Animal Feeding Operations in Iowa: Growth of an Industry and its Impacts

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Will Discuss

- What are Animal Feeding Operations (AFOs)
- History of AFOs in Iowa
- Construction Trends of AFOs
- Current Regulations for Design and Construction of AFOs
- Specific Rules for Construction in Alluvial soils or Karst Terrain
- Separation Distance Requirements for AFOs
- Current Regulations for Manure Application
- Other Rules or Policies DNR has Adopted to Protect Ground Water
- Ground Water Quality Impact from AFOs
- Ground Water Quantity Impact from AFOs

- Where We Go From Here

What is an AFO

"a lot, yard, corral, building or other area where animals are confined, fed and maintained for 45 days or more in any 12 month period"

- **Confinement**
  - totally roofed, cannot discharge
- **Open Feedlot**
  - unroofed building or partially roofed building or dirt lot
    - **no** crop, vegetation, or forage growth
    - residue is not maintained when animals present
- **Combined Facilities**
  - Confinement and open lot together
- **Pasture**

  - permanent vegetation, corn stubble-no rules

What is a Confinement?

- It’s totally roofed
- 100% manure containment

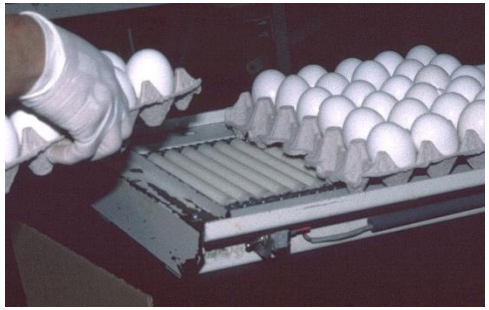
Swine Confinement

Open Feedlot

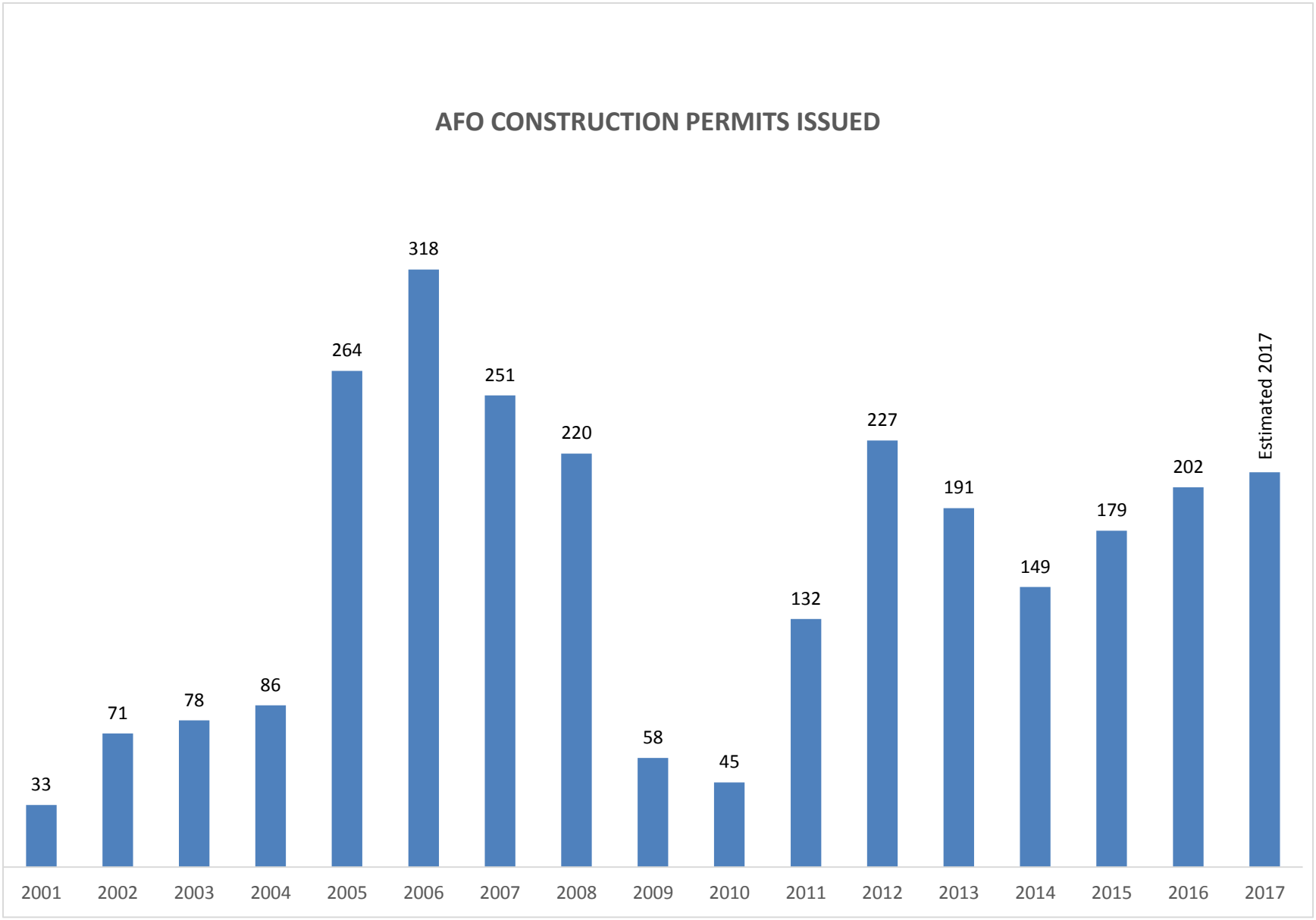
HISTORY OF AFOs IN IOWA

- 1969-First rules for open feedlots were adopted
- 1972-Updated rules for open lots and developed first confinement rules
- 1970s and 1980s saw several rule revisions and new rules
- 1990s saw large increase in confinements
- 1995-Major rule update for confinements. Set separation distance requirements, MMPs, manure application.
- 2000- open feedlots had been ignored for awhile so amnesty program (Iowa Plan) registered over 1600 open feedlots in Iowa to bring the large facilities into compliance
- 2002-saw more rule revisions. Distances, permit thresholds, matrix
- Since 2002 we have had about a dozen smaller rule change packages
- 2016 – last rule revision
- How have these rules impacted Iowa's Industry

