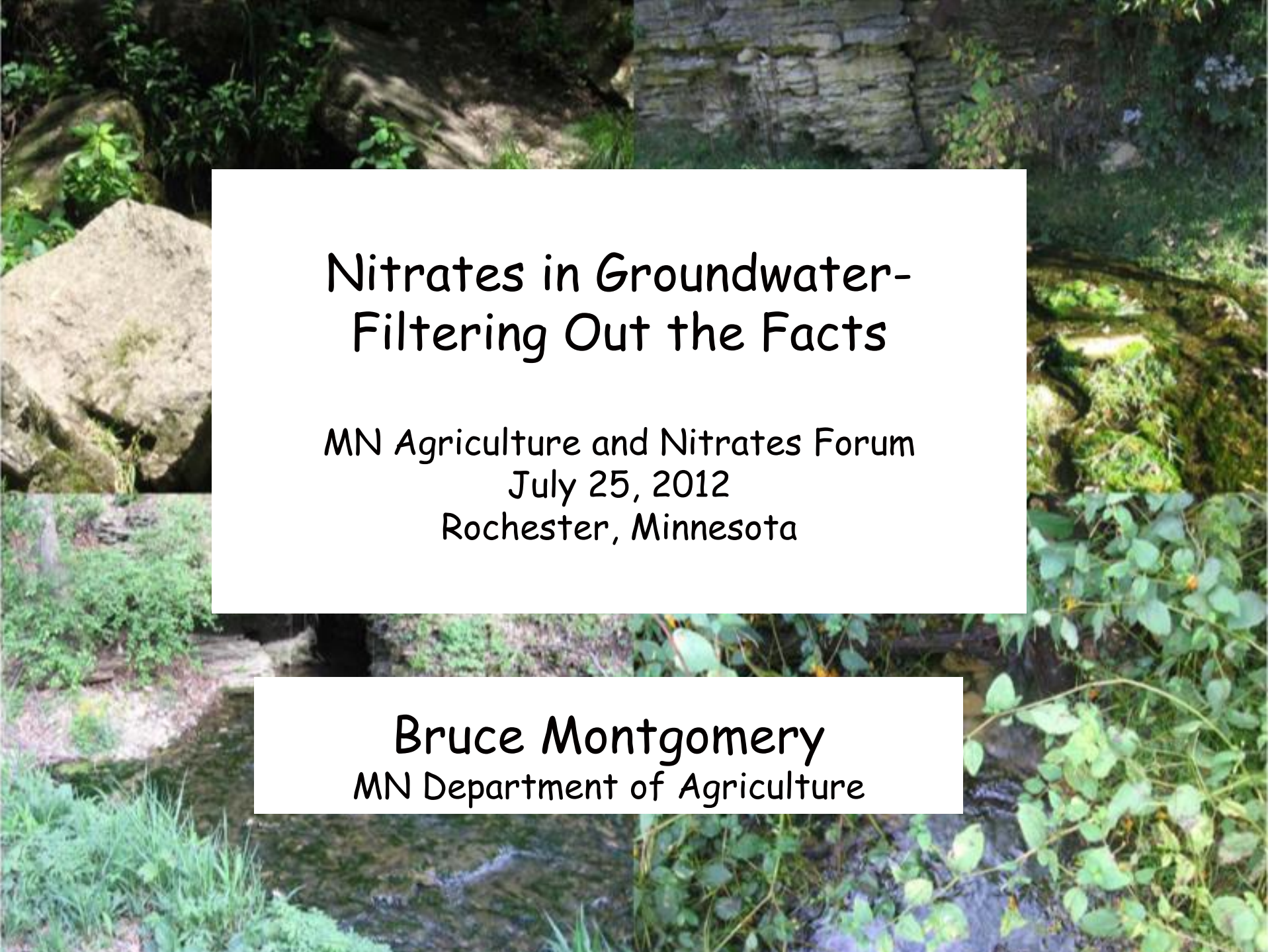


Nitrates in Groundwater- Filtering Out the Facts

MN Agriculture and Nitrates Forum
July 25, 2012
Rochester, Minnesota

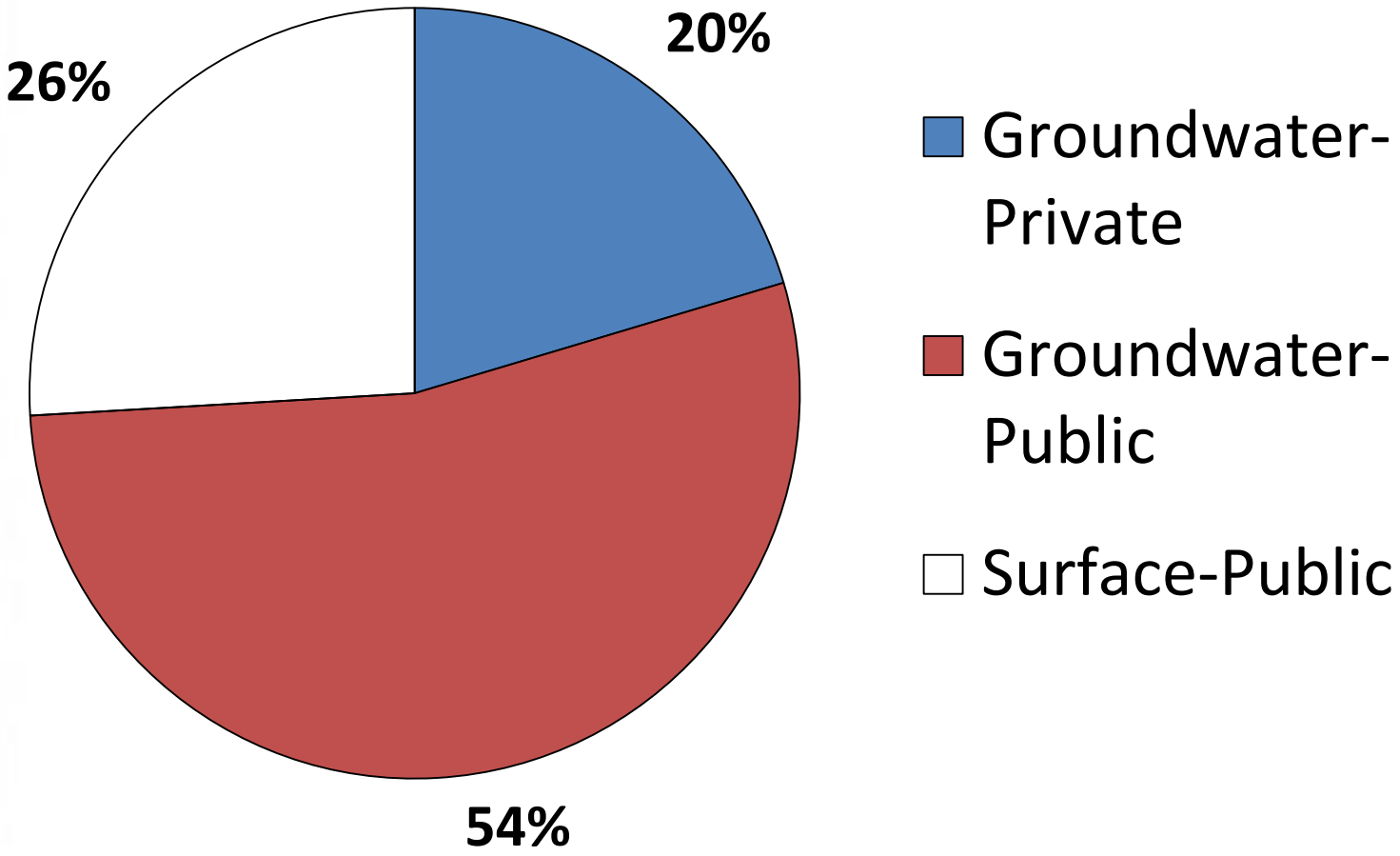
Bruce Montgomery
MN Department of Agriculture

Nitrogen Fertilizer Management Plan Review

- MDA is currently revising this Plan which has been in place since 1990;
- Plan provides direction on how the State should proceed when groundwater is adversely impacted by the use of nitrogen fertilizer;
- Committee is made up of agricultural organizations, state agencies, UM, county staff and environmental groups;
- Review and recommendations should be completed by early next year;
- Many of the materials discussed today have been presented and discussed

MINNESOTA DEPARTMENT OF AGRICULTURE

3 out of 4 Minnesotans get their drinking water from GROUNDWATER



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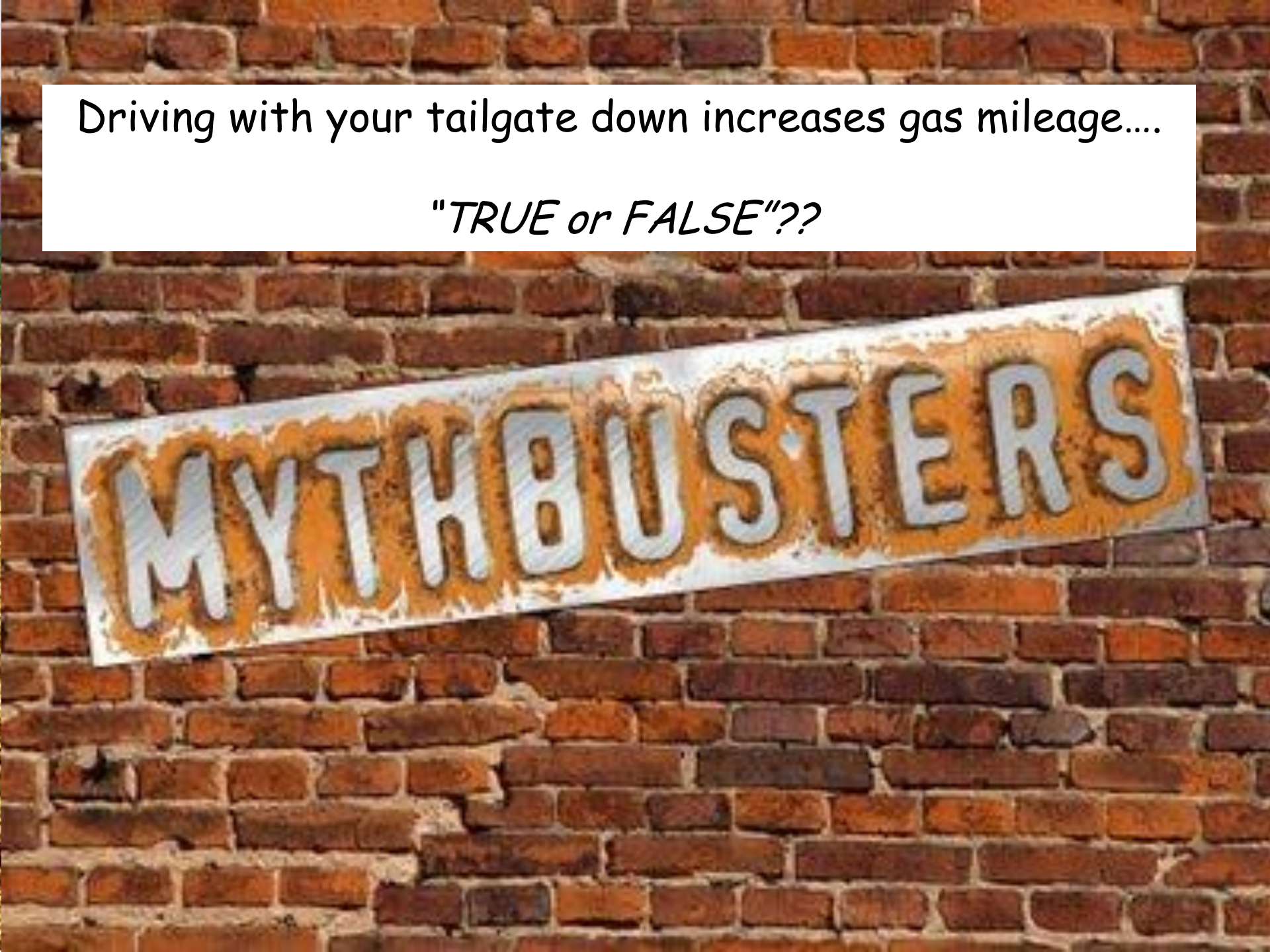
Mythbusters

MINNESOTA DEPARTMENT OF AGRICULTURE

Driving with your tailgate down increases gas mileage….

"TRUE or FALSE"??



Driving with your tailgate down increases your gas mileage?
Correct Answer---FALSE (BUSTED)

Sorry, You're Incorrect

A. True

The correct answer is:

B. False

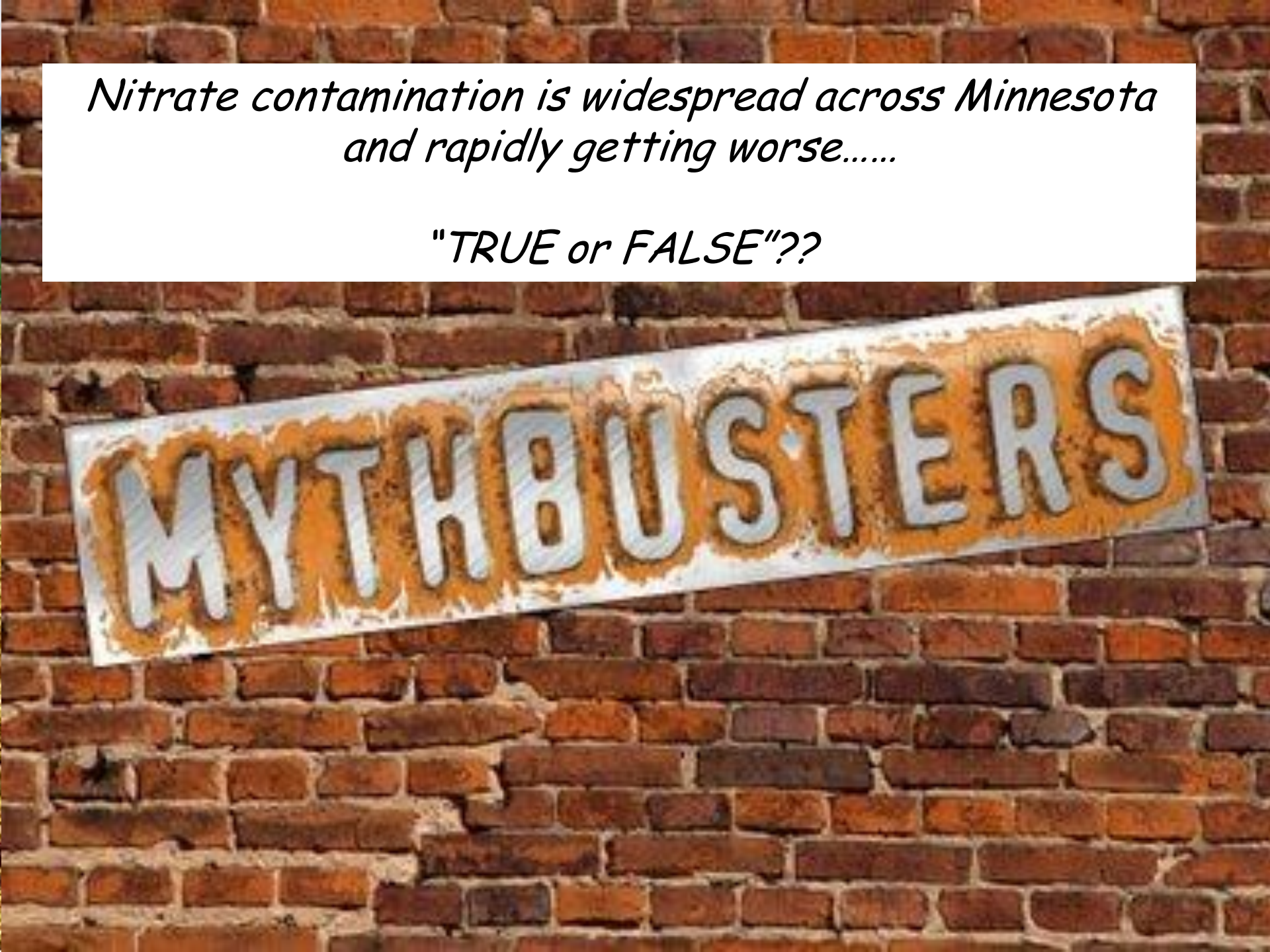
go. But when MythBusters Jamie Hyneman and Adam Savage drove identical trucks under the same conditions across the desert — one with the tailgate up and the other with it down — Jamie's tailgate-closed pickup outlasted Adam's by more than 30 miles.

Closing the tailgate actually improves fuel efficiency because it creates a type of airflow called a separated bubble within the bed of the truck. As wind rushes over the moving truck, that bubble of slow-moving air deflects it over the raised tailgate. By guiding surrounding air over and across the truck bed, that vortex effect prevents added drag.

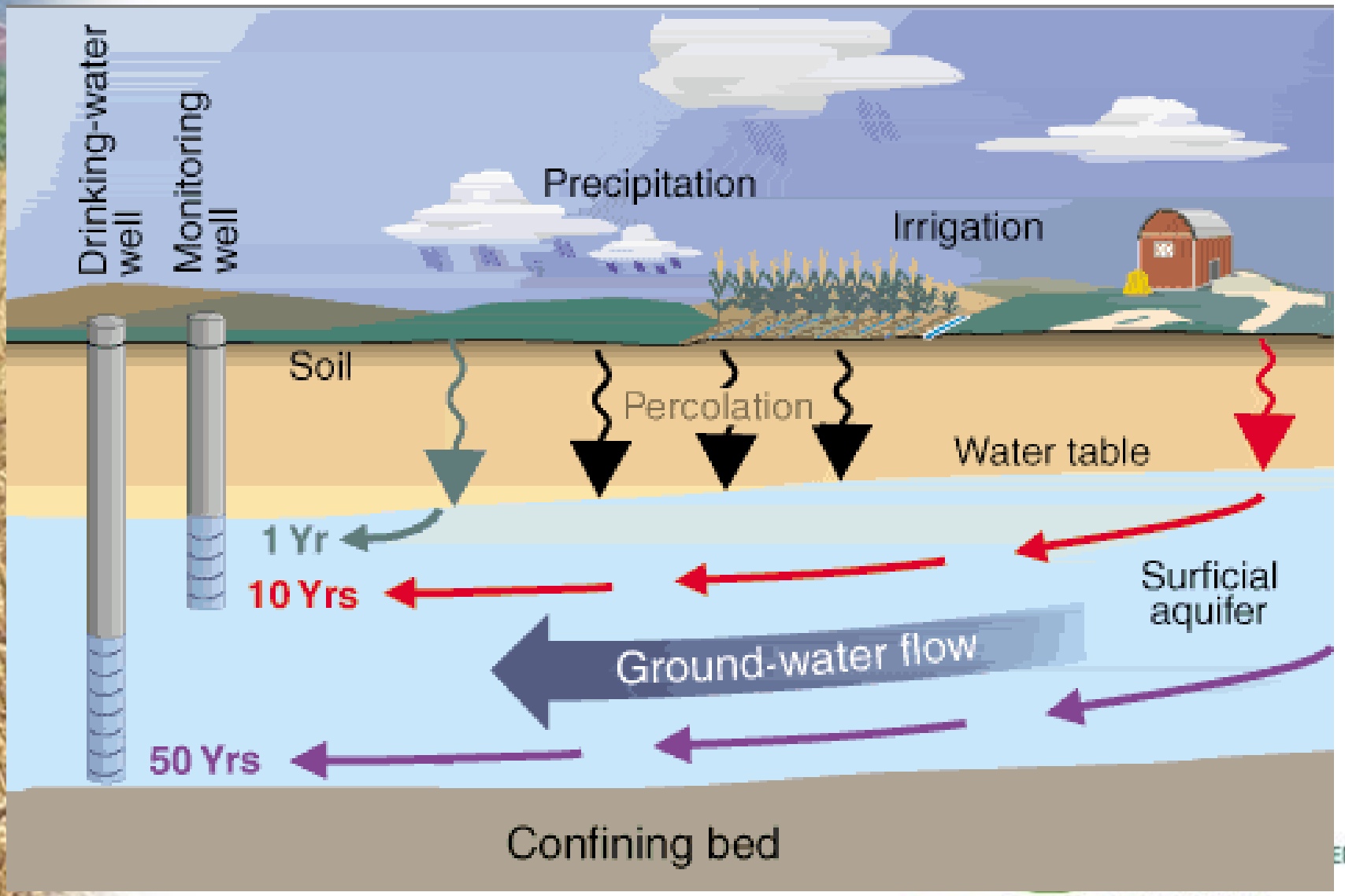
MINNESOTA DEPARTMENT OF AGRICULTURE

Nitrate contamination is widespread across Minnesota and rapidly getting worse……

"TRUE or FALSE"??



