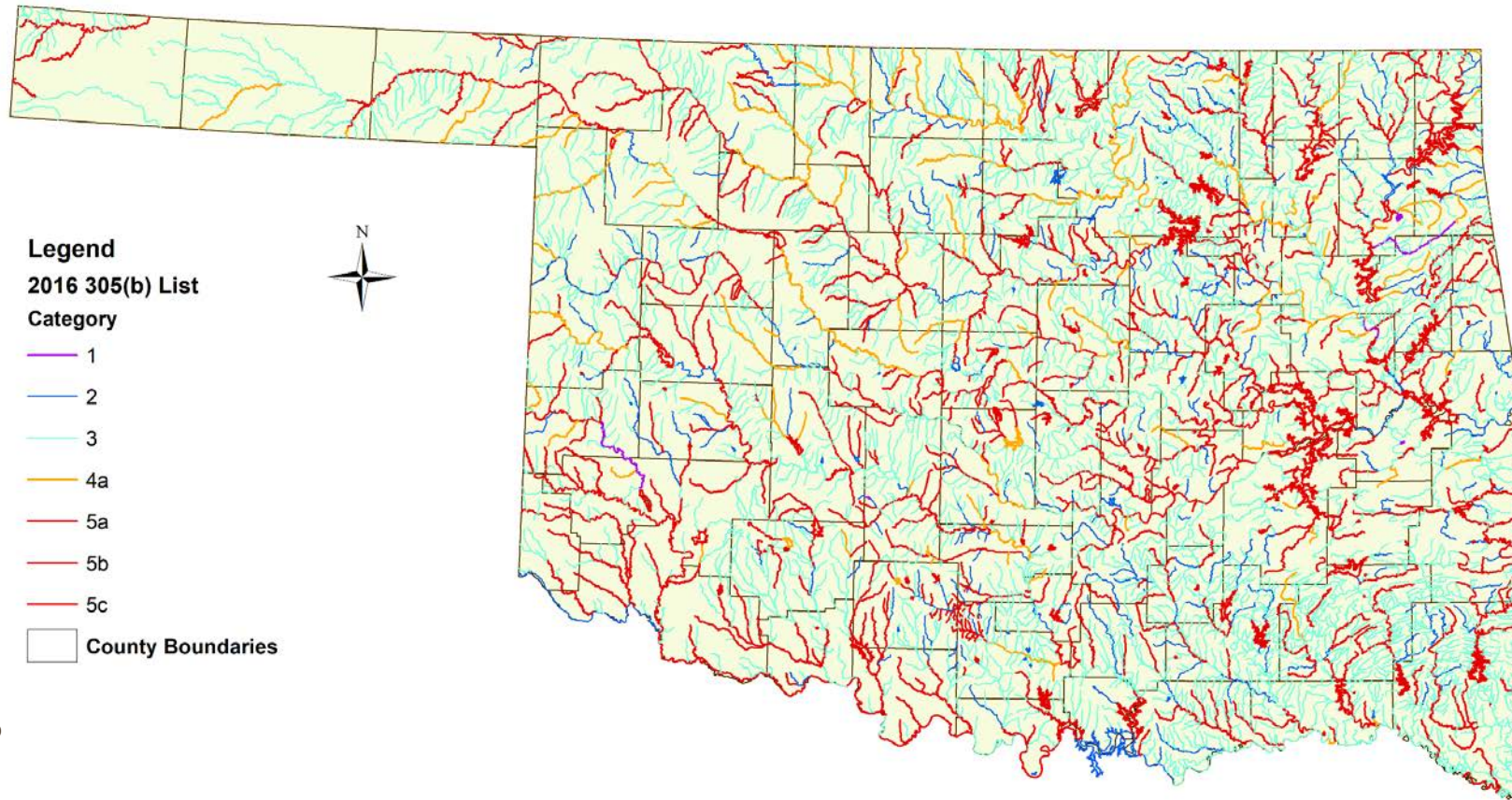
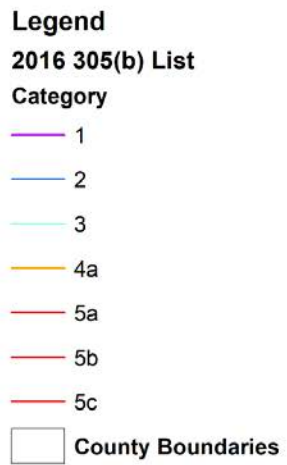
