Gallatin Groundwater Project: Assessing Cumulative Impacts to Groundwater in High Density Septic System Areas

Christine Miller, Tammy Swinney, Erinn Zindt, Torie Haraldson

MT Section AWRA Conference, October 10th, 2014

Background

- Between 1990 and 2009, the population of Gallatin County, Montana increased by approximately **79%** *(U.S. Census Bureau, 2007)*
- Some subdivision areas have been developed with individual septic systems for each home
- Wastewater effluent from areas of high septic system density can negatively impact groundwater and surface water quality



Photos: A. English

Background

- **~13,350 active septic systems** discharging about **4 million gallons per day of effluent** into groundwater in Gallatin County *(English, Assessment of Current Wastewater Treatment and Disposal in Gallatin County, 2010)*

- All treated **wastewater** from these septic systems as well as from municipal and public systems in Gallatin County is discharged to either **groundwater, surface water,** or applied to the land surface

- Many residents in the Gallatin Valley rely on **groundwater as their drinking water source**

Project Goal

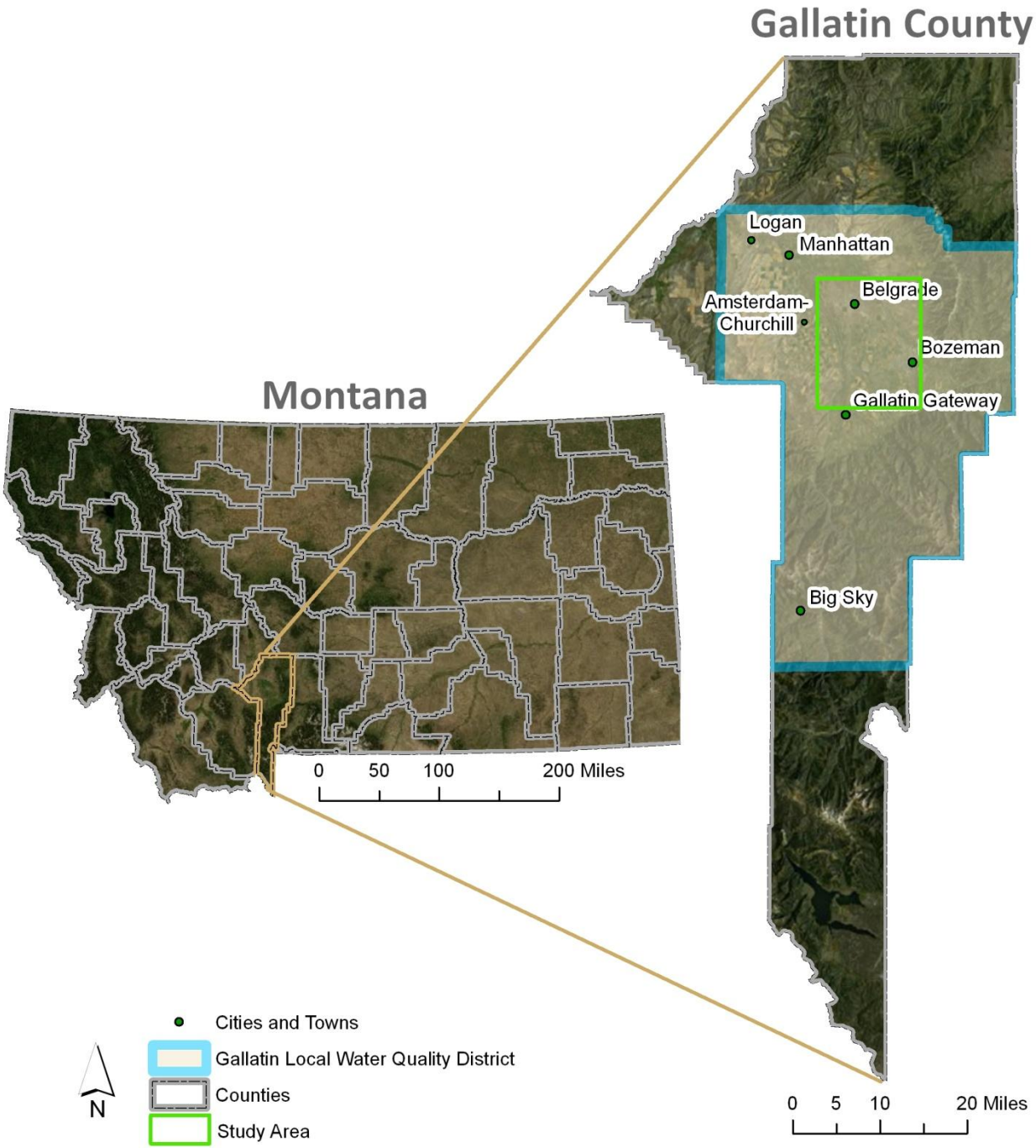
- *In the Gallatin Local Water Quality District, assess whether individual septic systems and public sewage systems in high density development areas are negatively impacting water quality.*

