San Antonio River Basin

- Basin 19
- 13 Classified Segments, including…

Basin # → 1911
Segment #
San Antonio River Basin

• Segments divided into Assessment Units (AU’s)

• Cibolo Creek:
  – 1902_01 – Lower 5 miles of segment
  – 1902_02 – From 5 mi. upstream of confluence with the SAR to FM 541
  – 1902_03 – FM 541 to confluence w/Clifton Branch
  – 1902_04 – Confluence w/Clifton Branch to confluence w/ Elm Creek
  – 1902_05 – Upper end of segment
Bacterial Impairments

• Primary Contact Recreation standard on the 13 classified segments:
  – 126 colony forming units (cfu)/100 mL

  50 colonies in a 10 mL dilution = 500 cfu/100 mL
Bacterial Impairments

• Segments w/Impairments:
  1901 – Lower SAR*
  1902 – Lower Cibolo*
  1903 – Lower Medina
  1906 – Lower Leon
  1908 – Upper Cibolo
  1910 – Salado Creek
  1911 – Upper SAR*

• Segments w/o Impairments:
  1904 – Medina Lake
  1905 – Upper Medina
  1907 – Upper Leon
  1909 – Medina Diversion Lake
  1912 – Medio Creek
  1913 – Mid-Cibolo*

*Denotes segments w/BST sample sites
Bacterial Impairments

- 83 Assessment Units (Including Unclassified Segments)
- 29 (34.9%) w/bacterial impairments
- Kendall, Bexar, Wilson, Karnes & Goliad Counties
Why Bacterial Source Tracking (BST)?

• Working Hypothesis…
  – Agricultural impact in urban waterways
  – Human Impact in rural waterways

• Shift in thought

Lower Cibolo Creek
To try and better understand the sources of bacterial loading contributing to the impairments throughout the San Antonio River basin.
What is BST?

- Fundamental idea is that some intestinal bacteria differs from one animal group to another, due to:
  - Basic Habitat
    - Body temp., food supply, digestive system, etc.
  - Natural Selection
    - Direct competition, prior exposure to agents like antibiotics
What is BST?

• Library “Independent” vs. “Dependent”:
  – Both depend on ‘sourcing’ bacteria from known organisms
  – Both use ‘signatures’ to identify sources of bacterial contamination
  – Dependent methods require a ‘library’ to be constantly updated
Methods

• Field Observations
  – Weather, recreation, flow level, water color, signs of wildlife

• Field Parameters:
  – Flow, DO, pH, specific conductance, temperature, days since last precipitation event

• Composite Sample
  – Grabs 5-minutes apart
BST Methods

• Library-dependent analysis, sources identified by AgriLife using ERIC-PCR and RiboPrinting
• 10 Isolates/sample
• Results in 3-Way & 7-Way Splits
  – High confidence
  – Less confidence in species classifications
### Phase 1 (Rural) - Lower San Antonio River & Tributaries

<table>
<thead>
<tr>
<th>Station ID</th>
<th>Site Description</th>
<th>Seg/AU</th>
<th>County</th>
<th>Lat</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>S0036</td>
<td>UNNAMED TRIBUTARY IMMEDIATELY UPSTREAM OF THE CONFLUENCE WITH THE SAN ANTONIO RIVER</td>
<td>1901_01</td>
<td>Goliad</td>
<td>28.660482</td>
<td>-97.392913</td>
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<td>S0037</td>
<td>ESCONDIDO CREEK IMMEDIATELY UPSTREAM OF THE CONFLUENCE WITH THE SAN ANTONIO RIVER</td>
<td>1901A_01</td>
<td>Karnes</td>
<td>28.847796</td>
<td>-97.749661</td>
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<td>17858</td>
<td>SAN ANTONIO RIVER @ US 59 4.6 KM SOUTHWEST OF GOLIAD, TEXAS</td>
<td>1901_01</td>
<td>Goliad</td>
<td>28.651148</td>
<td>-97.43291</td>
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<tr>
<td>12797</td>
<td>CIBOLO CREEK @ FM 81 EAST OF PANNA MARIA</td>
<td>1902_01</td>
<td>Karnes</td>
<td>28.972057</td>
<td>-97.874924</td>
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<tr>
<td>12879</td>
<td>SAN ANTONIO RIVER @ FM 791 SW OF FALLS CITY, TEXAS</td>
<td>1911_01</td>
<td>Karnes</td>
<td>28.951504</td>
<td>-98.064363</td>
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</tbody>
</table>
# Phase 1 Results

