

Rising Nitrates Levels!

What really can be done?

Data requirements



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October 13, 2011

Nitrates – Where are they and where are they going?

- Water Utility Perspective
- Nitrates – Hastings historical prospective of municipal well siting practice and lessons learned
- Additional water quality information needs
- Mapping and what you can do
- Inter-local Agreements
- Questions

Water Operators – Sharing of Ideas

- As a former employee of a local consulting firm we were told never tell anyone of your mistakes it makes the company look bad.
- As a utility employee I have enjoyed the freedom to discuss our trials and tribulations – Many times I have asked my peers for advice and been told “Not sure what to do but don’t do this or that as it did not work”

We learned by our mistakes

Water Systems are Unique

- Not all water systems are created equal
- Not all wells are created equal
- Learn all you can about your well, watershed and activities past and present that can impact your groundwater water quality
- Sharing ideas and thoughts with similar water system design and region is a good place to start gaining knowledge –

This is why we are here today

Municipal Well Siting Pre-1989

Hastings Historical Summary

- Find a city owned property in the area needing water pressure – Neighborhood Well
- Obtain NDOH approval for the site
- Drill well without a well house in case the well is bad – Install well house at a later date.
- Some questions on Superfund Activities in the area – 1980's EPA contractor confirmed drilling down gradient was a good idea

Pre-1989 Lessons Learned

- Drilling down gradient not a good idea – Well 20 unusable except for emergency fire protection
- VOC contamination larger than suspected by EPA or its contractors
- Don't trust EPA contractors for advice – Need to be involved in the local water issues to become better educated

Municipal Well Siting 1989 - 1997

- Develop map showing all wells within 1 mile of the city – Well spacing map
- Develop understanding of water gradient and extent of VOC contamination
- For new well sites find city, county or private properties that could be purchased

Municipal Well Siting 1989 – 1997

continued

- Drill test holes – Obtain geological log, electric and gamma logs (**A tough concept to sell**)
- Obtain water samples during test well development
- Build monitoring well to use for static water level readings during pump test
- Obtain NHHS approval of site

Municipal Well Siting 1989 – 1997

continued

- Drill Production well and well house
- Abandon monitoring well after pump test is completed
- Conducted Water Supply Study and Groundwater Modeling to define well head protection area – Airport and City Wellfield
- Obtain local water quality data from NRDs

1989 – 1997 Lessons Learned

- Geology varied significantly across the city – VOC contamination in the deepest parts of the aquifer – **VOC floating and sinking chemicals**
- Groundwater recharge from Platte River (1/2), precipitation (1/4) and irrigation return (1/4)
- Nitrates rising – Suspected 45,000 head feed yard up gradient of city wells as a point source

Feed Yard

Groundwater flow

T 8 N

T 7 N

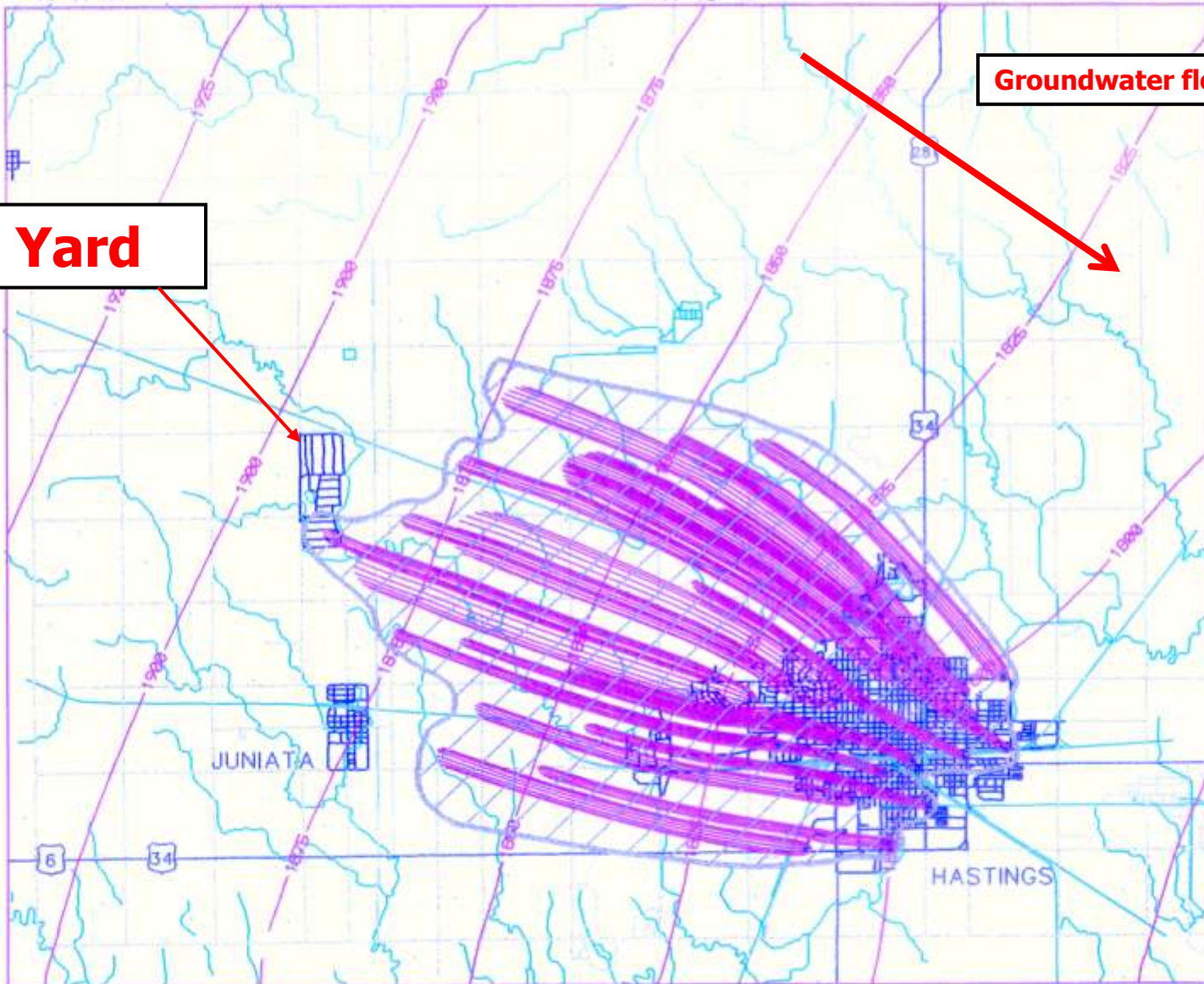
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HASTINGS