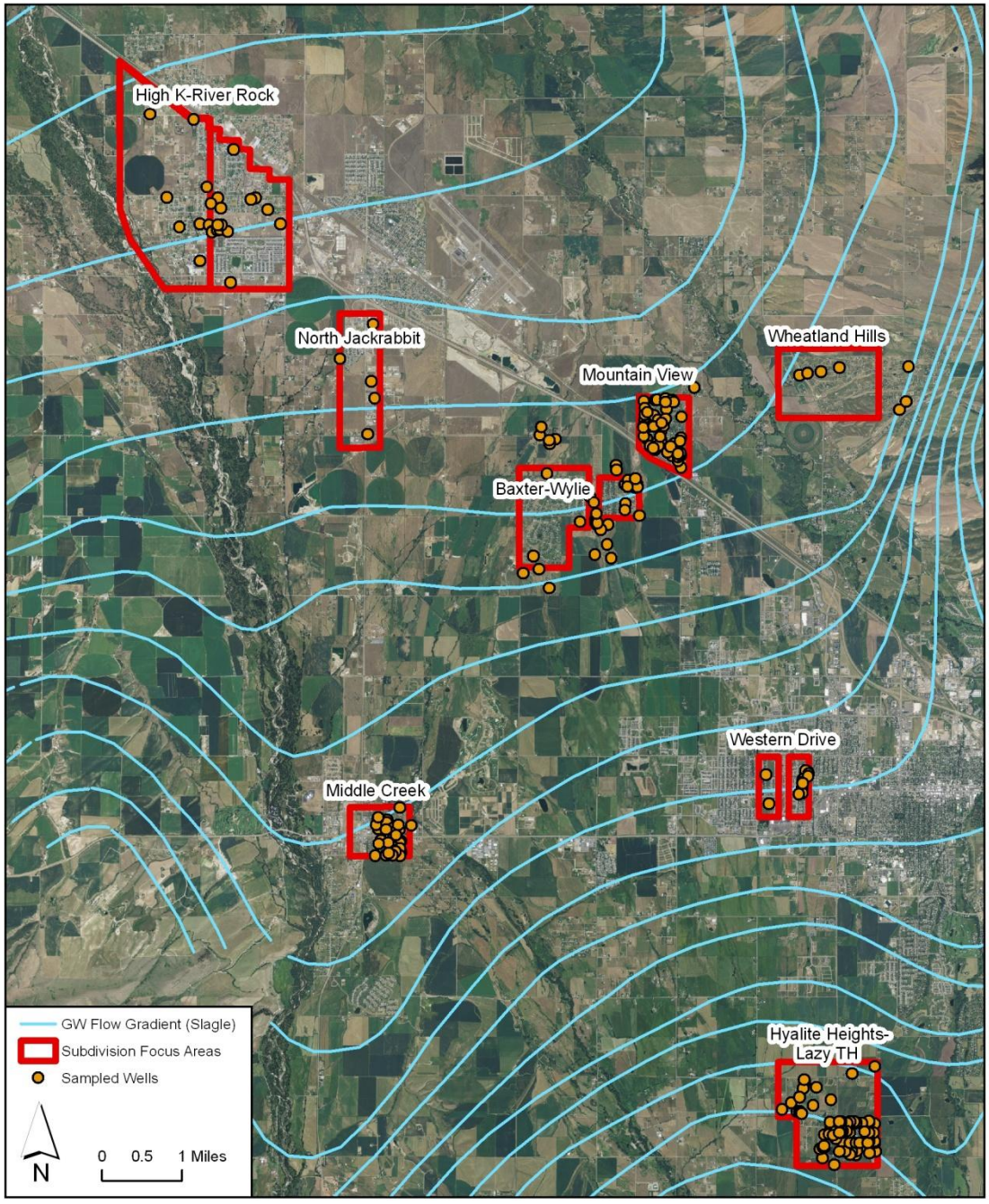
Project Questions

1) *Are areas of **high density septic systems and public sewage systems** measurably and **negatively impacting groundwater quality**?*

2) ***Have historical nitrate levels increased** down-gradient of subdivisions characterized by high density septic systems and public sewage systems?*

3) *Are **nitrate levels trending upward for public water supplies** down-gradient of developed areas?*


Gallatin County
Logan
Manhattan
Belgrade
Amsterdam-
Churchill
Bozeman
Gallatin Gateway
Big Sky
Montana
0 50 100 200 Miles
0 5 10 20 Miles
N
Cities and Towns
Gallatin Local Water Quality District
Counties
Study Area



