Gravel Roads -

The Economic Backbone of the State

ASHE - Central Dakota Section

Dale C. Heglund, PE/PLS, NDLTAP Director – May 10, 2016

Gravel Roads - Key Points

- [x] Looking Back
- [x] Roadway Problem #1
- [x] Expectation Shift
- [x] What is Gravel?
- [x] Technology Transfer
- [x] Helen Keller

Looking Back……

1796 – Patent Laws
1803 – Louisiana Purchase

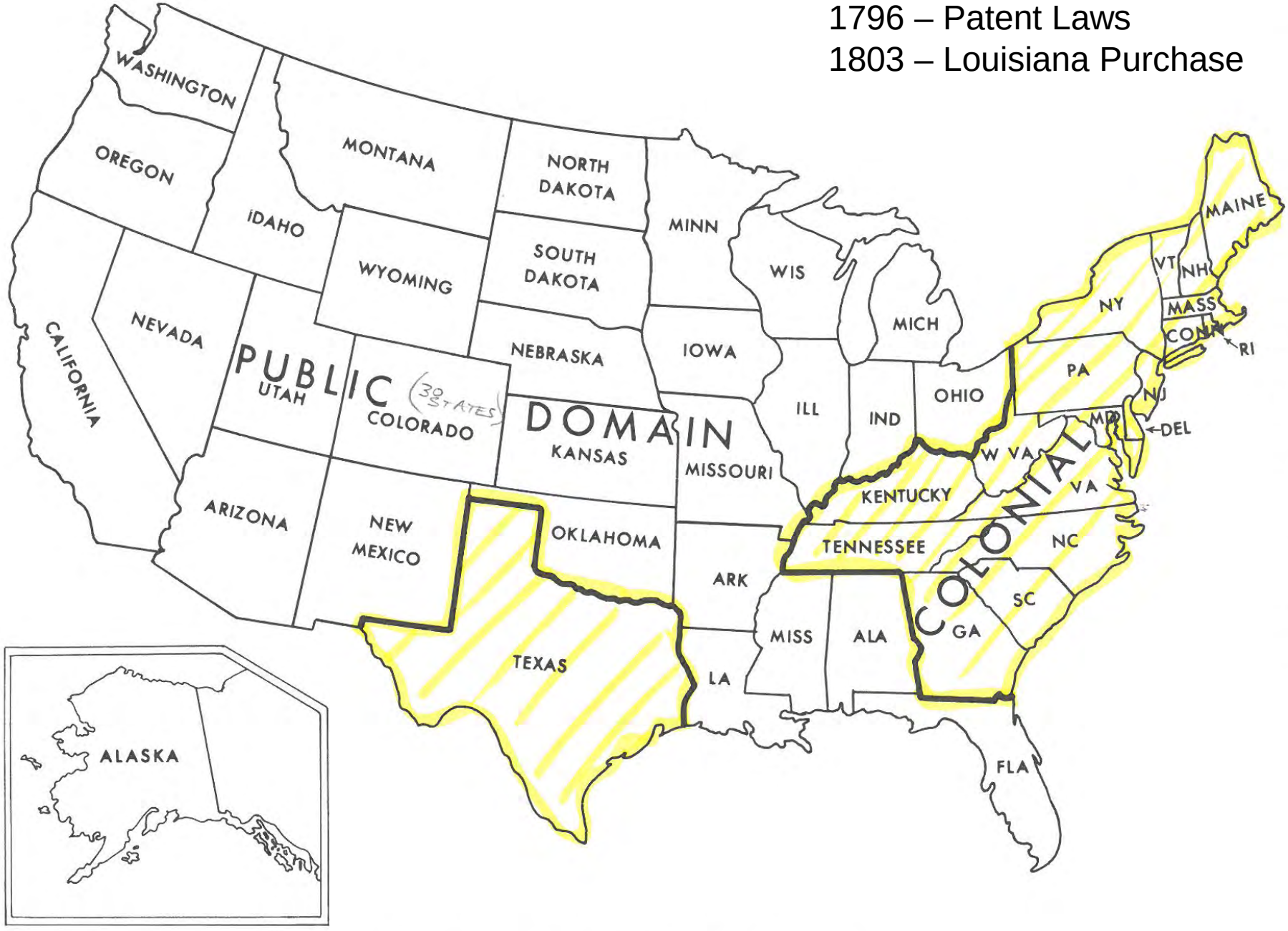
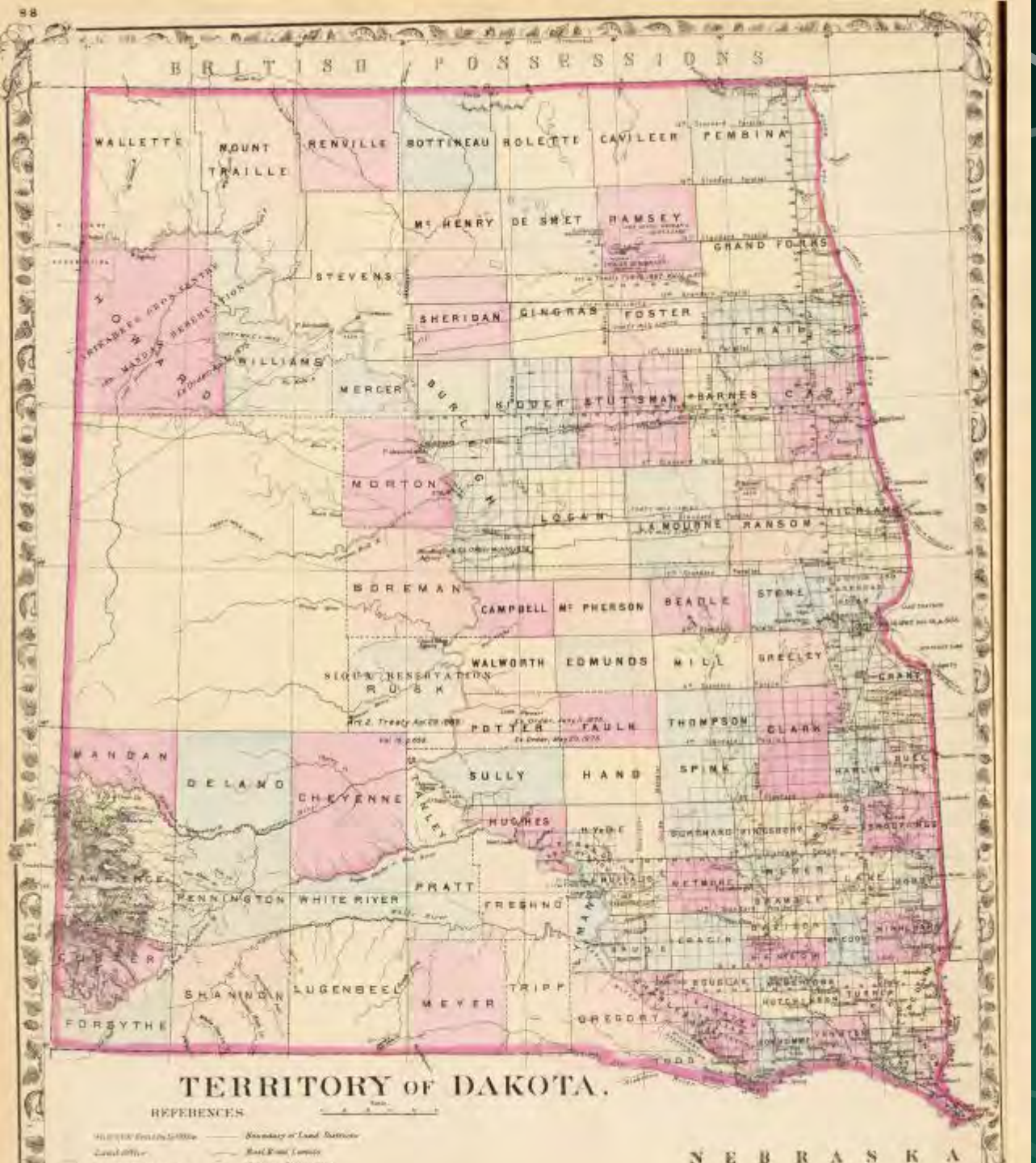
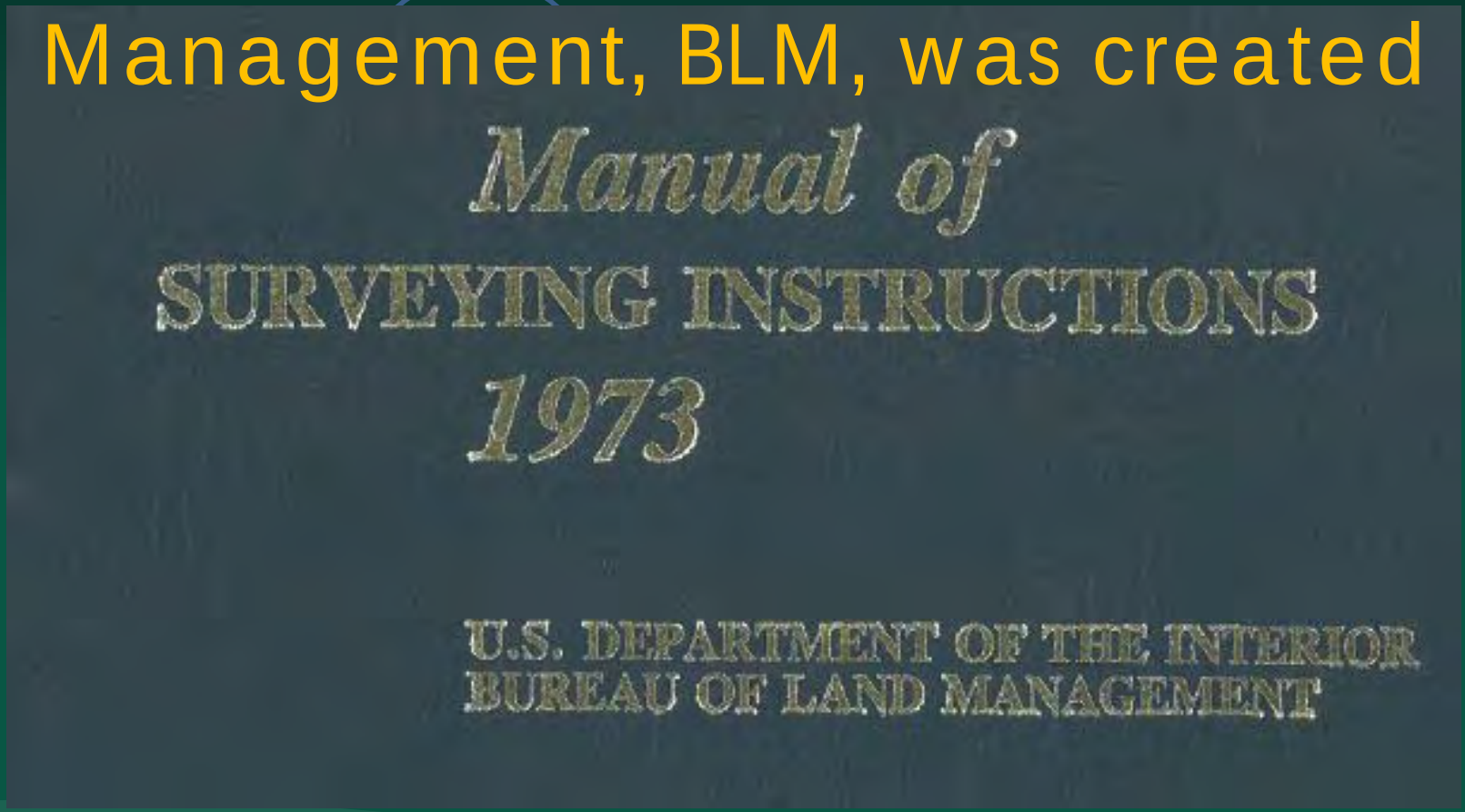


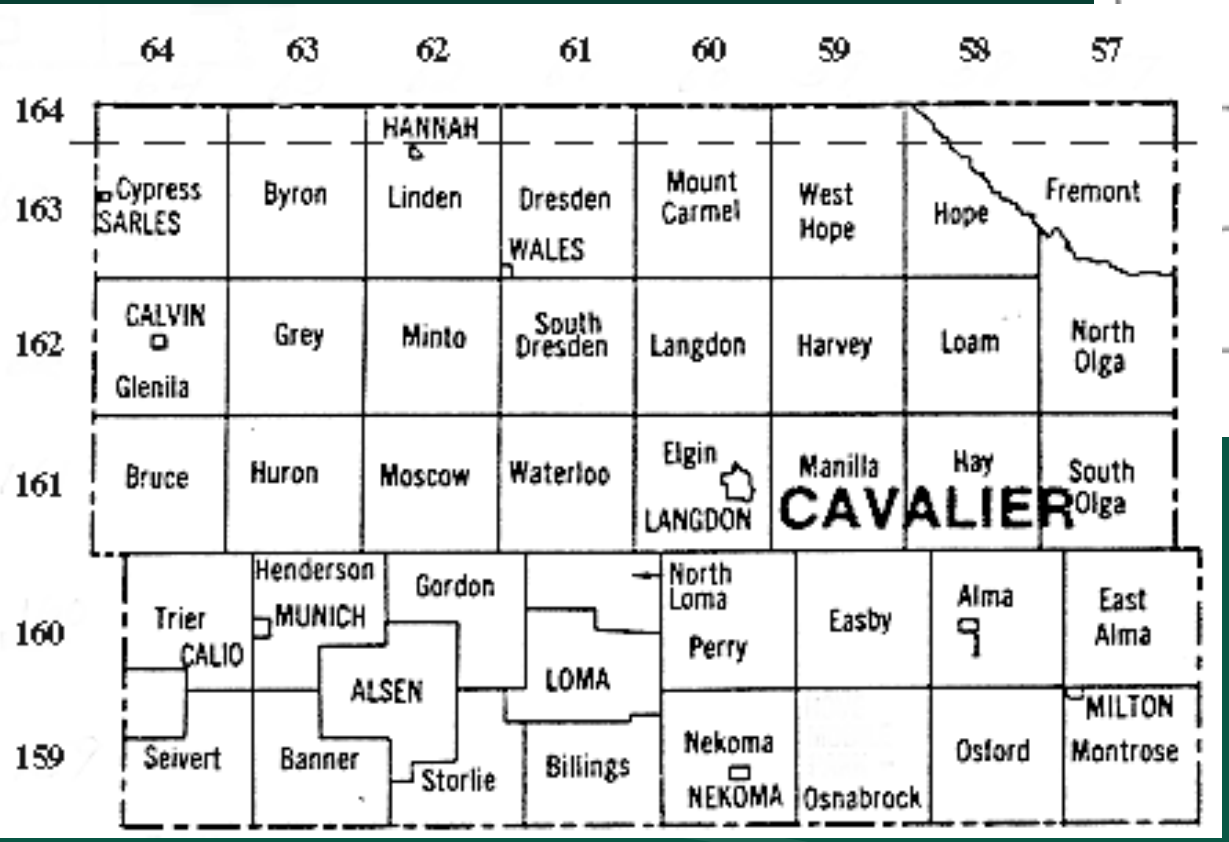
FIGURE 1.—The States created out of the Public Domain.



1889 North Dakota Statehood

1946 – General Land Office, GLO, was abolished and the Bureau of Land Management, BLM, was created





