Preserving and Protecting Rural Roads:

Proactive Steps Wisconsin Towns, Counties and the Ag Industry are Taking

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Why Industry is Involved

- **Road/Bridge issues in 3 top priorities identified in initial organizational meetings**
- **Continues to be a growing concern statewide and regionally.**

The Issues

- **Many rural roads are not designed for heavy loads.**
- **Farm equipment (all types) is getting larger and larger.**

The Issues

- **Farm equipment regulations (WisDOT) had not changed as equipment has evolved.**

The Issues

- **Unknown impact of innovations in axle spacing, tire design (and type) on rural roads.**

- **Conflicting previous research studies (SD, IA)**

The Issues

- **Many smaller loads vs. fewer large loads-which is best?**
- **PSI (Pounds per square inch) on pavement or axle weight?**

Background

- **Study initiated by Professional Nutrient Applicators Association of Wisconsin (PNAAW) in consultation with industry.**
  - Several others with similar interest, including Wisconsin Towns Association, Minnesota county highway engineers, DOT in IA, IL, MN, WI.

Background

- $640,000 invested by industry and agencies

MnROAD Research Facility

- A comprehensive pavement research facility
- Constructed in 1994 and located about 40 miles NW of the Twin Cities
- Mainline and Low Volume Road (LVR) sections
- Originally more than 4,500 sensors embedded within 40 sections
- Strain gauges, LVDTs, thermocouples, pressure cells, etc.

MnROAD Farm Loop

- PCC Test Sections

- HMA Test Sections

Background

- Industry Partnership
  - Manure Applicator Associations/groups
    - WI, MN, IA, OH-IN, PA, MI
  - Farm equipment manufacturers
    - Husky, Houle, Deere, CNH, AgCo
  - Tire manufacturers
    - Titan, Michelin, Firestone/Bridgestone

Major Objectives

- Determine pavement responses to selected agricultural equipment using instrumented pavements.
- Compare pavement response to typical 5-axle semi (80,000 lbs).

Testing Schedule

- As frost comes out (worst case) 08, 09, 10
  - Target frost law week
- Driest part of year (August) 08, 09, 10
  - Captured both a wet and dry August
- Mid-point temperature (November) 10

Cell 84 (Thick)

- 5.5” HMA with PG58-34
- 9” gravel aggregate base
- A-6 subgrade soil (existing subgrade soil).

Cell 83 (Thin)

- 3.5” HMA with PG58-34
- 8” gravel aggregate base
- A-6 subgrade soil (existing subgrade soil).

Calumet County Cross-Section

Cemetery Road, Forest Junction, Spring washout, 2012

- Cell 32
  - 5” PCC
  - 6” Aggregate base

- Cell 54
  - 7.5” PCC
  - 12” Aggregate base

Equipment Tested

- Provided by haulers and industry
- Could not have done it without our partners


S4 (Homemade 4400 gal – radial tires)


S5 (Homemade 4400 gal – flotation tires)


T6 (John Deere 8230, 6000 gal)


T7 (Case IH 335, 7300 gal)


S3 (AGCO Terragator 8204)


R4 (AGCO Terragator 9203)


T8 (Case IH 335, 9500 gal)


G1 (Case IH 9330, 1000 bushels)


R5 (AGCO Terragator 8144)


R6 (AGCO Terragator 3104)


Mn80 (Navistar 80-kip)


Mn102 (Mack 102-kip)


T1 (John Deere 8430, 6000 gal)


T2 (M. Ferguson 8470, 4000 gal)

MN: 80,000 LB

S1/S5: 4400 gal

MN: 102,000 LB

S2/S4: 4400 gal

T1: 6000 gal (Houle)

T2: 4000 gal

T3: 6000 gal (Husky)