Complicating Factors

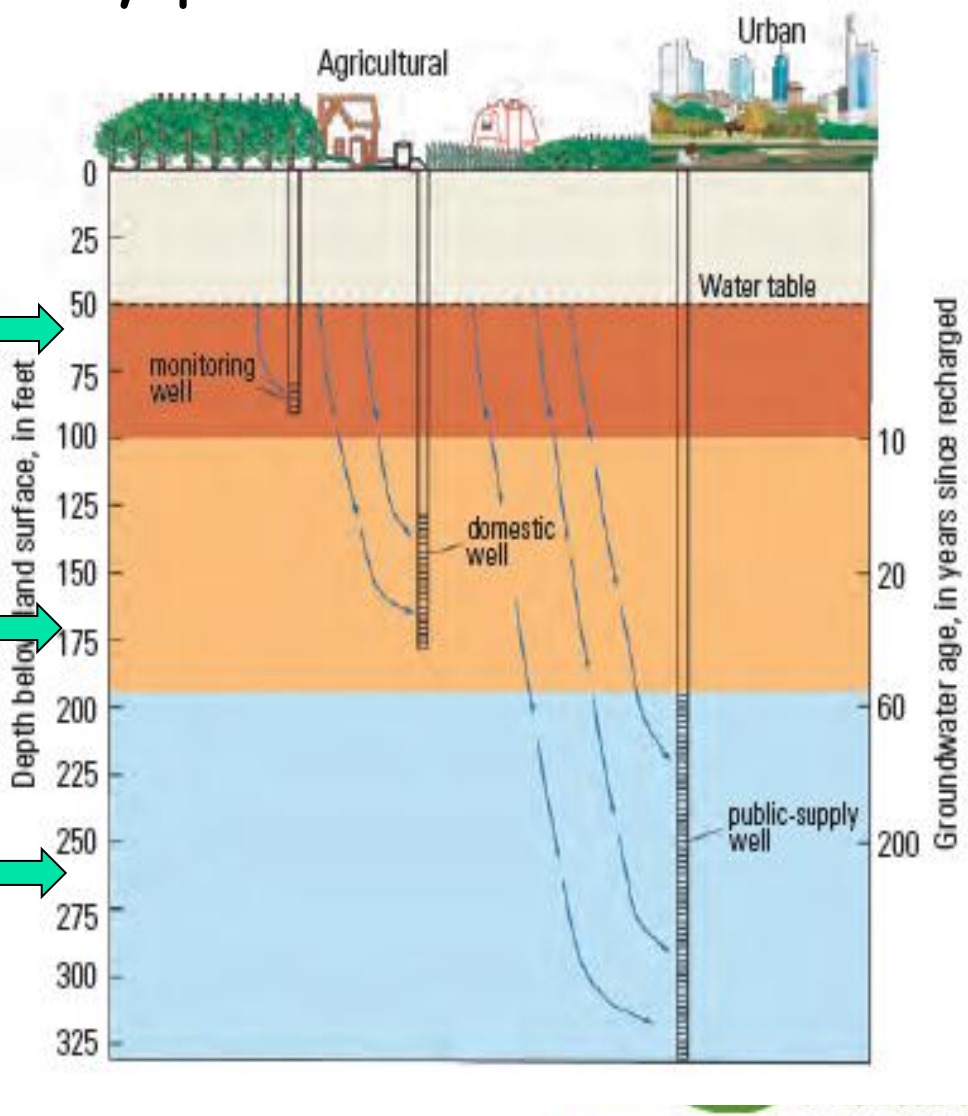


Important to note that well construction and placement has huge implications on most water quality parameters

Young Water (Sand points, observation wells)

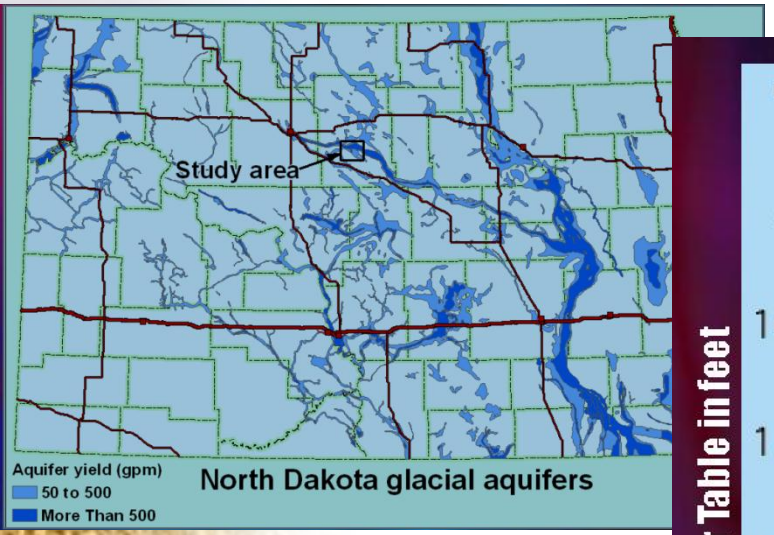
Moderate to Old

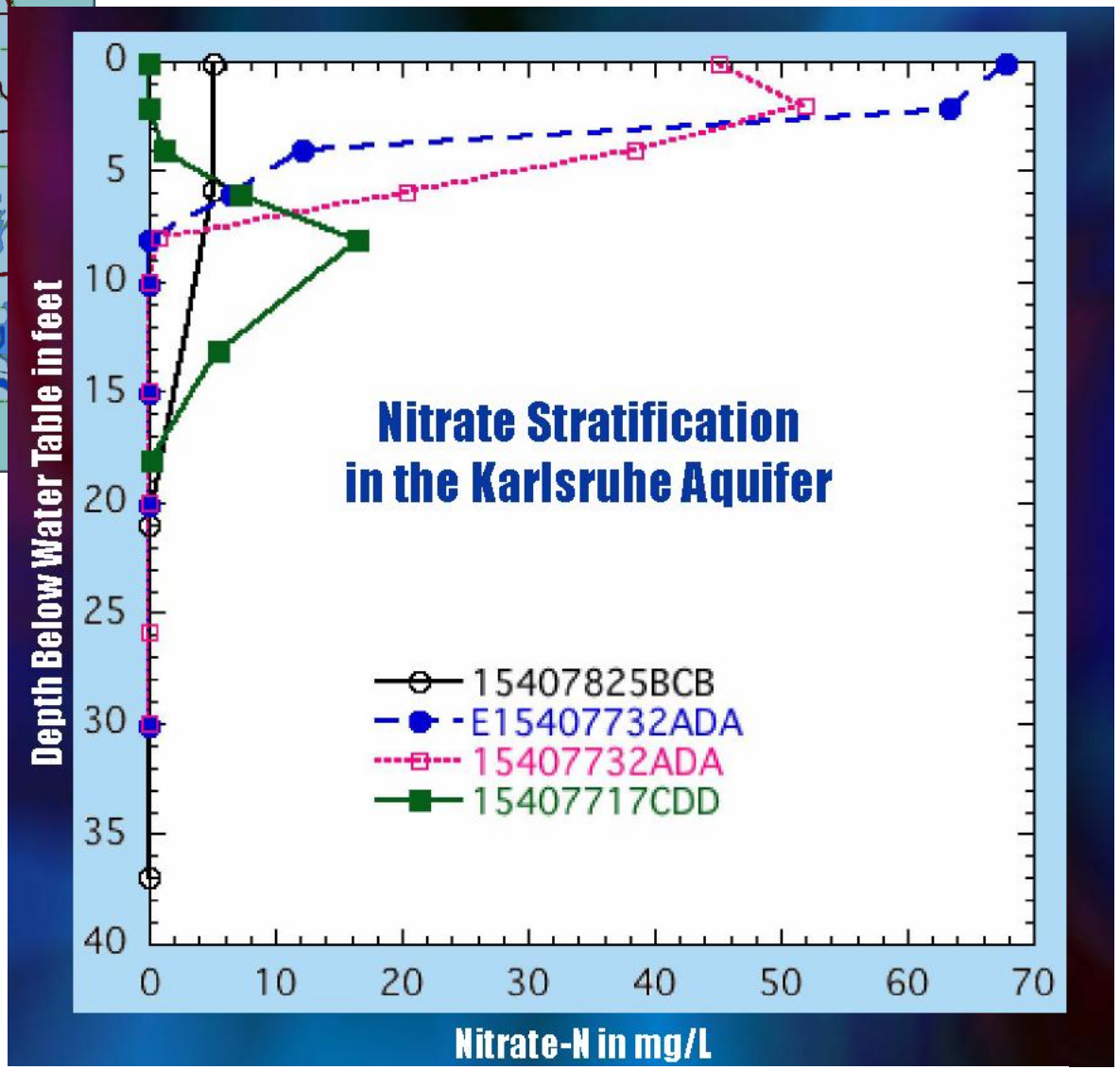
Oldest (Public water supply wells, high capacity irrigation)



PARTMENT

Nitrates Tend to Stratify Near the Top of the Aquifer





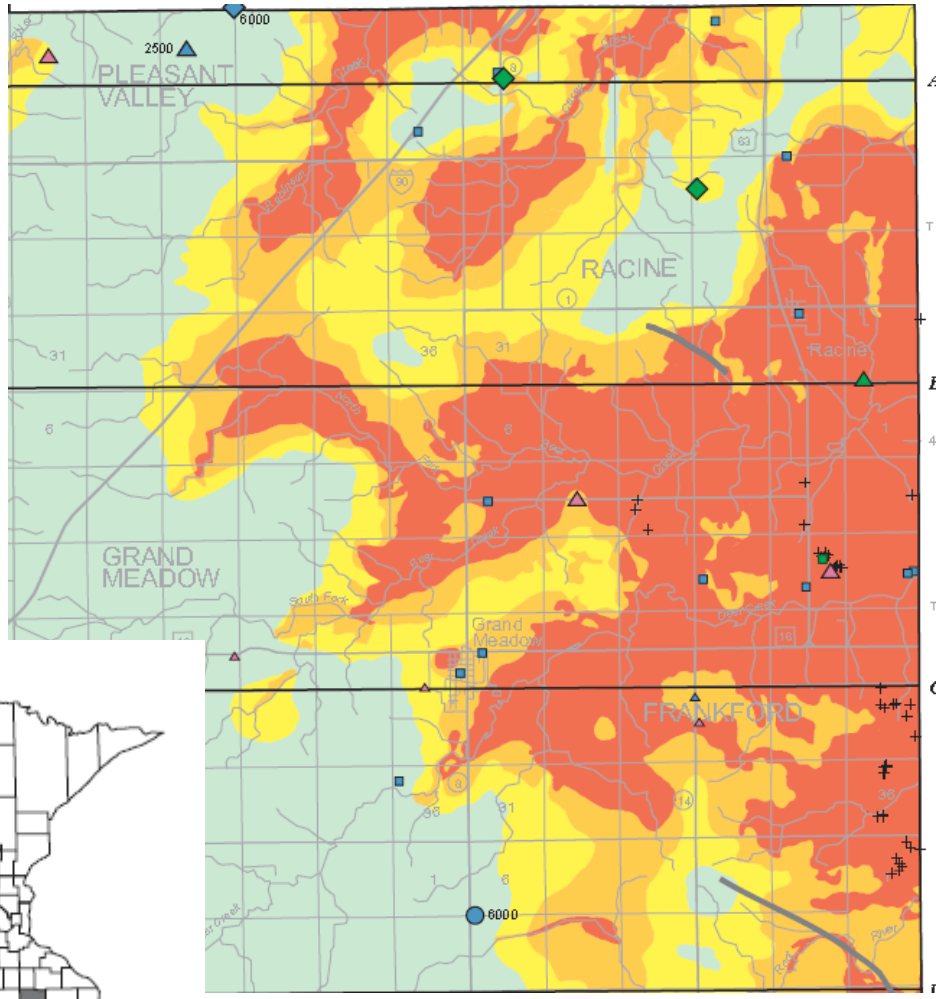
Data Source: Bill Schuh, North Dakota State Water Commission

Travel Times Can Vary Drastically on a Localized Scale

Sensitivity Ratings

Estimated vertical travel time for water-borne surface contaminants to enter the uppermost bedrock aquifers (target zone)

VH	**Very High**—Hours to months
H	**High**—Weeks to years
M	**Moderate**—Years to decades
L	**Low**—Decades to a century



LOCATION DIAGRAM

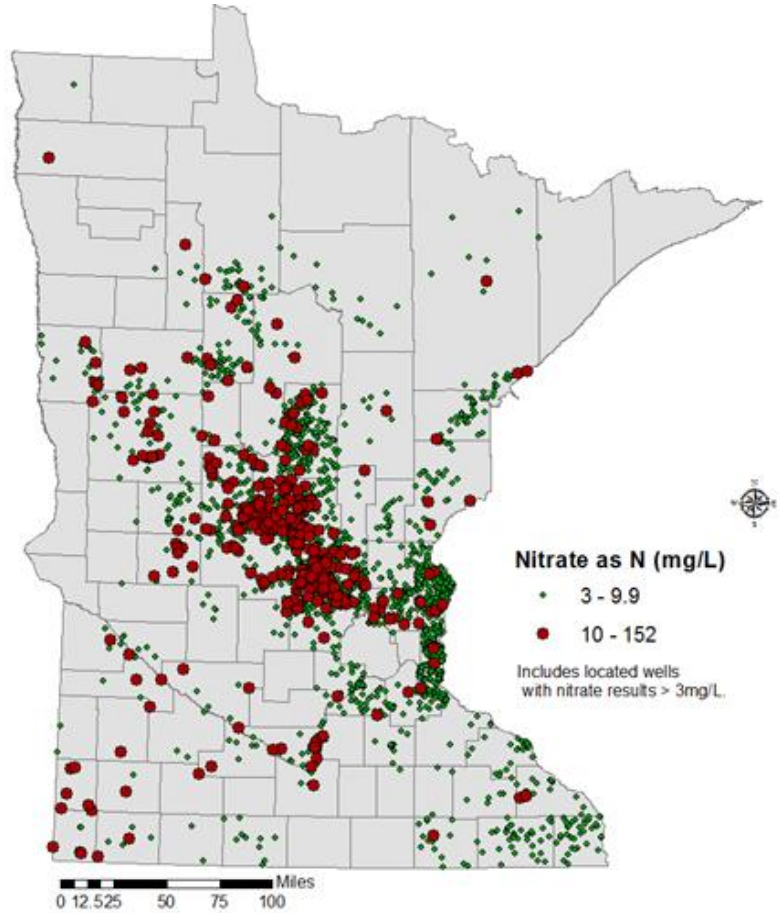
MINNESOTA DEPARTMENT OF AGRICULTURE

County Well Index Data

Nitrates in Private Drinking Wells

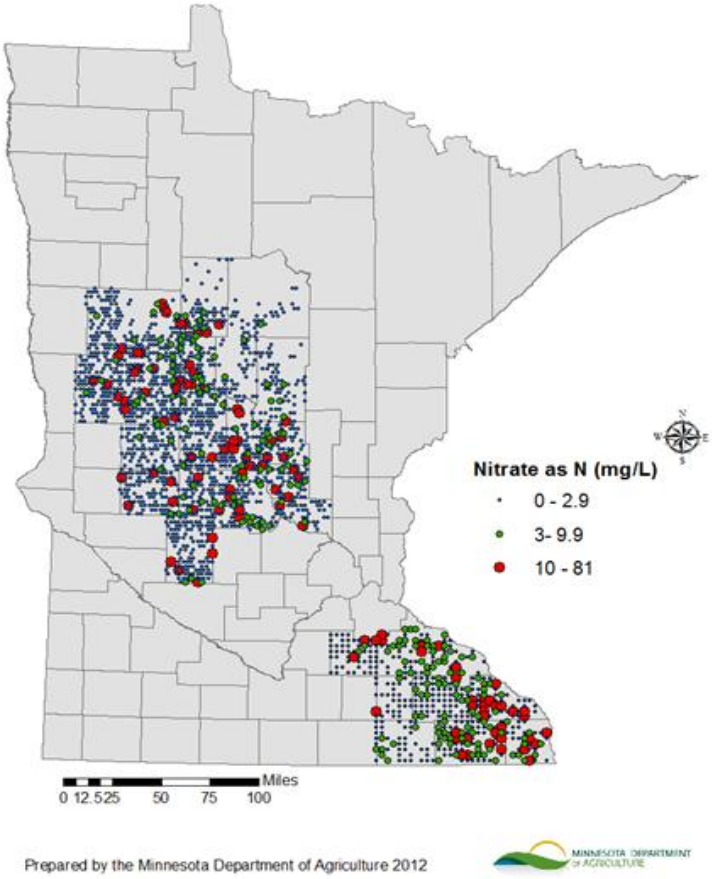
Based upon the County Well Index, (MDH), approximately 6% of all wells in the state exceed MCL;

Most elevated conditions are found in the Central Sands region and Washington/Dakota Counties



Two "Home Owner" Nitrate Monitoring Networks have been Recently Established

- Networks have been designed to provide low-cost nitrate trend information;
- Private wells;
- Homeowner participation is the cornerstone of the design;



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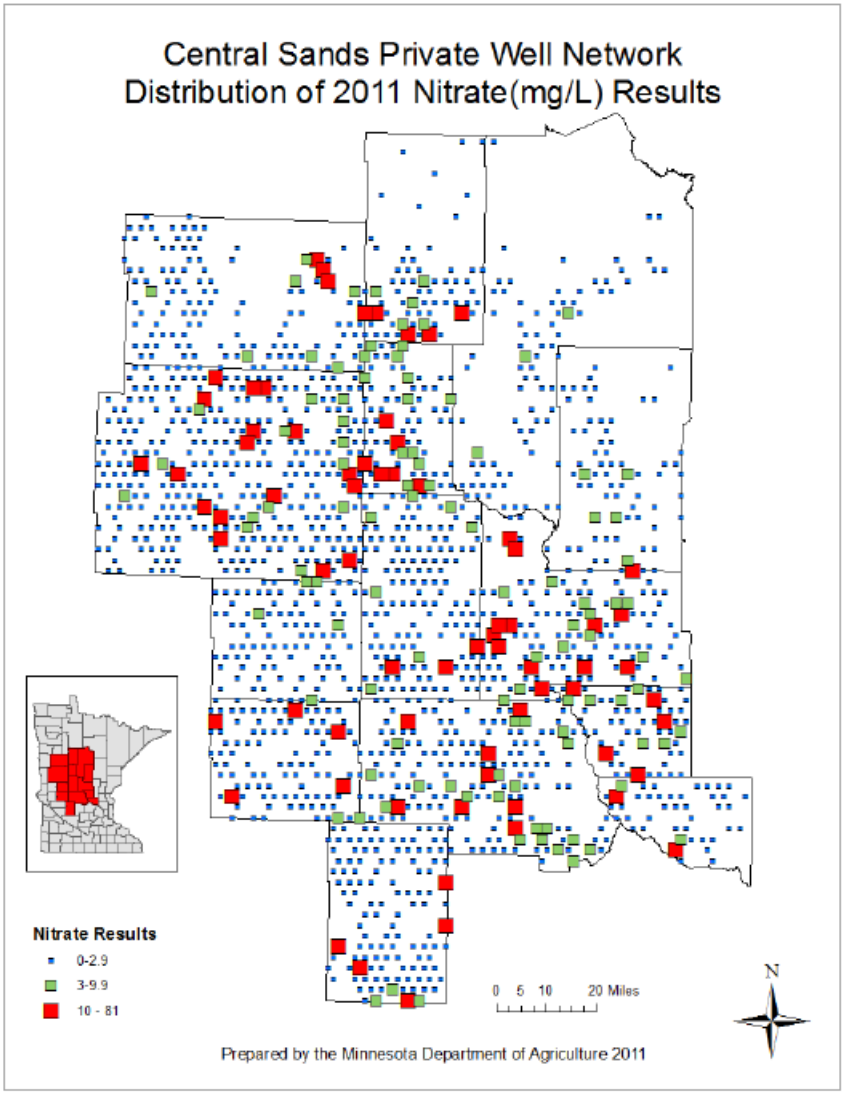
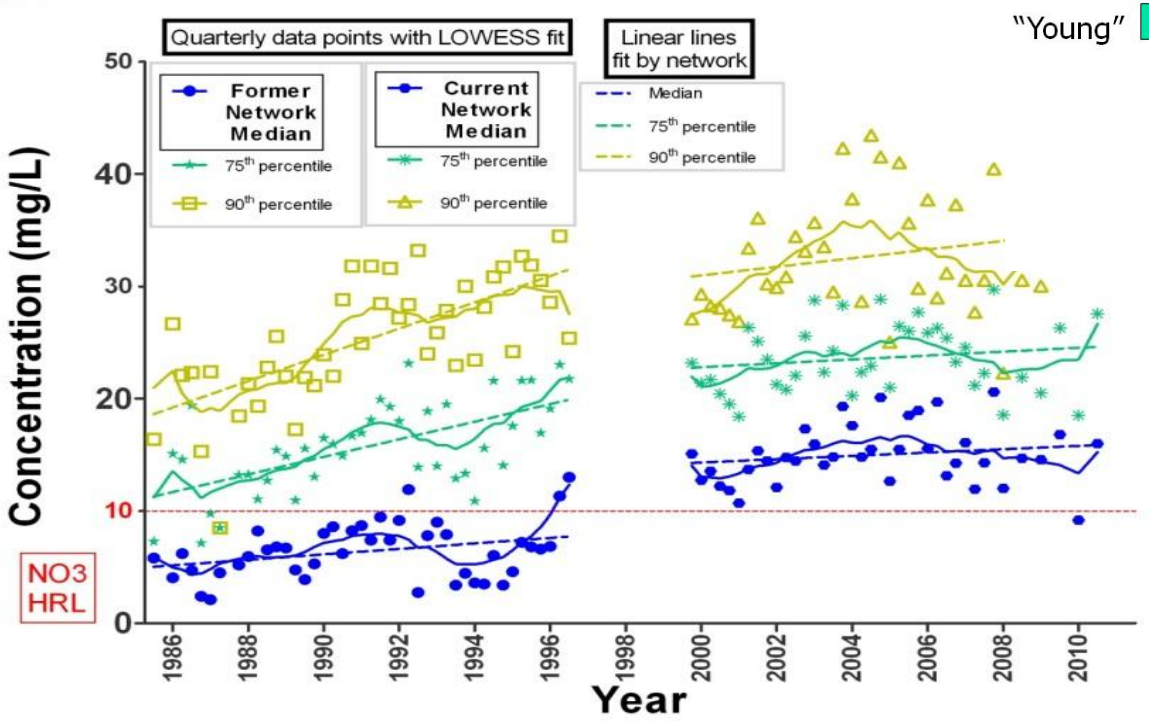
Nitrates in Private Drinking Wells in the Central Sands

- Home Owner Network Approach included 1,555 Minnesota families;
- This recent data (2011) suggests that about 5% > Health Standard (10 mg/L);
- Approx. 500-600 wells will be used for long-term trends

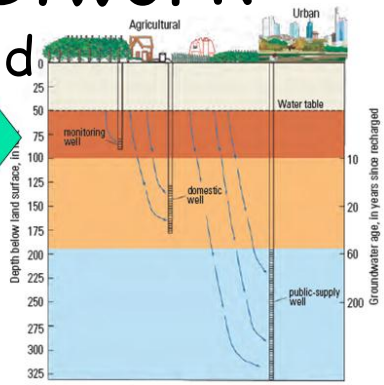


Nitrates in Central Sands Network

MDA Observation Wells-Edge of Field



"Young"



1990 2000 2010

This data strongly suggests that nitrate loading was appreciable in the 1990's and may now be stabilizing.

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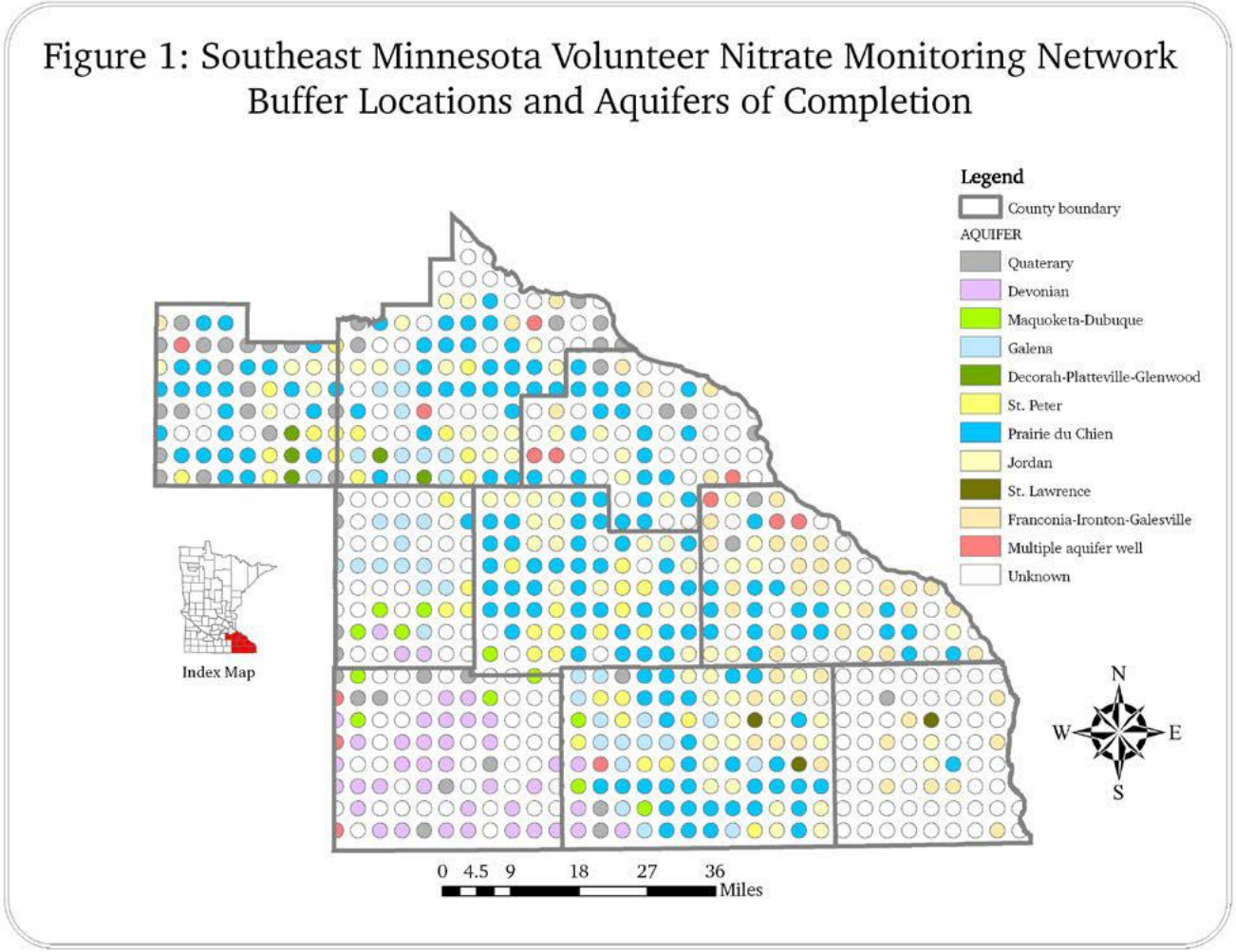
Southeast Nitrate Monitoring Network



