GROUND WATER QUALITY AND SUBSURFACE WASTEWATER SYSTEMS

Presented to:
Water Policy Interim Committee
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Helena, MT

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TOPICS

- **CONTAMINANTS IN WASTEWATER**
- **WATER QUALITY / NONDEGRADATION BACKGROUND**
- **IMPACTS FROM WASTEWATER DISCHARGES**
  - **GROUND WATER**
  - **SURFACE WATER**
- **EXAMPLES**

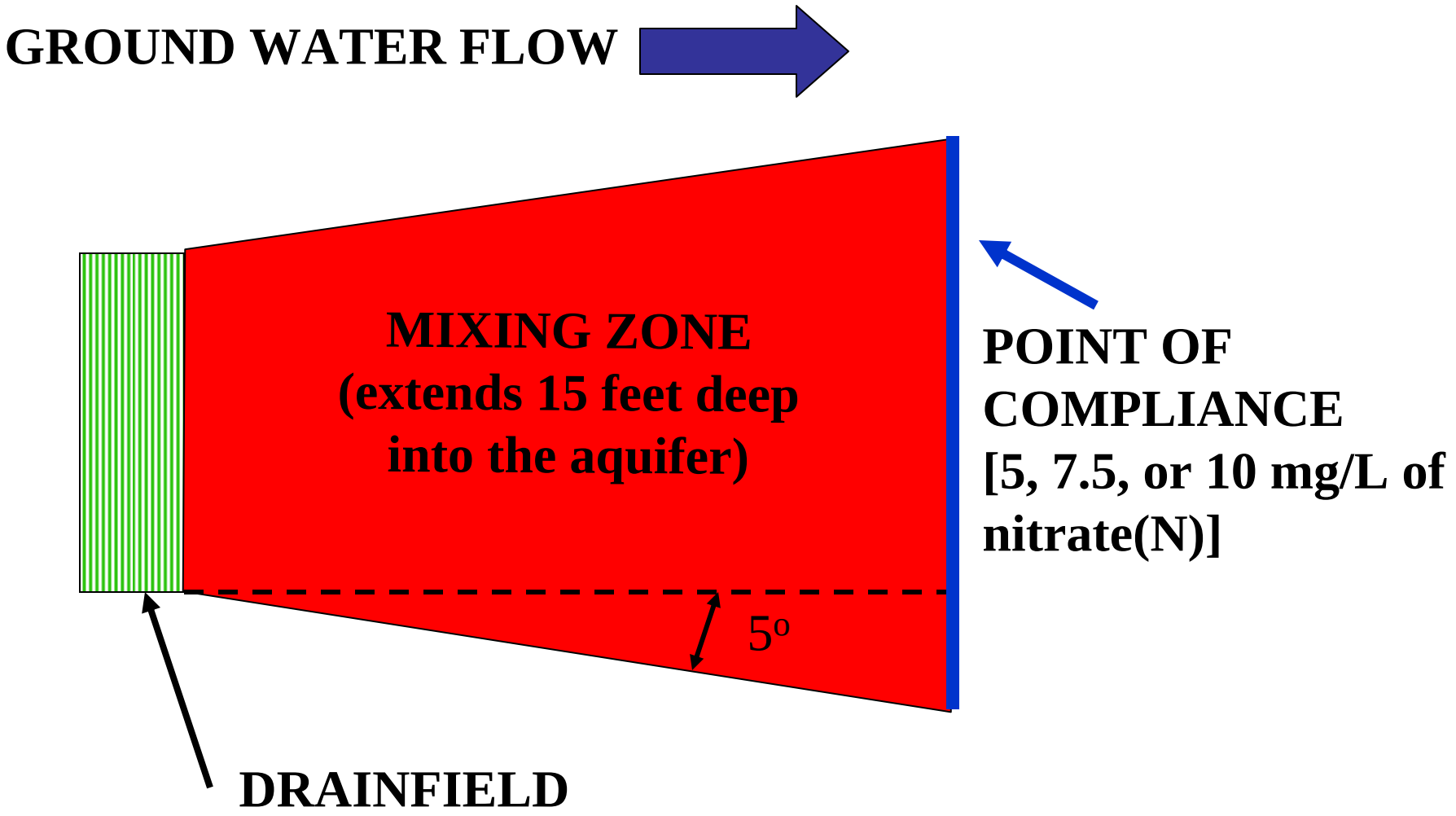
CONTAMINANTS OF CONCERN

- **PATHOGENS**
  - **Bacteria, viruses**
  - **Drainfields designed to remove**
- **NITROGEN**
  - **Human health impacts**
  - **Eutrophication in surface waters**
- **PHOSPHORUS**
  - **Eutrophication in surface waters**
- **PERSONAL CARE PRODUCTS & PHARMECEUTICALS (?)**
  - **Aquatic life impacts documented**
  - **Human health impacts not defined**

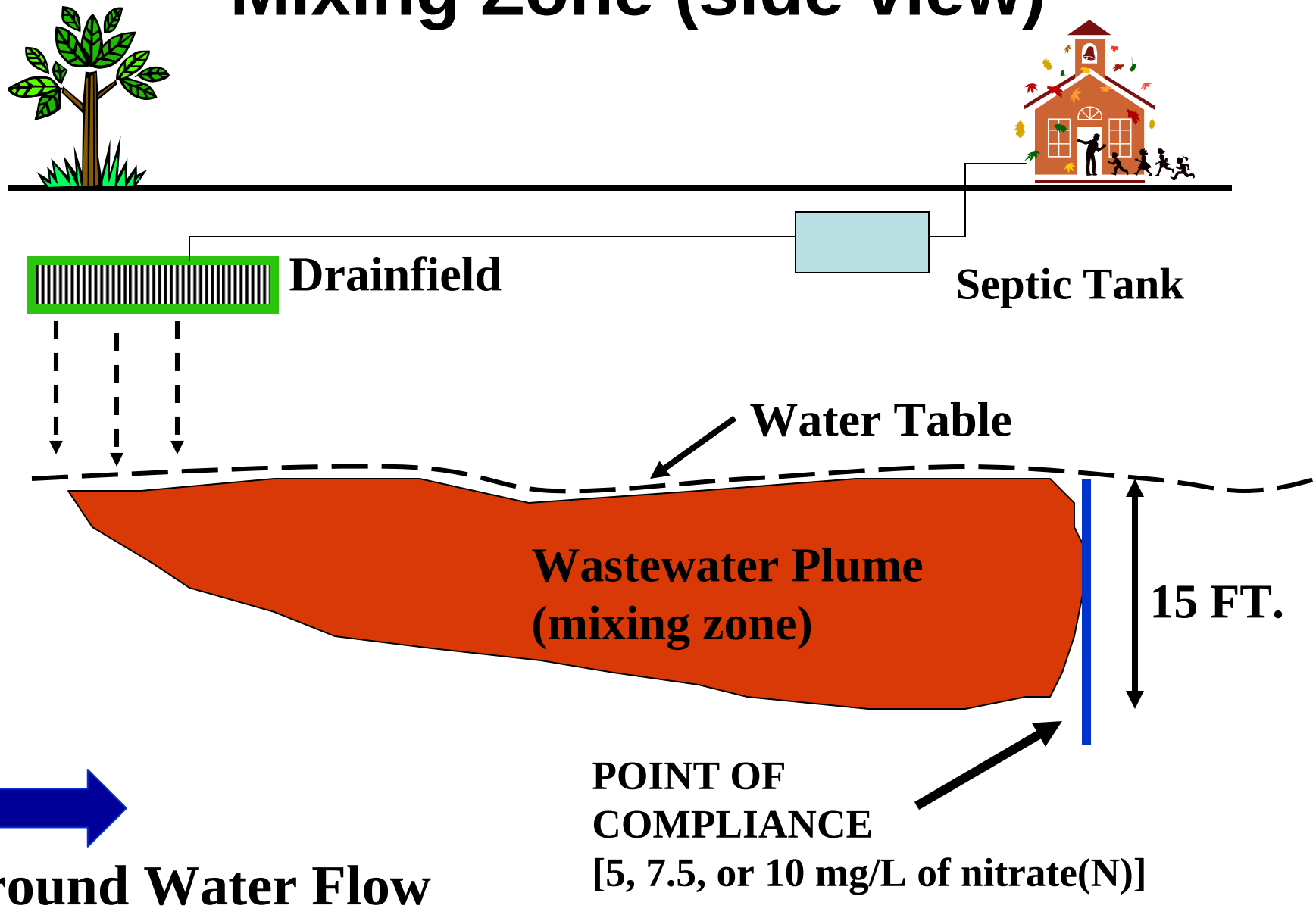
GROUND WATER QUALITY STANDARDS - NITROGEN