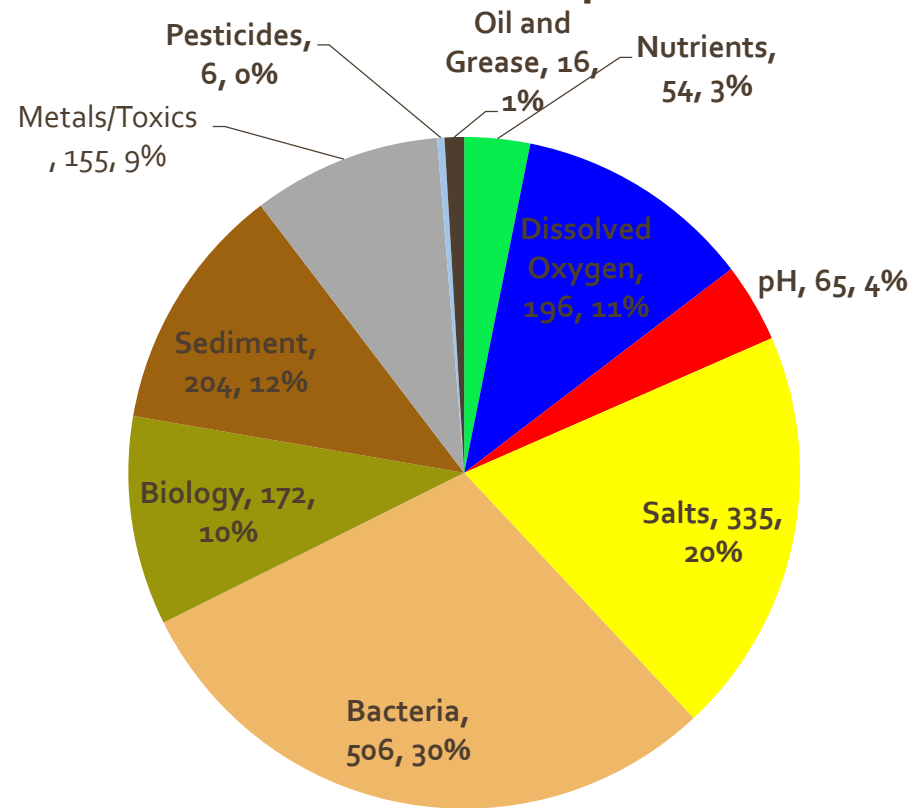