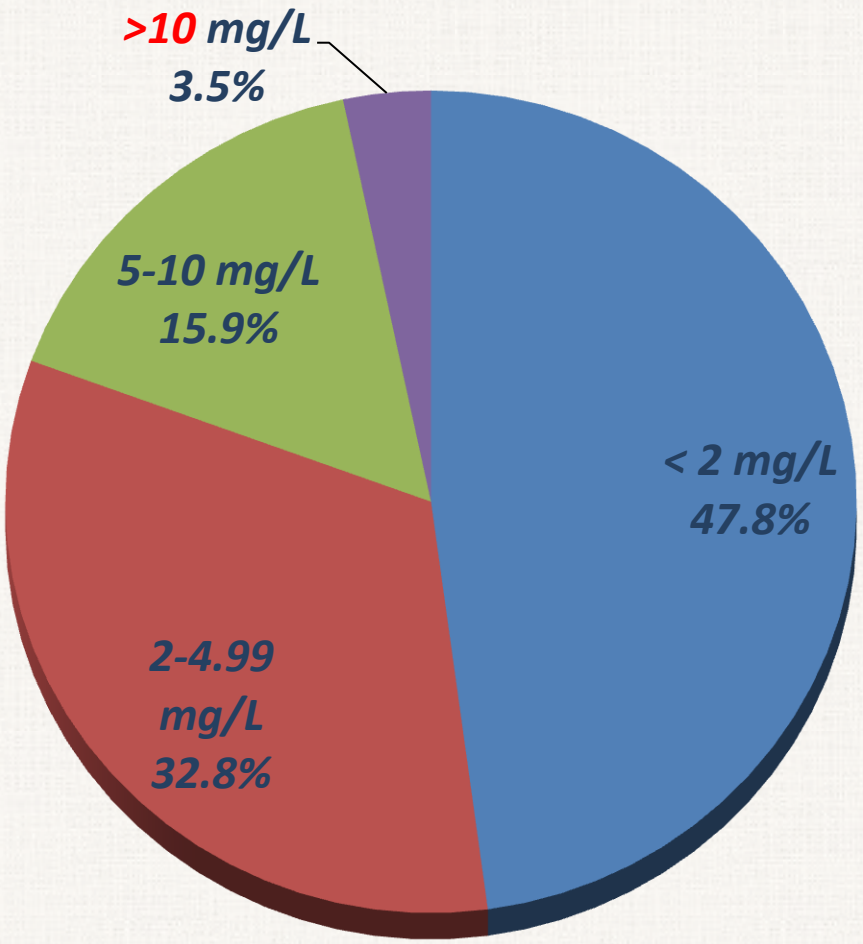
Groundwater flow is generally to the northwest in the Gallatin Valley

Wells sampled in subdivision focus areas are generally shallow (<100') and in alluvial aquifers

Methods

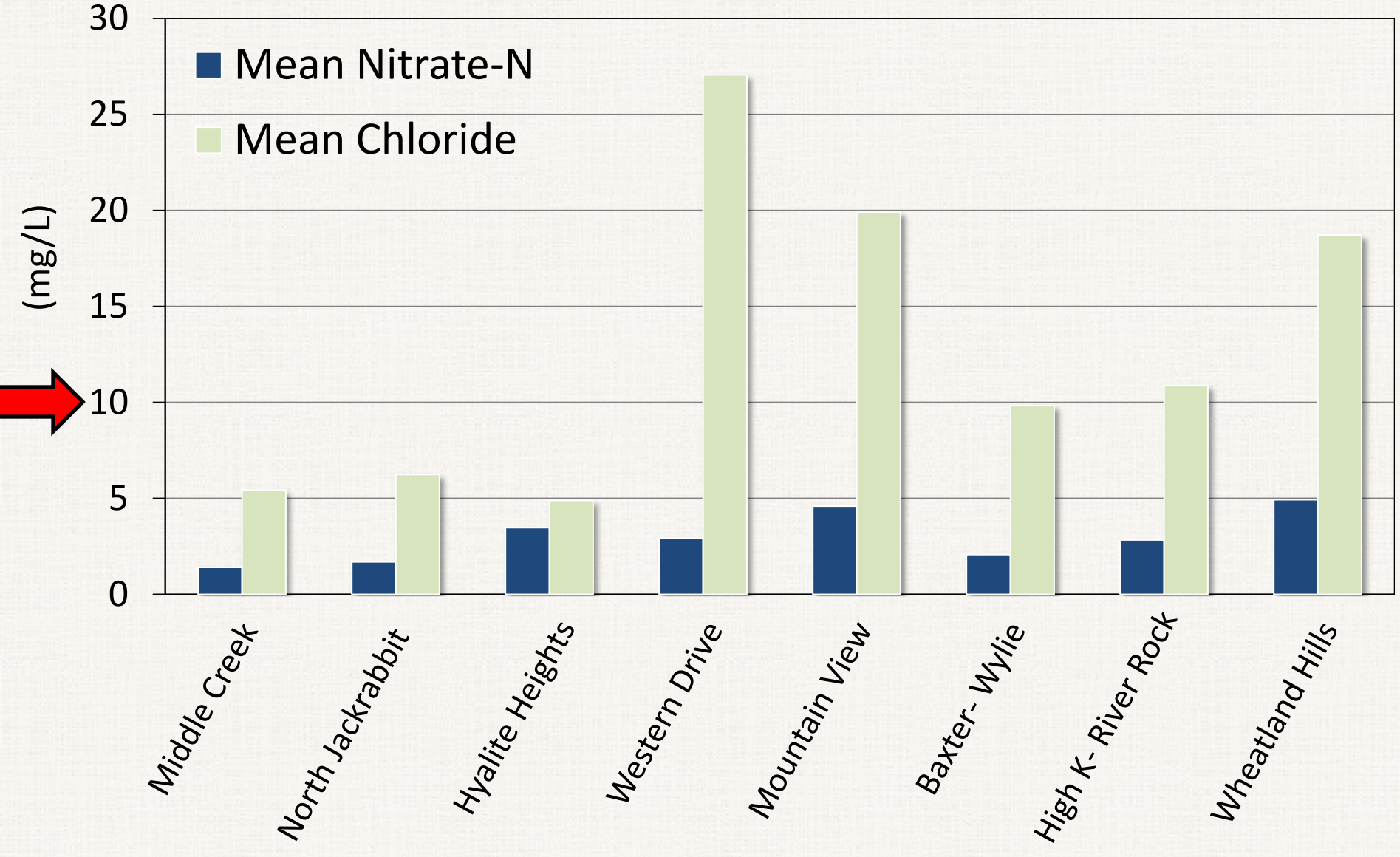
- **Groundwater sampling** of eight subdivision areas for various analytes
  - Nutrients (nitrate, orthophosphate)
  - Wastewater tracers (boron, chloride, specific conductivity)
  - Nitrate isotopes – can help identify source
- Gathered **historical nitrate data**
- Gathered data from nitrate sensitivity analyses from **non-degradation reports**
- Gathered **Public Water Supply nitrate data**

