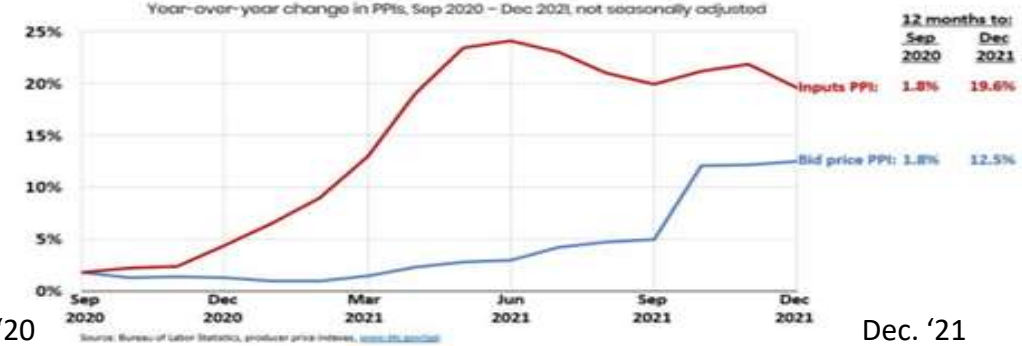
Q3 2021

Assn. of General Contractors

Figure 2

Change in prices for new nonresidential construction inputs vs. bid prices

Year-over-year change in PPIs, Sep 2020 – Dec 2021, not seasonally adjusted



Sep. '20 Dec. '21

Figure 2 shows how the gap between input costs and bid prices widened dramatically beginning in September 2020. In that month, both price indexes increased 1.8% from the year-earlier level. Then, through mid-2021, the year-over-year increase in input costs outran the rise in bid prices by larger amounts each month. As noted above, input prices moderated in the second half of 2021, while bid prices rose more than in past years. But the 12.5% annual increase through December in the bid price PPI was far short of the 19.6% input-price increase. As a result, contractors were absorbing more and more of the cost increases.

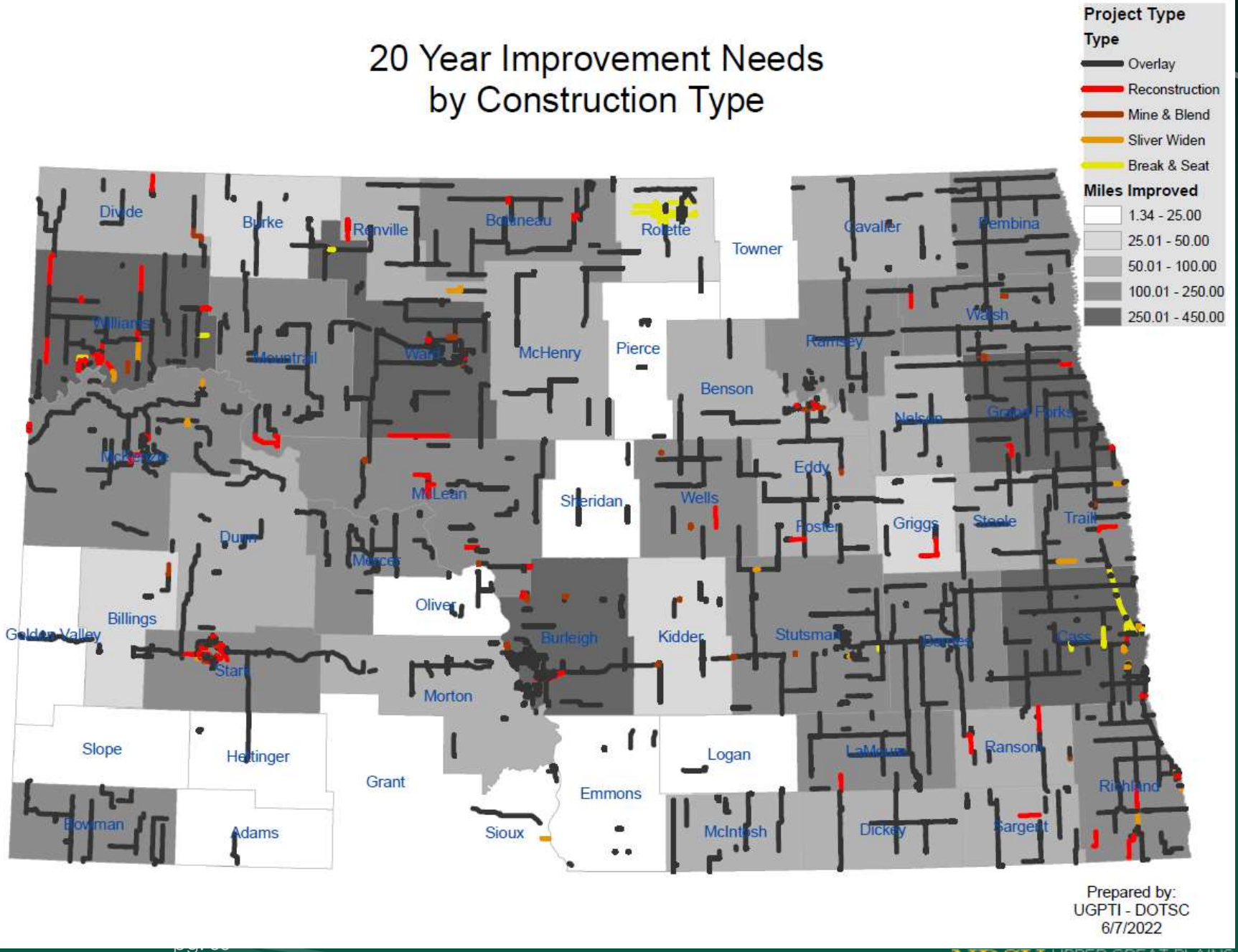
Moreover, the bid-price index only indicates the price contractors propose for new starts. On projects for which they had already submitted a bid or begun work, contractors were stuck with paying elevated materials prices that they could not pass on.