If Only We Could “Leave it to Beaver”: Water Quality Success in Main Creek

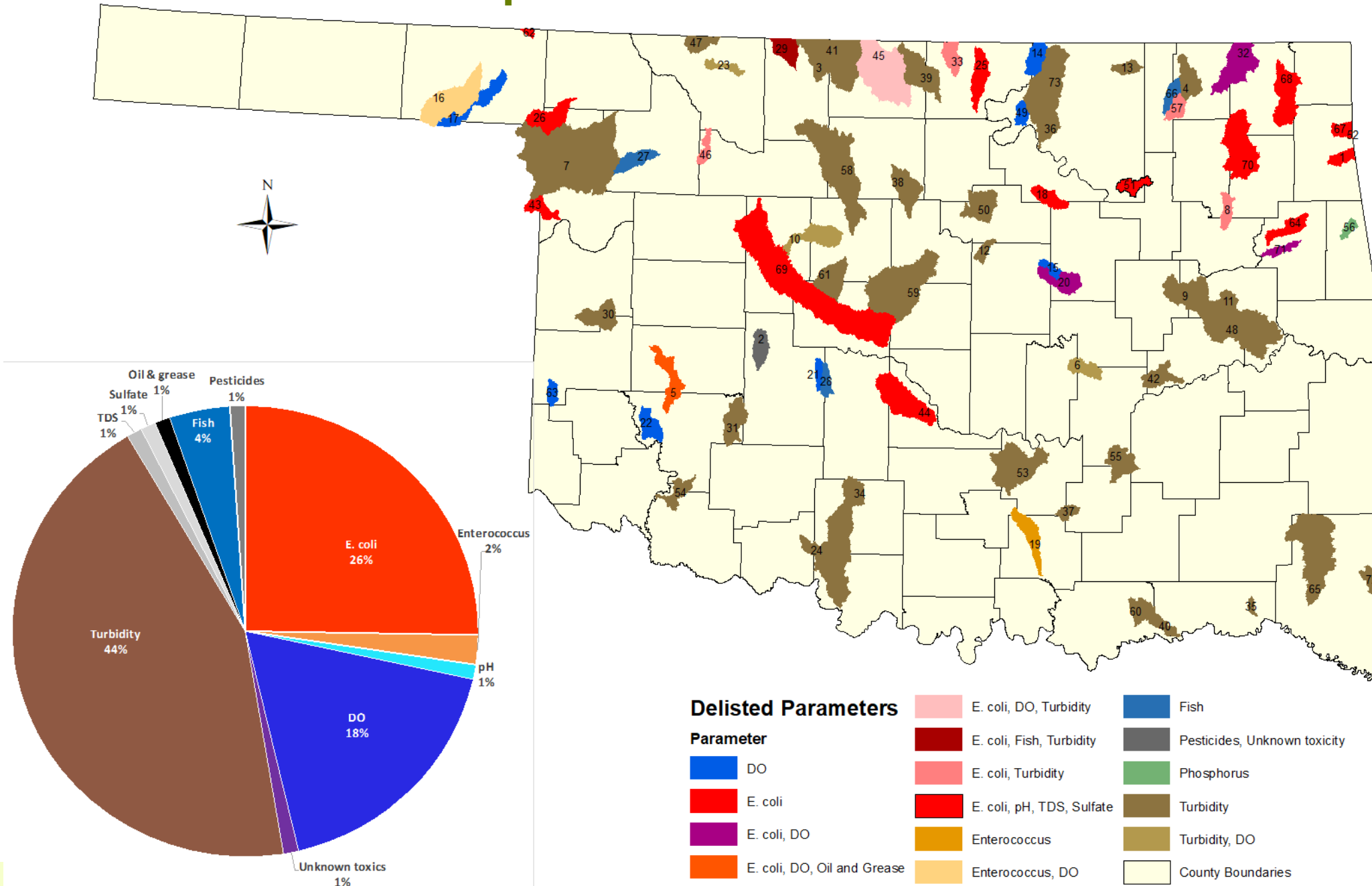
OCLWA, April 3-4, 2019, Stillwater, OK



2016 Causes of Impairment



Oklahoma Nonpoint Source Success Stories

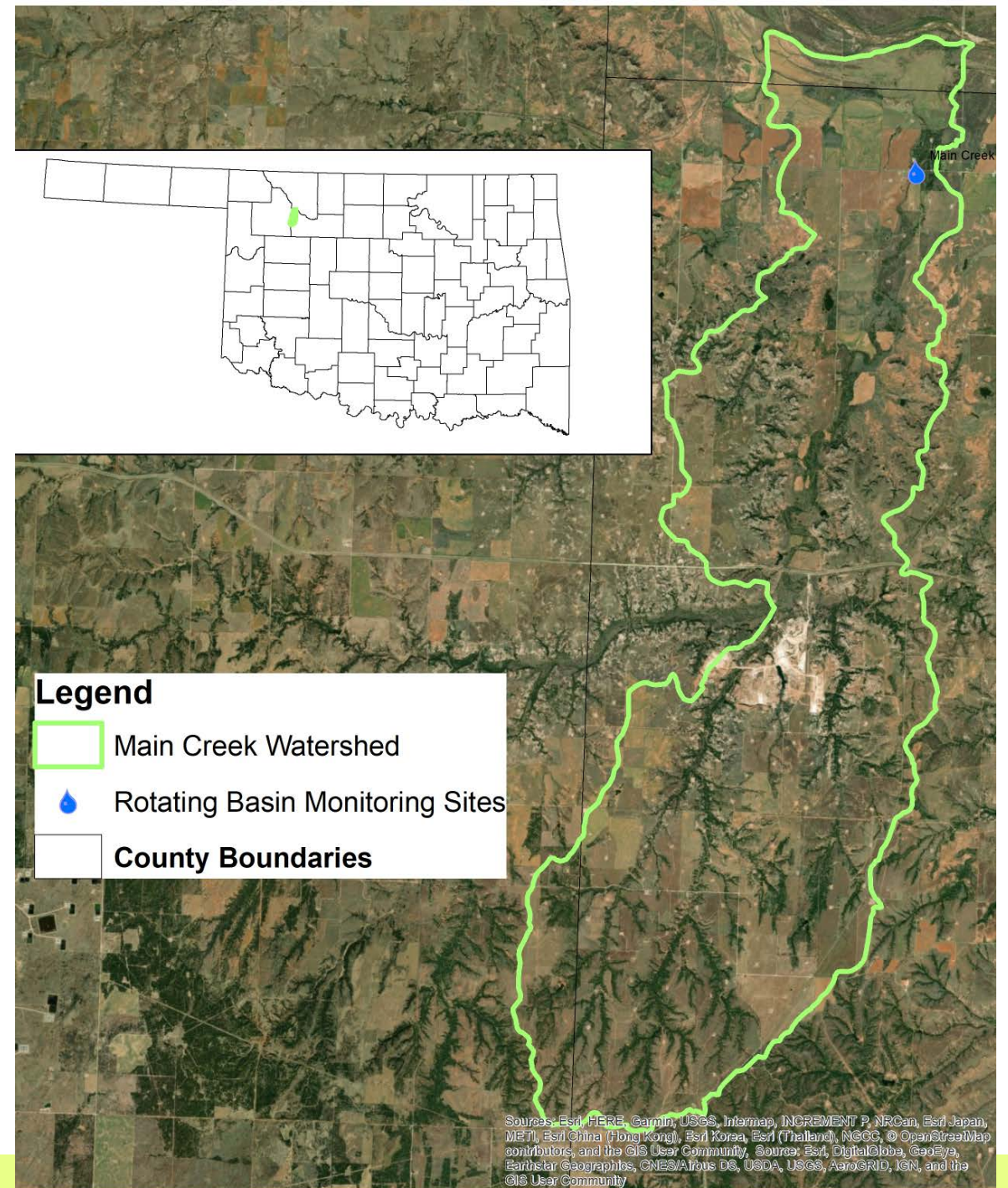


Main Creek



Main Creek

- 19 mile tributary to the Cimarron River
- 25,088 acre watershed in on the borders of Major, Woodward and Woods Counties
- Landuse is primarily rangeland/pasture (40%) with less than 23% in cropland.
- Most watershed channels are significantly incised which limits nearby landuse.
- Oil and gas production in the watershed has increased significantly since monitoring began in the early 2000s.





Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Swire, OpenStreetMap contributors, and the GIS User Community, Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNR AeroGRID, IGN, and the GIS User Community