Data Source: MDH

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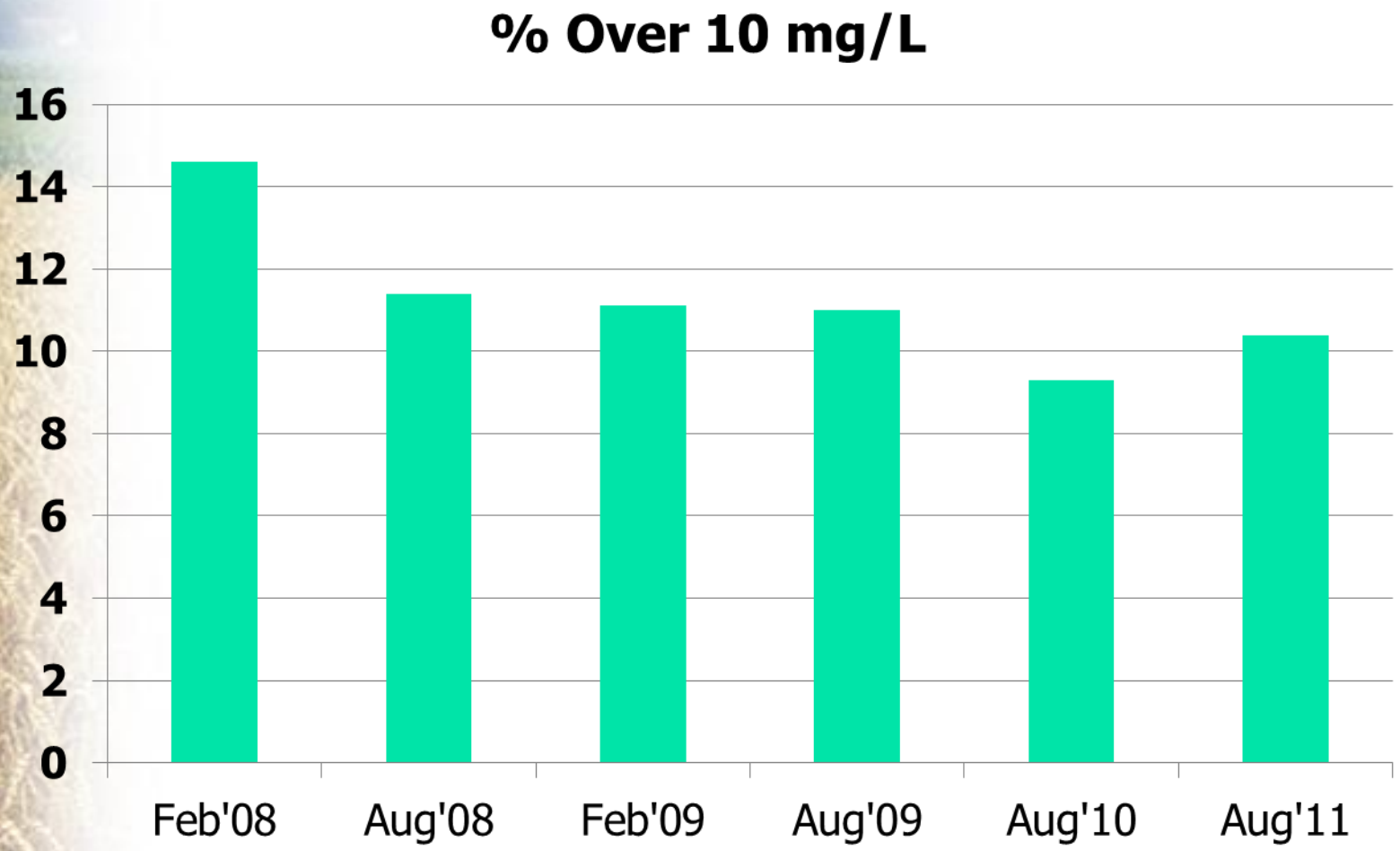
Southeast Nitrate Monitoring Network



Data Source: MDH

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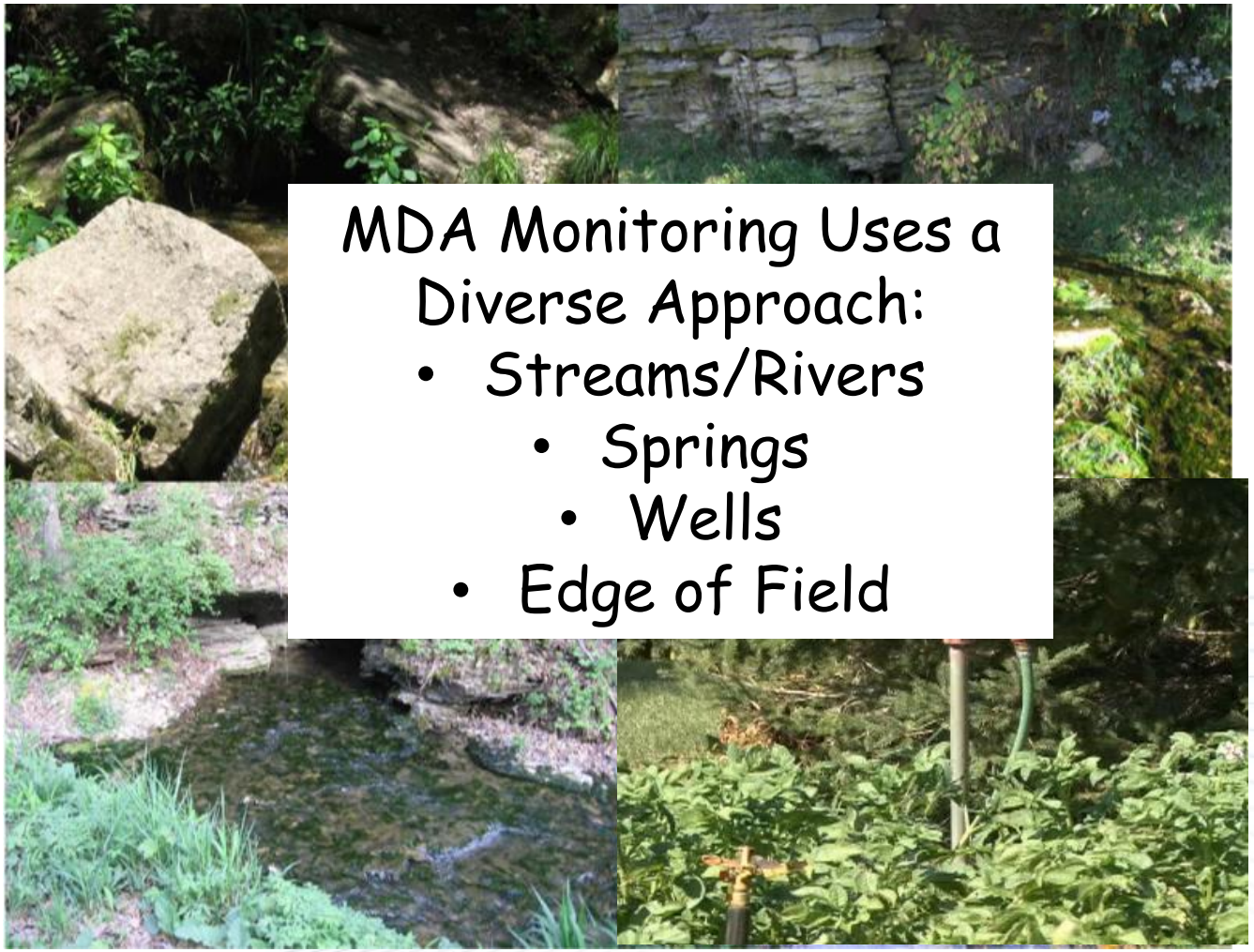
Monitoring Groundwater in Southeast Minnesota's Karst

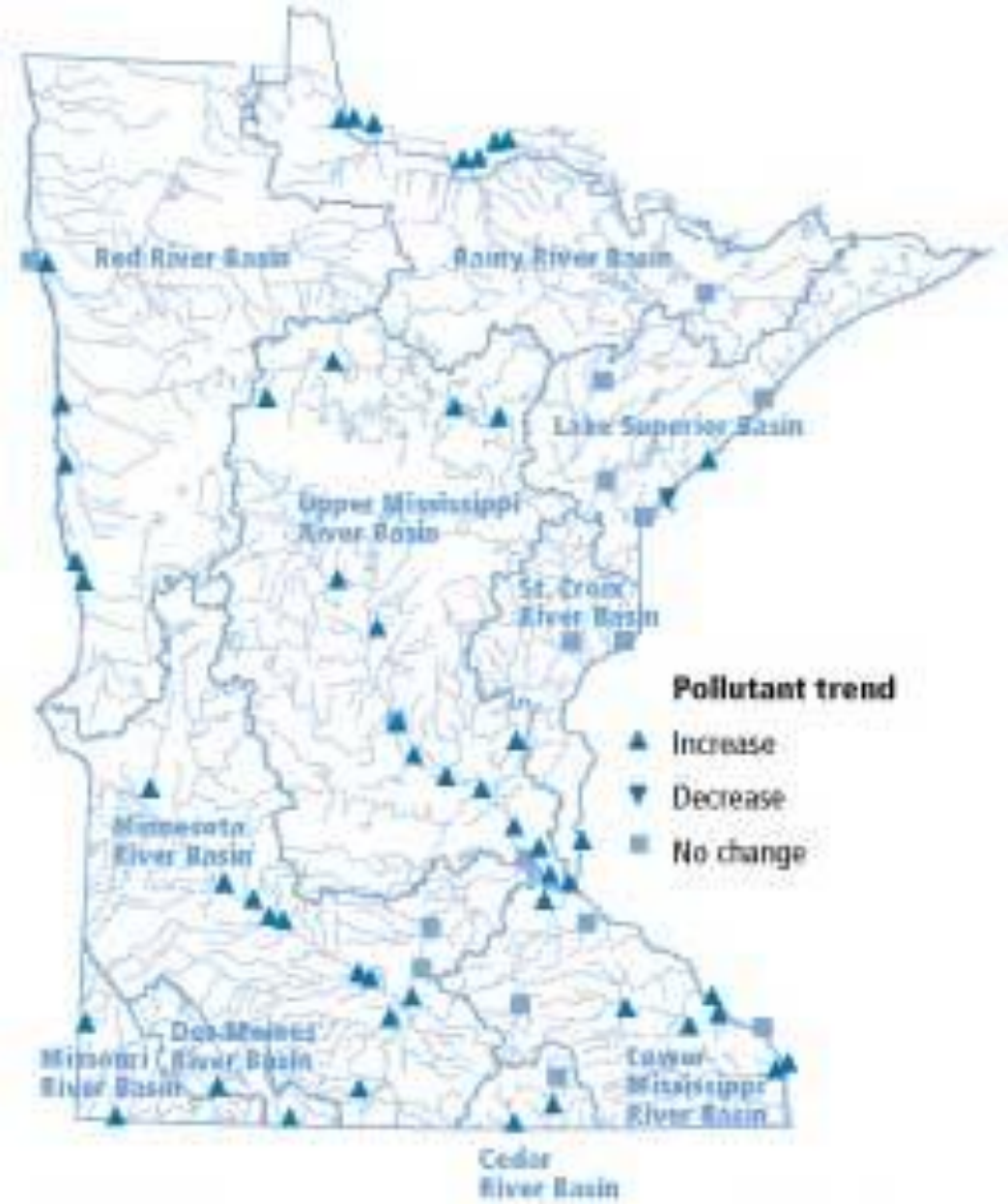


MDA Monitoring Uses a Diverse Approach:

- Streams/Rivers
- Springs
- Wells
- Edge of Field

MINNESOTA DEPARTMENT OF AGRICULTURE

Upward NO_3-N Trends in Surface Waters



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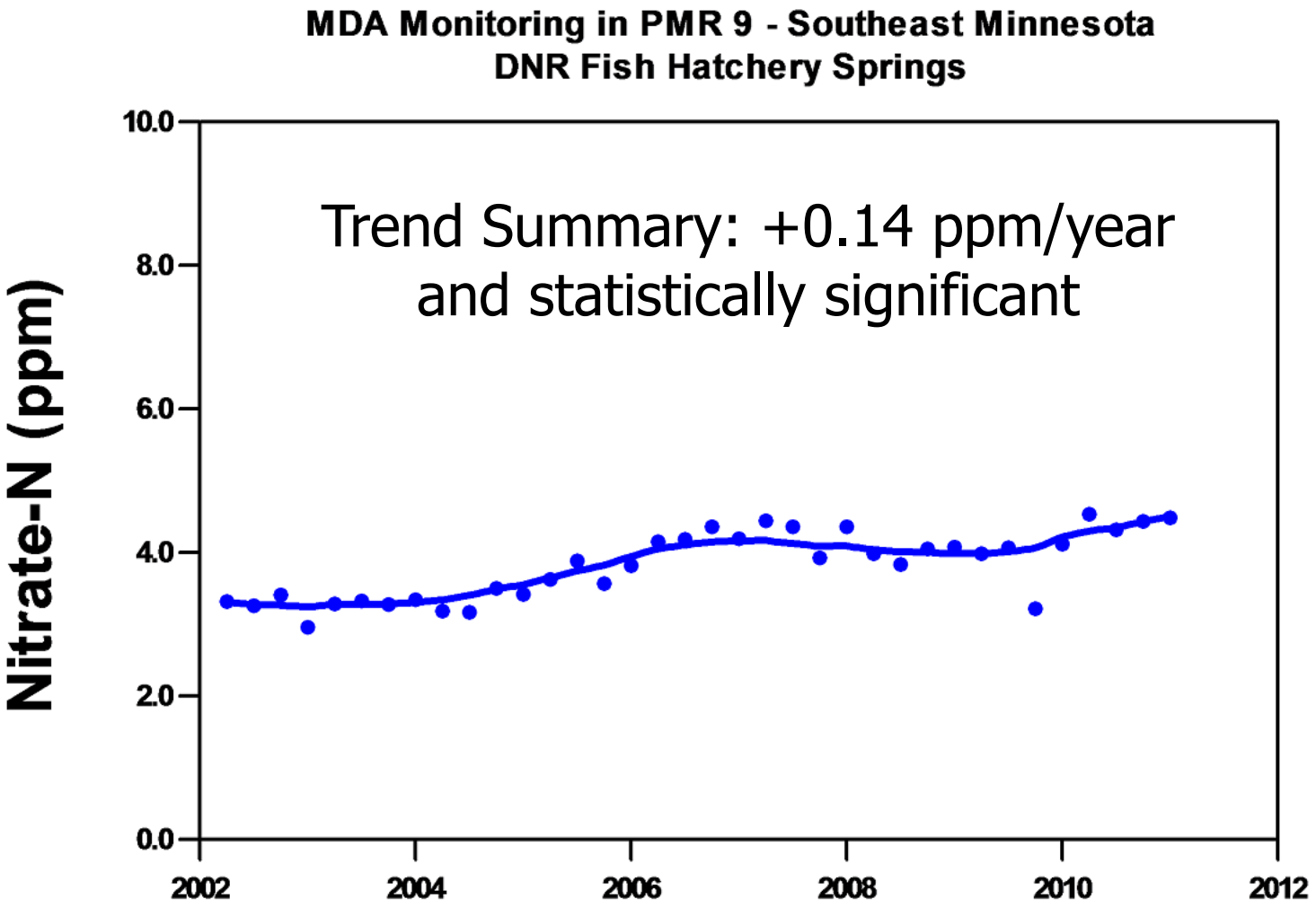
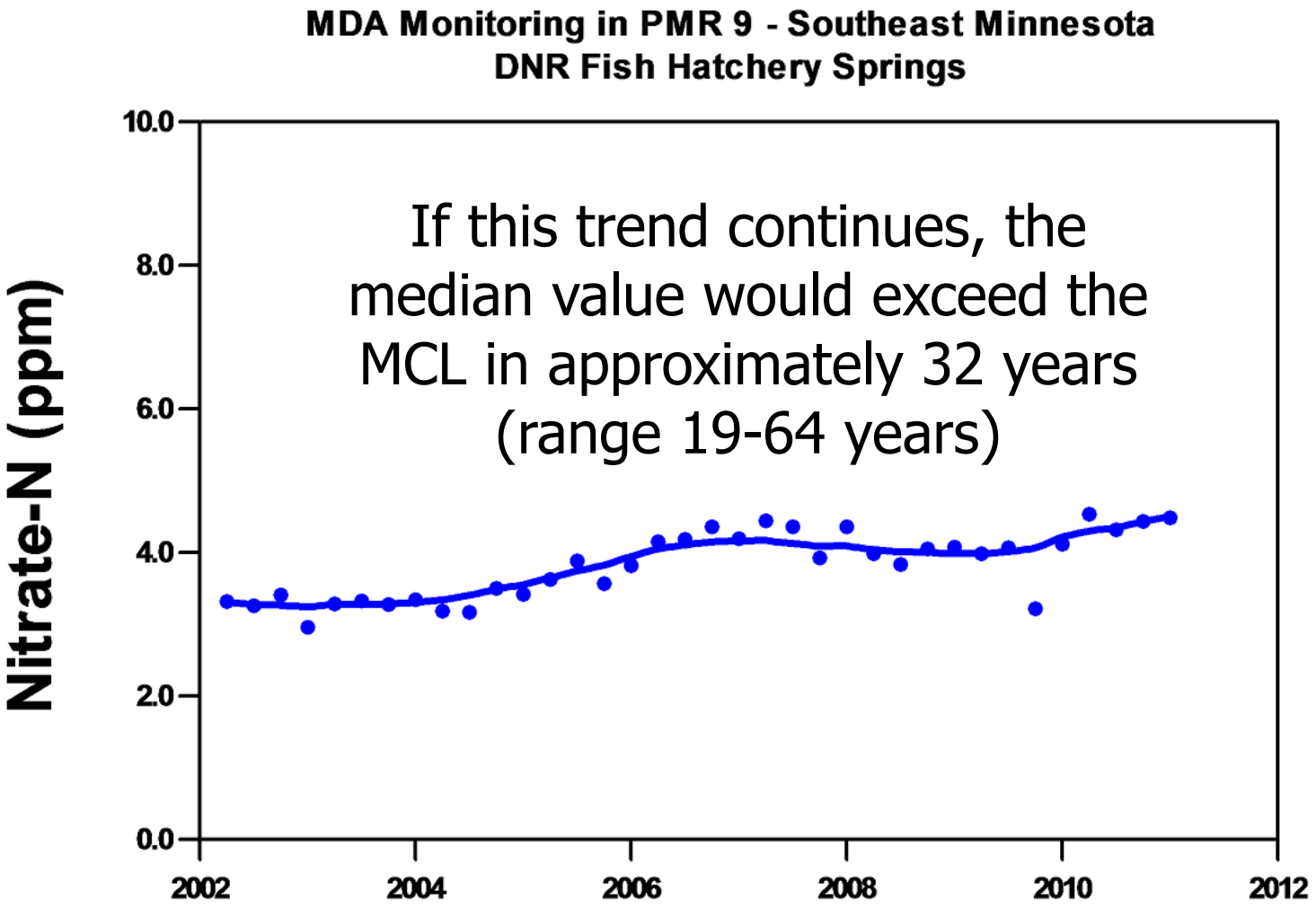
Spring Monitoring in SE Minnesota —What's Their Story?



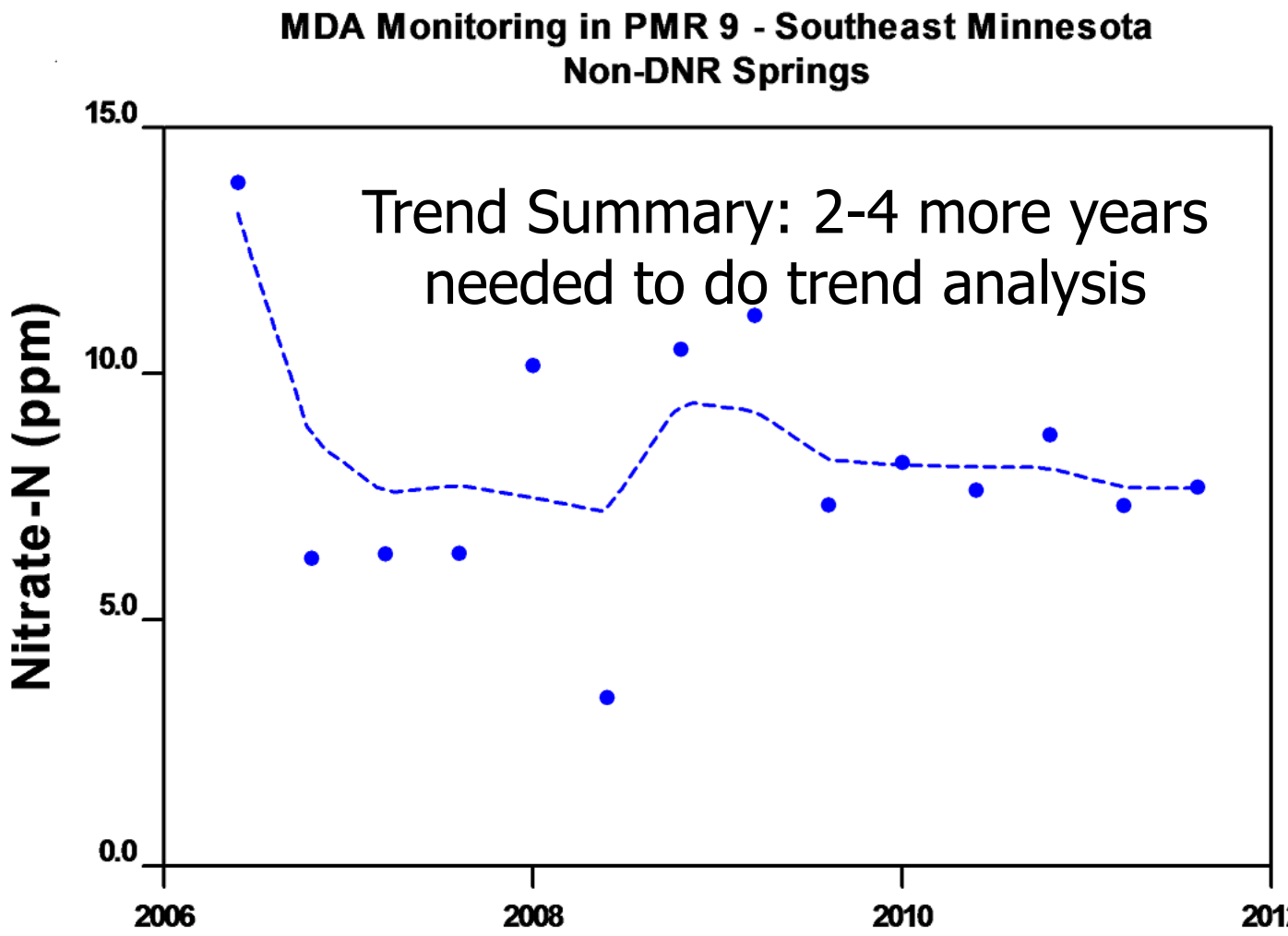
Data Source: John Hines, MDA Monitoring Unit

Spring Monitoring in SE Minnesota —What's Their Story?