- **GROUND WATER MIXING ZONE**
  - **Dilution is the Solution**
  - **Allows limited distance (100-500 ft) below discharge to exceed water quality limits**
- **THREE LIMITS:**
  - **10 mg/L – human health standard (DEQ-7)**
  - **7.5 mg/L – nondegradation (Level 2)**
  - **5.0 mg/L – nondegradation (non Level 2)**
- **CUMULATIVE IMPACTS ARE CALCULATED**

Ground Water Mixing Zone (aerial view)



Mixing Zone (side view)



SURFACE WATER QUALITY STANDARDS - NITROGEN

- **TWO NONDEGRADATION STANDARDS:**
  - ***Trigger Value*** **- can only increase nitrate by 0.01 mg/l in surface water**
  - ***Narrative standard*** **– no numeric value (aesthetic and ecological impacts)**
- **CUMULATIVE IMPACTS (?)**
  - **TMDLs**

WATER QUALITY STANDARDS - PHOSPHORUS

- **GROUND WATER STANDARD**
  - **None**
- **SURFACE WATER STANDARDS**
    - **Distance setbacks**
    - **Trigger value (increase of less than 0.001 mg/L)**
    - **Narrative standard**
- **CUMULATIVE IMPACTS (?)**
    - **TMDLs**

WATER QUALITY STANDARDS – PERSONAL CARE PRODUCTS & PHARMACEUTICALS

- **NO WATER QUALITY STANDARDS BY EPA (www.epa.gov/ppcp/)**
- **NO REGULATIONS FOR WASTEWATER SYSTEMS**
- **HELENA VALLEY STUDY (Miller & Meek)**
  - **Detected PPCPs in 32 of 35 wells tested**
- **MISSOULA STUDY (Godfrey & Woessner)**
  - **Detected PPCPs in septic tanks, WWTP influent, and WWTP effluent**