Tariffs have also driven up some prices. In November, the Commerce Department doubled the tariff on Canadian softwood lumber from 9% to 18%. The 25% tariff on steel and 10% tariff on aluminum imposed by President Trump have largely been left in place so far by President Biden. In addition, President Trump imposed tariffs on thousands of products from China but created an exclusion process that enabled some items not produced in the U.S. to be imported without the tariff. The Biden administration largely suspended the exclusions, adding to the number of items with tariff-induced price increases.

AGC

2022 CONSTRUCTION INFLATION ALERT | 4

20 Year Improvement Needs by Construction Type



Bridge Needs Data Source

- Data sources
  - Used the FHWA 2021 National Bridge Inventory System (NBIS).
    - Contained data from 2020-2021 bridge safety inspections (started with 2996 structures)
  - Extracted the existing box culverts 479*
  - Extracted 182 minimum maintenance road-based bridges
  - This study has 53 more bridges analyzed than last study plus 17 culvert bridges*.

Bridge Analysis Methodology

- Priority items:
  - Deck, Superstructure or Substructure <= 4
  - Structurally Deficient
  - On and Off system bridges on maintained roads
  - Bridge Needs Target (updated version of sufficiency rating)
  - New for this study, inclusion of Culverts with Bridge #s (structures 20' or greater, steel & concrete)

NBI is not tracking Sufficiency Rating

- Many States have been developing their own rating guidelines since 2016.
- UGPTI had its own SR calculator which was updated to include special reduction factors for scour critical, fracture critical, load posted and timber materials.
- This is now referred to as the Bridge Needs Target (BNT). New threshold is BNT<75 vs SR <80 – good correlation.

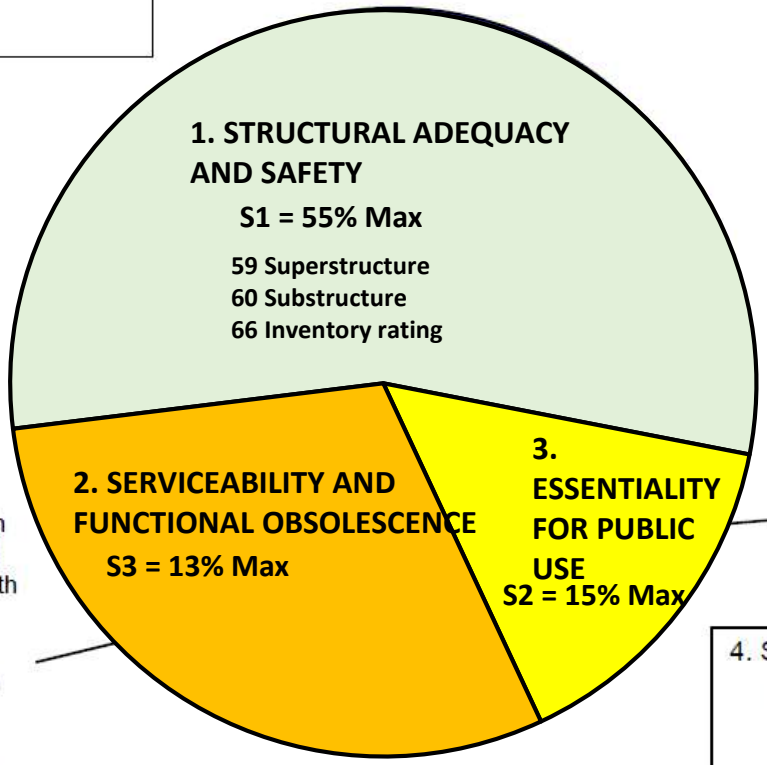
Bridge Sufficiency Rating Calculation Worksheet