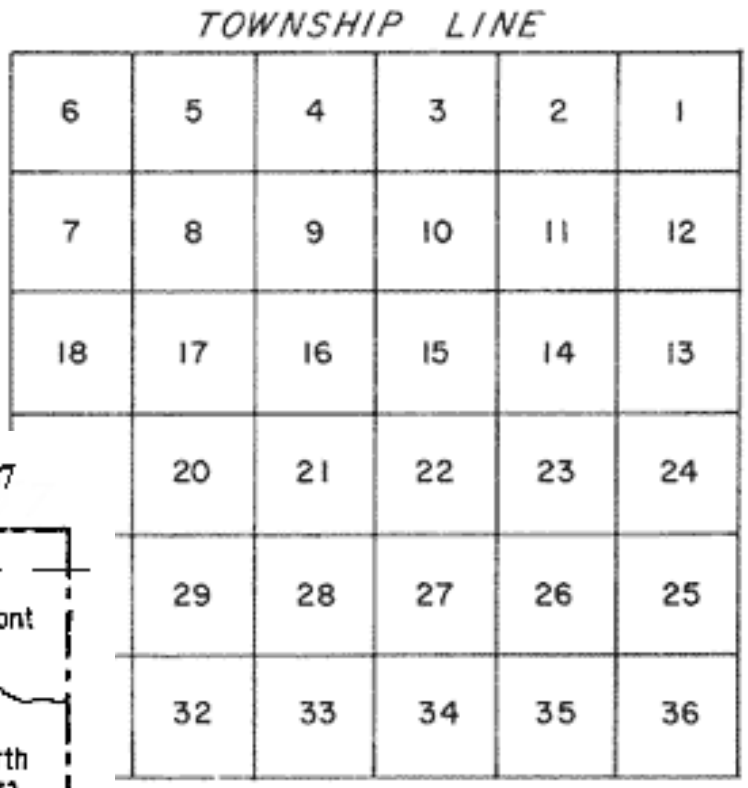
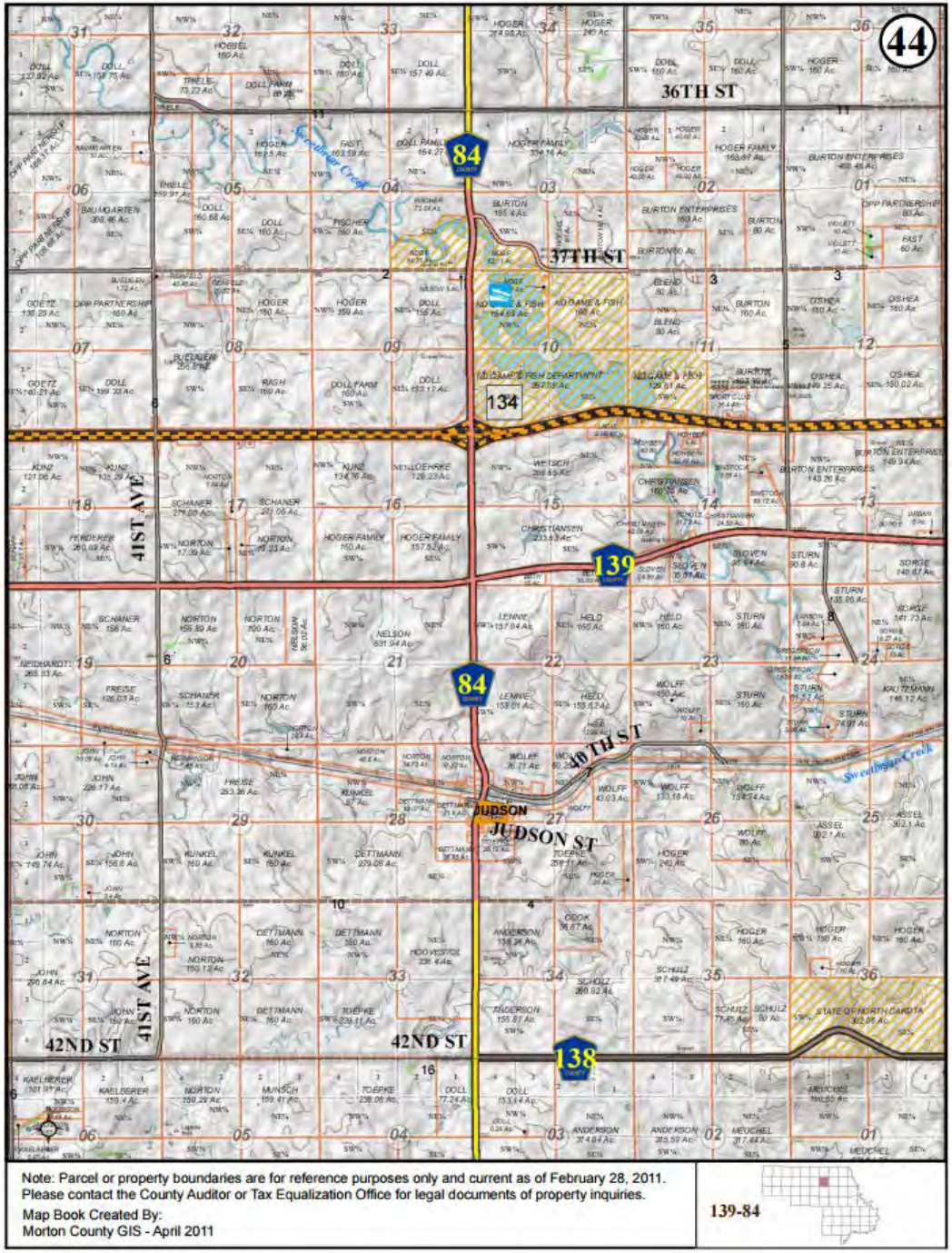


FIGURE 2.—A regular township.



NDSU UPPER GREAT PLAINS TRANSPORTATION INSTITUTE

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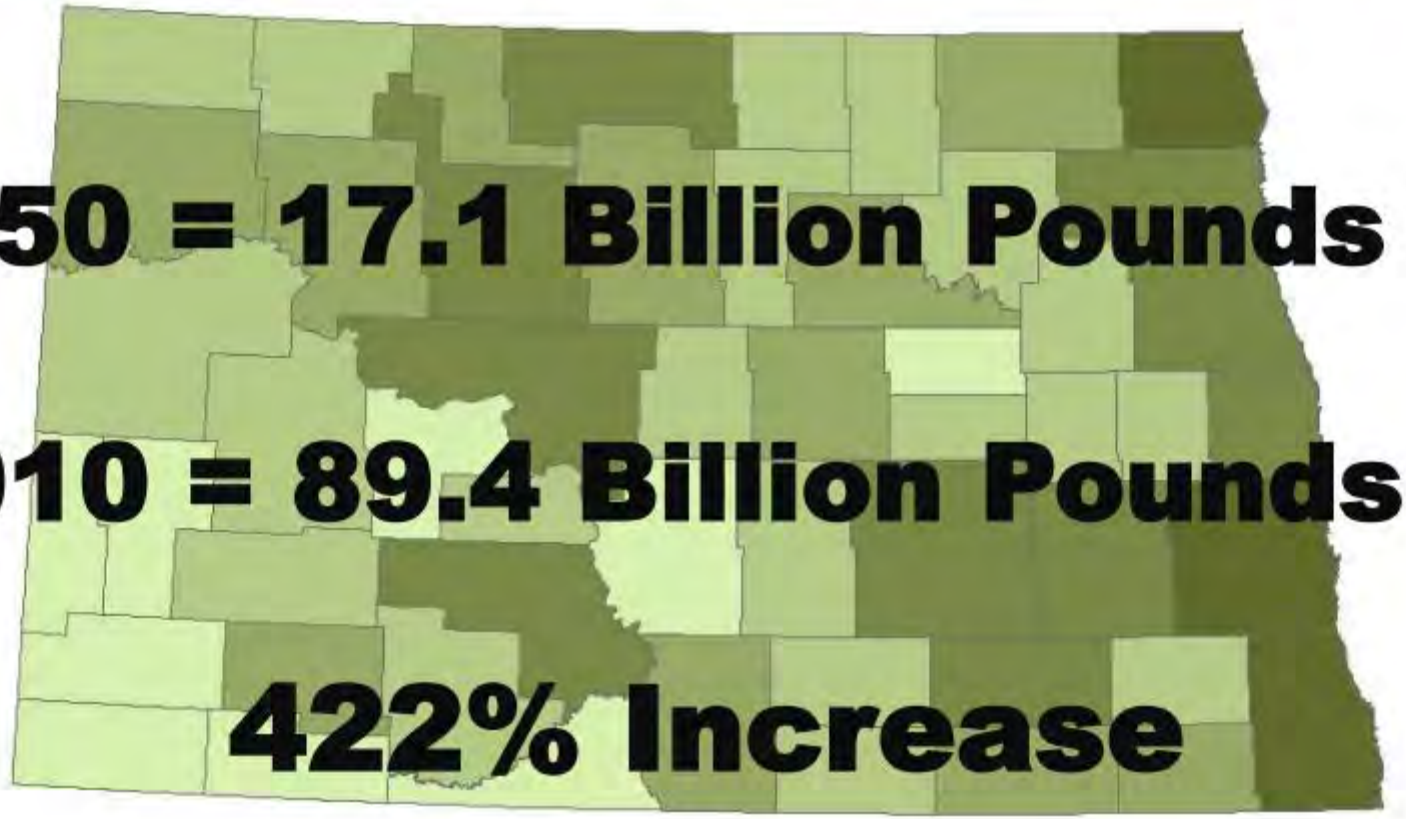
Agricultural Growth 1950-2010



1950 = 17.1 Billion Pounds

2010 = 89.4 Billion Pounds

422% Increase

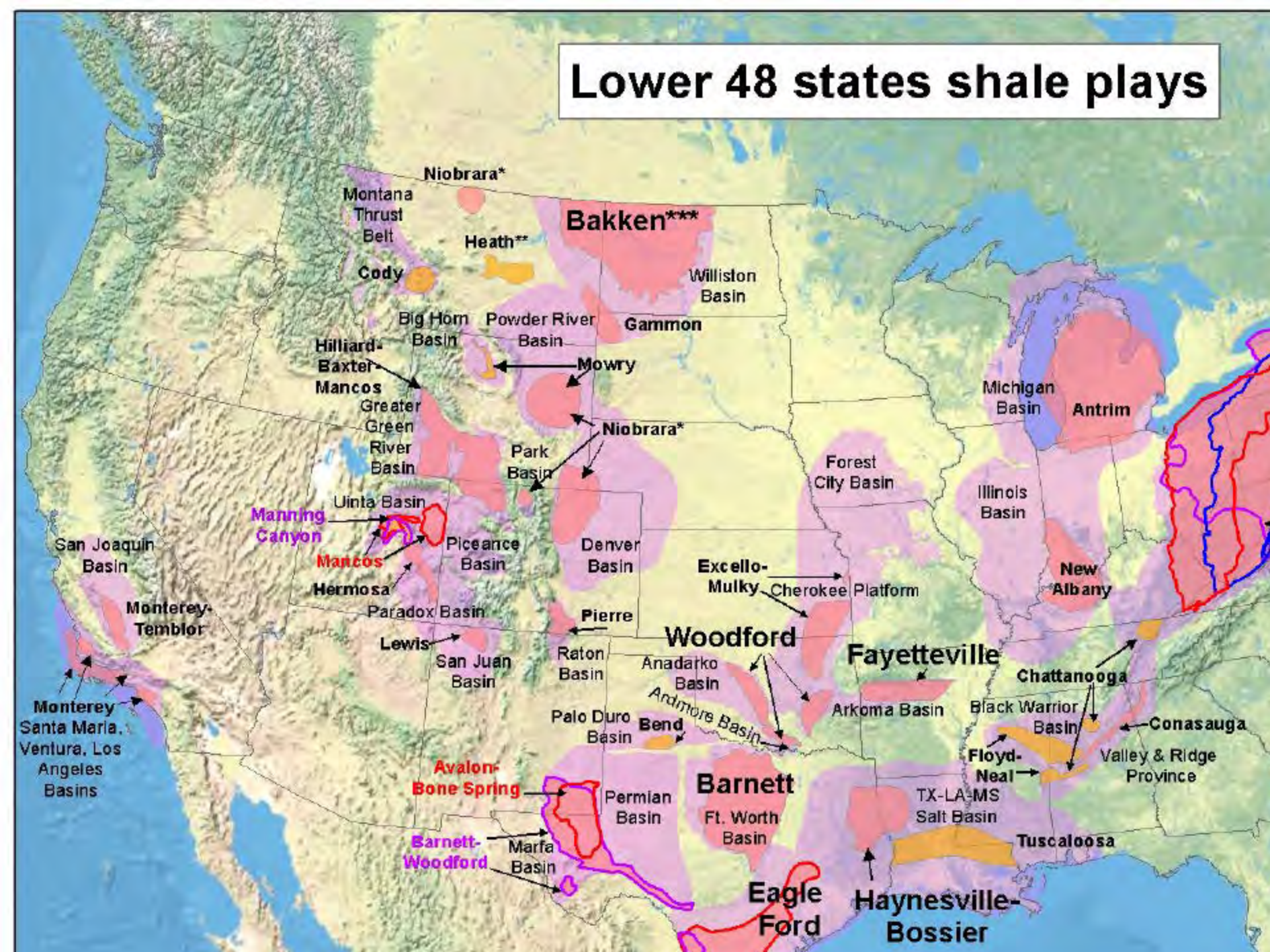
Legend

- 74,872,000 - 489,000,000 lbs
- 489,000,001 - 1,023,000,000 lbs
- 1,023,000,001 - 1,530,000,000 lbs
- 1,530,000,001 - 3,103,000,000 lbs
- 3,103,000,001 - 3,976,476,000 lbs

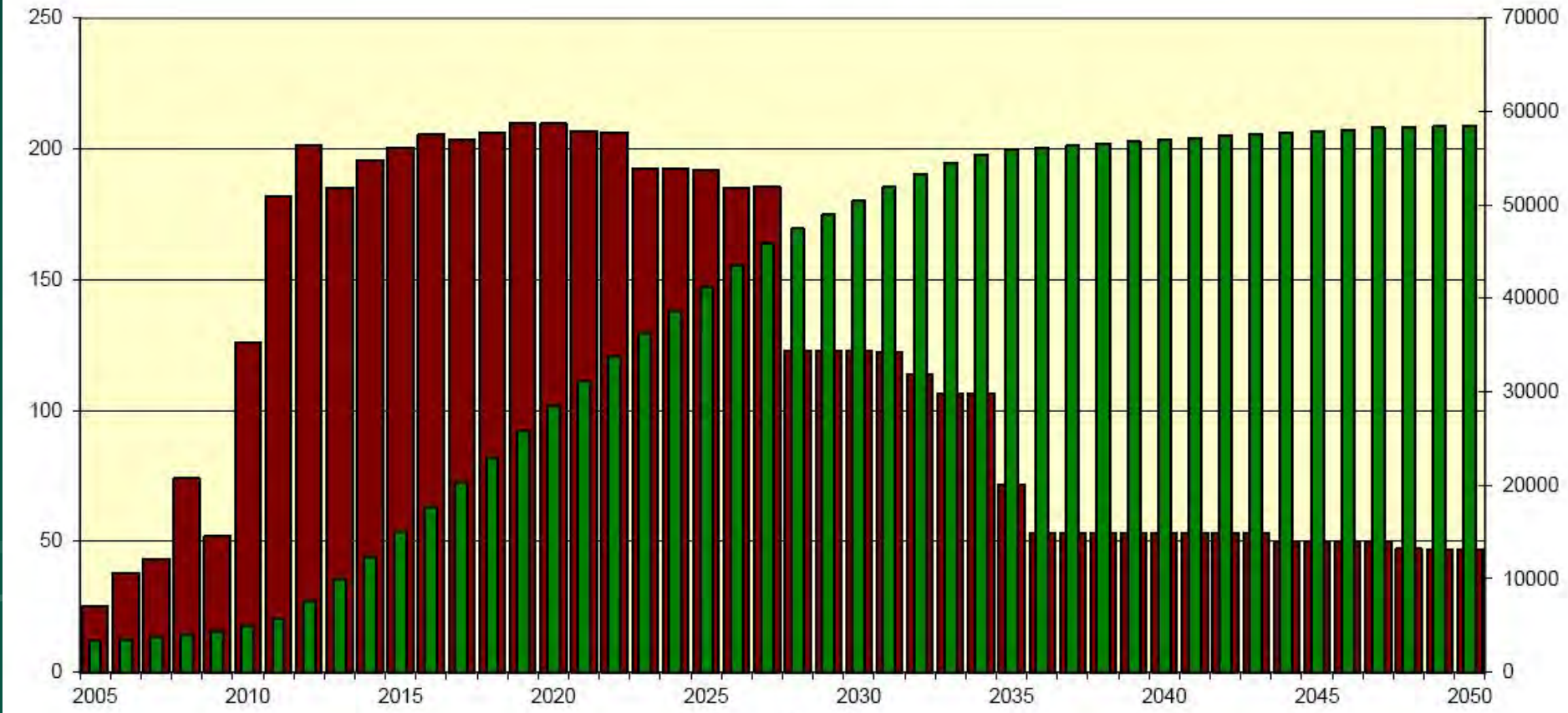
NDDOT
North Dakota Department of Transportation

