



SUBWATERSHED ASSESSMENT FOR THE UPPER ILLINOIS RIVER WATERSHED





Mission Statement:

IRWP works to improve the integrity of the Illinois River through:

- public education, community outreach, and
- implementation of conservation and restoration practices throughout the watershed.

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Table of Contents

Introduction.....	1
Glossary.....	2
General.....	4
Methods.....	6
Clear Creek.....	8
Moore's Creek.....	10
Lower Muddy Fork.....	12
Sager Creek.....	14
Goose Creek.....	16
Review.....	18
What Can You Do?	19

Introduction

The Upper Illinois River Watershed (UIRW) consists of 758 square miles within Benton (40%), Washington (60%), and Crawford (<0.5%) counties in northwest Arkansas. The headwaters of the Illinois River originate near Hogeys, Arkansas just south of Fayetteville. With several major tributaries originating in the urban areas within the watershed, the river flows west into Oklahoma and eventually into Lake Tenkiller near Tahlequah, Oklahoma. As of 2006, land use and land cover of the watershed was 41% forest, 46% pasture, and 13% urban. With a 14% increase in Washington County's population and a 17% increase in Benton County's population between 2010 to 2017, it is expected that the proportion of urban land use has increased since 2006.

Currently, the Illinois River is field monitored for water quality parameters by several agencies, including Arkansas Department of Environmental Quality (ADEQ), the United States Geological Survey (USGS), and University of Arkansas' Water Resources Center (AWRC). Unfortunately, many of the stations are located at the downstream portions of larger subwatershed confluences.

The designation as a priority subwatershed was given to HUC 12 subwatersheds by The Illinois River Watershed (IRWP) for the UIRW that were listed on ADEQ's 2016 303(d) list. Assessments were conducted on the following priority subwatersheds from 2018-2019: Moore's Creek (located near Lincoln), Sager Creek (located in Siloam Springs), Lower Muddy Fork (located near Prairie Grove), and Clear Creek (located near Fayetteville). Each assessment consisted of collecting and identifying macroinvertebrate communities and stream characteristics. All four subwatersheds are considered high priority for sediment, total nitrogen, and total phosphorus in Arkansas Natural Resource Commission's (ANRC) 2011-2016 NPS (Nonpoint Source Pollution) Management Plan.

In order to obtain a better ecological understanding of the UIRW, IRWP, with assistance from EAST (Education Accelerated by Service and Technology) programs at local Primary to Junior High schools, assessed ecological conditions at small geographic intervals along defined priority subwatersheds. In order to best identify areas of interest (i.e., below average to poor macroinvertebrate diversity) and subsequent best management practice recommendations for the watershed of those areas. EAST students helped collect stream characteristics and assisted in macroinvertebrate collection, identification, and counting. Students were able to gain skills in GIS mapping and experience in conducting science research in the field through the Ecological Assessment Project.

Recommended best management practices (BMPs) was determined based 2016 NLCD (National Land Cover Database) data.

Glossary

Alternative livestock watering - diverting livestock away from a creek by providing them an alternative water source, possibly pumping creek water to another water holding feature (e.g., stock tanks or ponds), including placing fencing along the creek to keep livestock out.

Best management practices (BMPs) - practice(s) that helps reduce nonpoint source pollution.

Bioswale - A relatively large sloped garden feature that consists of a landscape depression filled with vegetation and/or gravel. A BMP that helps collect stormwater runoff, encourage water infiltration into the soil, allow sediment and other debris to settle out of stormwater, promote plant uptake of nutrients, and reduce stormwater runoff from entering a creek or stream.

Excessive fertilizer - the over application on nutrients on lawns and/or hayfields, which can be reduced by testing the soil for nutrient content and only applying optimal rates of fertilizer based on nutrient recommendation for desired plant.

Macroinvertebrate - an organism that lacks a backbone and can be seen without the aid of a microscope. Used to determine water quality based on the fact that some aquatic macroinvertebrates can tolerate water pollution and some cannot.

Macroinvertebrate Diversity Rating - Water quality rating based on macroinvertebrate diversity richness as determined by streamside macroinvertebrate identification and counting

Nitrate - a nutrient that encourages plant growth. When applied excessively on land it will be collected in runoff water and enter waterbodies where it may promote excessive aquatic plant growth (e.g., algae). Excessive plant growth can deteriorate the health of an aquatic ecosystem.

Nonpoint source pollution - A source of pollution that is not from a specific point (e.g., pipe) but instead an area of land (i.e., farmland, cities, etc.) with multiple sources of pollution.

Pathogen - disease causing microorganisms (e.g., bacteria, virus, protozoa, etc.). A common pathogen that impacts water quality is the bacteria E. Coli, which is commonly found in the intestines of humans and animals.

Rain garden - A constructed garden located at a low point within a defined area of land and consists of native plants. It is a BMP that helps retain stormwater, encourage water infiltration into the soil, promote plant uptake of excess nutrients, and reduce overall stormwater runoff.

Riparian - a distinct and unique area of land adjacent to a waterbody, where terrestrial and aquatic ecosystems of like a creek, stream, or lake interact. Promotes improved water quality by reducing the amount of pollutants from surrounding lands from entering bodies of water by slowing the speed of stormwater runoff, allowing plant uptake of water, and encourages infiltration of water into the soil.

Glossary

Retention pond - typically a constructed pond that collects stormwater runoff from a surrounding area. In neighborhoods, street drains are usually used as the conveyance mechanism to direct stormwater to the retention pond.

Runoff - rain water that does not infiltrate the soil but instead runs off the land to a creek, stream, or lake.

Sulfate - a nutrient commonly found in nature, but at high levels can induce excessive bowel movements in humans and animals, which could result in dehydration.

Riparian buffer - a strip of planted riparian area at least 25 ft wide. A BMP used as a way to filter, reduce, and slow runoff from land before it enters a waterbody (e.g., runoff from a neighborhood flowing to a creek).

Stormwater mitigation - features in the landscape that help reduce runoff (e.g., bioswale, rain garden, or retention pond).

Water quality - the ability of water to support a determined use (e.g., drinking water, aquatic habitat, recreation, etc.) and is determined by analyzing the chemical, biological, and physical characteristics of the waterbody.

303(d) list - a list of impaired waterways in the State of Arkansas determined by the Arkansas Department of Environmental Quality.

General

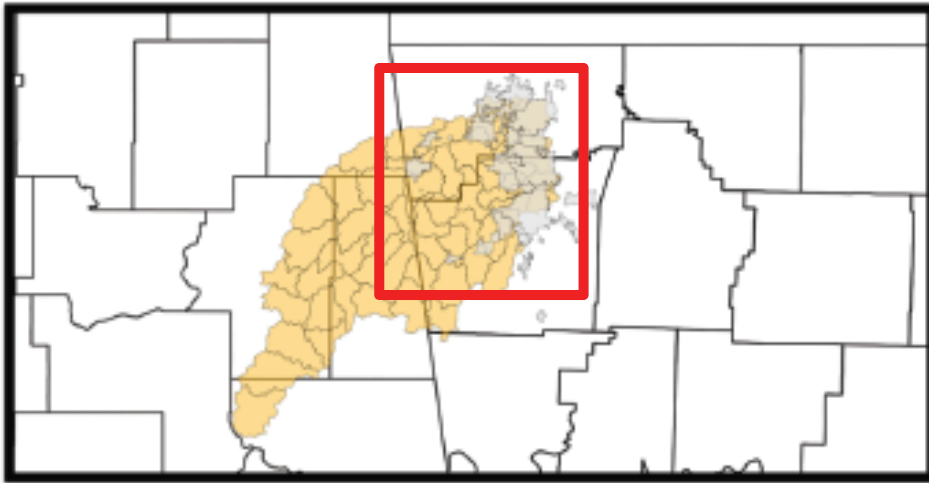


Figure 1. The Illinois River Watershed is an interstate watershed with a delineated boundary in Arkansas and Oklahoma. Area of interest (i.e., Upper Illinois River Watershed) is outlined in red.