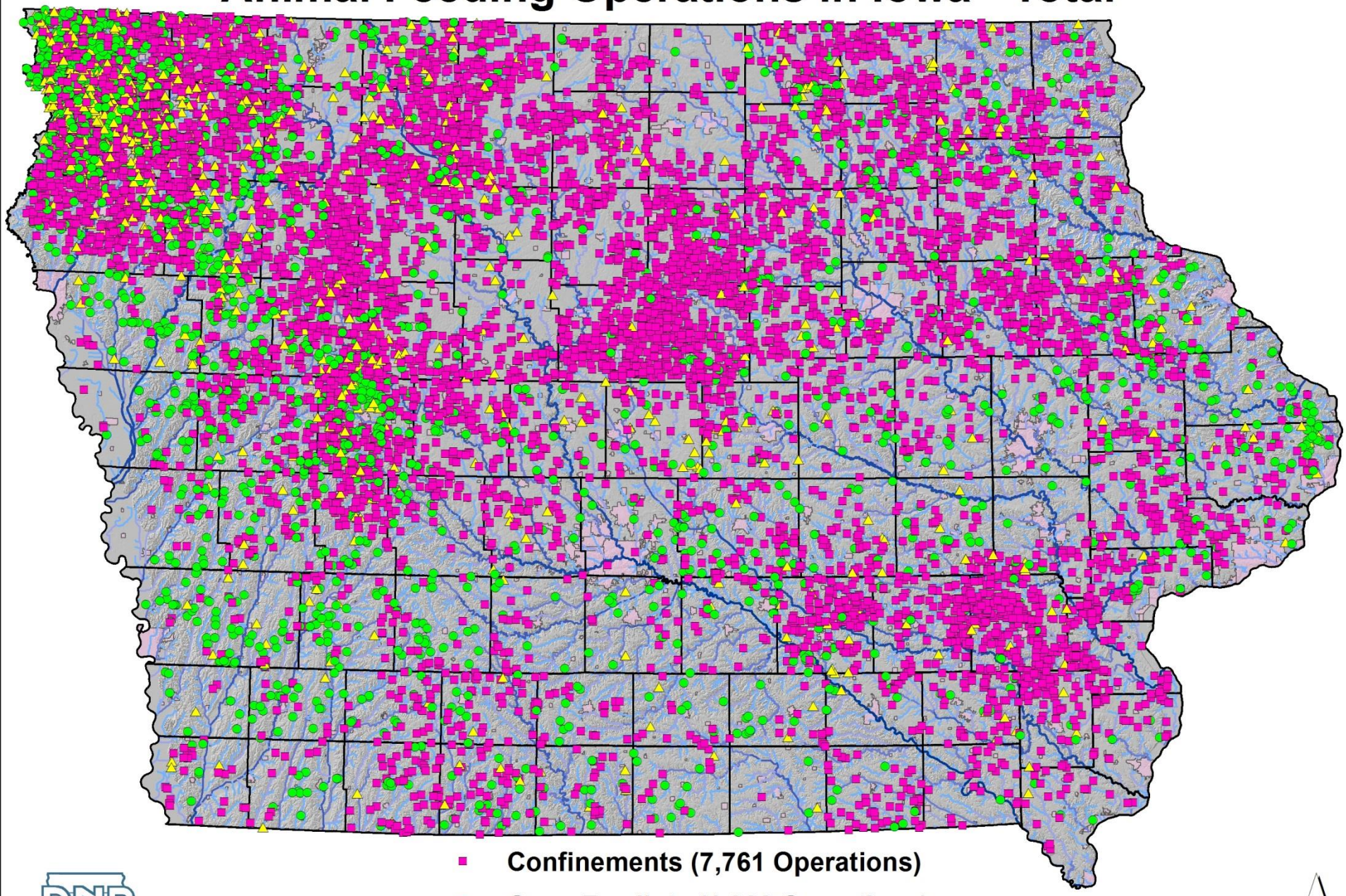
Iowa is *Tops* in Animal Production



- **# 1** in Pork production(22,400,000 hogs)
- **# 1** in Egg production(69,166,000 birds)
- **#4** in Cattle on feed (3,850,000 cattle)
- About 9,500 confinement sites not including SAFOs


AFO CONSTRUCTION PERMITS ISSUED
33
71
78
86
264
318
251
220
58
45
132
227
191
149
179
202
Estimated 2017
2001
2002
2003
2004
2005
2006
2007
2008
2009
2010
2011
2012
2013
2014
2015
2016
2017

Animal Feeding Operations in Iowa - Total



DNR Role

- Review Permit Applications
- Review Manure Management Plans
- Conduct Site Surveys of Proposed Sites
- Instruct County on Their Role in the Permit Process
- Issue Construction Permits
- May Visit Site During Construction
- May Inspect Site After Construction
- Check Manure Applicators During Land Application
- Investigate All Complaints

Confinements Come in Three "Sizes"

- Needs a construction permit
  - 1,000 or more animal units with formed storage
  - Any size with unformed storage
- Needs a manure management plan and Construction Design Statement approval
  - More than 500 animal units
- Is a small animal feeding operation, no permit or approval
  - 500 or less animal units (could be 4000 SAFO sites)
  - An Animal Unit is a value assigned to different animal types (i.e. adult hog = 0.4 and beef cattle =1)

Who Needs a Permit

- >1000 AU in Confinement
- 400,000 chickens < 3lbs
- 10,000 nursery pigs (15 pound average)
- 2,500 finishing pigs (150 pound average)
- 1000 beef cattle (1000 pound average)
- 715 dairy cows (1200 pound average)
- Any size AFO using an earthen pond for manure storage
- An Open Feedlot applying for a NPDES permit and over 1000 AUs needs a permit
- What does the permit get us…

What we like to see

What we like to see

Like to see this

What we like to see

Do not like to see this

Or this

Or this

Current Regulations

- What is DNR doing to ensure that manure storage structures are designed and built properly
- Structures can be earthen basins, cast in place concrete structures or prefabricated structures (Slurry Store)
- DNR has rules for design and construction of all types of manure storage structures.
- Conducted concrete contractor training this past winter at six sites around the state.

DNR Concrete Design

- DNR Chap 65 are the rules for concrete design and construction.
- They are not all inclusive and refer to American Concrete Institute as well as Midwest Plan Services.
- MN, IL, NE have stricter design and construction standards than Iowa. PE required in other states.
- DNR Construction Design Statement (CDS) is a design table for deep pit barns. By far the most popular design tool.

CDS provides for industry standards

Contractors must adhere to rules

Constructed properly concrete can last a long time

Precast Panels

DNR Earthen Basin Design

- Need soil borings and soil study
- Must be above ground water or artificially lower GW table (Max of 4 feet)
- Must meet permeability requirements (1/16th “/day at design depth) and conduct perm tests
- Requires PE design and certification
- May use an artificial liner
- Must check for existing tiles
- Minimum 6 months storage required
- DNR conducts regular inspections of earthen structures

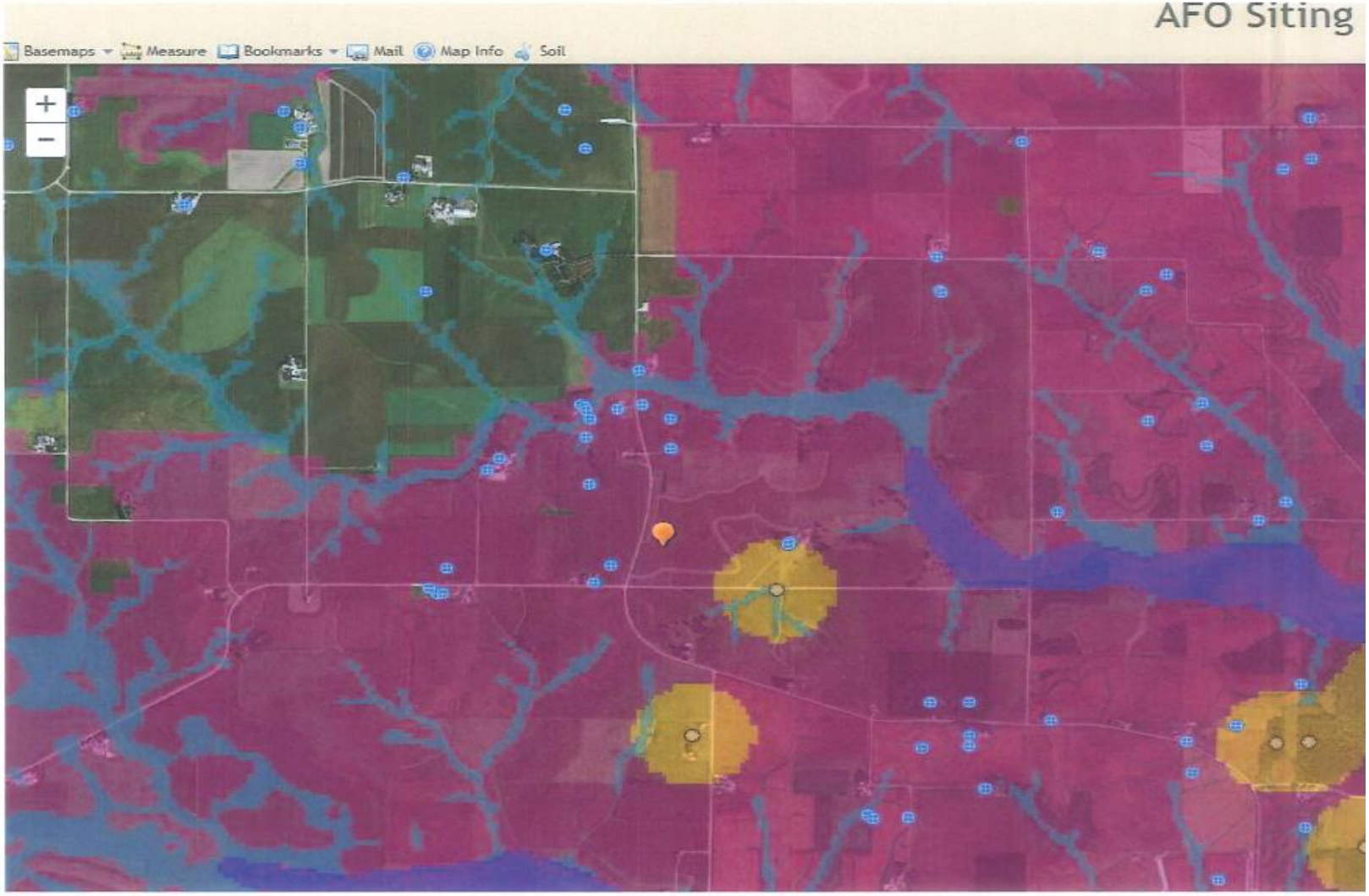

Dairy Confinement with multiple pond cells

Artificial Liner

Specific Rules for Alluvial Soils

- Alluvial soils on DNR Siting Atlas developed using the SCS Soil Surveys done in the 70's.
- If a confinement site is in alluvial soils you must let DNR determine if it is in flood plain.
- Cannot build an AFO confinement structure on the 100 year flood plain of a Major Water Source. (caveat)
- Flood Plain Maps are being developed to maybe replace alluvial soils maps