SGM

Ref: 'Recording and Coding Guide for the Structural Inventory and Appraisal of the Nation's Bridges', Report No. FHWA-PD-96-001

SUFFICIENCY RATING = $S_1 + S_2 + S_3 - S_4$

Sufficiency Rating shall not be less 0% nor greater than 100%



28 Lanes on Structure
29 ADT
32 Appr. Roadway Width
43 Structure Type, Main
51 Bridge Roadway Width
53 VC over Deck
58 Deck Condition
67 Structural Evaluation
68 Deck Geometry
69 Underclearances
71 Waterway Adequacy
72 Appr. Rdwy. Aliignment
100 STRAHNET Designation

19 Detour Length
29 ADT
100 STRAHNET Designation

4. SPECIAL REDUCTIONS

S_4 = 13% Max

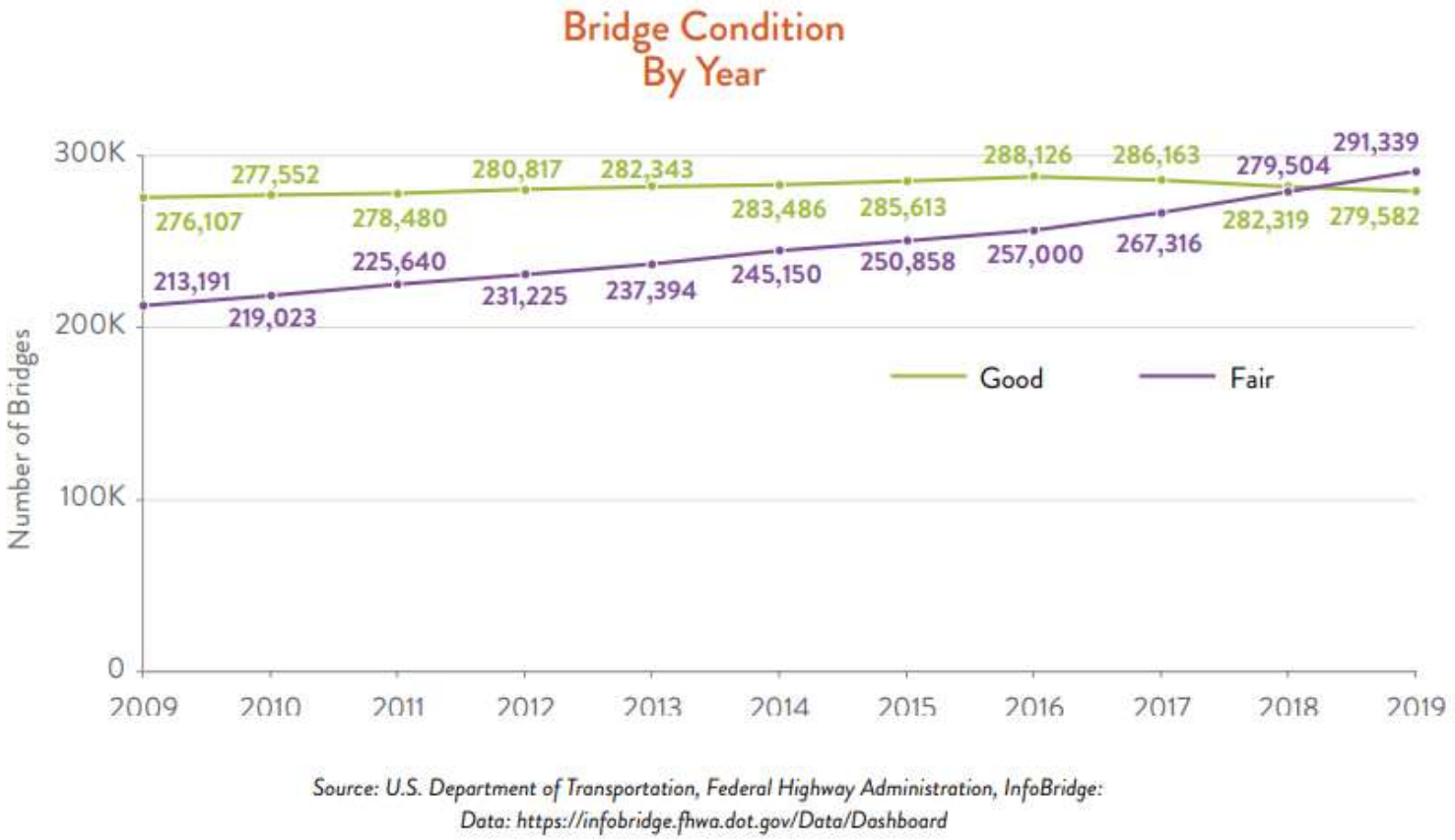
19 Detour Length
36 Traffic Safety Features
43 Structure Type, Main