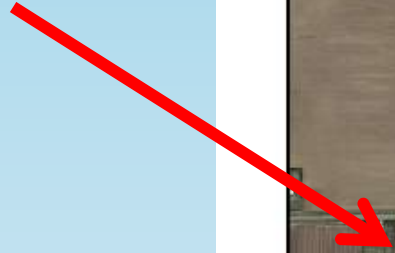
WELL HEAD PROTECTION AREA

Composite Capture Zone
for 20 Year Time-of-Travel



Feed Yard

Groundwater flow



Municipal Well Siting 1997 – 2008

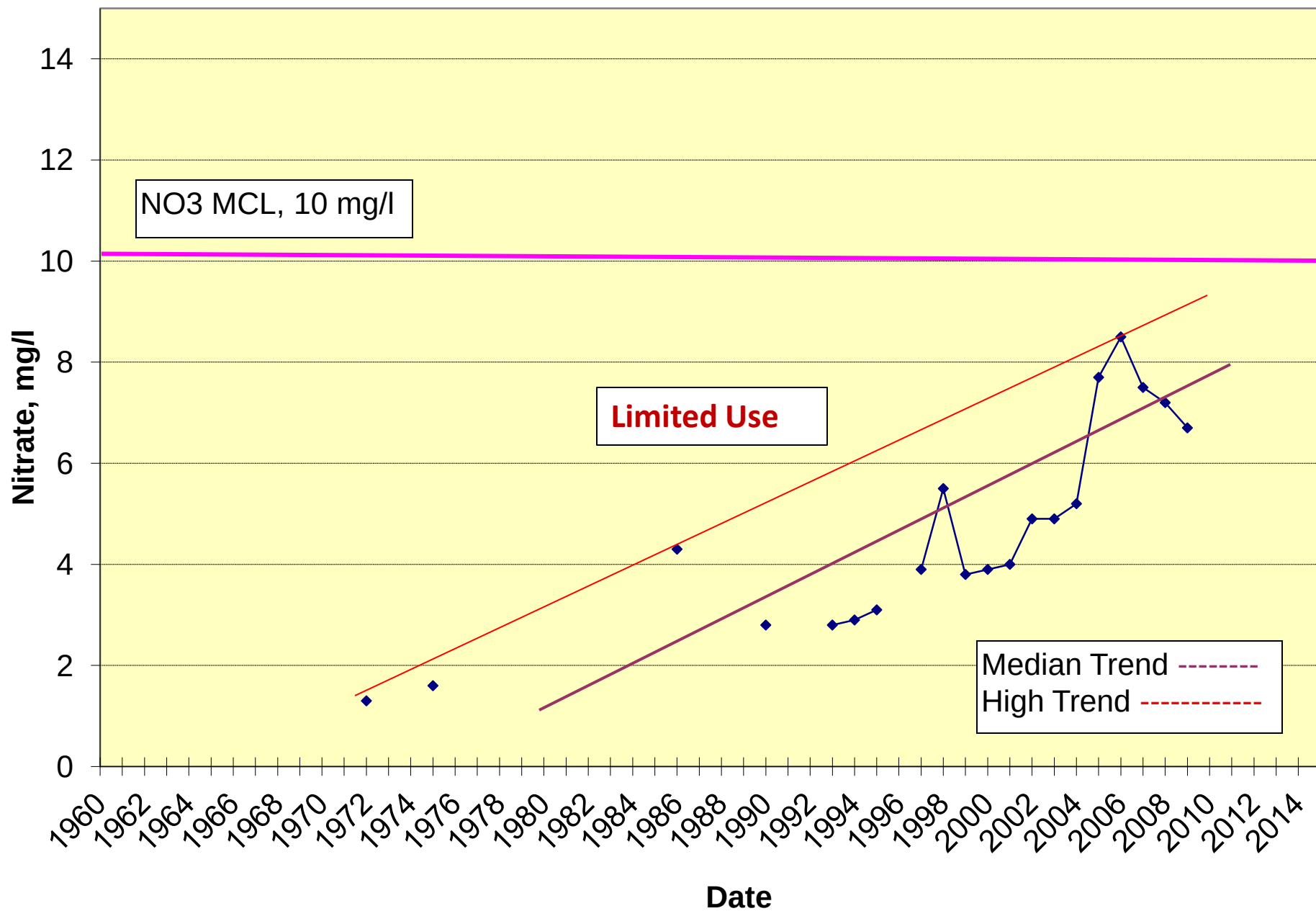
- Developed a Guardian Well sampling program for domestic wells owned by city or county employees living in the 5 to 10 year travel zone up gradient of the municipal wells.
- Better mapping of all wells within the 2 mile jurisdiction
- New wells were built on sites to allow for mixing and/or treatment – Not specifically designed for water quality just quantity

Municipal Well Siting 1997 – 2008

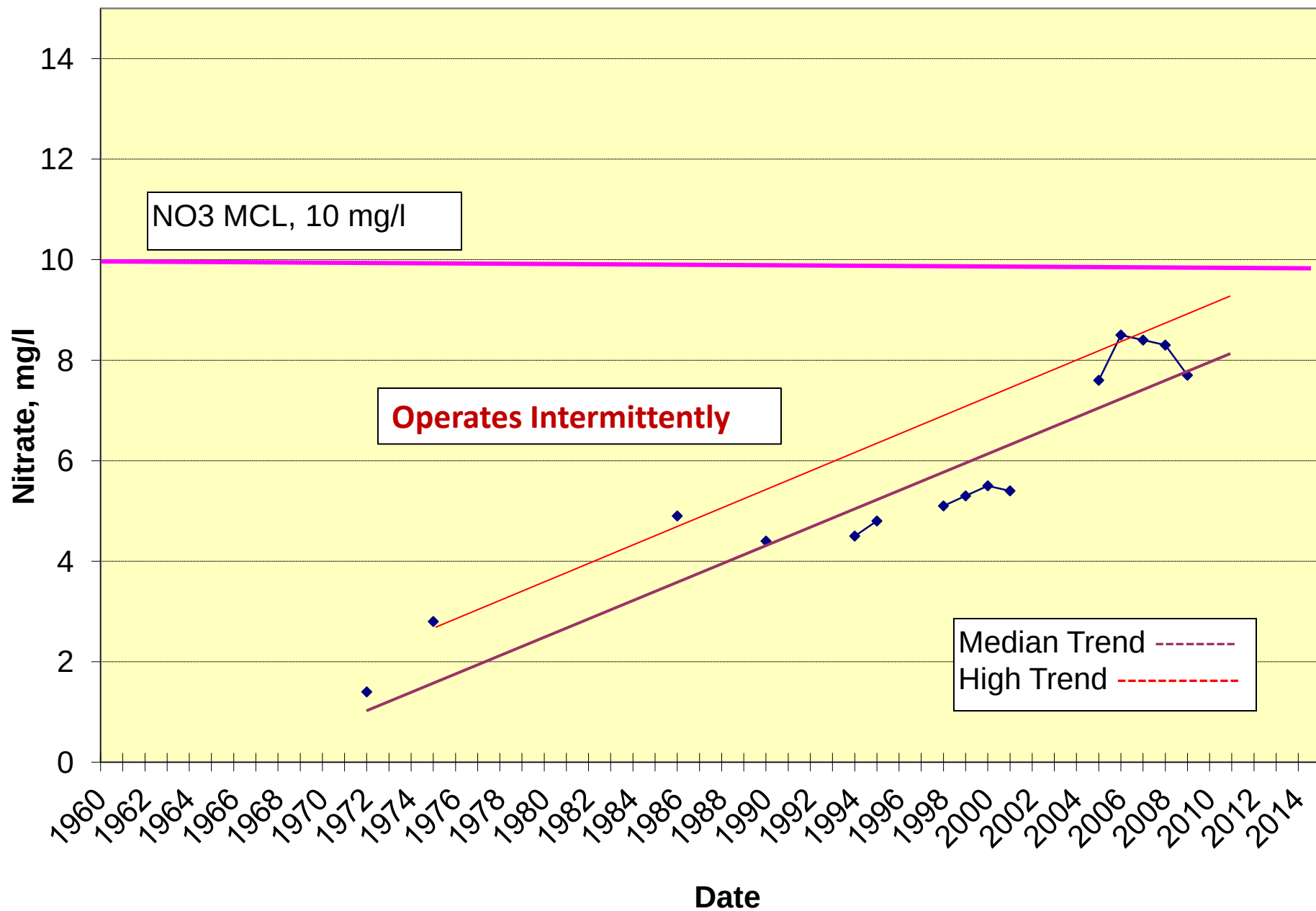
continued

- Available well sites limited due to number of irrigation wells and known areas of contamination
- Surface runoff testing conducted on Pawnee Creek – Runoff containing 30 lbs of N/Acre/inch of water applied
- Detailed analysis of the nitrates in the municipal wells – Graphing and historical data