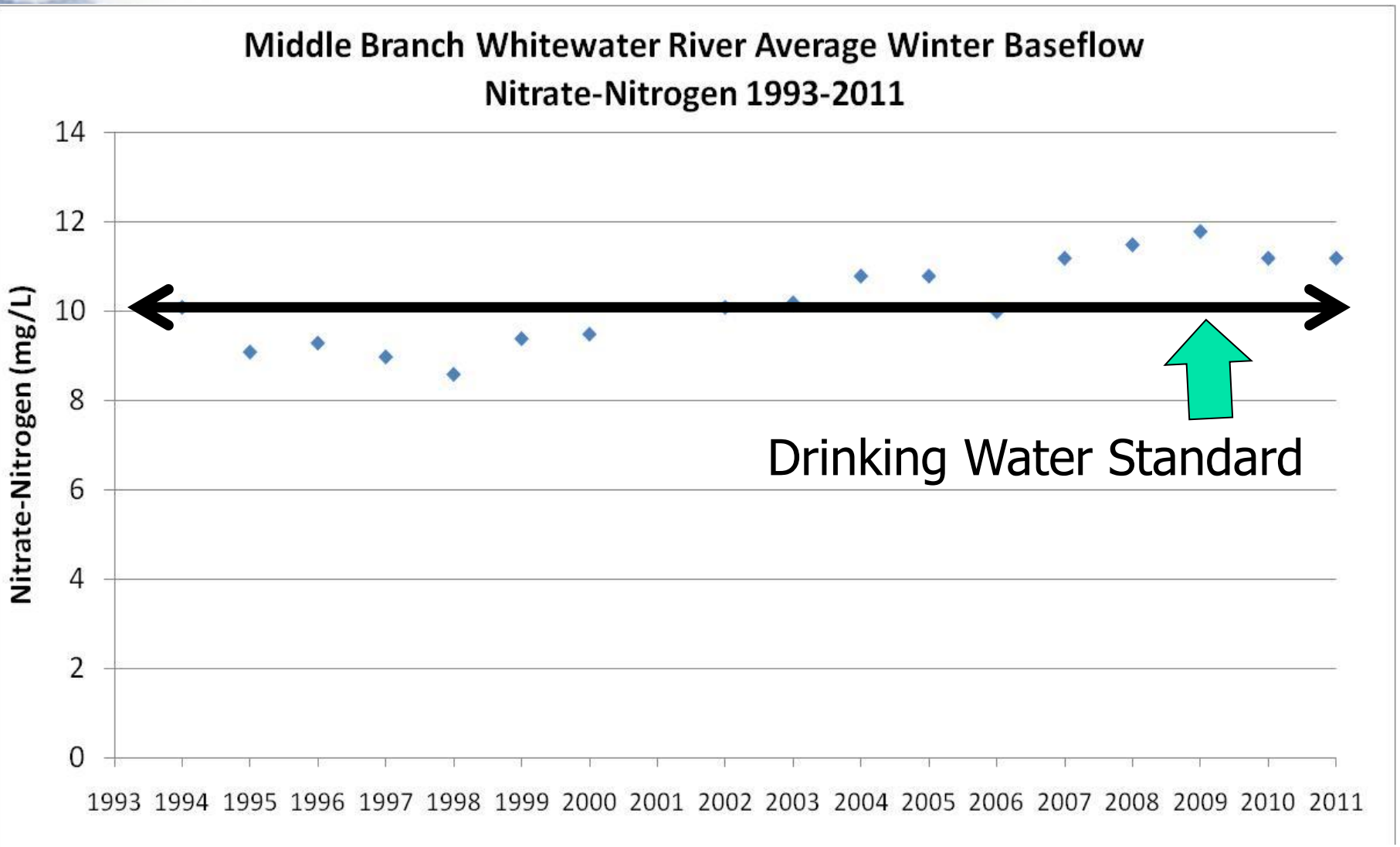
Data Source: John Hines, MDA Monitoring Unit

Spring Monitoring in SE Minnesota —What's Their Story?



Data Source: John Hines, MDA Monitoring Unit

"Baseflow"-Whitewater River

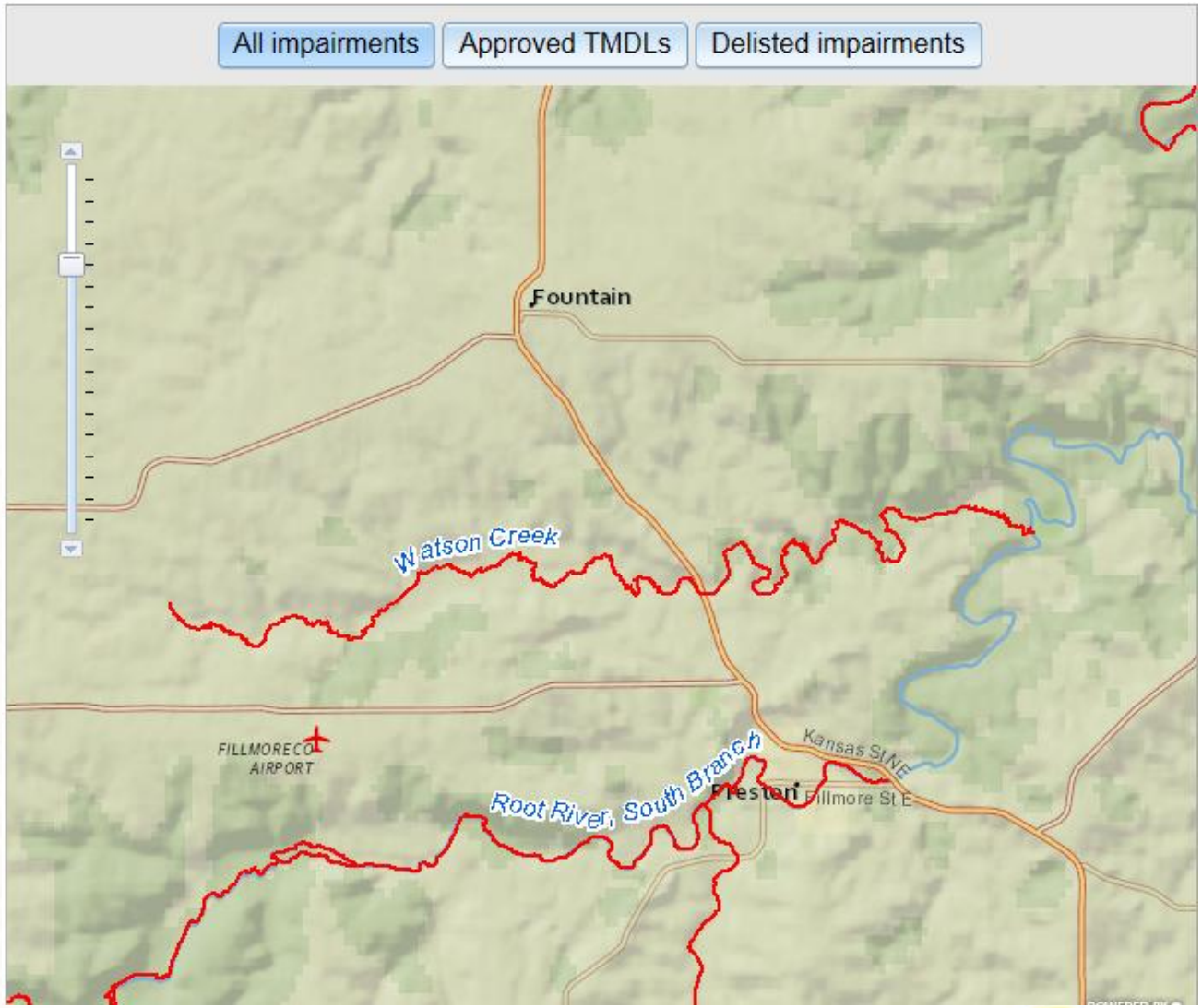


1995 2000 2005 2010

Data Source: MDA Monitoring Unit

MINNESOTA DEPARTMENT OF AGRICULTURE

Currently 11 Streams/Rivers On the Impaired Listing for Nitrates



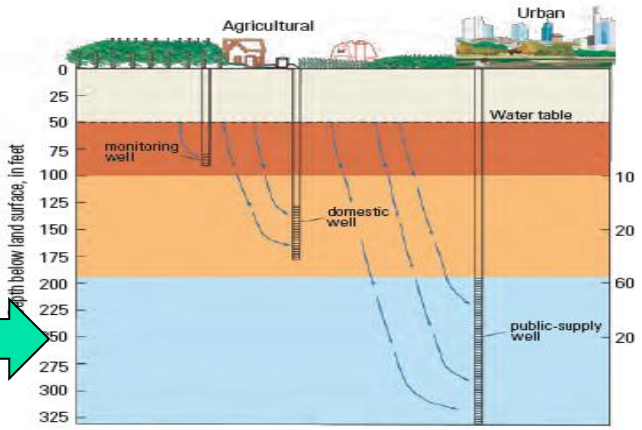
Data Source: PCA website

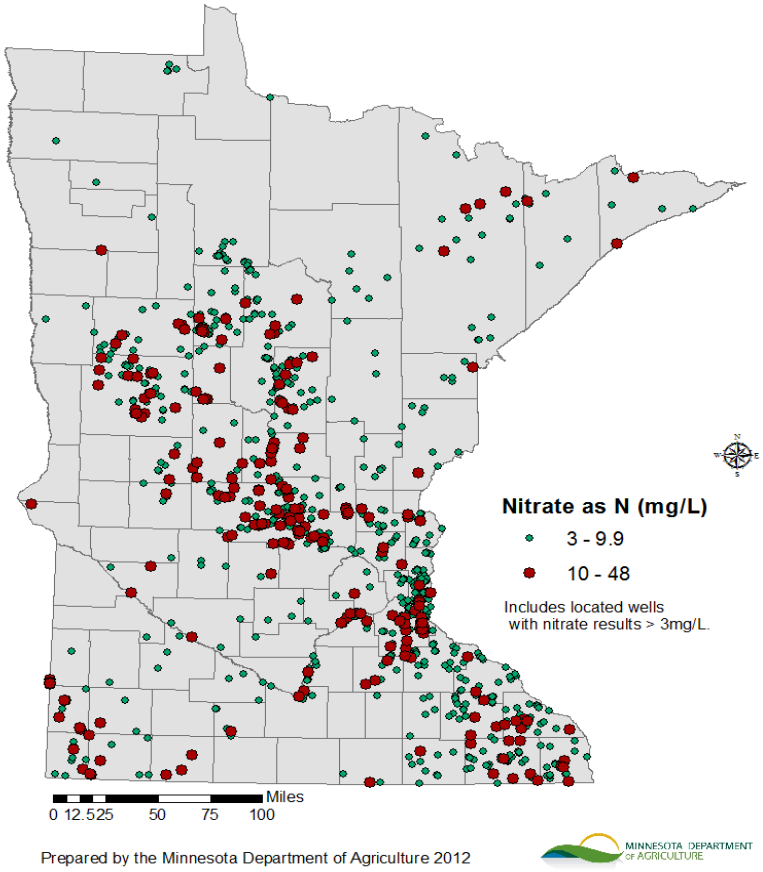
MINNESOTA DEPARTMENT OF AGRICULTURE

Nitrates in Public Water Supplies

Based upon MDH data, <u>less that 1%</u> of Minnesota's public water supplies exceed the MCL;

"Older"





<u>Figure 10</u>. Distribution of public water supply wells in the County Well Index with nitrate-N greater than 3 mg/L

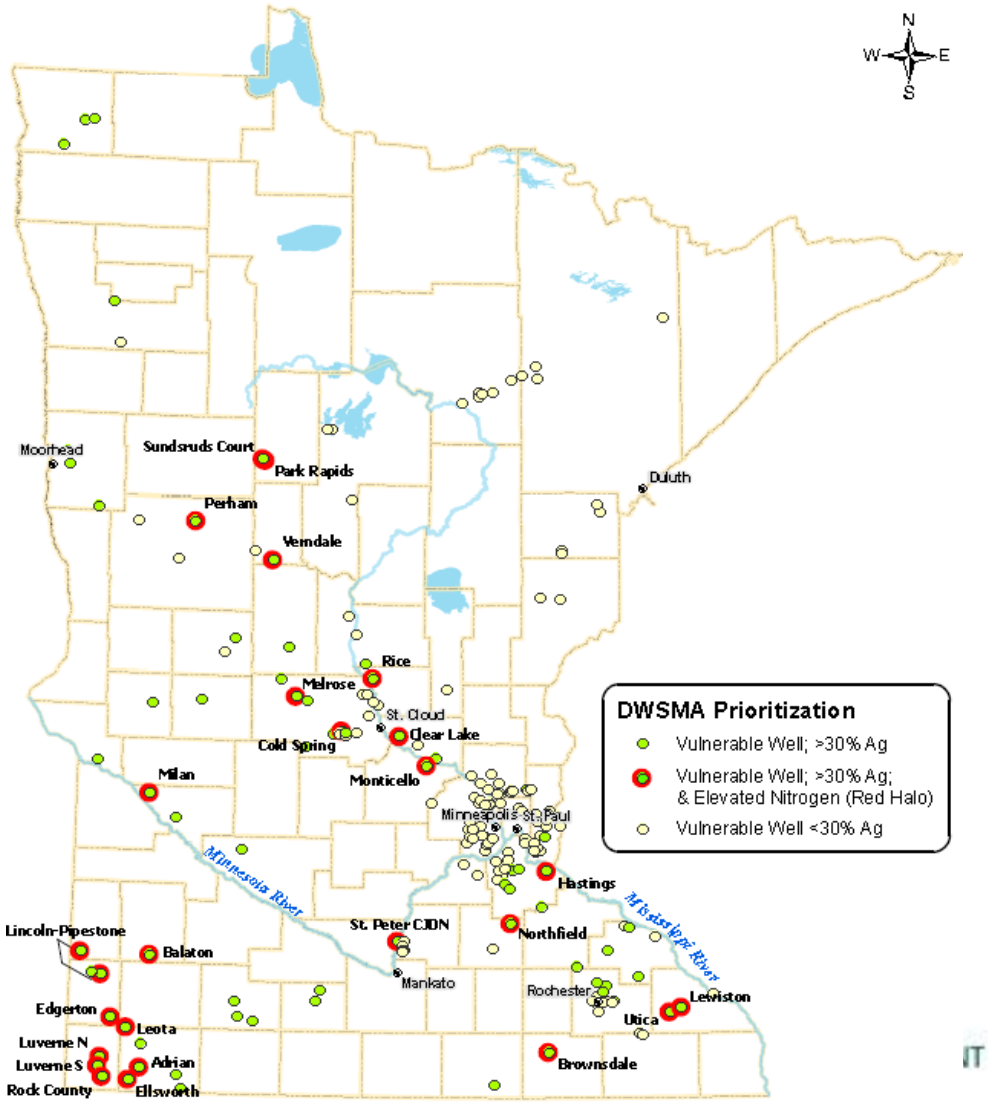
Data Source: MDH

MENT OF AGRICULTURE

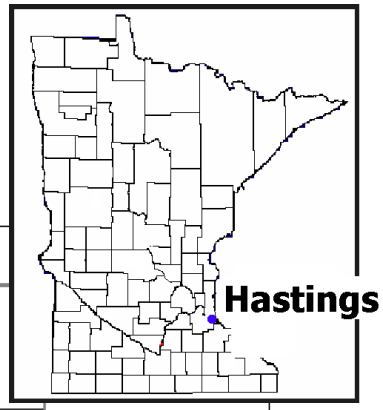
Ag Communities Dealing with Elevated Nitrate Issues

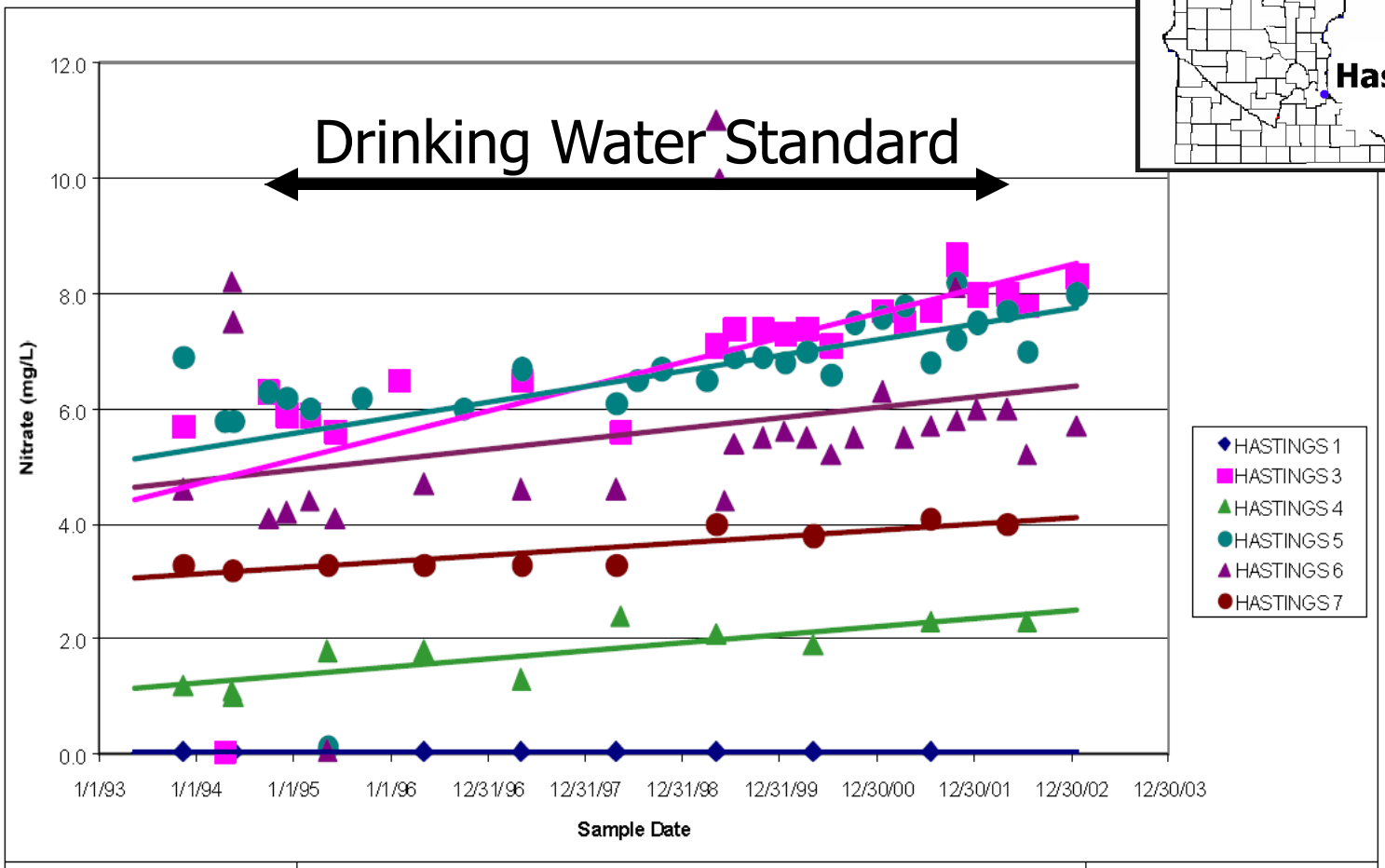
The number of communities currently dealing with elevated NO_3 –N conditions is well established and contained.

Data Source: MDH/MDA



Hastings Municipal Wells Nitrate Results 1993-2003





Hastings Municipal Wells
Nitrate Results 1993-2003

HANS Figure 2

DEPARTMENT OF AGRICULTURE

What's at Stake for Community Water Suppliers Dealing with Nitrate Problems?

- Nitrate removal systems typically cost between $2-3 Million for upfront construction costs and also maintenance costs

- Costs of drilling new and/or deeper wells;

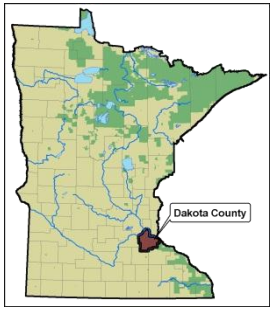
- Costs of 'blending" multiple wells to achieve get acceptable water quality;

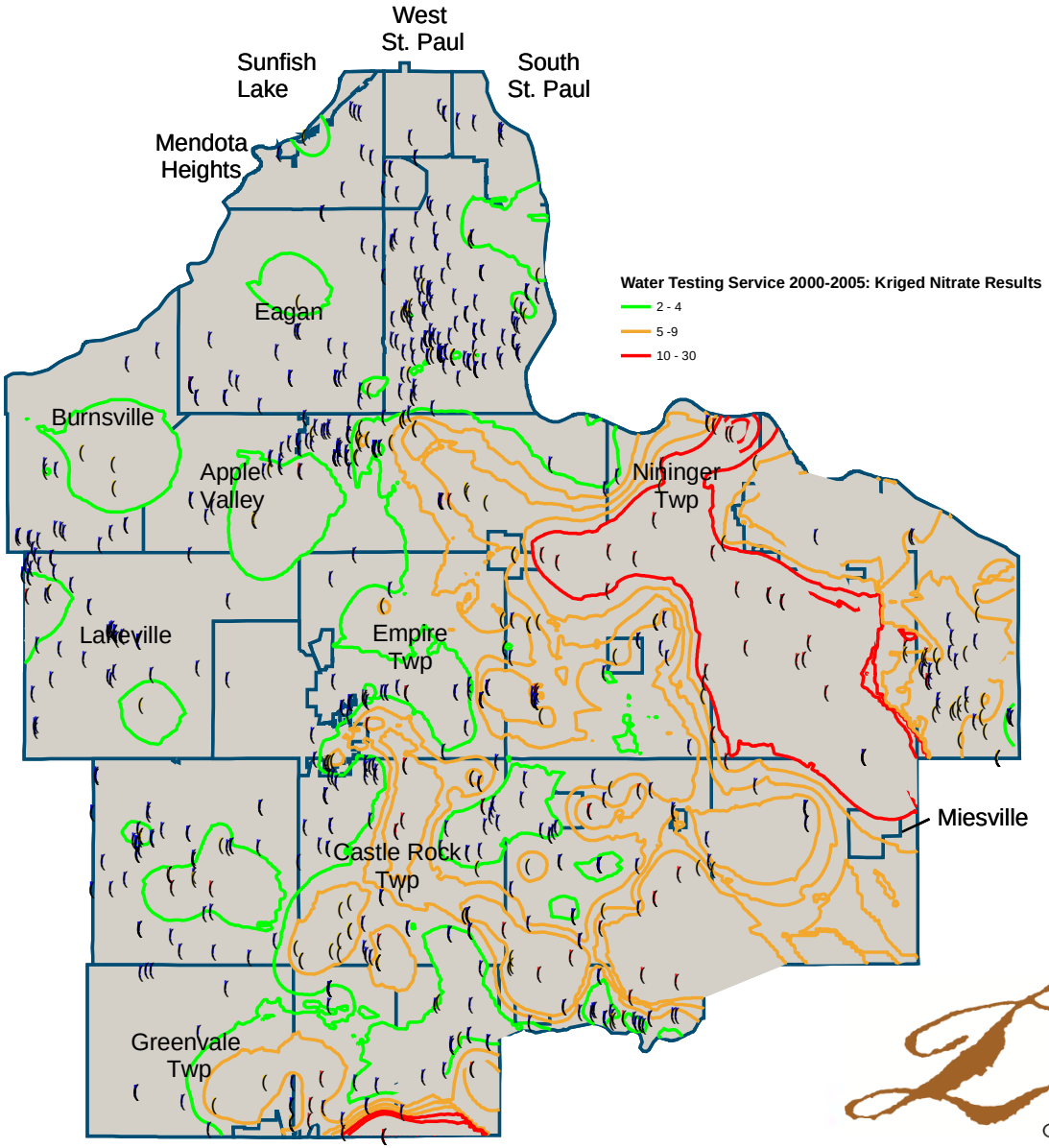
- Consumer costs are 2-6 times higher than non-impacted water supplies

Dakota County Water Testing Service

2000-2005 Nitrate Results

(860 results, kriged)



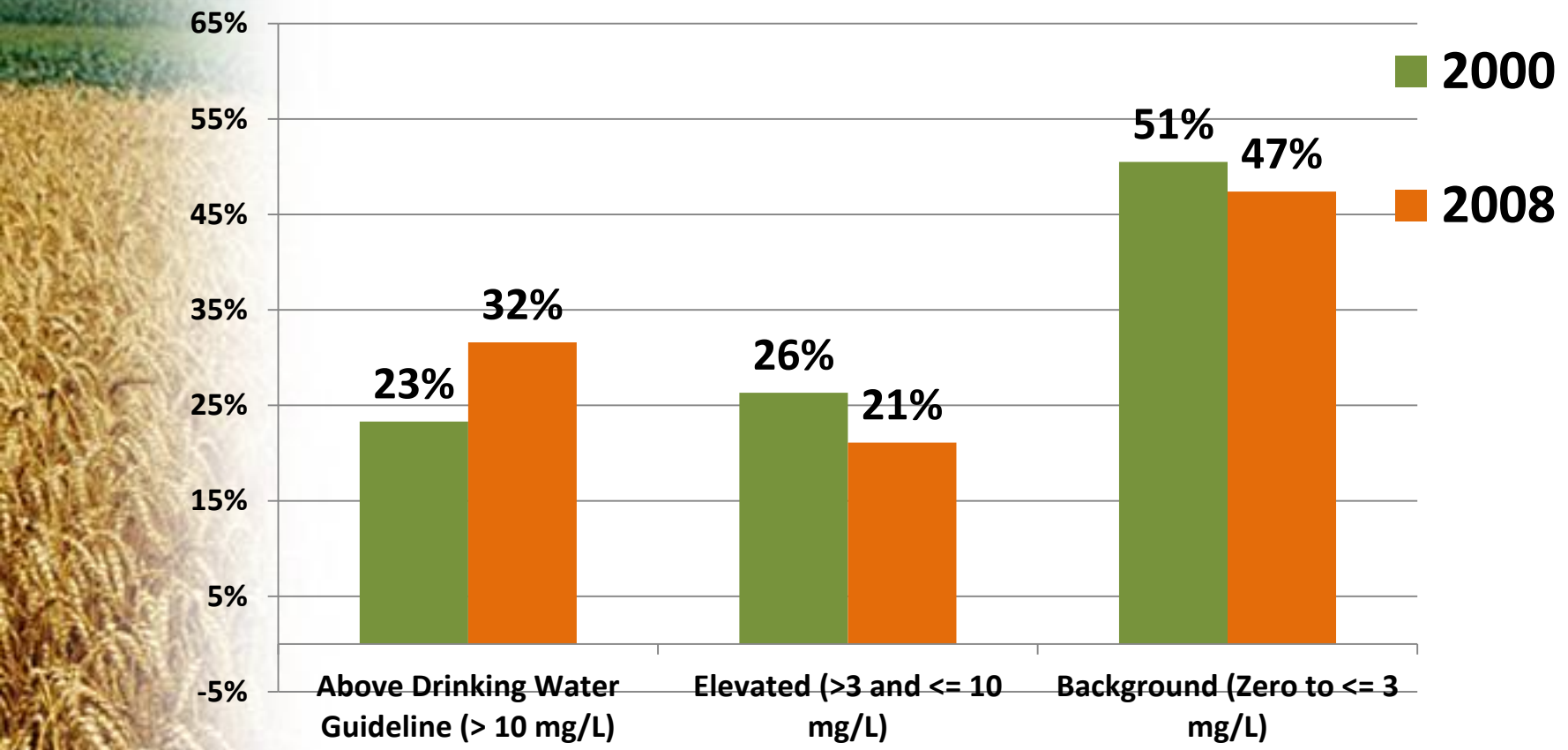


Dakota COUNTY

Hastings Area Private Drinking Water Wells

2000-2008 Comparative Results: Nitrate

n ~ 140 wells



Dakota COUNTY

Nitrate contamination is widespread across Minnesota and rapidly getting worse……

……..