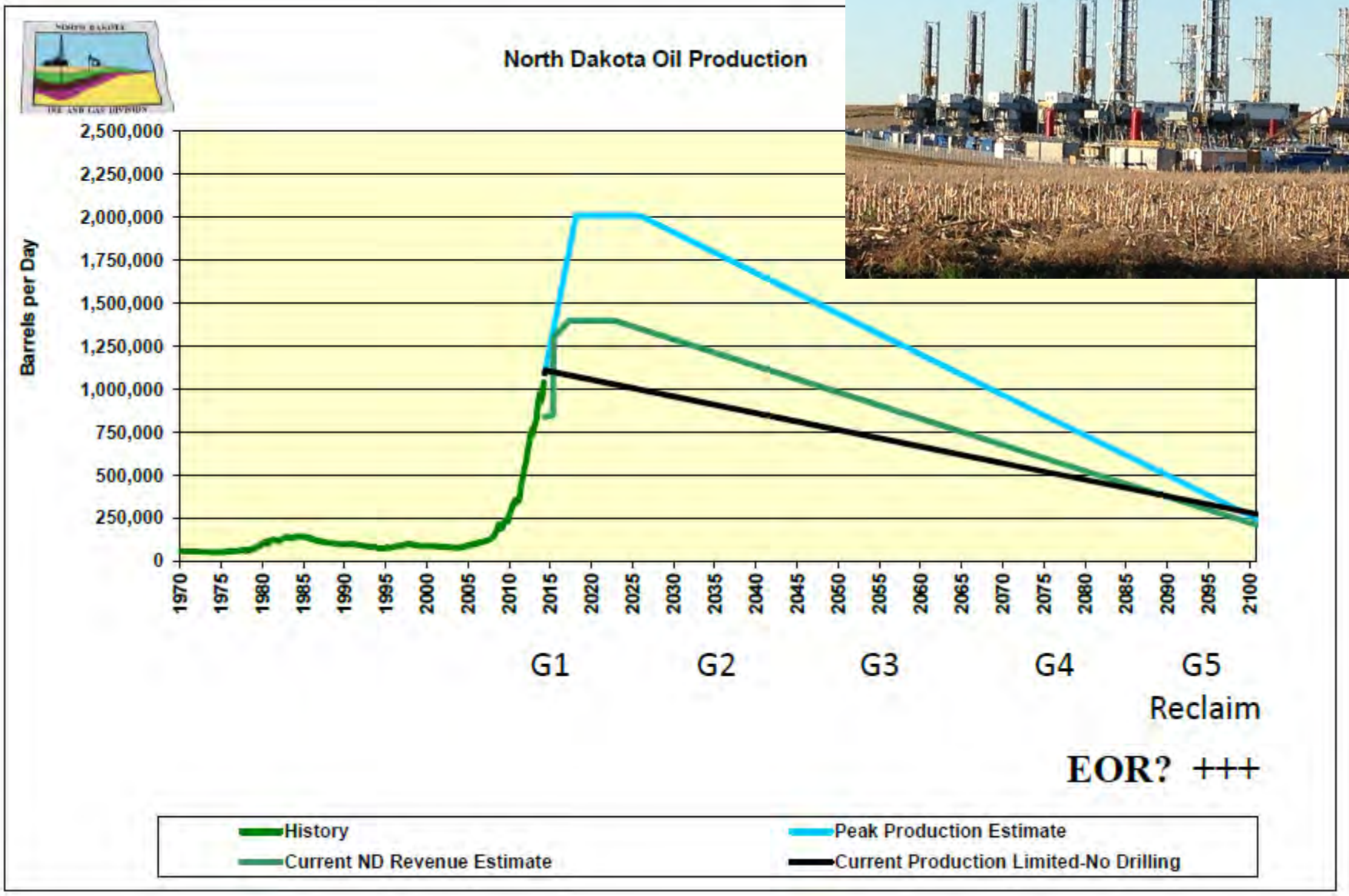

LONG LOAD


A35D
VOLVO

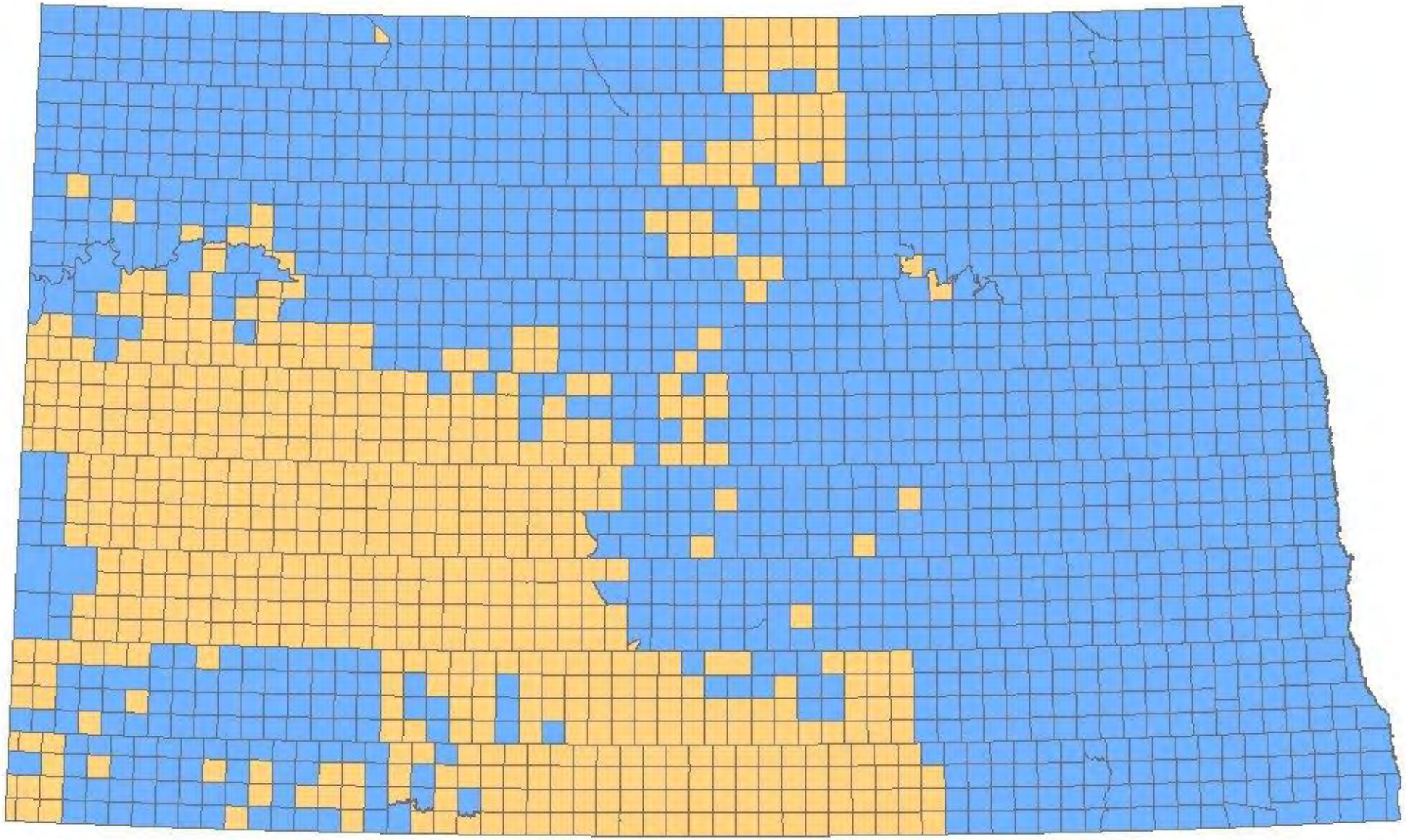

Lower 48 states shale plays
Niobrara*
Montana Thrust Belt
Bakken***
Heath**
Cody
Williston Basin
Big Horn Basin
Powder River Basin
Gammon
Hilliard-Baxter-Mancos
Mowry
Greater Green River Basin
Niobrara*
Park Basin
Michigan Basin
Antrim
Forest City Basin
Illinois Basin
Uinta Basin
Manning Canyon
Mancos
Hermosa
Piceance Basin
Denver Basin
San Joaquin Basin
Excello-Mulky
Cherokee Platform
New Albany
Monterey-Temblor
Paradox Basin
Pierre
Lewis
Woodford
Fayetteville
San Juan Basin
Raton Basin
Anadarko Basin
Chattanooga
Monterey
Santa Maria, Ventura, Los Angeles Basins
Ardmore Basin
Arkoma Basin
Black Warrior Basin
Conasauga
Palo Duro Basin
Bend
Floyd-Neal
Valley & Ridge Province
Avalon-Bone Spring
Barnett
Permian Basin
Ft. Worth Basin
TX-LA-MS Salt Basin
Barnett-Woodford
Marfa Basin
Tuscaloosa
Eagle Ford
Haynesville-Bossier

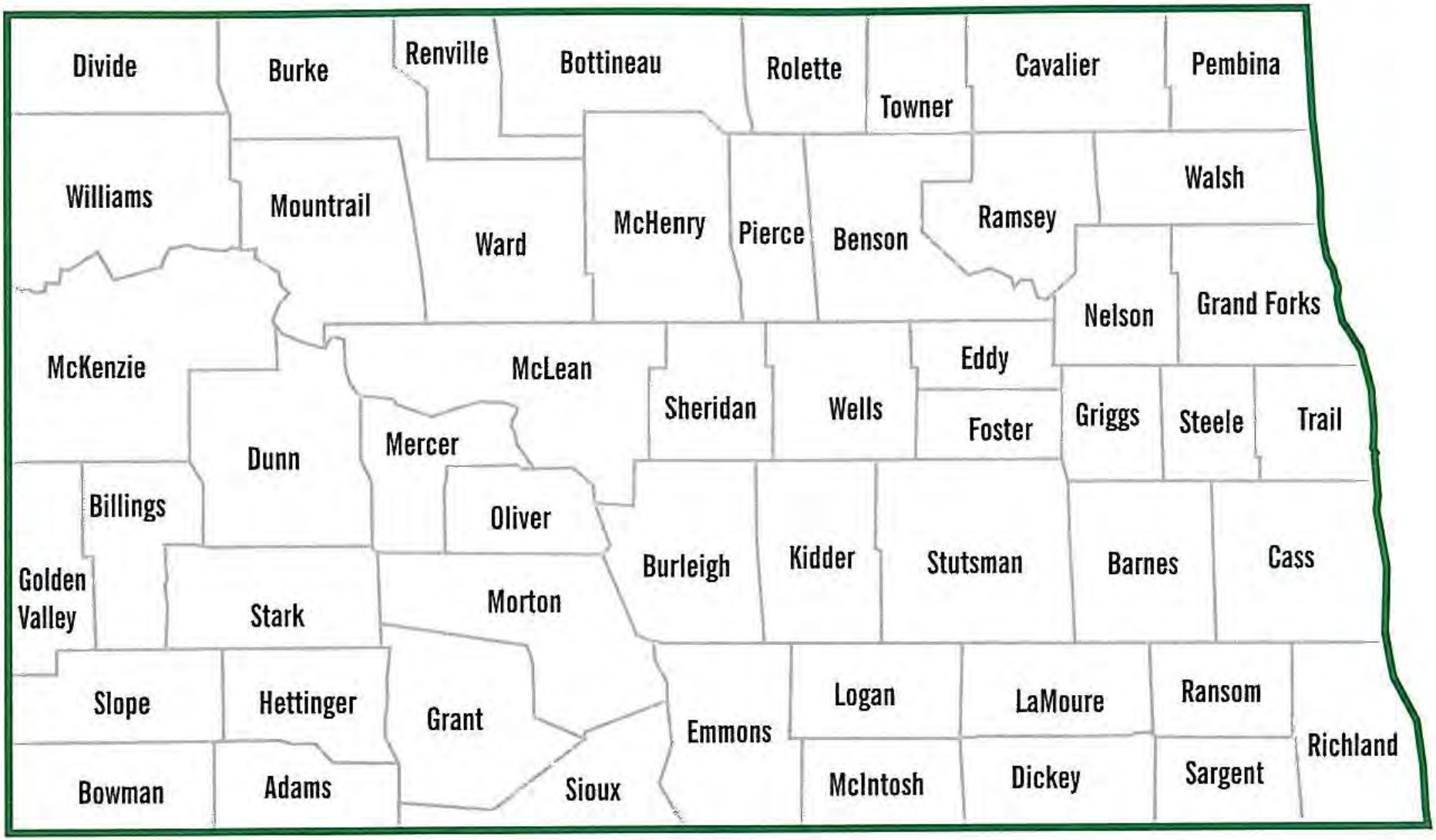
North Dakota Rigs and Wells

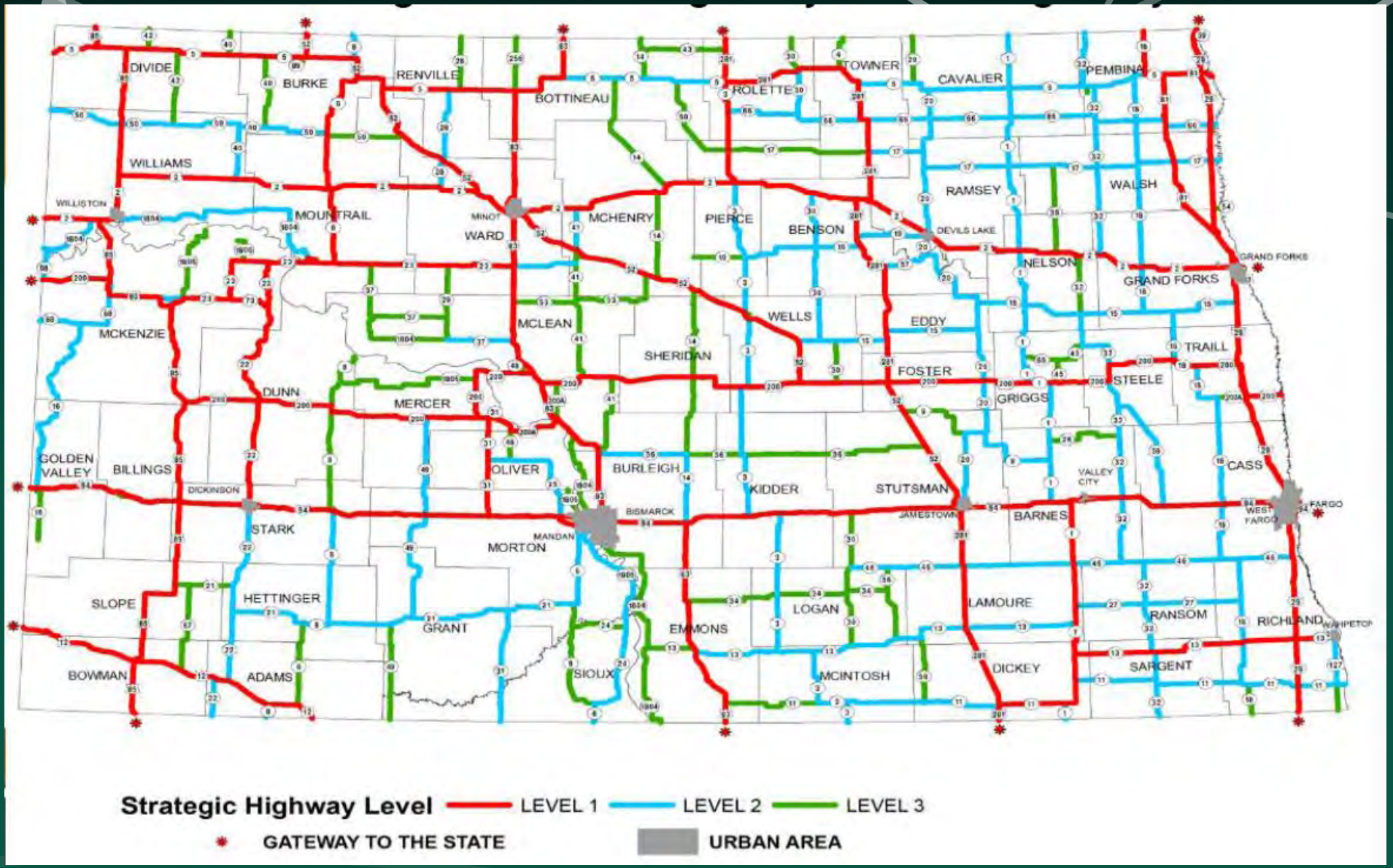



North Dakota Oil Production
Barrels per Day
2,500,000
2,250,000
2,000,000
1,750,000
1,500,000
1,250,000
1,000,000
750,000
500,000
250,000
0
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015
2020
2025
2030
2035
2040
2045
2050
2055
2060
2065
2070
2075
2080
2085
2090
2095
2100
G1
G2
G3
G4
G5
Reclaim
EOR? +++
History
Peak Production Estimate
Current ND Revenue Estimate
Current Production Limited-No Drilling

Organized Townships




Divide
Burke
Renville
Bottineau
Rolette
Towner
Cavalier
Pembina
Williams
Mountrail
Ward
McHenry
Pierce
Benson
Ramsey
Walsh
Nelson
Grand Forks
McKenzie
McLean
Sheridan
Wells
Eddy
Foster
Griggs
Steele
Trail
Dunn
Mercer
Oliver
Billings
Golden Valley
Stark
Morton
Burleigh
Kidder
Stutsman
Barnes
Cass
Slope
Hettinger
Grant
Emmons
Logan
LaMoure
Ransom
Richland
Bowman
Adams
Sioux
McIntosh
Dickey
Sargent



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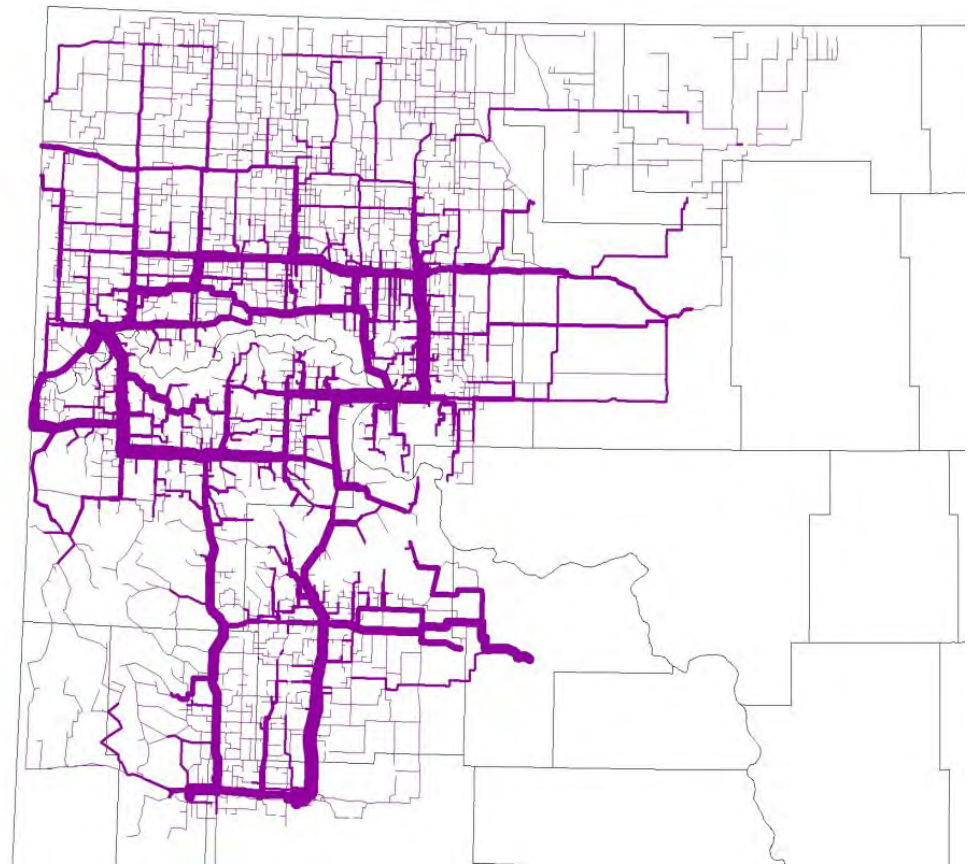
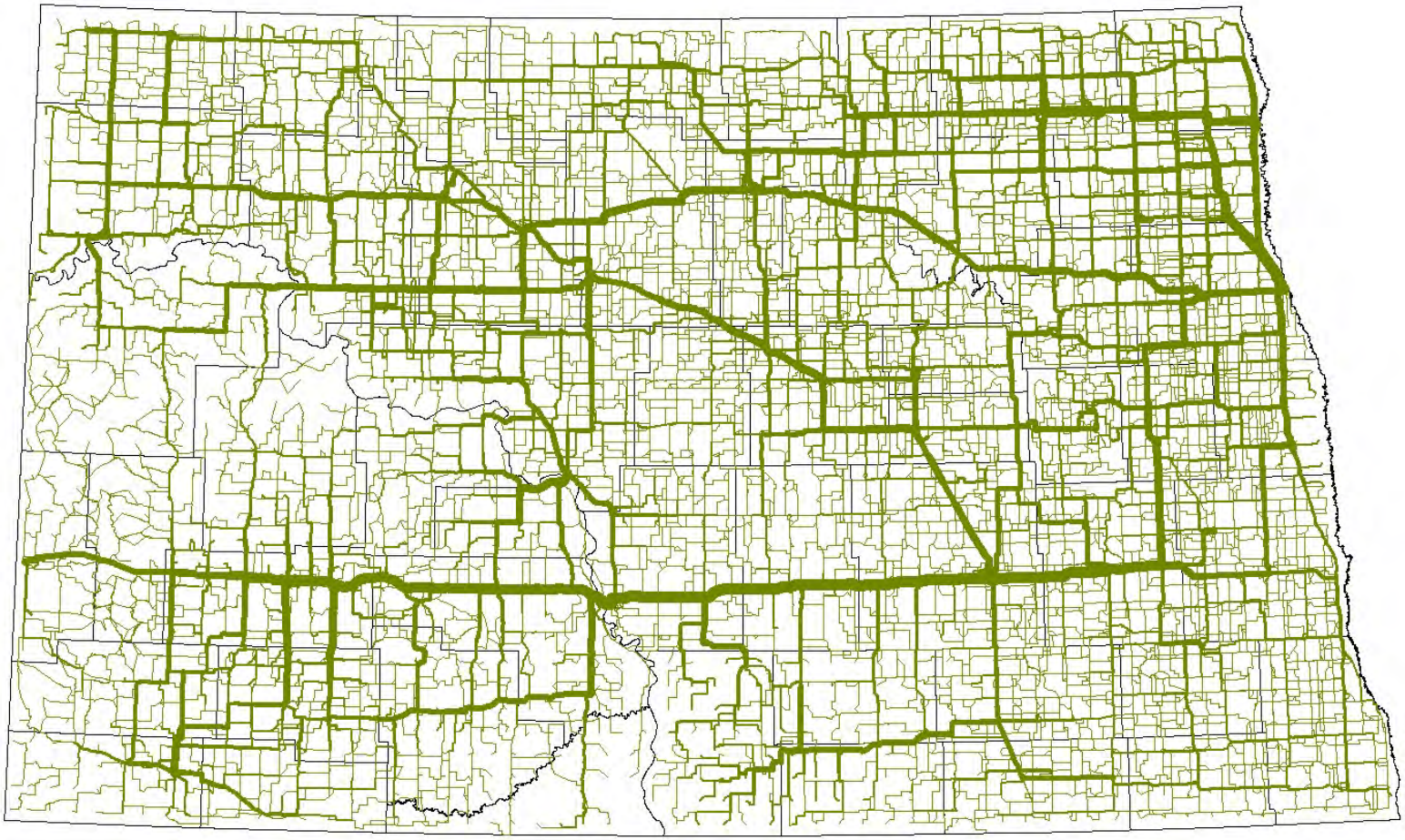
Oil Exploration Traffic Projections