DNR Siting Atlas shows potential karst and known Sinkholes



Upgraded Concrete Standards in Karst

- If proposing a formed manure storage structure in karst terrain there are upgraded standards.
- Soils Study (Two soil borings or test pits **located** in each structure) Soil borings should be located within footprint. Test pits should be located just outside of footprint.
- Minimum of a 5 foot thick layer of low perm soil between bottom of formed structure floor and karst bedrock. Layer must start directly beneath the pit floor and be continuous.
- Two foot thick engineered clay liner can be substituted in lieu of 5' of native soil. PE is required.
- Minimum 5 inch thick reinforced concrete floor.
- Karst terrain can be refuted. A new soil boring or existing well log (within 200 feet) can be submitted to refute the karst terrain if the boring or log shows a minimum of 25 feet between bottom of pit floor and karst bedrock.
- Test pits are compacted and bore holes are filled with bentonite.

Sink Holes

- Siting Atlas shows all mapped sinkholes with a 1000’ radius around them. These are shaded yellow.
- Could be unmapped sinkholes we do not know about. Rules would also apply. “Closed” sinkholes we cannot find are exempt.
- Need Secondary Containment if you build a manure storage structure in the yellow shading, regardless of the drainage pattern.
- SCB are additional containment structures that exempt certain separation distances
- Upgraded concrete standards also apply if the site drains towards a sinkhole.

Minimum Separation Distances

- Depends on the size of the proposed confinement facility. Assume a new 4800 head swine finisher site. (pretty common size site)
- Barns must be 500 feet from a water source (bed and bank) and ag drainage well intake.
- 1000 feet from a major water source. (lake or river as listed in Chap 65)
- 100 feet from a deep well. 200 feet from a shallow well
- 2500 feet from designated wetland.
- Some distances increase if an earthen basin is used.
- SCB can exempt to all water sources and wetlands but not wells
- Other distances apply to residences, businesses public use areas, etc.
- Need to be 1875 feet from a residence however 2500 feet from cemetery

Manure Application

- All confinement sites >1250 head of hogs (>500 AUs) must have an approved Manure Management Plan (MMP) This Plan shows acres needed for proper agronomic rate of manure application

- Anyone hauling or applying manure from a confinement site, other than a SAFO (<1250 hogs), must be a certified manure applicator.

- Applicators must renew every three years.

- Applicators must follow the MMP and separation distances when applying

Liquid Manure Application

- Must be applied at agronomic rates per approved MMP.
- Minimum distance to a sinkhole, well, designated wetland, water source, major water source or ag well inlet(if directly injected or incorporated on same date applied) **0** feet

- Majority of liquid manure is injected

- Distances increase if manure is not incorporated.

Liquid Manure Application (con't)

- If a 50 foot wide buffer strip is used to protect the designated area (water sources, wells, sinkholes, wetlands etc.) manure can be applied up to the buffer strip.

- Cannot irrigate manure within 200 feet of an unplugged ag well or ag well inlet.

Challenges with Manure Application

- Over 10 billion gallons of liquid manure need to be applied to fields annually. Majority of them in the Fall.
- Challenge to keep track of that many haulers and applicators.
- Applicators run non stop for weeks. Accidents happen.
- Weather affects application. May not get through winter with storage so it does get applied.
- Have restrictions on winter application.

Solid or Dry Manure

- Majority of dry poultry manure is sold under Iowa Code Chapter 200A and is not regulated by the DNR but IDALS. (remember the 70 million birds)

- Dry bedded cattle barn manure and scraped open feedlot manure is the majority of the “dry” manure handled through DNR.

- May be stockpiled and land applied throughout the year.

- Has same distance requirements based on incorporation or not incorporated as liquid manure to designated areas.

Winter Application of Liquid Manure

- 2009 rule passed regarding winter manure application and stockpiling requirements.

- Between Dec 21 and April 1 you cannot apply liquid manure to a field with 1” or more of snow cover or ½” of ice cover unless an emergency exists. (snow covered rule)

- Between Feb 1 and April 1 you cannot apply liquid manure to a field that has more than 2” of frost present unless an emergency exists. (frozen ground rule)

What is an Emergency

- Broken water line and pit is filling up
- Natural Disaster (record rainfall)
- Unusual weather conditions (extreme wet Fall)
- Does not apply to a confinement site built after May 26, 2009 that has less than 6 months of manure storage.

Runoff from Snow Covered or Frozen Ground

Manure on Snow Covered or Frozen Ground

- If you qualify for an emergency you must contact the DNR
- Land must be identified in MMP for winter application
- Down gradient tile inlets must be covered
- Must be applied 200 ft from a water source, well, sinkhole, designated wetland or ag drainage well.
- Must be applied 800 ft from high quality water resource

Other Rule Changes the DNR has Implemented improve Water Quality

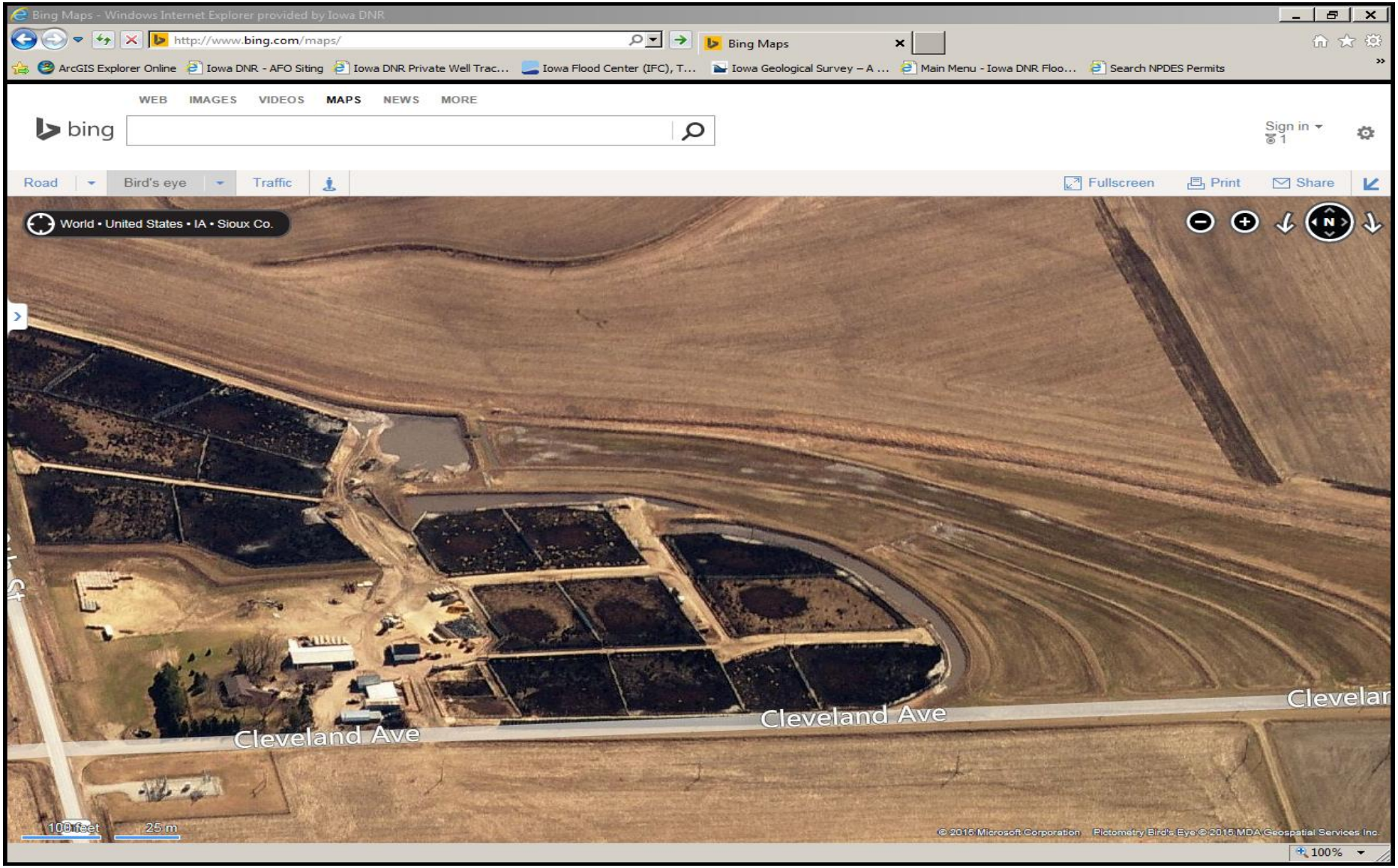
- Alternative Technology- In 2003 the DNR partnered with EPA, Cattlemens Association and ISU to allow NPDES permitted open feedlots to construct and operate vegetative treatment areas in lieu of conventional effluent basins.