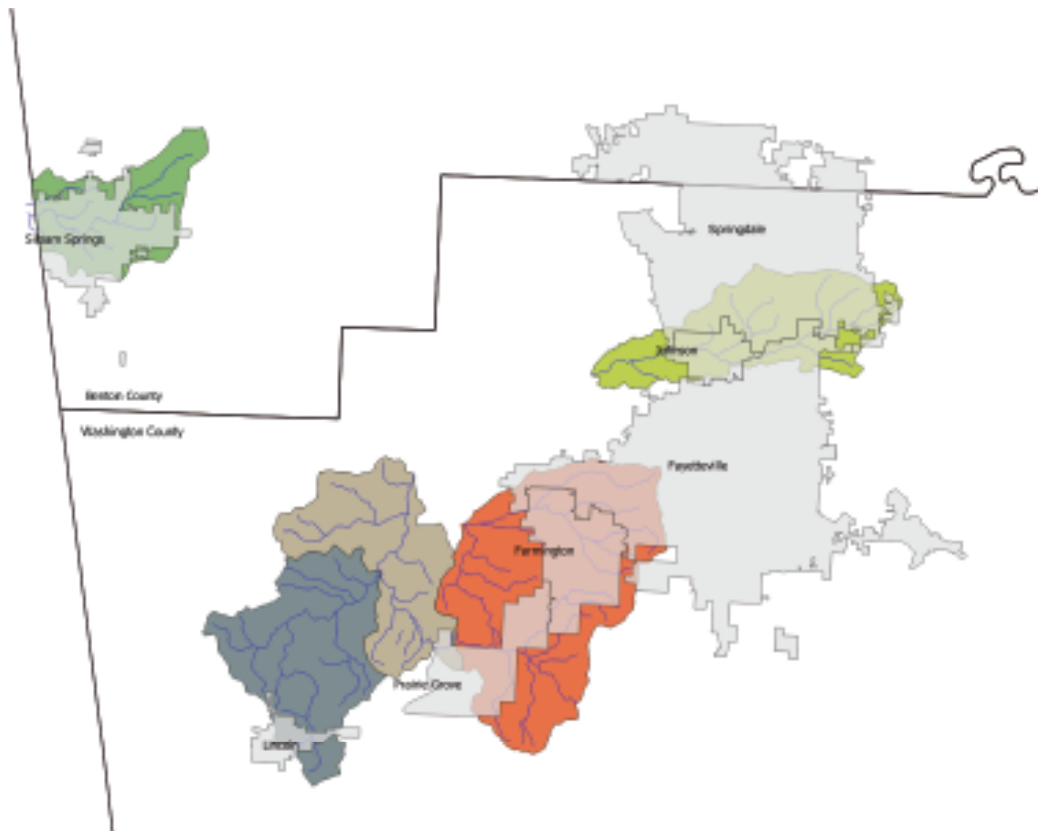


Figure 2. Priority subwatersheds for the 2019 UIRW Ecological Assessment: Clear Creek (Fayetteville, Johnson, and Springdale), Lower Muddy Fork (Prairie Grove), Moore's Creek (Lincoln), Sager Creek (Siloam Springs), and Goose Creek (Farmington; non-priority).

General

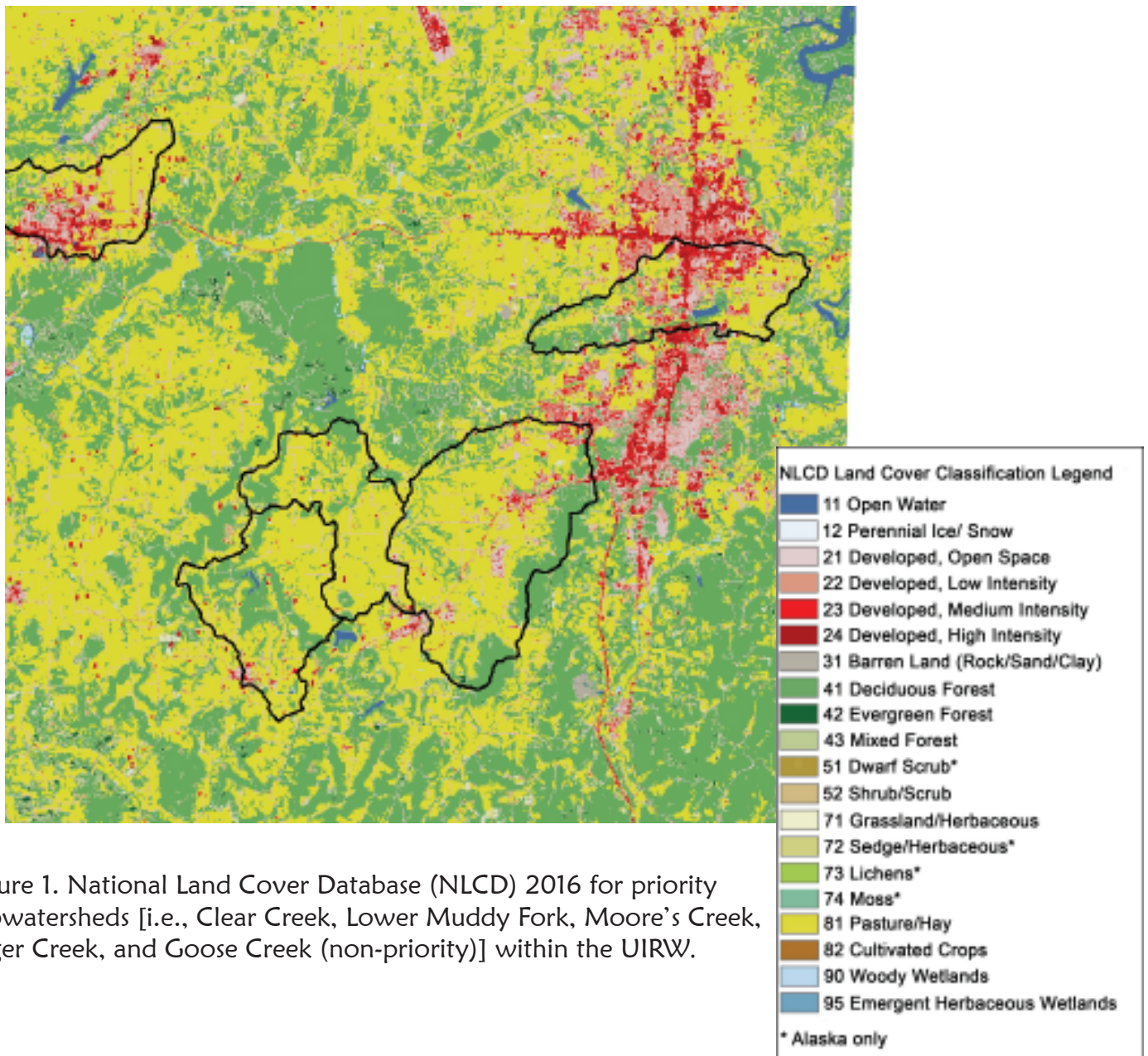


Figure 1. National Land Cover Database (NLCD) 2016 for priority subwatersheds [i.e., Clear Creek, Lower Muddy Fork, Moore's Creek, Sager Creek, and Goose Creek (non-priority)] within the UIRW.

Methods

Stream Characteristic Determination:

• EPA 841-B97-003-Monitoring Water Quality Volunteer Stream Monitoring: A Methods Manual. 4.4.1- Stream Habitat Walk

- 300 ft stream reach, subdivided into 25 ft sections
- Each 25 ft section observation was obtained by standing at the most downstream section and looking upstream.



Macroinvertebrate Diversity Rating Methods For Water Quality:

• EPA 841-B97-003-Monitoring Water Quality Volunteer Stream Monitoring: A Methods Manual. 4.4.2- Streamside Biosurvey - Macroinvertebrates

- Sample area - Composite of three 3'x 3' riffle locations over 300' stream reach.
- Macroinvertebrate identification based on Izaak Walton League of America- Stream Insects & Crustaceans



• Macroinvertebrate Diversity Rating Determination:

- 1.) Abundance per macroinvertebrate species calculated (i.e., 1-9 rare, 10-99 common, 100+ dominant).
- 2.) Weighted factor given to each pollution sensitivity group in relation to abundance (e.g., Pollution sensitive group + rare = 5.0).
3. Total abundance per pollution sensitivity group is summed and multiplied by its weighted factor (e.g., 3 rare, pollution sensitive group invertebrates * 5 = 3 * 5 = 15).
- 4.) Water quality rating determined by summing all pollution sensitivity groups with their abundance. (e.g., 3 rare, pollution sensitive species * 5 = 15; 2 rare, pollution tolerant species * 1.2 = 2.4; 15 + 2.4 = 17.4).
- 5.) Water quality rating scale:
<20 Poor; 20-40 Fair; >40 Good (e.g., 17.4 = Poor)