Bridge Needs County Advisory Panel

2021 - 23 Local Bridge Needs Target Proposal

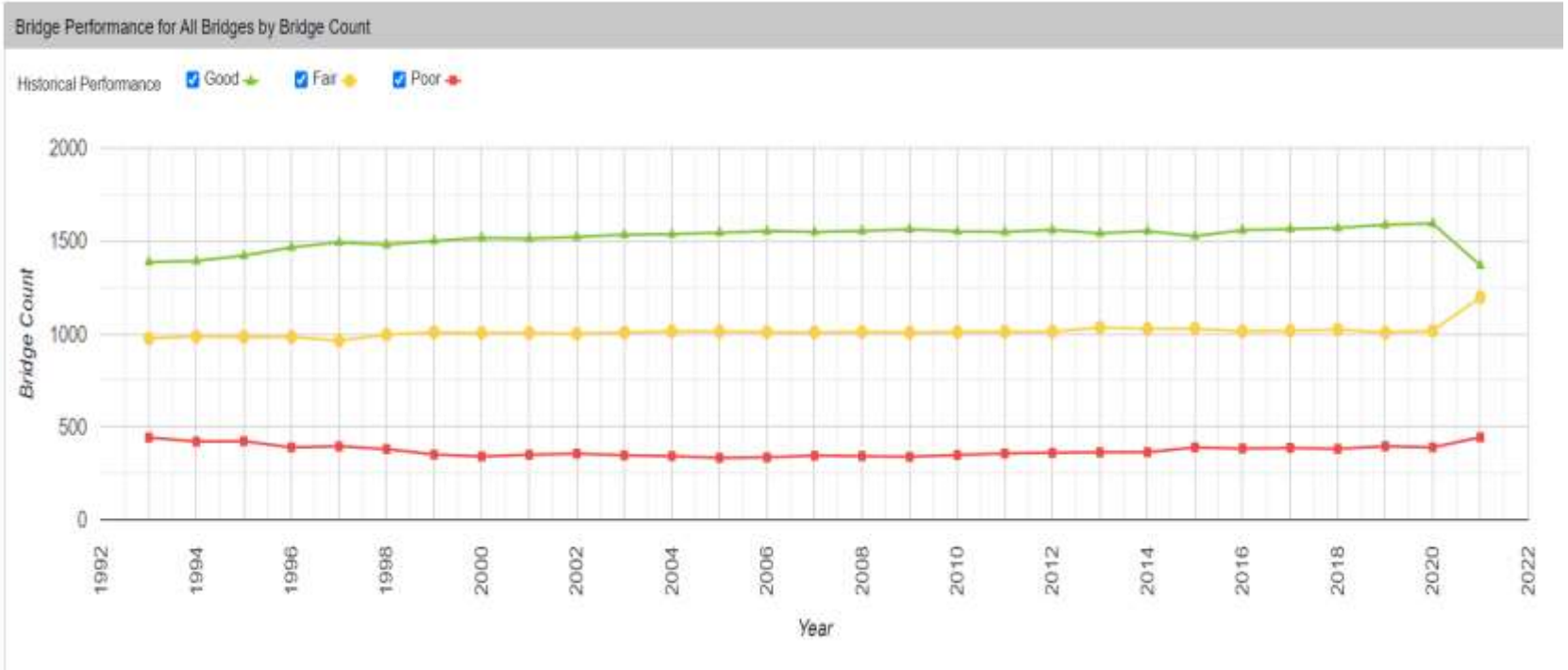
Name	County	Email	
Ritch Gimbel	Bottineau	ritch.gimbel@co.bottineau.nd.us	
Shane Biggs	Bowman	sbiggs@bowmancountynd.gov	
Jason Benson	Cass	bensonj@casscountynd.gov	
Nick West	Grand Forks	nick.west@gfcounty.org	
Josh Loegering	Lamoure	josh.loegering@co.lamoure.nd.us	
Suhail Kanwar*	McKenzie	skanwar@co.mckenzie.nd.us	*now in Houston, Tx.
John Saiki	Morton	John.saiki@mortonnd.org	
Tim Faber	Sargent	tim.faber@co.sargent.nd.us	
Al Heiser	Stark	aheiser@starkcountynd.gov	
Dana Larsen	Ward	dana.larsen@wardnd.com	

Nation wide bridge conditions



Source: U.S. Department of Transportation, Federal Highway Administration, InfoBridge: Data: https://infobridge.fhwa.dot.gov/Data/Dashboard