G1: 1000 Bushel

T4: 7300 gal

T5: 9500 gal

S3: 1800 gal

R4: 2400 gal

R5 (*8144*): 2300 gal

R6(3104): 4200 gal

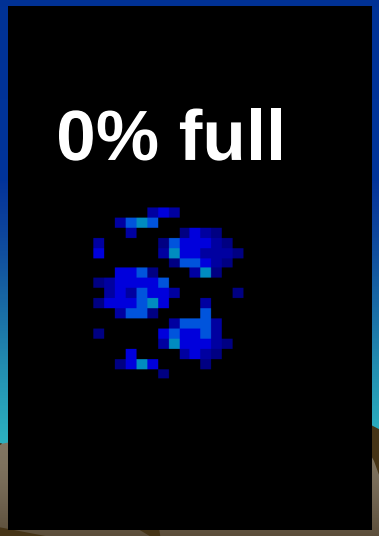
Testing

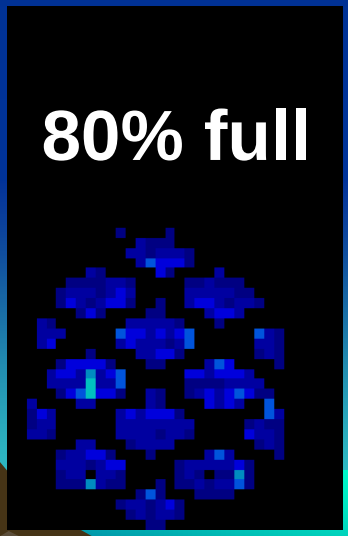
Test Season	Test Dates	Vehicle Passes	
		AC	PCC
Spring 2008	March 17th – 19th & 24th – 26th	400	48
Fall 2008	August 26th – 29th	282	72
Spring 2009	March 16th – 20th	960	170
Fall 2009	August 24th – 28th	782	360
Spring 2010	March 15th – 18th	776	344
Fall 2010	August 18th – 19th	426	204
	Total	3,626	1,198

Weights

Vehicle ID	Type	Vehicle Make	Size	Gross Weight	Max Axle Weight	# of Axles
S4	Straight Truck	Homemade	4400 gal	65622 lb	24678 lb	3
S5	Straight Truck	Homemade	4400 gal	62220 lb	23474 lb	3
S3	Terragator	AGCO Terragator 8204	1800 gal	49246 lb	34000 lb	2
R4	Terragator	AGCO Terragator 9203	2400 gal	58018 lb	43742 lb	2
R5	Terragator	AGCO Terragator 8144	2300 gal	47100 lb	29950 lb	2
R6	Terragator	AGCO Terragator 3104	4200 gal	74700 lb	41900 lb	2
T1	Tanker	John Deere 8430 w/ Houle tank	6000 gal	81320 lb	29044 lb	4
T2	Tanker	Massey Ferguson 8470 w/ Husky tank	4000 gal	64028 lb	20042 lb	4
T6	Tanker	John Deere 8230 w/ Husky tank	6000 gal	89600 lb	33900 lb	4
T7	Tanker	Case IH 335 with Houle tank	7300 gal	105200 lb	26300 lb	5
T8	Tanker	Case IH 335 with Houle tank	9500 gal	134200 lb	25200 lb	6
G1	Grain Cart	Case IH 9330 with Parker 938 cart	1000 bushels	87400 lb	57200 lb	3
Mn80	Semi Truck	Navistar	NA	80150 lb	17800 lb	5
Mn102	Semi Truck	Mack	NA	103100 lb	25000	5

Axle Weight and Contact Pressure Measured





Results

- Pavement damage did occur under certain conditions, but not under others
- Several key steps you can take to minimize damage potential

Cell 83 (Spring,09)

Cell 32 (Spring 09)

Cell 83 (Fall 09)

Key Damage Variables

- Axle weight
- Distance from edge of pavement
- Pavement Construction / Drainage