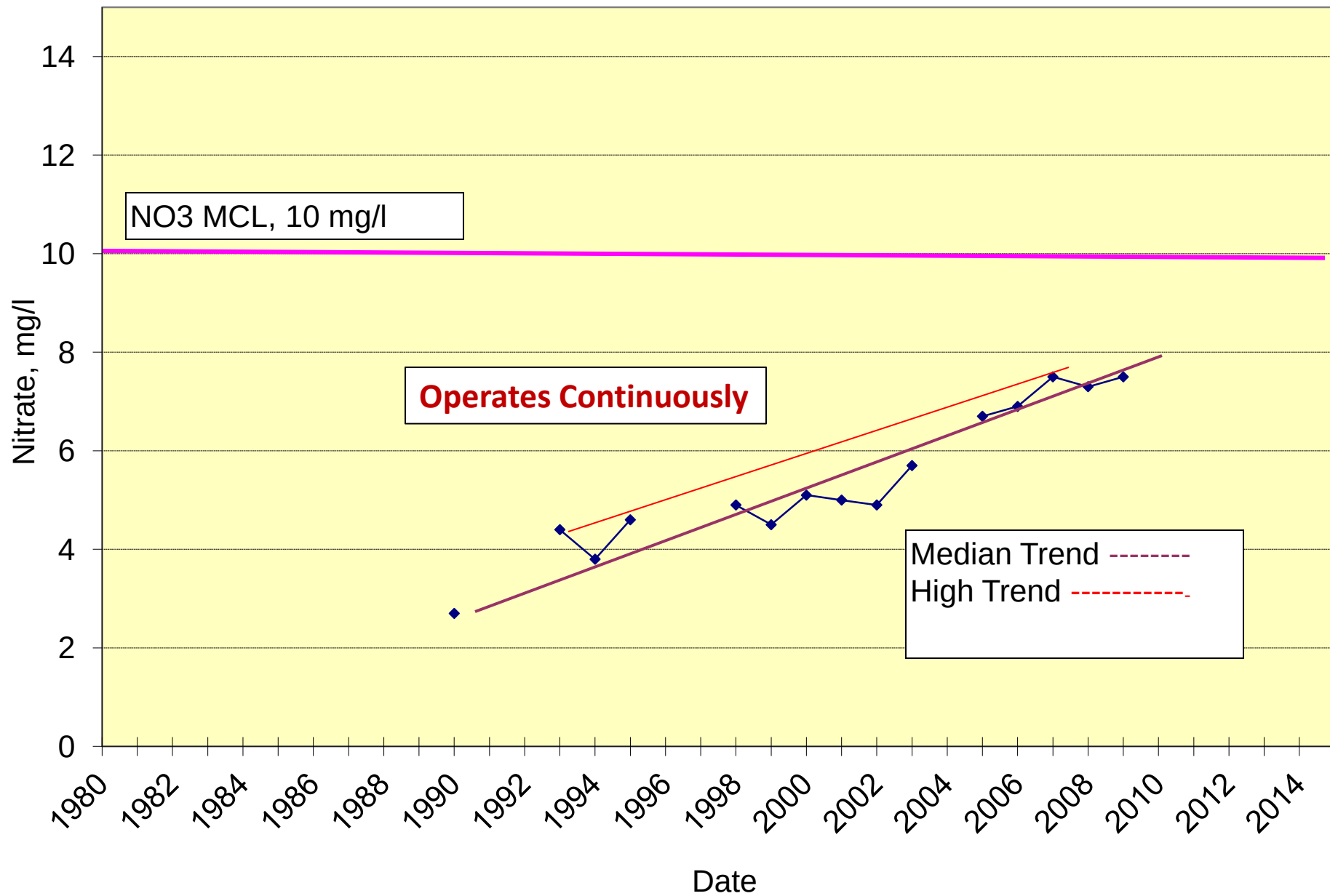
Well 8 - Nitrate Concentration



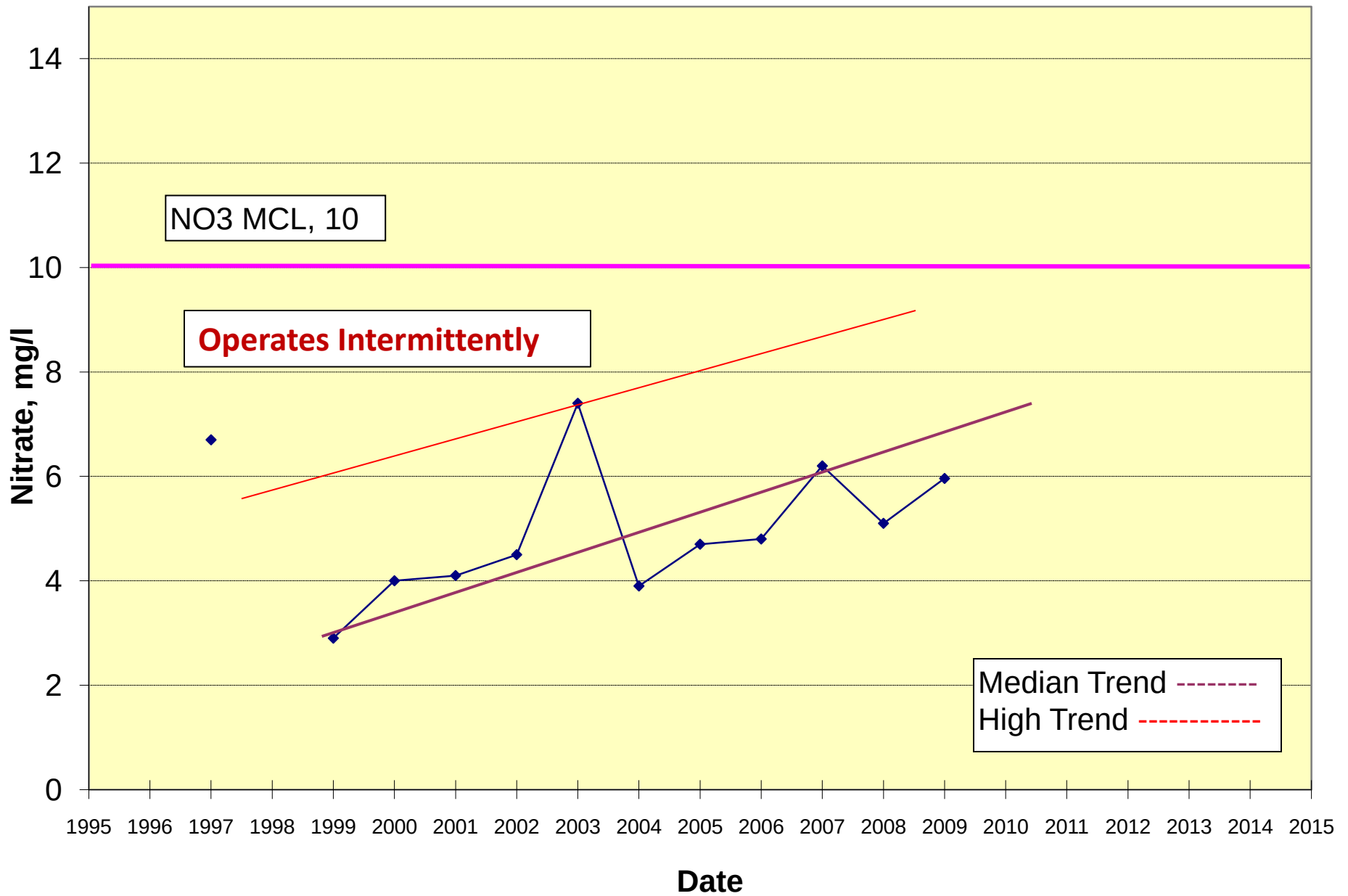
Well 16 - Nitrate Concentration



Well 21 - Nitrate Concentration



Well 28 - Nitrate Concentration



Municipal Well Siting 1997 – 2008

continued

- Well 11 pump study completed and showed high levels in the first 5 minutes of well operation at 30 mg/l and dropped off to 6.5 mg/l in less than 30 minutes – **Do your wells behave this way?**
- Well 17 pump run and rest test completed and showed that nitrates levels rise with use and then reduce after resting for a few days - **Do your wells behave this way?**

1997 – 2008 Lessons Learned

- Nitrates seem to be a regional issue far greater in extent than VOC's – No where to hide
