

Building a Database to Predict the Future

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Why????

- Becker County MN Engineer
- 2008 - County Board Requests
- Brad's rambling story....

...Critical step for effective
Transportation Asset Management

TAM Summary



Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
 - Developed by UGPTI for ND Needs Study
 - Recent upgrade to GRIT 2.0
 - Developed support agreement non-ND Counties

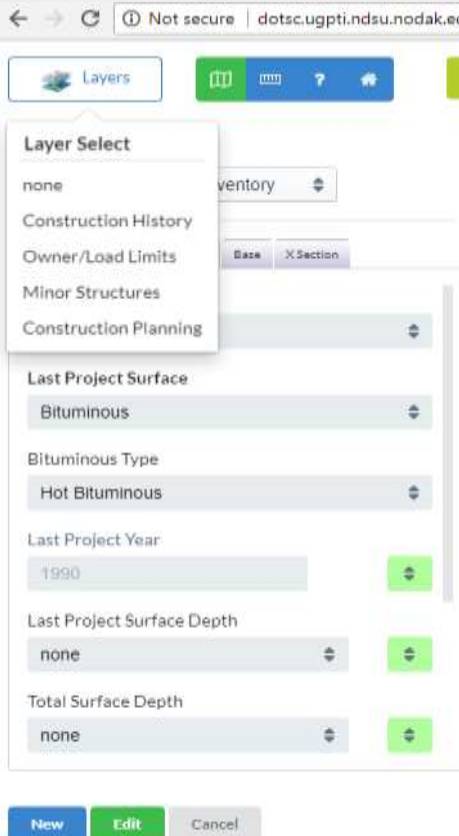
The screenshot displays the GRIT web application interface. The main map area shows an aerial view of a road network with colored overlays representing surface age. A legend titled "Surface Age" indicates the following categories:

- 25 or more Years (Red)
- 20 - 24 Years (Orange)
- 15 - 19 Years (Yellow)
- 1 - 14 Years (Green)
- This Year (Grey)

On the left side, there is a "Layer Select" panel with various options such as "Construction History", "Owner/Load Limits", and "Last Project Surface". Below this panel are "New", "Edit", and "Cancel" buttons. On the right side, there is a "Layer List" panel showing a list of layers, including "NEEDS STUDY RESULTS 2014" and "GRIT CONSTRUCTION HISTORY". The browser address bar at the top shows the URL: dotsc.ugpti.ndsu.nodak.edu/grit-app-test/maing.