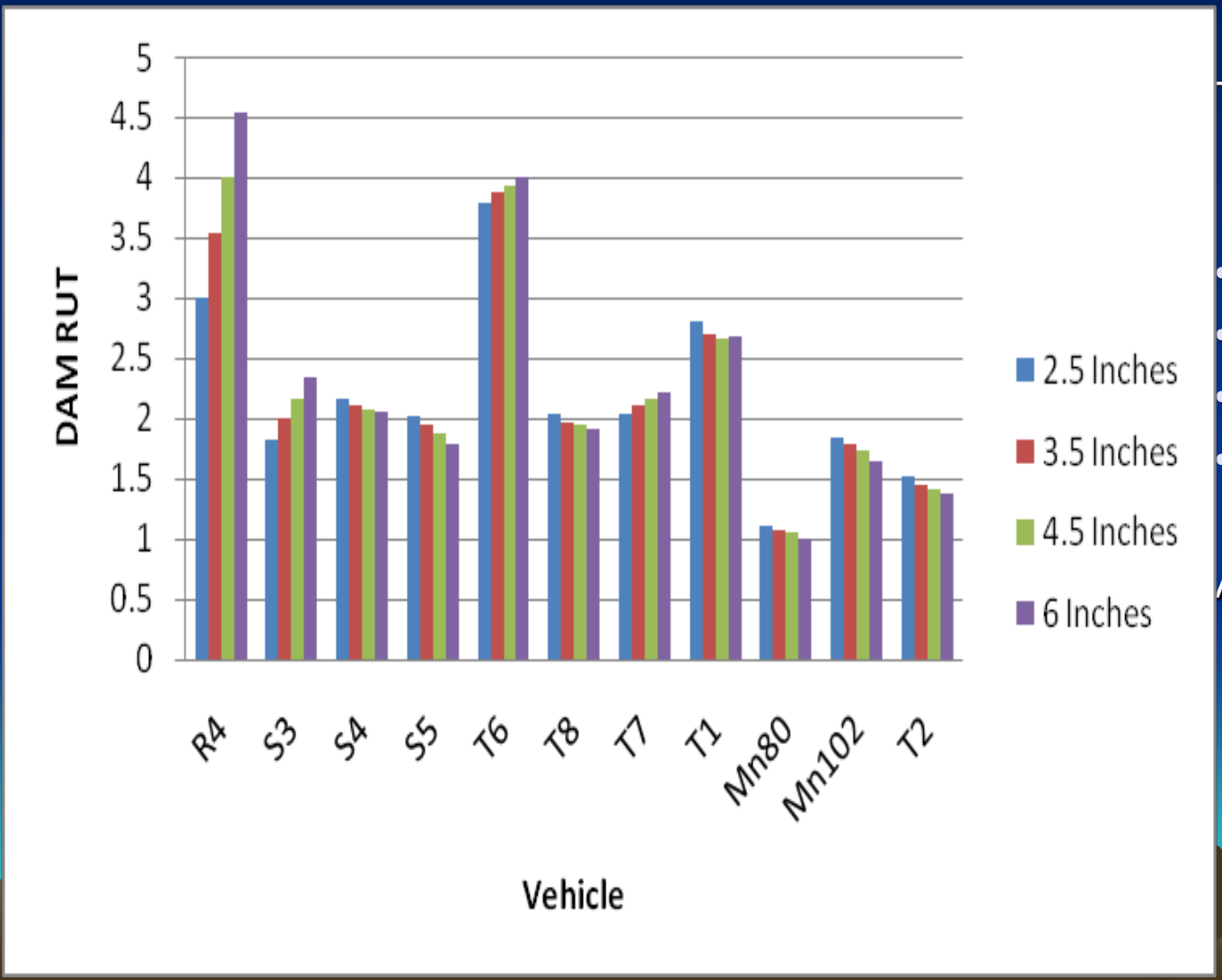
Axle Weight / Equipment

- Per-axle weight is a critical factor – much more so than total vehicle weight
- Equipment must be properly set up and adjusted

Vehicle Weight (# of Axles)

- T6, John Deere 8230, **6000 gal**
  - 100%: 60.0 kip (26.5 and 33.5 kip)
- T7, Case IH 335, **7300 gal**
  - 100%: 79.5 kip (26.3, 26.2, and 26.0 kip)
- T8, Case IH 335, **9500 gal**
  - 100%: 94.2 kip (23.3, 23.7, 23.5, and 23.7 kip)

Rutting potential: heaviest axle



T1 and T6 are both 6,000 gal tankers.

- T1 is balanced
- T6 is not
- T8 is 9,500 gal/4 axle
- T7 is 7,300 gal/3 axle

ALL are more damaging than 80K semi

Distance from edge of pavement

- Asphalt strain / subgrade damage ***drop*** by >75% if center of tire is 16 or more inches way from asphalt edge
- Concrete: Key is slab edge distance