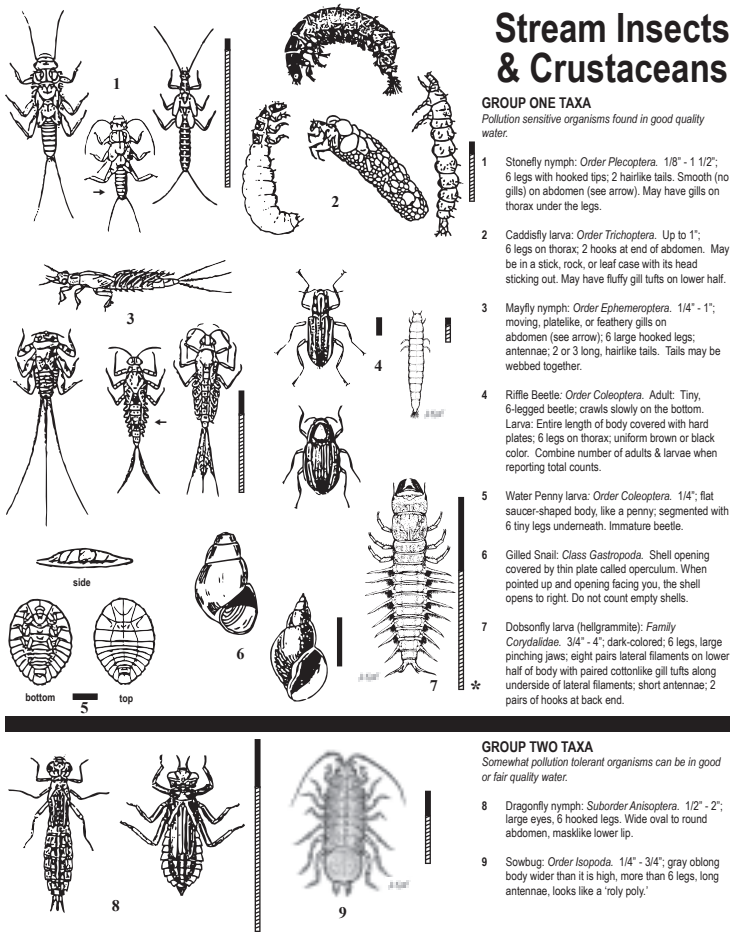


Figure 1. Photos depicting macroinvertebrate and stream characteristic collection of Clear Creek 2019.

Good	●
Fair	●
Poor	●
No Data	●

Figure 2. Macroinvertebrate Diversity rating scale legend.

Methods



* May be larger.
-Solid bar indicates approx. minimum size. Combined solid and striped bar is approx. maximum size.-

Stream Insects & Crustaceans

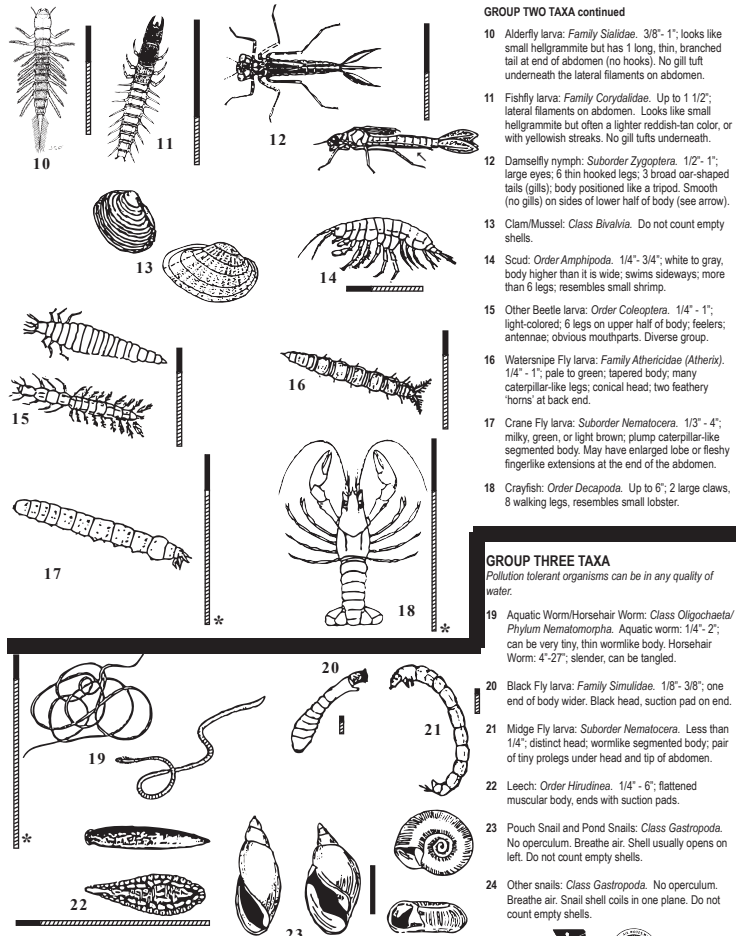
GROUP ONE TAXA
Pollution sensitive organisms found in good quality water.

- 1 Stonefly nymph: Order Plecoptera. 1/8" - 1 1/2"; 6 legs with hooked tips; 2 hairlike tails. Smooth (no gills) on abdomen (see arrow). May have gills on thorax under the legs.
- 2 Caddisfly larva: Order Trichoptera. Up to 1"; 6 legs on thorax; 2 hooks at end of abdomen. May be in a stick, rock, or leaf case with its head sticking out. May have fluffy gill tufts on lower half.
- 3 Mayfly nymph: Order Ephemeroptera. 1/4" - 1"; moving, platelike, or feathery gills on abdomen (see arrow); 6 large hooked legs; antennae; 2 or 3 long, hairlike tails. Tails may be webbed together.
- 4 Riffle Beetle: Order Coleoptera. Adult. Tiny, 6-legged beetle; crawls slowly on the bottom. Larva: Entire length of body covered with hard plates; 6 legs on thorax; uniform brown or black color. Combine number of adults & larvae when reporting total counts.
- 5 Water Penny larva: Order Coleoptera. 1/4"; flat saucer-shaped body, like a penny; segmented with 6 tiny legs underneath. Immature beetle.
- 6 Gilled Snail: Class Gastropoda. Shell opening covered by thin plate called operculum. When pointed up and opening facing you, the shell opens to right. Do not count empty shells.
- 7 Dobsonfly larva (hellgrammite): Family Corydalidae. 3/4" - 4"; dark-colored; 6 legs, large pinching jaws; eight pairs lateral filaments on lower half of body with paired cottonlike gill tufts along underside of lateral filaments; short antennae; 2 pairs of hooks at back end.

GROUP TWO TAXA
Somewhat pollution tolerant organisms can be in good or fair quality water.

- 8 Dragonfly nymph: Suborder Anisoptera. 1/2" - 2"; large eyes, 6 hooked legs. Wide oval to round abdomen, masklike lower lip.
- 9 Sowbug: Order Isopoda. 1/4" - 3/4"; gray oblong body wider than it is high, more than 6 legs, long antennae, looks like a 'toly poly'.

Save Our Streams



GROUP TWO TAXA continued

- 10 Alderfly larva: Family Sialidae. 3/8" - 1"; looks like small hellgrammite but has 1 long, thin, branched tail at end of abdomen (no hooks). No gill tuft underneath the lateral filaments on abdomen.
- 11 Fishfly larva: Family Corydalidae. Up to 1 1/2"; lateral filaments on abdomen. Looks like small hellgrammite but often a lighter reddish-tan color, or with yellowish streaks. No gill tufts underneath.
- 12 Damselfly nymph: Suborder Zygoptera. 1/2" - 1"; large eyes; 6 thin hooked legs; 3 broad oar-shaped tails (gills); body positioned like a tripod. Smooth (no gills) on sides of lower half of body (see arrow).
- 13 Clam/Mussel: Class Bivalvia. Do not count empty shells.
- 14 Scud: Order Amphipoda. 1/4" - 3/4"; white to gray, body higher than it is wide; swims sideways; more than 6 legs; resembles small shrimp.
- 15 Watersnipe Fly larva: Family Athricidae (Atherix). 1/4" - 1"; pale in green; tapered body; many caterpillar-like legs; conical head; two feathery 'horns' at back end.
- 16 Crane Fly larva: Suborder Nematocera. 1/3" - 4"; milky, green, or light brown; plump caterpillar-like segmented body. May have enlarged lobe or fleshy fingerlike extensions at the end of the abdomen.
- 17 Crayfish: Order Decapoda. Up to 6"; 2 large claws, 8 walking legs, resembles small lobster.

GROUP THREE TAXA
Pollution tolerant organisms can be in any quality of water.