Inventory

- Geographic Roadway Inventory Tool (GRIT)
 - Currently 4 Layers of Data

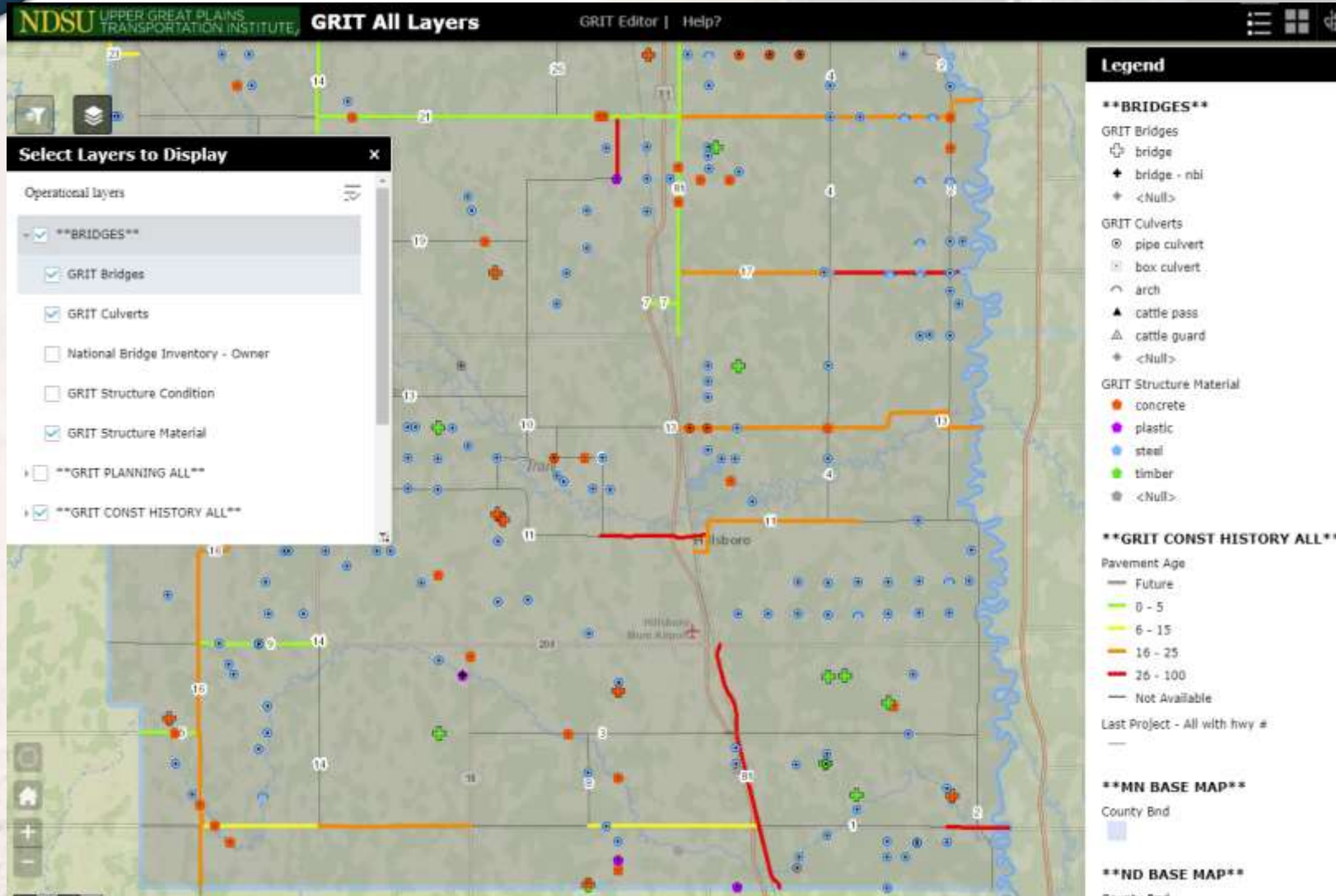


Construction History	Construction Planning	Bridges	Load Restrictions	Maintenance
Location	Location	Location	Location	Const History
Highway	Highway	Highway	Highway	Segments
Surface Type	Project Type	Type	Owner	Bituminous
Proj Type	Project #	Material	Func. Class	Seal Coat
LP Year	Planned Year	Span	Maintenance	Crack Seal
LP Depth	Status	Cell Diameter	Road Type	Patching
Total Depth	Bid Open Date	Cell Width	Seas. Load Limit	Striping
Base Type	Cost	Cell Height	Seas. Gross Lmt	Year
Base Depth	Start Date	Length	Yr Rnd Limit	Cost
Base Year	Public Impact	Year Installed	Yr Rnd Gross	Gravel
Base Treatment	Restrictions	Cover Depth		Blading
SubGrd Strength	Detour	Replace Cost		Regravel
Treatment	Comments	Condition		Reshape
Lane Width	Funding Srce	Rating Date		Spot Repair
Shoulder Width	Funding Splits	GVW Limit		Dust Control
Grade Year	Fund Commit	Axle Limit		Frequency
Striping				Cost
Rumble Strips				Concrete
Curbs				Cracks
Inslope				CPR
ROW				Cost
Owner				