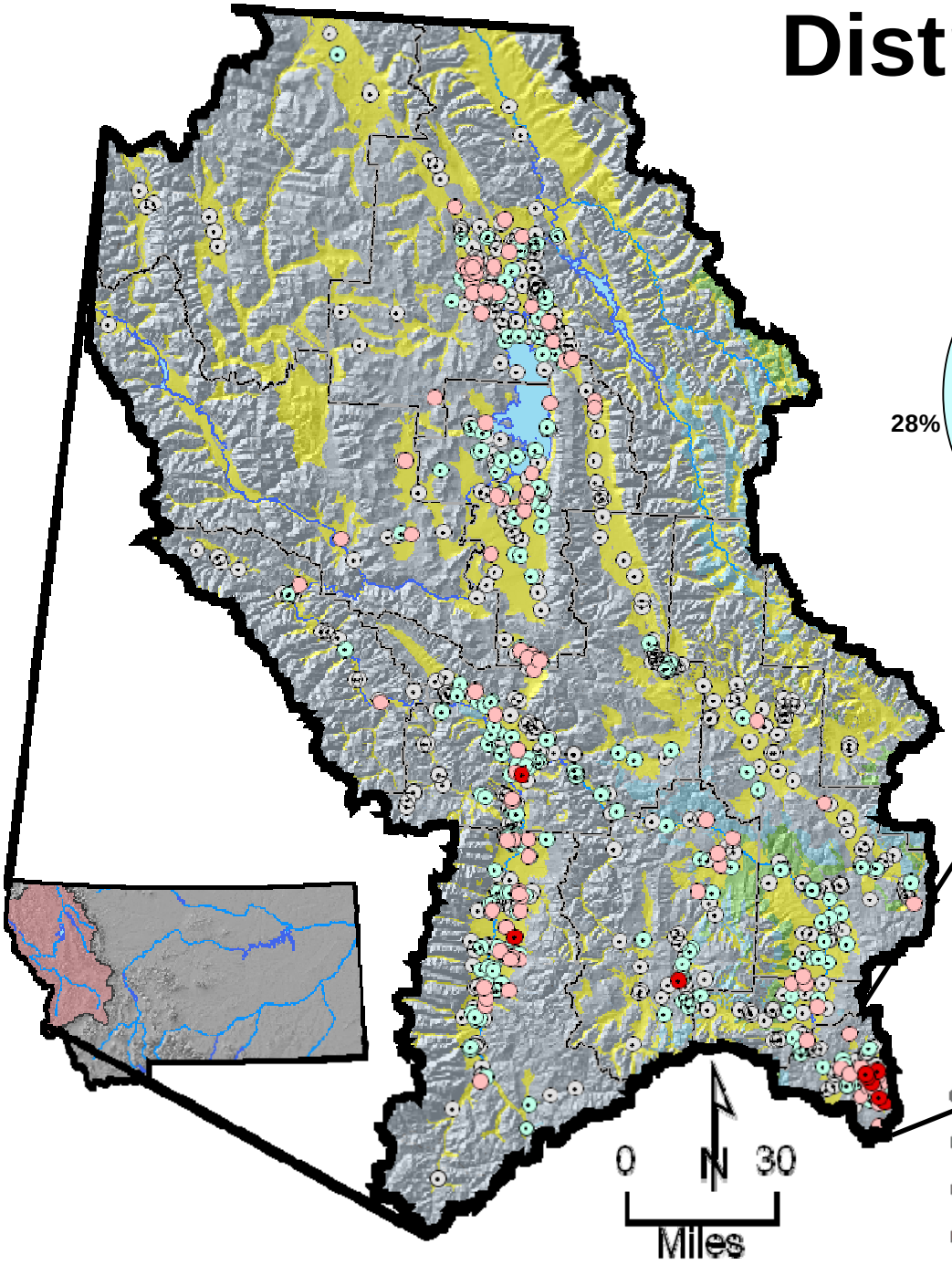
EXAMPLES OF GROUND WATER PROBLEMS AND SUBDIVISION DEVELOPMENT

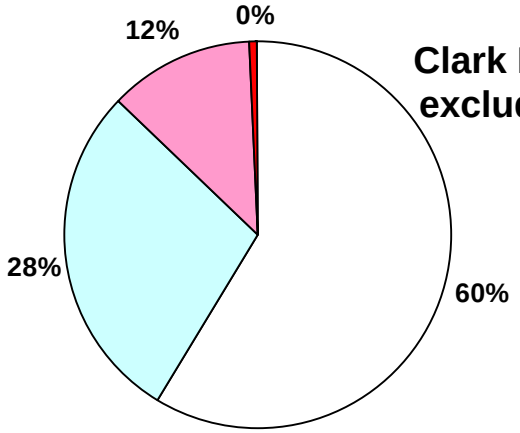
SOUTH OF BUTTE

- **Shallow, fractured granitic bedrock (Boulder Batholith)**
- **High and low density developments**
- **Poor soils (minimal organic material)**
- **Unpredictable flow directions**
- **Unpredictable nitrate concentrations**
- **Older septic systems(?)**