Results – Nitrate-N in 2013 Samples

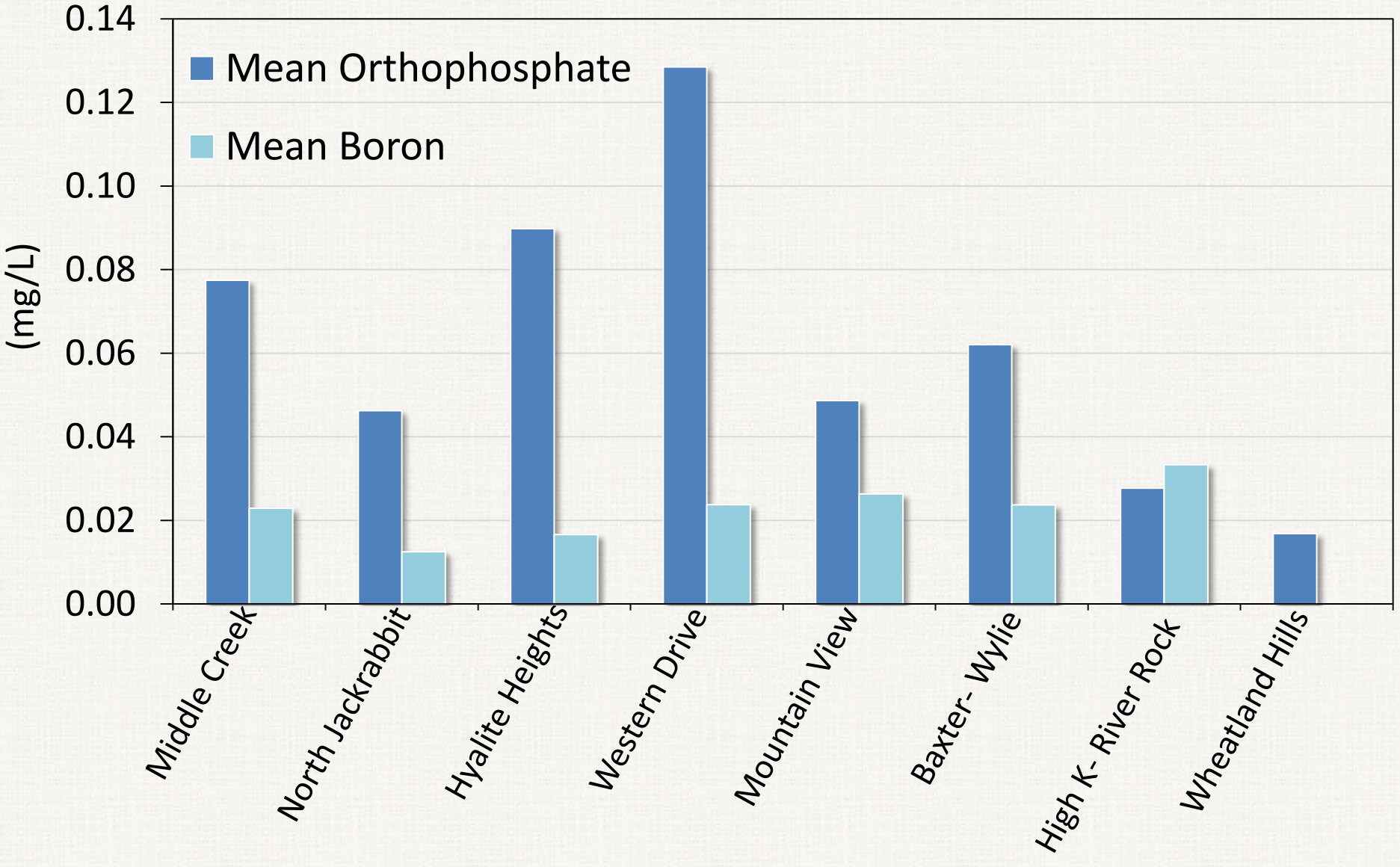


Elevated nitrate is not a widespread problem in