- The nitrate problem extends outside the city's two mile jurisdiction
- Gross Alpha, Uranium, Arsenic, Iron and Pesticides may be issues that haven't been addressed

2010 Water and Soil Sampling

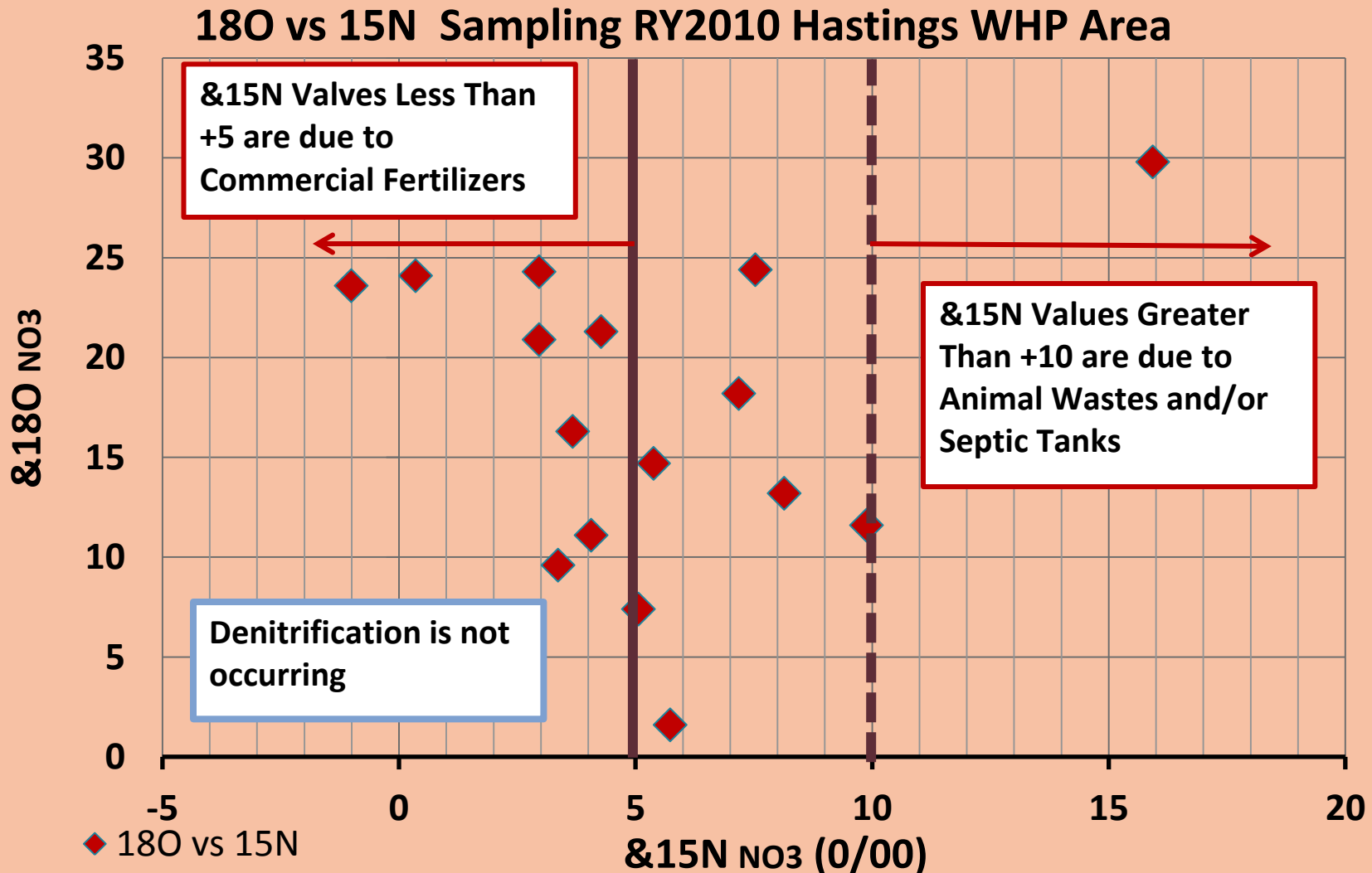
- In 2010, 576 water samples were collected for nitrates over a 76 square mile area – 87.5% sampling of all known wells in the HWPA
- Nitrate Isotope of 16 wells
- Vadose Zone Sampling conduct on 19 sites

2010 Lessons Learned

- Density of testing showed areas of high levels of contamination not previously seen by NRD
- Nitrate Isotope testing showed that nitrates from ammonia fertilizer not the feed yard
- Vadose Zone Sampling showed 500 to 2000 lbs of Nitrogen below root zone. Problem will be with us for decades