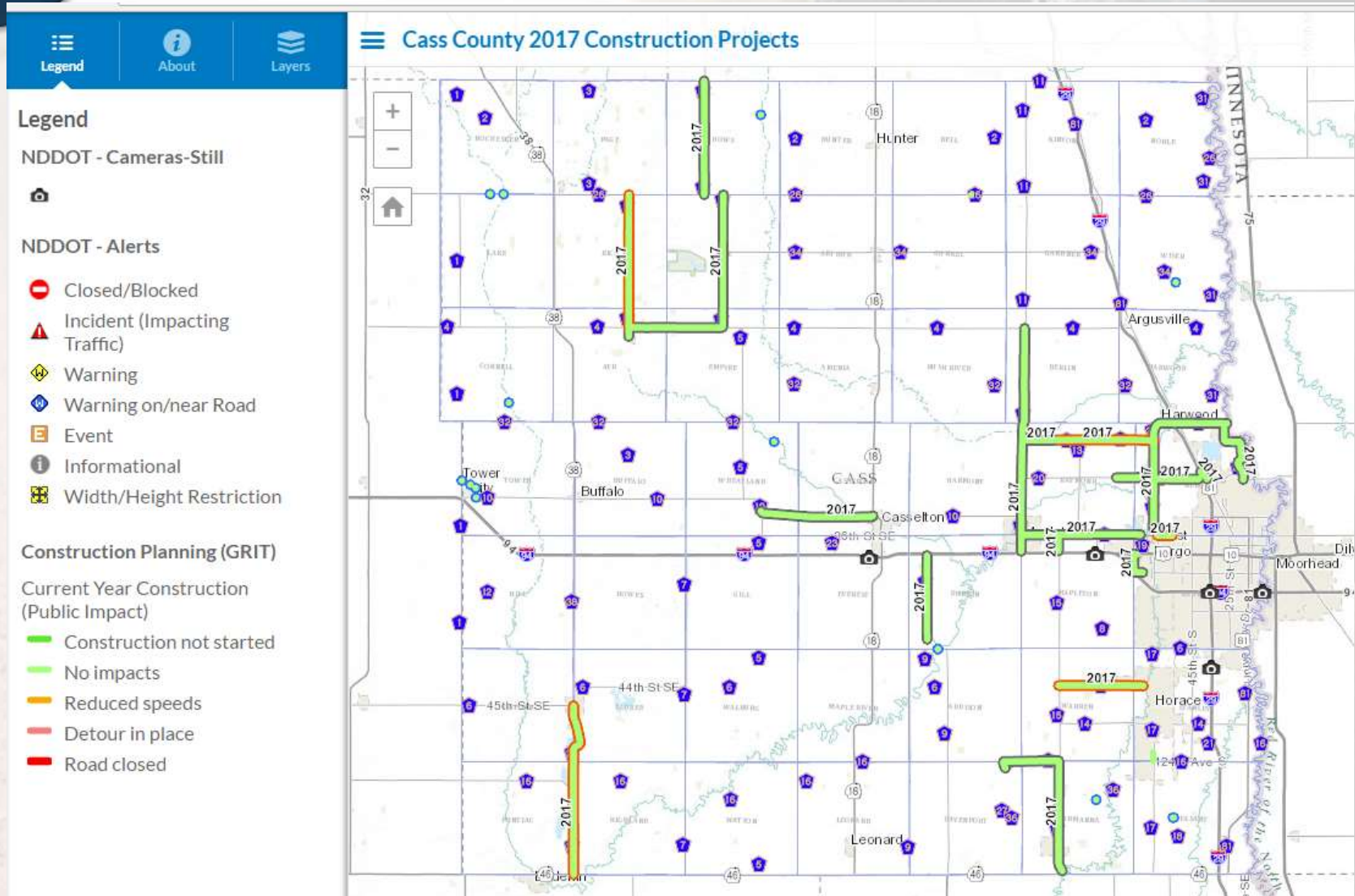
Inventory

- **Geographic Roadway Inventory Tool (GRIT)**
 - Web Map viewers for all data items
 - GIS format for combining data