"TRUE or FALSE"??

- Statewide-abundant with excellent water quality;
- We will be able to answer the trend question with greater certainty in the future;

Nitrate contamination is widespread across Minnesota and rapidly getting worse……

……..

"TRUE or FALSE"??

- Dakota County – very significant problems;
- Southeast-conflicting info, some trends in surface waters are concerning
- Wellheads…….generally contained but some very significant upward trends at 3-5 locations;

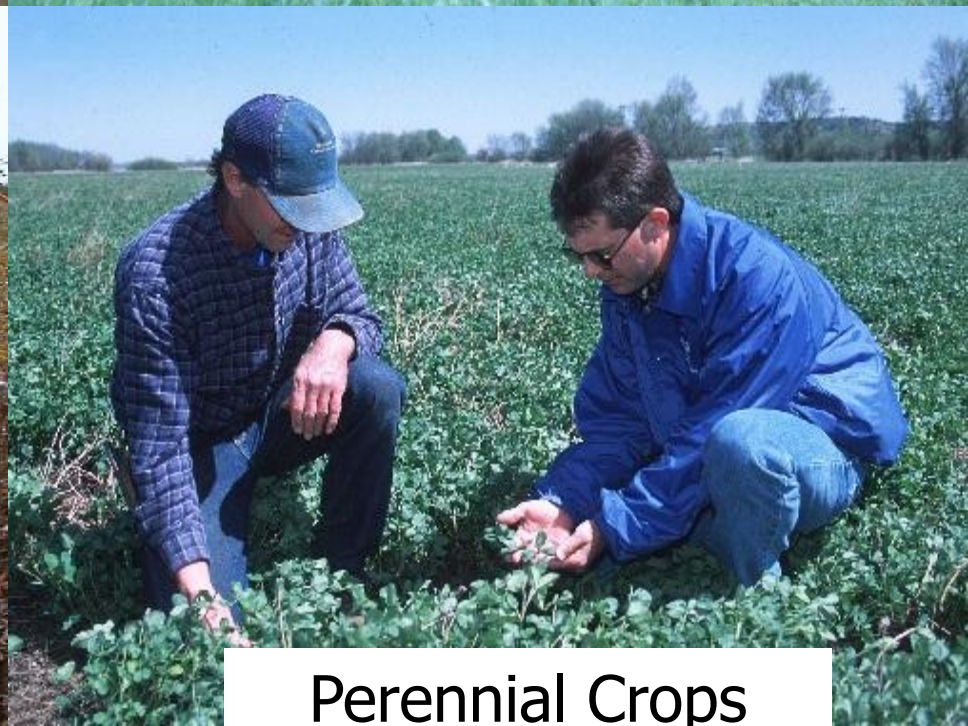
Crop Selection and their Historic Acreages Help Explain Nitrate Trends in Groundwater….
"TRUE or FALSE"??

Crops with Low N Loss Leaching Potential

Alfalfa and Clover

Vegetated Pasture

Native Prairie/CRP Plantings

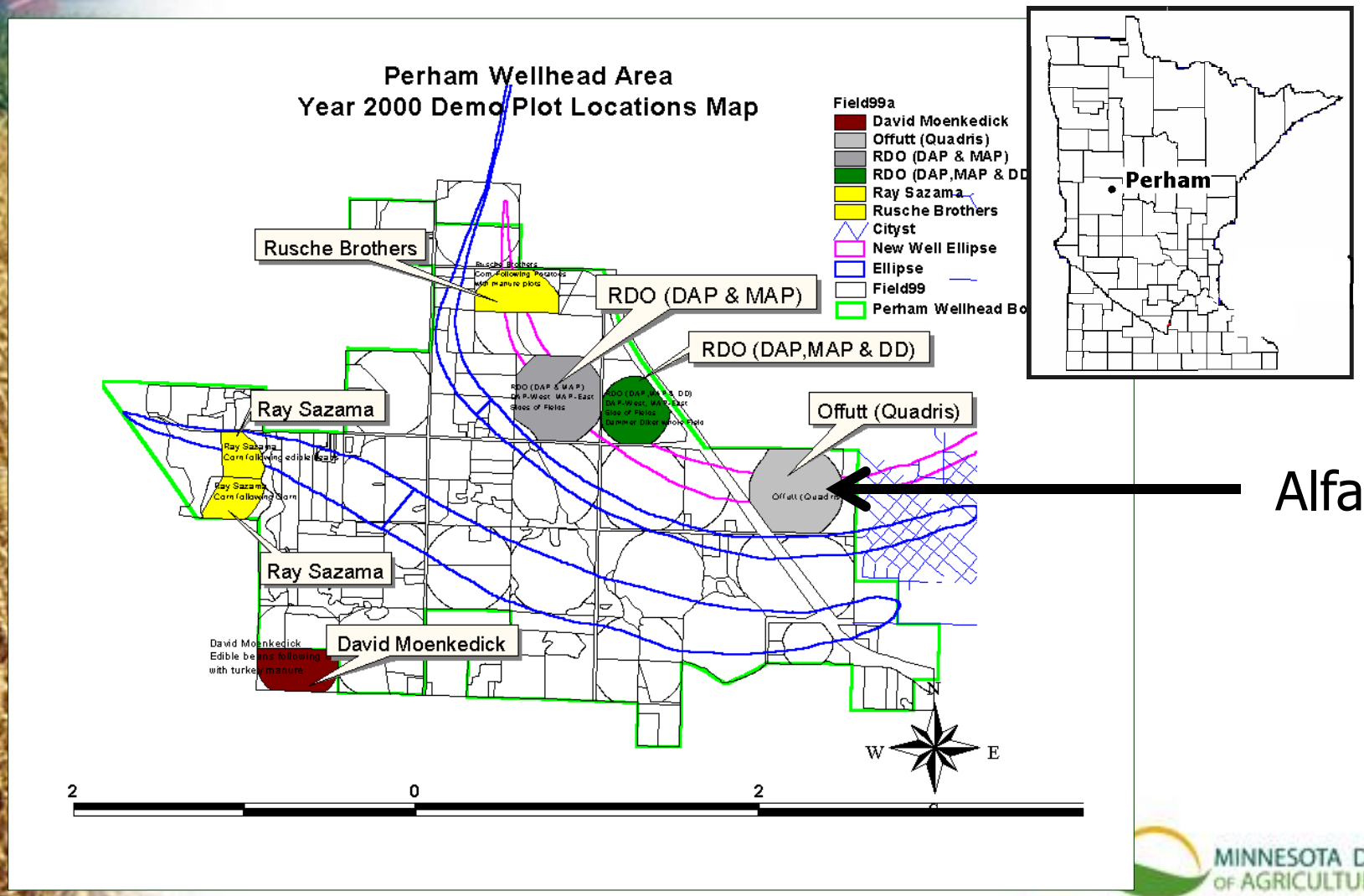


Perennial Crops

Alfalfa, Clovers, Orchard Grass, and Other Perennials Are Excellent Nitrogen Scavengers

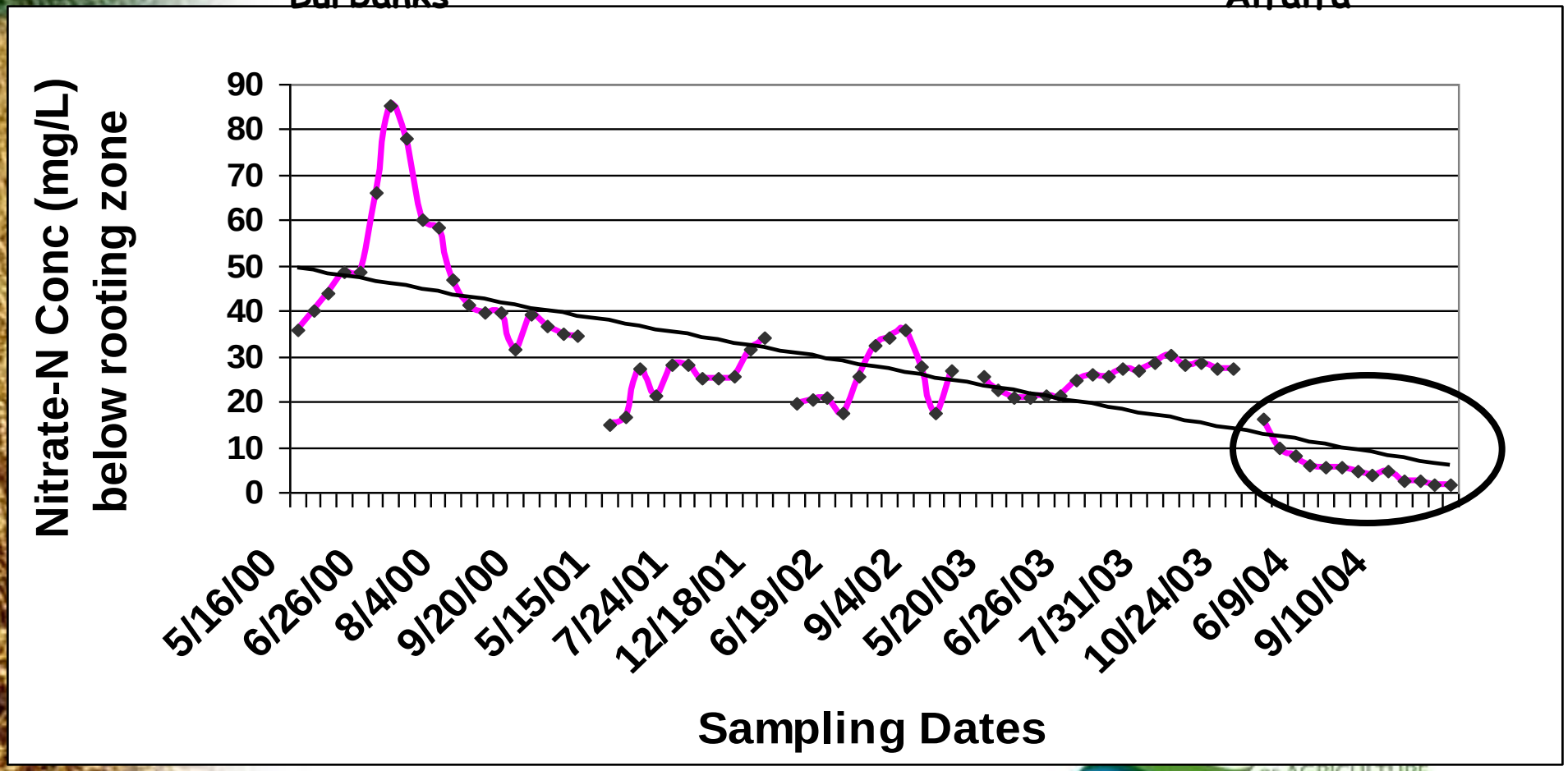
MINNESOTA DEPARTMENT OF AGRICULTURE

One Key Irrigation Pivot Was Voluntarily Converted to Alfalfa from 2003-2007



MINNESOTA DEPARTMENT OF AGRICULTURE

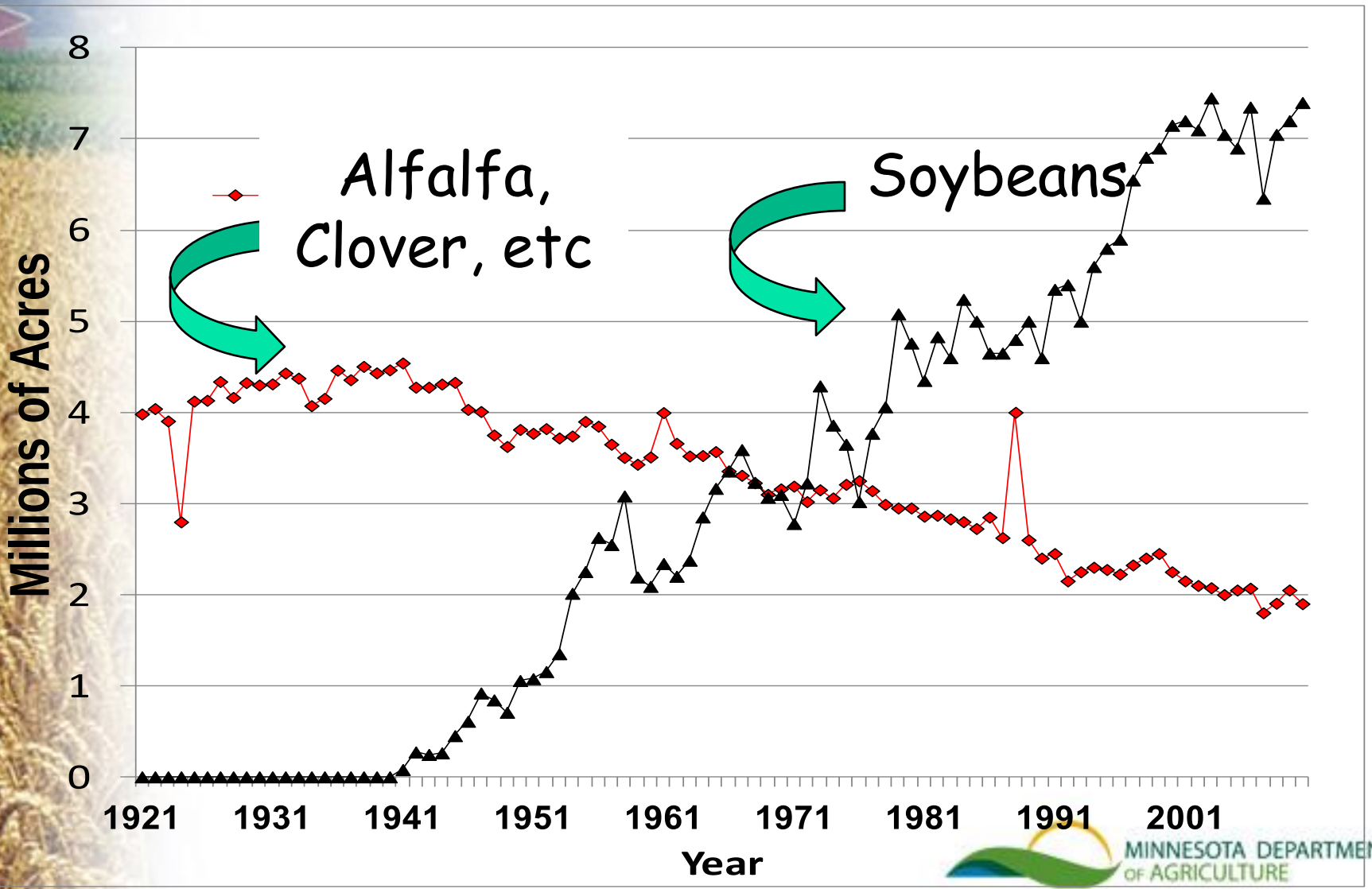
Impact of Crop Types under Irrigated, Coarse-Textured Soils Perham SWPA



The Last 90 Years…..

Acreage Trends in Minnesota's "Legume" Crops

(All Hay and Soybeans)



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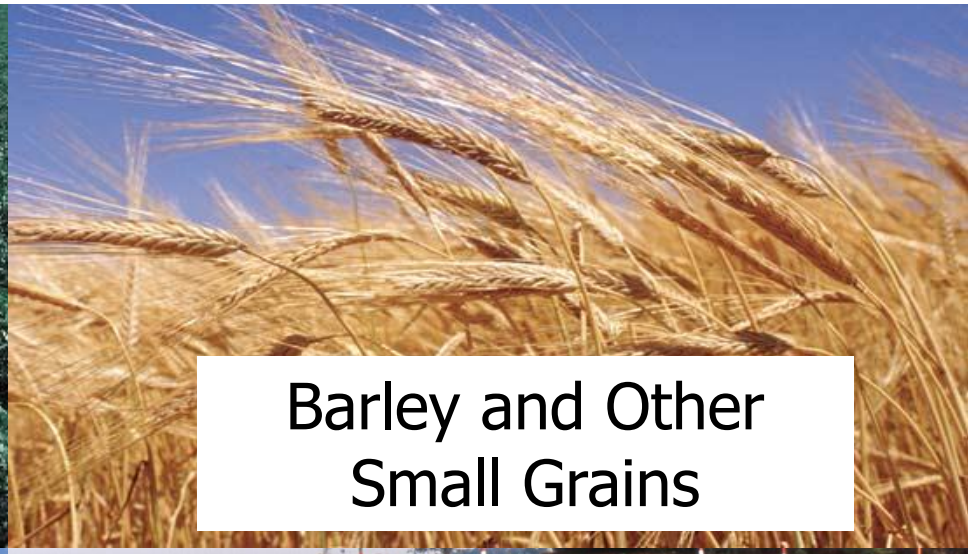
Crops with Medium N Loss Leaching Potential

Soybeans



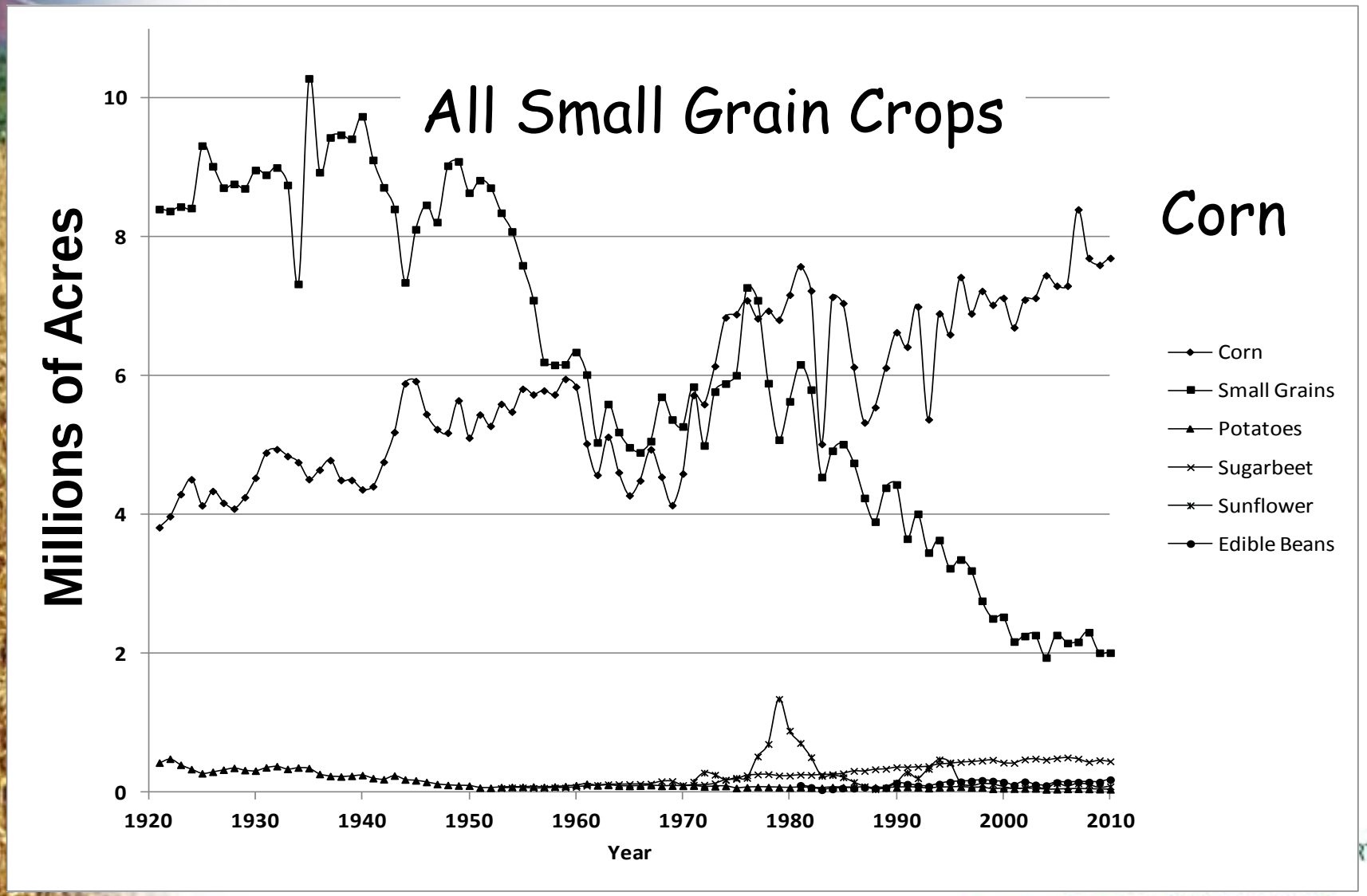
Barley and Other Small Grains

Wheat

Sugar Beets

The Last 90 Years…..