- 19 Aquatic Worm/Horsehair Worm: Class Oligochaeta/Phylum Nematotompha. Aquatic worm: 1/4" - 2"; can be very thin, wormlike body. Horsehair Worm: 4" - 27"; slender, can be tangled.
- 20 Black Fly larva: Family Simuliidae. 1/8" - 3/8"; one end of body wider. Black head, suction pad on end.
- 21 Midge Fly larva: Suborder Nematocera. Less than 1/4"; distinct head; wormlike segmented body, pair of tiny prolegs under head and tip of abdomen.
- 22 Leech: Order Hirudinea. 1/4" - 6"; flattened muscular body, ends with suction pads.
- 23 Pouch Snail and Pond Snails: Class Gastropoda. No operculum. Breathe air. Shell usually opens on left. Do not count empty shells.
- 24 Other snails: Class Gastropoda. No operculum. Breathe air. Snail shell coils in one plane. Do not count empty shells.

* May be larger.
-Solid bar indicates approx. minimum size. Combined solid and striped bar is approx. maximum size.-



01/10
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Figure 1. Macroinvertebrate guide from Walton League of America Stream Insects & Crustaceans.

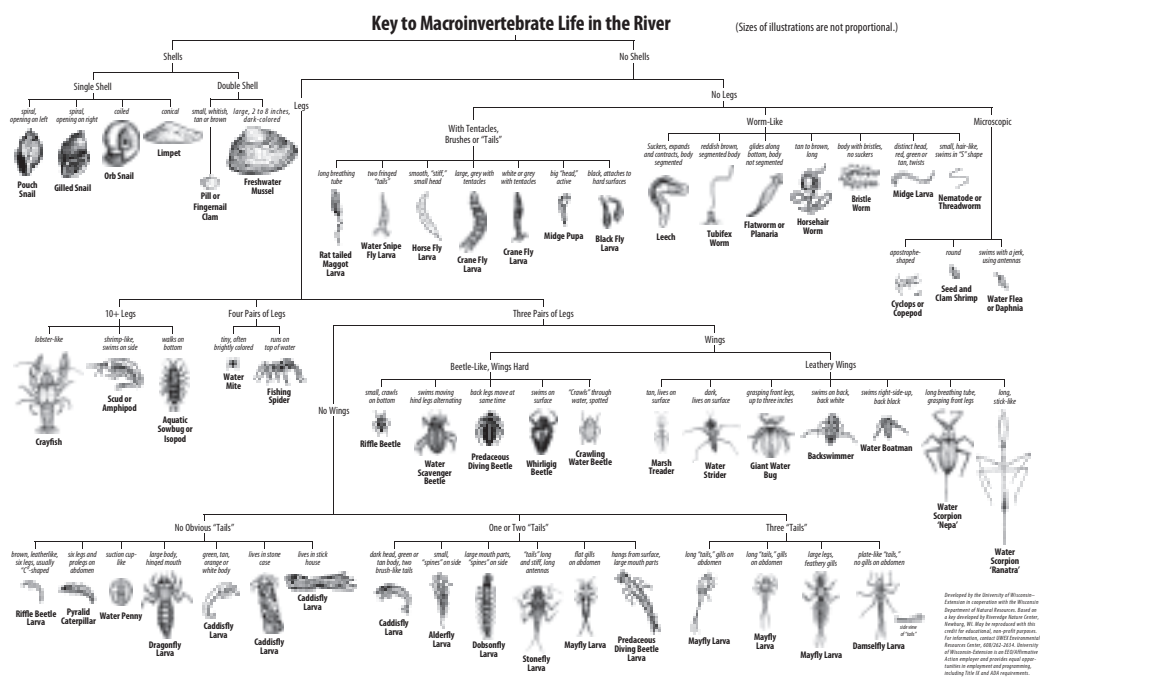
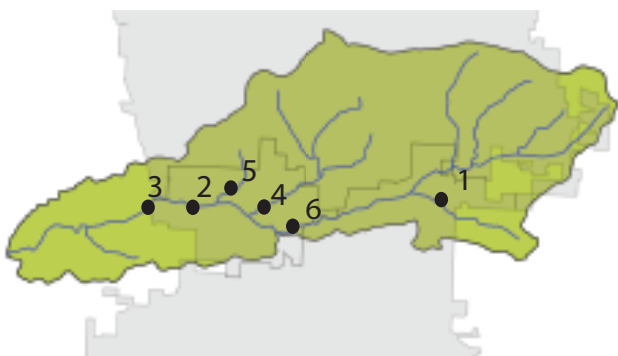


Figure 2. Dichotomous key of aquatic macroinvertebrates commonly used for water quality analysis.

Clear Creek

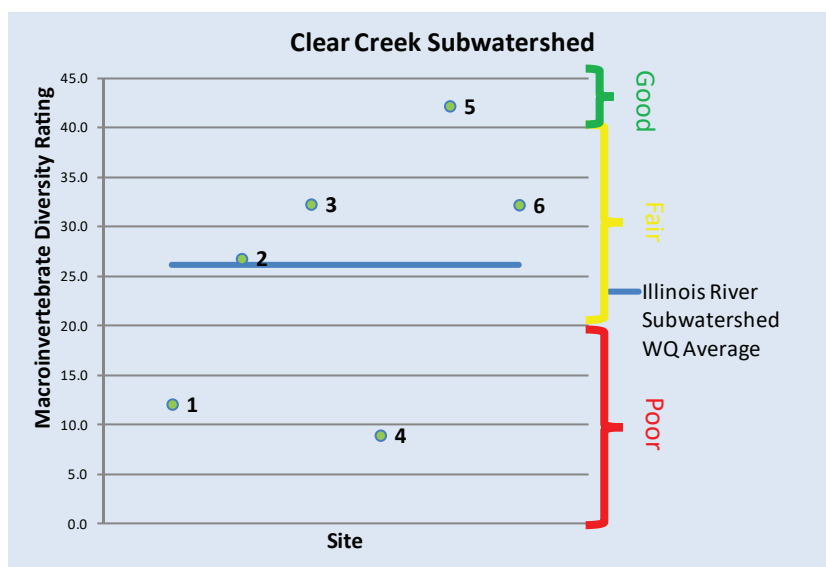


2016 303(d) Impairment:

- Pathogens

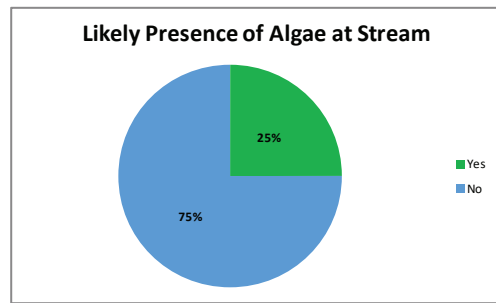
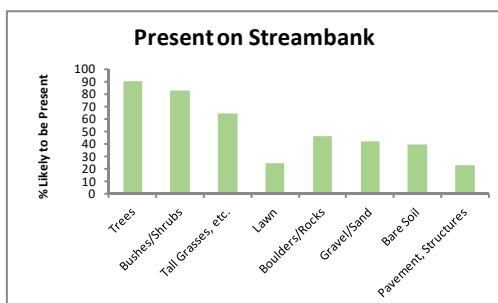
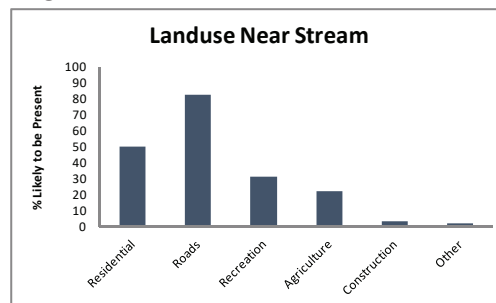
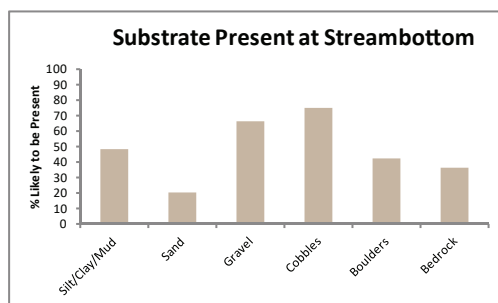
2018 303(d) Impairment:

- Pathogens



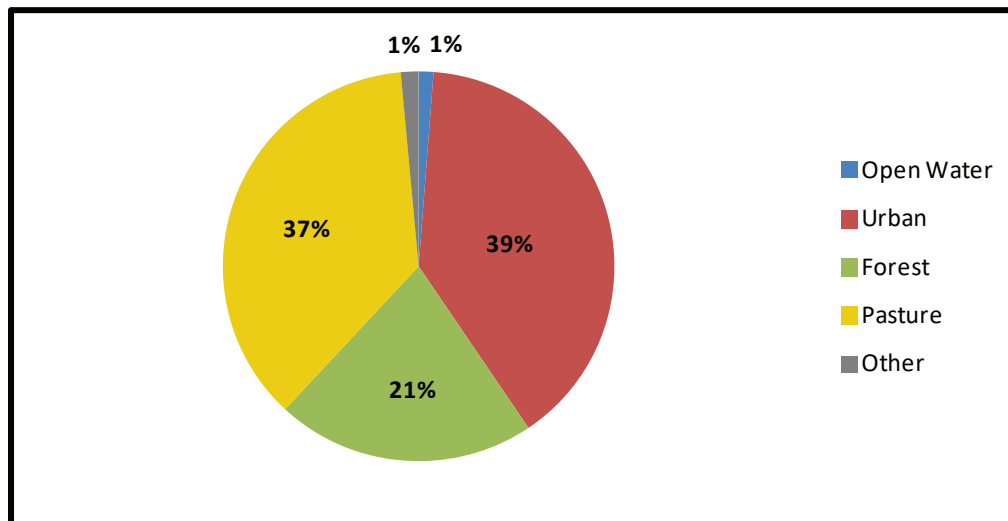
Two year, seasonal average Macroinvertebrate Diversity (MD) rating for each assessed site in the Clear Creek Subwatershed as compared to the average of all assessed subwatersheds in the Illinois River Watershed.

Common Characteristics Present During Habitat Surveys (75ft)



Clear Creek Continued...

2016 Land Cover of the Clear Creek Subwatershed



Analyses of Sites of Interest:

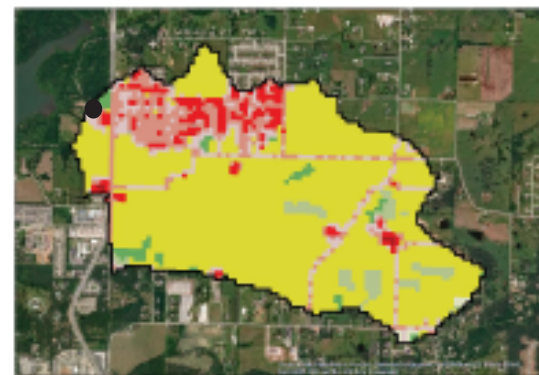
- Site 1 and 4 have a poor MD ratings and are less than the Illinois River Subwatershed Average.
- Site 1 has headwaters in a mix of pasture and urban landscape, is a tributary of Lake Fayetteville.
- Site 4 has headwaters in an urban landscape and was dry during one summer sampling period. The streambed is heavily gravel, so the water may have went subsurface.

Recommended BMP's that may Improve Water Quality Upstream of Sites of Interest: Site 1

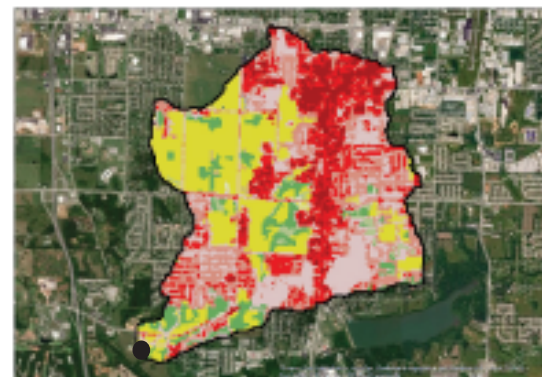
- Stormwater mitigation
- Riparian buffers (> 25 ft)
- Rotational Grazing of Cattle
- Alternative livestock watering

Site 4

- Stormwater mitigation
- Riparian buffers (> 25 ft)
- Excessive Fertilizer Reduction



Site 1. Mini-watershed and landuse



Site 4. Mini-watershed and landuse

Moore's Creek

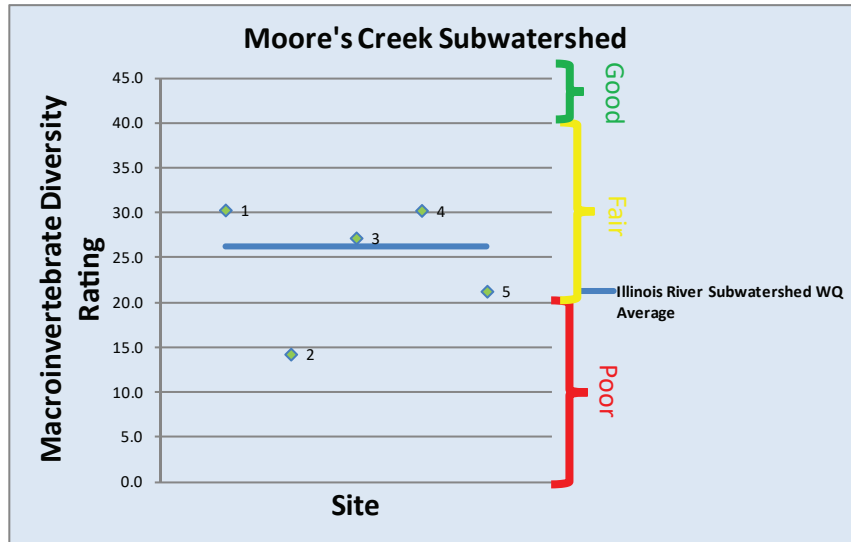


2016 303(d) Impairment:

- Pathogens
- Sulfate

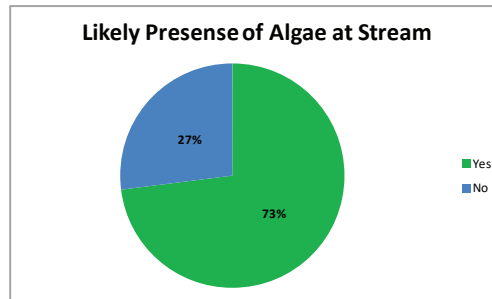
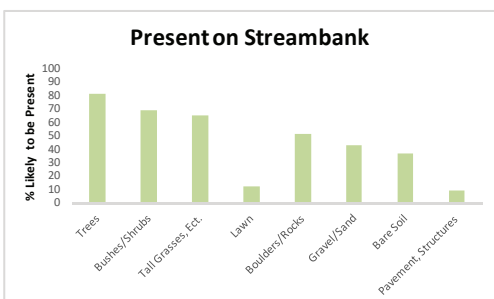
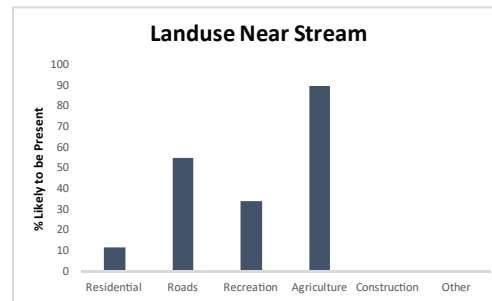
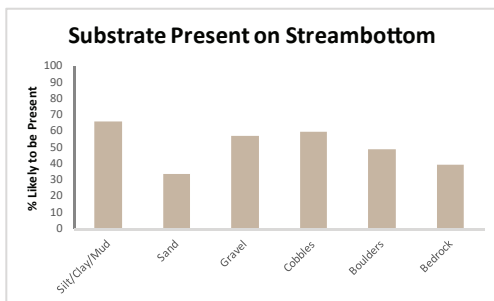
2018 303(d) Impairment:

- Pathogens
- Sulfate



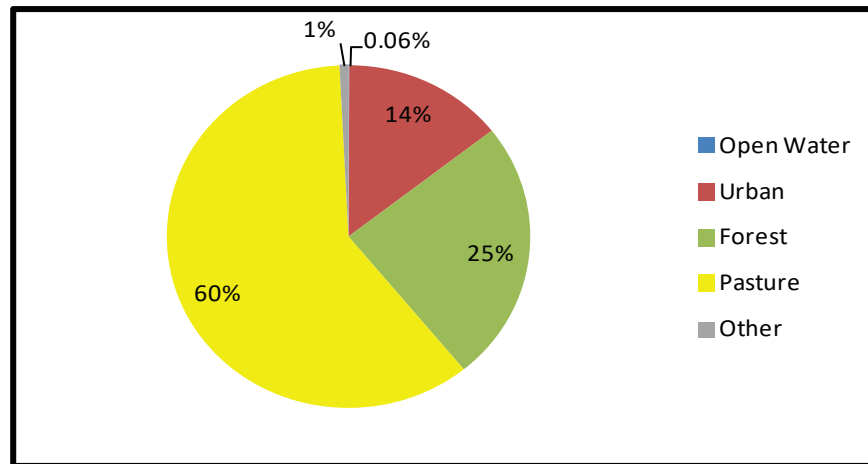
Two year, seasonal average Macroinvertebrate Diversity (MD) rating for each assessed site in the Moore's Creek Subwatershed as compared to the average of all assessed subwatersheds in the Illinois River Watershed.