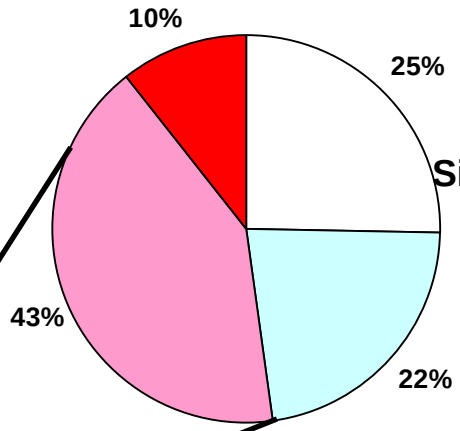
Distribution of Nitrate

Clark Fork Basin





Clark Fork Basin samples excluding Silver Bow Co.
n = 707

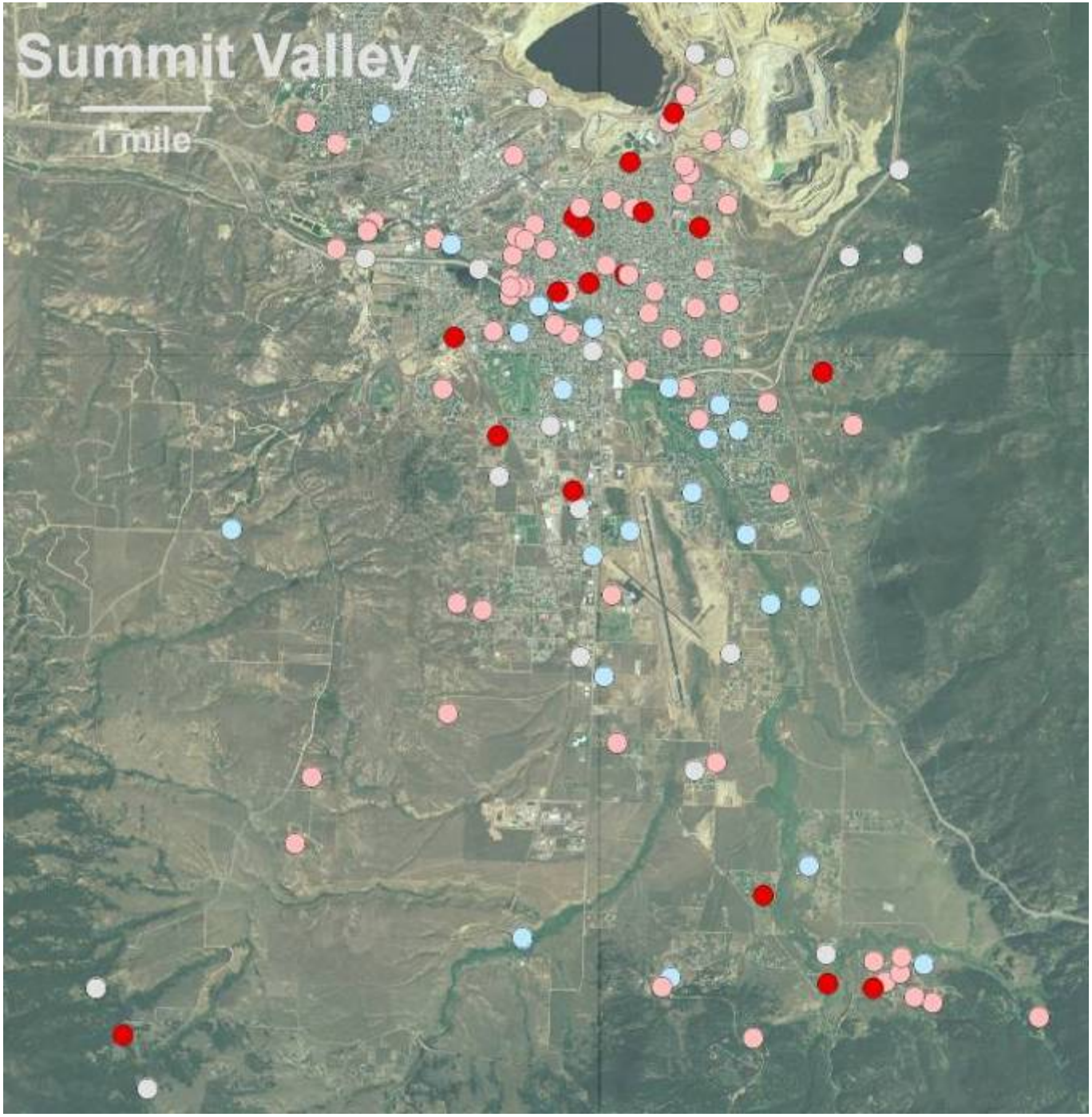


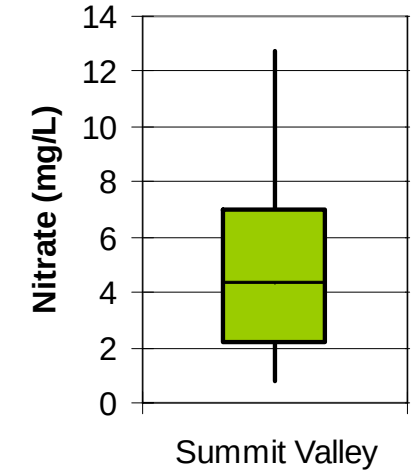
Silver Bow Co. samples
n = 67

Nitrate Concentrations

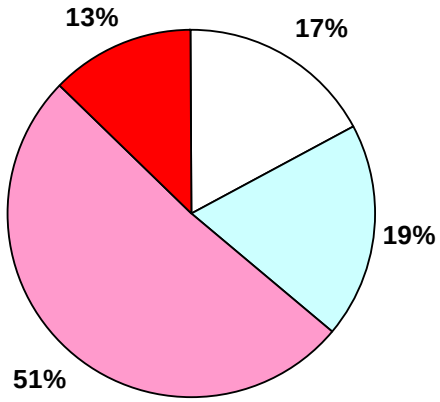
- not detected or less than 0.5 mg/L
- Low level: 0.5 - 2.0 mg/L
- Impacted: 2.0 - 10.0 mg/L
- MCL exceedance: > 10.0 mg/L