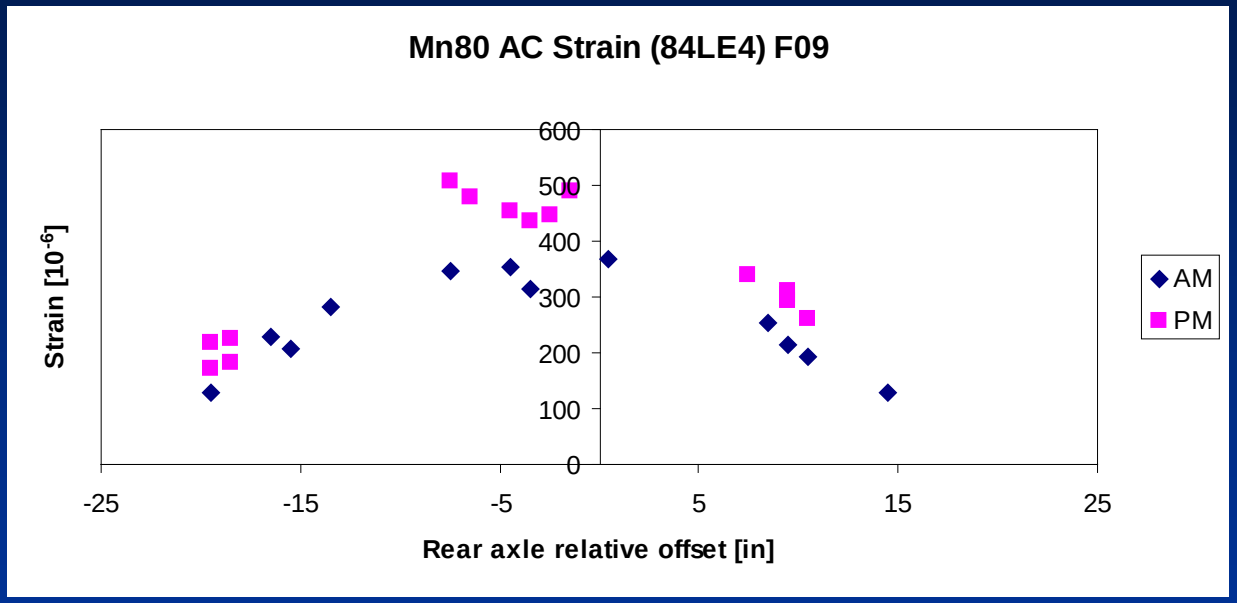
Distance from edge of pavement

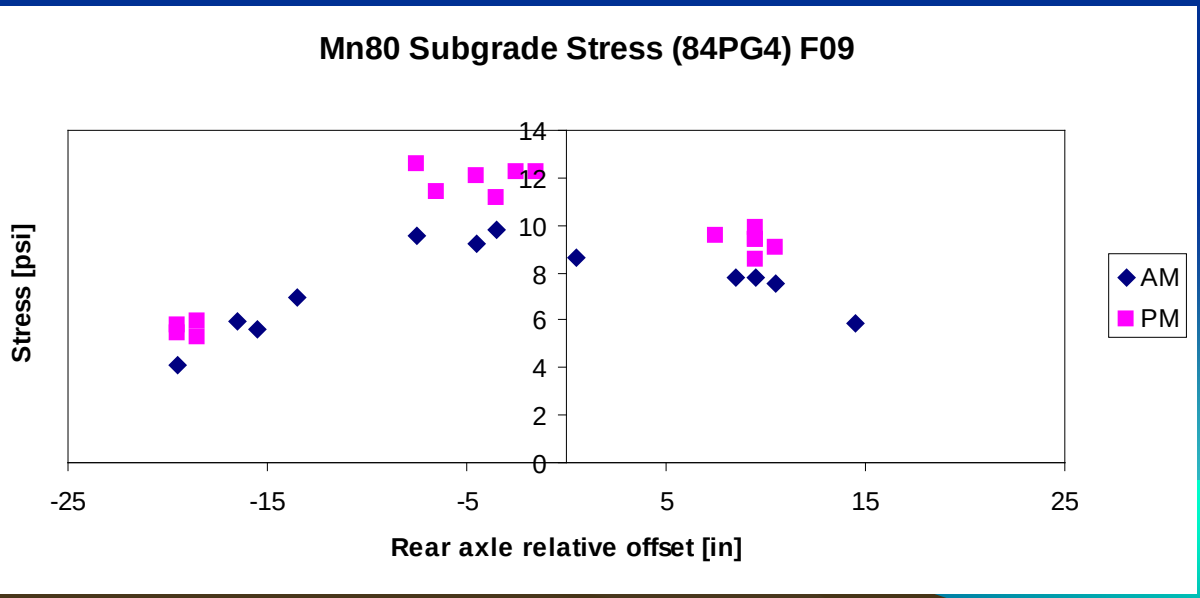
- Paved shoulder (if not driven on) makes a huge difference

Seasonal Differences

- Avoid critical times of year
  - When frost is leaving the subgrade
  - When road subgrade is wet
- Consider critical time of day
  - Less damage in morning than afternoon
    - Move manure in morning in early spring

Time of Day


Mn80 AC Strain (84LE4) F09
Strain [10-6]
600
500
400
300
200
100
0
-25
-15
-5
5
15
25
Rear axle relative offset [in]
AM
PM


Mn80 Subgrade Stress (84PG4) F09
Stress [psi]
14
12
10
8
6
4
2
0
-25
-15
-5
5
15
25
Rear axle relative offset [in]
AM
PM

Pavement Construction

- Quality of subgrade/asphalt is critical.
  - Where contractor skimped (2½ vs. 3½ inches of asphalt), damage appeared quickly.
  - No damage seen on 5 ½ in

Bottom Line

- 3 ½ inch thick asphalt showed more damage for ALL ag equipment than 80K truck

- 5 ½ inch thick asphalt showed negligible damage (manure tankers)

Proactive Steps to Extend the life of rural roads

Proactive Solutions: Short and Long Term

- Move traffic away from shoulders
  - Sheboygan, Waupaca, Manitowoc Counties
- Improve Drainage
  - Brown, Waupaca
- Change road construction
  - Brown, Waupaca, Door Counties

Short Term: Move traffic to center of road

- One way traffic (limited or full) is the best way to accomplish it
- Safer operation

One Way traffic

- Applicators & farmers work with local towns and counties to make roads one-way for manure hauling

Shoulder Driving

- Increase distance between asphalt edge and tire center.
- Do not drive on shoulder
  - 1’ asphalt on mud will not protect the road the same as a well built shoulder

Note where tire is in relation to shoulder edge!