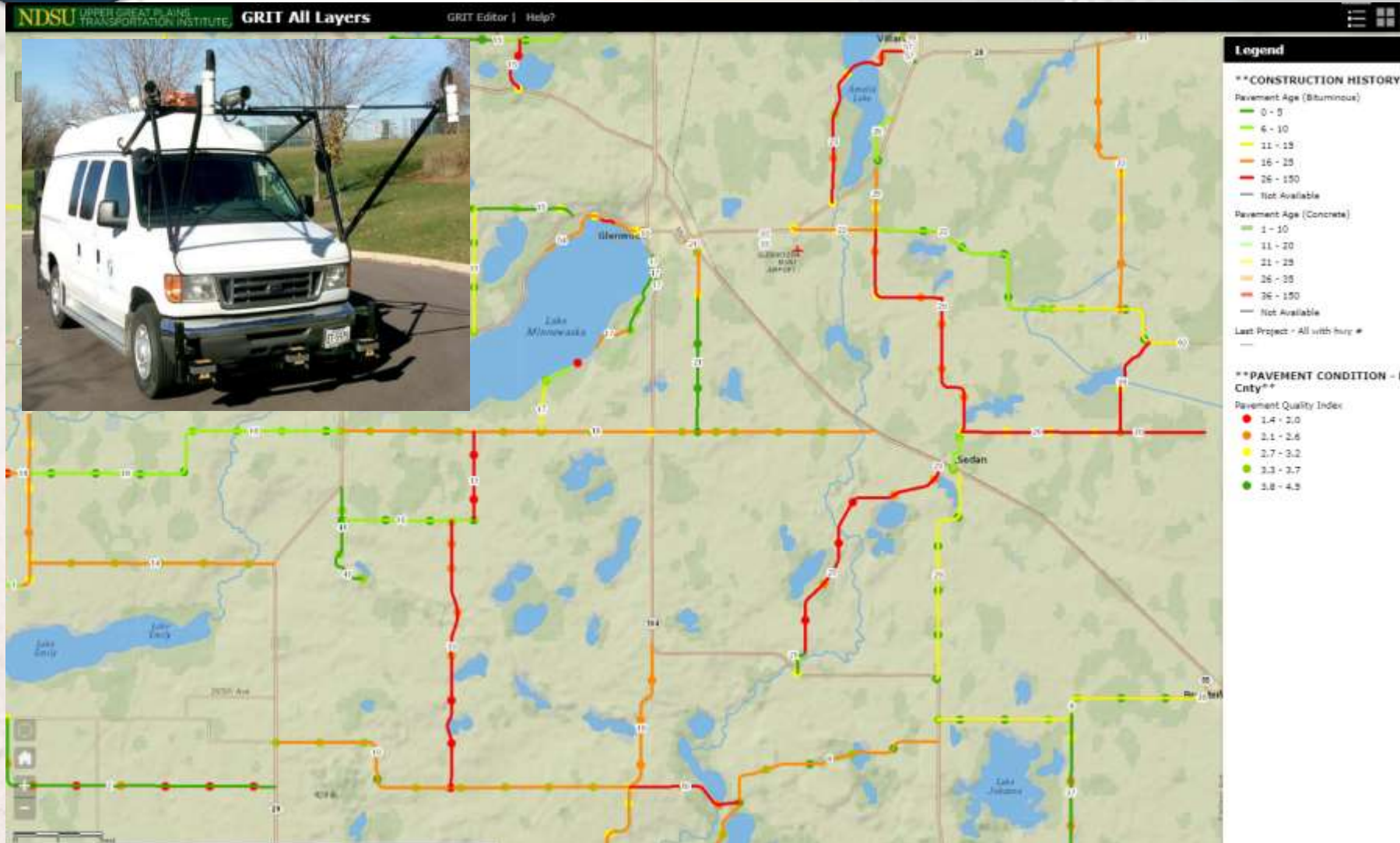
Inventory

- Geographic Roadway Inventory Tool (GRIT)
 - GIS Web Services for all Data



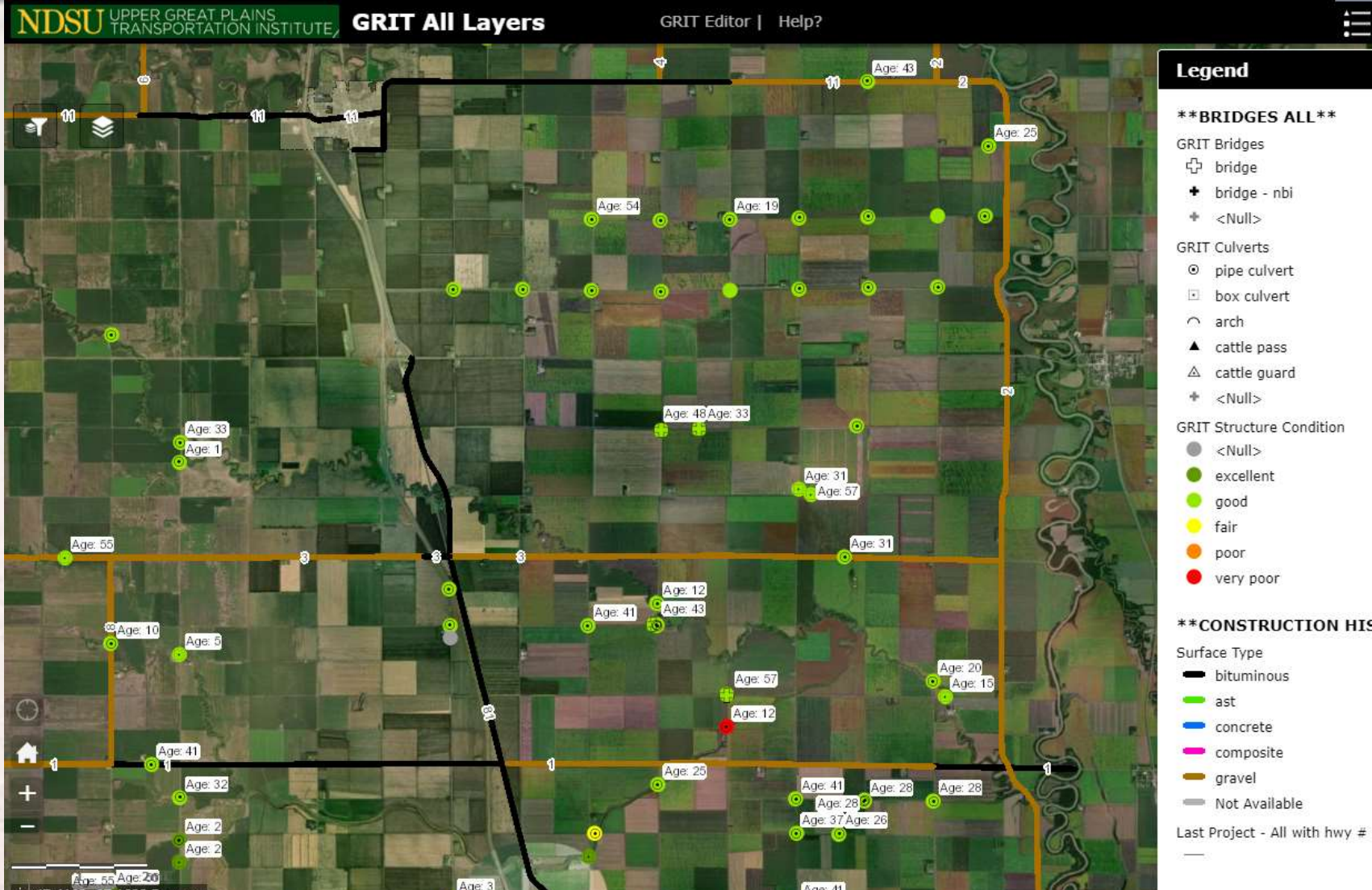
Performance Assessment

- Geographic Roadway Inventory Tool (GRIT)
 - Pavement Condition Rating



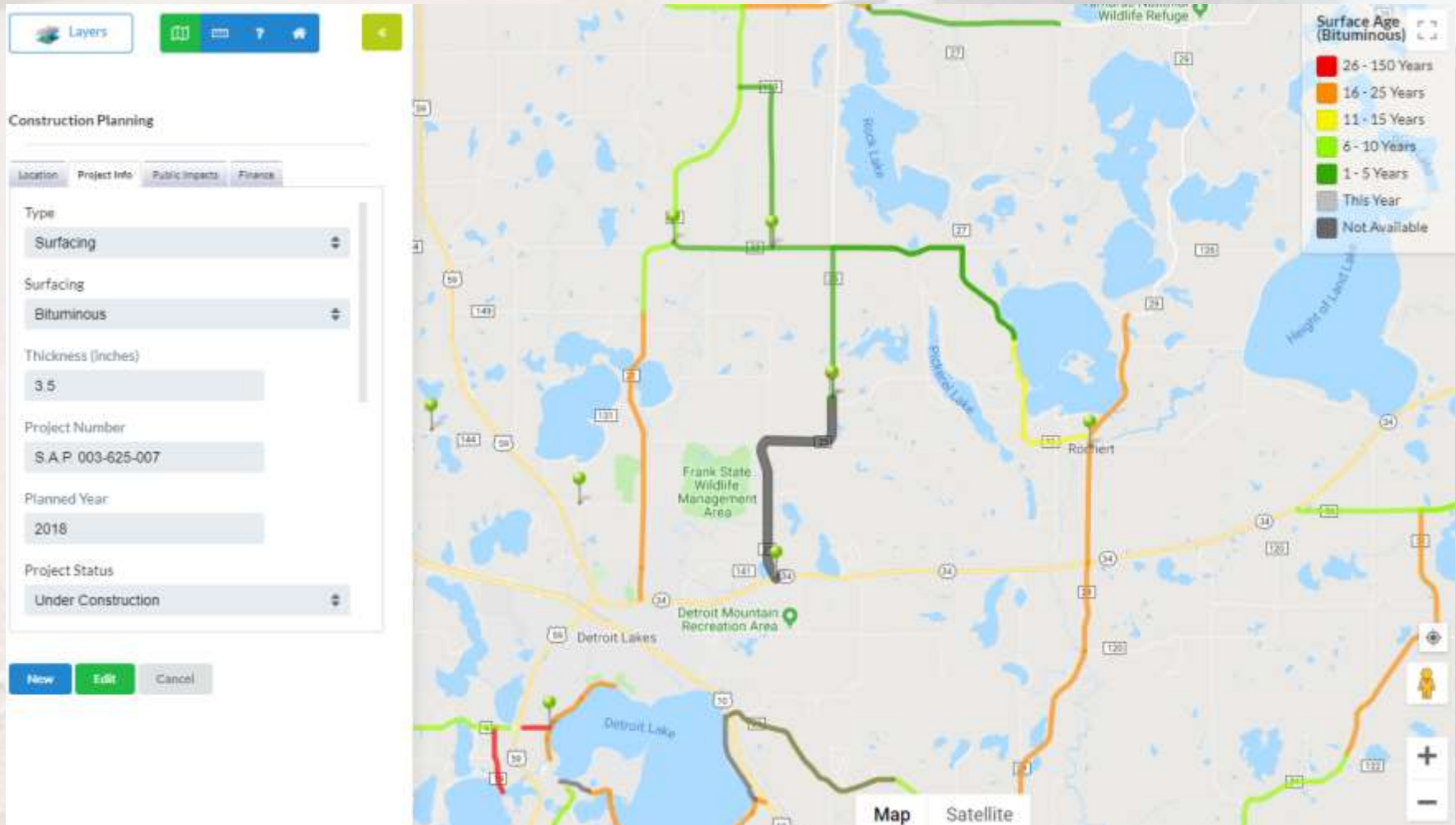
Performance Assessment

- Geographic Roadway Inventory Tool (GRIT)
 - Bridge Condition Rating



Short Term Plans

- **Geographic Roadway Inventory Tool (GRIT)**
 - Construction Planning Layer (5 Yr Plan)
 - Created by using current measures (condition or age)



Short Term Plans

- Geographic Roadway Inventory Tool (GRIT)
 - In Viewers Overlay 5 yr plan on performance data
 - Performance data ONLY from last year



- **Geographic Roadway Inventory Tool (GRIT)**
 - MN LRRB Performance Prediction Project
 - Spring 2019 Completion

Goals

- Develop seamless data integration processes with MnDOT pavement condition and traffic data with GRIT inventory data.
- Develop a pavement condition forecasting module within GRIT based on the AASHTO 93 model.
- Provide on-line GIS web maps and services to prioritize roadway construction schedules and multi-year plans.

Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
 - Adding a Performance Section to the Construction History Layer