Example of predicted traffic flows over road network

Crude oil movements

Crop Movement Projections - Wheat



State (7,407 miles)

7,407 miles paved with 8% concrete

County/Local (97,662 miles – 59,039 miles gravel)

10,847 miles CMC System with 44% paved
Total surfaced = 65,905 miles with 10% paved
Total unsurfaced – 31,757 miles with 6% improved

Cities = 1,897 miles total with 189 miles gravel
Total miles for state and local roads = 106,965 miles

The #1 Problem With a Gravel Road:

It’s not a paved road!


EC

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Gravel roads reopen in oil patch

4/29/16 Bis Trib

LAUREN DONOVAN
Bismarck Tribune

Gravel roads were reopened throughout the oil patch Thursday, ending a long stretch when heavy truck traffic was brought to a standstill to prevent roads from being damaged during rain and snow accumulations.

Some counties lifted the ban starting bright and early Thursday while others waited until noon to give roads a bit longer to firm up now that the rains have stopped, giving way to clearer skies and a light breeze.

The ban for anything heavier than 12,000 pounds — about the weight of a pickup — went into effect Sunday or Monday, depending on the location and was the second week of road closures in some areas.

Dennis Nelson, Williams County's highway superintendent, said the inconvenience for some needing to haul heavy loads and freight into the patch was far outweighed by the beneficial moisture after a long, dry winter.

He said he'd been looking at the roads and for now, "They're looking good."

In Billings County, highway superintendent Jeff Iverson said gravel roads were reopened Thursday and the rain and snow had the effect of putting a smile on pretty much everyone's face.

"We were tired of all that brown," said Iverson, adding that the benefit is reduced fire danger in the moist countryside.

Counties post their road status at www.ndenergy.org. The National Weather Service in Bismarck forecasts no significant rain for the next week.

Reach Lauren Donovan at 701-220-5511 or lauren@westriv.com.

Welcome rainfall not so much for oil patch truckers

4/26/16 Bis Trib

LAUREN DONOVAN
Bismarck Tribune

Trucks trying to move oil, salt water and other product around the oil patch are encountering a long string of days when gravel roads are closed for heavy-duty business.

The rain and soft drizzle caused counties to close roads again this week, starting Sunday, after being closed for three to four days days last week.

As of Monday, the restriction limiting weight to 12,000 pounds — about a pickup weight and excepting school buses — is in effect in McKenzie, Billings, Stark, Dunn, Williams and Mountrail counties. The restriction won't be lifted until conditions dry out again.

This adds up to a substantial number of days when trucks have to severely lighten loads of oil and salt water, and freight, or sit tight until the ban is lifted.

"It's one of the longest stretches since the spring of 2012. This is a long one," agreed McKenzie County Commissioner Ron Anderson.

The immediate forecast doesn't look promising for reopening the roads anytime soon, but six hours of warm sunshine, or even just a wind and no more rain could change that outlook in a hurry. Counties post their road status on www.ndenergy.org.

Dunn County Highway Superintendent Mike Zimmerman said he catches a little grief from out-of-state truckers who come in unaware of the ban.

"I tell them it might cost them a $1,000 to get stuck a day or two, but the taxpayers have to pay tens of thousands of dollars to repair the roads," he said.

He said he turned down an overweight permit Monday from a trucker who wanted to haul a 446,000 pound load down a gravel road.

"I said, `Uh, no,'" Zimmerman said.

Overall, there are far fewer trucks moving around the countryside these days, with oil drilling cut back and few wells being hydraulically fractured. Companies are turning to above-ground hoses to move water from ponds or wells to frack sites rather than endless rounds of water tanker trucks, Anderson said.

What hasn't changed is the need to haul salt water off of oil well sites. Salt water is produced on nearly a one-to-one barrel ratio as oil and roughly 1 million barrels of the salt water is either trucked or piped for deep well injection.

Patrick Walker, owner of a disposal company, 1804 Operating, said his company notices the drop when tankers can't haul away the salt water. He said oil companies maintain enough storage to have a buffer when roads are closed or blocked.

Reach Lauren Donovan at 701-220-5511 or lauren@westriv.com.


1 vehicle
1 year
1 ton dust per mile
Each mile with 100 cars per day
= 100 tons of fines per year!

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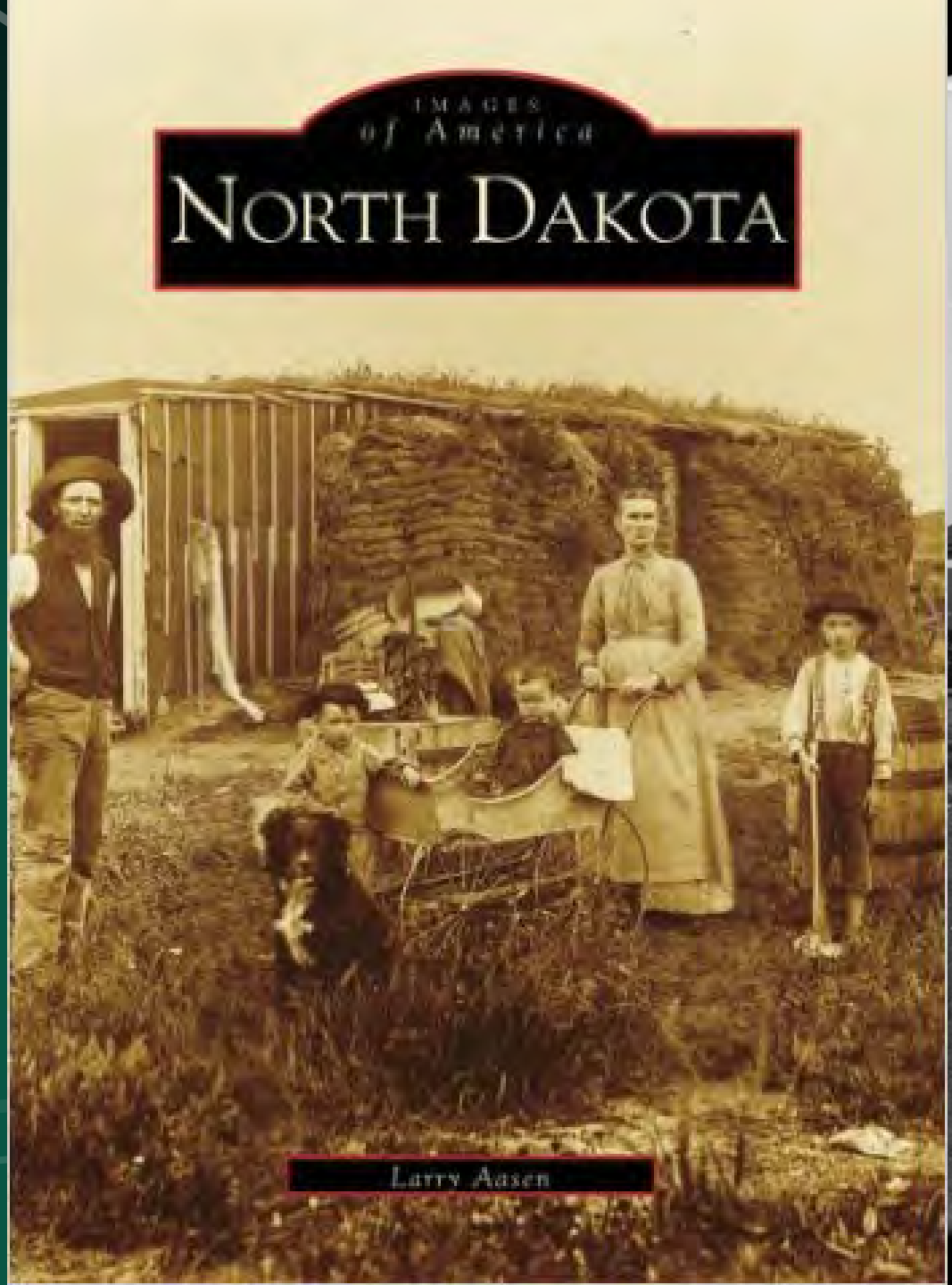
Expectation Shift…..


IMAGES
of America
NORTH DAKOTA
Larry Aasen

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5051

What is Gravel????

Gravel Roads

Part II

Back to the Basics

Local Technical Assistance Program
Department of Civil Engineering
Montana State University-Bozeman
Bozeman, MT

2000

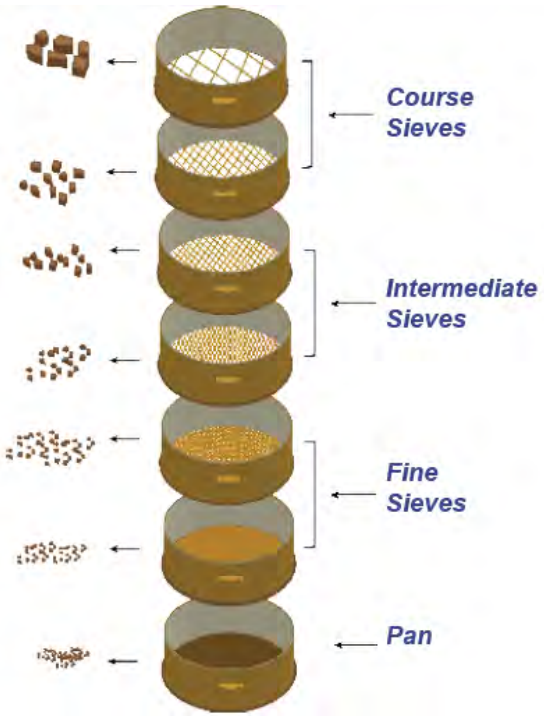


FIGURE 13:
Testing gradation.

Specifications and testing are key to gravel acquisition

- Hardness
- Gradation
- Percentage of fractured stone
- Plasticity index (cohesive material – clay - binder)

SDDOT Standard Specifications – 2015 Edition

Section 882 – Aggregates for Granular Bases and Surfacing

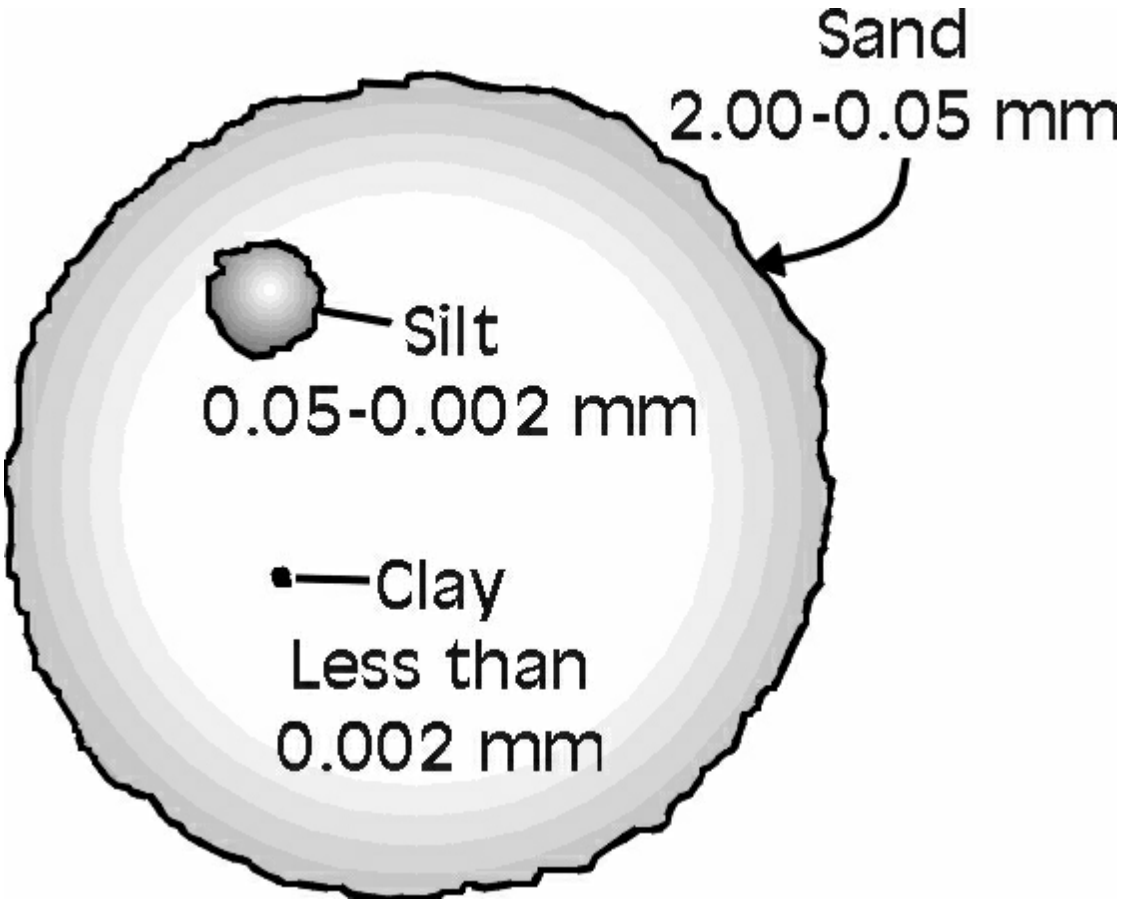
TABLE 1

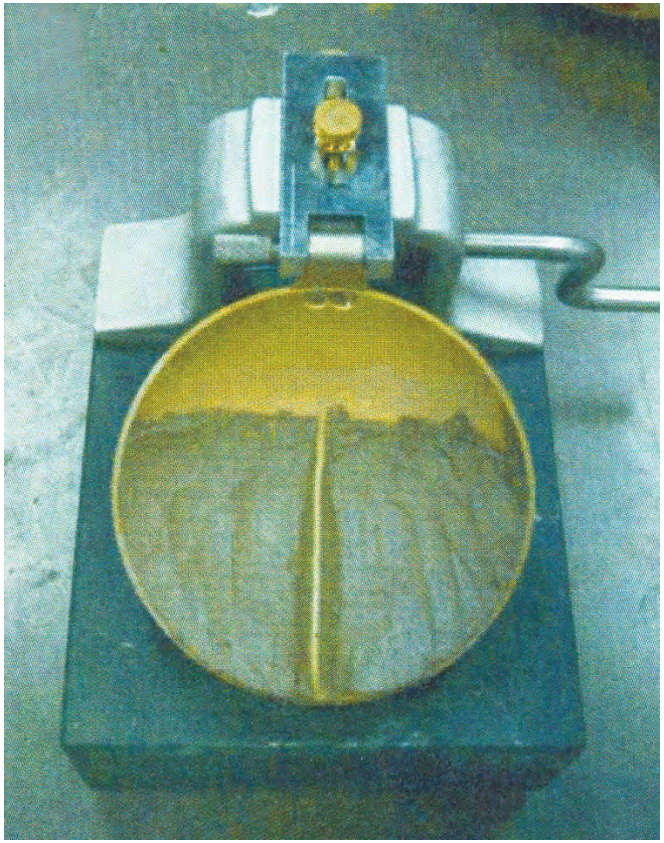
REQUIREMENT	Subbase	Gravel Cushion	Aggregate Base Course	Limestone Ledge Rock		Gravel Surfacing	Pit	Granular
				Base Course	Gravel Cushion			
Sieve	Percent Passing							
6 inch								
2 inch	100							
1 inch	70-100	100	100	100	100			
3/4 inch		80-100	80-100	80-100	80-100	100		
1/2 inch		68-91	68-91	68-90	68-90			
#4	30-70	46-70	46-70	42-70	42-70	50-78		
#8	22-62	34-58	34-58	29-53	29-53	37-67		
#40	10-35	13-35	13-35	10-28	10-28	13-35		
#200	0.0-15.0	3.0-12.0	3.0-12.0	3.0-12.0	3.0-12.0	4.0-15.0		