Main Creek Initial (2002-2003) Monitoring Data

Parameter	Value	Parameter	Value
Mean Dissolved Oxygen	9.75 mg/L	Mean Sulfate	1580.7 mg/L
Mean % Saturation	93.24	Mean Nitrate	0.5520 mg/L
Mean Average Temperature	13.6 °C	Mean Nitrite	0.0165 mg/L
Mean Alkalinity	154.2 (CaCO ₃)	Mean Ammonia	0.0654 mg/L
Mean Total Hardness	1842.1 (mg/L as CaCO₃)	Mean TKN	1.1770 mg/L
Mean Conductivity (μS/cm)	3,197 (μS/cm)	Mean orthophosphorus	0.0330 mg/L
Mean pH	7.99 (s.u.)	Mean Total Phosphorus	0.1728 mg/L
Mean Turbidity	65.4 NTU	Mean Total Dissolved Solids	2889.0 mg/L
Mean Flow	13.86 cfs	Mean Total Suspended Solids	64.5 mg/L
Base Flow	10.32 cfs	Mean CBOD ₅	2.8 mg/L
Mean Chloride	221.7 mg/L	Total Habitat Score	49.2
Geomean E. coli	150.18 colonies per 100 ml	Geomean Enterococcus	109.33 colonies per 100 ml
Fish Community % of Reference	0.83 = good	Benthic Macroinvertebrate % of Reference	0.67 = slightly impaired