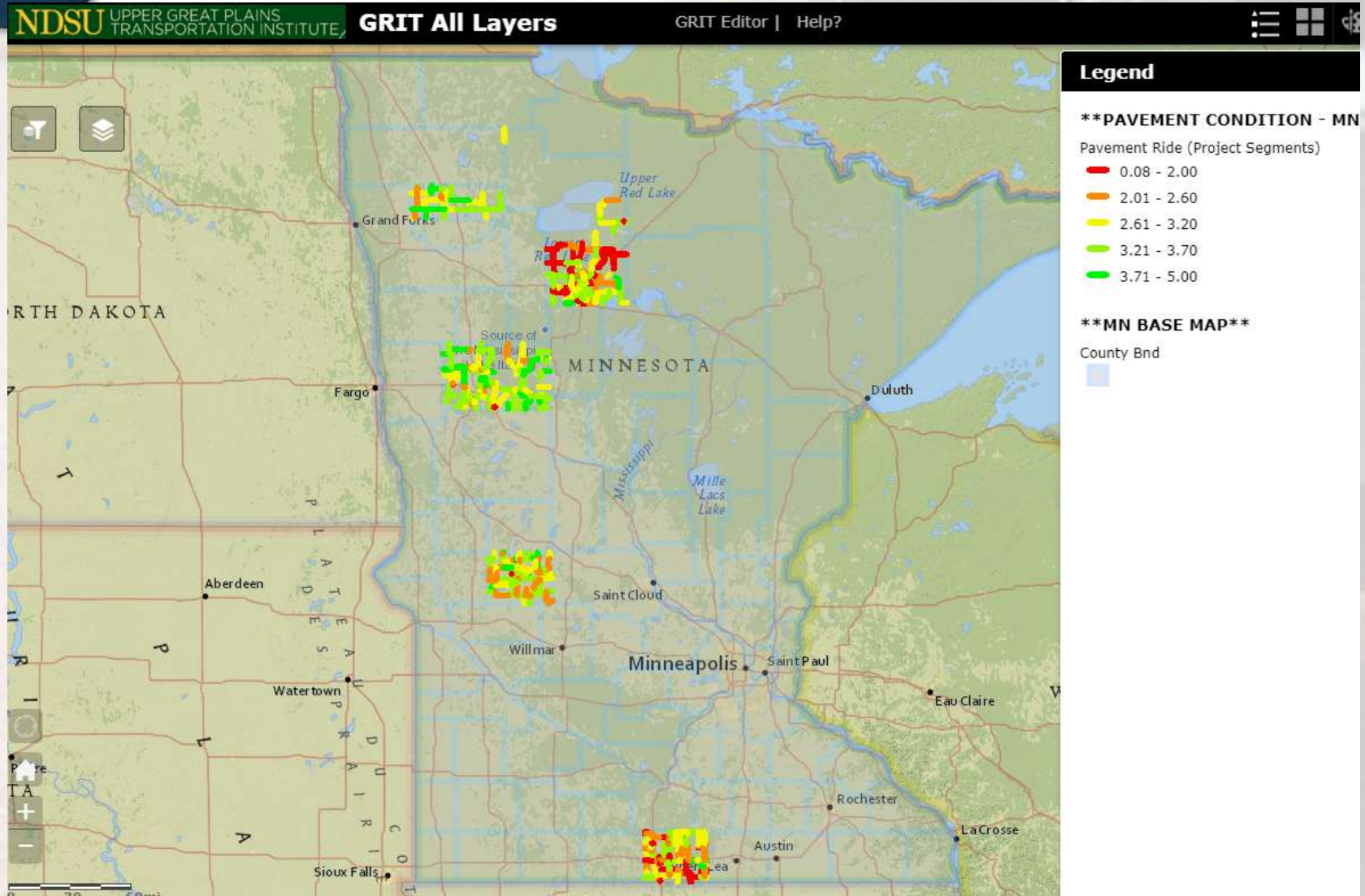
The screenshot displays the 'Performance' configuration section of the GRIT software. At the top, there are two dropdown menus: 'Construction History' and 'Performance'. Below these are four main columns: 'Condition', 'Strength', 'Traffic', and 'Future'. Each column contains a list of data fields. The 'Condition' column includes PSR Ride, PSR Condition, PSR Comb, IRI, PCI, Rut, and Date (collected). The 'Strength' column includes SN, GE, Soil Factor, and R-Value. The 'Traffic' column includes AADT, Truck AADT, ESALs, Year, AADT - 20 Year, Truck AADT - 20 Year, ESALs - 20 Year, Year - 20 Year, and Project Factor. The 'Future' column includes a 'Year (20 from current)' dropdown, Planned Project Year, another Planned Project Year, PSR Comb, and Age. Brackets on the right side of the 'Future' column indicate that the two 'Planned Project Year' fields are calculated from a spatial join, while the 'PSR Comb' and 'Age' fields are calculated from all data using the AASHTO equation. Each of the four main columns has an 'Add Manually' button at the bottom. At the bottom left, there are two star icons: a yellow one labeled 'Calculated' and a green one labeled 'Entered by User'. The 'Soil Factor' and 'R-Value' fields in the 'Strength' column, and the 'Add Manually' button in the 'Traffic' column, are highlighted in green.

Condition	Strength	Traffic	Future
PSR Ride	SN	AADT	Year (20 from current)
PSR Condition	GE	Truck AADT	Planned Project Year
PSR Comb	Soil Factor	ESALs	Planned Project Year
IRI	R-Value	Year	PSR Comb
PCI		AADT - 20 Year	Age
Rut		Truck AADT - 20 Year	
Date (collected)		ESALs - 20 Year	
		Year - 20 Year	
		Project Factor	

Calculated (Yellow Star) Entered by User (Green Star)

Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
 - 1st Task - combining performance data with Inventory
 - This is pavement condition data averaged on project history



Condition Forecasting

- **Geographic Roadway Inventory Tool (GRIT)**
 - With all inventory, planning, and Performance data geospatially combined model calculates what condition and age will be over the next 25 years.

$$\log(W_{18}) = Z_R \times S_o + 9.36 \log(SN + 1) - 0.20 + \frac{\log\left(\frac{\Delta PSI}{4.2-1.5}\right)}{0.40 + \frac{1094}{(SN+1)^{5.19}}} + 2.32 \log(M_R) - 8.07$$