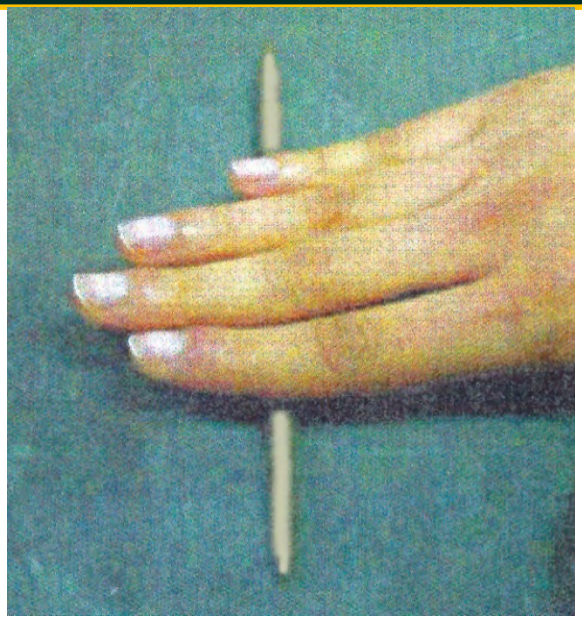
Gravel Surfacing

100
50-78
37-67
13-35
4.0-15.0

Sieve Size	NDDOT Cl 13	Montana Gravel Surfacing	SD & FHWA Gravel Roads Manual	Sample County Spec	Proposed ND Gravel Surfacing
3"					
1-1/2"					
1"	100	100		100	100
3/4"	70-100	80-90	100	90-100	70-100
1/2"		60-80			
3/8"				50-90	
No. 4	38-75	50-70	38-75	35-80	38-75
No. 8	22-62	37-60	37-67		22-62
No. 10				20-70	
No. 30	12-45				12-45
No. 40		13-35	13-35	10-40	
No. 200	7-15	4-18	4-15	8-15	7-15
PI		4-12	4-12	4-12	4-12
Shale (max %)	12.0				12.0
LA Abrasion (max %)	50				50
NDDOT 4, Fractured Faces	10				10


Sand
2.00-0.05 mm
Silt
0.05-0.002 mm
Clay
Less than
0.002 mm





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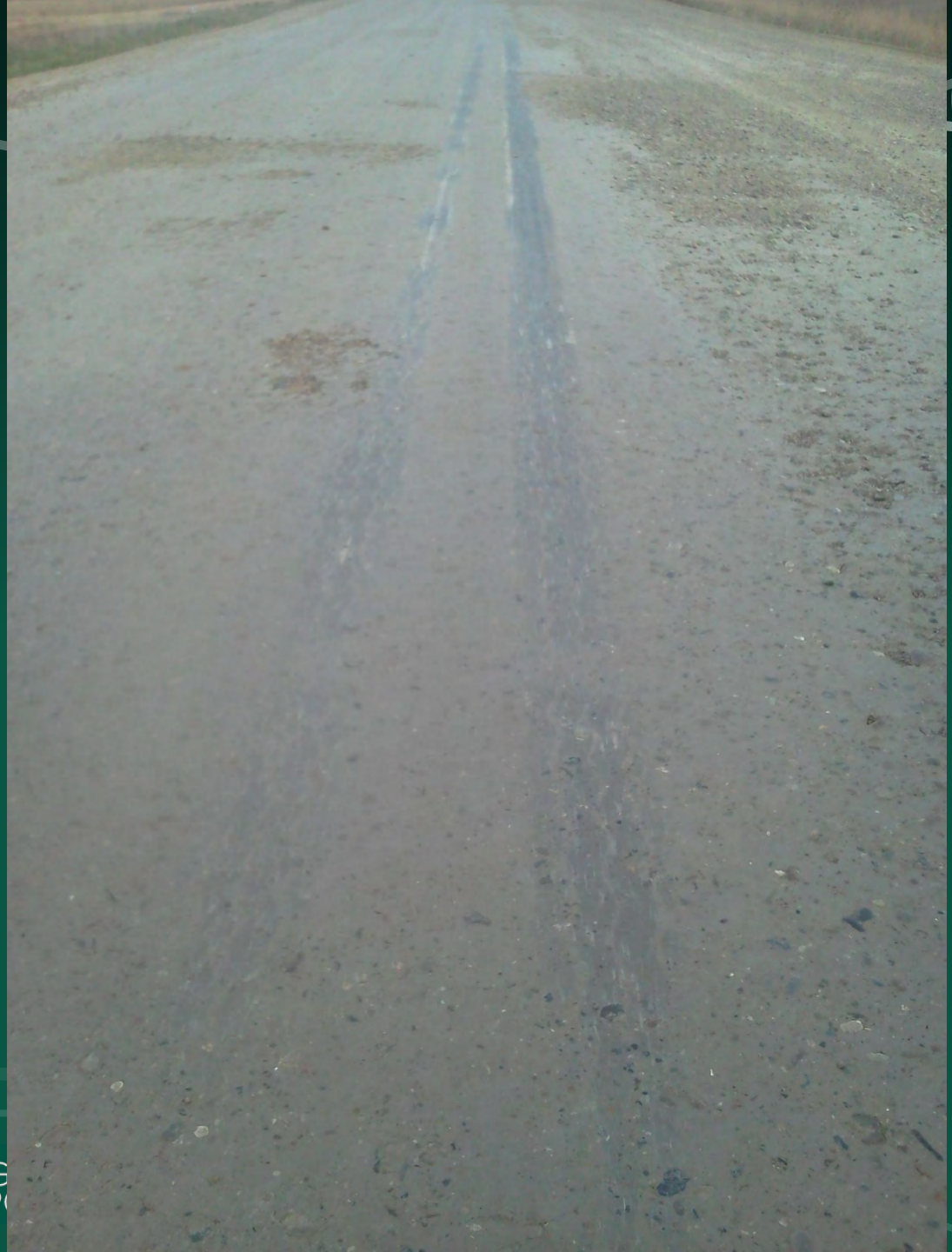
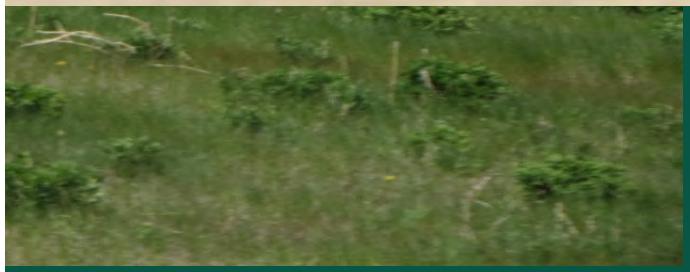



angle of repose



Who Gets Blamed for Poor Performing Gravel?

The Operator

The Operator cannot make good gravel out of bad gravel

- Good quality surface gravel may cost more, but it is worth the extra cost
- Quality can only be determined by proper field sample testing in a materials lab
- Approximately $200.00 per sample


12/03/2012


CATERPILLAR

Paradigm Shift

STATE	PROJECT NO.
ND	ROM-0300(130)

JOB
NORTH DAKOTA
DEPARTMENT OF TRANSPORTATION

ROM-0300(130)

Bottineau, Burke, Mclean, Mountrail, & Renville Counties

Minot Minuteman Complex Regraveling

GOVERNING SPECIFICATIONS:
2014 Standard Specifications adopted by
Department of Transportation and the Sup
effective on the date the project is adverti

PROJECT NUMBER \ DESCRIPTION
ROM-0300(130)
Minot Minuteman
Complex Regraveling

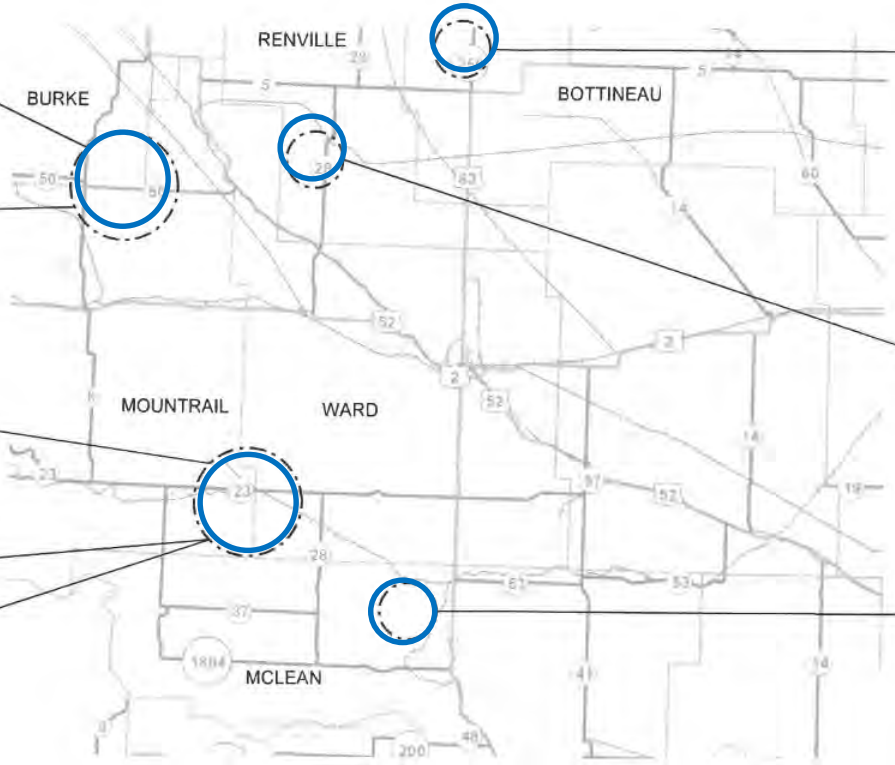
Site K-10
Burke County
NW 1/4 Sec 8
T159N
R90W
3.3 miles
Roadway Width 27'
Aggregate Depth 2"
Spot Repair, Regraveling

Site K-06S
Mountrail County
NW 1/4 Sec 8
T159N
R90W
2.9 miles
Roadway Width 25'
Aggregate Depth 2"
Spot Repair, Regraveling

Site H-02b
Mountrail County
NW 1/4 Sec 19
T 153 N
R 89 W
3.2 miles
Roadway Width 25'
Aggregate Depth 2"
Spot Repair, Regraveling

Site H-05a
Mountrail County
NW 1/4 Sec 23
T 151 N
R 89 W
4.0 miles
Roadway Width 25'
Aggregate Depth 2"
Spot Repair

Site H-05b
Mountrail County
NW 1/4 Sec 23
T 151 N
R 89 W
1.2 miles
Roadway Width 25'
Aggregate Depth 2"
Spot Repair



Site O-09a
Bottineau County
NW 1/4 Sec 3
T 162 N
R 83 W
3.0 miles
Roadway Width 28'
Aggregate Depth 2"
Spot Repair, Regrading

Site O-09b
Bottineau County
NW 1/4 Sec 3
T 162 N
R 83 W
3.0 miles
Roadway Width 28
Aggregate Depth 2
Spot Repair, Regr

Site M-05
Renville County
NW 1/4 Sec 8
T 159 N
R 86 W
4.6 miles
Roadway Width 26'
Aggregate Depth 2"
Spot Repair, Regrading

Site D-08
Mclean County
NW 1/4 Sec 15
T 150 N
R 84 W
7.2 miles
Roadway Width 30'
Aggregate Depth 0"
Shoulder Repair, Regrading

DESIGNERS

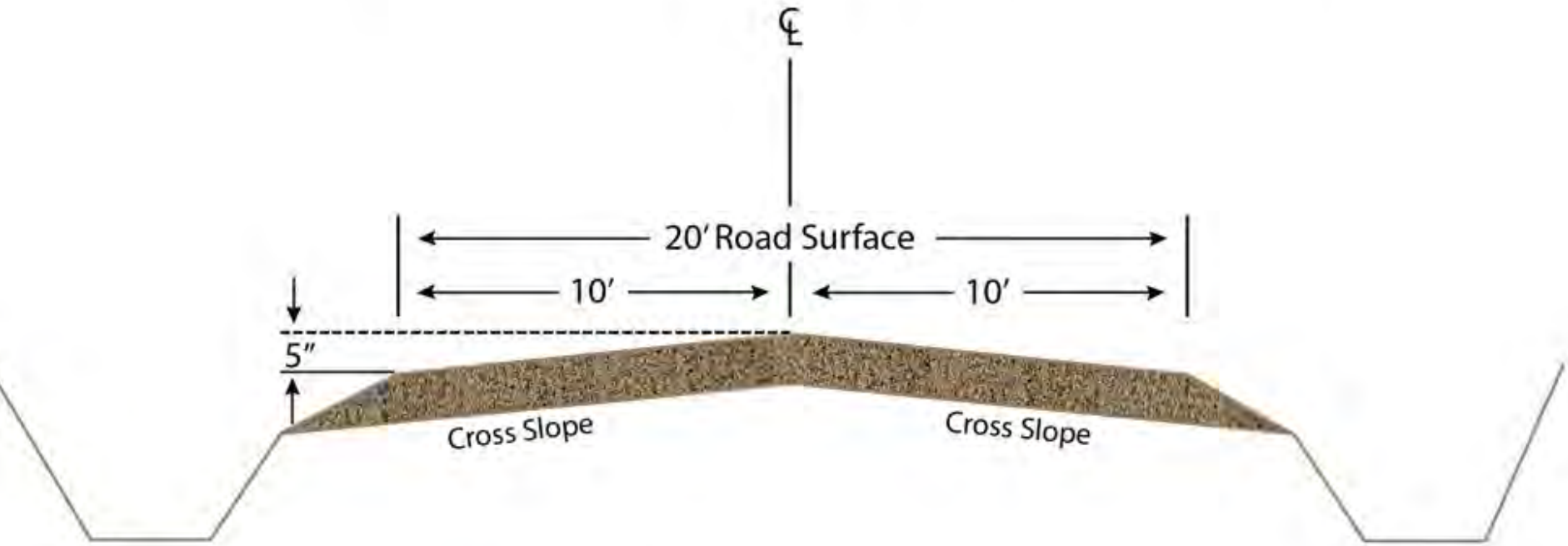
APPROVED DATE

I hereby certify that the attached plans were prepared by me or under my direct supervision and that I am a duly registered professional engineer under the laws of the state of ND.

APPROVED DATE

Technology Transfer

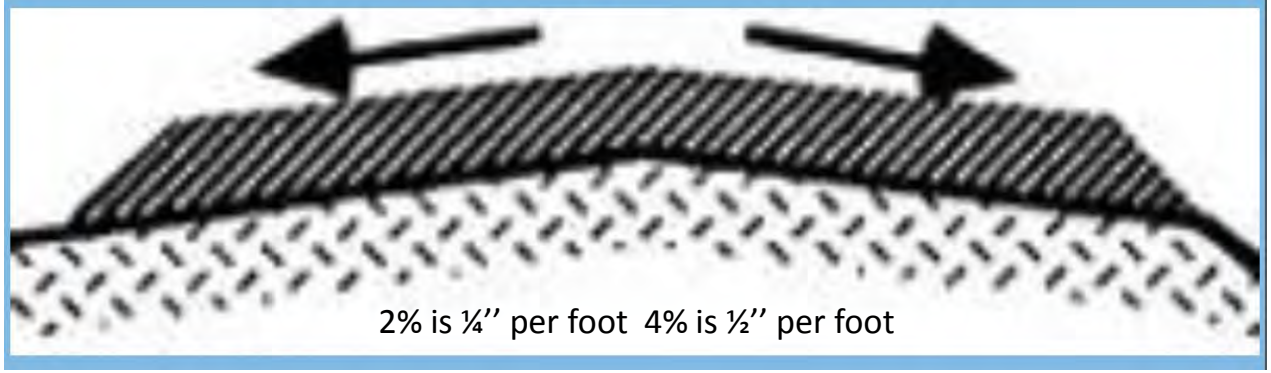
An example of shape to be maintained



Note: 4% crown is equivalent to 1/2 inch per foot drop on the cross slope.

2% for future pave 4% for unpaved

Gravel at or near 4%



2% is ¼'' per foot 4% is ½'' per foot


CAT


Geotechnical
Subsurface Exploration, Drilling and Testing
Geotechnical Site Characterization
SPT & CPT Exploration Methods
In-Situ Testing and Performance Monitoring
Materials
Onsite Observation and Monitoring
Construction Quality Control and Quality Assurance Programs
Field and Laboratory Testing and Analysis
Engineering Design and Review of Concrete, Grout, and Asphaltic Concrete Mixes
Construction Materials Selection, Compatibility, and Acceptability Consulting
Terracon
Environmental
Facilities
Geotechnical
Materials
ROAD SCHOLAR


MULCHER


CATERPILLAR
CAT
Butler

7 Classroom Training Sessions in 2015

26 Field Trainings

RDO and Butler Sponsored
Lunch at each location

Total Trained for 2015 = 388

RDO EQUIPMENT CO.