the wells sampled

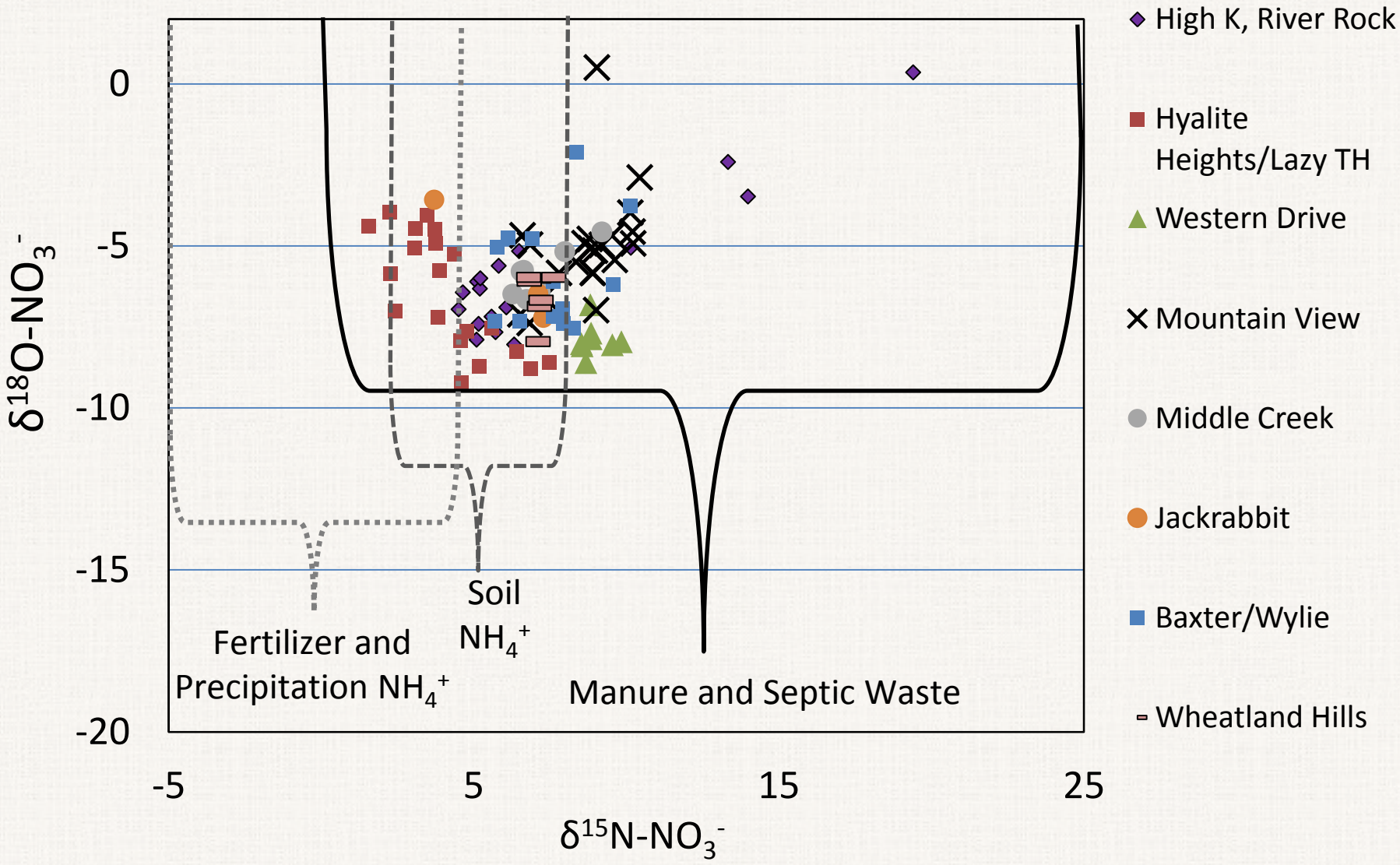
Results - Mean Nitrate-N and Chloride for Subdivision Focus Areas