MBMG – Ground-Water Assessment Program

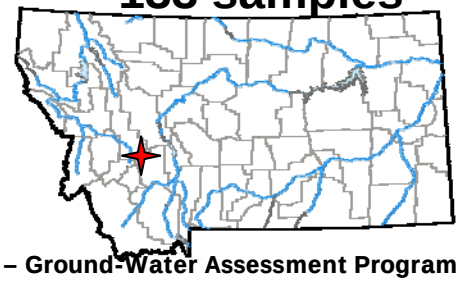




□ < 0.5 □ 0.5 - 2 □ 2 - 10 ■ > 10

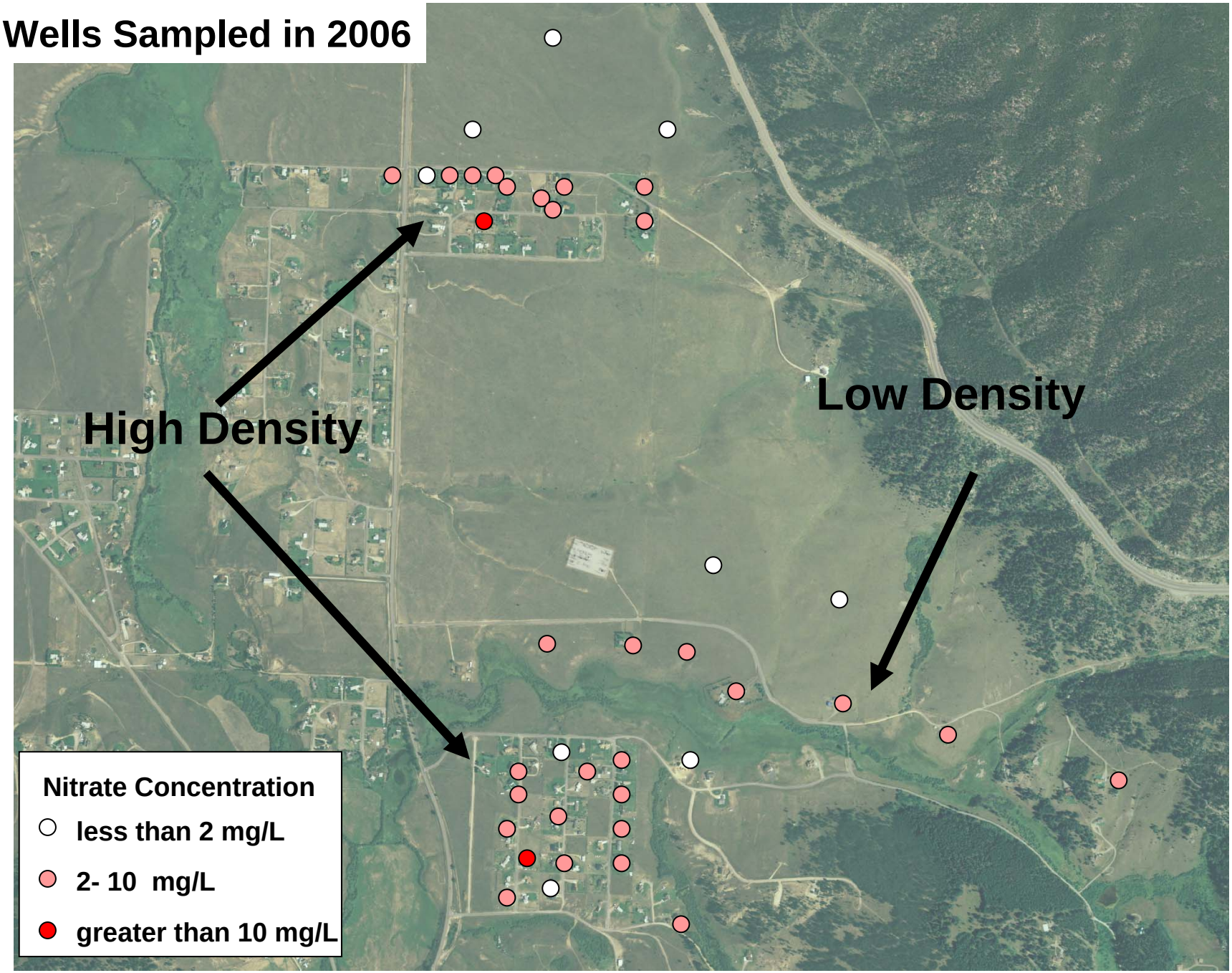


133 samples



MBMG – Ground-Water Assessment Program

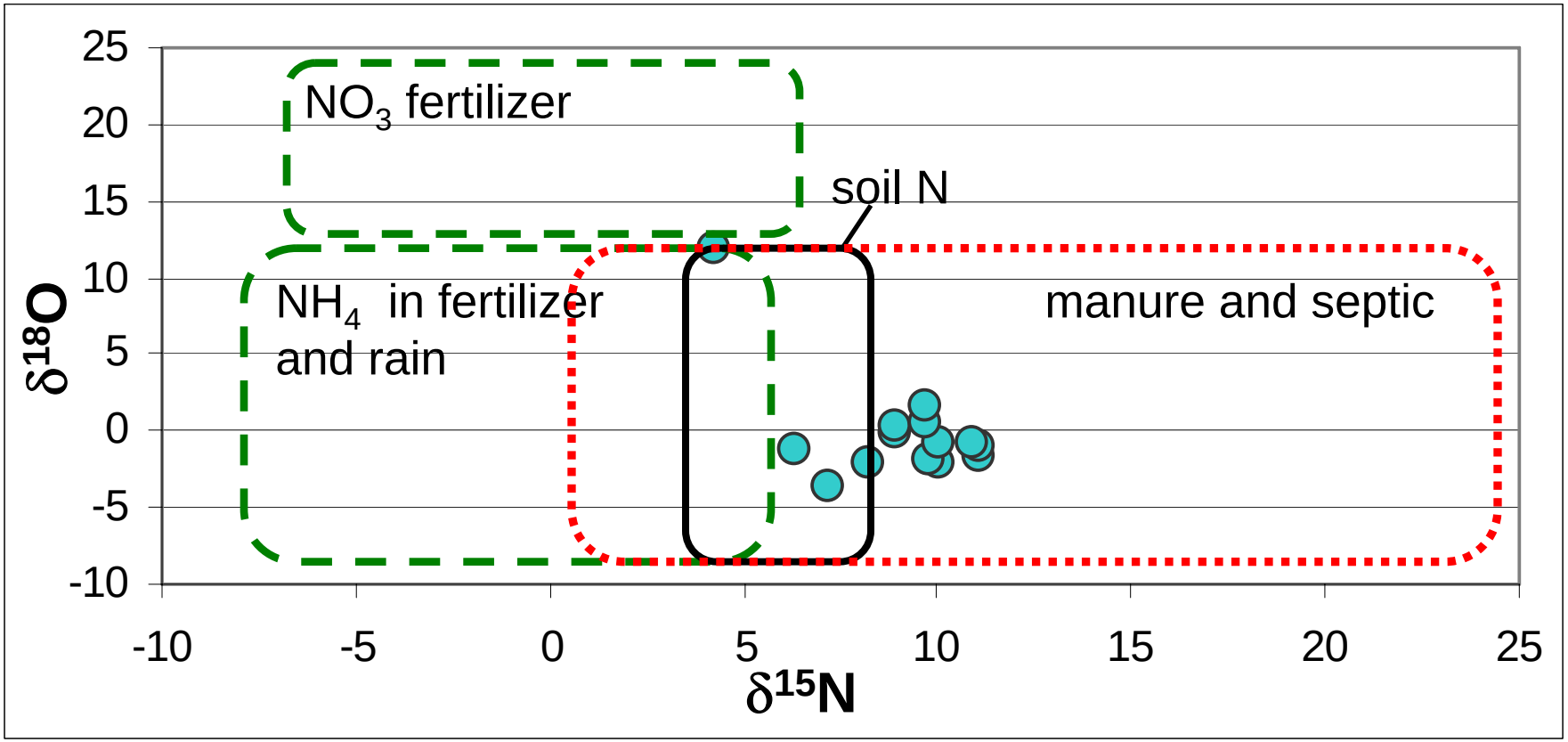
Wells Sampled in 2006



MBMG – Ground-Water Assessment Program

Typical Ranges of $\delta^{18}O$ and $\delta^{15}N$ of Nitrate (NO_3)

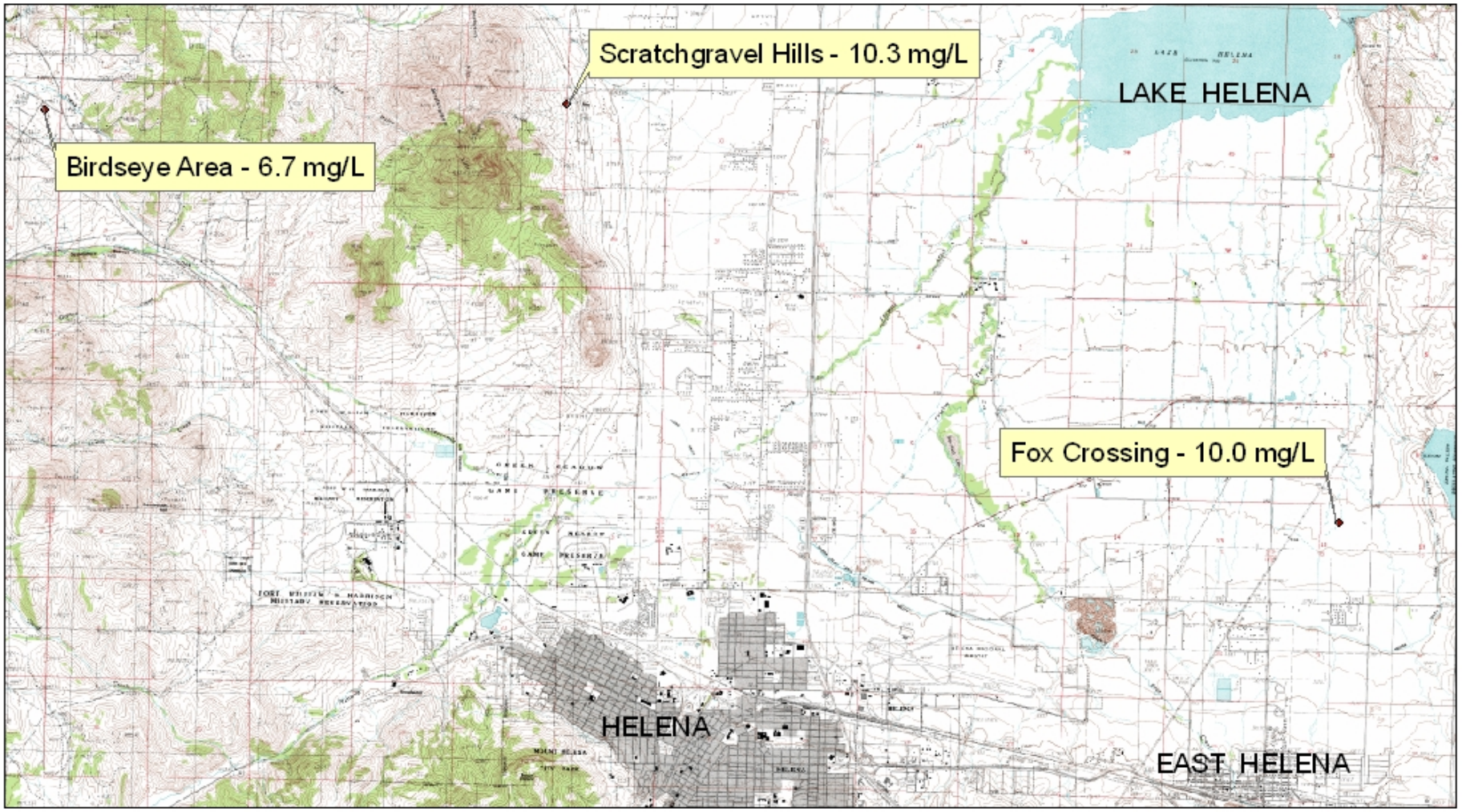
(modified from Kendall and Aravena, 2000)