Butler CAT

NDSU UPPER GREAT PLAI
TRANSPORTATION

High shoulders
Berms - curbs - secondary ditch

Pretend Blading


JOHN DEERE

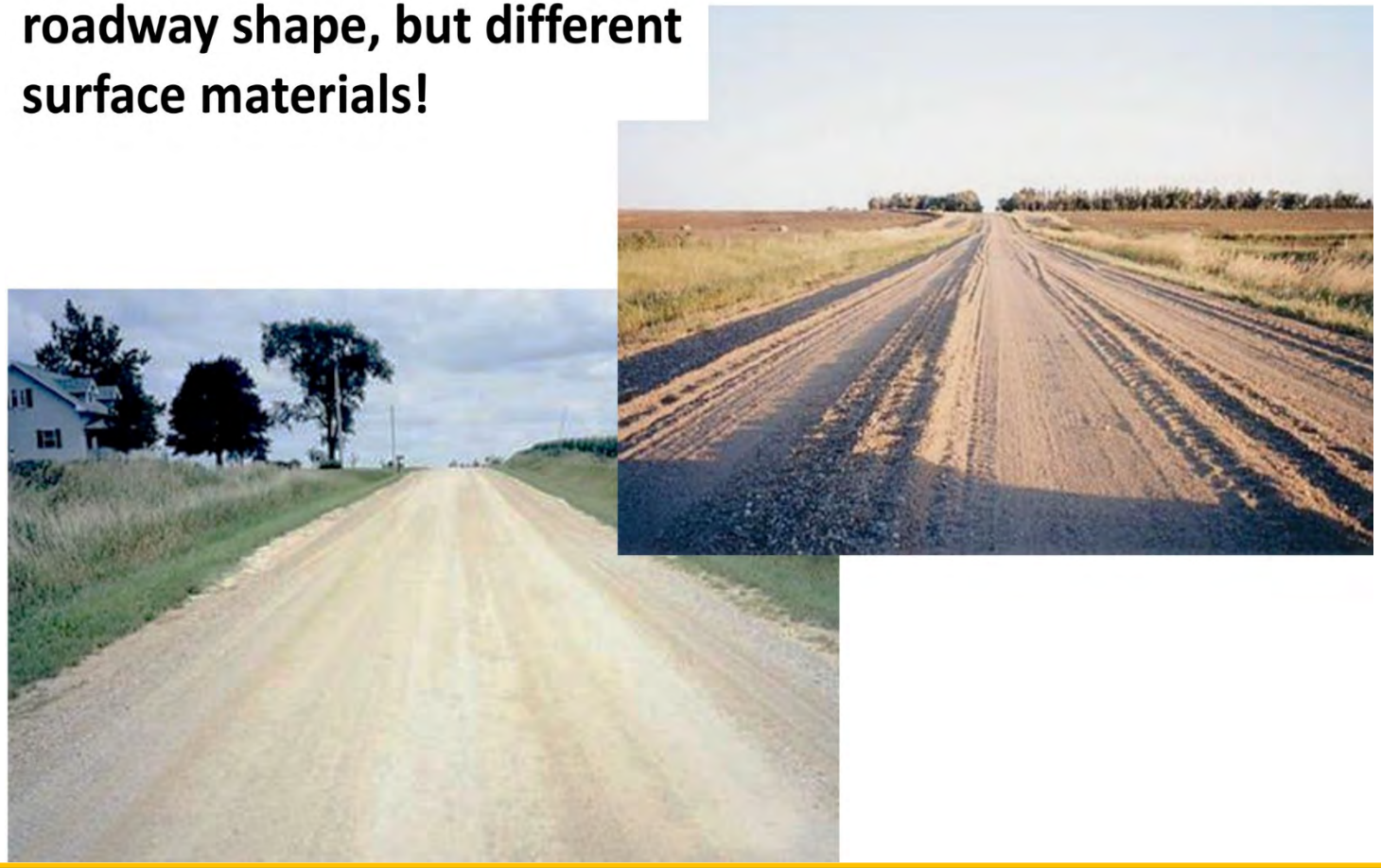

DEERE

A 25-ton load of gravel covers only 320 linear ft to place one inch of gravel on one mile 20 ft wide.


CATERPILLAR

Dramatic Contrast -

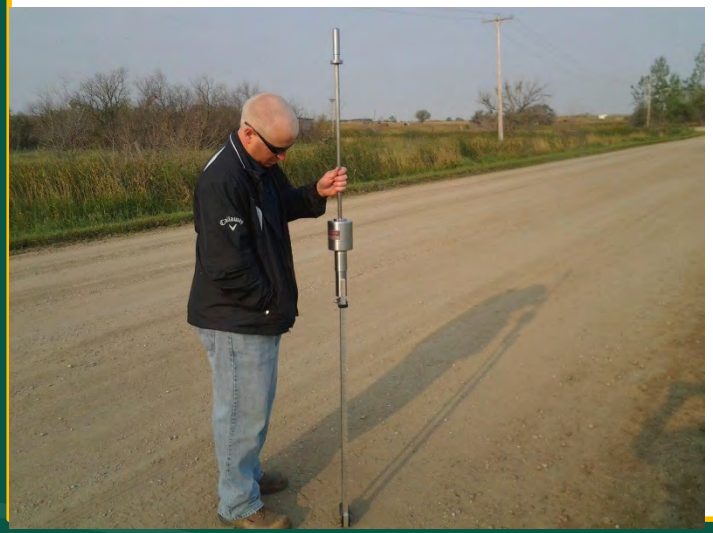
Similar traffic volume, similar roadway shape, but different surface materials!



Great contrast in surface condition due to quality difference of surface gravel

Foundation Strength

- Dynamic Cone Penetrometer, **DCP**
- Relates cone drop count to resistance
- Translates to soil strength



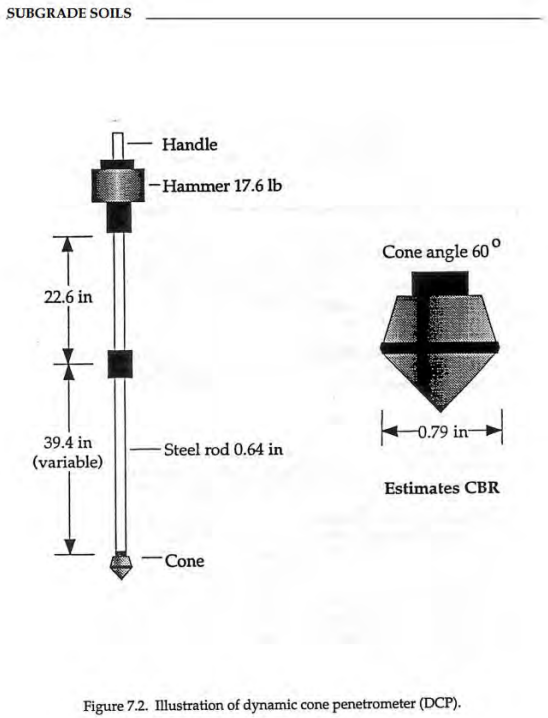


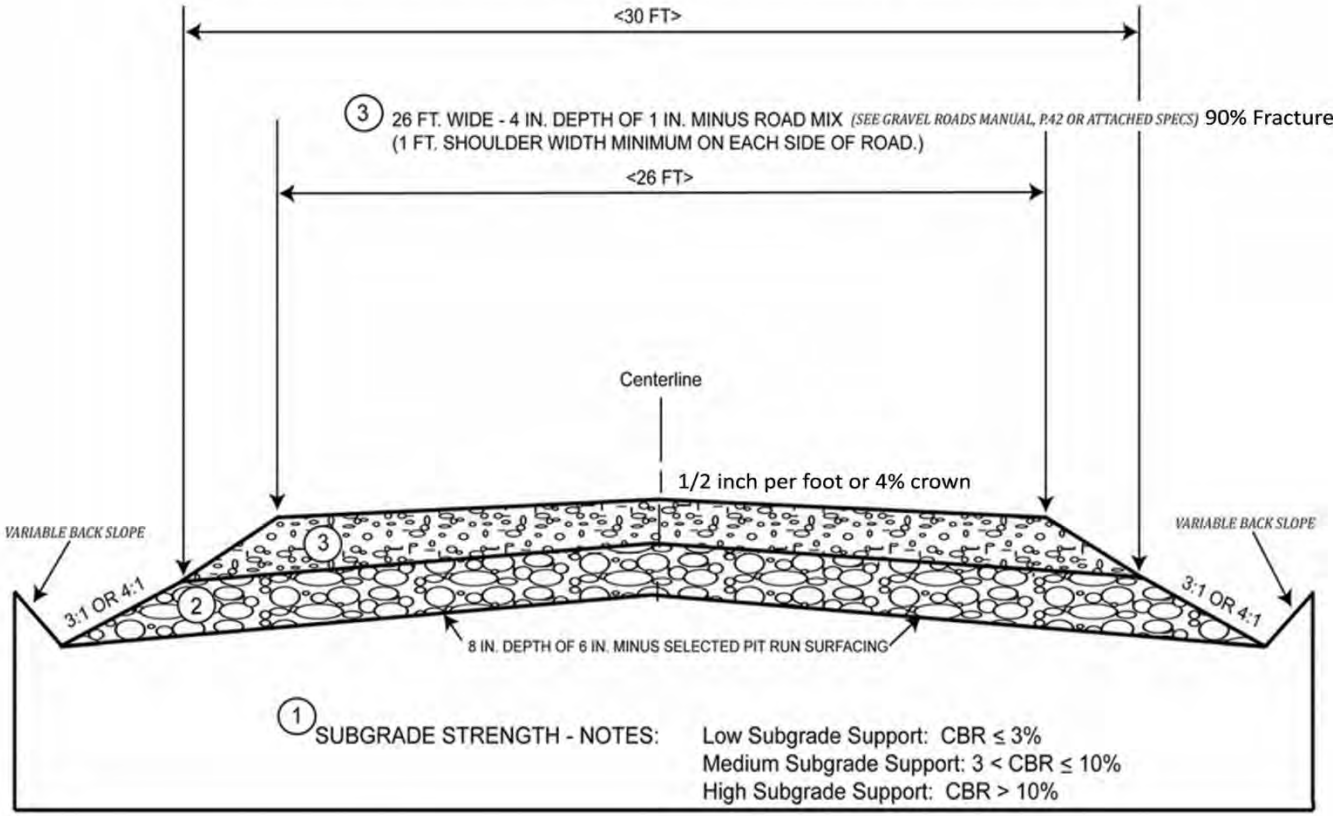
Figure 7.2. Illustration of dynamic cone penetrometer (DCP).

Foundation Strength

- California Bearing Ratio, **CBR-** How strong is the ground, less than 3 = poor
- Compares on-site soil to crushed rock

- CBR less than 0.2 -sink up to your knees
- CBR of less than 0.5 sink up to your ankles
- CBR of 1 your heels will sink about ¼ inch
- CBR of 4 a spike heel will make a slight indentation

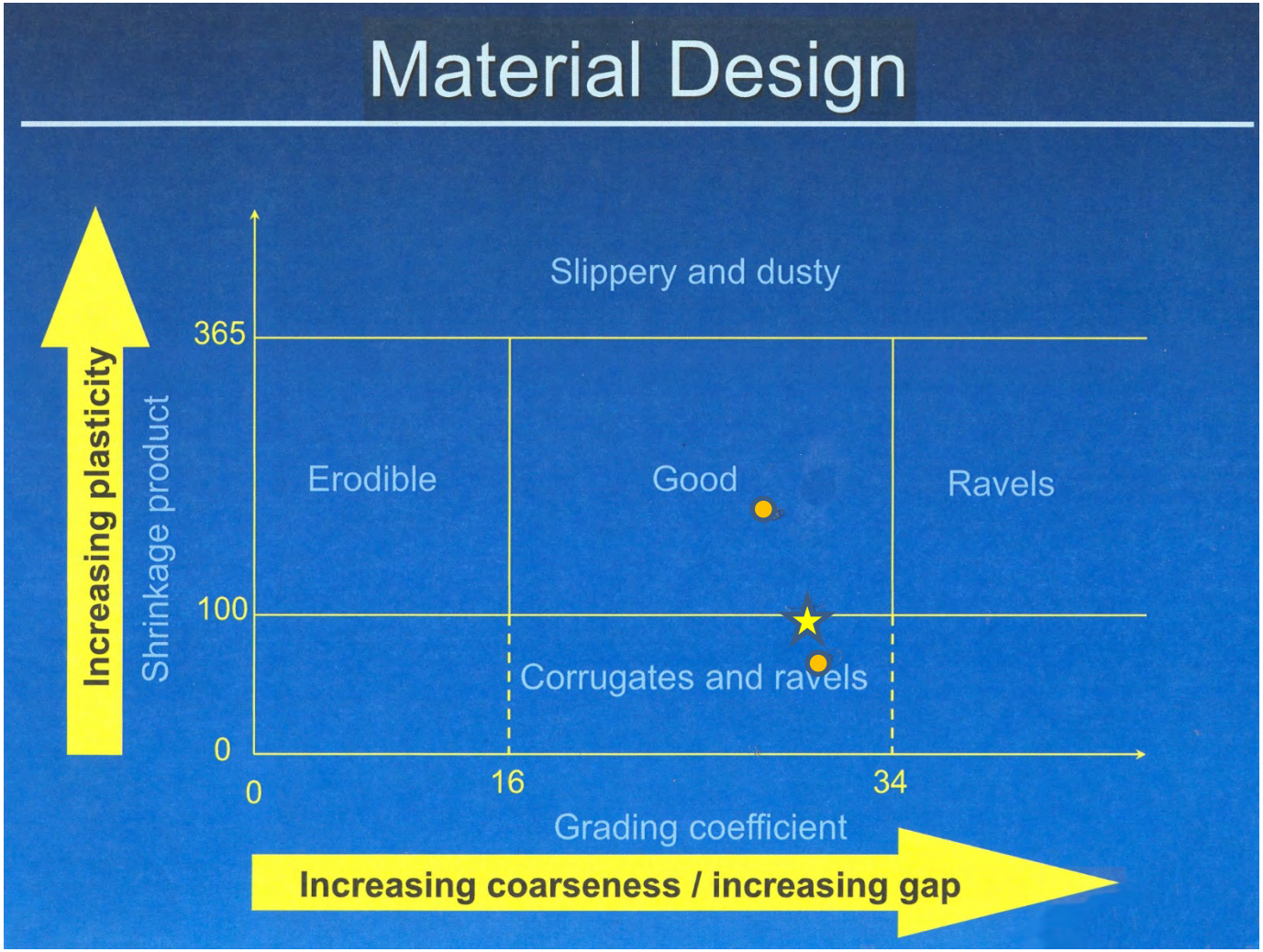
Montana County Minimum Road Standards

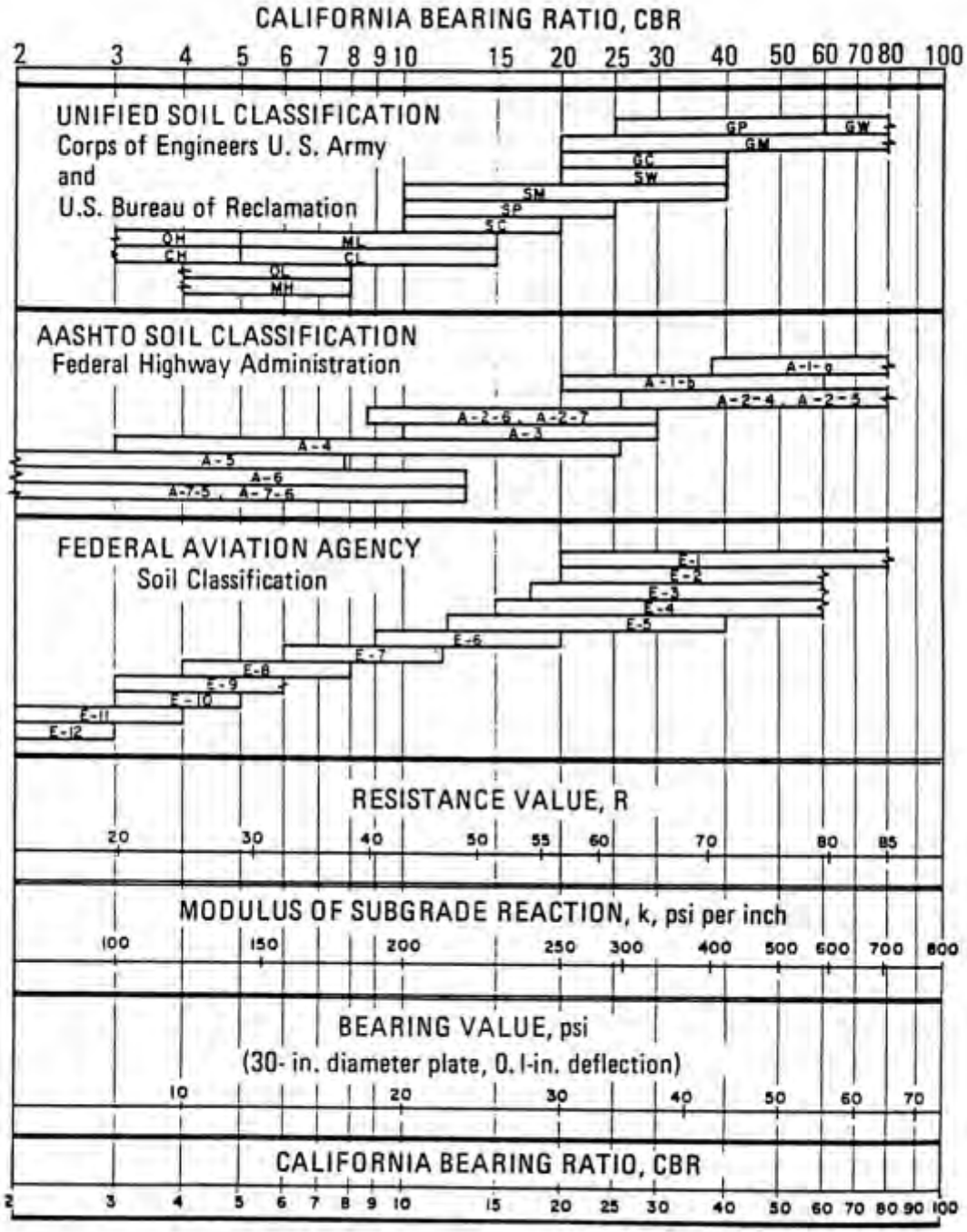


THE SUM OF LAYERS 2 AND 3 MUST ≥ (GREATER THAN OR EQUAL TO) DESIGN VALUES STATED IN TABLE 6 *(GRAVEL ROADS, PAGE A11)* - ATTACHED

Montana LTAP • 1-800-541-6671 • June 2015

Material Design




CALIFORNIA BEARING RATIO, CBR
2 3 4 5 6 7 8 9 10 15 20 25 30 40 50 60 70 80 100
UNIFIED SOIL CLASSIFICATION
Corps of Engineers U. S. Army
and
U.S. Bureau of Reclamation
GP
GW
GM
GC
SW
SM
SP
SC
OH
CH
ML
CL
OL
MH
AASHTO SOIL CLASSIFICATION
Federal Highway Administration
A-1-a
A-1-b
A-2-4 , A-2-5
A-2-6 , A-2-7
A-3
A-4
A-5
A-6
A-7-5 , A-7-6
FEDERAL AVIATION AGENCY
Soil Classification
E-1
E-2
E-3
E-4
E-5
E-6
E-7
E-8
E-9
E-10
E-11
E-12
RESISTANCE VALUE, R
20 30 40 50 55 60 70 80 85
MODULUS OF SUBGRADE REACTION, k, psi per inch
100 150 200 250 300 400 500 600 700 800
BEARING VALUE, psi
(30- in. diameter plate, 0.1-in. deflection)
10 20 30 40 50 60 70
CALIFORNIA BEARING RATIO, CBR
2 3 4 5 6 7 8 9 10 15 20 25 30 40 50 60 70 80 90 100

From: Gravel Roads, Maintenance and Design Manual (FHWA/ South Dakota LTAP, April 2005)

Appendix A:
Gravel Road Thickness Design Methods
The South Dakota Catalog Design Method

The method is rather crude because it only relies on two parameters, heavy trucks and subgrade support condition.