Proactive Solutions

Two Creeks (Manitowoc County) approach Rockland (Brown County)

- Farmer, hauler, town meet prior to application
  - Farmer/hauler and town chair discuss routes for hauling, considering traffic, road condition, topography and safety.
  - All parties mutually agree on best route for loaded and empty traffic.
    - Given and take by all sides.

Proactive Solutions
Lima (Sheboygan County) approach

- Farmer, hauler, town meet prior to application
  - Designate certain roads as one way ***except*** for emergency traffic for limited time period (2-3 days).
  - All traffic (including farmer and hauler) must follow.
    - Empties go long way around.
    - Also done in Two Creeks in Manitowoc County

Proactive Solutions
Lima (Sheboygan County) approach

- Farmer, hauler, town meet prior to application
  - Farmer meets with neighbors, road users (school busses) to inform/explain in advance. Town notifies 911 and local responders.
  - Town and farmers should set procedure (who to contact – clerk, who notifies fire dept, etc and required advance notice)

Proactive Solutions
Lima (Sheboygan County) approach

- Results and Suggestions
  - Lack of education led citizens to move barricades.
  - Enforcement needed at start to spread word that signs must be obeyed (warnings, not tickets)
  - “No Complaints” in Two Creeks in Manitowoc County

Proactive Solutions

One Way Roads - Costs

- May save or cost farmer money – depending on other roads, traffic patterns and bridges
  - Loaded right turns, simple return path – **20% more loads per hour possible**
    - Not meeting empties (slow down/pull over)
    - Not meeting cars/passed by cars
  - Longer run with empties can wipe out savings.

Proactive Solutions

Town of Wrightstown (Brown Co) approach

- Farmer, hauler, town meet prior to application
  - Close short segment of certain roads to allow dragline to lay over road surface for limited time period (2-3 days).
  - Placement to minimize traffic disruption and hassle to residents on road
    - Other applicators have used this approach and place drive-over ramps to allow emergency traffic to pass.

Proactive Solutions

200+ in Wisconsin

- Dedicated borings/culverts for pipelines / draglines
  - Extends to private property on both sides
  - Thread-through
  - Direct connect

Proactive Solutions
Underpavement/long distance pipes

- Construction Considerations
  - State/County/Town permitting process
    - Annual inspections required?
  - Road/Pavement impacts
  - Location compared to other utilities
    - Inside/outside public Right-of-Way?

Proactive Solutions
Underpavement/long distance pipes

- Long-Term Considerations
  - Ownership/maintenance
  - Farm membership in Diggers Hotline
    - Green Valley Dairy/Rosendale Dairy
  - Future costs
    - Relocation/road reconstruction

Proactive Solutions

Door County Pull-offs

Allows semis to unload off the road – serve as a "focal point" for a one mile radius

Unintended Consequences

- Issue: weight on edge AND de-acceleration
- Solutions:
  - Closing road and parking in middle
  - Paved pad for transfer
    - Brown County