2010 Lessons Learned

continued



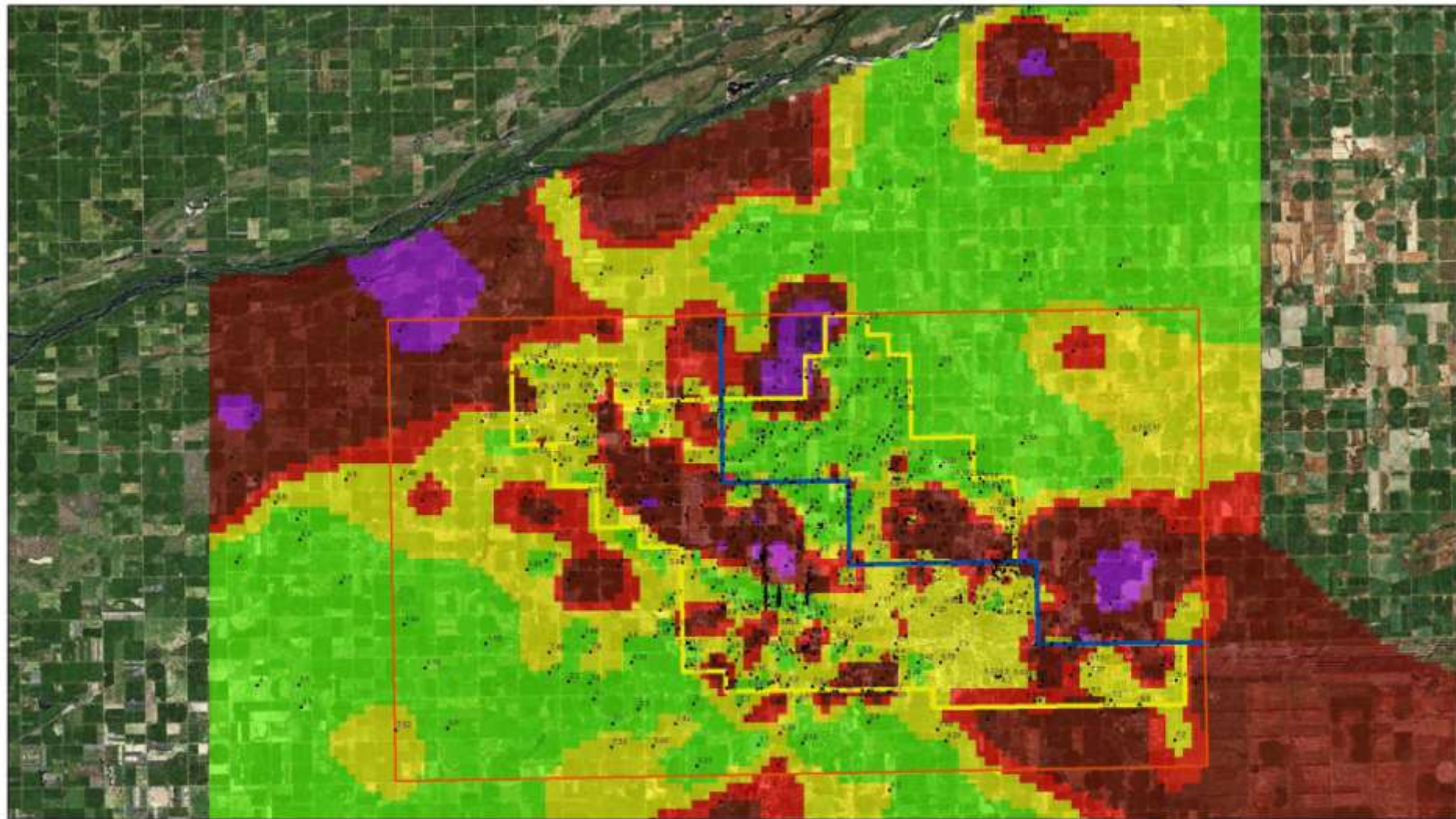
2011 Water Sampling

- In 2011, irrigation well sampling area exceeding 200 square miles
- Hall County and Platte River data provided by CPNRD
- Pesticide, Uranium, Gross Alpha, Metals and Inorganic sampling conducted

2011 Lessons Learned

- Pesticides do not appear to be an issue
- Suspect low density of sample collection in some areas may not have captured areas of higher nitrates
- Nitrates along the Platte River moving towards Hastings well field

Nitrate Map



Nitrate mg/L



Direction of groundwater flow

2011 Hastings Wellhead Protection Area Map

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Drawn By: Simon Bern

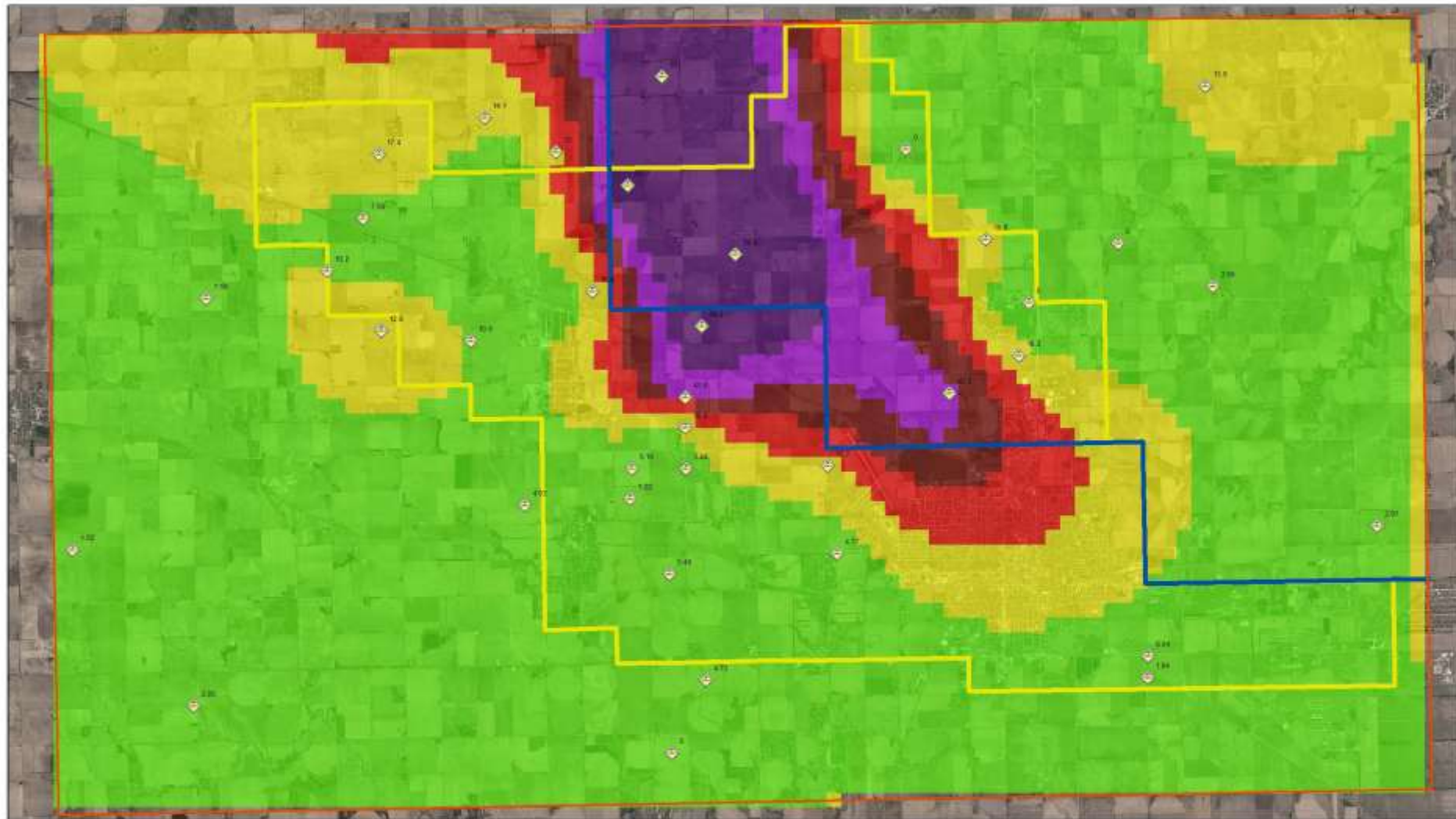
Date: 10/12/2011

2011 Lessons Learned

continued

- Uranium found 2.5 times higher than 30 ug/l MCL – More testing need

Uranium Map



Uranium mg/L



Direction of groundwater flow

2011 Hastings Wellhead Protection Area Map

Path: Z:\Projects\Hastings Wellhead Protection\MXD\WellheadProtection_Main_v2.mxd