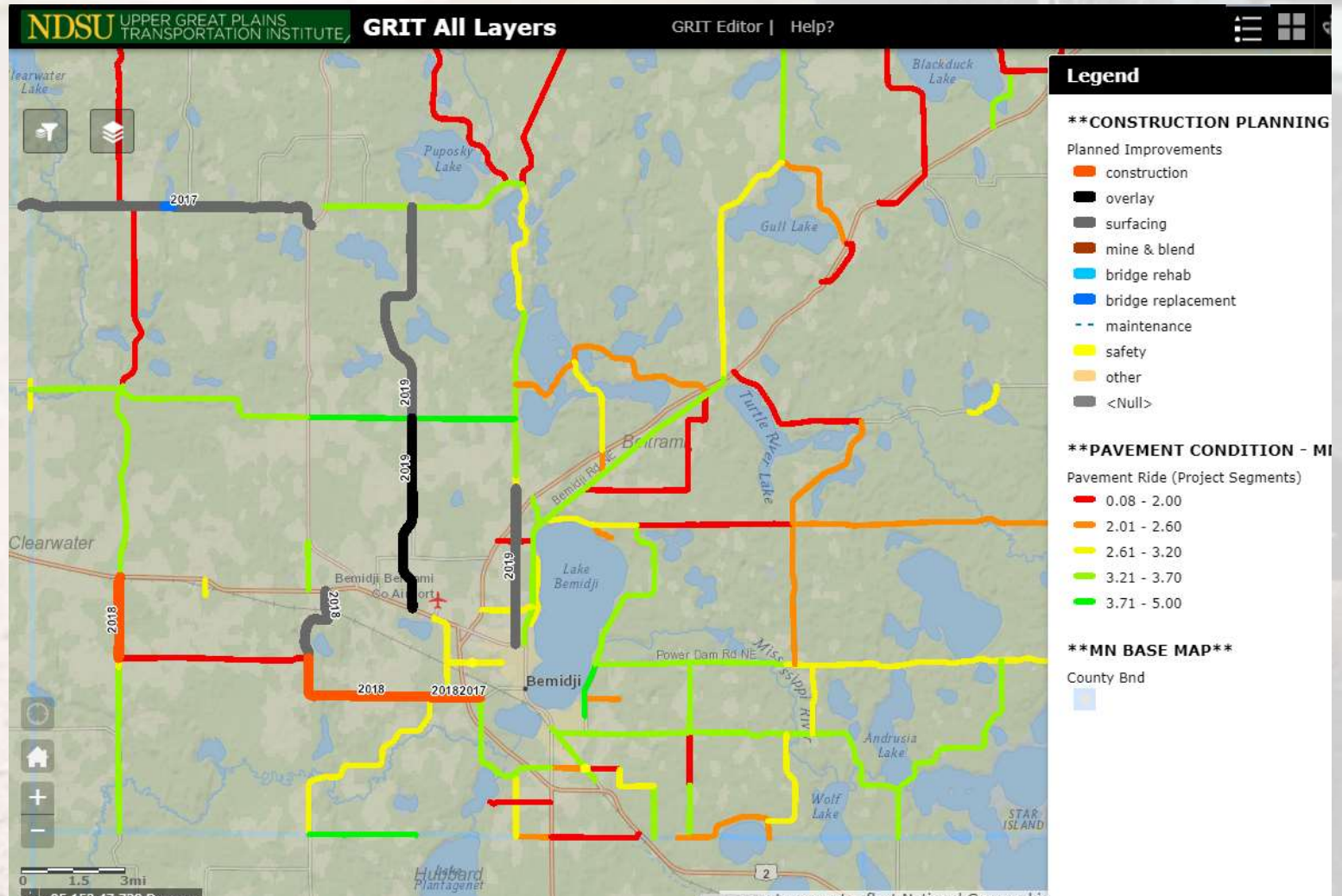
where:

- W_{18} = predicted number of 18-kip equivalent single axle load applications
- Z_R = standard normal deviate
- S_o = combined standard error of the traffic prediction and performance prediction
- ΔPSI = difference between the initial design serviceability index, p_o , and the design terminal serviceability index, p_t
- M_R = resilient modulus (psi)
- a_i = i^{th} layer coefficient
- D_i = i^{th} layer thickness (in.)

Condition Forecasting

Geographic Roadway Inventory Tool (GRIT)

- Developing future year plans
- BUT this time the condition and age will be for that future year