- Currently have 13 permitted AT sites in the state.

- After some learning curve issues all 13 sites appear to be operating properly with little impact to the ground water. Only have 10 years of data.

Feedlot with conventional effluent storage basin

AT site with VTAs



VTA with good stand of grass

Gated pipe and harvested VTA

Summary of DNR Rules to help Environment and Ground Water

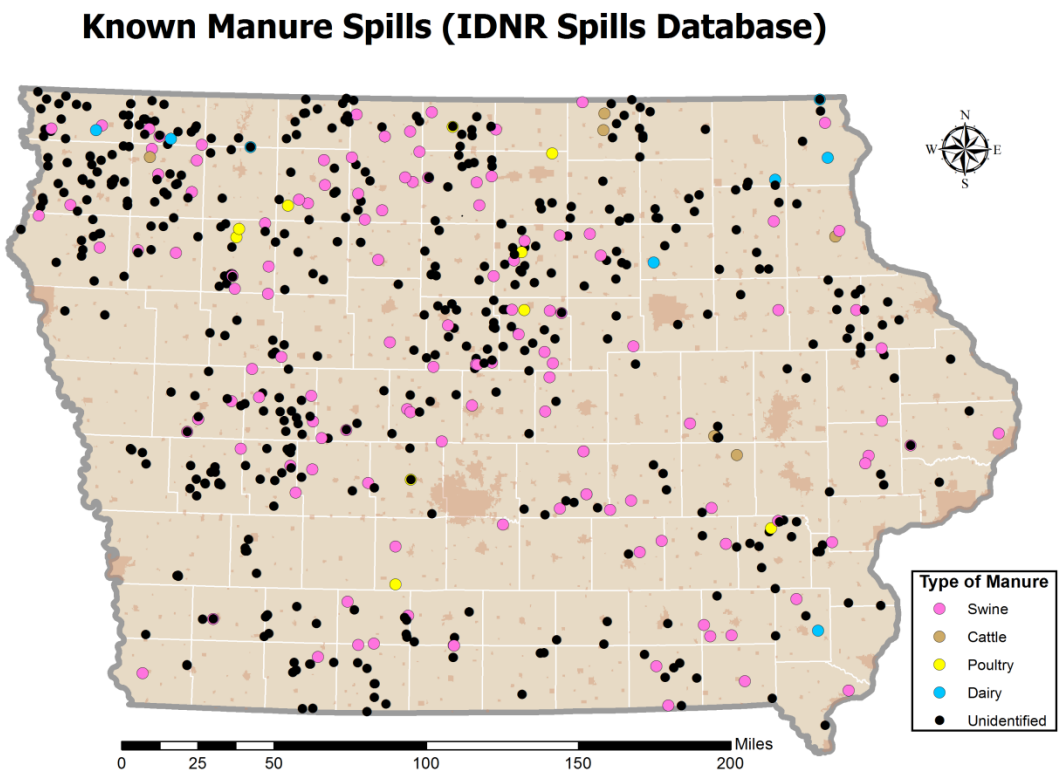
- Have permitting requirements for AFOs.
- Have rules governing the design and construction of concrete and earthen manure storage structures
- Have restrictions on confinement structures in alluvial and karst soils. Banned earthen basins in karst in 2004.
- Have minimum separation distances for confinement structures. Have tightened up these distances over the years. (water source)
- Have rules on manure application
- DNR updates rules as necessary
- Added livestock truck wash rule
- Iowa DNR and EPA currently involved in Work Plan

- Are they working?

Manure Spills and Fish Kills

- Between 1996 and 2012 approximately 800 reported manure spills.
- 4,464,257 fish killed by animal waste (1995-2016: DNR Fish Kill database)

- Vast majority of spills and fish kills are during manure pumping, hauling and land application.



AFOs Impact to Groundwater Quantity

- About 13,000 AFOs in Iowa:
  - At 3.0 employees per site using 50 gpd = 2,000,000 gpd
  - 23 million swine finishers using 2 gpd = 46,000,000 gpd
  - 4 million cattle using 17 gpd = 68,000,000 gpd
  - 70 million birds using 0.129 gpd = 9,000,000 gpd
  - **Estimated Total use across state = 125 MGD**
- Bob Libra reported that in 1998 the use was 110 MGD (So we are likely closer to 200 MGD)
- Livestock accounts for roughly 3.5% of water use statewide; however, Sioux County Rural Water sends 95% to livestock

Ground Water Quantity Concerns

- Increasing number of AFOs
- Iowa's ground water supply is being reduced
- Localized depletion is a concern
- Think of the thousands of miles of field tile installed in Iowa. Instead of recharging aquifers it is transported right to the creeks
- ** I do think the next generation is much more aware of resources than previous

What's in that swine manure?

	Analyte	Result Range or Value	Quantitation Limit	Units	Method Name(s)
Bacteria	Fecal Coliform	170000 - 500000		MPN/100mL	SM21 9221E
	Membrane Fecal Coliform	560 - 570000	10	cfu/100mL	SM21 9222D
Nutrients	Ammonia Nitrogen as N	690 - 5400	0.05	mg/L	TIM 780-86T, LAC10-107-06-1J, SM 4500-NH3 C
	Nitrate + Nitrite Nitrogen as N	<0.05 - 1.7	0.05	mg/L	EPA 353.2
	Nitrate Nitrogen as N	<0.5 - 54		mg/L	EPA 300.0
	Nitrite Nitrogen as N	<0.5 - 20		mg/L	EPA 300.0
	Organic Nitrogen as N	61 - 4200		mg/L	TIM 786-86T, SM 18 4500-P E, LAC10-107-06-2E
	Filterable Ortho Phosphate as P	400		mg/L	TIM 781-86T
	Ortho Phosphate as P	48 - 190	0.02	mg/L	LAC10-115-01-1A, SM 18 4500-P E
	Phosphate	66 - 350		mg/L	EPA 300.0
	Total Phosphate as P	240		mg/L	TIM 787-86T
Basic Chemistry	Bromide	<0.5 - 26		mg/L	EPA 300.0
	Chloride	85 - 1900		mg/L	EPA 325.3, EPA 300.0
	Dissolved Calcium	35 - 160	1	mg/L	EPA 200.7
	Dissolved Iron	0.73 - 6.2	0.02	mg/L	EPA 200.7, SM 3111B
	Dissolved Magnesium	2.5 - 58	0.1	mg/L	EPA 200.7
	Dissolved Manganese	0.06 - 0.3	0.02	mg/L	SM 3111B
	Dissolved Potassium	1100 - 3400	1	mg/L	EPA 200.7
	Dissolved Sodium	260 - 820	0.5	mg/L	EPA 200.7
	Fluoride	<0.5 - 460		mg/L	EPA 300.0
	Laboratory pH	7.1 - 8		pH Units	SM 4500-H+ B, EPA 150.1
	Sulfate	<2 - 570		mg/L	EPA 300.0
	Total Alkalinity as $CaCO_3$	4200 - 19000	1	mg/L	SM 2320B
	Total Organic Carbon	710 - 22000		mg/L	EPA 415.1, SM 5310 B
VOC's	2-Butanone	110	100	ug/L	EPA 8260
	Acetone	140	100	ug/L	EPA 8260
	Toluene	130	50	ug/L	EPA 8260

What's not?