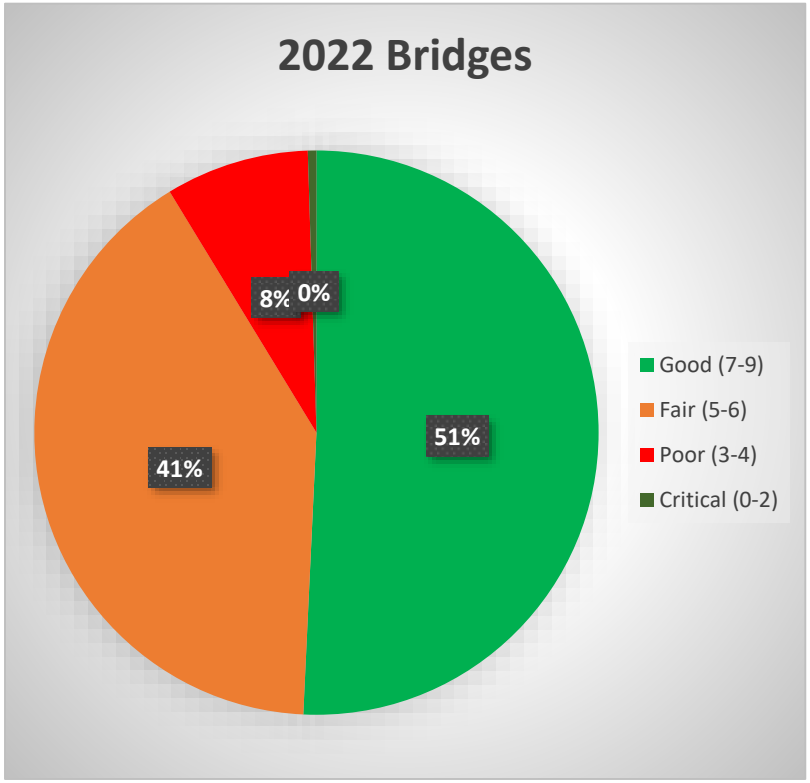
NBI ND Local Bridge Performance



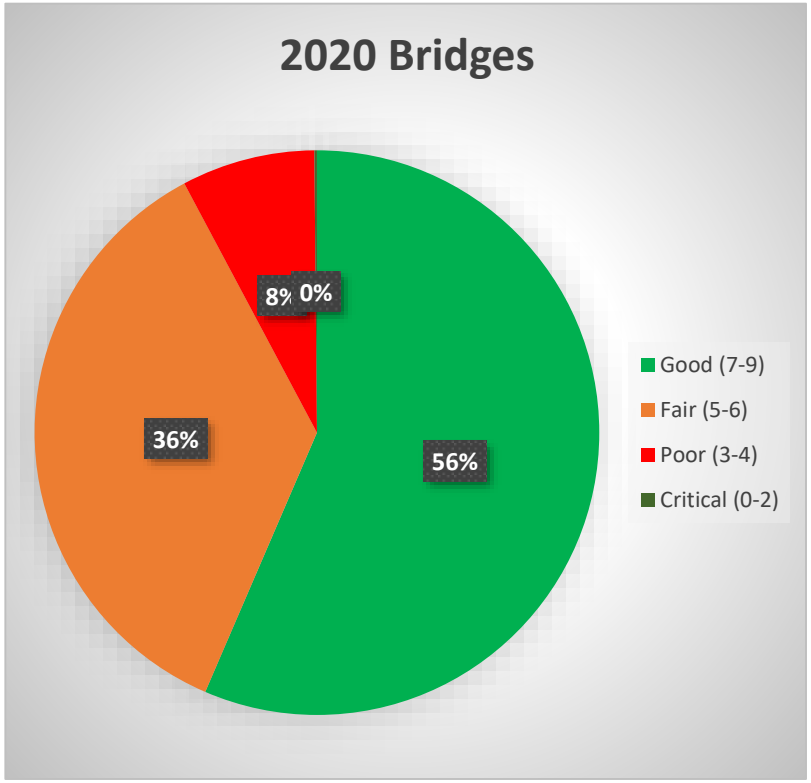
Good news is there are 110 less bridges posted for load in the 2021 NBI data Compared to the 2020 NBI data. 574 now vs. 684 then. (ND Local Bridges)

ND Local Bridge Conditions

Based on 2021 NBI data



Based on 2019 NBI data



2022 Bridge Needs Study Results

Table 44: Component Ratings [alternative format] 2022

Component Ratings	Deck		Superstructure		Substructure	
	Bridges	Percent	Bridges	Percent	Bridges	Percent
Good (7-9)	1152	56.25%	1267	54.26%	990	42.40%
Fair (5-6)	803	39.21%	910	38.97%	1011	43.30%
Poor (3-4)	87	4.25%	153	6.55%	312	13.36%
Critical (0-2)	6	0.29%	5	0.21%	22	0.94%