Main Creek Second Cycle (2007-2009) Monitoring Data

Parameter	Value	Parameter	Value
Mean Dissolved Oxygen	9.69 mg/L	Mean Sulfate	1661.2 mg/L
		Mean Nitrate	0.3664 mg/L ↓
Mean Average Temperature	14.9 °C	Mean Nitrite	0.0374 mg/L
Mean Alkalinity	167 (CaCO ₃)	Mean Ammonia	0.0106 mg/L ↓
Mean Total Hardness	1921.7 (mg/L as CaCO₃)	Mean TKN	0.3483 mg/L ↓
Mean Conductivity (μS/cm)	2748 (μS/cm)	Mean orthophosphorus	0.0443 mg/L ↓
Mean pH	7.98 (s.u.)	Mean Total Phosphorus	0.0833 mg/L ↓
Mean Turbidity	67.9 NTU	Mean Total Dissolved Solids	2992.1 mg/L
Base Flow	9.34 cfs	Mean Total Suspended Solids	79.5 mg/L
Mean Chloride	239.1 mg/L	Total Habitat Score	61.6 ↑
Geomean E. coli	177.67 colonies per 100 ml	Geomean Enterococcus	159.06 colonies per 100 ml
Fish Community % of Reference	0.86 = good	Benthic Macroinvertebrate % of Reference	0.84 = not impaired ↑

Main Creek Third Cycle (2012-2013) Monitoring Data

Parameter	Value	Parameter	Value
Mean Dissolved Oxygen	10.72 mg/L	Mean Sulfate	1809.9 mg/L ↑
Mean Oxygen % Saturation	100.41	Mean Nitrate	0.1810 mg/L ↓
Mean Average Temperature	13.5 °C	Mean Nitrite	0.0200 mg/L ↓
Mean Alkalinity	158 (CaCO ₃)	Mean Ammonia	0.0230 mg/L
Mean Total Hardness	2187.6 (mg/L as CaCO₃) ↑	Mean TKN	0.3350 mg/L
Mean Conductivity (μS/cm)	3529.3 (μS/cm) ↑	Mean orthophosphorus	0.0117 mg/L ↓
Mean pH	7.87 (s.u.)	Mean Total Phosphorus	0.0285 mg/L ↓
Mean Turbidity	16.85 NTU ↓	Mean Total Dissolved Solids	3159.5 mg/L ↑
Base Flow	5.73 cfs ↓	Mean Total Suspended Solids	20.0 mg/L ↓
Mean Chloride	324.1 mg/L ↑	Total Habitat Score	62
Geomean E. coli	77.66 colonies per 100 ml ↓		
Fish Community % of Reference	0.57 = poor	Benthic Macroinvertebrate % of Reference	1.05 = not impaired

Water Quality Success



NONPOINT SOURCE SUCCESS STORY

Oklahoma

Implementing Agricultural Conservation Practices Improves Bacteria and Turbidity Levels in Main Creek

Waterbody Improved

High bacteria concentrations and elevated turbidity resulted in the impairment of Main Creek and placement on Oklahoma's Clean Water Act (CWA) section 303(d) list of impaired waters in 2004 (*Escherichia coli*) and 2006 (turbidity). Pollution from grazing, hay production and cropland areas contributed to these impairments. Implementing conservation practice systems (CPS) to promote better quality grazing lands and improved cropland management decreased bacteria and turbidity levels in the creek. As a result, Main Creek was removed from Oklahoma's 2010 CWA section 303(d) list for turbidity; it has also been recommended for delisting for *E. coli* on the 2016 CWA section 303(d) list. Main Creek now fully supports its warm water aquatic and primary body contact designated uses.