No Detections of these:	Quantitation Limit
Benzene	<50 ug/L
Bromodichloromethane	<50 ug/L
Bromoform	<50 ug/L
Bromomethane	<50 ug/L
Carbon disulfide	<50 ug/L
Carbon tetrachloride	<50 ug/L
Chlorobenzene	<50 ug/L
Chloroethane	<50 ug/L
Chloroform	<50 ug/L
Chloromethane	<50 ug/L
cis-1,3-Dichloropropene	<50 ug/L
Dibromochloromethane	<50 ug/L
Ethylbenzene	<50 ug/L
Methylene chloride	<100 ug/L
Styrene	<50 ug/L
Tetrachloroethene	<50 ug/L
trans-1,3-Dichloropropene	<50 ug/L
Trichloroethene	<50 ug/L
Vinyl chloride	<50 ug/L
Xylene (total)	<50 ug/L

Feedlot with earthen basin.


Dairy Confinement with multiple pond cells

Basins Have Been Monitored

- 1997 ISU Study- concluded that 36% of the 31 basins studied did leak at a greater rate than the current IDNR standards.
- Seepage was determined by measuring basin levels.
- The basins studied were at least 3 years old.
- The basins constructed in till performed better than basins built in more coarse grained soils.
- IDNR rules have not changed since 1999 regarding soil liners.

MN Study Results

- MPCA study in 2001 compared the ground water contamination at existing confinement earthen manure storage basins, unlined open feedlot runoff basins and concrete lined open feedlot runoff basins.

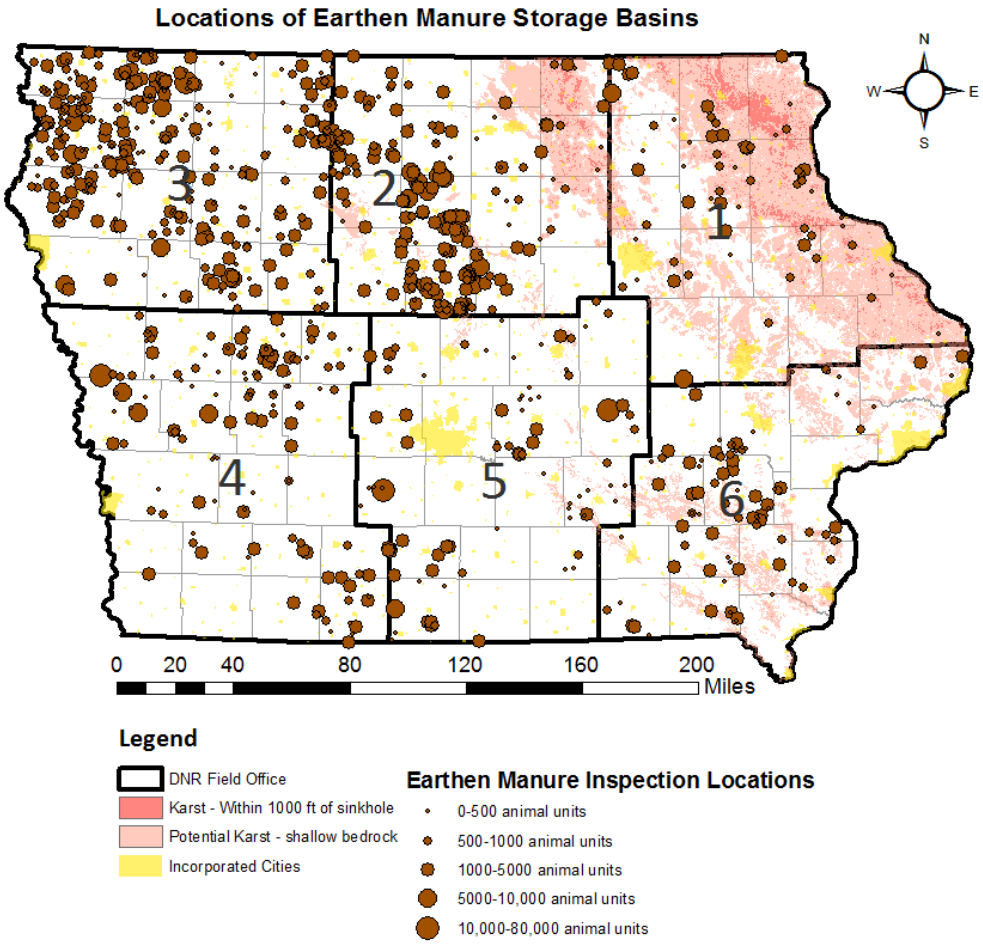
- Unlined basins produced greatest impact to ground water while concrete lined basins produced minor impacts to ground water.

- Suggested that unlined basins be located minimum of 300 feet away from surface waters and wells if basin is constructed in fine grained soils.

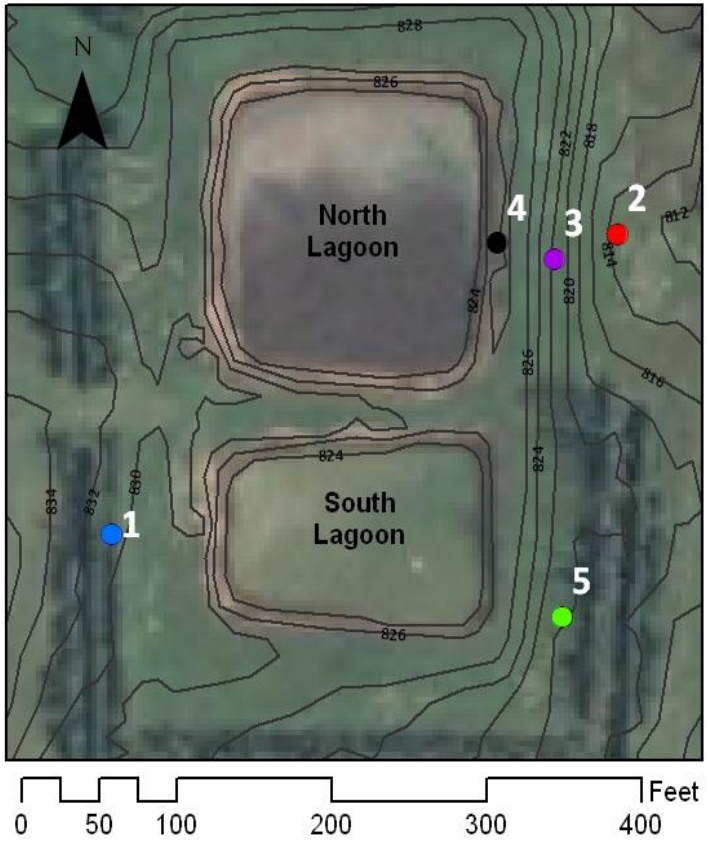
- DNR rules require all earthen basins to be 500 feet from a water source and 400 feet to a well.

