Background

- Plum Creek listed as impaired for bacteria and nutrients (2008 Texas Water Quality Inventory & 303(d) List of Impaired Waterbodies)

- Geronimo Creek first listed in 2000 for concern for nutrient enrichment because of nitrate-nitrogen

- Geronimo Creek listed on the 2008 and 2010 303(d) lists for not supporting contact recreation use because of *E. coli* bacteria.
Objectives/Scope

• 3-year project to determine possible sources of elevated nitrates
• Scope includes the Plum Creek (PC) and Geronimo Creek (GC) Watersheds
• 7 SW sites (PC-5, GC-2)
• 2 Springs (PC-1, GC-1)
• 2 GW sites (PC-1, GC-1)
• 1-2 rainfall sites
Sources of Nitrates?

- Possible point and nonpoint pollution throughout watershed
- Mixed land cover with increasing urban development, oil & gas production, and agricultural activities that may contribute nitrate to watershed
- Naturally occurring in groundwater
- Atmospheric deposition
Background

Potential Sources of Bacteria, Nutrients, and other contaminants

<table>
<thead>
<tr>
<th>Potential Sources</th>
<th>Bacteria</th>
<th>Nutrients</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Urban Runoff</td>
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<tr>
<td>Pets</td>
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<td><strong>Wastewater</strong></td>
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<tr>
<td>Septic Systems</td>
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<td>Wastewater Treatment Facilities</td>
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<td><strong>Agriculture</strong></td>
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<td>Sheep and Goats</td>
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<td>Horses</td>
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<td>Cattle</td>
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<td>Cropland</td>
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<td>Feral Hogs</td>
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<tr>
<td><strong>Oil and Gas Production</strong></td>
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</tbody>
</table>

1 Other contaminants may include, but are not limited to, dissolved solids, pesticides, herbicides, and emerging contaminants (D. Magin, GBRA, written commun., Jan. 2014)

(Berg and others, 2008, p. 30)
Approach

- Four (4) synoptic sampling events—approximately quarterly
- 48 environmental samples total (SW, Spring, GW, Rainfall)
- Samples analyzed for major ions, nutrients, and $\delta^{15}$N, $\delta^{18}$O, and $\delta$D isotopes
- 6 QA samples (1 SW field blank, 1 GW field blank, 4 replicates – 1 each synoptic)
Why Nitrogen Isotopes?

- Environmental isotopes are naturally occurring in the environment.
- Based on the number of protons and neutrons that make up the atomic mass of an element.
- We look at ratios of abundance of each isotope of an element.
- Value of $\delta^{15}N$ are isotopically distinct and can be used to distinguish possible sources of nitrate.

Clark and Fritz (1997)
Sources and Sinks

- Used in association with $\delta^{18}O$, $\delta^{15}N$ also can provide information on the kinetic and thermodynamic processes of the nitrogen cycle

Clark and Fritz (1997)
Relevance/Benefits

- Identification of possible sources of elevated nitrates and other nutrients allows Federal, State, and Local agencies to develop targeted mitigation plans while minimizing costs.

- Provides information on the presence and source(s) of nitrates in an area with mixed land cover.

- Provides water managers with valuable water availability and water supply information.
Planned Publications

- A USGS Scientific Investigations Report (SIR) is planned at the completion of the project.
References Cited