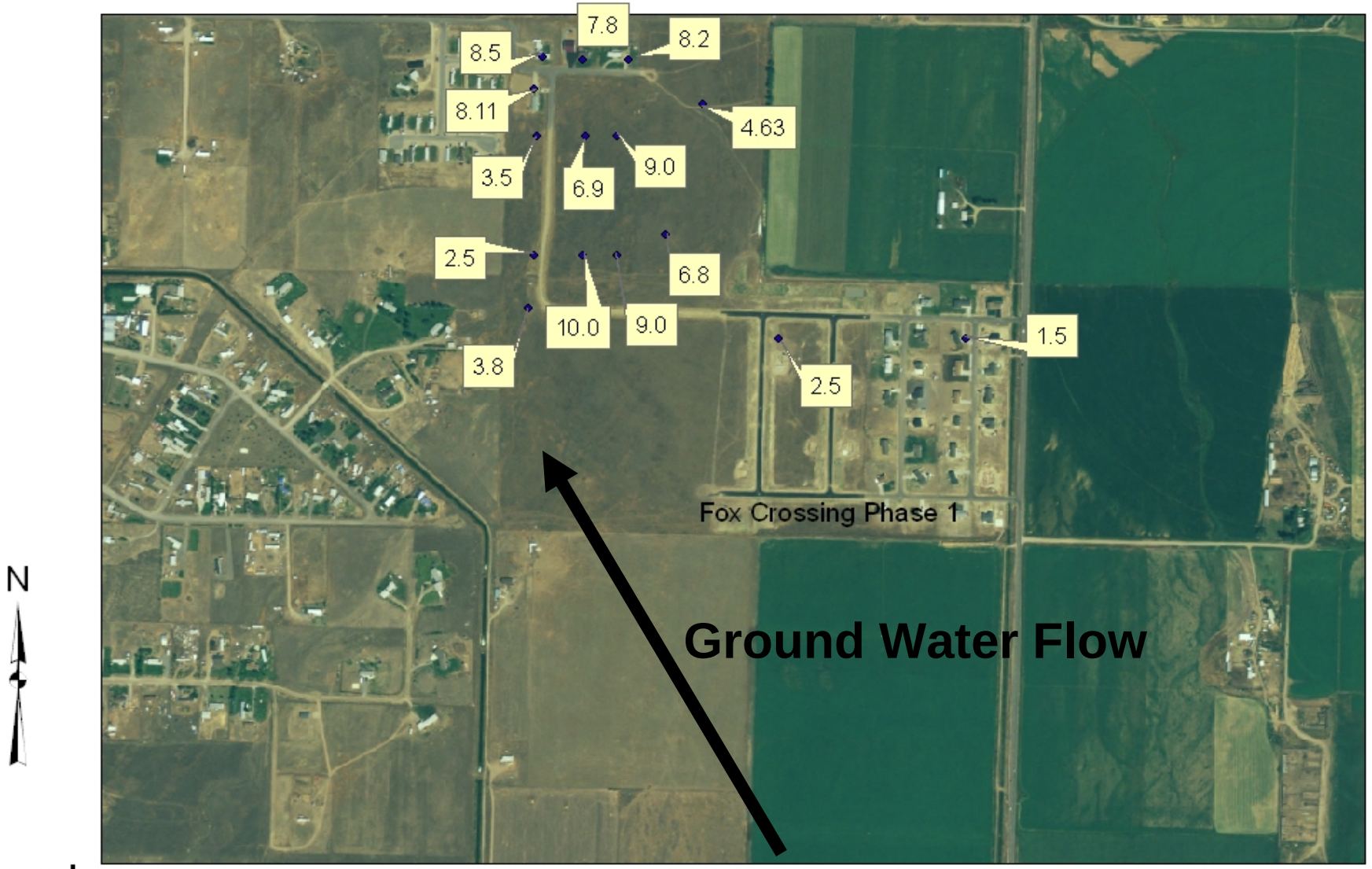
HELENA

- **Shallow fractured granitic bedrock (Boulder Batholith) on two sites**
- **Finer grained unconsolidated material on third site (Fox Crossing)**
- **Low density upgradient from wells**

SOME ELEVATED NITRATE LOCATIONS IN THE HELENA VALLEY



FOX CROSSING SUBDIVISION in the ALLUVIAL AQUIFER of the HELENA VALLEY



Legend

- WellInfo

Nitrates in mg/L

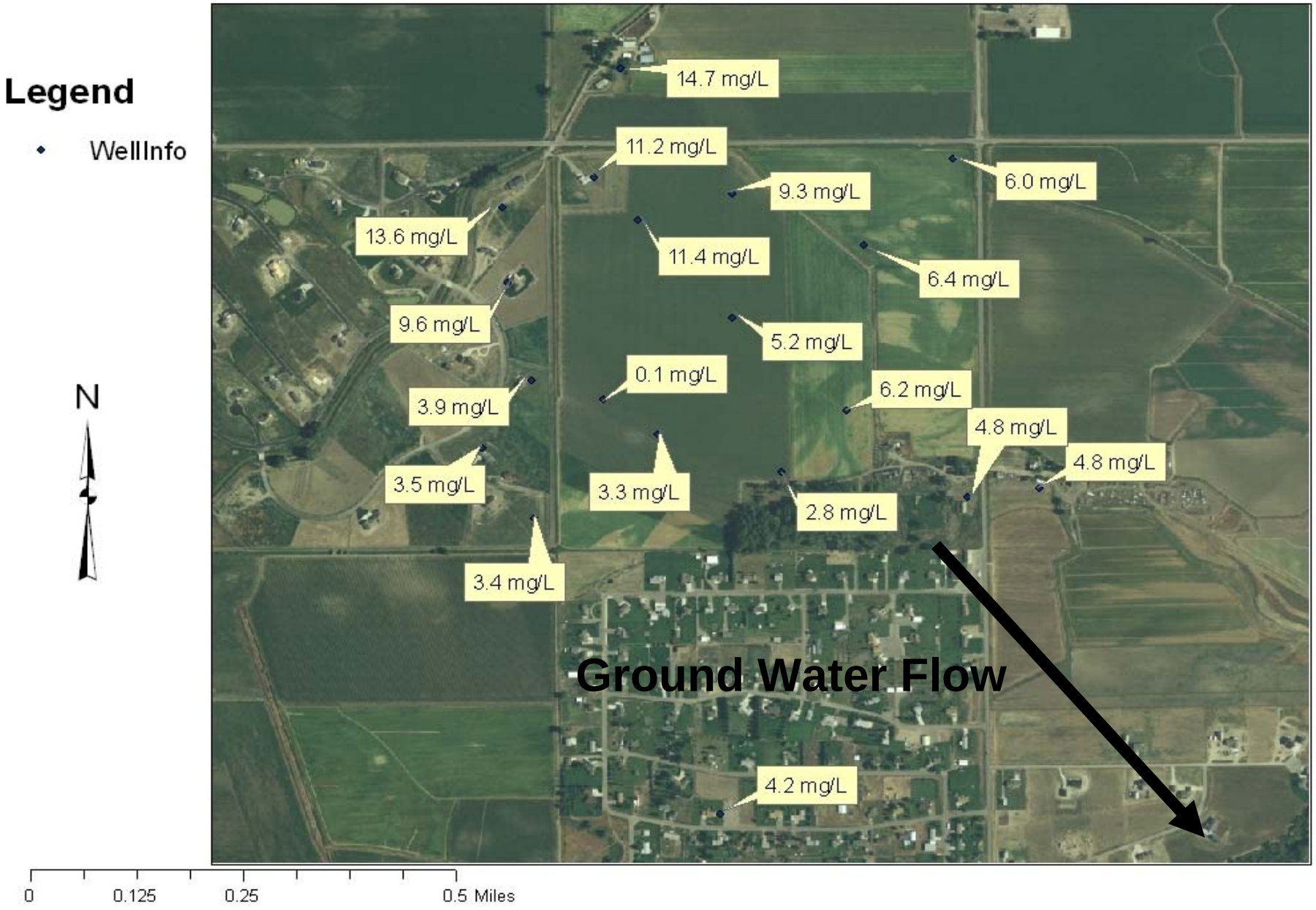
Fox Crossing Phase 1 was not present when the wells were sampled.