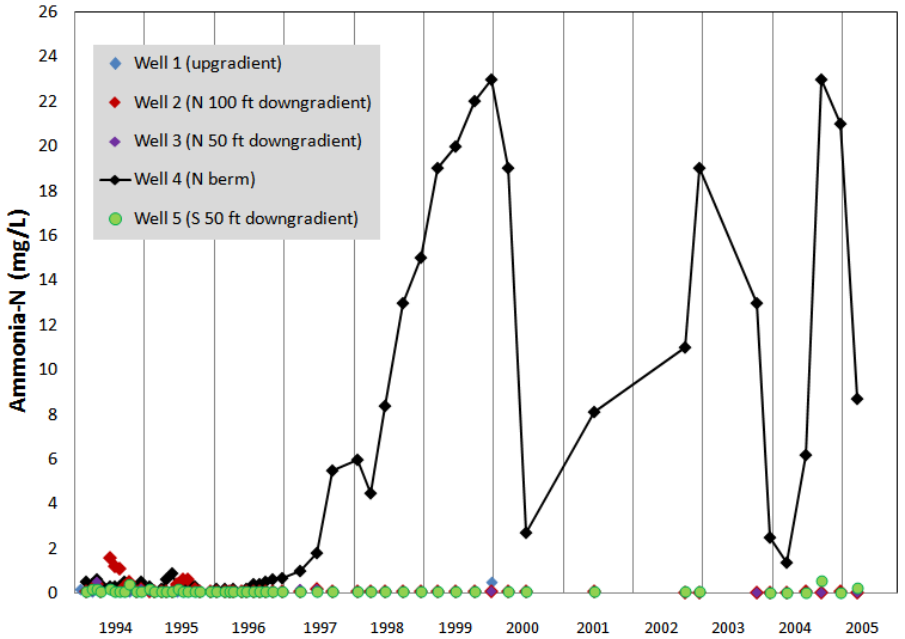
Earthen Basin Monitoring

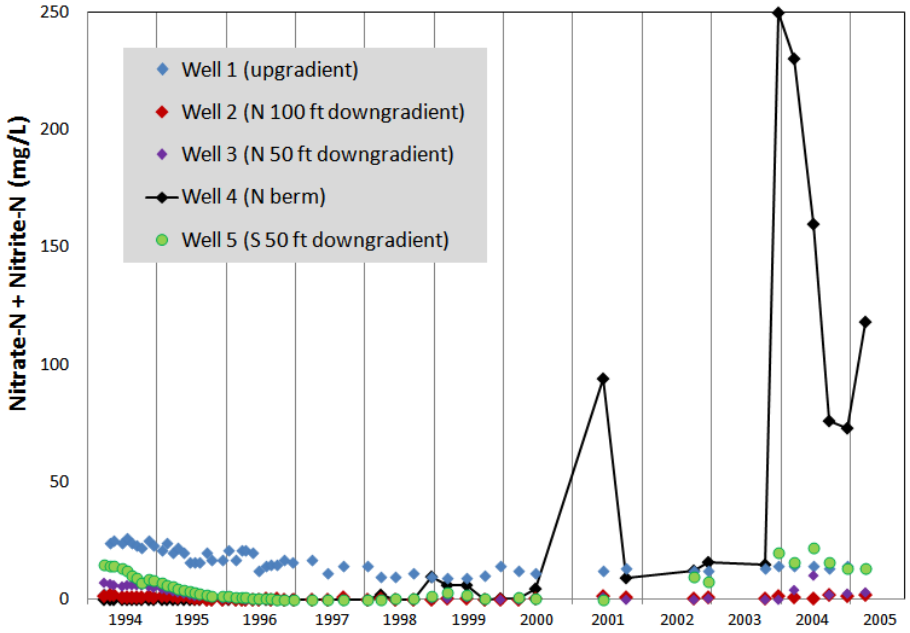
- Currently have nearly 1000 earthen basins in Iowa.
- From 1990 – 2010 (?) any permitted earthen manure storage basin, that was artificially lowering the groundwater, was required to install monitoring wells and take quarterly samples for 2 years. Samples were usually analyzed for nitrate as N (NO_3-N), ammonia as N (NH_4-N), and chloride (Cl^-).



1994-2005 GSB/DNR Study







Tile monitoring

- Deep pit concrete structures and earthen basins must have perimeter tile surrounding the structure. Used for both artificial ground water lowering and monitoring.
- An inspection or sample port is required on tiles that do not daylight on the property.
- Inspection ports can be smelled during a site visit to see if structure may be leaking
- Quarterly sampling for new structures in karst areas for ammonia-N for 2 years (2004-2009)

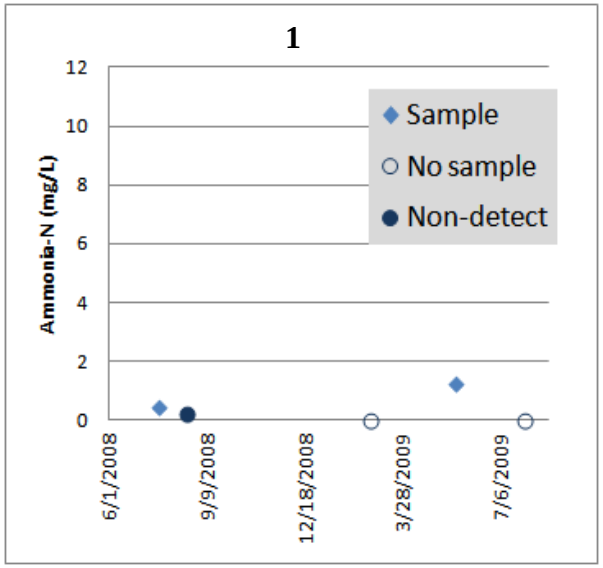
Iowa blessed with a lot of low perm soil

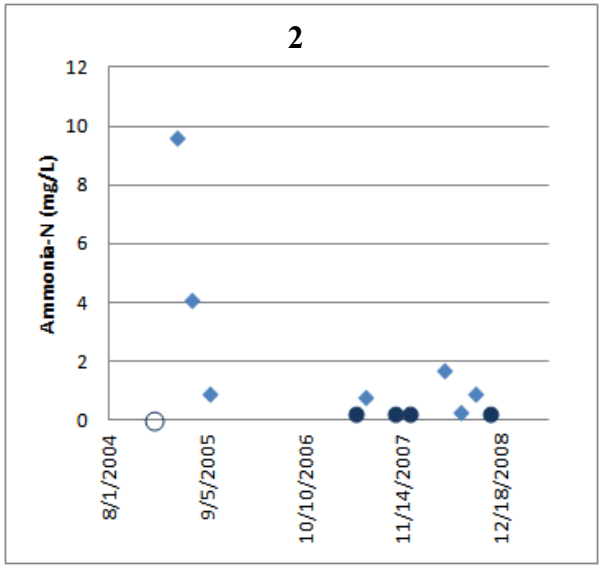
Perimeter Tile around a deep pit barn must drain somewhere

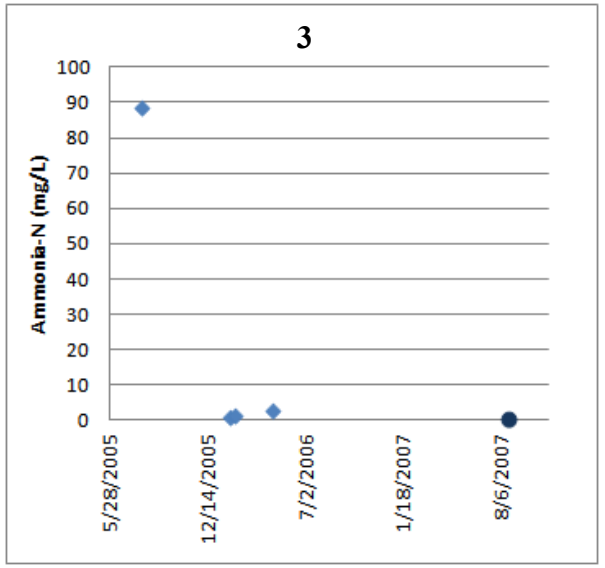
DNR Groundwater Monitoring of Concrete Structures in Karst

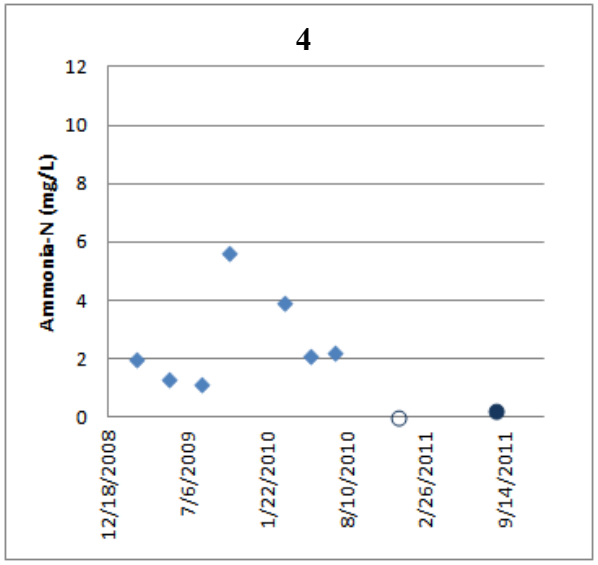
- Data from new deep pit concrete manure storage structures built in the karst regions.
- DNR rules require that 5 feet of low perm soil between concrete floor and karst bedrock.
- Samples were collected from the perimeter tiles.
- Difficulty obtaining samples due to low/no flow in tiles or accessibility.
- 1 to 4 years of data collected.