Common Characteristics Present During Habitat Surveys (75ft)



Moore's Continued...

2016 Land Cover of the Moore's Creek Subwatershed



Analyses of Sites of Interest:

- Site 2 had a poor MD rating and Site 5 had a fair MD rating.
- Both Site 2 and 5 have a MD rating less than the Illinois River Subwatershed Average.
- Site 2 has headwaters in a mix of pasture and urban landscape but mostly urban.
- Site 5 has headwaters in a pasture landscape with significant forested areas.

Recommended BMP's that may Improve Water Quality Upstream of Sites of Interest:

Site 2

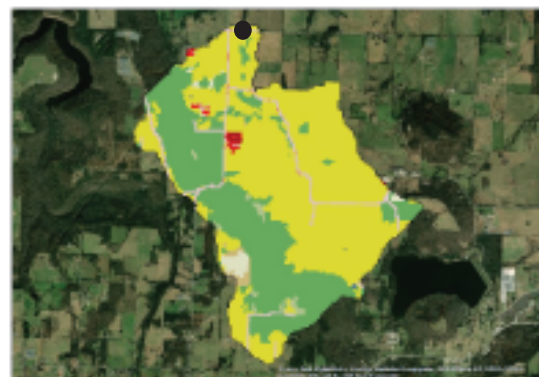
- Stormwater mitigation
- Riparian buffers (> 25 ft)
- Rotational Grazing
- Alternative livestock watering

Site 5

- Riparian buffers (> 25 ft)
- Rotational Grazing of Cattle
- Alternative livestock watering
- Conservation of forested acres
- Excessive Fertilizer Reduction



Site 2. Mini-watershed and landuse

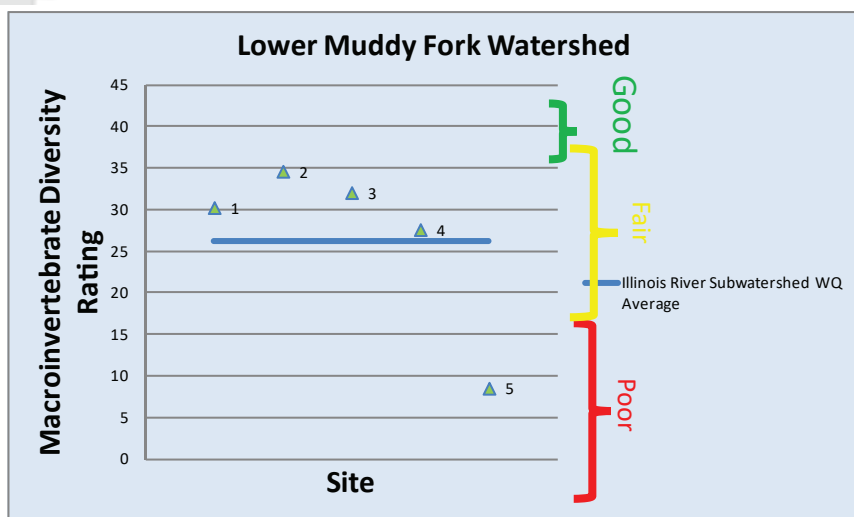


Site 5. Mini-watershed and landuse

Lower Muddy Fork

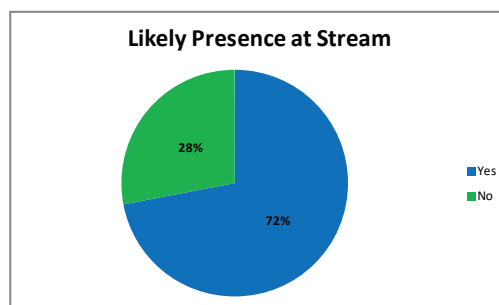
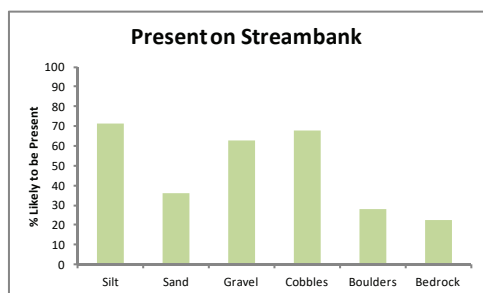
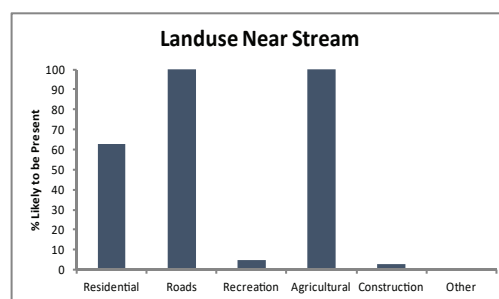
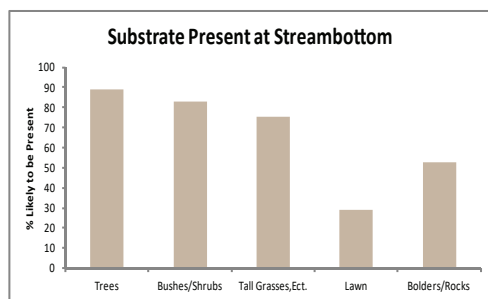


- 2016 303(d) Impairment:
- Pathogens
 - Sulfate
- 2018 303(d) Impairment:
- Pathogens
 - Sulfate



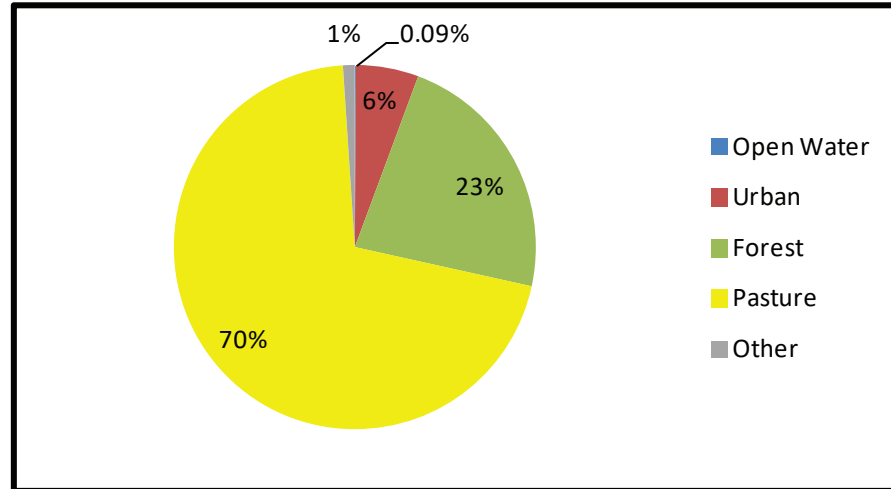
Two year, seasonal average Macroinvertebrate Diversity (MD) rating for each assessed site in the Lower Muddy Fork subwatershed as compared to the average of all assessed subwatersheds in the Illinois River Watershed.

Common Characteristics Present During Habitat Surveys (75ft)



Lower Muddy Fork Continued...

2016 Land Cover of the Lower Muddy Fork Subwatershed



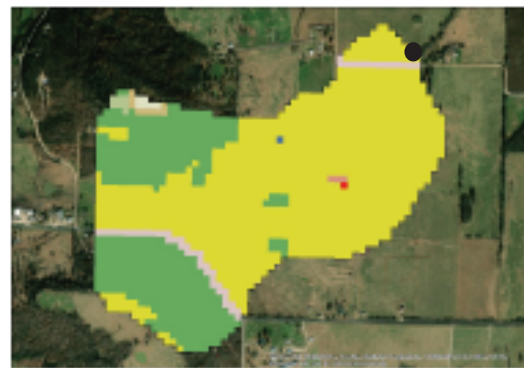
Analyses of Sites of Interest:

- Site 5 had a poor MD ratings and is less than the Illinois River Subwatershed Average.
- Site 5 has headwaters in pasture landscape with forested areas, a narrower stream width than other sites, and runs adjacent to a gravel road the entire length.
- Site 5 has dried out during one summer sampling period and has been known by people familiar with the creek to dry out during the end of summers. Therefore, may not be suitable for some macroinvertebrates that have long larval life stages.