Problem

Main Creek is a 19.1-mile stream flowing through Woodward and Major counties and into Woods County, Oklahoma, before discharging to the Cimarron River (Figure 1). Land use in the 25,000-acre watershed is primarily pasture and grasslands (40 percent of total) for cattle and hay production. About 27 percent of the watershed is forested and approximately 23 percent is cropland used primarily for wheat production.

Poor grazing and cropland management contributed to excess turbidity and bacteria in Main Creek. It was listed as impaired for *E. coli* in 2004 when the geometric mean of samples collected during the recreational season was 1,058 colony forming units/100 milliliters (CFU). The primary body contact recreation designated use is considered impaired. If the geometric mean exceeds 126 CFU for *E. coli*.

Main Creek was also added to the section 303(d) list in 2006 because 17 percent of assessed baseflow turbidity samples violated standards. An Oklahoma stream is considered to violate the turbidity standard when more than 10 percent of baseflow samples are higher than 50 nephelometric turbidity units (NTU). On the basis of these assessment results, Oklahoma added Main Creek (OK620320010180_00) to the 2004 and 2006 CWA section 303(d) lists for nonattainment of the warm water aquatic and primary body contact designated beneficial uses.

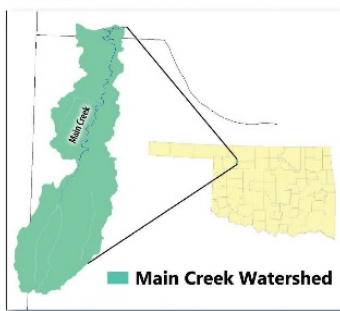
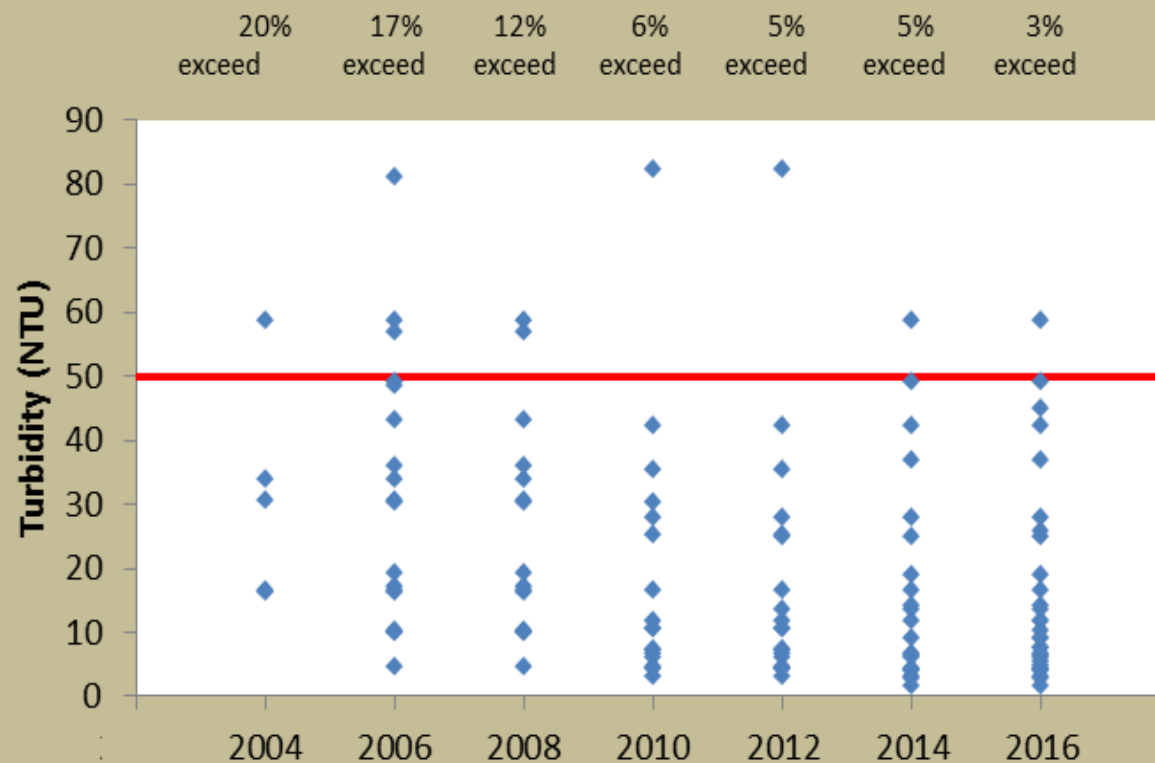


Figure 1. Main Creek is in northwestern Oklahoma.

Project Highlights

Landowners in the watershed worked with the Major, Woods and Woodward county conservation districts, the U.S. Department of Agriculture's (USDA) Natural Resources Conservation Service (NRCS) and USDA Farm Services Agency (FSA) to implement CPS through Oklahoma NRCS's Environmental Quality Incentives Program (EQIP), Oklahoma's general conservation technical assistance program, and FSA's Conservation Reserve Program (CRP). From 2004 to 2010, landowners improved many acres of pasture and grasslands, which reduced runoff of bacteria and other pollutants.

Main Creek, Turbidity

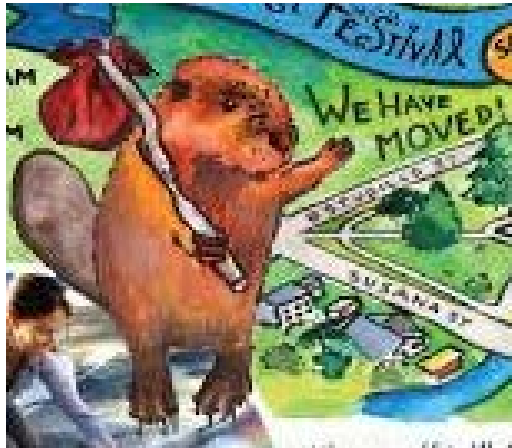


Dates on represent assessments completed for Integrated Reporting periods, which differ from the assessments shown on previous slides

Conservation Practices Implemented

	Units	% of grazing or cropland in watershed
Prescribed Grazing (grazing land)	6,820 acres	68%
Livestock access control (cropland)	550 acres	10%
Watering facilities and wells	4	
Forage and biomass planting (pasture)	183 acres	2%
Nutrient management	267 acres	2%
Brush management	1,921 acres	19%
Integrated pest management	130 acres	1%
Conservation crop rotation	288 acres	5%
Cover crops	195 acres	3%
Reduced or no tillage	441 acres	8%
Cropland conversion to native grass	181 acres	3%
Upland wildlife habitat management	121 acres	1%

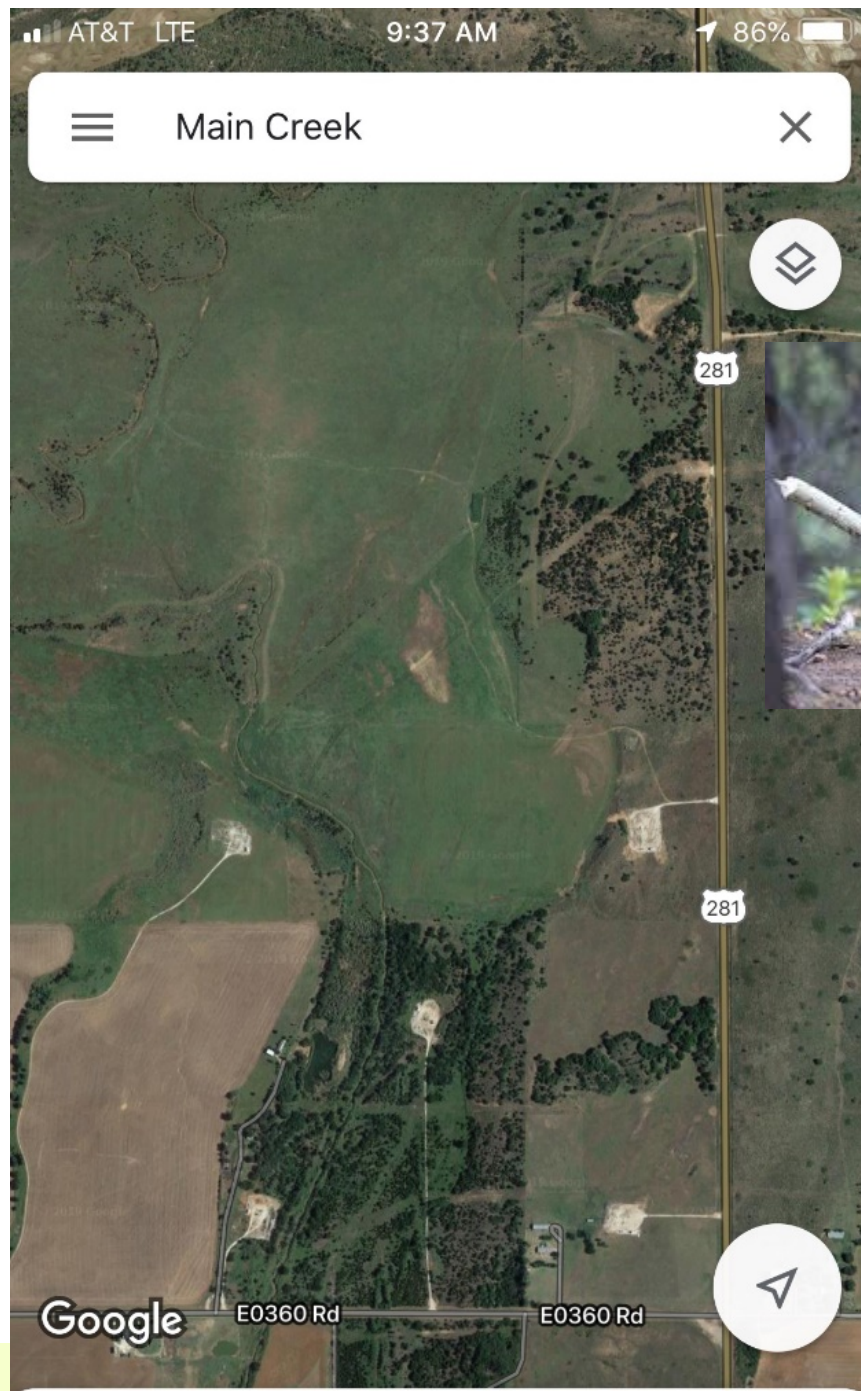




Main Creek Fourth Cycle (2017-2019) Monitoring Data*

Parameter	Value		Parameter	Value	
Mean Dissolved Oxygen	9.54 mg/L		Mean Sulfate	1672.67 mg/L	↓
Mean Oxygen % Saturation	100.41		Mean Nitrate	0.3427 mg/L	↑
Mean Average Temperature	18.1 °C		Mean Nitrite	0.1093 mg/L	↑
Mean Alkalinity	154 (CaCO ₃)		Mean Ammonia	0.0215 mg/L	
Mean Total Hardness	2,250 (mg/L as CaCO₃)	↑	Mean TKN	0.3433 mg/L	
Mean Conductivity (μS/cm)	3454.44 (μS/cm)	↓	Mean orthophosphorus	0.0221 mg/L	↑
Mean pH	8.02 (s.u.)		Mean Total Phosphorus	0.0383 mg/L	↑
Mean Turbidity	18.25 NTU	↑	Mean Total Dissolved Solids	3193.3 mg/L	
Base Flow	6.72 cfs	↓	Mean Total Suspended Solids	29.1 mg/L	↑
Mean Chloride	250.8 mg/L	↓	Total Habitat Score	80.8	↑
Geomean E. coli	Not enough samples		Mean flow	18.25 cfs	↑
Fish Community % of Reference	1.27 = good	↑			

* Does not include all data collected from 2017/2019, only data available at the time of this presentation



Potential Role of Beaver Dams in Improving Water Quality?

- **What effects do they have on the stream?**
 - **I know they:**
 - Significantly increase depth in the reach downstream of the bridge
 - Improve habitat diversity
 - **I think they:**
 - decrease temperature
 - increase oxygenation
 - Increase sedimentation and further decrease turbidity
 - Improve the fish community
 - Improve the habitat overall



Questions?



- Shanon Phillips
- Oklahoma Conservation Commission
- 405-522-4728
- Shanon.Phillips@conservation.ok.gov