Table 44: Component Ratings [alternative format] 2020

Component Ratings	Deck		Superstructure		Substructure	
	Bridges	Percent	Bridges	Percent	Bridges	Percent
Good (7-9)	915	58%	1385	61%	1145	51%
Fair (5-6)	604	38%	734	33%	842	37%
Poor (3-4)	66	4%	136	6%	264	12%
Critical (0-2)	1	0%	2	0.09%	6	0.27%

Bridge Replacement Costs

- Unit cost model
  - Based on 2021-22 NDDOT county bid reports
    - Examples obtained from Local Govt. Div.
    - Includes approach roadway, preliminary and construction engineering
- Replacement cost projections:
  - Bridges: $370/sf. deck area up from $295 with maintenance cost up to $0.35 from 0.30/sf
  - Culverts: $450,000 per single barrel box and $800,000 per multiple barrel box. Length ratio increased from 1.7 to 1.8 (width = 32').

Culverts >20’ with Bridge #s

- A total of 17 culvert bridges are included in the total bridge needs using this criteria.

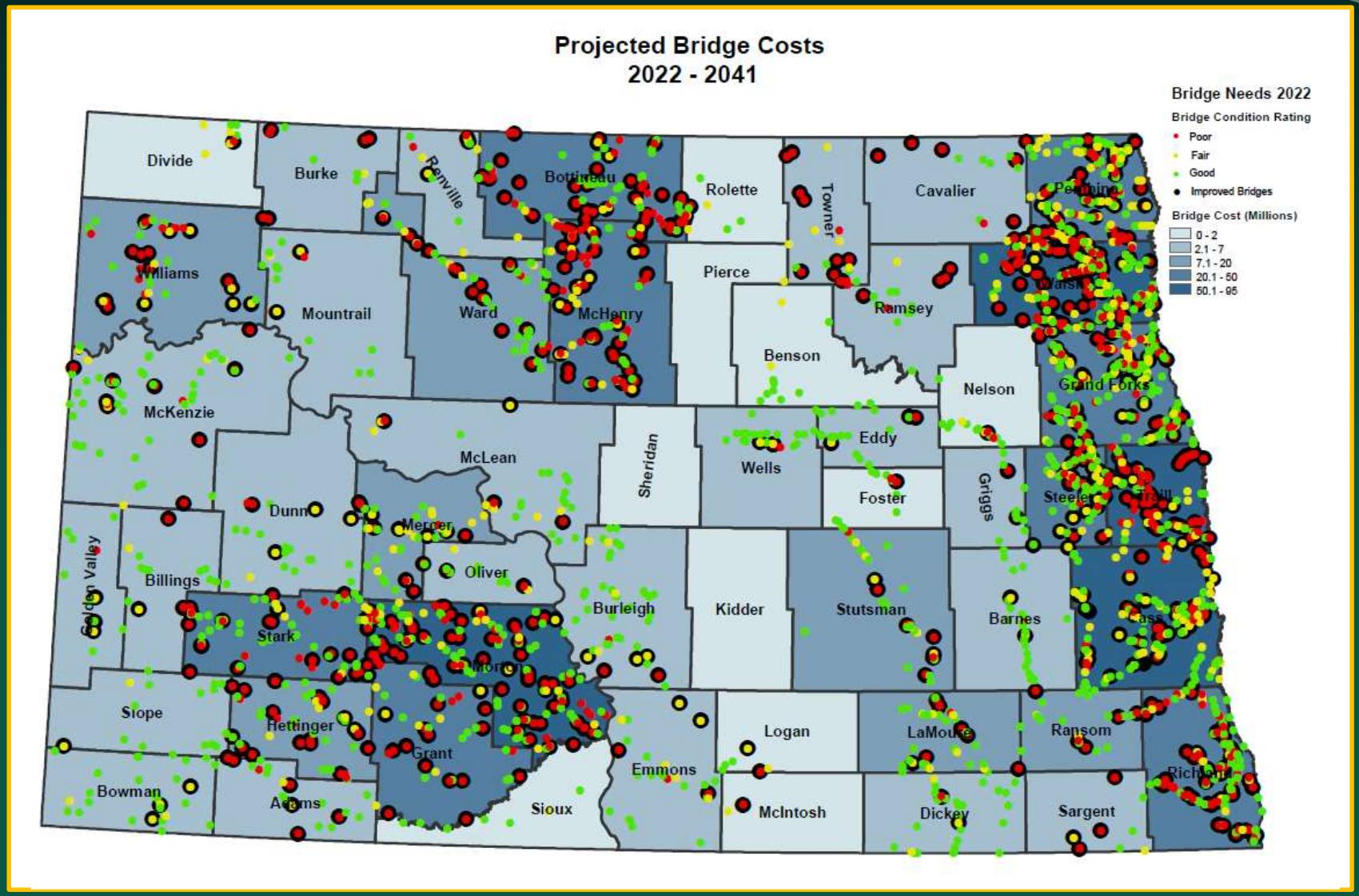
- Culvert bridges built from steel with a condition code of 5 or less and those built from concrete with a condition code of 4 or less are included.
- One culvert made of timber and it is in fair condition.