Drawn By: Simeon Berns

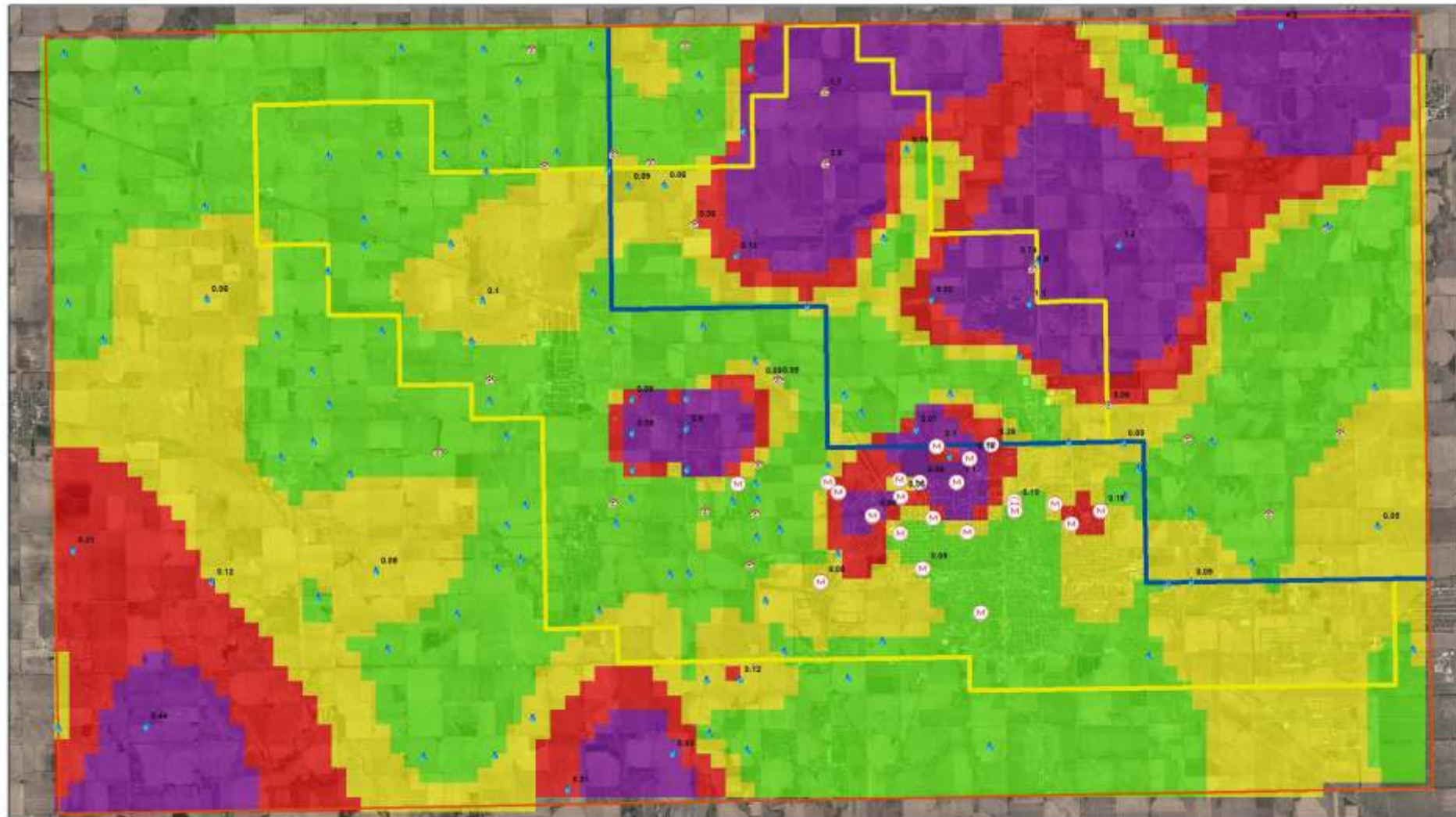
Date: 10/12/2011

2011 Lessons Learned

continued

- Iron 10 times secondary MCL of 0.3 mg/l

Iron Map



Direction of groundwater flow

2011 Hastings Wellhead Protection Area Map

Path: Z:\Projects\Hastings Wellhead Protection\MXD\WellheadProtection_Main_v2.mxd