Longer Term Solutions

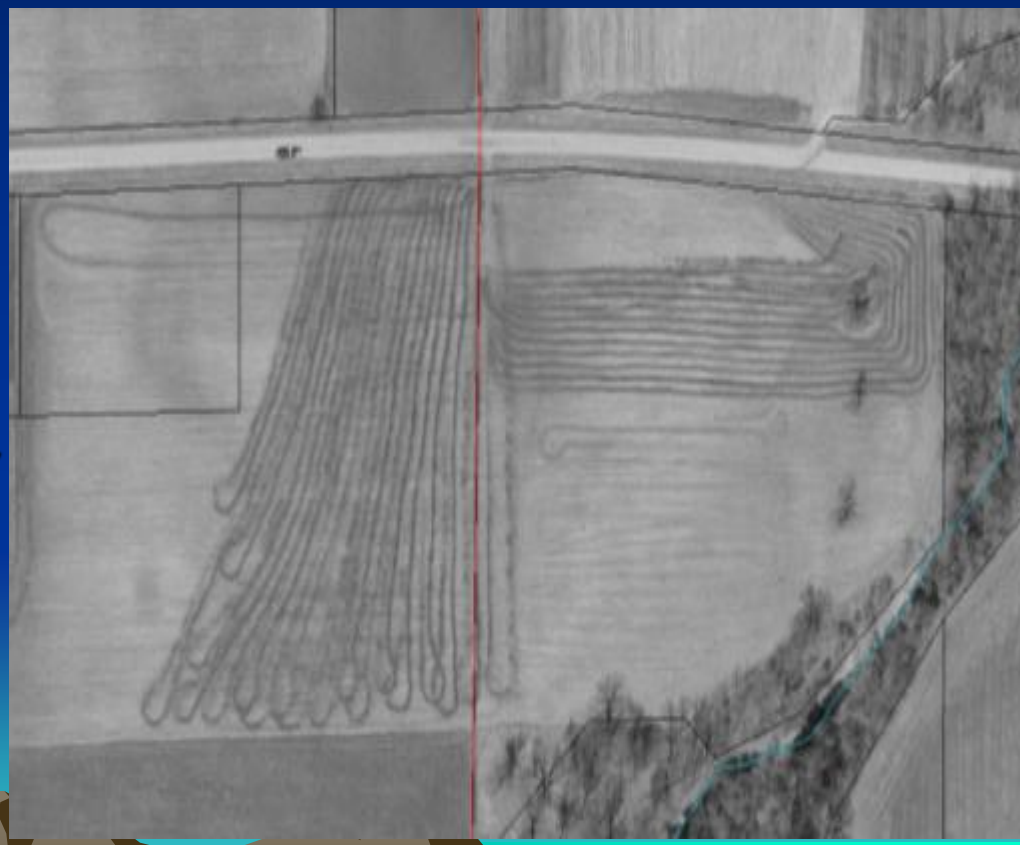
- What causes the damage and what can be done?

Intersections: De-acceleration

Intersections: De-acceleration

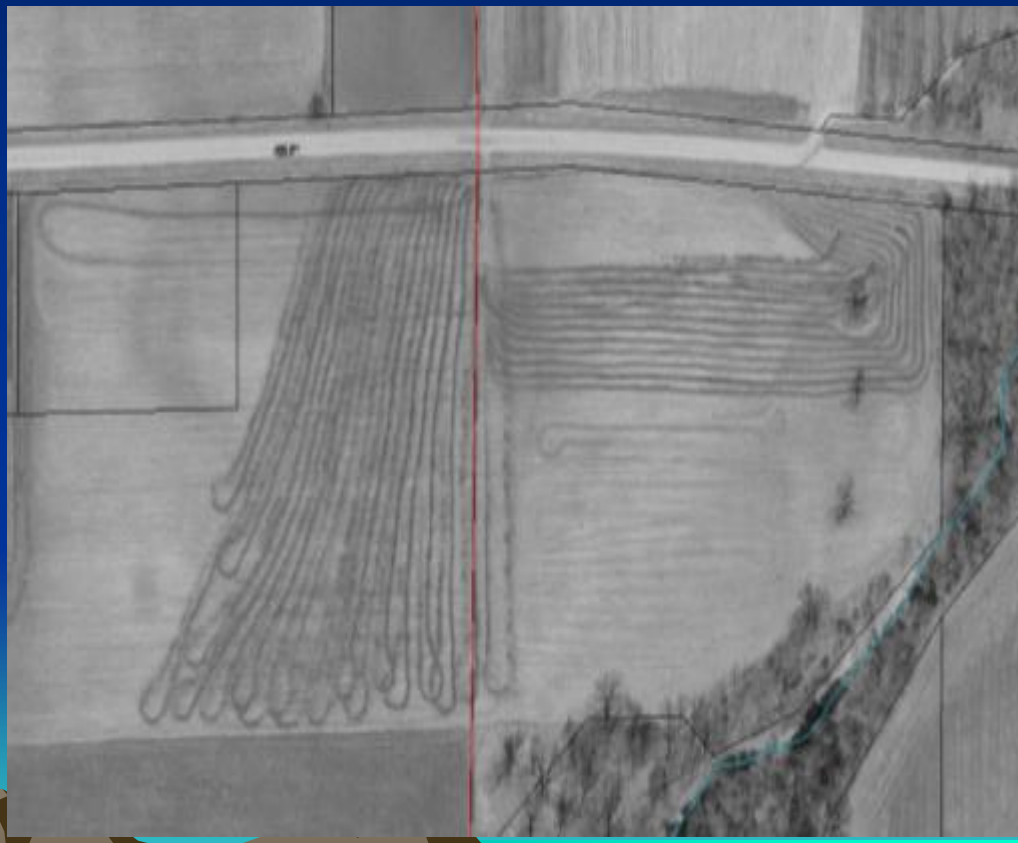
Edge Eaters

- Cut thru road ditch
- Turning in and out of driveway
  - Driveway entry
  - Far edge where equipment turning wide runs on shoulder