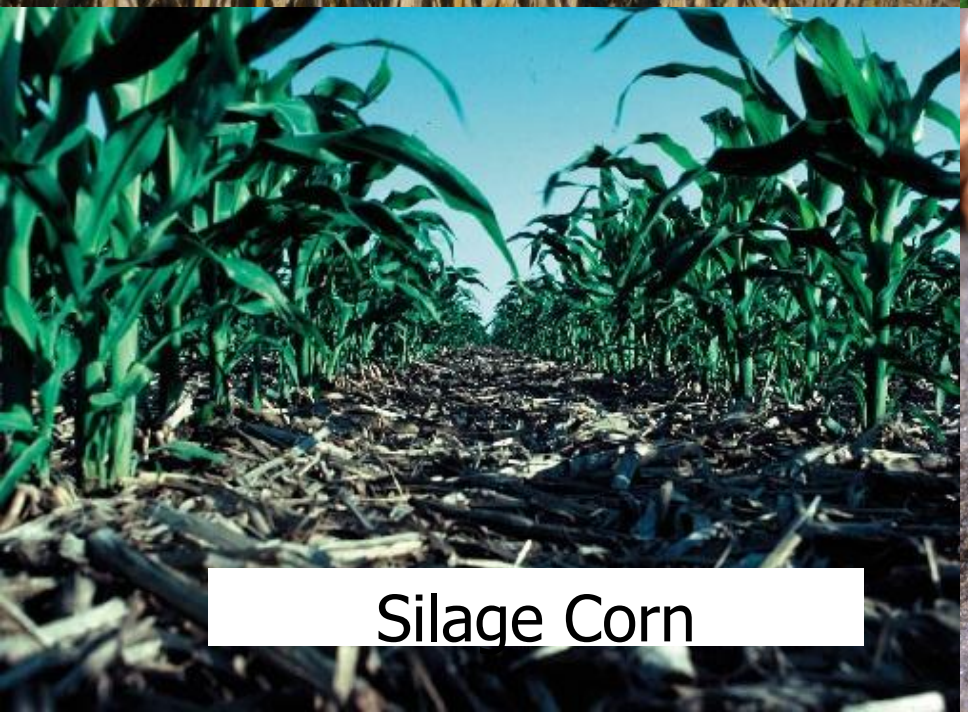
Acreage Trends for Minnesota's Major Nitrogen Demanding Crops



Crops with High N Loss Leaching Potential

Grain Corn

Potatoes

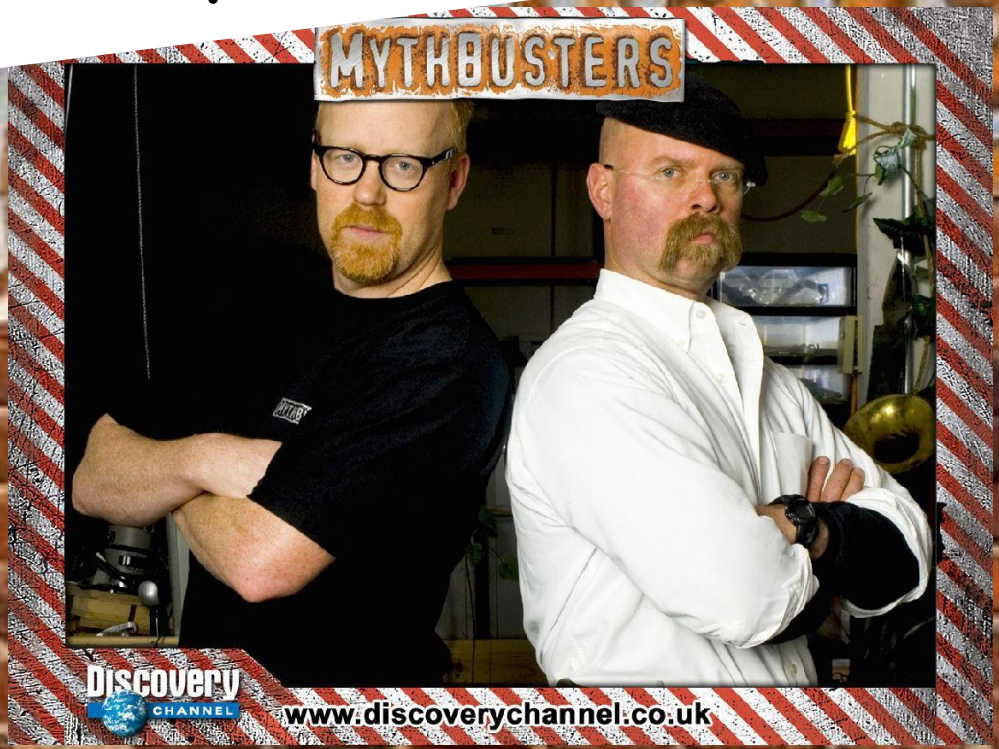


Silage Corn

Edible Beans

Crop Selection and their Historic Acreages Help Explain Nitrate Trends in Groundwater….
"TRUE or FALSE"??

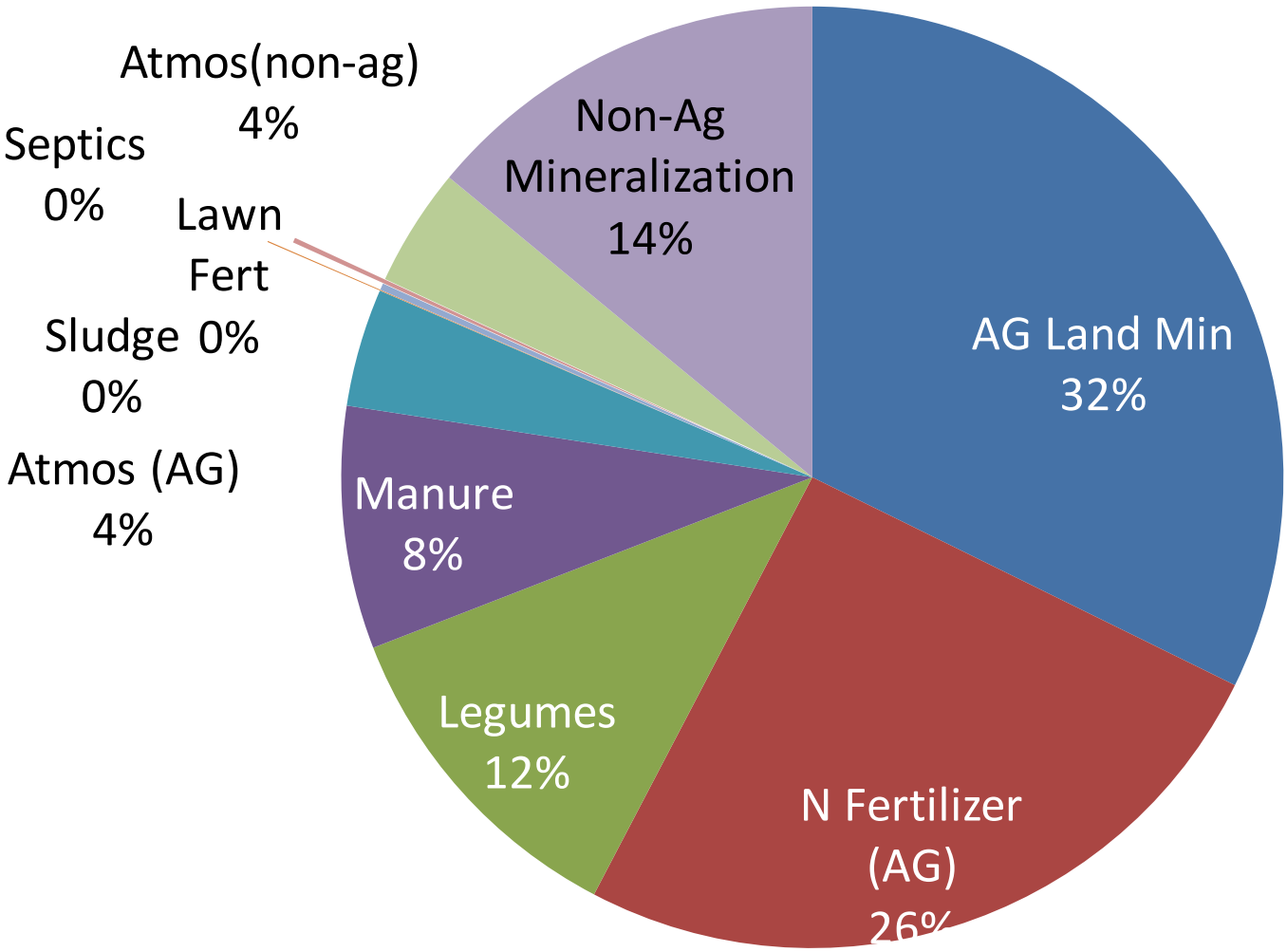
Plausible.



Nitrogen inputs on AG lands dwarf all the other sources…..

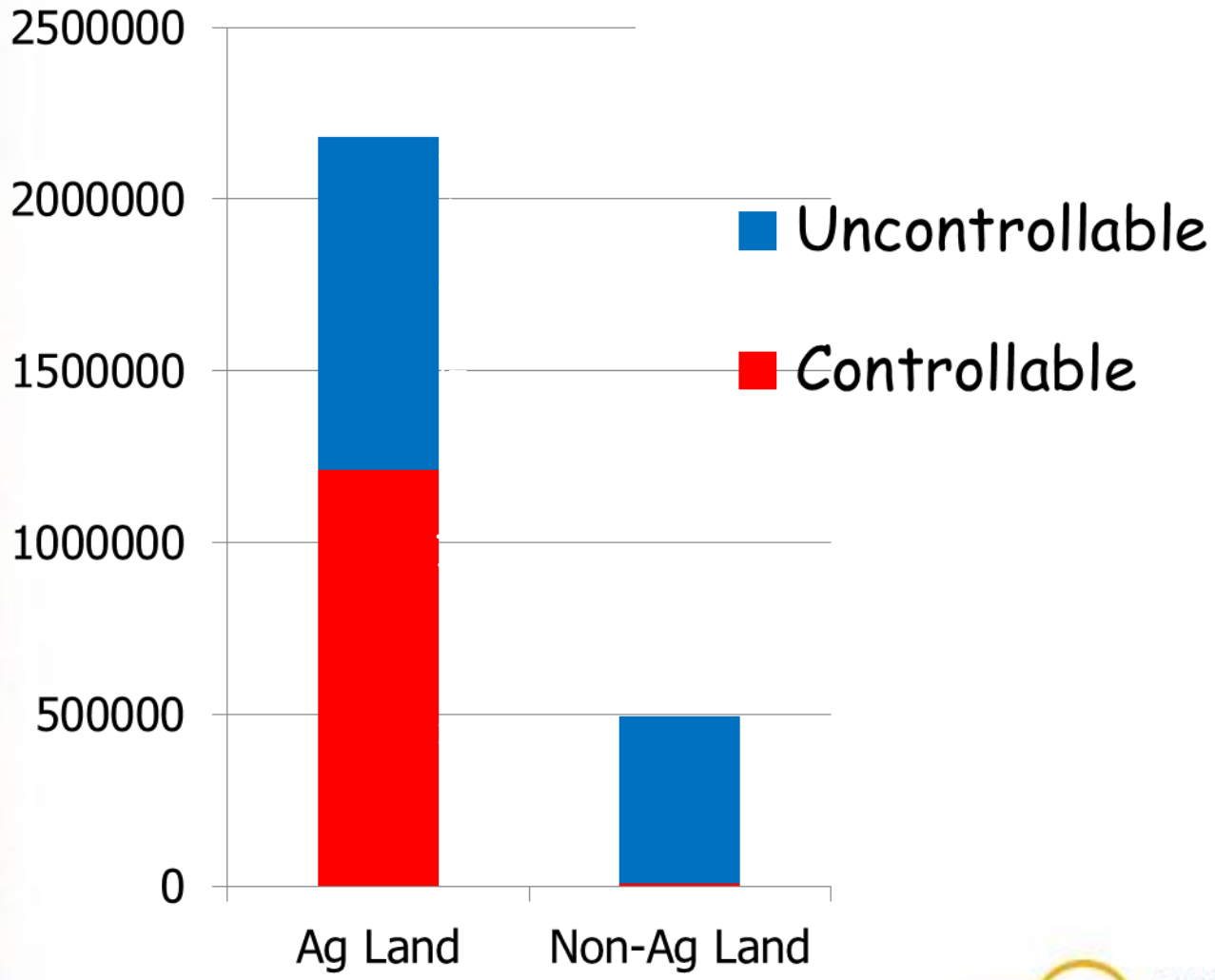
"TRUE or FALSE"??

Most Recent Nitrogen Budget Analysis on Inputs to Land (not water)



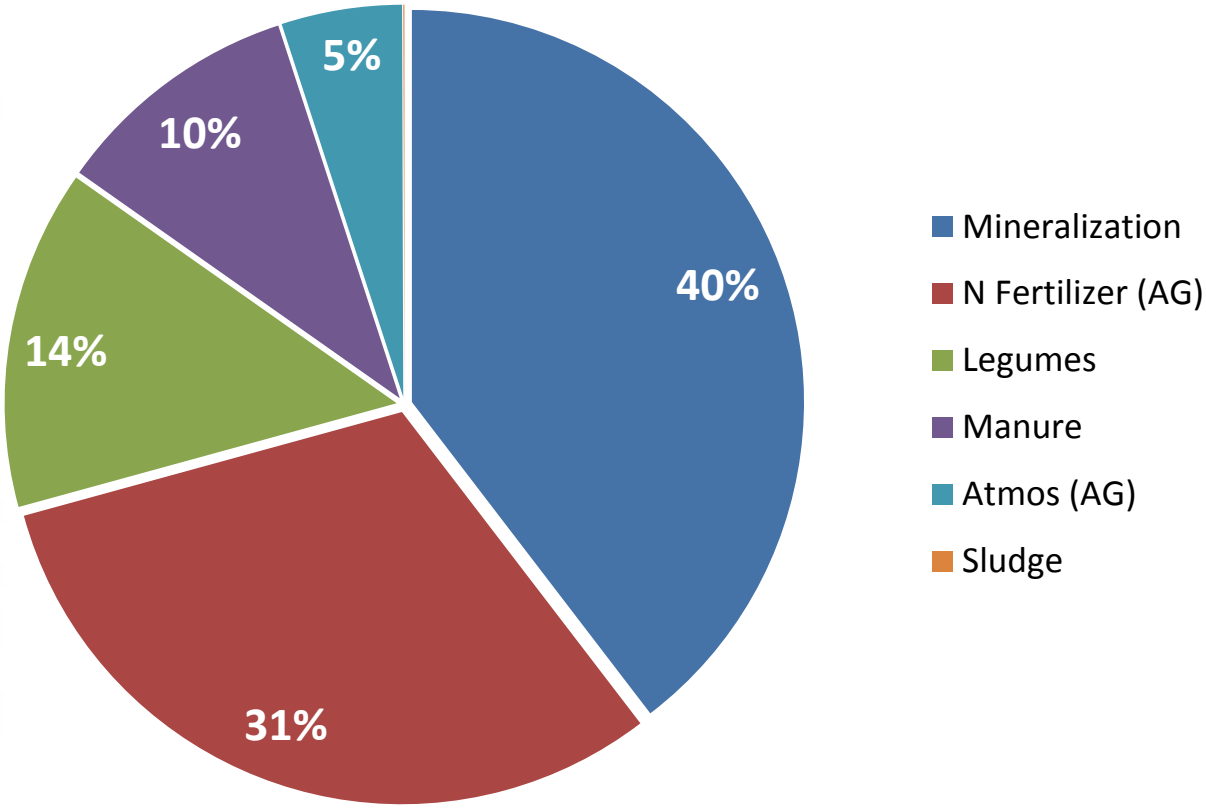
Data Source: Wall, PCA

82% of Minnesota's Nitrogen Inputs are linked to Agricultural Land



MINNESOTA DEPARTMENT OF AGRICULTURE

We Have Direct Management Control Over About 55% of the N Inputs



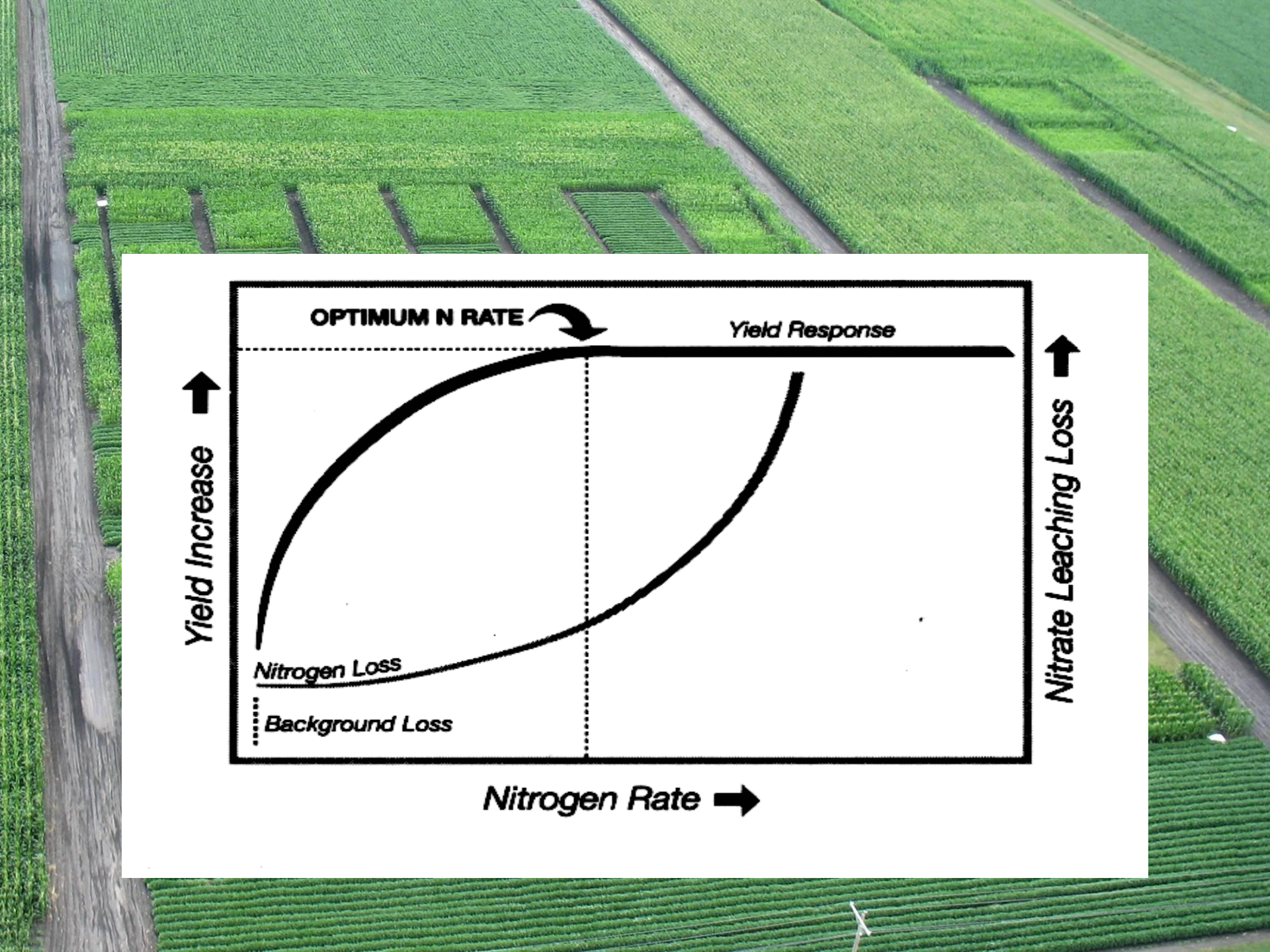
MINNESOTA DEPARTMENT OF AGRICULTURE

Nitrogen inputs on AG lands dwarf all the other sources…..

"TRUE or FALSE"??

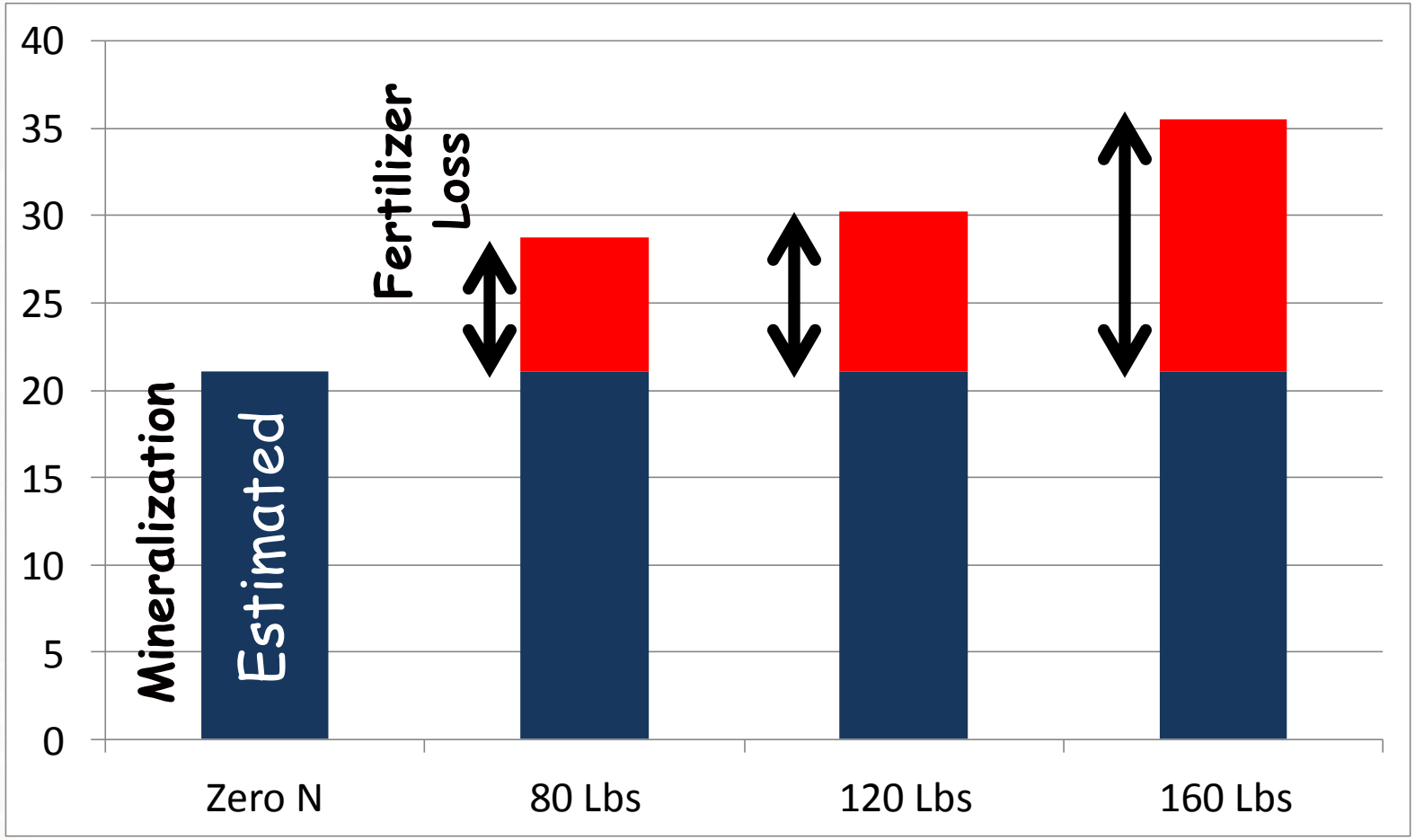
Nitrate losses would not be a problem if farmers stopped putting on nitrogen fertilizer…….
"TRUE or FALSE"??

MYTHBUSTERS


OPTIMUM N RATE
Yield Response
Yield Increase
Nitrate Leaching Loss
Nitrogen Loss
Background Loss
Nitrogen Rate

Partitioning Nitrate-N Losses from Mineralization and Fertilizer Applications

(SROC Waseca, 2000-2003 Wetter than normal years)



Data Source: Randall and Vetch, SROC

Estimated Check using 10 ml/L, 9.3 inches of drainage which is one inch higher due to poorer water use efficiency)

MINNESOTA DEPARTMENT OF AGRICULTURE

Nitrate losses would not be a problem if farmers stopped putting on nitrogen fertilizer…….
"TRUE or FALSE"??