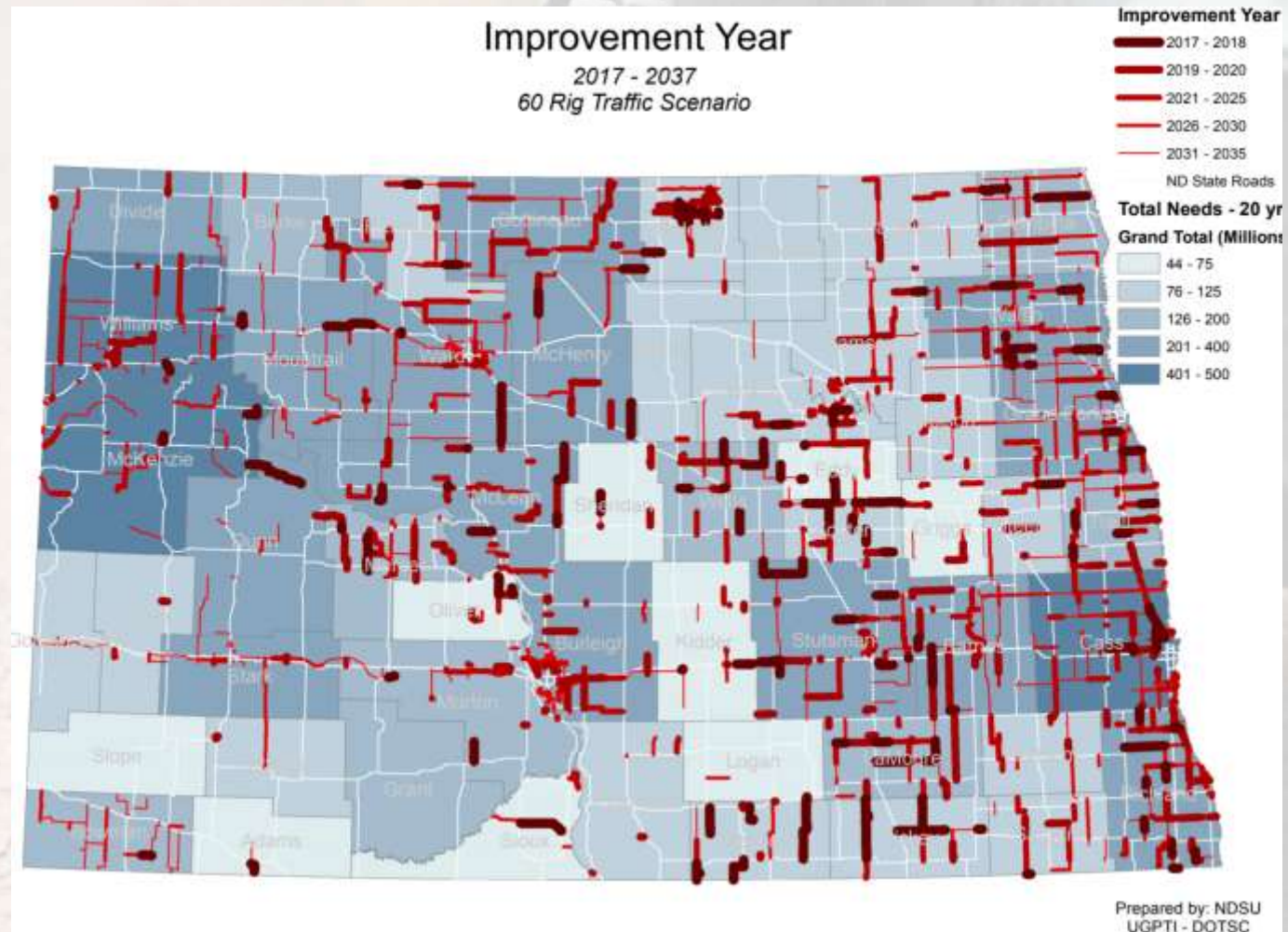


• The Final Steps of TAM

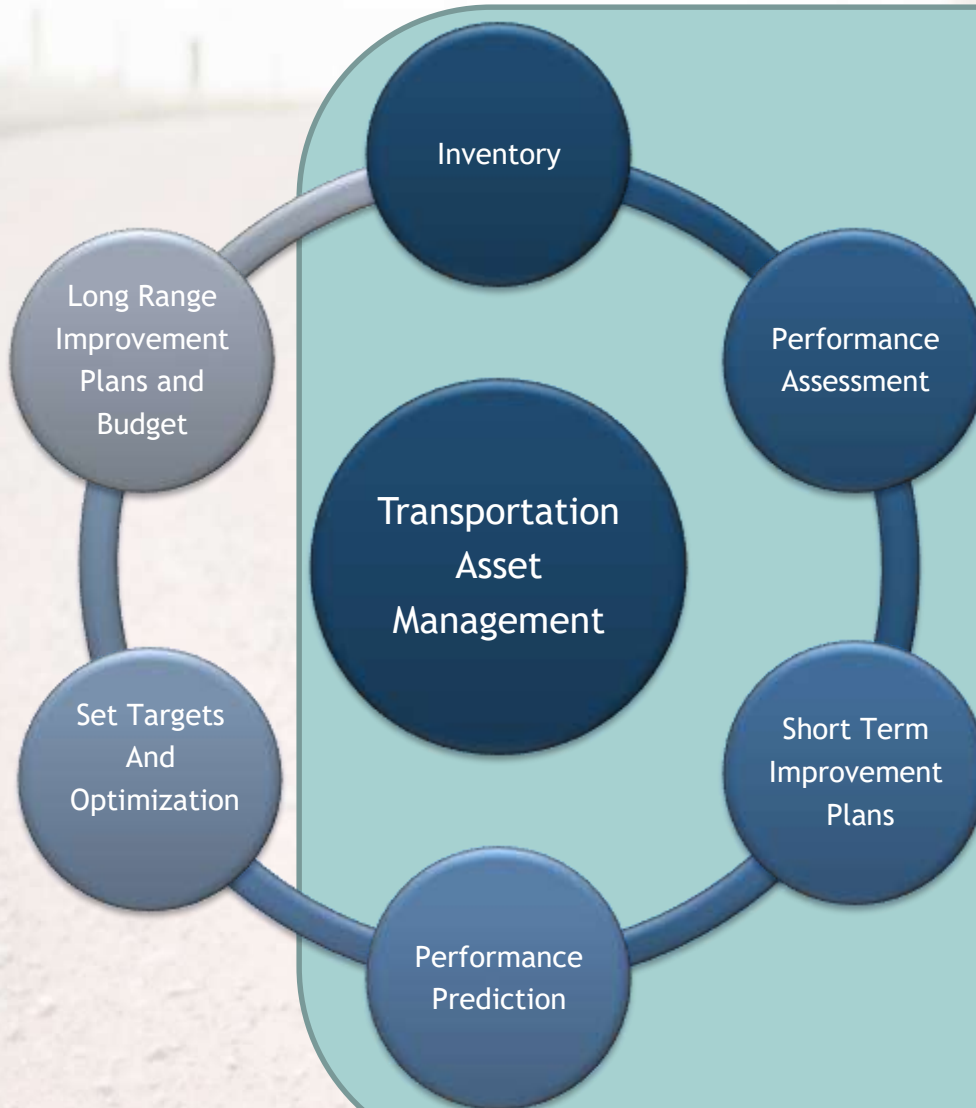
- Setting Targets and Optimization Models
- Output 20 year Needs and Improvements
- Engineers and Managers generally prefer to use the data and develop their own long range plans

Set Targets
And
Optimization

Long Range
Improvement
Plans and
Budget



Building a Database to Predict the Future



This is the Database we need to build!

More Information/Resources

- See the UGPTI Website at
 - <https://www.ugpti.org/>
 - Resources/Asset Inventory
- Email Contacts
 - Bradley.wentz@ndsu.edu
 - Andrew.Wrucke@ndsu.edu

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