Total Bridges with Replacement Needs

- **2022 =** 698 bridges
- 2020 = 625 bridges
- 2016 = 703 bridges
- 2014 = 733 bridges

Bridge Maintenance Costs

- Preventive maintenance:
  - $0.30/sf./year – deck washing, deck and crack sealing and joint maintenance (off system bridges, deck sealing)
  - $0.35/sf./year (on system bridges to allow for deck washing, sealing, ice control costs)
- Rehabilitation:
  - This has been removed as local governments are mostly replacing bridges that are in poor condition. Maint. needs provides an offset.


Projected Bridge Costs
2022 - 2041
Bridge Needs 2022
Bridge Condition Rating
Poor
Fair
Good
Improved Bridges
Bridge Cost (Millions)
0 - 2
2.1 - 7
7.1 - 20
20.1 - 50
50.1 - 95
Divide
Burke
Renville
Bottineau
Rolette
Towner
Cavalier
Pembina
Williams
Mountrail
Ward
McHenry
Pierce
Ramsey
Walsh
Benson
Nelson
Grand Forks
McKenzie
McLean
Sheridan
Wells
Eddy
Foster
Griggs
Steele
Dunn
Mercer
Oliver
Billings
Golden Valley
Burleigh
Kidder
Stutsman
Barnes
Cass
Stark
Morton
Slope
Hettinger
Grant
Logan
LaMoure
Ransom
Richland
Bowman
Adams
Sioux
Emmons
McIntosh
Dickey
Sargent

Needs Estimates for County, Township and Tribal Roads and Bridges

Results of Unpaved Analysis

Period	Statewide ($M)
2022-23	$ 656.16
2024-25	$ 647.09
2026-27	$ 661.48
2028-29	$ 661.10
2030-31	$ 647.69
2032-41	$ 3,233.08
2022-41	$ 6,506.61

Results of Paved Analysis

Period	Statewide ($M)
2022-23	$ 588.24
2024-25	$ 498.16
2026-27	$ 383.81
2028-29	$ 317.72
2030-31	$ 290.24
2032-41	$ 1,213.53
2022-41	$ 3,291.69

Results of Bridge Analysis

Period	Statewide ($M)
2022-23	$139.42
2024-25	$139.42
2026-27	$139.42
2028-29	$139.42
2030-31	$139.42
2032-41	$18.45
2022-41	$715.57