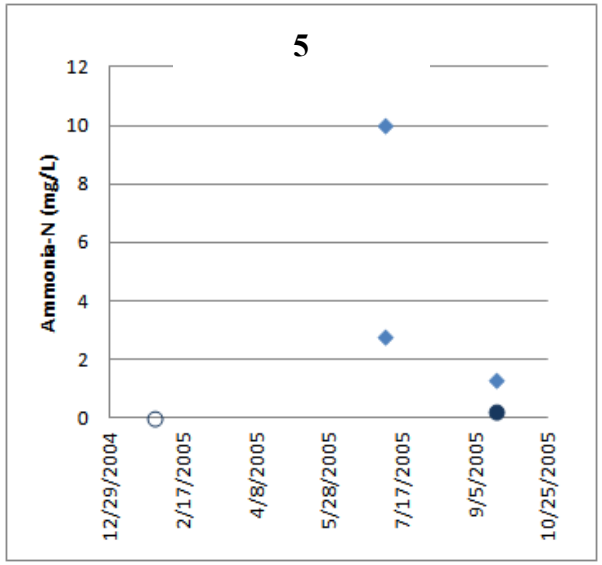
Karst Sites – monitoring of perimeter tiles

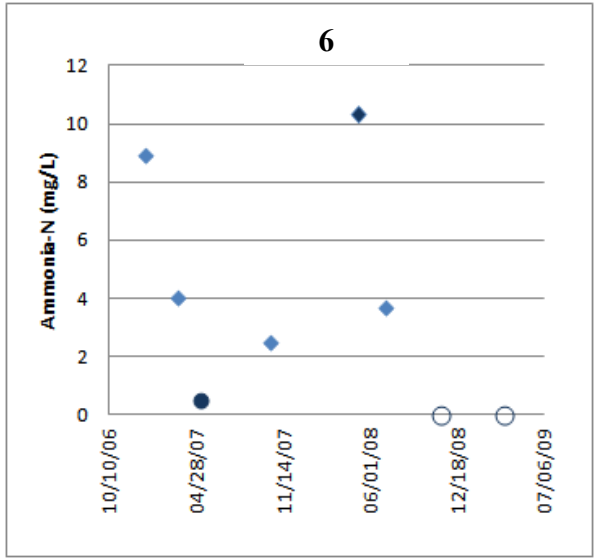




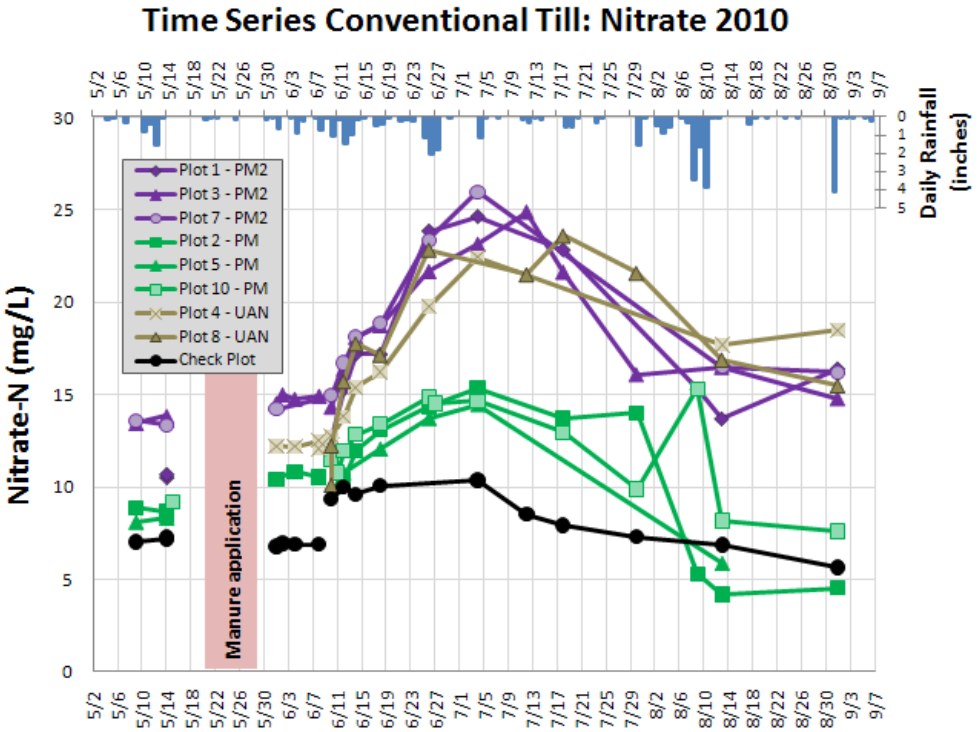


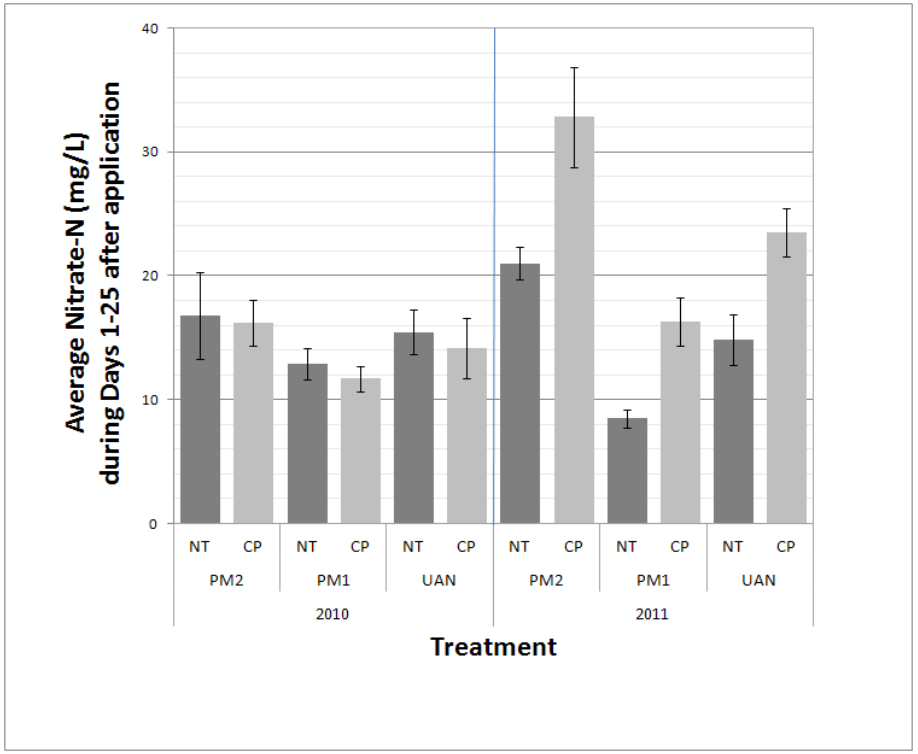






Nitrate in Tiles





•Study compared 100 (PM1) and 200 lb N/acre (PM2) applications of poultry manure and commercial fertilizer (UAN) on no-till (NT) and chisel-plowed (CP) plots.

•2010 was a above-average wet year. 2011 was a below-average dry year.

AFOs Impact to Groundwater

- When properly sited, designed, permitted and constructed manure storage structure likely present a localized threat to groundwater (<500 ft).

- Land-application of manure (and commercial fertilizer) has a widespread effect on groundwater.

- Runoff from unregulated lots and spills have acute impacts.

Challenges in AFO World

- Increasing number of confinements in state
- Limited number of approvable sites. Seeing more waivers and Secondary Containment Barriers utilized
- Increasing cost of commercial fertilizer results in increased number of confinements
- Livestock friendly state and growing number of opponents to confinements
- Seeing slight trend in different legal owners on same site (avoiding permit process)
- More Counties scrutinizing confinement permit applications and failing matrixes
- Still have unpermitted and unknown sites out there to find and inspect
- Still have a lot of liquid manure applied yearly as well as commercial
- Limited number of DNR specialists
- SAFOs are exempt from many rules and trend may be to construct SAFOs instead and open lot barns