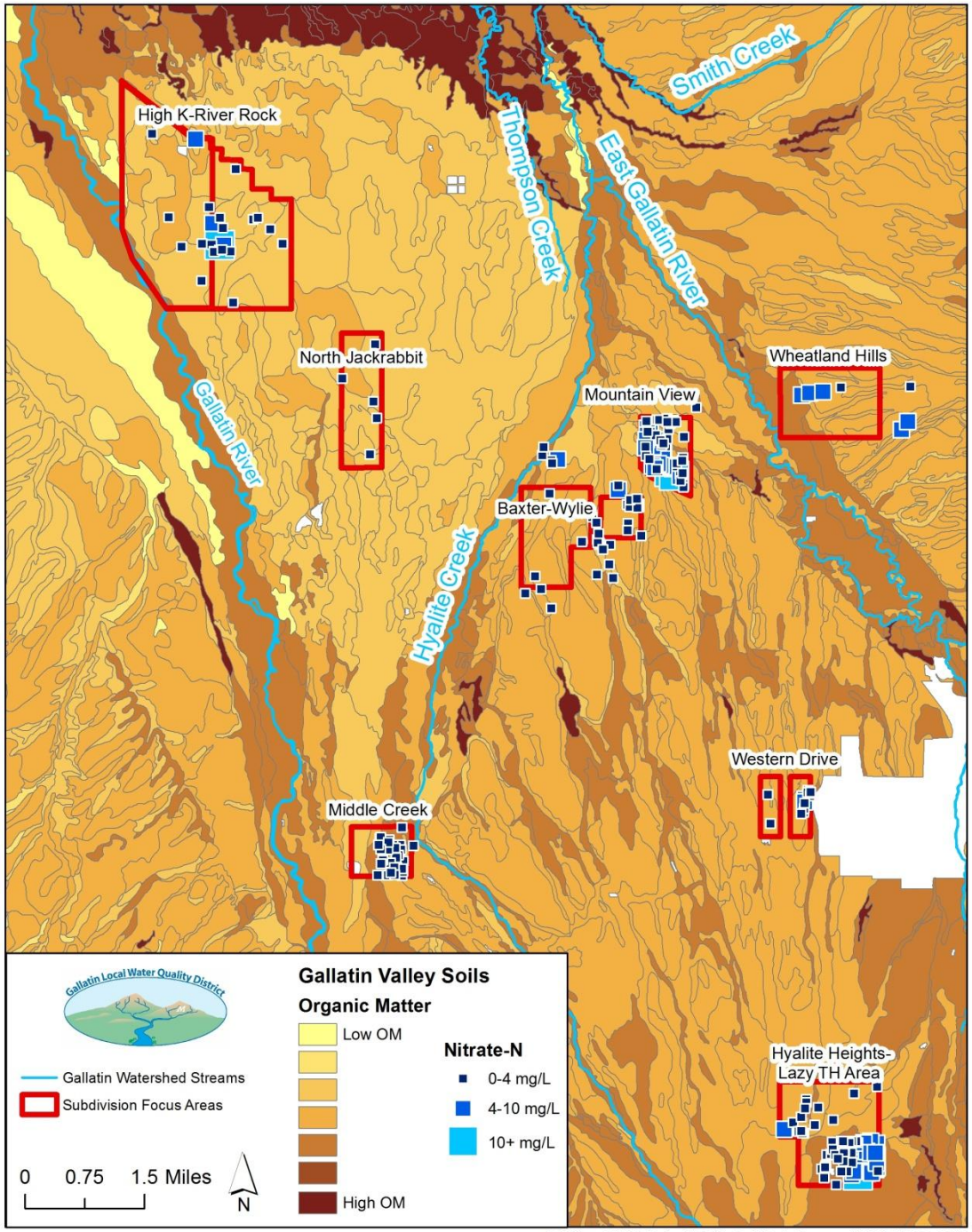


Results - Mean Orthophosphate-P and Boron for Subdivision Focus Areas



Results – Nitrate Isotopes