<table>
<thead>
<tr>
<th>Station</th>
<th>Ambient Samples</th>
<th>E. coli Geomean (cfu/100 mL)</th>
<th>Avg. Flow (cfs)</th>
<th>High-Flow Samples</th>
<th>E. coli Geomean (cfu/100 mL)</th>
<th>Avg. Flow (cfs)</th>
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<tbody>
<tr>
<td>Goliad Trib.</td>
<td>4</td>
<td>320.6</td>
<td>0.2</td>
<td>2*</td>
<td>5099.0</td>
<td>0.2</td>
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<td>SAR @ US 59</td>
<td>4</td>
<td>94.4</td>
<td>280.0</td>
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<td>2683.3</td>
<td>930.5</td>
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<td>Escondido Creek</td>
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<td>452.6</td>
<td>1.3</td>
<td>2</td>
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<td>Cibolo @ FM 81</td>
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<td>137.7</td>
<td>29.2</td>
<td>2</td>
<td>1805.5</td>
<td>548.0</td>
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<tr>
<td>SAR @ FM 791</td>
<td>4</td>
<td>102.6</td>
<td>195.5</td>
<td>2</td>
<td>1578.0</td>
<td>1256.0</td>
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</tbody>
</table>

*Sample collected March 9, 2016; results yet to be received*
Phase 1: 3-Way Split

Source classification of *E. coli* isolates (combined n=296) from 29 combined samples
Phase 1: 7-Way Split

Overall 7-Way Split

- Non-Avian Wildlife (n=109)
- Avian Wildlife (n=48)
- Cattle (n=28)
- Other Livestock, Avian (n=18)
- Other Livestock, Non-Avian (n=29)
- Human (n=21)
- Pets (n=15)
- Unidentified (n=28)

Source classification of *E. coli* isolates (combined n=296) from 29 combined samples
**Phase 1: Species Summary**

*10 Most Common Isolate Origins*

<table>
<thead>
<tr>
<th>Species</th>
<th>Count</th>
</tr>
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<tbody>
<tr>
<td>Opossum</td>
<td>42</td>
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<tr>
<td>Cattle</td>
<td>27</td>
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<tr>
<td>Feral Hog</td>
<td>25</td>
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<tr>
<td>Chicken</td>
<td>23</td>
</tr>
<tr>
<td>Raccoon</td>
<td>20</td>
</tr>
<tr>
<td>Coyote</td>
<td>17</td>
</tr>
<tr>
<td>Deer</td>
<td>17</td>
</tr>
<tr>
<td>Dog</td>
<td>16</td>
</tr>
<tr>
<td>Human</td>
<td>15</td>
</tr>
<tr>
<td>Duck</td>
<td>15</td>
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</tbody>
</table>

Source classification of *E. coli* isolates (combined n=296) from 29 combined samples
<table>
<thead>
<tr>
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</tr>
</thead>
<tbody>
<tr>
<td>14211</td>
<td>CIBOLO CREEK @ CR 389 NEAR CESTOHOWA, TEXAS</td>
<td>1902_02</td>
<td>Karnes</td>
<td>29.01700</td>
<td>-97.91900</td>
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<tr>
<td>S0060</td>
<td>CLIFTON BRANCH IMMEDIATELY UPSTREAM OF ITS CONFLUENCE WITH CIBOLO CREEK</td>
<td>1902C_01</td>
<td>Wilson</td>
<td>29.20291</td>
<td>-97.99999</td>
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<tr>
<td>S0061</td>
<td>UNNAMED TRIBUTARY OF CIBOLO CREEK 30 METERS UPSTREAM OF CR 401</td>
<td>1902</td>
<td>Wilson</td>
<td>29.21996</td>
<td>-98.00966</td>
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<tr>
<td>12805</td>
<td>CIBOLO CREEK @ FM 539</td>
<td>1902_03</td>
<td>Wilson</td>
<td>29.27977</td>
<td>-98.05329</td>
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<tr>
<td>12741</td>
<td>MARTINEZ CREEK ON NORTH GABLE ROAD SOUTH OF ZUEHL</td>
<td>1902A_01</td>
<td>Bexar</td>
<td>29.44415</td>
<td>-98.16889</td>
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<tr>
<td>12919</td>
<td>CIBOLO CREEK 40 METERS DOWNSTREAM FROM IH 10/US 90 ON EAST BANK</td>
<td>1913_01</td>
<td>Bexar</td>
<td>29.50055</td>
<td>-98.18639</td>
</tr>
</tbody>
</table>
## Phase 2