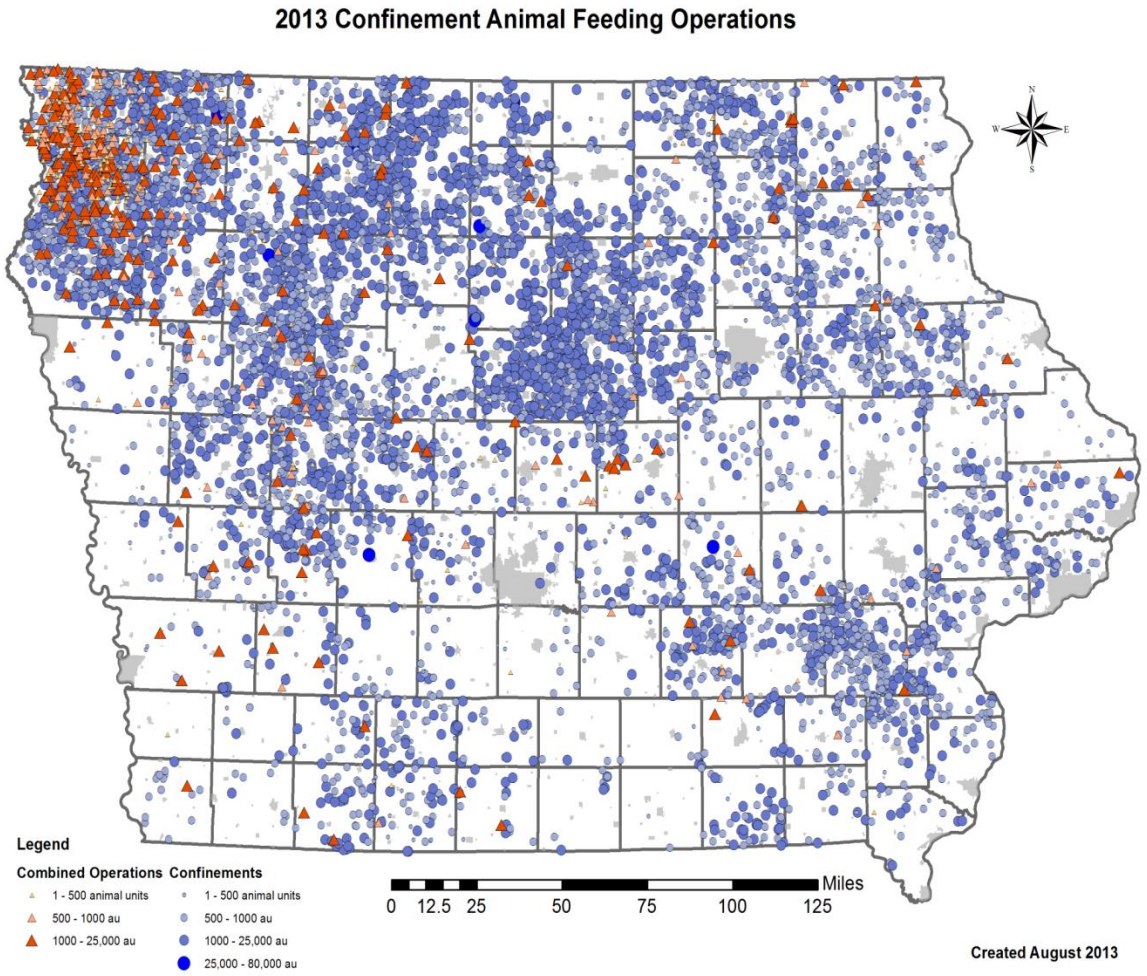
Can we do more?

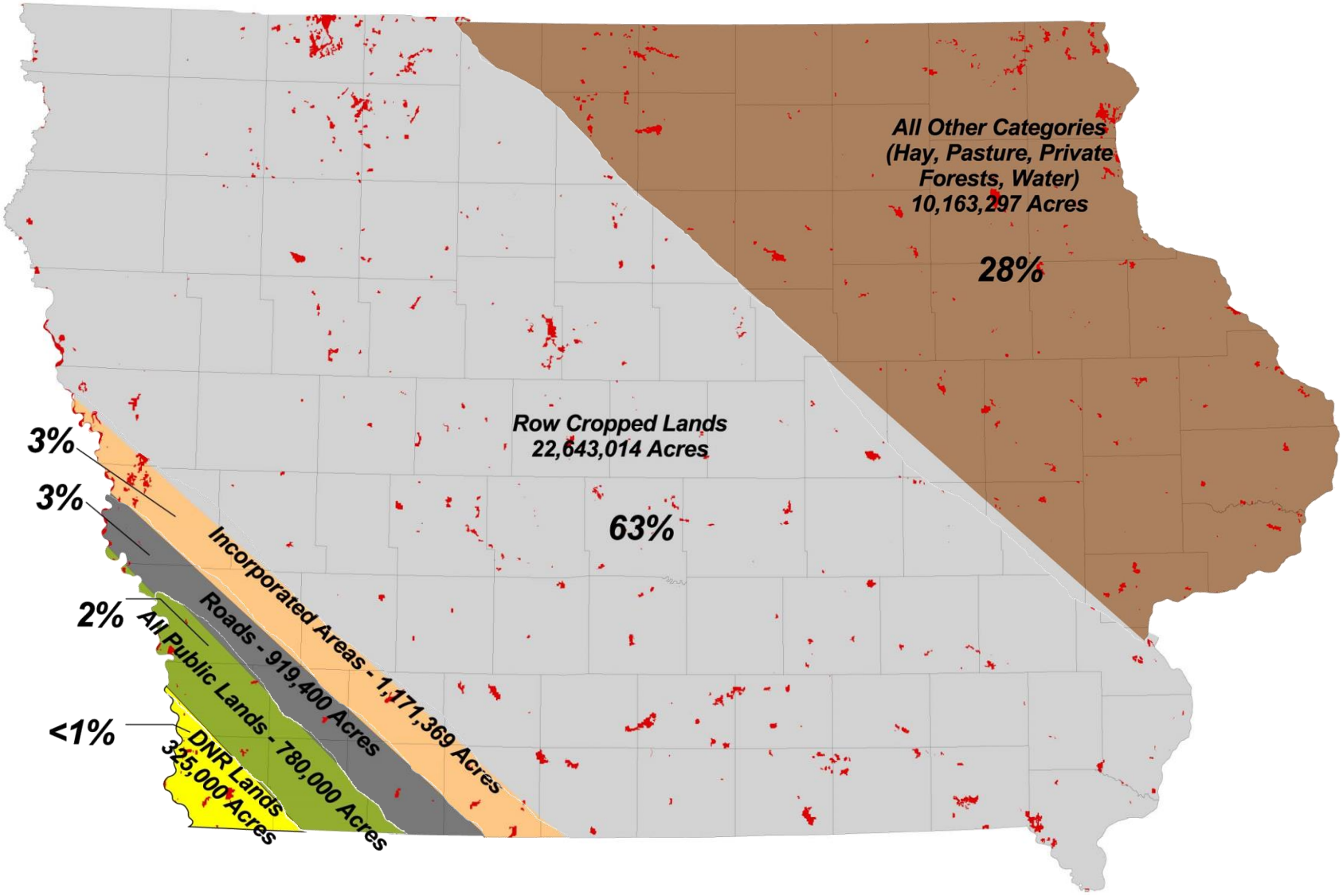
1. Still have some unplugged ag drainage wells.
2. Still have likely hundreds of wells at risk in small feedlots.
3. Still have unplugged wells on old acreages.
4. Have covered sinkholes farmed over or tiled into.
5. Not every structure is inspected after construction.
6. Have thousands of SAFOs built with little rules.
7. Cannot oversee all manure application.
8. Revise Master Matrix to include groundwater protection.
9. Tile bio-reactors and cover crops. Recently featured in Register.

Small unpermitted open lots

Will we run out of room

- Seems like several Counties may have 100% of cropped fields in a MMP.



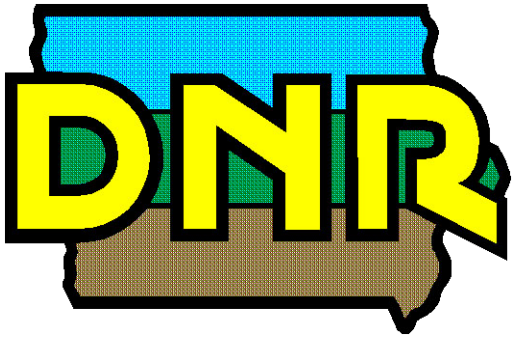

All Other Categories
(Hay, Pasture, Private
Forests, Water)
10,163,297 Acres
28%
Row Cropped Lands
22,643,014 Acres
63%
3%
Incorporated Areas - 1,171,369 Acres
3%
Roads - 919,400 Acres
2%
All Public Lands - 780,000 Acres
<1%
DNR Lands
325,000 Acres

How many AFOs can we support

- Based on 63% of the state in row crops,
- Using average of 500 acres needed for each AFO to spread manure,
- Land can support 45,700 AFOs(Currently 11,000)
- Will never see that many due to separation distances
- Likely will mean larger sites or more smaller SAFO sites or multiple owner sites
- More waivers and Secondary Containment designs

Mother Nature or poor planning

Questions?



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Thank You