Drawn By: Simon Berns

Date: 10/12/2011

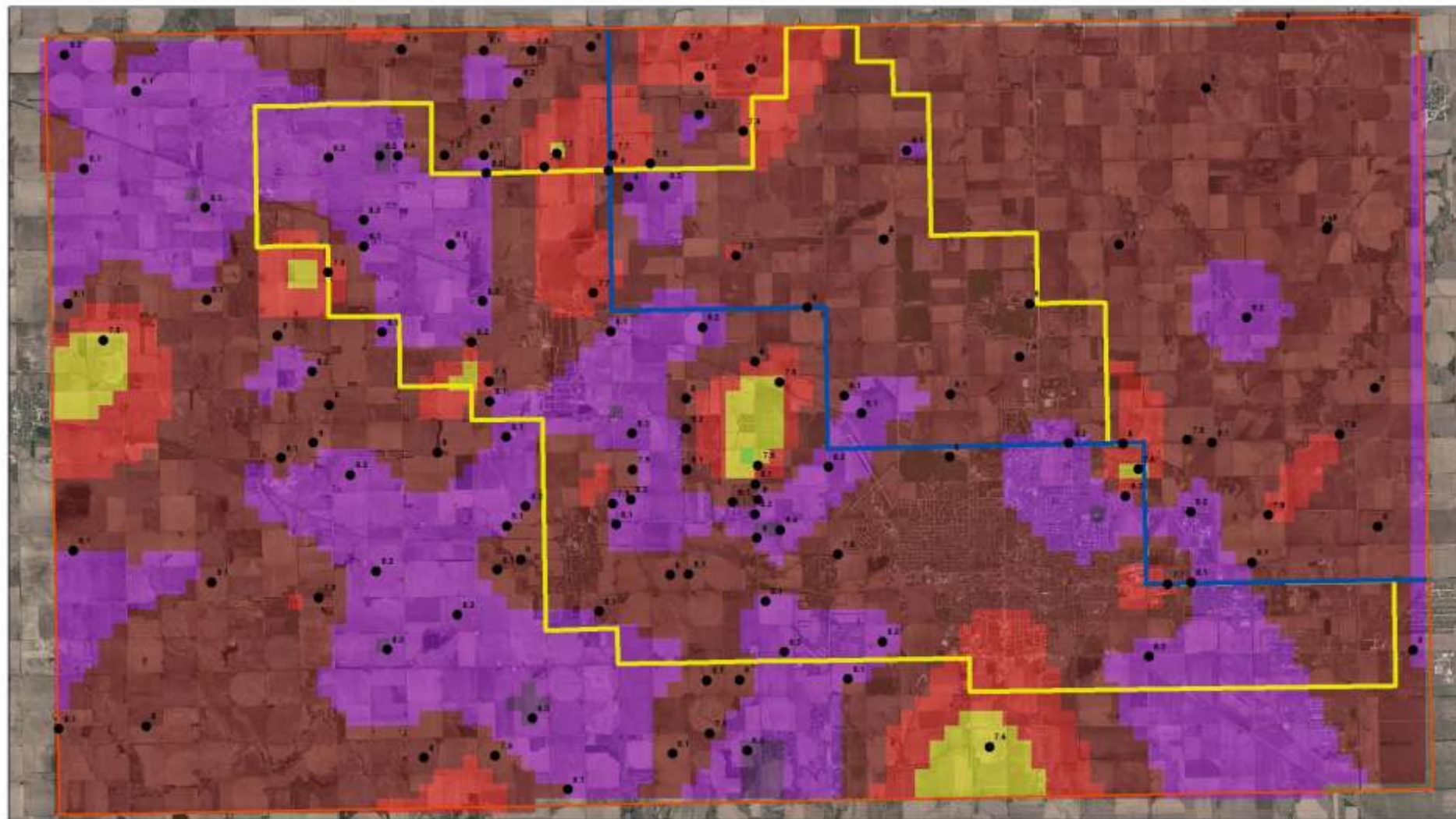
2011 Lessons Learned

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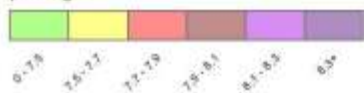
- pH levels have risen from range 7.2 to 7.5 to a range of 7.8 to 8.2 pH – Higher pH levels extends to Platte River

We do not know what this means!

pH Map



pH mg/L



Direction of groundwater flow

2011 Hastings Wellhead Protection Area Map

Path: Z:\Projects\Hastings Wellhead Protection\MXD\WellheadProtection_Main_v2.mxd

Drawn By: Simone Berns

Date: 10/12/2011

Low cost mapping

- Dot Method – use color and size to designate amount of nitrates
- Get aerial photo from NRD or NRCS office – Map area for area twice the 20 year travel
“Hopefully your community will be viable for more than 20 years”
- Focus testing on up gradient irrigation wells they provide a better representation of future groundwater quality