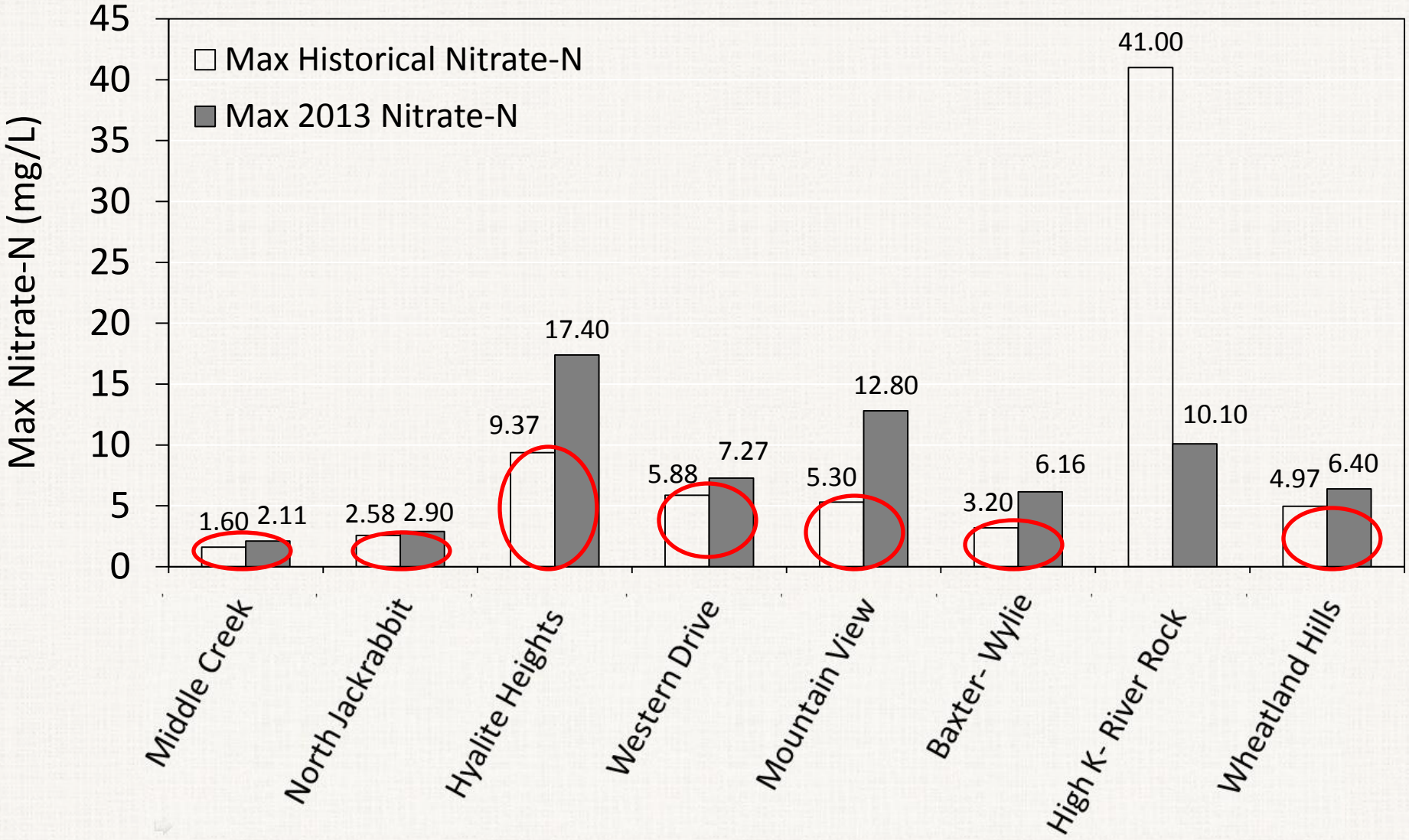




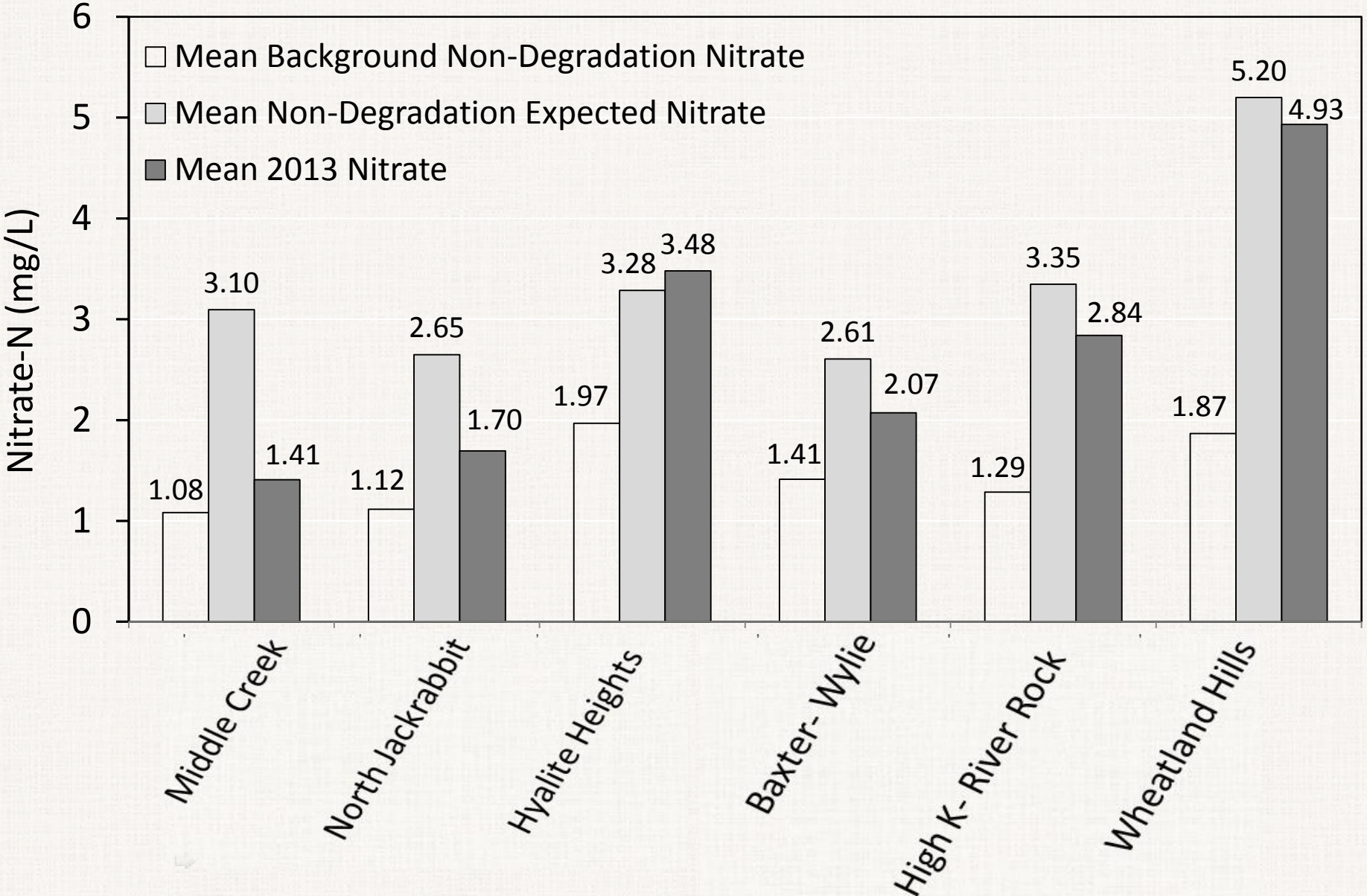
C. Miller, GLWQD. April 2014. Soil Data Source: USDA NRCS 2012