Table 6: Suggested Gravel Layer Thickness for New Or Reconstructed Rural Roads.

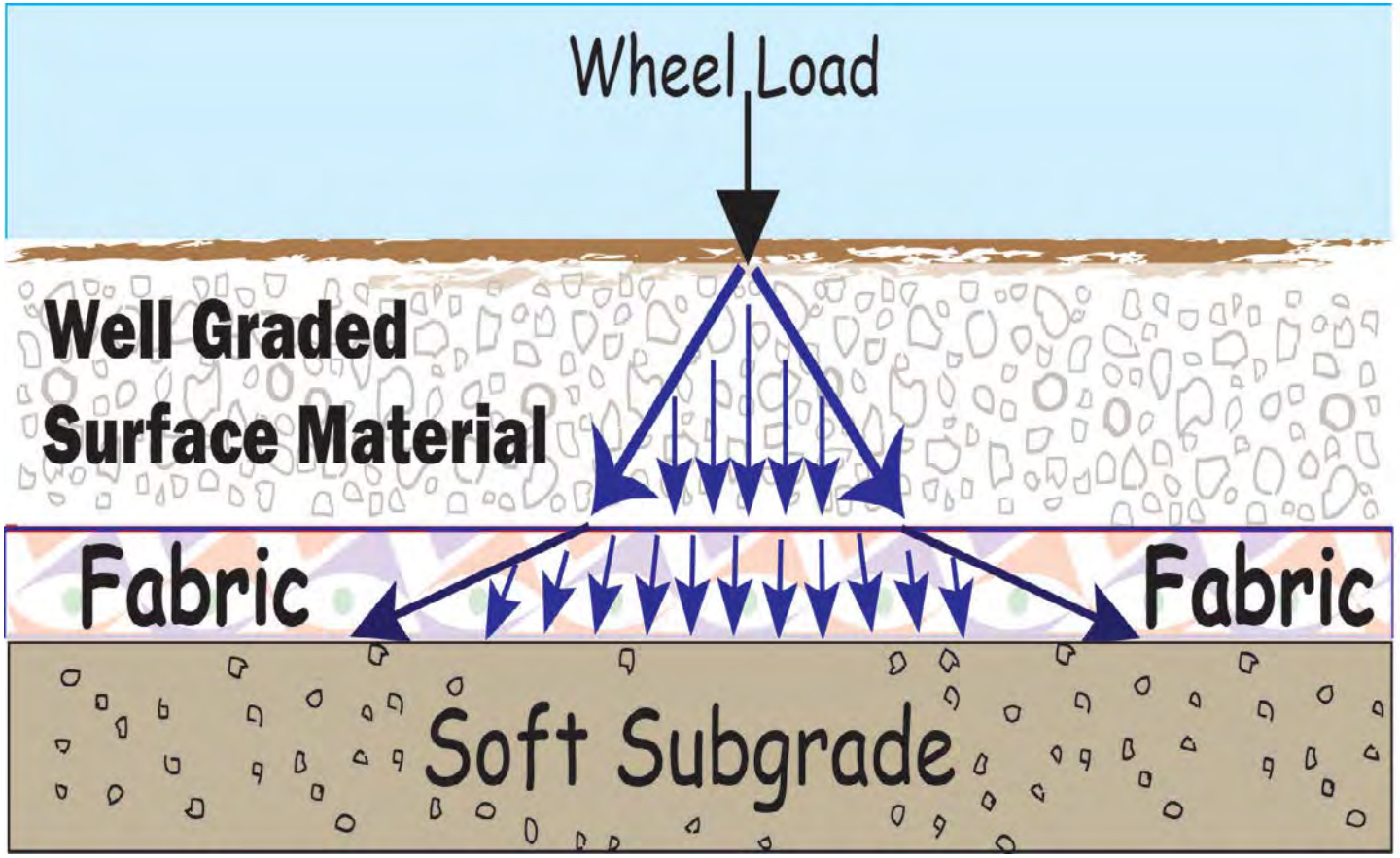
Estimated Daily Number of Heavy Trucks	Subgrade Support Condition(1)	Suggested Minimum Gravel Layer Thickness, mm (in.)
0-5	Low	165 (6.5)
	Medium	140 (5.5)
	High	115 (4.5)
5-10	Low	215 (8.5)
	Medium	180 (7.0)
	High	140 (5.5)
10-15	Low	290 (11.5)
	Medium	230 (9.0)
	High	180 (7.0)
25-50	Low	370 (14.5)
	Medium	290 (11.5)
	High	215 (8.5)

Notes: (1)Low Subgrade support: CBR$\leq$ 3 percent;
Medium Subgrade support: 3 < CBR $\leq$ 10 percent;
High Subgrade support: CBR > 10 percent

Table 4.2. Suggested gravel layer thicknesses for new or reconstructed rural roads.

Estimated daily no. of heavy trucks	Subgrade support condition[1]	Suggested minimum gravel layer thickness, mm (in)
0 to 5	Low	165 (6.5)
	Medium	140 (5.5)
	High	115 (4.5)
5 to 10	Low	215 (8.5)
	Medium	180 (7.0)
	High	140 (5.5)
10 to 25	Low	290 (11.5)
	Medium	230 (9.0)
	High	180 (7.0)
25 to 50	Low	370 (14.5)
	Medium	290 (11.5)
	High	215 (8.5)

Notes. [1] Low subgrade support: average CBR $\leq$ 3 percent; medium subgrade support: 3 percent < average CBR $\leq$ 10 percent; high subgrade support: average CBR > 10 percent. [2] CBR = California Bearing Ratio of the in-place subgrade soils. Methods of estimating CBR are discussed in section 7 of


Wheel Load
Well Graded
Surface Material
Fabric
Fabric
Soft Subgrade


CAT

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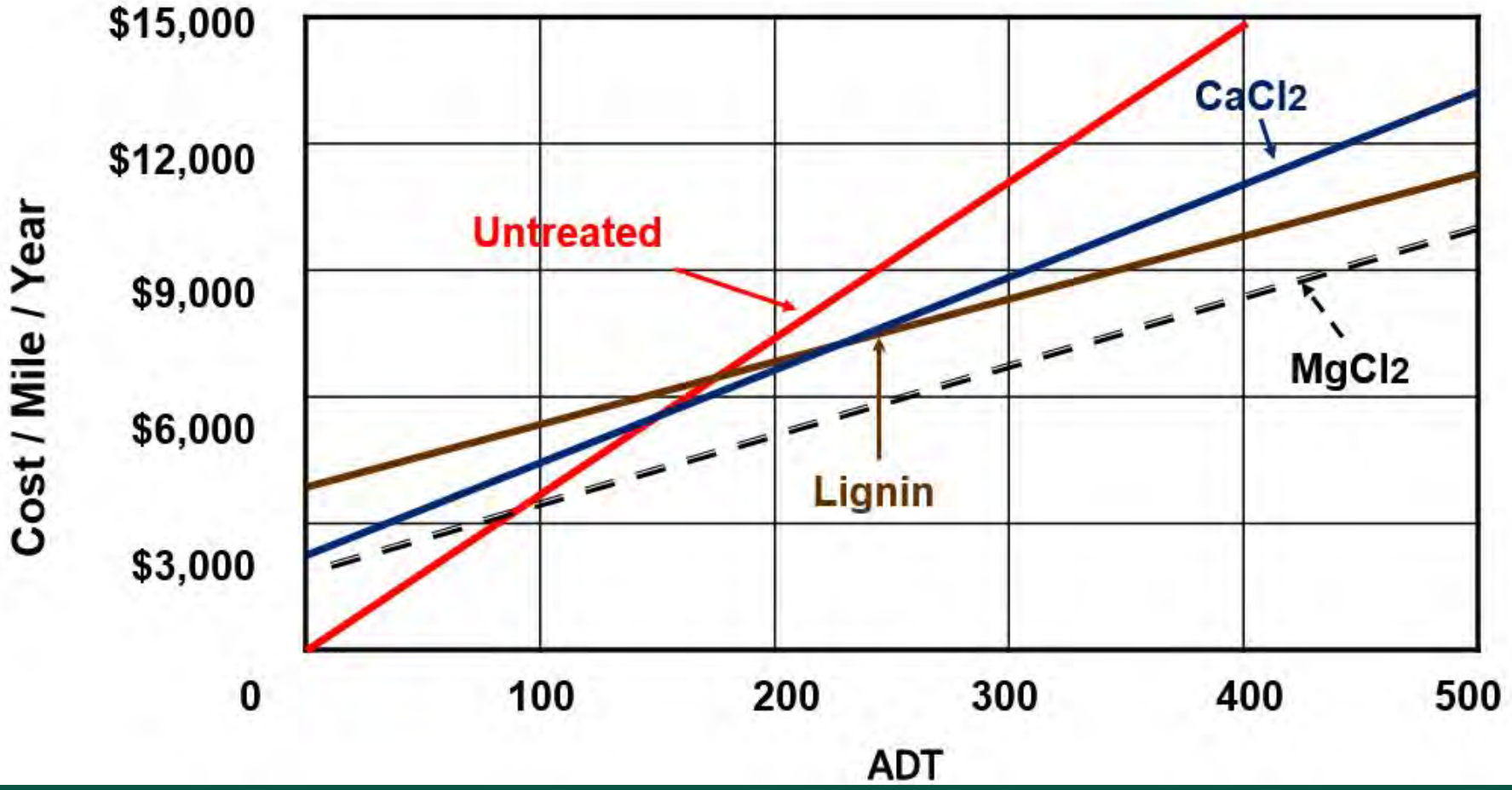
Cost of Treatment vs ADT



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- Publications
- Ground Water
- Waste Water
- Surface Water
- Storm Water
- Animal Feeding Operations

Rules & Forms

- **GENERAL / MISCELLANEOUS RULES**

  Standards of Quality for Waters of the State - NDAC 33-16-02.1

  Control, Prevention, and Abatement of Pollution of Surface Waters - NDCC Chapter 61-28 (also applies to ground

- **GROUND WATER PROTECTION PROGRAM RULES**

- **GUIDELINES FOR THE USE OF OILFIELD SALT BRINES IN DUST AND ICE CONTROL**

ND

SDDOT/SDLTAP Surface Gravel Study

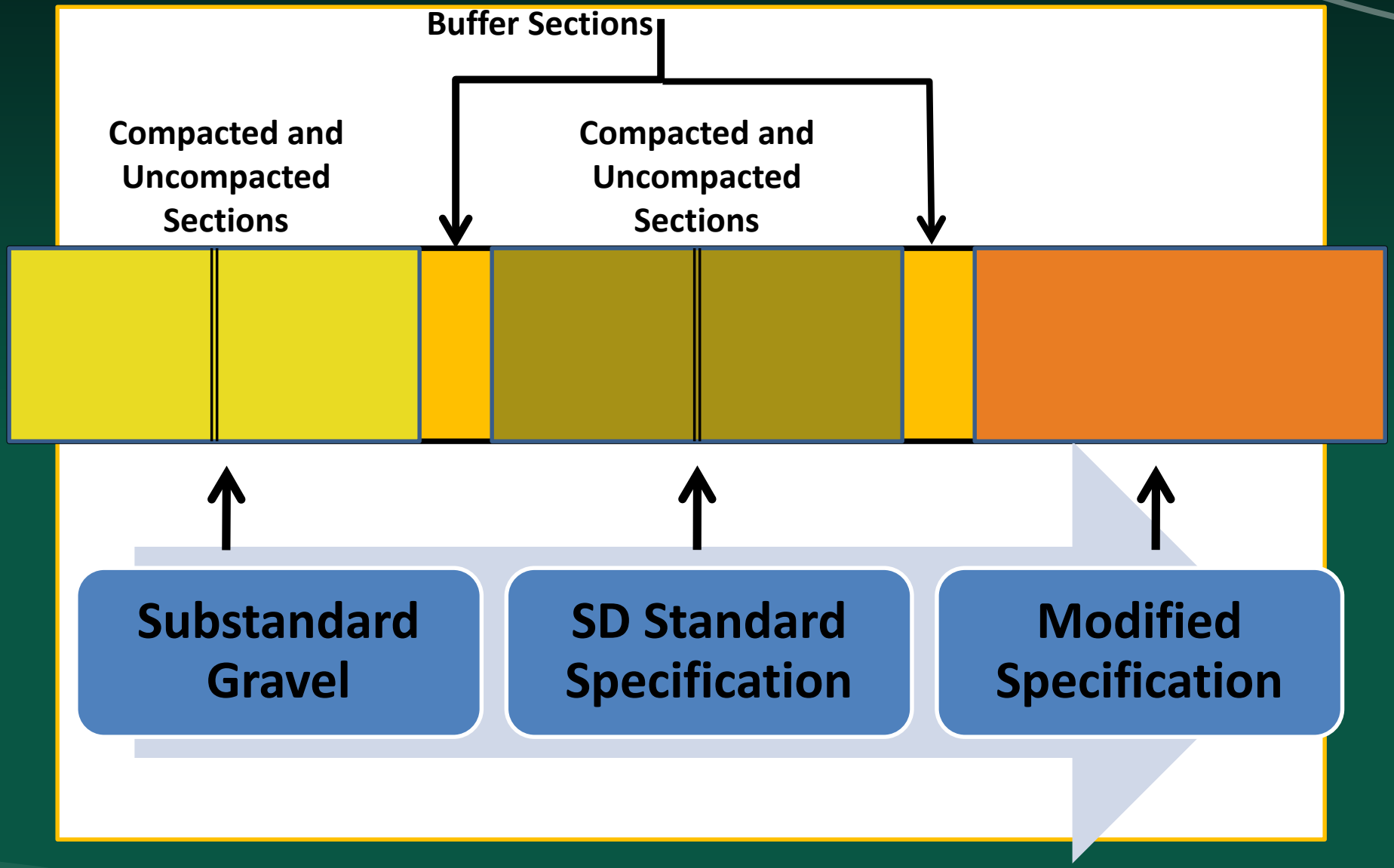
Brookings Site:

Constructed in 2011

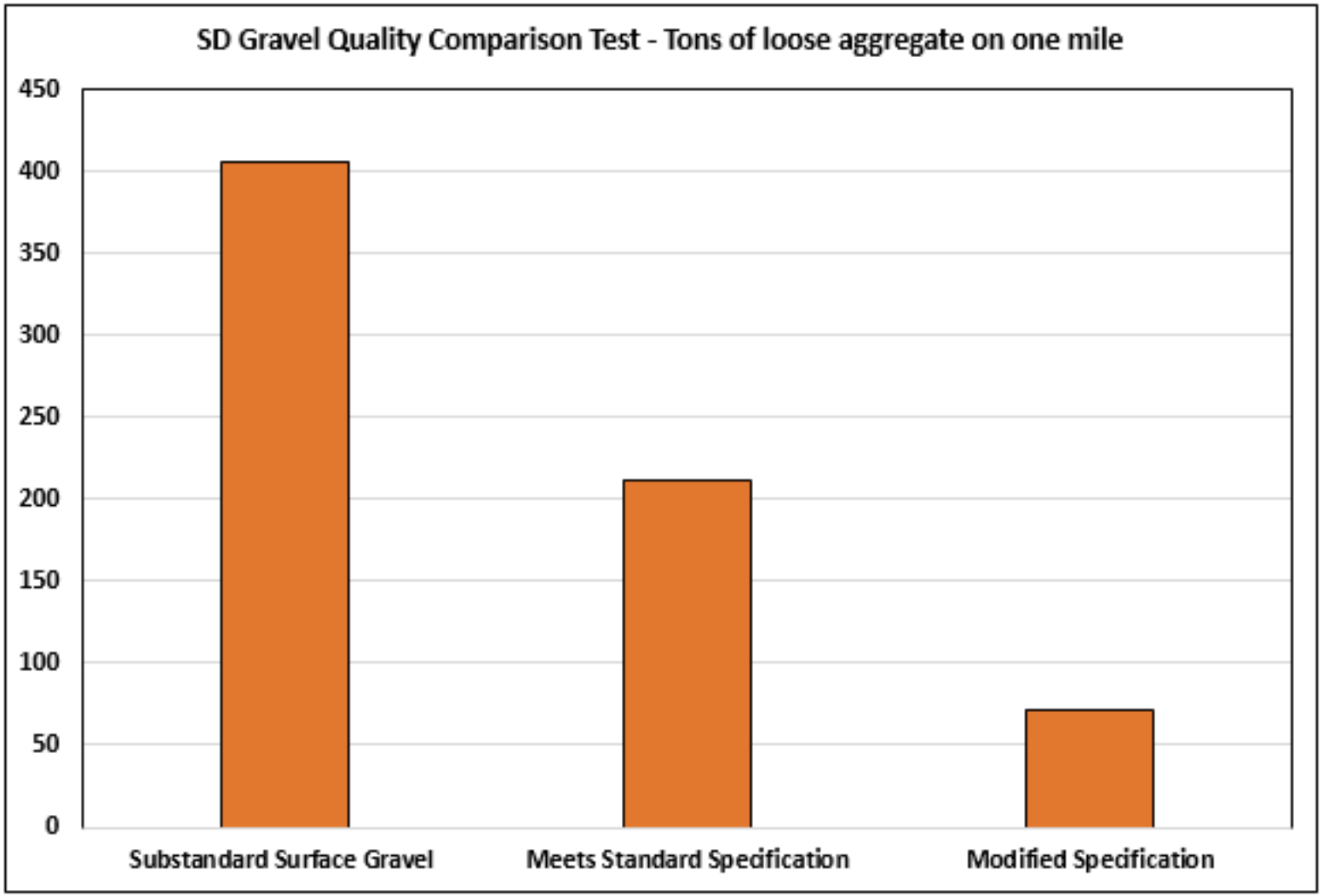
Observed in 2012, 2013, 2014 & 2015

Focus of Test Project

- **Primary focus is on effect of gravel quality on life-cycle cost of gravel road maintenance**
- **Three types of gravel used in study:**
  1. **Substandard but commonly used – meets no spec except top size control – one inch minus.**
  2. **Barely meets SDDOT Gravel Surfacing Spec – percent passing #200 sieve is low and/or plasticity index (PI) at bottom of range at 4**
  3. **Modified SDDOT Spec – higher minimums of 10% passing #200 sieve and PI at 7.**