Ground water mapped at N32°W (west side) to N36°W (east side)

BILLINGS/LAUREL

- **High permeability, thin gravel aquifer**
- **Shallow water table**
- **Historic agricultural land use**
- **Converting to residential**
- **Variable nitrate due to fertilization/development patterns (?)**

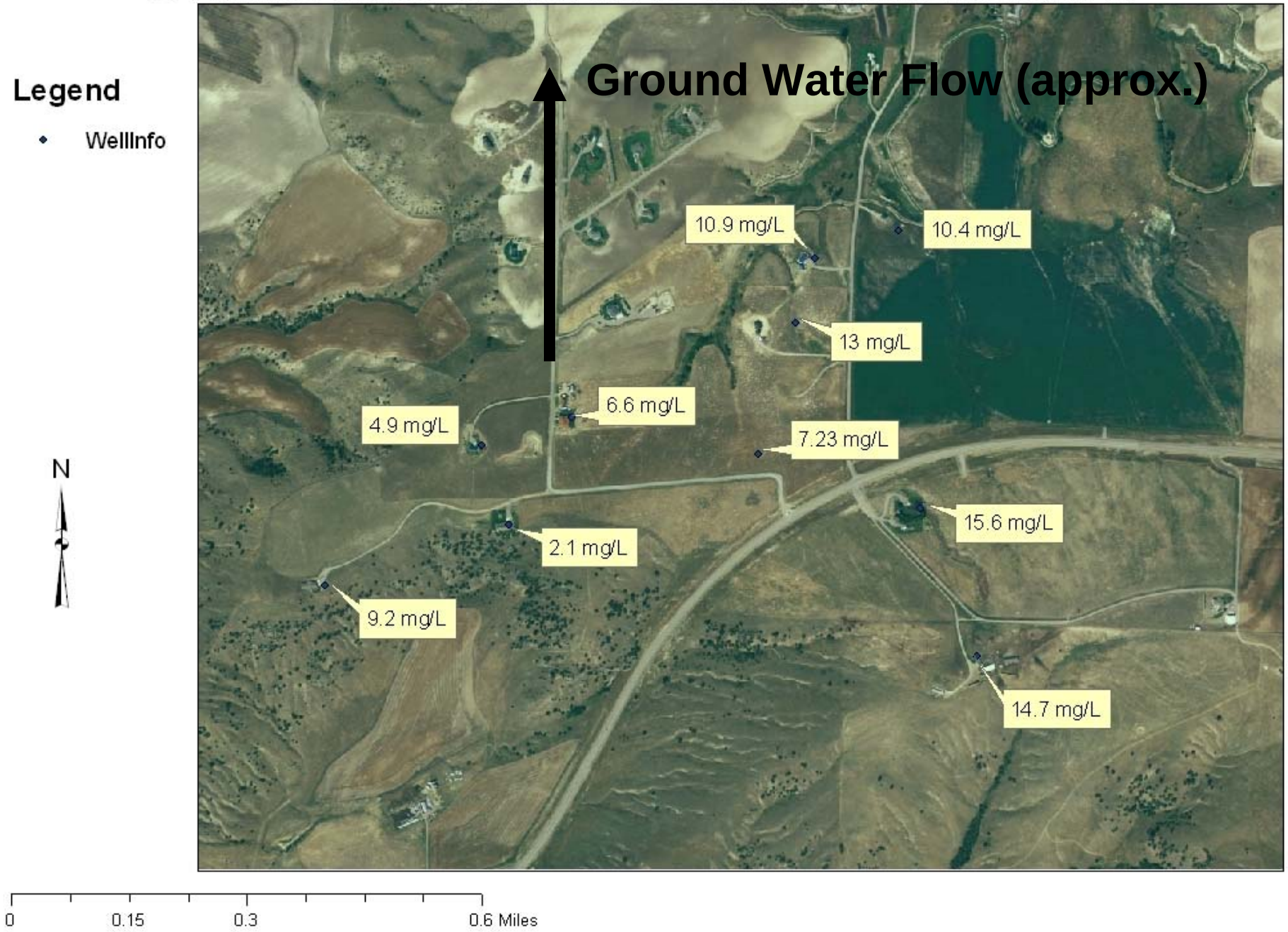
BROOKWOOD - YELLOWSTONE COUNTY - NITRATE CONCENTRATIONS



NORRIS/BOZEMAN

- **Shallow, fractured granitic bedrock (Boulder Batholith)**
- **Low density development**
- **No other surrounding sources**