Statewide Needs Results

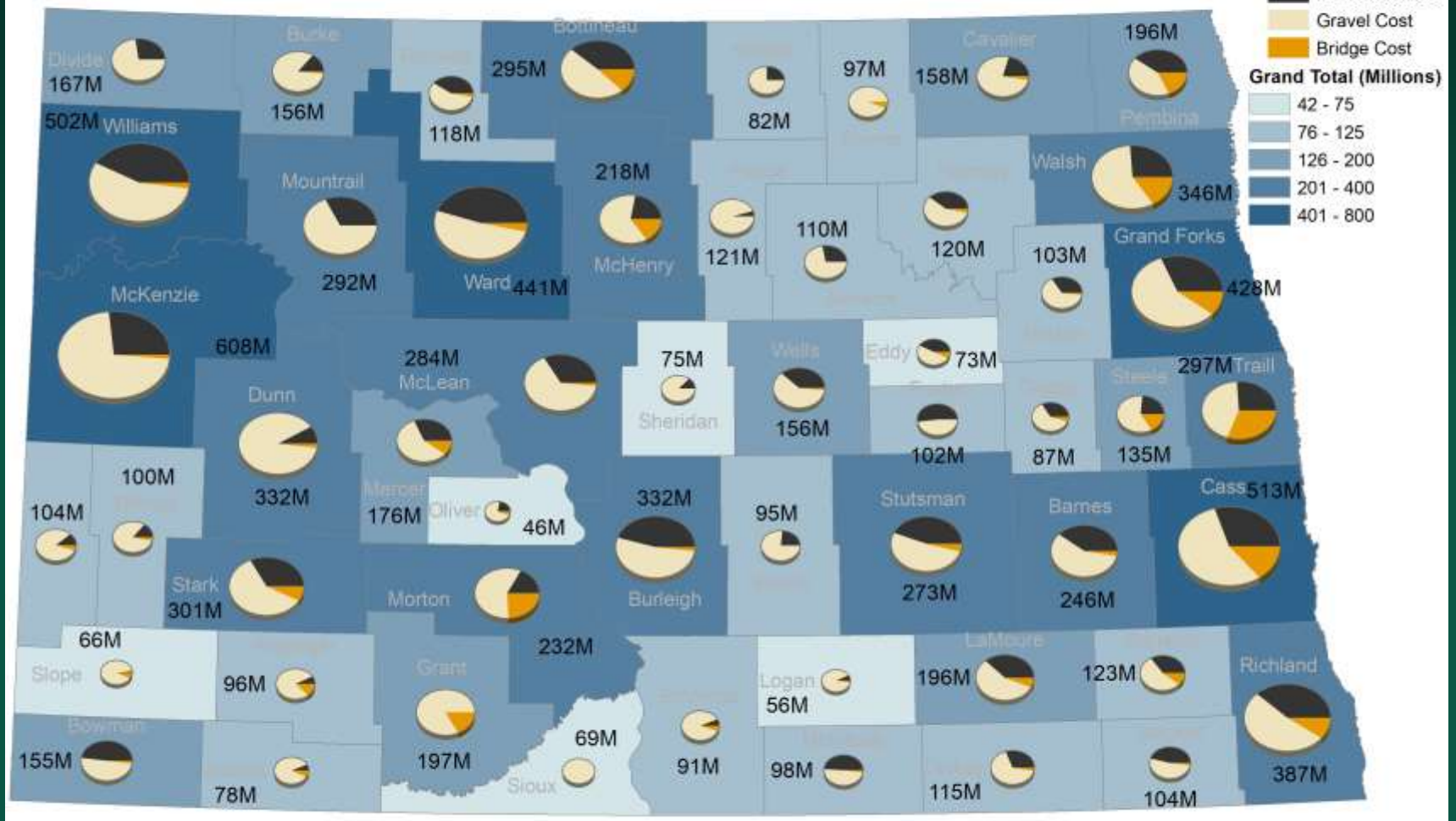
Period	Unpaved ($M)	Paved ($M)	Bridges ($M)	Total ($M)
2022-2023	$ 656.16	$ 588.24	$139.42	$1,383.82
2024-2025	$ 647.09	$ 498.16	$139.42	$1,284.67
2026-2027	$ 661.48	$ 383.81	$139.42	$1,184.71
2028-2029	$ 661.10	$ 317.72	$139.42	$1,118.24
2030-2031	$ 647.69	$ 290.27	$139.42	$1,077.35
2032-2041	$ 3,233.08	$ 1,213.53	$18.45	$4,465.06
2022-2041	$ 6,506.61	$ 3,291.69	$715.57	$10,513.87

Comparison to Previous Study

Category	2020-2039 ($M)	2022-2041 ($M)	% Change
Unpaved	$6,056.34	$6,506.61	7.43%
Paved	$2,668.49	$3,291.69	23.35%
Bridges	$498.81	$715.57	43.46%
Total	$9,223.64	$10,513.87	13.98%

Projected Total Costs

Pavement, Gravel, and Bridge Needs
2022 - 2041



Prepared by:
UGPTI - DOTSC
7/2/2022

Report Timeline

- July 25 – Draft report will be posted on the UGPTI webpage and comment period begins
  - Email submittal preferred to ndsu.roadneeds@ndsu.edu.

  https://www.ugpti.org/downloads/road_needs/
- August 25 – comment period ends
- September 1 – report update complete, communicate to Legislature

Draft Document on Webpage

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Assessment of ND County and Local Road Needs

2021-2023 Legislative Study

Related Links

- Study Overview
- Study Updates
- Geographic Roadway Inventory Tool (GRIT)

This effort responds to the North Dakota Legislature's request for a study of the transportation infrastructure of all county, township, and tribal roads and bridges in the state. UGPTI is currently developing and analyzing traffic, bridge, pavement and unpaved road data in order to forecast investment needs for the next 20 years. Infrastructure needs will be estimated using the most current crop and oil production forecasts, traffic estimates, and roadway condition data. Agricultural and oil related traffic is modeled in detail at sub-county level. Oil related traffic will be predicted for individual spacing units, whereas agricultural production is estimated at the township level.

- **View the Draft Report** *(PDF, 4193K)*
- View the Supplemental Information

For questions on the report, contact ndsu.roadneeds@ndsu.edu.

Final Reports from Past Legislative Studies

- 2019-2021 — Study of County and Local Roadway Needs
- 2015-2017 — Study of County and Local Roadway Needs
- 2013-2015 — Study of County and Local Roadway Needs
- 2011-2013 — Study of County and Local Roadway Needs

Questions or Comments?

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