One subdivision area with elevated nitrate is located in an area of higher soil organic matter

Results – Historical vs. 2013 Nitrate

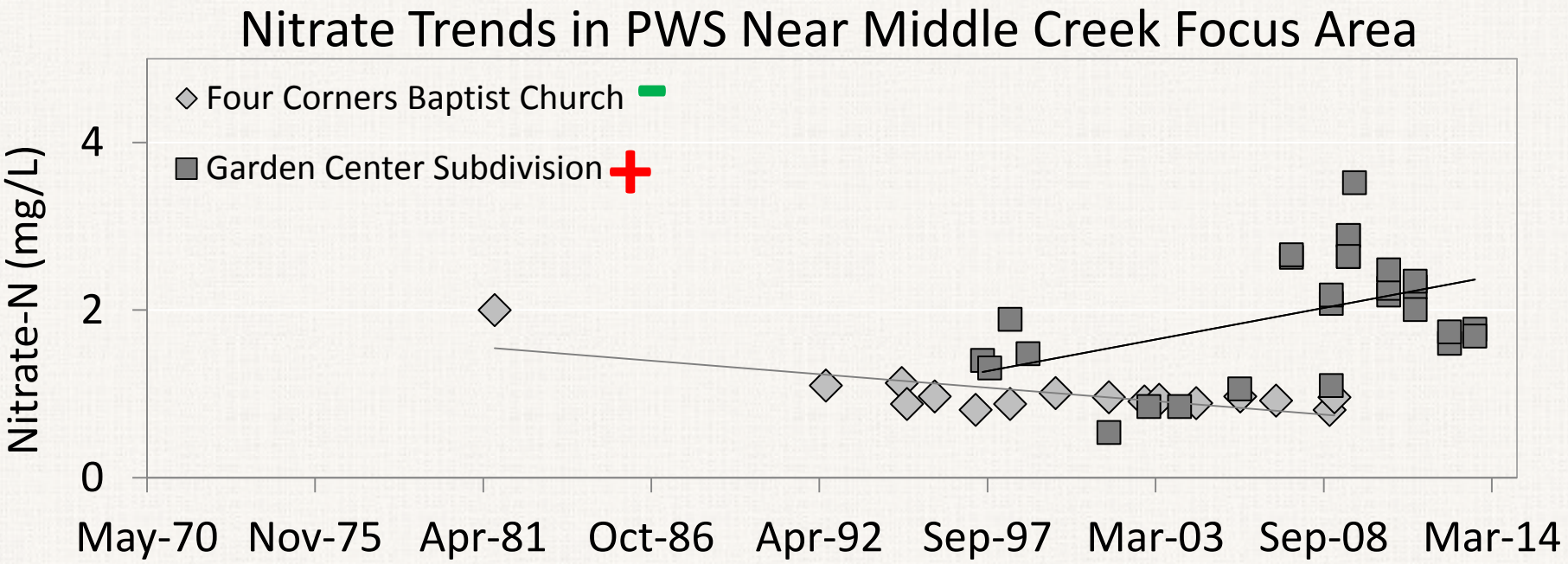


Non-Degradation and Nitrate



Results – Nitrate Trends in Public Water Supplies near Subdivision Focus Areas

Example:



Slope of linear trend lines compared (increasing ☹ or decreasing ☺)

Conclusions

- **Widespread** cumulative effects from septic systems on groundwater **currently not observed**
- Localized areas of concern
- Nitrate source: septic/animal waste and/or soils, fertilizer in some areas
- Increasing nitrate levels in groundwater, expected to continue
- Some public water supplies show an increase in nitrate

Recommendations

- Educational Efforts
  - Maintain septic systems (pumping, inspections)
  - Appropriately fertilize lawns and gardens
    - (Minimize additional nutrient additions to groundwater)
  - Avoid excessive watering (reduce nitrate leaching)
- Continue to encourage community water and wastewater systems
  - Especially in Source Water Protection (SWP) areas
  - Regular monitoring required
  - Problems pinpointed and more easily remedied compared to diffuse contamination from array of septics

Recommendations Cont'd

- Encourage installation and sampling of down-gradient monitoring wells for new developments
  - Early identification of water quality problems or wastewater treatment system problems
  - Long term water quality data sets created
- Annual testing of domestic drinking water
  - Protect health of Gallatin Valley residents consuming water from private domestic wells
  - Long term water quality data sets created

Thank you to:

- *Montana DEQ 319 Grant Funding*
- *Gallatin County Planning Department*
- *Gallatin City-County Environmental Health Services (EHS)*
- *Gallatin County GIS Department*
- *Homeowners and residents who allowed GLWQD staff to sample their domestic wells*
- *Gallatin County/MSU Extension*

Thank you!

Questions?