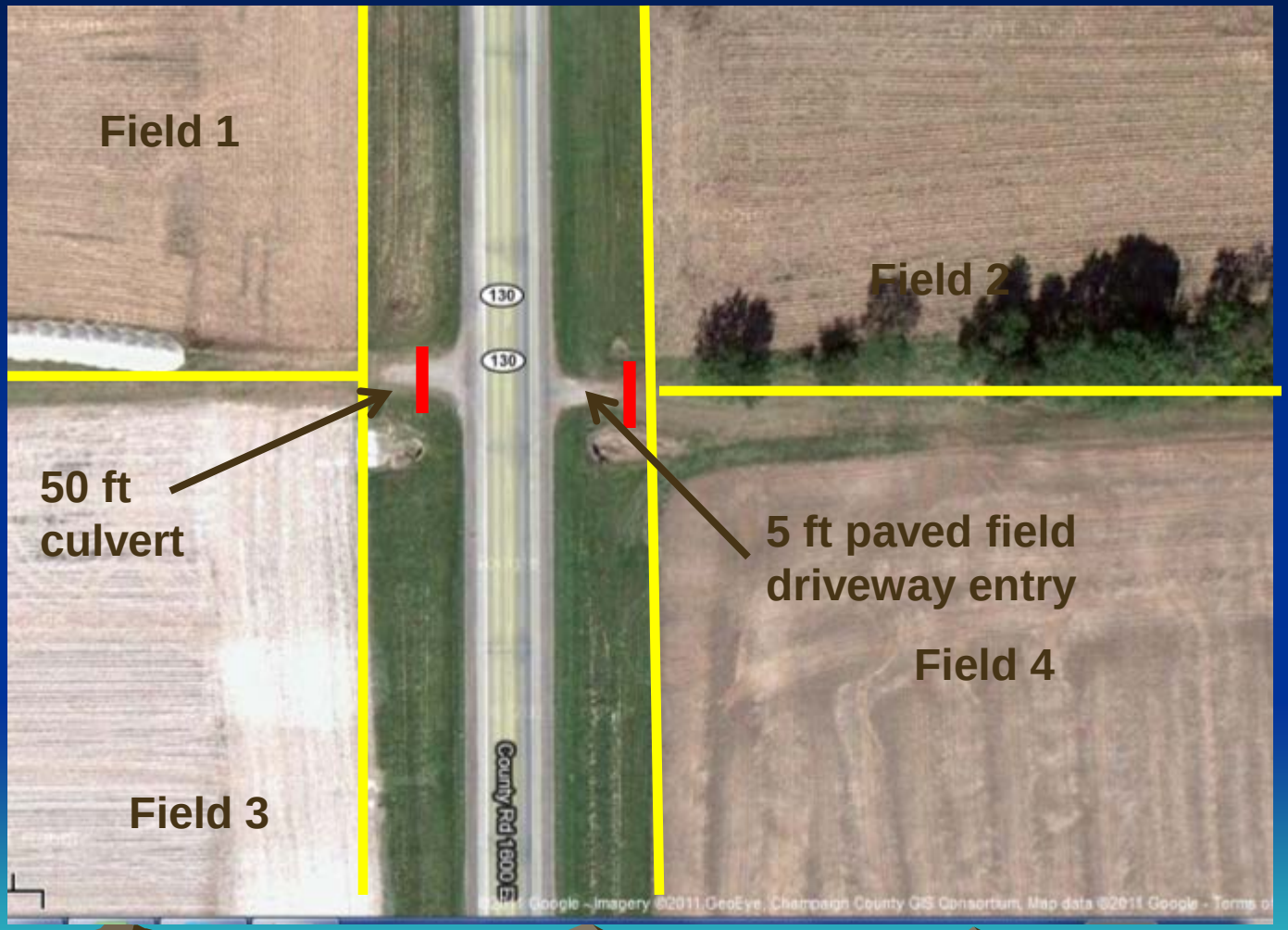
Edge Eaters

- Solutions
  - 50’ culverts
  - Enter field only at driveways



Moved and Shared Driveways

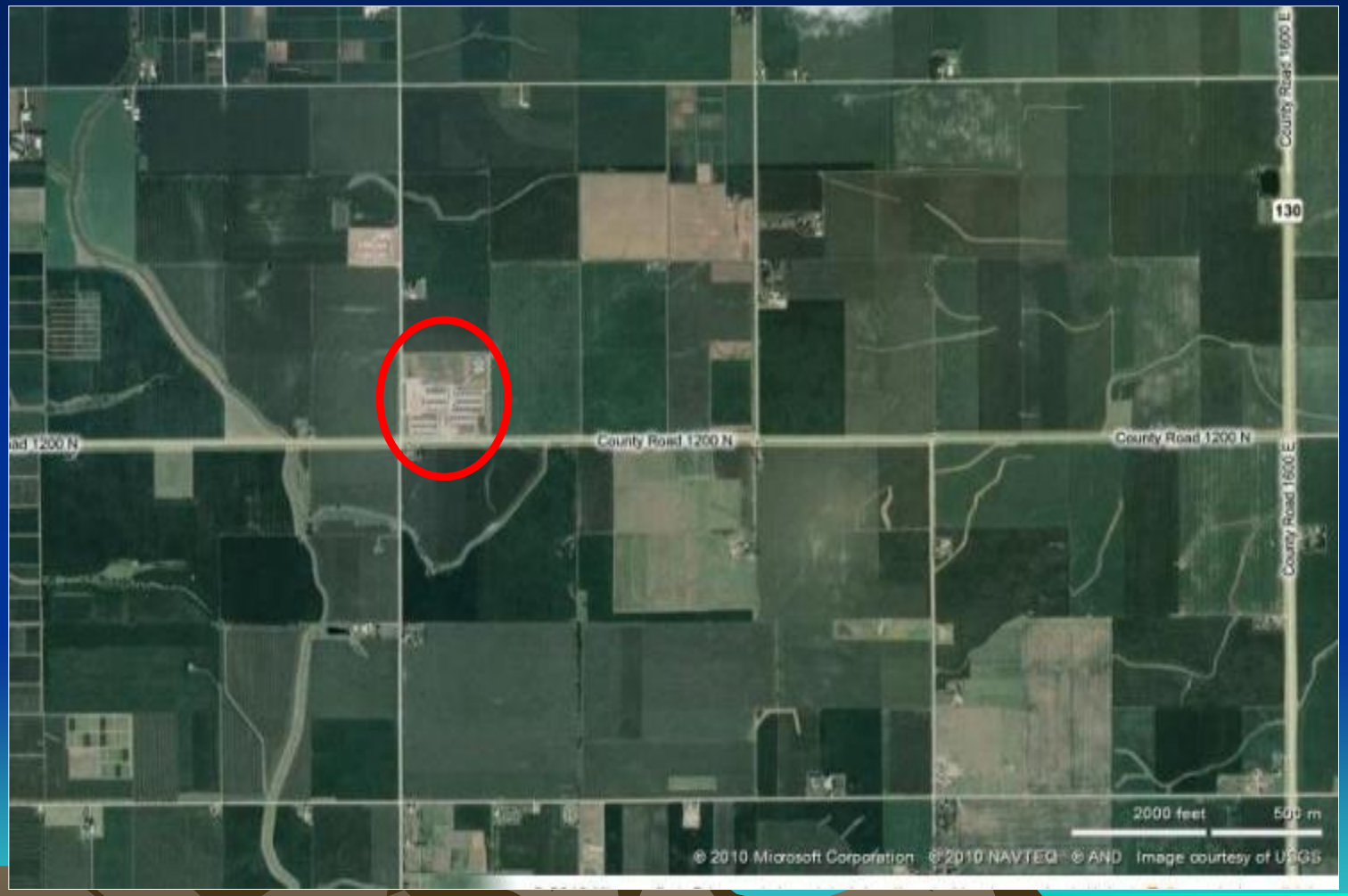
Moved and Shared Driveways



Rebuilding roads near farms

- Investment (by farm and by local government) up front can prevent problems

Selective Investment



Selective Investment

- Invest in high quality subgrade / surface
  - Acceleration
  - Deceleration
  - Turning / driveways
- Pave shoulders at turning points

Selective Investment

- Longer culverts at field and farm driveways with paved shoulders
- Curb and Gutter / drainage improvements
  - Protect pavement edge
  - Proper drainage

Selective Investment

How to pay for necessary improvements?

- TIF (Tax Increment Financing) district
- Special Assessments for specific improvements that impact only the farm
  - Turn lanes, wider culverts

Proactive Solutions

- Investigate before repairing.
  - Drainage in subgrade
  - Asphalt/subgrade thickness
  - Poor repair = future failure

Bottom Line

- Long term solution needs to involve farmers, towns/counties and the industry

Bottom Line

- Innovation needed given time crunch in our narrowing application window
  - Knee-jerk reactions (no hauling in spring, etc) are not going to solve the long term problem, and will cause even more problems long term.

Solutions require Partnerships

Counties and Farms:

- Need good roads
- Have limited resources
- Must work together to solve this issue

Questions?

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