False. There will always be some losses under row crop production. However, using recommended rates that optimize yields can significantly reduce unnecessary nitrate loading to our water resources

Nitrate contributions from Golf Courses and Lawns are excessive…. "True or False"???

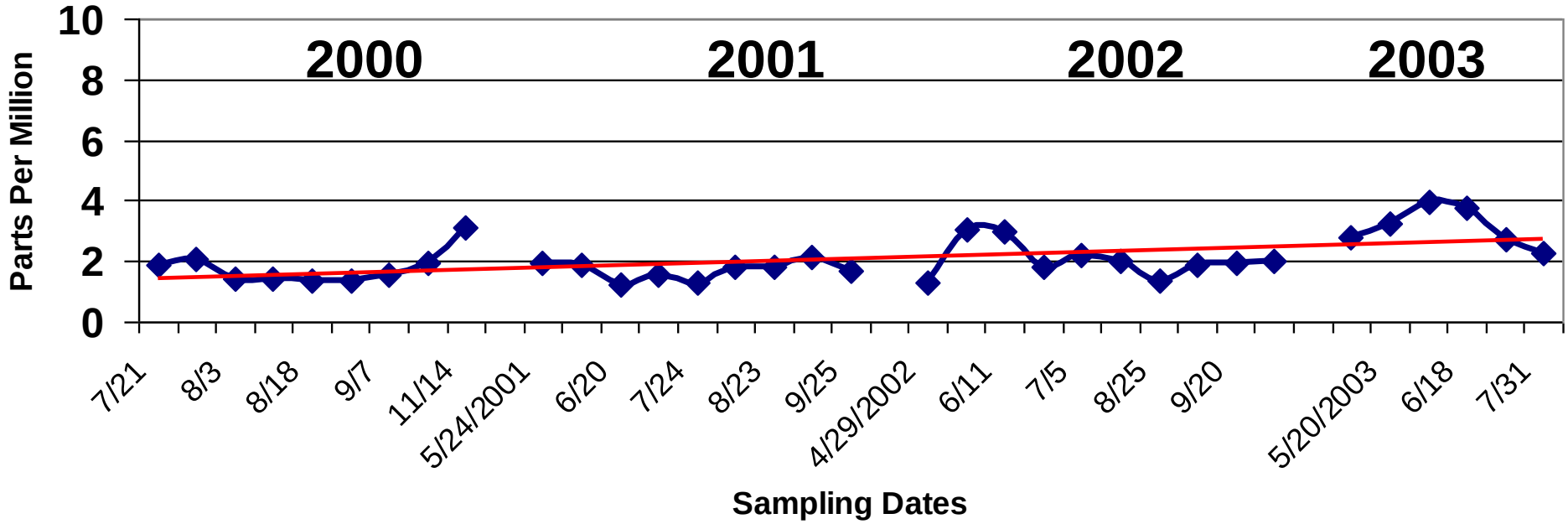
Perham Golf Course Demonstration Project

MINNESOTA DEPARTMENT OF AGRICULTURE

Perham Golf Course

Nitrate-N Levels Below the Fairways

Lake Side Country Course at Perham Demonstration Project



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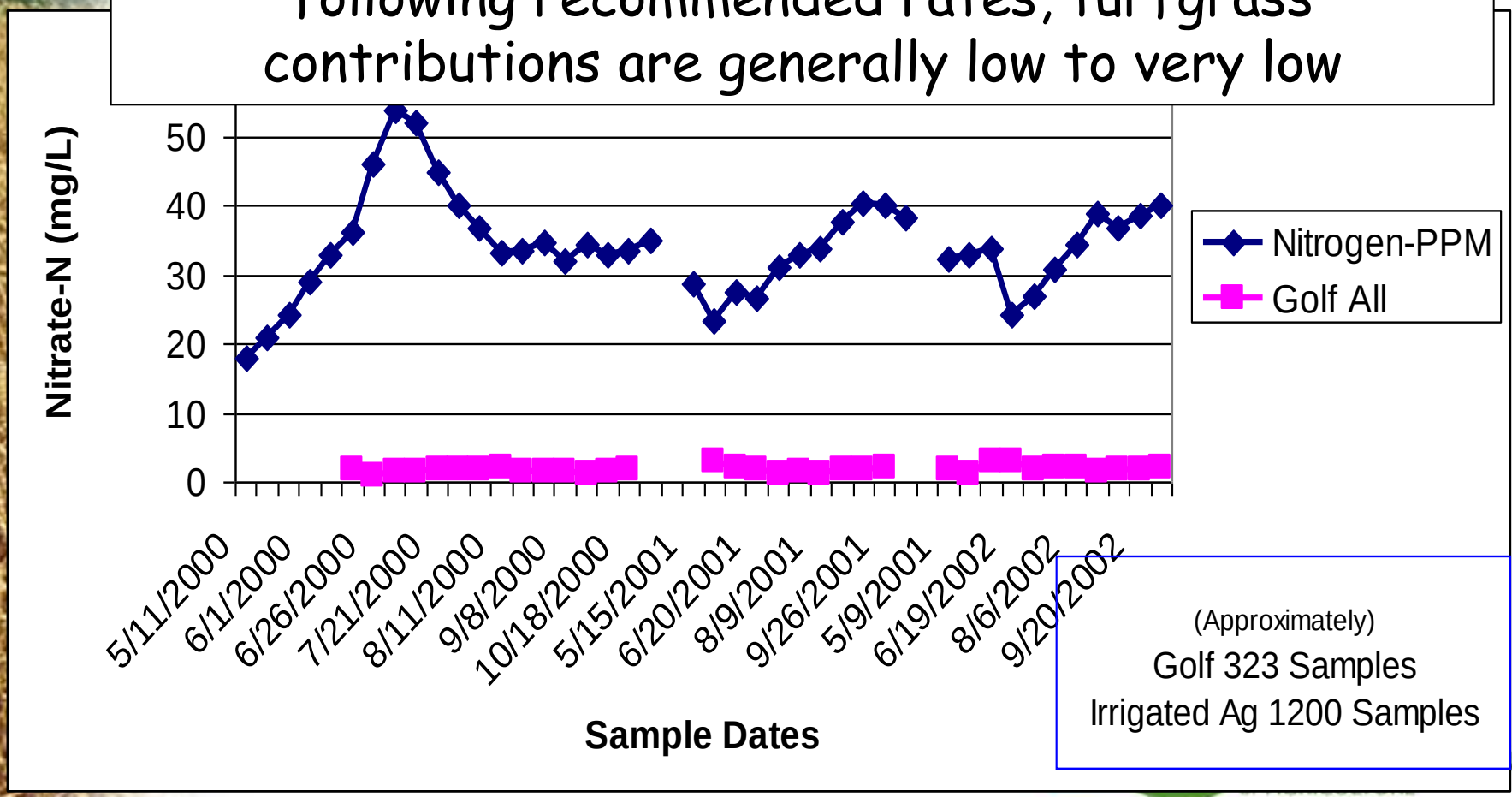
Nitrate-N Concentrations under Traditional Irrigated Cropping Rotation vs. Golf Course

Perham Wellhead Protection Area

Due to the dense fibrous root system, coupled with following recommended rates, turfgrass contributions are generally low to very low



Nitrate-N Concentrations under Traditional Irrigated Cropping Rotation vs. Golf Course

Perham Wellhead Protection A

Nitrate contributions from Golf Courses and Lawns are excessive??... "True or False"???

5/11/2000
6/1/2000
6/26

(Approximately)
Golf 323 Samples
gated Ag 1200 Samples

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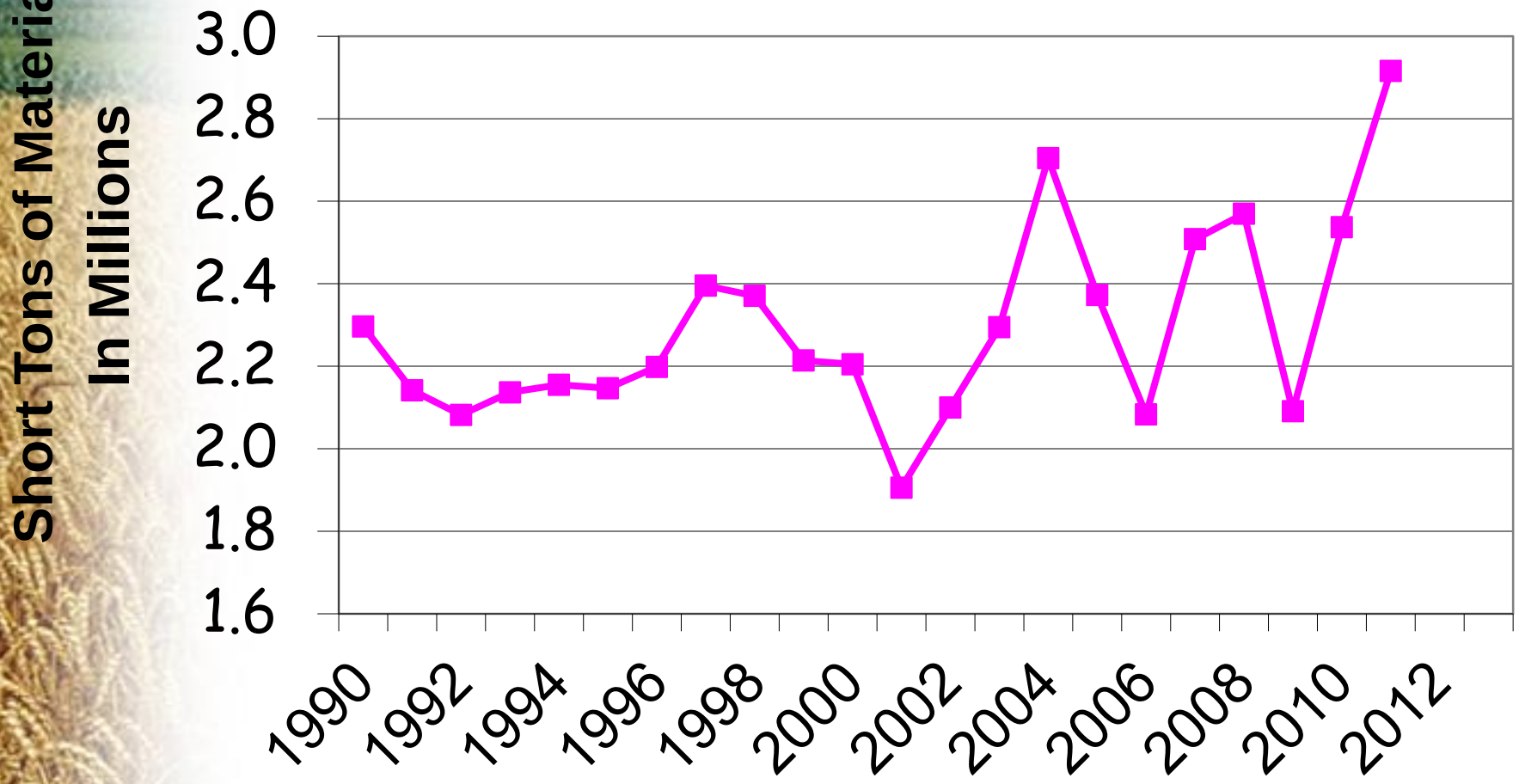
Nitrogen fertilizer sales have sky-rocketed to support the record corn production….
"TRUE or FALSE"??

Trends in Total Fertilizer Tonnage Sold in Minnesota



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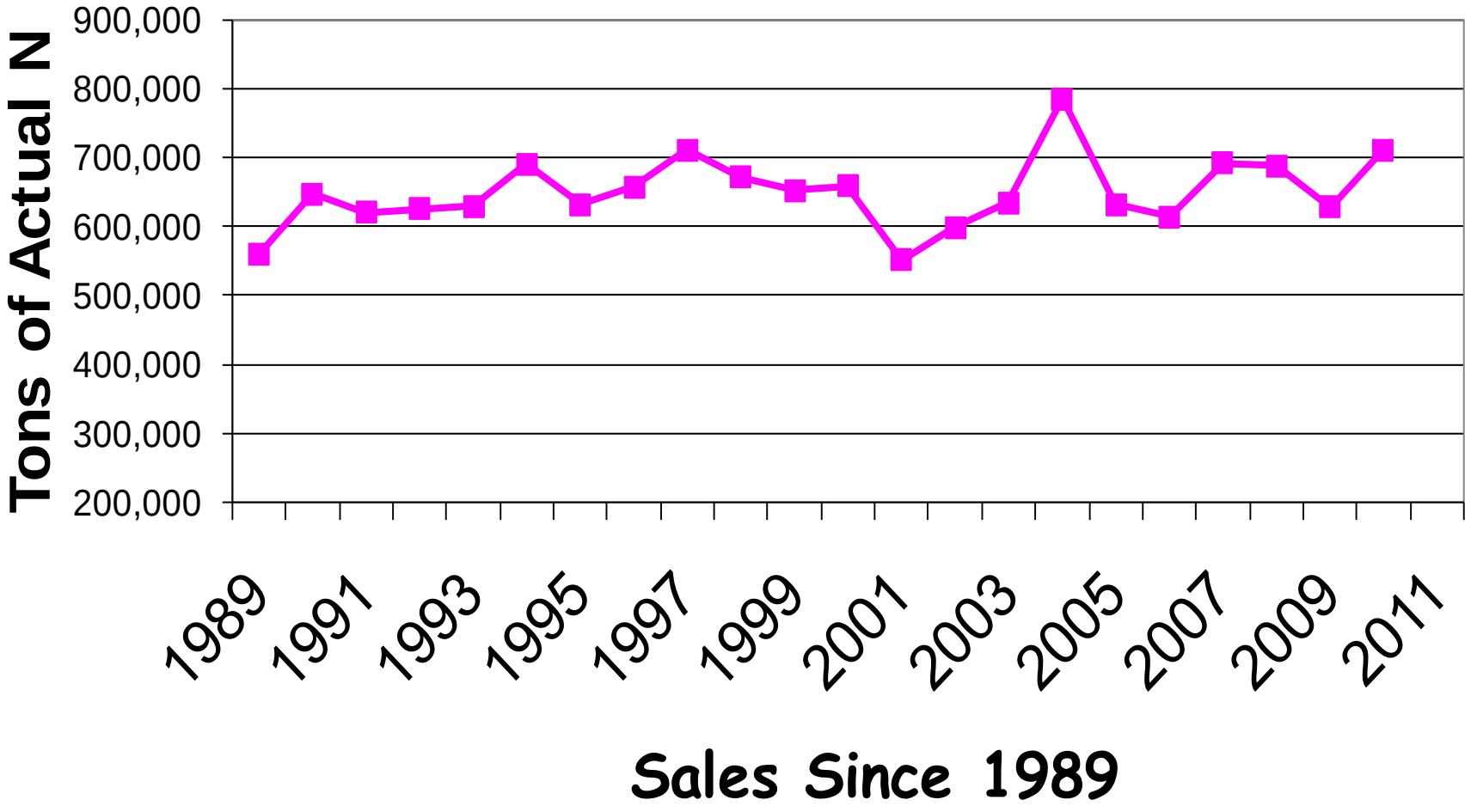
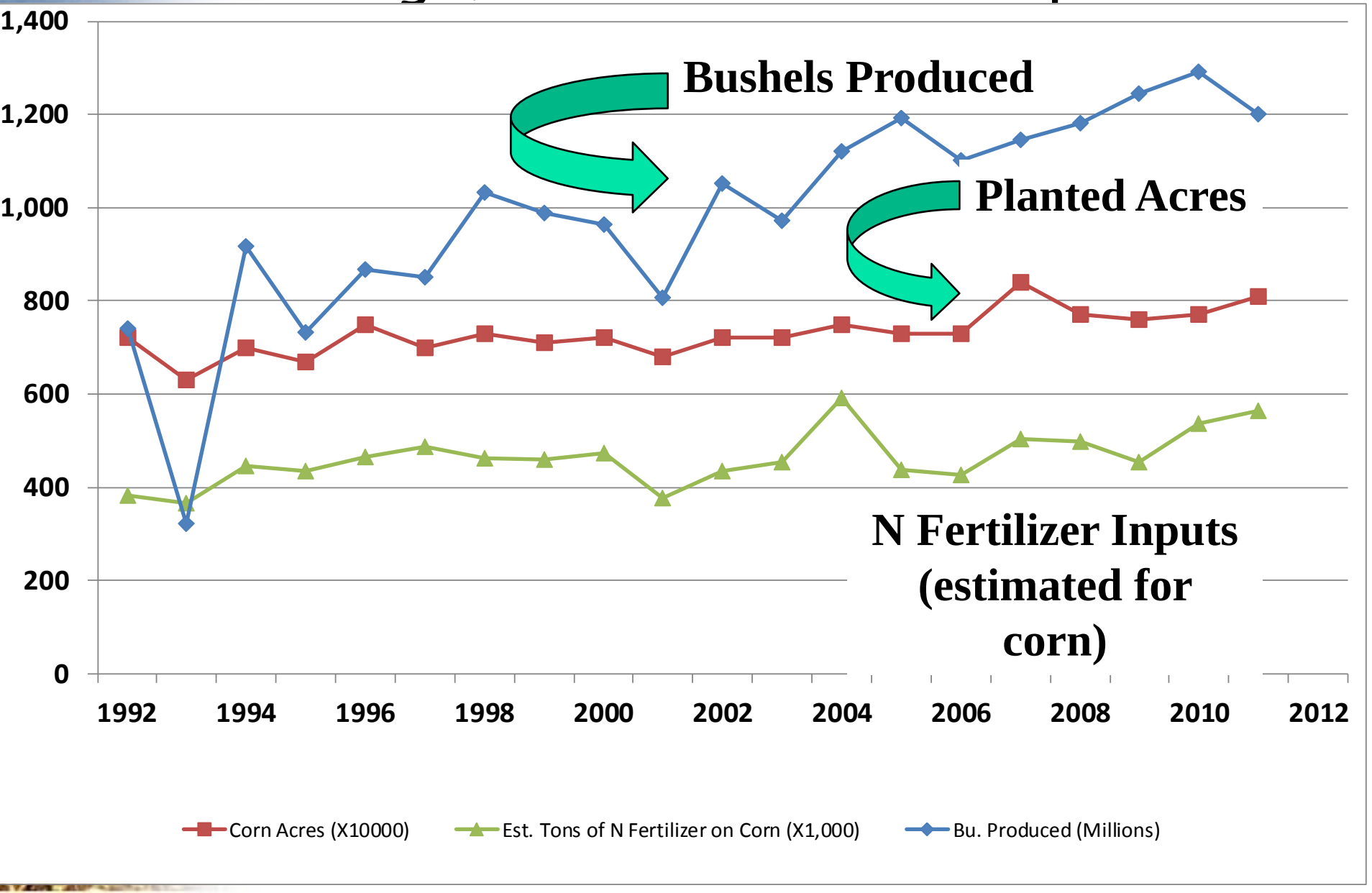
Commercial Nitrogen Fertilizer Sales Trends in Minnesota: 1989-2011

Data Source: MDA, TVA, and AAPFCO



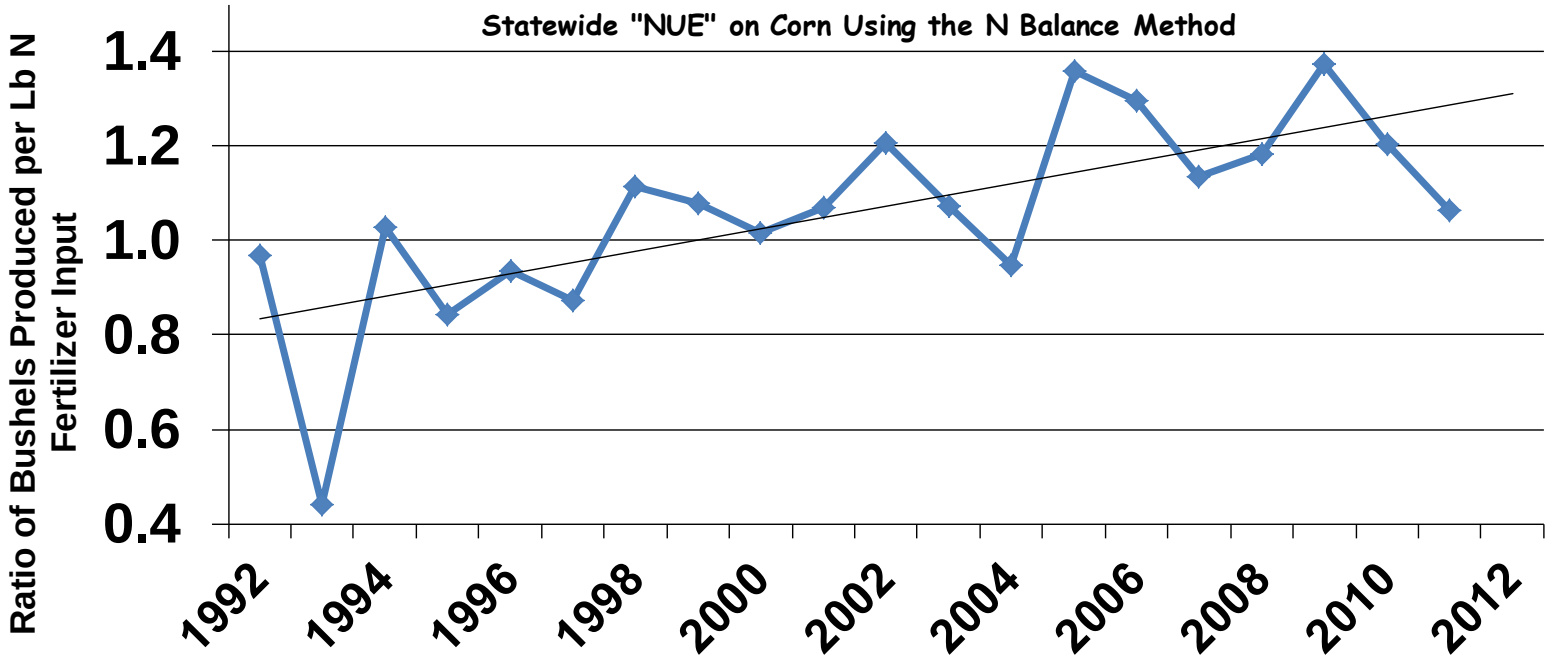
Ten Year Averages 1991-2000: 654,988 2001-2010: 653,481