<table>
<thead>
<tr>
<th>Station</th>
<th>Ambient Samples</th>
<th>$E. coli$ Geomean (cfu/100 mL)</th>
<th>Avg. Flow (cfs)</th>
<th>High-Flow Samples</th>
<th>$E. coli$ Geomean (cfu/100 mL)</th>
<th>Avg. Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cibolo @ CR 389</td>
<td>3</td>
<td>126.0</td>
<td>54.3</td>
<td>2</td>
<td>9695.4</td>
<td>1020.0</td>
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<tr>
<td>Clifton Branch Confluence</td>
<td>3</td>
<td>470.9</td>
<td>0.17</td>
<td>2</td>
<td>1553.1</td>
<td>0.9</td>
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<tr>
<td>Unnamed Cibolo Tributary</td>
<td>3</td>
<td>551.8</td>
<td>0.2</td>
<td>2</td>
<td>3435.1</td>
<td>0.2</td>
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<tr>
<td>Cibolo @ FM 539</td>
<td>3</td>
<td>249.2</td>
<td>36.3</td>
<td>2</td>
<td>3566.5</td>
<td>423.0</td>
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<td>Martinez Creek @ N Gable</td>
<td>3</td>
<td>308.7</td>
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<td>3203.1</td>
<td>101.0</td>
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<td>Cibolo Down IH-10</td>
<td>3</td>
<td>73.1</td>
<td>21.3</td>
<td>2</td>
<td>358.9</td>
<td>37.0</td>
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</table>
Cibolo Creek @ CR 389

July 30, 2015

April 13, 2015 – 1020 cfs
Phase 2: 3-Way Split

Overall 3-Way Split

- **Wildlife** (n=164) - 52.7%
- **Livestock & Domesticated Animals** (n=82) - 26.4%
- **Human** (n=12) - 3.9%
- **Unidentified** (n=53) - 17.0%

Source classification of *E. coli* isolates (combined n=311) from 30 samples
Phase 2: 7-Way Split

Source classification of *E. coli* isolates (combined n=311) from 30 samples
Phase 2: Species Summary

Source classification of *E. coli* isolates (combined n=311) from 30 samples
Basin Wide: 3-Way Summary

Overall 3-Way Split

Source classification of *E. coli* isolates (combined n=607) from 59 samples
Basin Wide: 7-Way Summary

Overall 7-Way Split

- Non-Avian Wildlife (n=233)
- Avian Wildlife (n=88)
- Cattle (n=47)
- Other Livestock, Avian (n=36)
- Other Livestock, Non-Avian (n=52)
- Human (n=33)
- Pets (n=37)
- Unidentified (n=81)

Source classification of *E. coli* isolates (combined n=607) from 59 samples
10 Most Common Isolate Origins

- Opossum: 72
- Cattle: 57
- Feral Hog: 56
- Chicken: 42
- Human: 39
- Coyote: 37
- Raccoon: 32
- Duck: 31
- Goat: 29
- Dog: 28

Source classification of *E. coli* isolates (combined n=607) from 59 samples
# Phase 3

29 Feb 2016 – 9 March 2016

## Phase 3 (Urban) - Upper San Antonio River & Tributaries

<table>
<thead>
<tr>
<th>Station ID</th>
<th>Site Description</th>
<th>Seg/AU</th>
<th>County</th>
<th>Lat</th>
<th>Long</th>
</tr>
</thead>
<tbody>
<tr>
<td>12909</td>
<td>SAN ANTONIO RIVER AT MULBERRY STREET</td>
<td>1911_09</td>
<td>Bexar</td>
<td>29.45618</td>
<td>-98.47589</td>
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<tr>
<td>12906</td>
<td>SAN ANTONIO RIVER AT PECAN STREET</td>
<td>1911_09</td>
<td>Bexar</td>
<td>29.42864</td>
<td>-98.49173</td>
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<tr>
<td>12904</td>
<td>SAN ANTONIO RIVER AT ALAMO STREET</td>
<td>1911_09</td>
<td>Bexar</td>
<td>29.41034</td>
<td>-98.49525</td>
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<tr>
<td>12707</td>
<td>SAN PEDRO CREEK AT FURNISH STREET</td>
<td>1911D_01</td>
<td>Bexar</td>
<td>29.40626</td>
<td>-98.51049</td>
</tr>
<tr>
<td>12897</td>
<td>SAN ANTONIO RIVER AT IH 410 LOW WATER CROSSING CAMINO COAHUILATECHAN 0.25 KM BELOW THE BRIDGE IN SAN ANTONIO</td>
<td>1911_07</td>
<td>Bexar</td>
<td>29.31953</td>
<td>-98.44889</td>
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## Phase 3

<table>
<thead>
<tr>
<th>Station</th>
<th>Ambient Samples</th>
<th><em>E. coli</em> (cfu/100 mL)</th>
<th>Flow (cfs)</th>
<th>High-Flow Samples</th>
<th><em>E. coli</em> (cfu/100 mL)</th>
<th>Flow (cfs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SAR @ Mulberry</td>
<td>1</td>
<td>650</td>
<td>8.7</td>
<td>1</td>
<td>&gt;20000</td>
<td>231</td>
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<td>SAR @ Pecan</td>
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<td>1</td>
<td>14000</td>
<td>25</td>
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<td>San Pedro Creek @ Furnish</td>
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<td>SAR @ Loop 410</td>
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<td>240</td>
<td>21</td>
<td>1</td>
<td>&gt;20000</td>
<td>704</td>
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Future of Effort

• Three additional Phase 3 samples
• Pending results will determine high-flow or ambient collection

SAR @ Mulberry
Questions???