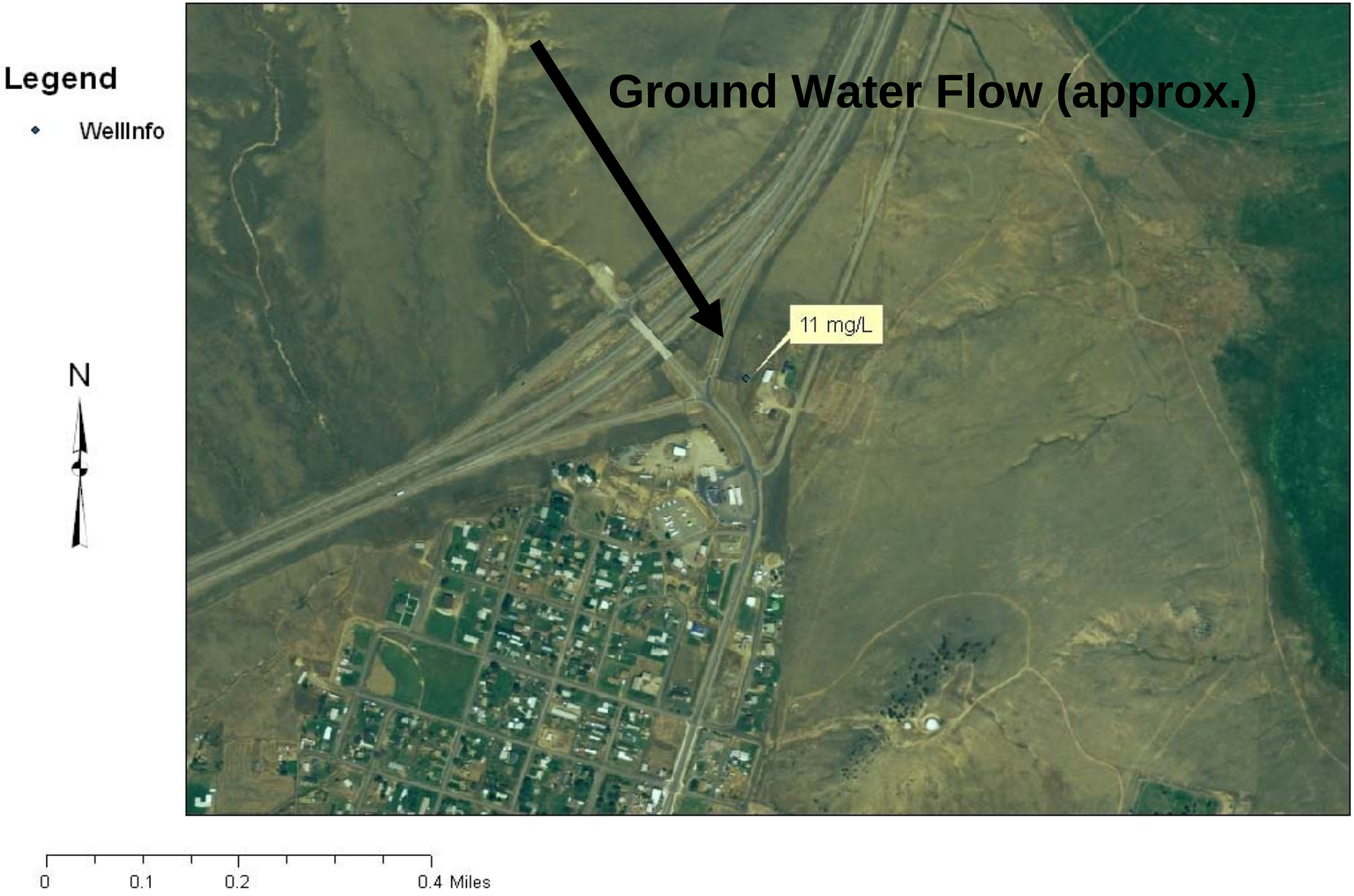
GALLATIN COUNTY - NORRIS ROAD - WIERDA SUBDIVISION AREA

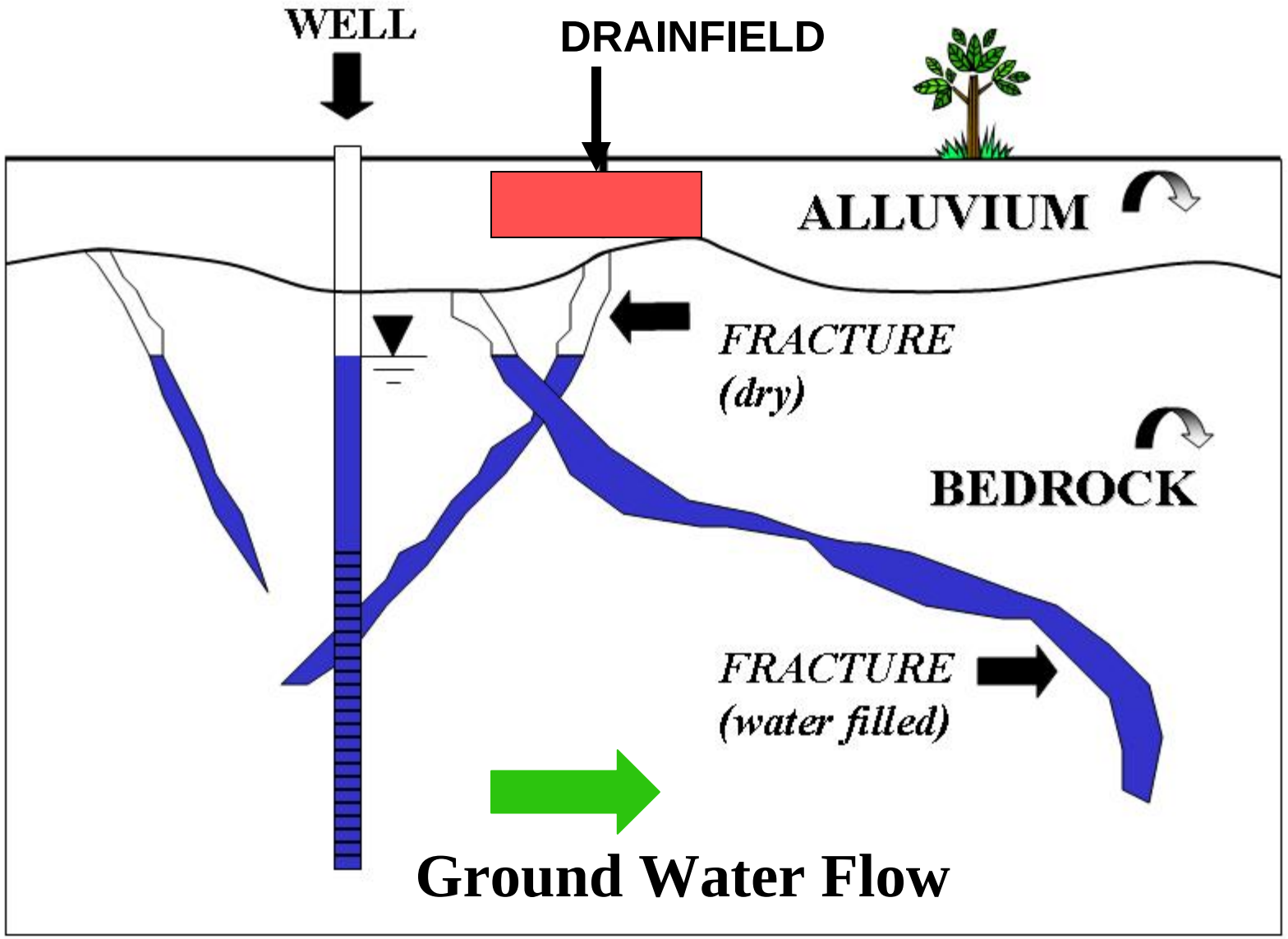


BOULDER

- **Shallow, fractured granite bedrock (Boulder Batholith)**
- **Low upgradient density**
- **No upgradient sources**
- **On-site drainfield downgradient of well**

BOULDER - JEFFERSON COUNTY - NITRATE CONCENTRATIONS




WELL
DRAINFIELD
ALLUVIUM
FRACTURE
(dry)
BEDROCK
FRACTURE
(water filled)
Ground Water Flow