Relationship between Grain Corn Production, Acreage, and N Fertilizer Inputs



Bushels of Corn Produced per Lb of N Fertilizer

1992 to 2011



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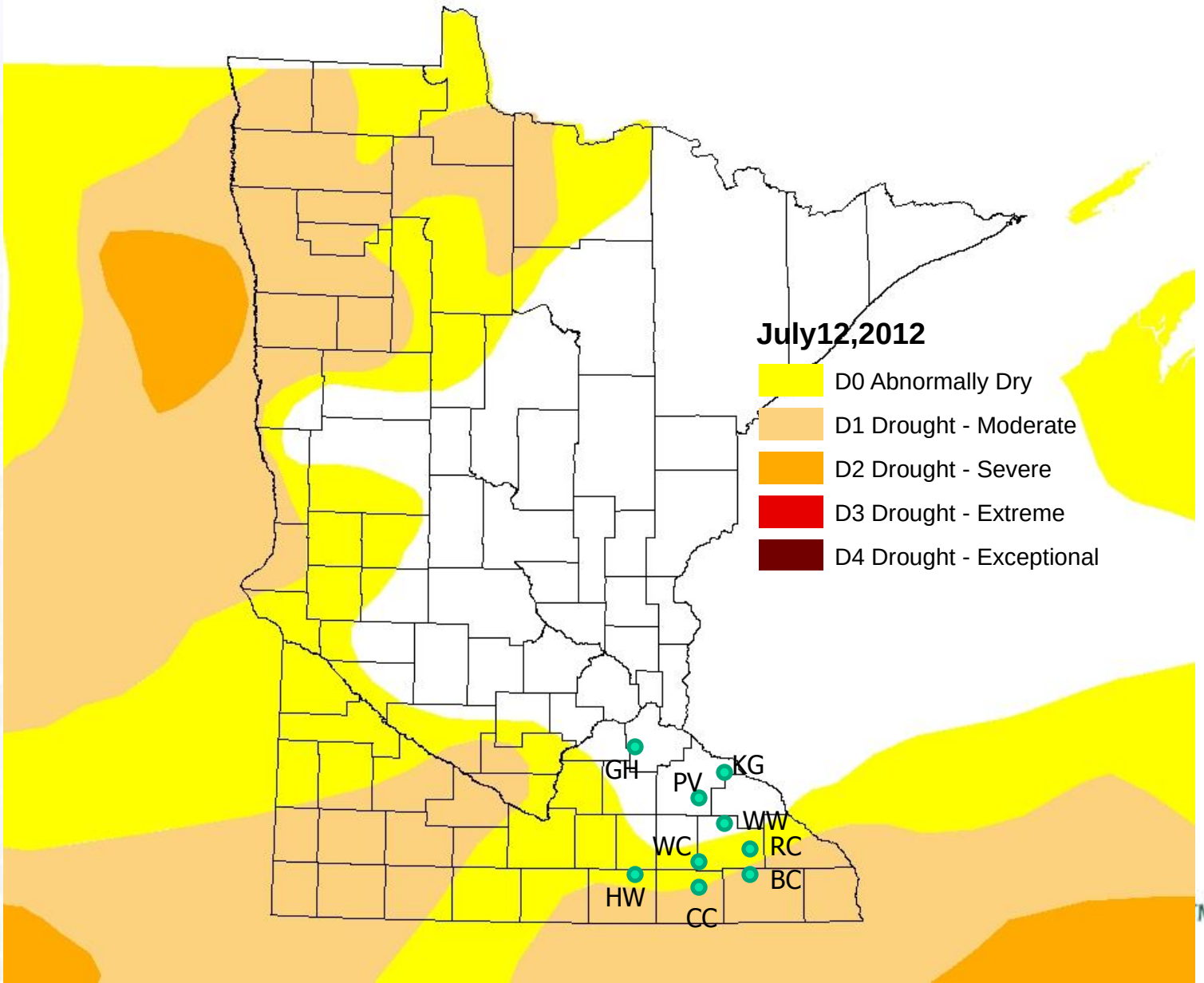
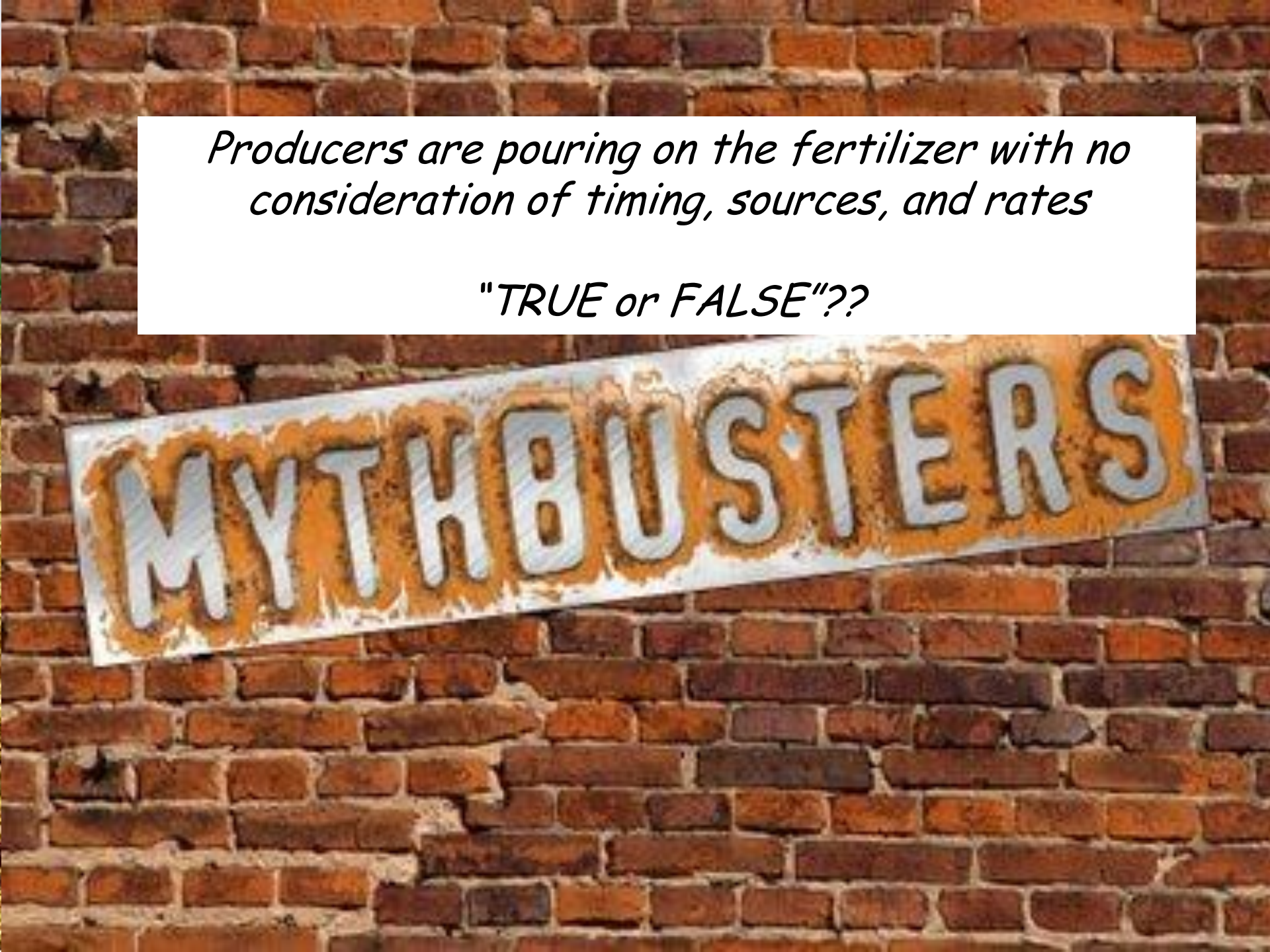
2012 Drought Impacts on N Recovery and Feed Quality?



Nitrogen fertilizer sales have sky-rocketed to support the record corn production….
"TRUE or <u>FALSE</u>"??

Producers are pouring on the fertilizer with no consideration of timing, sources, and rates

"TRUE or FALSE"??



Characterizing Regional and Statewide Fertilizer Practices

Survey of Nitrogen Fertilizer Use on Corn in Minnesota

Peter Bierman[1], Carl Rosen[1], Rod Venterea[1,2], John Lamb[1]

[1]University of Minnesota – Department of Soil, Water, and Climate
[2]United States Department of Agriculture – Agricultural Research Service

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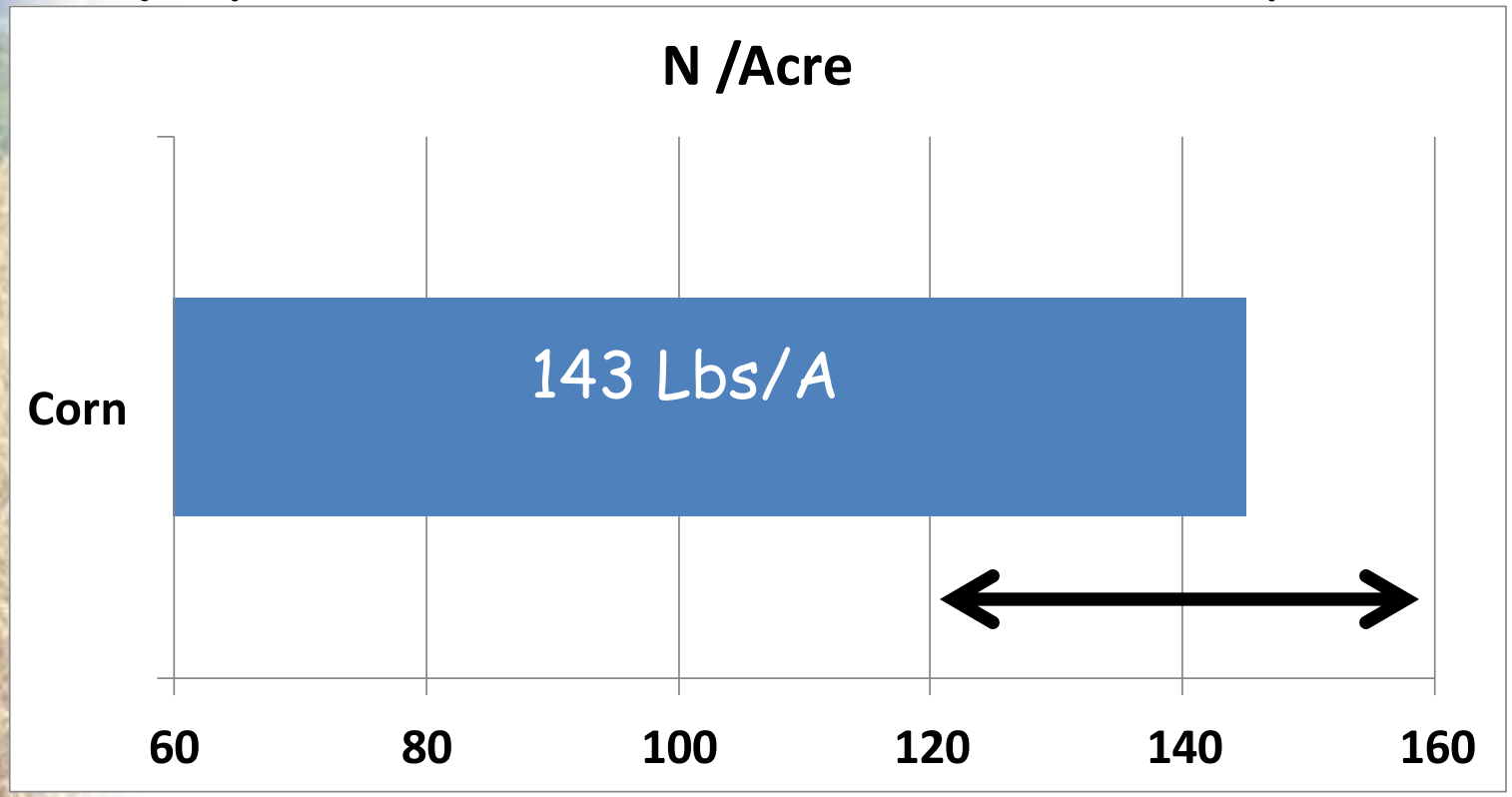
NASS Corn Grower N Survey-2010

Statewide N Fertilizer Rates on Non-Manured Corn

(Represents 17% of the fields surveyed)



Acceptable Range 120 to 165
(0.10 Value Ratio)

Bierman et al., 2011

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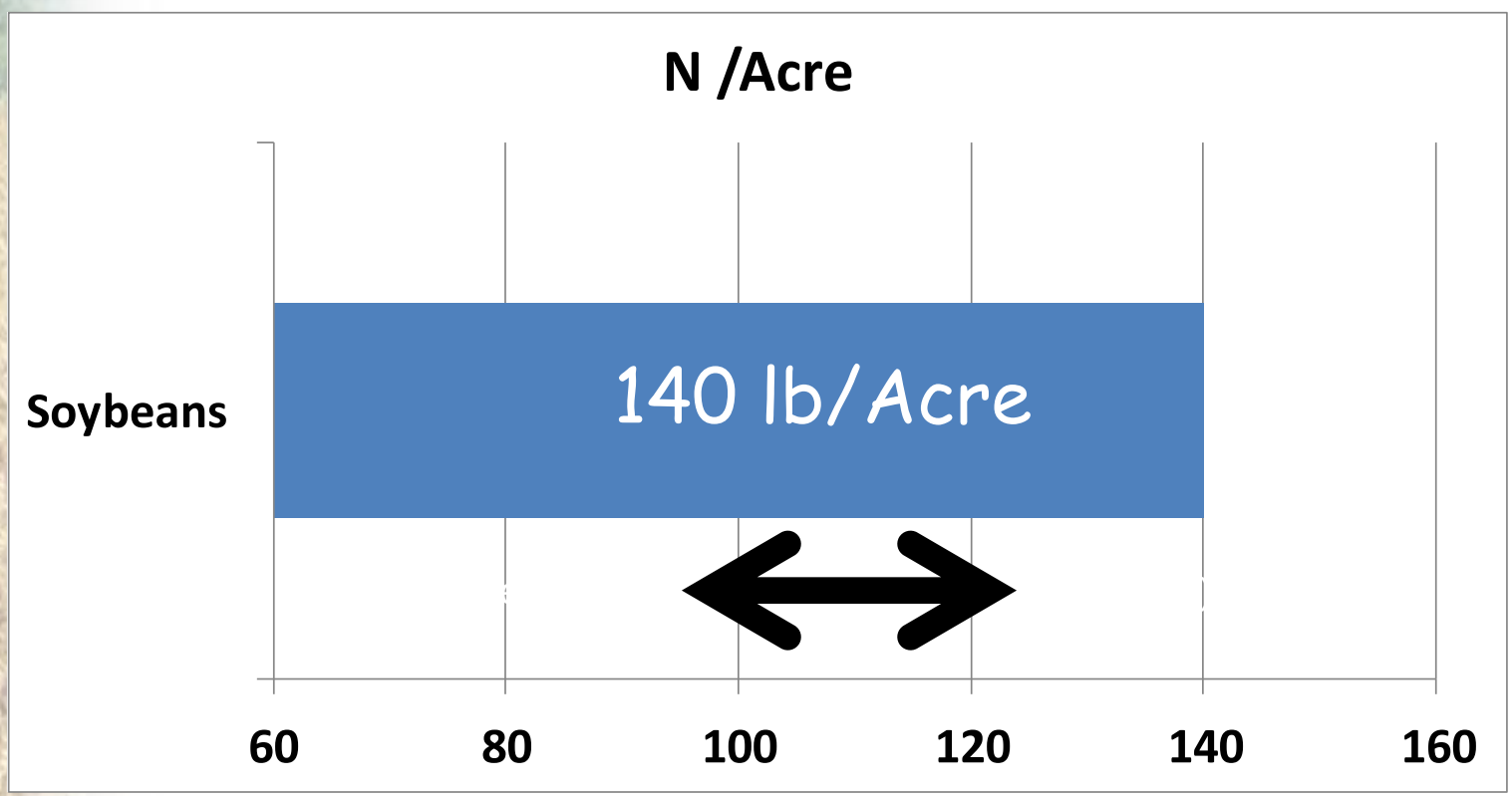
NASS Corn Grower N Survey-2010

Statewide N Fertilizer Rates on Non-Manured Corn

(75% of the fields surveyed followed beans)



Acceptable Range 90 to 125
(0.10 Value Ratio)

Bierman et al., 2011

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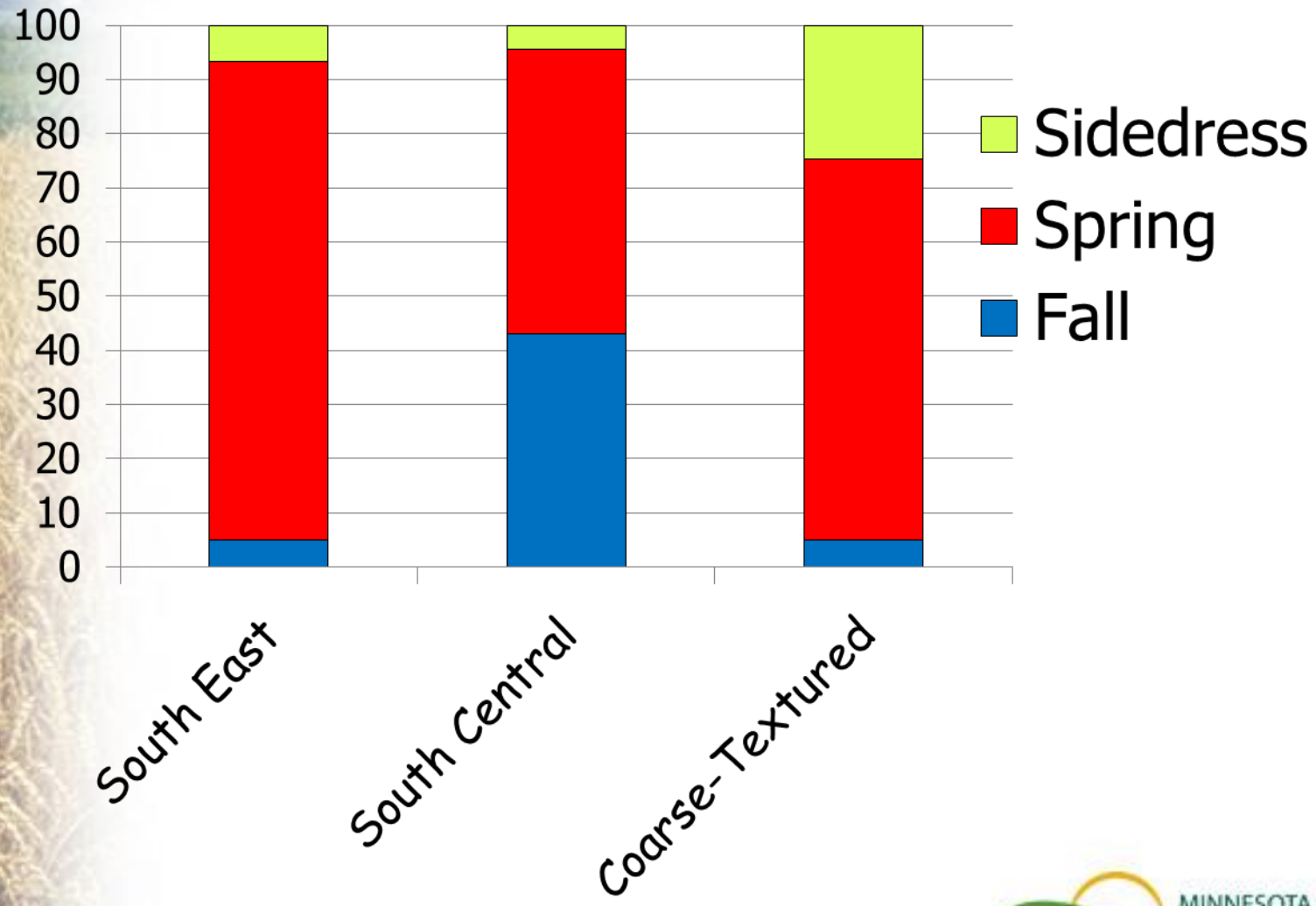
NASS Corn Grower N Survey-2010

Timing of the Major N Source on Corn



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Producers are pouring on the fertilizer with no consideration of timing, sources, and rates

"TRUE or FALSE"??

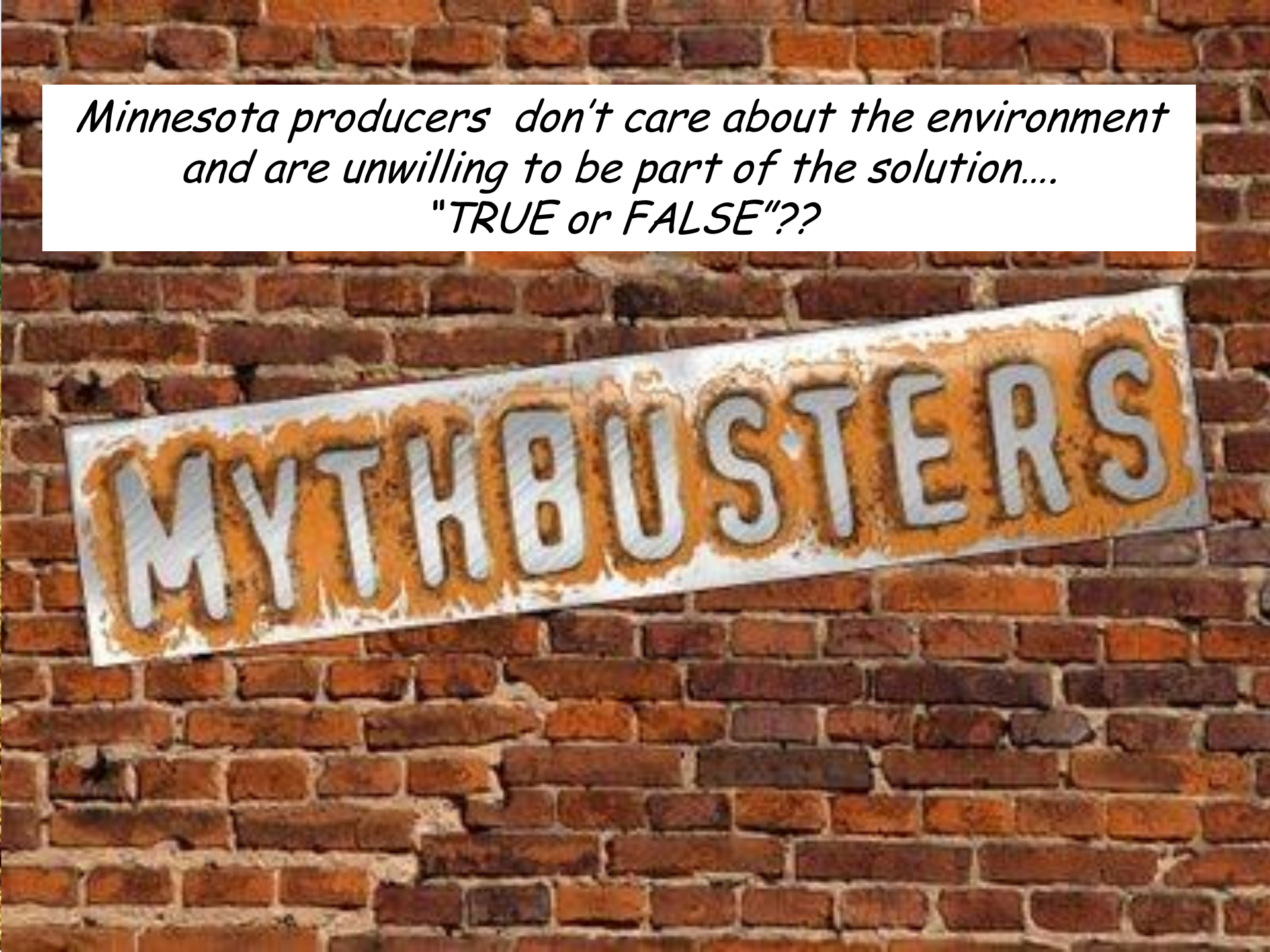
Producers are pouring on the fertilizer "TRUE or FALSE"??

In general, MN producers do good to great jobs at using the right source, timing and placement;

Producers in many cases fail to take full advantage of soybean credits;

Producers have made significant gains in manure crediting and management

Minnesota producers don't care about the environment and are unwilling to be part of the solution….
"TRUE or FALSE"??



Some Examples of Successful Innovations Within Wellhead Protection Areas

- Introducing Alternative Cropping Systems (Park Rapids, Perham, St. Peter);
- Introducing N Efficient Potato Varieties (Perham and Park Rapids);
- Introducing ESN, N-Serve, and other slow release products (Cold Spring, Perham, St. Peter, Park Rapids, Verndale, etc);
- Land Swapping with City (Perham);
- Accelerated EQIP and CRP Signed Ups (Holland);
- Bioreactors (St. Peter)

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Discovery Farms Minnesota

Discovery Farms Minnesota is a farmer-led initiative to gather information and assess the water quality impacts of different types of farms, in landscapes all across Minnesota

MAWRC
MINNESOTA AGRICULTURAL WATER RESOURCES COALITION

MINNESOTA DEPARTMENT OF AGRICULTURE

Root River Field to Stream Partnership

Water Monitoring

CLEAN WATER LAND & LEGACY AMENDMENT

OTA DEPARTMENT
CULTURE