Buffer Sections
Compacted and Uncompacted Sections
Compacted and Uncompacted Sections
Substandard Gravel
SD Standard Specification
Modified Specification

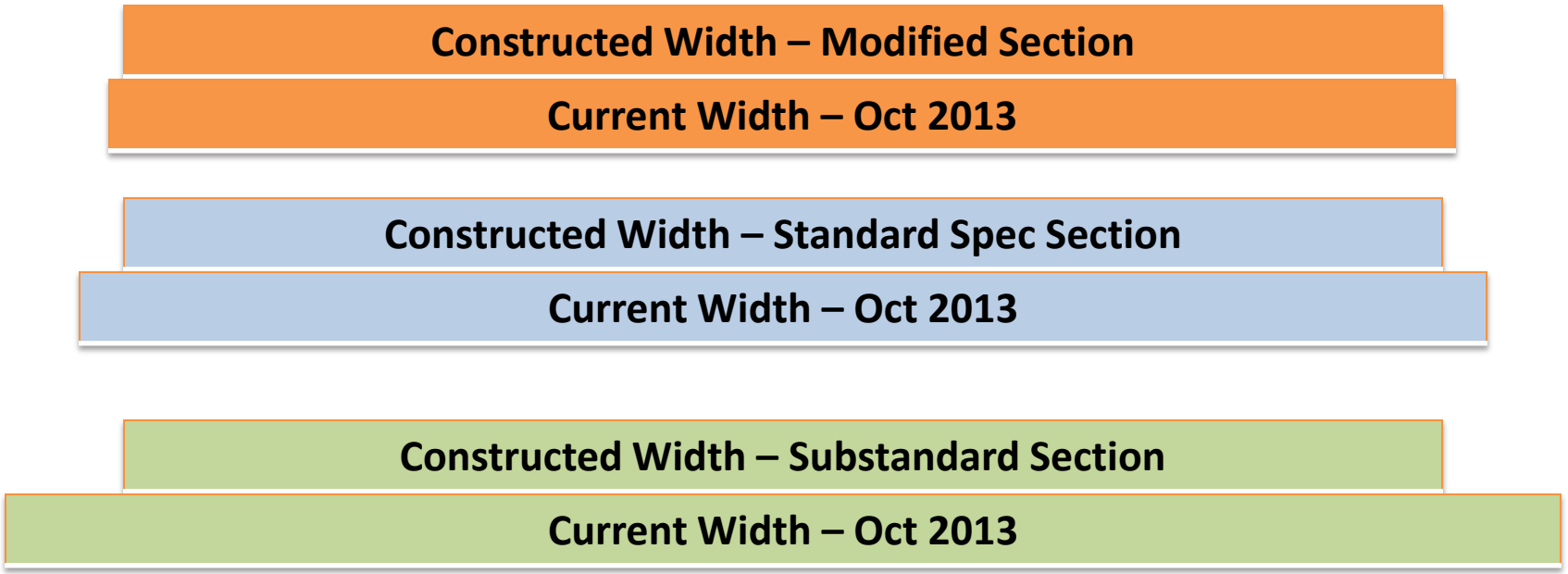
Volume of loose aggregate measured in a dry season was the biggest difference in the test sections.



The float test (loose aggregate)

Substandard section – aggregate has moved outward over 4 ft since construction

Change in Roadway Surface Width
Constructed Width – 21.5 ft on all sections



Current width ranges from 22 ft on modified section (top bar) to 25.25 ft on substandard section (bottom bar)

One of the biggest challenges was finding gravel that meets the modified SDDOT Specification: "Shall have minimum plasticity index (PI) of seven". (Even higher minimum was considered in project planning)

One way to meet modified spec – blend different material from separate sources

Road mixing natural clay to get a high quality surface gravel

The modified section in the spring after construction

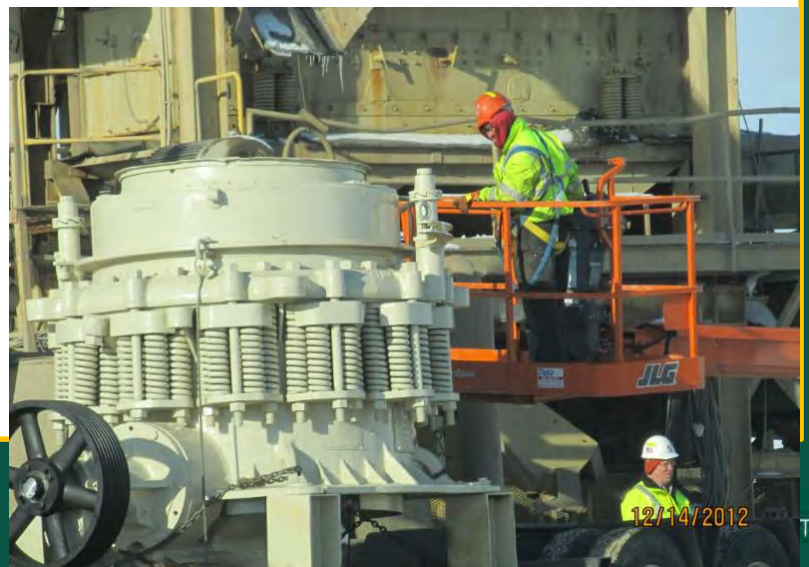
Corrugation was a problem on the substandard section. No corrugation on the modified section.

Concluding Points

- **Meeting basic SDDOT standard surface gravel specification reduces loose aggregate by 1/3 to 1/2.**
- **2012: 405 tons of loose aggregate on substandard section and only 71 tons on modified section.**
- **No corrugation ever observed on standard or modified material.**

Concluding Points (Con't)

- **Blade maintenance <u>four times on substandard section</u> and <u>once on modified</u>!**
- **Some aggregate producers have resisted change - prefer to produce as they always have – no close control of % passing the #200 sieve and plasticity index.**



Wyoming

	Substandard Uncompacted	Substandard Compacted	Barely Meets SDDOT Spec Uncompacted	Barely Meets SDDOT Spec Compacted	Modified SDDOT Spec
Loose gravel (tons/mile)	185	150	100	110	16
Corrugation (inches in height)	≤1 (2 days after blading and 3 inches of rain)	≤1 (2 days after blading and 3 inches of rain)	None	None	None
Roadway surface width (feet; all built 21½ feet)	26	26	24	24	22
Rutting	≤1	≤1	None	None	None

Blending fines into loose aggregate rejuvenates roads

Gravel roads can develop problems due to floating aggregate, an excess of large rocks left on the surface of the road when rainfall, vehicle traffic, or maintenance operations erode the fine particles binding the gravel together.

Local agencies have generally addressed the problem of floating aggregate by simply regraveling a road with an appropriate mix of new gravel and silt or clay fines. However, some parts of Minnesota have limited sources of aggregate, and extracting and hauling it to the road site are becoming more expensive.

To help reduce costs, the LRRB sponsored a project to see whether mixing fines into existing aggregate on a road could be an alternative to regraveling.

Test sections in Beltrami County provided significant cost savings over the control section. The section that received 83 tons of crusher dust cost $3,100 (36 percent) less than the aggregate control section, while the section that received only 50 tons of crusher dust saved $5,200 (61 percent).

The research suggests that the aggregate rejuvenation procedure will provide local agencies an option to save money while treating their gravel roads if a suitable binder is available and less expensive than locally available aggregate.

The final report (*Aggregate Road Surface Rejuvenation*, MnDOT 2015-04) and a technical summary (*Blending Fines into Existing Loose Gravel Costs Less Than Regraveling*, MnDOT 2015-04TS) are available at **lrrb.org**. *LTAP*

Minnesota

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DEPARTMENT OF TRANSPORTATION SUPPORT CENTER

Local Road Surface Selection Tool

Home Analysis Administration Hel

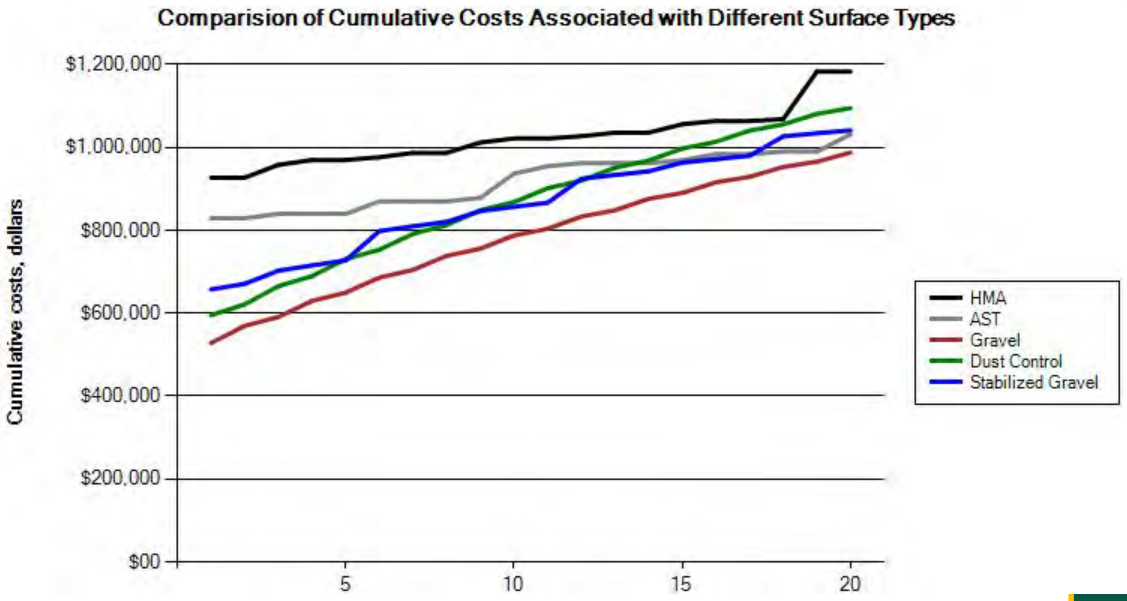
This analytical tool applies the low-volume road manager
under the project titled "Local Road Surfacing Criteria (SD
study is to develop a methodology that allows the user to co
different road surfaces. Specifically, this tool is used to dete
maintaining roads with different surfaces and selecting the
a specific set of circumstances. More information about this
clicking "Software Introduction".

Click "Start Analysis" to start a regular analysis.
Click "Administrator Login" to log in if you are an administrator.
Detailed user's guide is available by clicking "User's Guide".

DISCLAIMER: Although the information generated by this model has b
is believed to be reliable, the information generated by this model is for est
Transportation Institute and North Dakota State University make no repr
implied, regarding the accuracy or reliability of the model or results.



Surface Type	HMA	AST	Gravel	Dust Control	Stabilized Gravel
Total Initial Cost	$ 927,149	$ 804,269	$ 508,773	$ 568,200	$ 646,413
Total Maintenance Cost	$ 255,799	$ 227,348	$ 478,962	$ 526,793	$ 395,040
Total Salvage Value	$ 0	$ 0	$ 0	$ 0	$ 0
Total Agency Cost	$ 1,182,948	$ 1,031,617	$ 987,735	$ 1,094,993	$ 1,041,453



Geographic Roadway Inventory Tool (GRIT)

Easy to use software – free

Initial data to support Needs Study

Map based – Google Maps

Web browser based – any platform

- Mobile/touchscreen capable with GPS

County independent data editing

Compatible with existing interactive map

Linear Referencing or compatible with…

DOTSC Team Develops

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DEPARTMENT OF TRANSPORTATION SUPPORT CENTER
Geographic Roadway Inventory Tool

Unpaved Road Investment Needs (millions)

Period	Statewide	Oil Patch	Non-Oil
2015-2016	$548.0	$299.4	$248.6
2017-2018	$547.9	$299.2	$248.7
2019-2020	$547.5	$298.6	$248.9
2021-2022	$545.6	$296.6	$249.0
2023-2024	$541.9	$292.7	$249.2
2025-2034	$2,667.5	$1,422.9	$1,244.6
2015-2034	**$5,398.4**	**$2,909.4**	**$2,489.0**

Transportation Learning Network (TLN)

Transportation Learning Network
A partnership with MDT, NDDOT, SDDOT, WYDOT and the Mountain-Plains Consortium Universities

PRESENTATION SERIES 2015-2016

Gravel Roads Maintenance – New Manual Review

DATE: April 13, 2016
TIME: 9:00am – 3:30pm CT
REGISTRATION DEADLINE: April 1, 2016
DELIVERY: Video Conference
PRESENTATION HOURS: 5.5 hours

PRESENTATION DESCRIPTION

This presentation will help attendees develop a better understanding of the importance of materials, techniques, and equipment needed for maintaining and repairing gravel roads. It will provide technical details for best practices including blading techniques, shoulder management, proper roadway crown concepts and the use of fabrics for the repair of water saturated roadbeds. The workshop will show the benefits to be gained from good maintenance practices, enhance the skills of gravel road maintenance personnel. It will cover the changes to the updated Gravel Roads – Maintenance and Design Manual released last Fall. It will cover how to spec quality gravel, roadway design basics, work zone traffic control and much more.

SPEAKER(S)

Ken Skorseth is currently the Special Projects lead for the South Dakota Local Transportation Assistance Program (LTAP) at SDSU. Ken retired as the SDLTAP Program Manager in the fall of 2015. He has 12 years of experience in the highway and heavy construction industry and eight years as the Deuel County Highway Superintendent. Ken has studied unpaved roads across the US and as far away as New Zealand. He has lectured on the subjects of gravel road maintenance and low volume road maintenance to audiences of engineers, managers, elected officials and maintenance workers over the past 20 years. Ken has been coined the **Gravel Guru**. His passion for the subject is contagious. The fruit of Ken's efforts to update and expand the ultimate resource for gravel roads, the *Gravel Roads – Maintenance and Design Manual*, were unveiled in the August 2015 revised manual release.

TARGET AUDIENCE

This presentation is intended for state, county, or city personnel, technical staff, and maintenance forces responsible for maintenance of gravel shoulders or gravel roads. Private contractors employed to perform haul road maintenance on gravel roads are also encouraged to attend. *This presentation was last shown on April 9, 2015. While some of Ken's presentation is a repeat, the information is worthy of review. Additionally, Ken has added some new information that will be of interest to those attending a second time.* Be the first to hear what's new in gravel roads, sign-up for this must-attend presentation.

REGISTRATION / FEES

REGISTRATION DEADLINE: April 1, 2016

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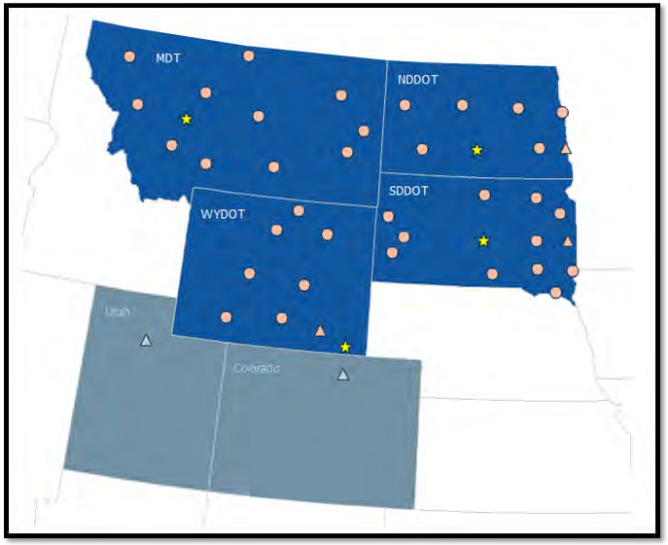

Materials testing is the foundation to quality roadway projects.

Contact

Sharon Taylor
NDDOT Materials and Research
Training Coordinator
701.328.6937
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Rachel A. Leigh
North Dakota State University
Upper Great Plains Transportation Institute
Instructional Design Specialist
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More online training modules and video demonstrations forthcoming.

NDDOT
North Dakota
Department of Transportation

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MATERIALS TESTING

Self-Paced Online Training Modules
Video Demonstrations

NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

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- Local Road Needs Study
- Staff Presentations

NDLTAP

Gravel/Motor Grader Resources

Roadway design, gravel quality and motor grader operation are key factors for maintaining gravel roadways. NDLTAP's Gravel/Motor Grader Resource section is a one-stop shop for gravel roadway information, providing gravel roadway training and technology ranging from resource publications to hands-on motor grader field training.

- Gravel Roads Manual *(PDF, 18278K)*
- Montana 2000 Gravel Manual *(PDF, 4900K)*
- Motor-Grader Maintenance Presentation *(PDF, 3549K)*
- Slope Meter *(PDF, 2024K)*
- Gravel Roads - Sargent County Township Meeting
- Montana Gravel Road Video - Flathead County *(MACRS/Montana LTAP production)*
- Gravel Road Maintenance: Meeting the Challenge (video) *(AMK Production Services)*

With more than 50% of North Dakota's 106,00 mile roadway network relying on gravel surfacing it is imperative that gravel roadway technologies be shared and that technology advancements be an integral part of the state's asset management plan.

Helen Keller

“Alone we can do so little;
together we can do so much.”

Thank You!

Dale C. Heglund, PE/PLS
NDLTAP Director
701-318-6893
Dale.Heglund@ndsu.edu

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NORTH DAKOTA LOCAL TECHNICAL ASSISTANCE PROGRAM

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