Recommended BMP's that may Improve Water Quality Upstream of Sites of Interest:

Site 5

- Riparian buffers (> 25 ft)
- Rotational Grazing of Cattle
- Conservation of forested area
- Alternative livestock watering



Site 5. Mini-watershed and landuse

Sager Creek (Arkansas Only)

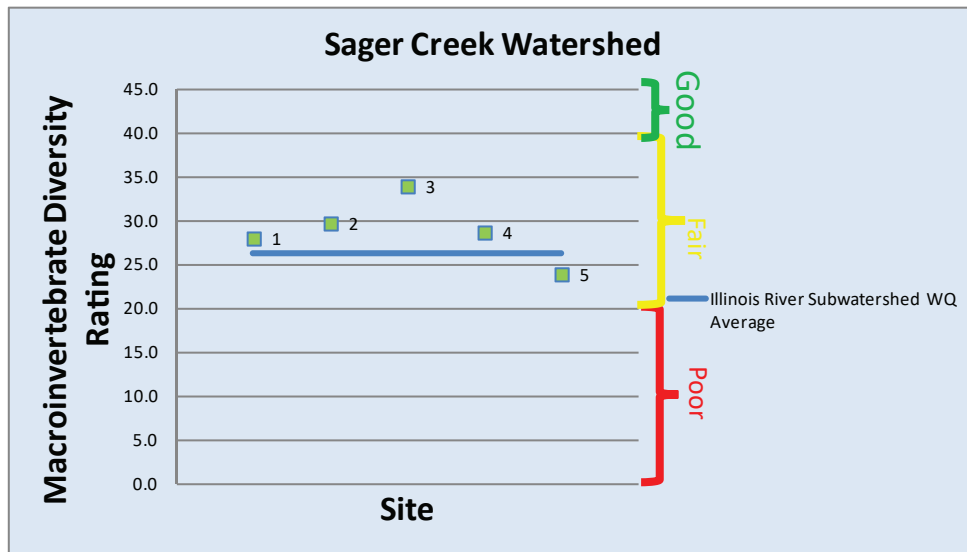


2016 303(d) Impairment:

- Nitrates

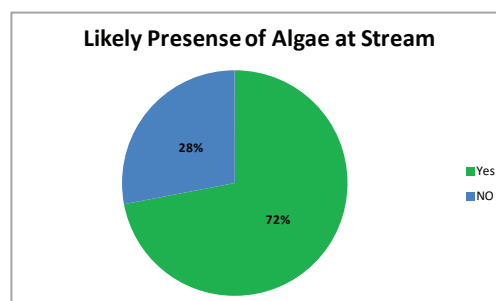
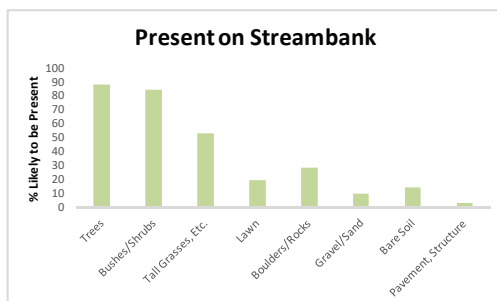
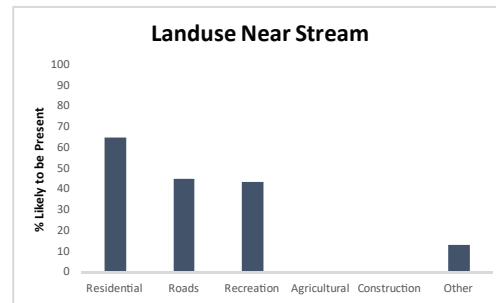
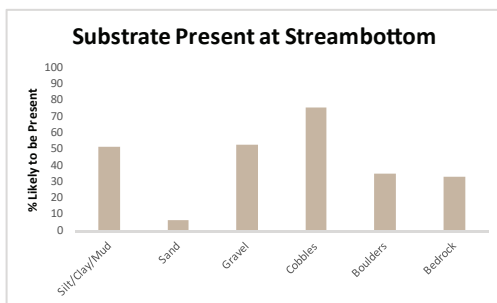
2018 303(d) Impairment:

- None



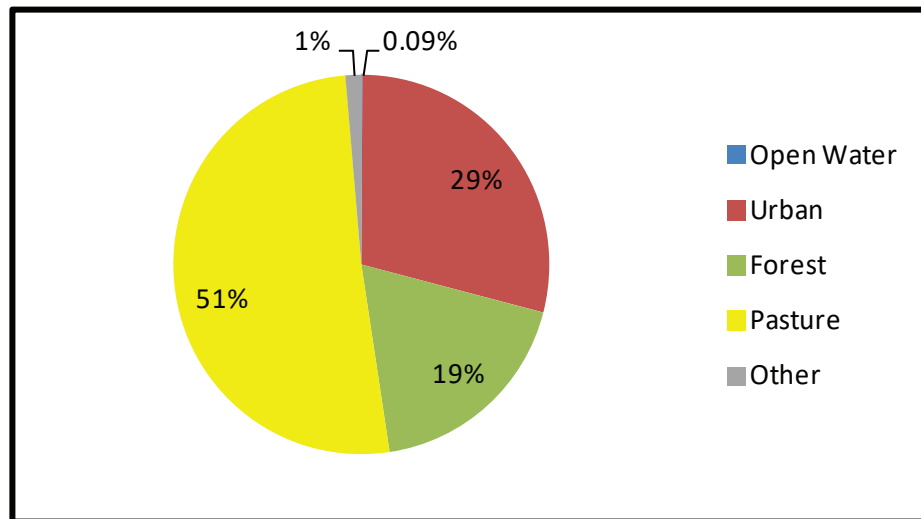
Two year, seasonal average Macroinvertebrate Diversity (MD) rating for each assessed site in the Sager Creek Subwatershed as compared to the average of all assessed subwatersheds in the Illinois River Watershed.

Common Characteristics Present During Habitat Surveys (75ft)



Sager Creek Continued...

2016 Land Cover of the Sager Creek Subwatershed



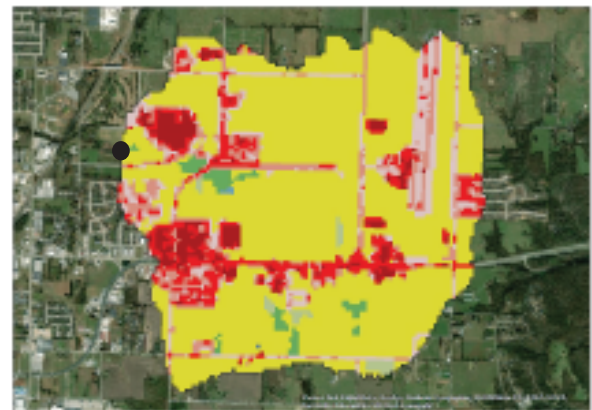
Analyses of Sites of Interest:

- Site 5 had a fair MD ratings but was less than the Illinois River Subwatershed Average.
- Site 5 has minimal to no flow, upstream of a small rock dam, wetland type landscape, and headwaters in an area with dense urban and pasture landscape.
- Macroinvertebrates were collected using a “Muddy Streambed” technique of jabbing stream habitats, such as, in-stream vegetation, woody debris, etc. That differs than the typical collection within riffles.