Dot Map

2010 Water Sample Results
Irrigation, Municipal, Industrial, etc.
(High Capacity Wells)

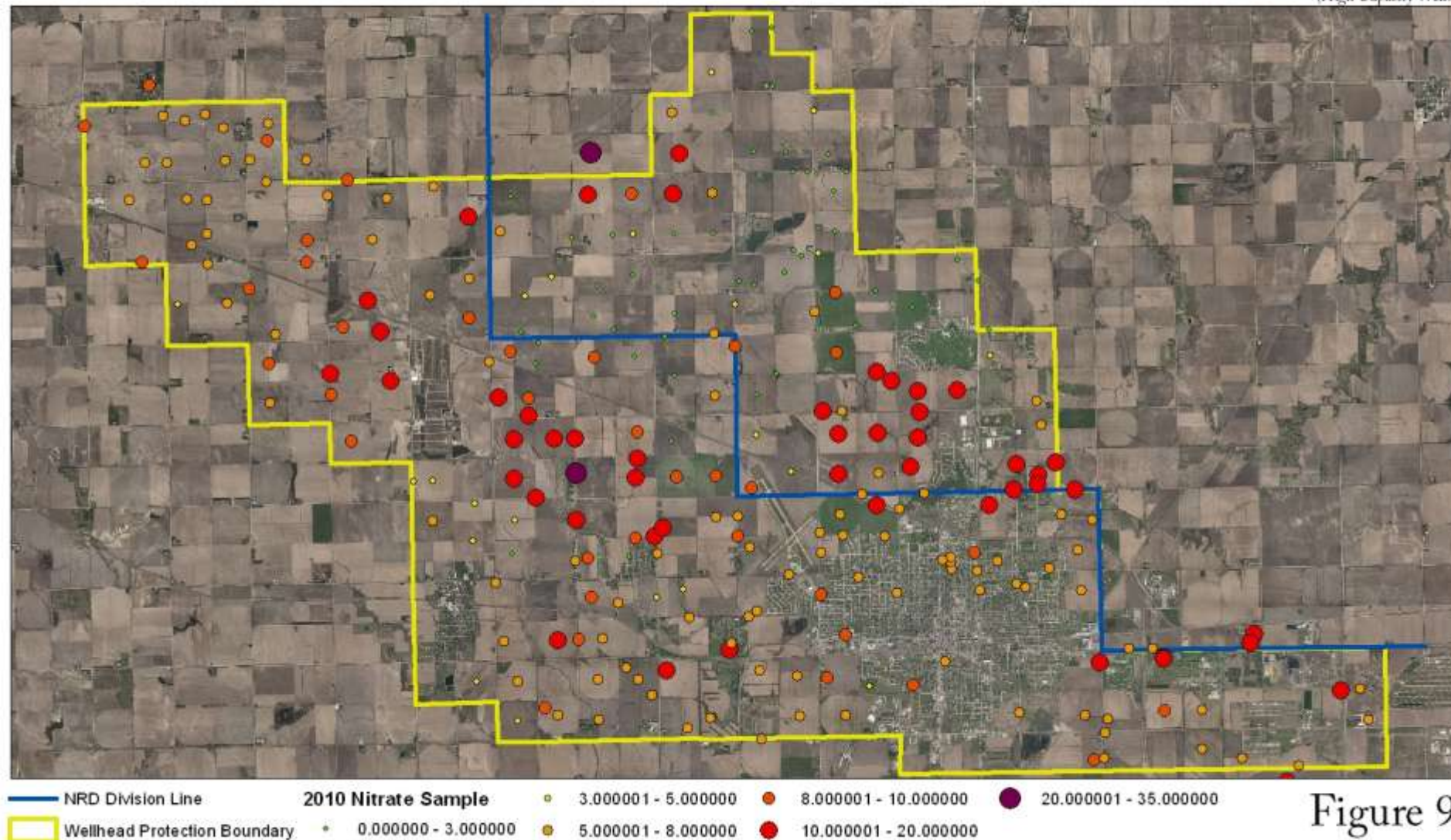


Figure 9

Low cost mapping continued

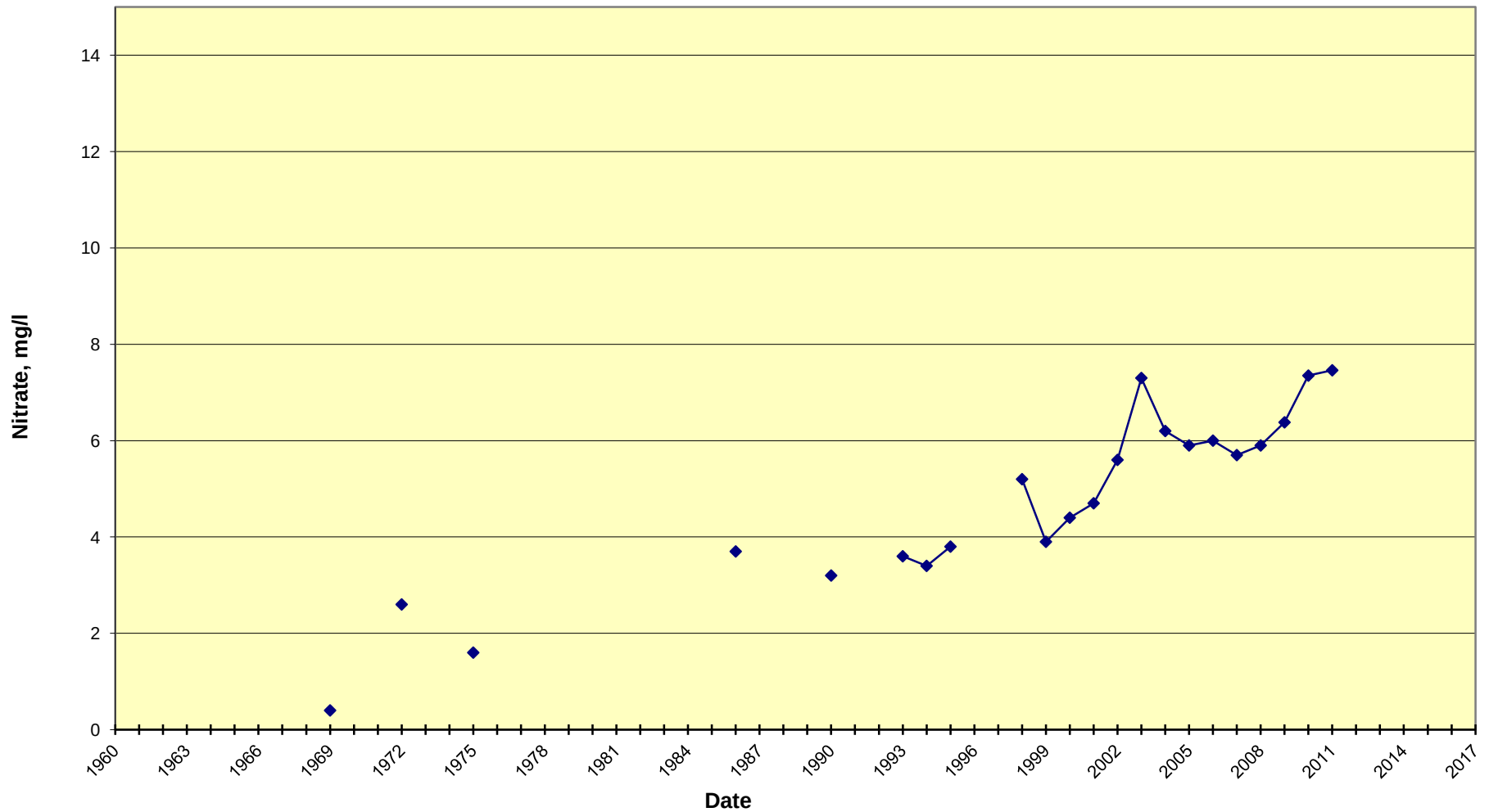
- Sample at least 50% of the irrigation wells in your mapped area
- Test at least half the samples for inorganics
- Focus testing on irrigation wells they provide a better representation of groundwater quality
- Watch how you take samples – significant difference in wells, after rest, after running and beginning and end of the irrigation season

Historical Graphing

- Graph your historical results – changes come slowly
- Find historical data where you can – For example “Chemical Analyses of Nebraska Municipal Water Supplies, July 1969, NDOH”
- Sample more frequently to understand seasonal and operational changes

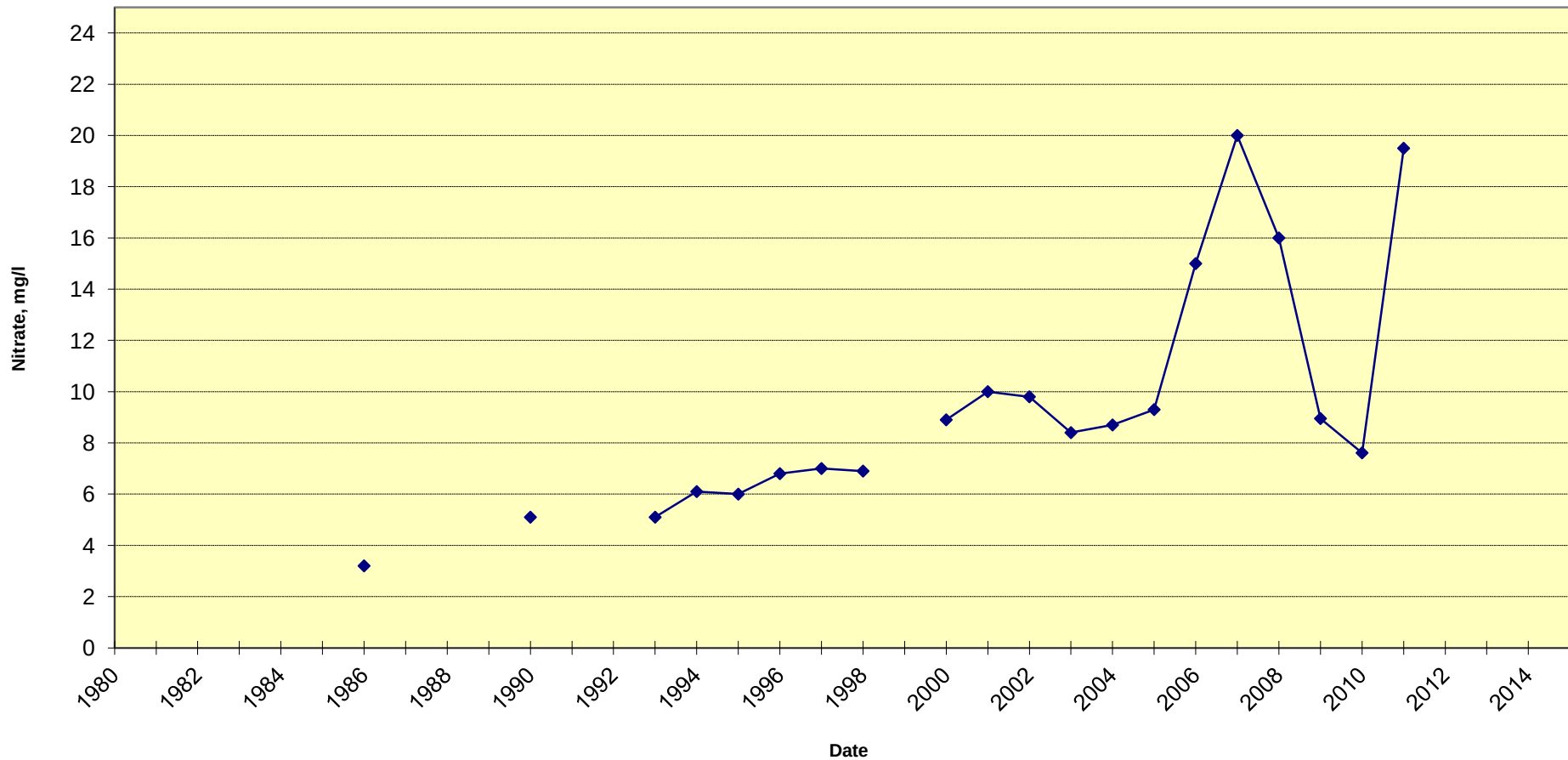
Nitrate Graphing

Well 1 - Nitrate Concentration



Nitrate Graphing

Well 17 - Nitrate Concentration



Inter-local Agreements

- Water operators need to be able to get outside the city limits to do sampling – **Inter-local agreements needed with NRD**
- Enlist the help of other agencies and work with the rural community – **You need to put boots on the ground and get data collected**

Questions