Recommended BMP's that may Improve Water Quality Upstream of Sites of Interest:

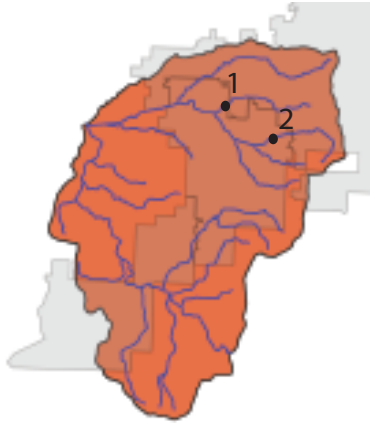
Site 5

- Stormwater mitigation
- Riparian buffers (> 25 ft)
- Rotational Grazing of Cattle



Site 5. Mini-watershed and landuse

Goose Creek

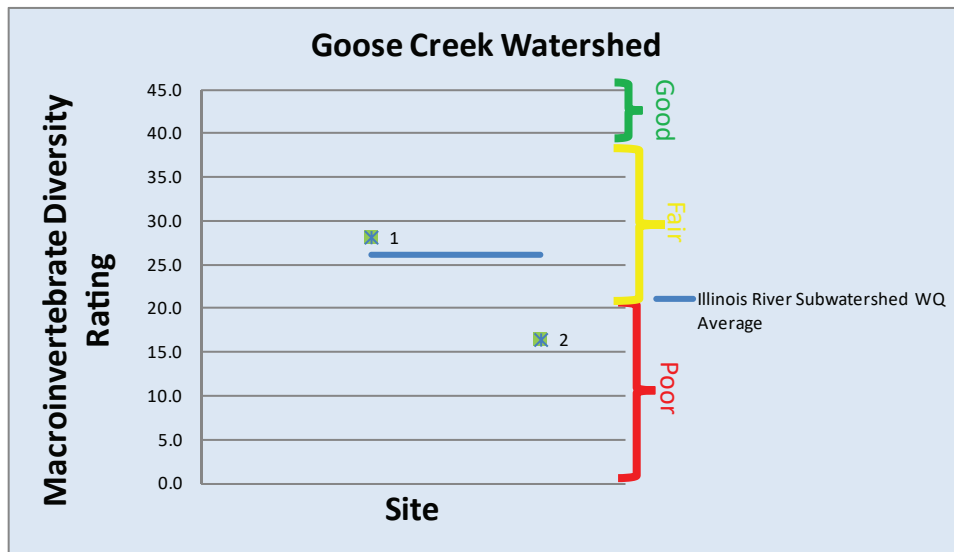


2016 303(d) Impairment:

- None

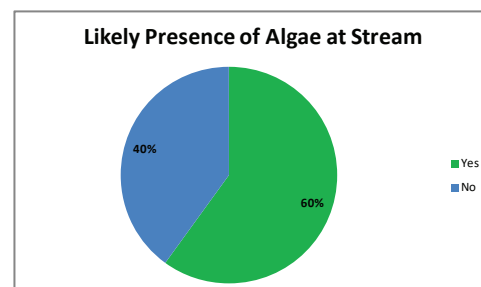
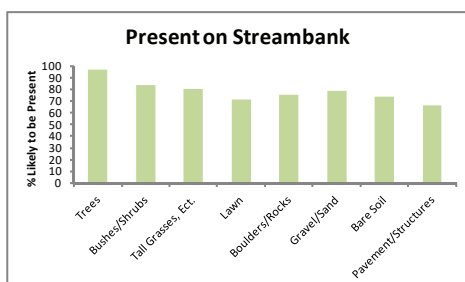
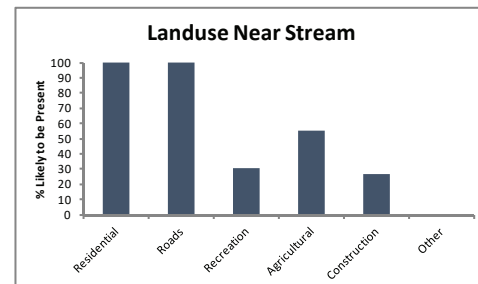
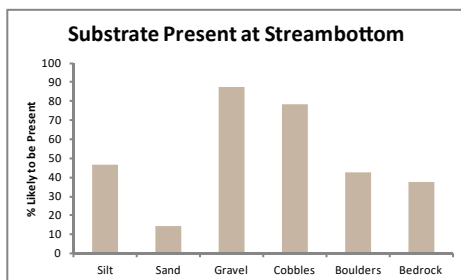
2018 303(d) Impairment:

- None



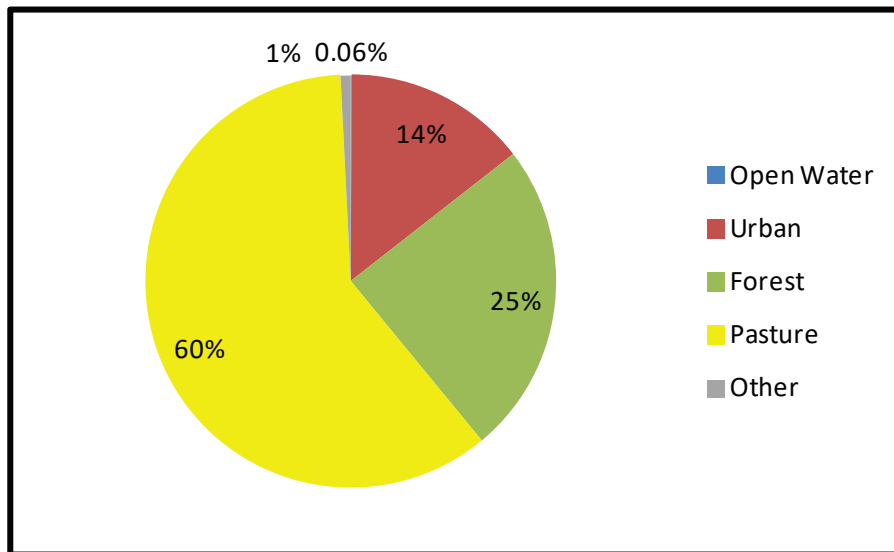
Two year, seasonal average Macroinvertebrate Diversity (MD) rating for each assessed site in the Goose Creek Subwatershed as compared to the average of all assessed subwatersheds in the Illinois River Watershed.

Common Characteristics Present During Habitat Surveys (75ft)



Goose Creek Continued...

2016 Land Cover of the Goose Creek Subwatershed



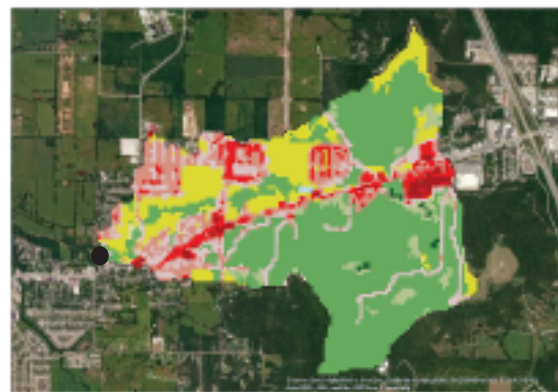
Analyses of Sites of Interest:

- Site 2 had a poor MD rating and falls below the Illinois River Subwatershed average.
- Site 2 is located in a public park with a playground and parking lot near the site.
- Site 2 had several pooled sections and small, shallow riffles. A concrete bridge with several culvert pipes separated a portion of the stream reach.

Recommended BMP's that may Improve Water Quality Upstream of Sites of Interest:

Site 2

- Stormwater mitigation
- Riparian buffers (> 25 ft)
- Conservation of forested area



Site 2. Mini-watershed and landuse

Review

Recap:

- 5 out of 23 sites assessed had a macroinvertebrate diversity score of poor. Reasoning could include flow regime, lack of optimal in stream features (i.e., riffles), sampling error, or potentially water pollution.
- 17 out of 23 sites assessed had a macroinvertebrate diversity score of fair with 2 having a diversity score below the sub-watershed site average. Recommended BMPs could benefit any stream in the fair category.
- Only 1 site assessed had a macroinvertebrate diversity score of good.

2019 IRWP Restoration Projects in Priority Subwatersheds

SUBWATERSHED	CONSERVATION PRACTICES UNDERWAY	MILES RESTORED
Clear Creek	Forested Riparian Buffer	0.38
Clear Creek	Forest Stand Improvement, Riparian Buffer Expansion	0.19
Lower Muddy Fork	Tree/Shrub Establishment, Streambank Stabilization, Forest Stand Improvement, Fence, Watering Facility, Heavy Use Area	0.06
Clear Creek	NWSG establishment, forest stand improvement, tree/shrub establishment	1.43

What Can You Do?

Here are tips from the University Arkansas Extension-Stormwater Education Program to help keep our local streams Clean!

*For more information on NWA Stormwater Education go to:

<https://www.uaex.edu/environment-nature/water/stormwater/nwastormwater/>

Know the Flow

How can I do my part?

It's easy! Here are 10 things you can do at home to prevent stormwater runoff pollution:



1. Don't dump
2. Pick up pet waste
3. Fix auto leaks
4. Don't litter
5. Apply fertilizers responsibly
6. Keep leaves and grass off streets
7. Redirect downspouts
8. Use a car wash
9. Practice mindful pest control
10. Minimize erosion



uaex.edu/stormwater
#KnowTheFlowNWA

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The Illinois River Watershed Partnership

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Data was collected with the assistance of
local EAST/Stream Teams:

