Poteau River HUC-8
Watershed Management Plan

Prepared for the City of Waldron
December 2022
By:

GBMc & ASSOCIATES NOW Alliance TECHNICAL GROUP

UofA DIVISION OF AGRICULTURE RESEARCH & EXTENSION University of Arkansas System | ARKANSAS WATER RESOURCES CENTER

Poteau River Watershed Management Plan

319 Project Number: 20-1100

Prepared for:

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EXECUTIVE SUMMARY

In 2005 EPA released a guidance handbook for developing watershed-based management plans (EPA, 2005). This watershed management plan (WMP) has been developed based largely on the 2005 EPA guidance and addresses the nine minimum elements required by EPA in plans written for the 319 Non-Point Source Control Program. Preparation of this plan was funded by an EPA 319 Grant (sub-Grant Agreement 20-1100) through the Arkansas Department of Agriculture, Natural Resources Division (NRD). The City of Waldron, the sub-grantee, provided match to help fund the preparation of the WMP. Two other EPA 319 Grants provided most of the data utilized in the preparation of this plan (GBMC, 2016 and Haggard, 2018).

The assessment portion of this plan contains data collected over approximately 9 years, with the most recent data being collected from 2017-2020 specifically for development of this plan. The ranking of key/critical subwatersheds and the proposed management measures are based largely on that assessment work. The WMP includes identification of critical subwatersheds at a small scale (12-digit HUC) and ranked implementation measures to reduce non-point source pollution loading from critical areas.

Poteau River Watershed (PRW) is a priority watershed for the Arkansas Nonpoint Management Program and has listed streams on the Arkansas Department of Energy and Environments Division of Environmental Quality (DEQ) 2018 303(d) list. The PRW (HUC-8) is approximately 557 mi^2 in size with 30 HUC-12 subwatersheds ranging in size from 0.9 mi^2 to 119 mi^2. The watershed is primarily located in the Arkansas River Valley with small portions in the Ouachita Mountains and the Boston Mountains ecoregions (Omernick, 1987). The watershed spans three counties in Arkansas; Sebastian, Scott and Polk Counties, and the watershed ultimately drains to the Arkansas River. The PRW spans across Oklahoma and Arkansas. This WMP will focus on the Arkansas portion of the watershed.

Sediment (turbidity) and nutrients appear to be the principal concern in the watershed today, particularly as it relates to non-point source pollution. Several sources are believed to be contributors to these elevated levels including runoff from agriculture (pasture/hay), unpaved roads, and streambank erosion.

Reductions in total suspended sediment (TSS) loading and nutrients (nitrogen and phosphorus) of approximately 35%, will be targeted in critical/priority areas in an effort to improve water quality, ensure maintenance of the state in-stream criteria and reduce sediment and nutrient loading to Lake Wister in Oklahoma, which is under a TMDL in Oklahoma.

The primary recommendations to improve water quality, for the key/priority subwatersheds in this WMP, are provided in Section 6, and a summary is provided the table below.

Table 6.4.1. Prioritization of recommended Watershed Management Practices.

Rank	Poteau River	James Fork	Management Action (Practice)
1	Bull/Square/EF, Lower Jones, & Ross	Cherokee Creek & Prairie Creek	Implementation of pasture BMPs (rotational grazing, lower cattle stocking rate, & improve riparian buffers)
2	Ross, Bull/Square/EF, & Headwaters Poteau River	Cherokee	Riparian buffer/Vegetated filter Strips
3	--	Upper Sugarloaf, Prairie Creek, & West Creek	Streambank stabilization
4	Bull/Square/EF, Ross,& East Shadley	--	Unpaved road maintenance and upgrades
5	--	BB/Johnson/SH, Headwaters James Fork, & Gap Creek	Streambank stabilization
6	Headwaters Poteau River	BB/Johnson/SH	Implementation of pasture BMPs (rotational grazing, lower cattle stocking rate, & improve riparian buffers)
7	Headwaters Poteau River, Upper Jones, & Bull/Square/EF	Cherokee Creek	Implementation of residential/commercial BMPs
8	--	Riddle Creek & Gap Creek	Streambank stabilization
9	Upper Black Fork, & Headwaters Poteau River	BB/Johnson/SH	Unpaved road maintenance and upgrades
10	East Shadley	West Creek	Implementation of pasture BMPs

1.0 INTRODUCTION

Since the late 1980s the Environmental Protection Agency (EPA) has encouraged states and territories to manage their waters using a watershed approach. The watershed approach provides a framework to assess and manage water quality and water resources on a drainage basin (watershed) basis. Using a drainage basin approach, the attention not focused on point source discharges (sewage and wastewater treatment plants) and stream disturbances in the stream corridors, but also on of anthropogenic land uses and the effects they have on stormwater run-off (non-point sources) in the watershed.

In 2005 EPA released a guidance handbook for developing watershed-based management plans (EPA, 2005). This Watershed Management Plan (WMP) has been developed based largely on the 2005 EPA guidance and addresses the nine minimum elements required by EPA in plans written for the 319 Non-Point Source Control Program (Table 1.1). Preparation of this plan was funded partially by an EPA 319 Grant (Sub-Grant Agreement 20-1100) through the Arkansas Department of Agriculture, Natural Resources Division (NRD). The City of Waldron, the sub-grantee, has spearheaded the efforts in the Arkansas portion of the Poteau River Watershed (PRW) over the past seven years.

Table 1.1. EPA nine minimum elements.

EPA Nine Minimum Elements	Location Addressed in Watershed Management Plan
Element 1- Identification of causes of impairment and pollutant sources	Section 3.0, 4.0, 5.0
Element 2- Estimate of load reductions expected from management measures	Section 4.0
Element 3- Non-point source measures required to achieve load reductions	Section 6.0
Element 4- Estimate of funding needed and sources of funding to implement plan	Section 9.0
Element 5- Information and education component	Section 8.0
Element 6- Schedule for implementation	Section 6.0
Element 7- Interim measurable milestones	Section 6.0
Element 8- Criteria to measure success of reduction goals	Section 7.0
Element 9- Monitoring component to evaluate effectiveness of implementation measures	Section 7.0

Arkansas Department of Agriculture, NRD designated the PRW as a priority watershed in the Nonpoint Source Pollution Management Plan during the 2006-2011 Plan and continued it in the 2018-2023 Plan. The NRD is the primary agency in Arkansas that spearheads nonpoint source (NPS) pollution control and is the agency through which 319 grant funding is managed for projects such as this. The NRD listed parameters of concern in the 2021 Arkansas Annual Report for the PRW are nutrients and metals. Six of the NRDs objectives for this watershed in Arkansas will be accomplished through, or as a result of development of this WMP, and many of the remaining 11 objectives will be set in motion by this plan's implementation priorities. The six that will be accomplished are:

> 19.1. Continue development of the Nine Element Plan until U.S. Environmental Protection Agency (EPA) acceptance of the plan.
> 19.2. Continue to develop support for implementation of the Nine Element Plan among potential cooperating entities and the general public.
> 19.3. Provide technical and financial assistance to local cooperating entities to implement the Nine Element Plan as resources allow.
> 19.5. As resources allow, use remote sensing and Geographical Information Systems (GIS) analysis to identify subwatersheds where more extensive assessment is needed. Conduct targeted geomorphological and bioassessment to identify and target implementation of streambank stabilization projects for high impact sites
> 19.6. Continue to refine models as new data becomes available to represent sediment and nutrient loads in the watershed and instream processes to enable prioritization of implementation projects in subwatersheds.
> 19.12. Continue to increase public awareness and provide education to build support for citizen action to improve water quality in the watershed.

The approved Arkansas 2018 303(d) list contains 4 assessment units (stream segments) of the Poteau River and one segment of an Unnamed Tributary of the Poteau River. There are 2 assessment units of the Poteau River that are on the Category 4a list. Category 4a indicates that water quality criteria are not being met but a TMDL has been written for the listed parameters. The parameters not in attainment include turbidity and total phosphorus.

The other two assessment units are on the Category 5 list as those parameters are not meeting water quality criteria for one or more designated uses and have been prioritized. The causes for the two Poteau River assessment units on the Category 5 list include dissolved oxygen, turbidity and sulfate with sources listed as industrial point source, municipal point source, surface erosion and unknown with a medium priority. The medium priority indicates that the waterbody is not meeting water quality criteria but may be de-listed in the future with permit revisions to correct the problem. The Unnamed Tributary of the Poteau River is listed for chloride, and total dissolved solids (TDS) with an unknown source and is considered a low priority. A site-specific criteria study was completed for the Unnamed Tributary of Poteau River and the Poteau River from Business Highway 71 to the Stateline. The study changed the in-stream criteria for the Unnamed Tributary of the Poteau River chloride, sulfate and TDS limits to 180, 200, 870 mg/L, respectively. The study also changed the criteria for the Poteau River at Business Highway 71 to the Stateline for chloride, sulfate and TDS to 185, 200, 786 mg/L.

Nutrients, metals, and sediment (turbidity) appear to be the principal concern in the watershed today. Several sources are believed to be contributors to these elevated levels including surface erosion and an industrial and municipal NPDES discharges.

Over the past decade approximately seven water quality studies have been completed in the PRW. One of the larger studies was a watershed monitoring program which was implemented in 2016 and 2017 by the University of Arkansas. This monitoring program included extensive water quality sampling and physicochemical analysis under various flow regimes, at multiple stream stations in the watershed. It also included gaging of each of the key streams in the watershed so flow and loading could be measured. This study along with other key studies will all be discussed in Section 3 of this WMP (Lasater, 2017 and Lasater and Haggard, 2021).

This WMP has been developed based primarily on evaluation/analysis of existing watershed monitoring data and new data collected over the past six years specifically to develop this comprehensive WMP. The WMP includes identification of critical subwatersheds at a small scale (12-digit HUC) and ranked implementation measures to reduce non-point source pollution loading from critical areas in Arkansas. This WMP will be used to direct watershed protection activities and watershed restoration activities with the ultimate goal being reduction of pollutant loading and protection of the watershed.

2.0 WATERSHED DESCRIPTION

The PRW is a priority watershed for the Arkansas Nonpoint Management Program and has listed streams on the Arkansas Department of Energy and Environments Division of Environmental Quality (DEQ) 2018 303(d) list. The PRW (HUC 11110105) is approximately 557 mi^2 in size with 30 HUC- 12 subwatersheds (Figure 2.1). The Poteau River watershed spans over three counties; Scott, Sebastian and Polk Counties in Arkansas. The watershed range in size from 0.9 mi^2 to 119 mi^2. The Arkansas portion of the watershed is in the Arkansas River Valley and the Ouachita Mountain ecoregions (Omernick, 1987). The PRW spans across Oklahoma and Arkansas. This WMP will focus on the Arkansas portion of the watershed.

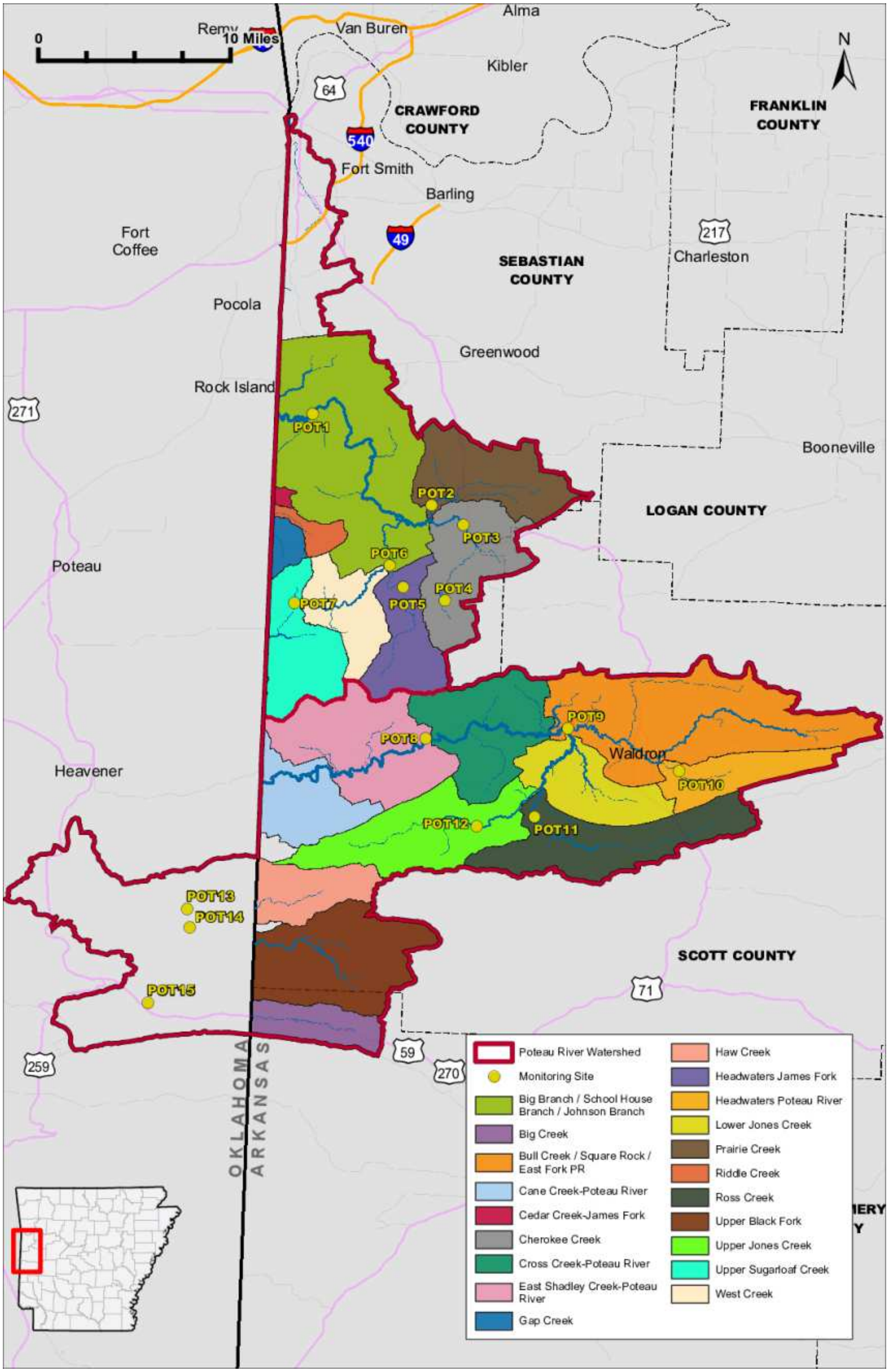

Figure 2.1. General overview of PRW showing subwatersheds and the University of Arkansas monitoring locations.

The Poteau River runs west to Oklahoma into Lake Wister and ultimately back to Arkansas and into the Arkansas River near Fort Smith. The PRW has two main river systems within the HUC-8, the Poteau River in the southern half and James Fork in the northern portion of the watershed. Overall PRW is a mostly rural watershed with an abundance of pasture and hay fields and a substantial number of poultry operators with the heaviest concentration in the Poteau River portion of the watershed. Apart from the highly developed area near Fort Smith, the James Fork portion watershed is mostly populated by rural residents with only a few small towns.

Overall, the watershed is dominated by forest landuses (68%) (Figure 2.2). Hay and/or pasture land uses comprise a fairly high percentage (20%), while developed areas make up approximately 5% of the watershed (NLCD, 2019). The most northern watershed (Cedar Creek – Poteau River) has an abnormally high concentration of developed land that likely skews this value high. Soils on the land surface in the subwatersheds are primarily dominated by the Enders-Mountainburg complex, Carnasaw-Sherless complex, and Leadvale silt loam. These soils are composed mostly of a gravelly fine sandy loam, fine sandy loam and silt loam and have a moderate overall potential for erosion (Figure 2.3.) Slopes are fairly flat overall (6.3% on average) with some moderately steep slopes (averages for HUC-12s ranged from 2.7%-14.6%) (Figure 2.4.) The moderately steep slopes in the watershed make it somewhat vulnerable to erosion in un-forested areas.

All waters in the state of Arkansas have Designated Uses applied to them that dictate the level of water quality that must be maintained. The drainages in the PRW, including the primary (10-digit HUC) ones (Poteau River, Jones Creek, James Fork) are designated for the following uses by the Arkansas Pollution Control and Ecology Commission (ADPCE):

- Primary contact recreation
- Secondary contact recreation
- Domestic, industrial, and agricultural water supply
- Fisheries (Aquatic life), Perennial in Arkansas River Valley or Ouachita Mountains

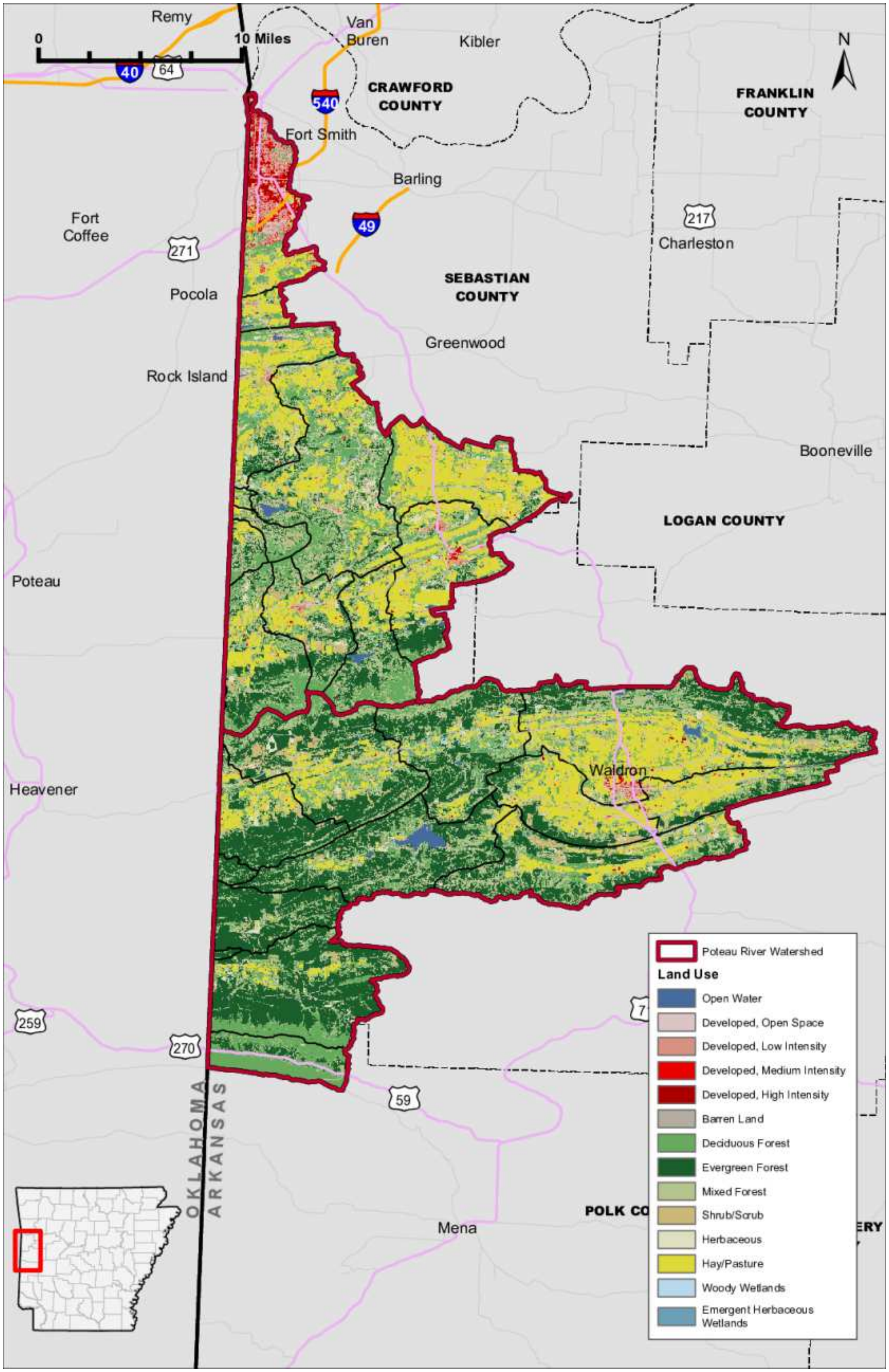

Figure 2.2. Poteau River Watershed land uses (NLCD 2019) with the middle red line dividing the James Fork and Poteau River portions.

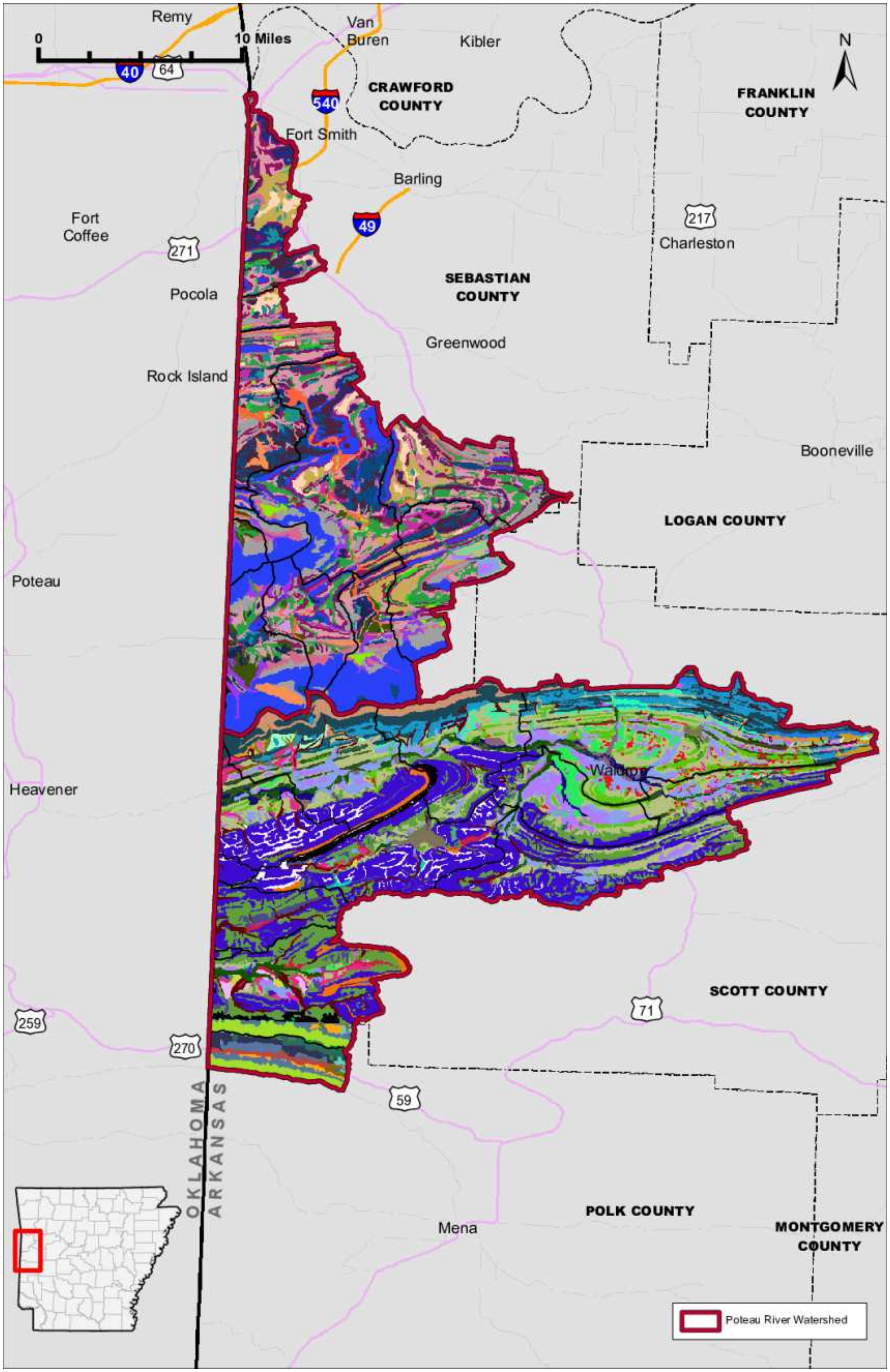

Figure 2.3. Map of soils in the PRW with the middle red line dividing the James Fork and Poteau River portions.

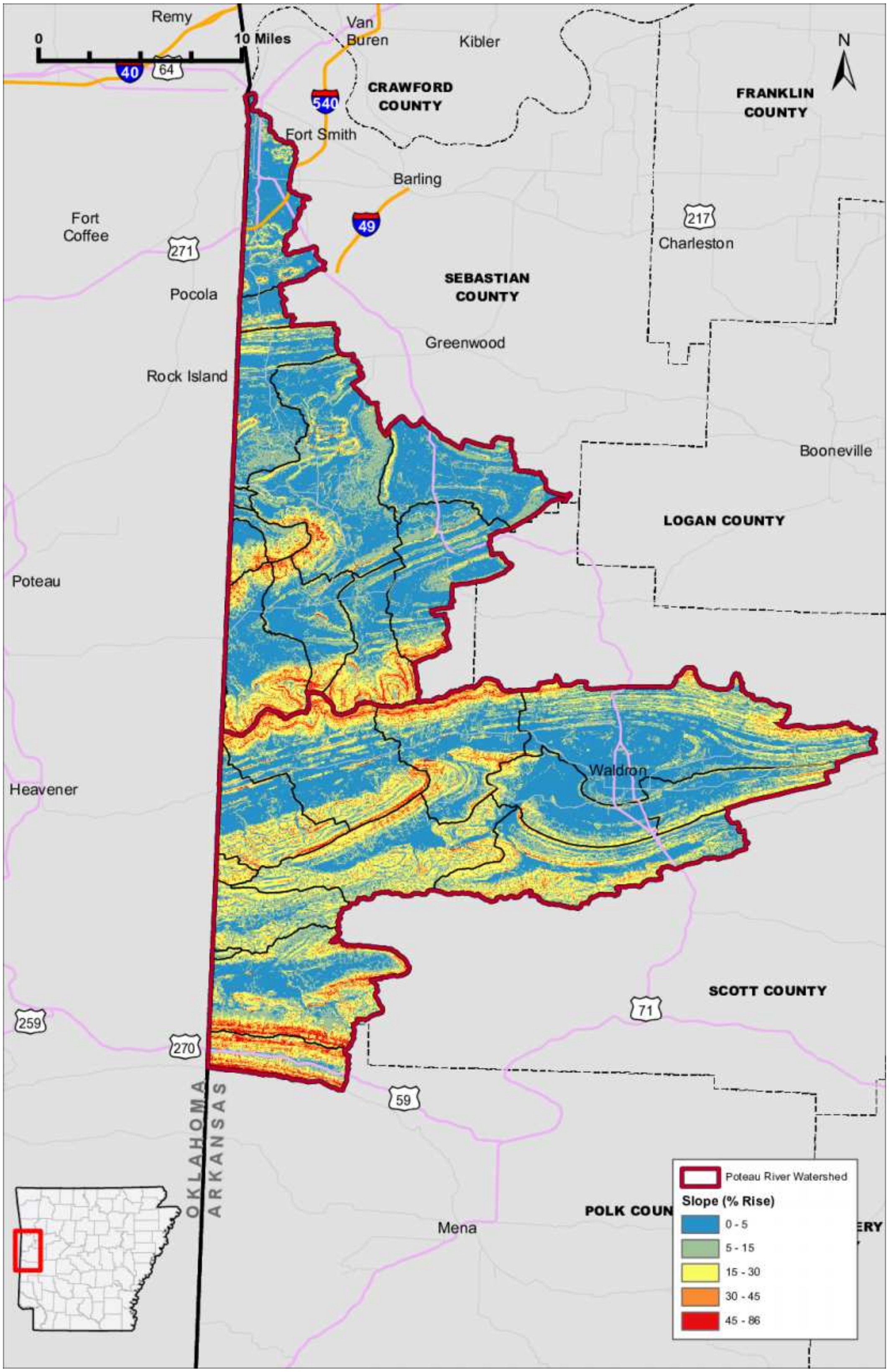

Figure 2.4. Land surface slope in the PRW with the middle red line dividing the James Fork and Poteau River portions.

3.0 WATERSHED ASSESSMENT

A comprehensive assessment was completed on the PRW to evaluate its physical, chemical, and hydrologic condition. In total there are 30 HUC-12 subwatersheds in the HUC-8 PRW. Data evaluated from the watershed spans from 2011-2020. All data was considered for use in this assessment. More recent studies that have been completed are listed below:

1. Two special studies were conducted in relation to Section 4G (site specific criteria) of the Arkansas Surface Water Quality Standards. These studies focused on the mineral concentrations in the PRW near Waldron (GBMc & Associates, 2011 and 2015).
2. Water Quality Monitoring of the Poteau River Watershed - 319 grant project No. 16-1100 objective was to look at water quality in the watershed to identify sources of nonpoint source pollution. (City of Waldron and GBMc & Associates, 2018)
3. Watershed Investigative Support to the Poteau Valley Improvement Authority. Stream Water Quality to Support HUC- 12 Prioritization in the Lake Wister, Oklahoma. Funding provided by Poteau River Valley Improvement Authority (PVIA) and work completed by Arkansas Water Resource Center (AWRC) (AWRC, 2018).
4. In Oklahoma, watershed investigative support to the PVIA. stream water quality to support HUC- 12 prioritization in the Lake Wister Watershed, Oklahoma: August 2017 through May 2019. Funding provided by PVIA and work completed by AWRC (AWRC, 2019).
5. In Oklahoma, Lake Wister Water Quality Modeling in Support of Nutrient and Sediment TMDL Development. October 2019. (Scott and Patterson, 2022).
6. University of Arkansas received a 319 grant (17-300) in 2016 and collected data at 15 monitoring locations that covered 14 of the 30 HUC- 12 subwatersheds (Lasater and Haggard, 2021).

In regard to water quality monitoring data, the 2017 University of Arkansas study data is the primary focus of the water quality and loading assessment (AWRC, 2019). Each of the 30 subwatersheds and 15 monitoring stations depicted on the map (Figure 2.1) were evaluated by the University of Arkansas. The 2018 319 study completed by GBMc & Associates and this current 319 grant study is providing all of the other assessment related data including historical data review, Unified Stream Assessments (USAs), desktop analysis, streambank erosion, and the Soil and Water Assessment Tool (SWAT) modeling.

The PRW has two main river systems within the HUC- 8, the Poteau River in the southern half of the watershed and the James Fork in the northern half of the watershed. All data tables and charts will be presented separately since there is no confluence of the two in Arkansas and the James Fork enters the Poteau River downstream of Lake Wister.

A description of each assessment component is contained in the following sections. The subwatersheds that have been evaluated by the University of Arkansas represent a cross-section of the entire HUC- 8 PRW. Subwatersheds that were not assessed directly will be compared to similar subwatersheds that were assessed. Although there were 15 HUC- 12 subwatershed monitoring stations, the sites only represent 14 subwatersheds as there were two monitoring locations in one of the HUC-12 subwatersheds. For this WMP we focused the overall assessment on 20 subwatersheds (defined at approximately a 12-digit HUC level) that were believed to be reasonable and manageable sized, similar groupings.

These subwatersheds are believed to be a reasonable transect of all the subwatersheds in the PRW and should facilitate informed management for the entire watershed. There are 30 HUC-12 subwatersheds total in the PRW; 25 subwatersheds were assessed. Six of the subwatersheds were combined and treated as two subwatershed groupings that make up a list of 20 below. A surrogate was used in subwatersheds that did not have monitoring locations within them but are included in the assessment. Surrogates were chosen based on land use similarity. In 6 of the 20 subwatersheds, a monitoring station is a surrogate (i.e. a station on another stream with similar watershed attributes is used to represent it) and that surrogate station is noted in the list below along with the other subwatersheds that are the focus of this assessment.

James Fork

1. Big Branch / Johnson / School House Branch-James Fork (Pot-1) abbreviated as Big/Johnson/SH
2. Big Creek (Pot-15)*
3. Cedar Creek-James Fork (Used Pot-7 as surrogate)
4. Cherokee Creek (Pot-3)
5. Gap Creek (Used Pot-7 as surrogate)
6. Headwaters James Fork (Pot-5)
7. Prairie Creek (Pot-2)
8. Riddle Creek (Used Pot-7 as a surrogate)
9. Upper Sugarloaf Creek (Pot-7)
10. West Creek (Pot-6)

Poteau River

1. Bull Creek-Poteau River / Square Rock Creek / East Fork Poteau River (Pot-9) abbreviated as BC/SR/EFPR
2. Cane Creek-Poteau River (Used Pot-8 as surrogate)
3. Cross Creek-Poteau River (Pot-8)
4. East Shadley-Poteau River (Used Pot-8 as surrogate)
5. Haw Creek (Pot-13) *
6. Headwaters Poteau River (Pot-10)
7. Lower Jones Creek (Used Pot-12 as surrogate)
8. Ross Creek (Pot-11)
9. Upper Black Fork (Pot-14)*
10. Upper Jones Creek (Pot-12)

*These monitoring locations are in Oklahoma; however, the data was converted to a per square mile basis then multiplied by watershed area in Arkansas to allow only the Arkansas portion to be considered in this assessment.

The majority of the PRW was assessed by monitoring. Therefore, only approximately 30% of the subwatersheds did not have a monitoring location and a surrogate was used.

One watershed not included in the list is Cedar Creek-Poteau River. The watershed is in the very northern portion of the PRW and land use in the subwatershed is 62% developed. This watershed is not included in the overall assessment for the following reasons:

1. The subwatershed does not drain into Lake Wister or any 303(d) listed reaches of the overall PRW.
2. The lower portion and smaller tributary, Cedar Creek, confluences with the Poteau River 8.9 miles before the Poteau enters the Arkansas River, and as such does not effect water quality in the critical portions of the watershed.
3. The unusually high concentration of urban areas in this subwatershed is an anomaly when compared to the rest of the mostly rural watershed, and would skew the assessment unreasonably.

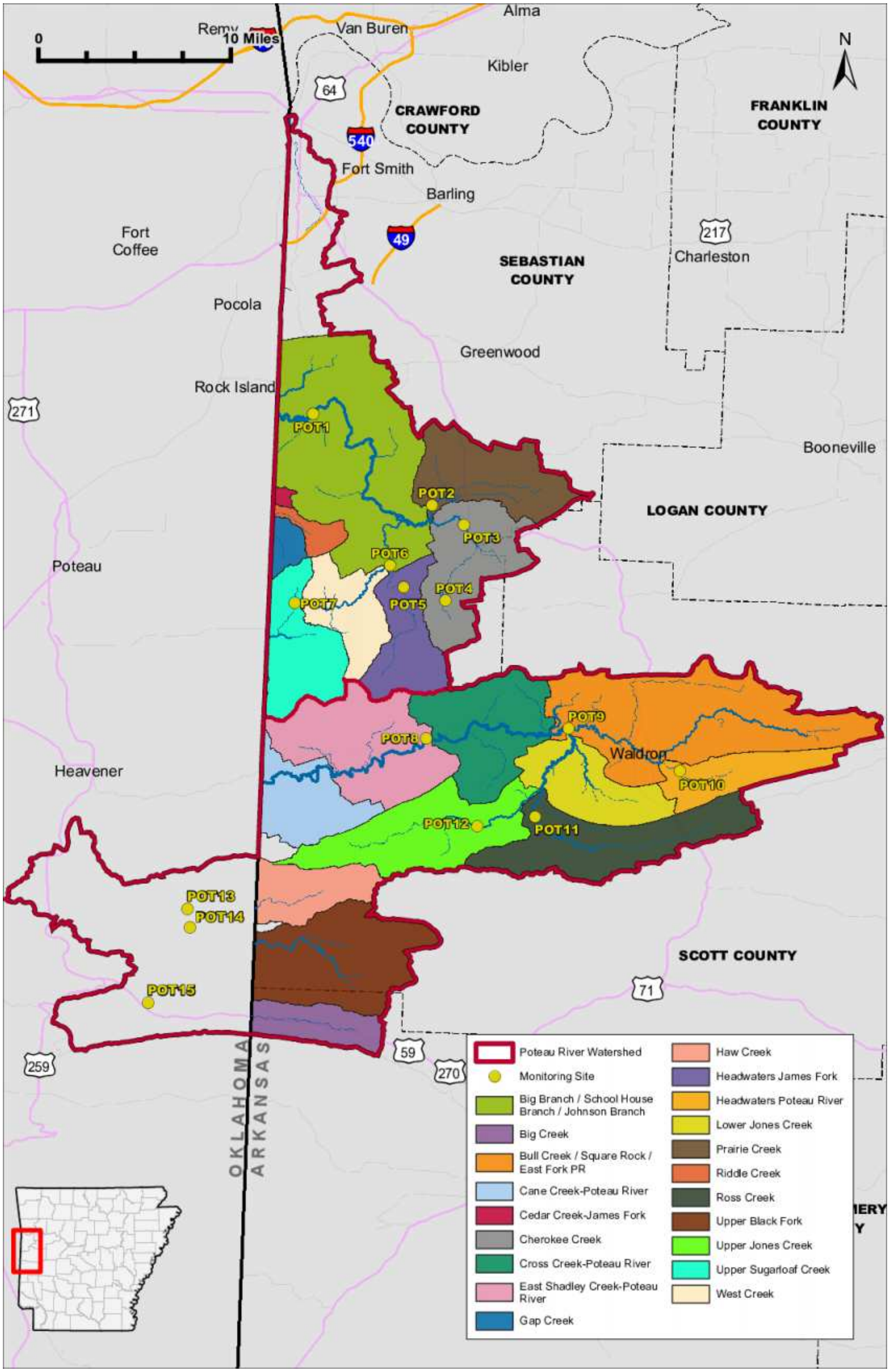

Figure 3.1. University of Arkansas sampling locations within respective subwatersheds assessed.

3.1 GIS Non-point Source Assessment

A desktop assessment of the PRW was completed using GIS resources including soils maps, land surface slope (DEM), land use, aerial photographs, etc. The assessment was focused on identifying possible critical land areas and non-point sources of pollutants that could be transported to the stream system during storm water runoff events. The assessment was completed on all subwatersheds, with an emphasis on the 20 subwatersheds noted above.

3.1.1 Land Use by Subwatershed

Land use was evaluated using 2019 NLCD land use land cover data from the Multi-Resolution Land Characteristics Consortium. Land use is an important attribute in a watershed analysis. The percent of pasture, cultivated crops, and developed areas can provide great insight into a watershed's potential for NPS pollution. A summary of the land use assessment is provided in Table 3.1.1.1.

Cherokee Creek had the highest medium and high intensity development at 1.3%. The subwatersheds having the highest percentage of pasture are Prairie Creek (58%), Lower Jones Creek (46%), and Cherokee Creek (39%). Whereas Cross Creek-Poteau River, Riddle Creek, Upper Black Fork, Upper Jones Creek, Haw and Big Creek had the lowest (<10%). Pastures are generally associated with cattle use, and/or hay, commercial fertilizer, poultry litter used as fertilizer, or any combination of the four. Each association can be a source of nutrients to the stream system. Figures 3.1.1.1 and 3.1.1.2 below is a visual representation of each subwatersheds' land use. Due to the potential for the NPS loading results from pasture/hay and developed land uses, these two land use criteria (developed and hay/pasture) were used in the ranking matrix to help assess key watershed issues.

Table 3.1.1.1. Percent land use by subwatershed in 2019.

Watershed	HUC name	Watershed Area (mi^2)	Forest	Hay / Pasture	Developed Open Space/Low Intensity & Barren	Developed Medium & High Intensity	Herbaceous, Wetlands & Shrub/Scrub
James Fork	Big / Johnson / SH	119.4	55.5	28.6	6.4	0.5	8.4
	Big Creek	13	96.7	0.0	2.5	0.3	0.6
	Cedar Creek-James Fork	0.9	61.7	21.3	4.7	0.1	12.2
	Cherokee Creek	28.2	45.3	38.5	7.5	1.3	7.4
	Gap Creek	4.3	80.2	14.9	3.2	0.3	1.5
	Headwaters James Fork	19.3	76.3	16.6	4.4	0.2	2.6
	Prairie Creek	27.3	28.1	58.4	5.9	0.5	7.1
	Riddle Creek	4.4	82.3	5.0	4.0	0.1	8.6
	Upper Sugarloaf Creek	23	75.5	15.9	2.7	0.3	5.6
	West Creek	17.4	59.7	22.0	5.4	0.7	12.2
Poteau River	Cane Creek-Poteau River	20.1	72.9	18.0	4.1	0.2	4.8
	Cross Creek-Poteau River	31.3	82.9	9.7	3.6	0.1	3.7
	East Shadley Creek-Poteau River	38.3	75.7	12.0	3.7	0.1	8.5
	Haw Creek	15.8	93.6	0.4	2.4	0.0	3.7
	Headwaters Poteau River	16	49.4	36.9	7.7	0.9	5.2
	BC/SR/EFPR	72.6	24.2	24.2	6.0	1.0	5.8
	Lower Jones Creek	21.6	41.2	45.7	6.0	0.7	6.5
	Ross Creek	35	70.6	16.0	4.6	0.4	8.4
	Upper Black Fork	39.2	91.2	4.1	2.1	0.0	2.6
	Upper Jones Creek	34.7	86.5	3.3	7.5	0.1	2.7

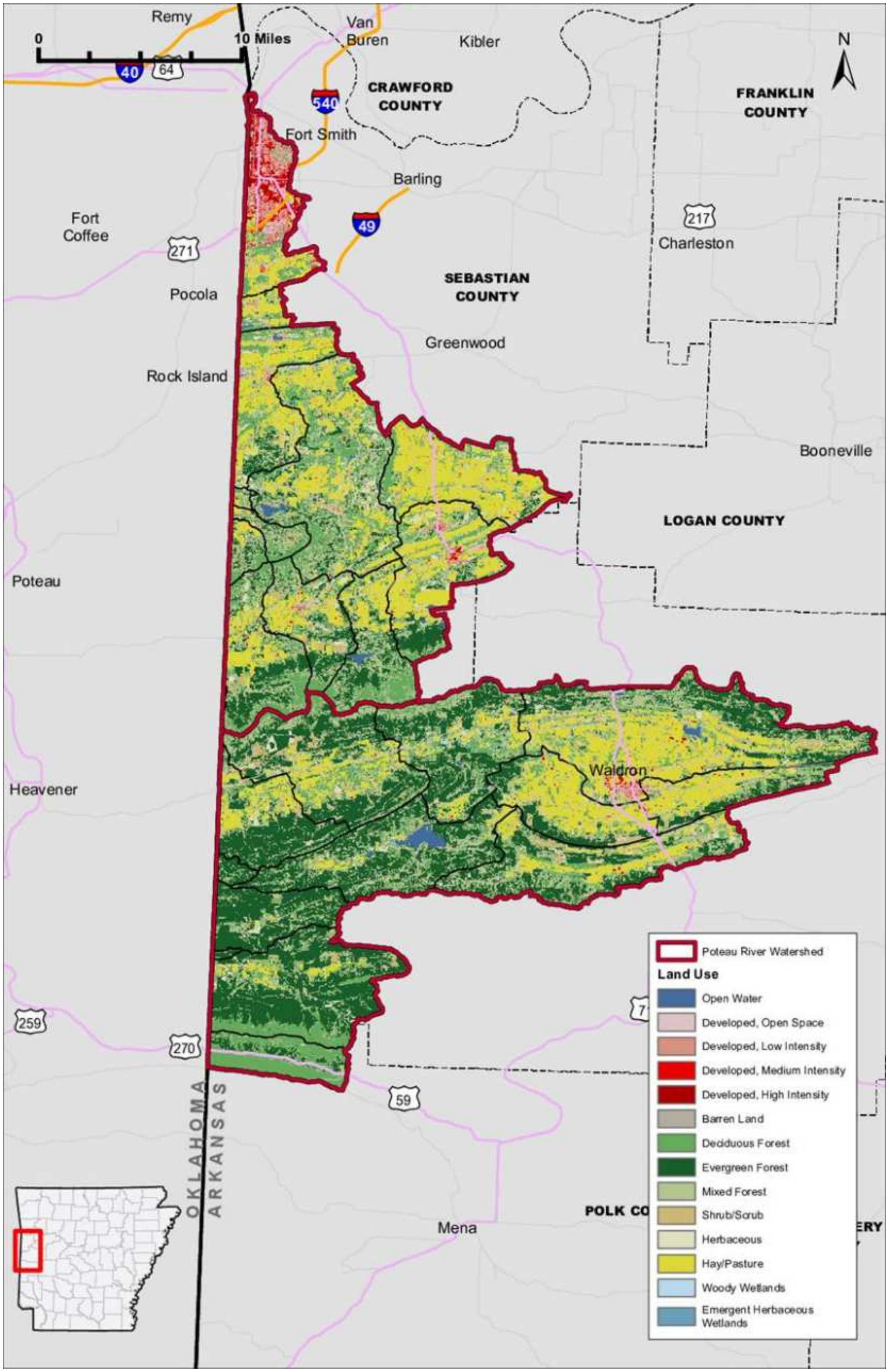

Figure 3.1.1.1. PRW land use land cover by subwatershed in 2019.

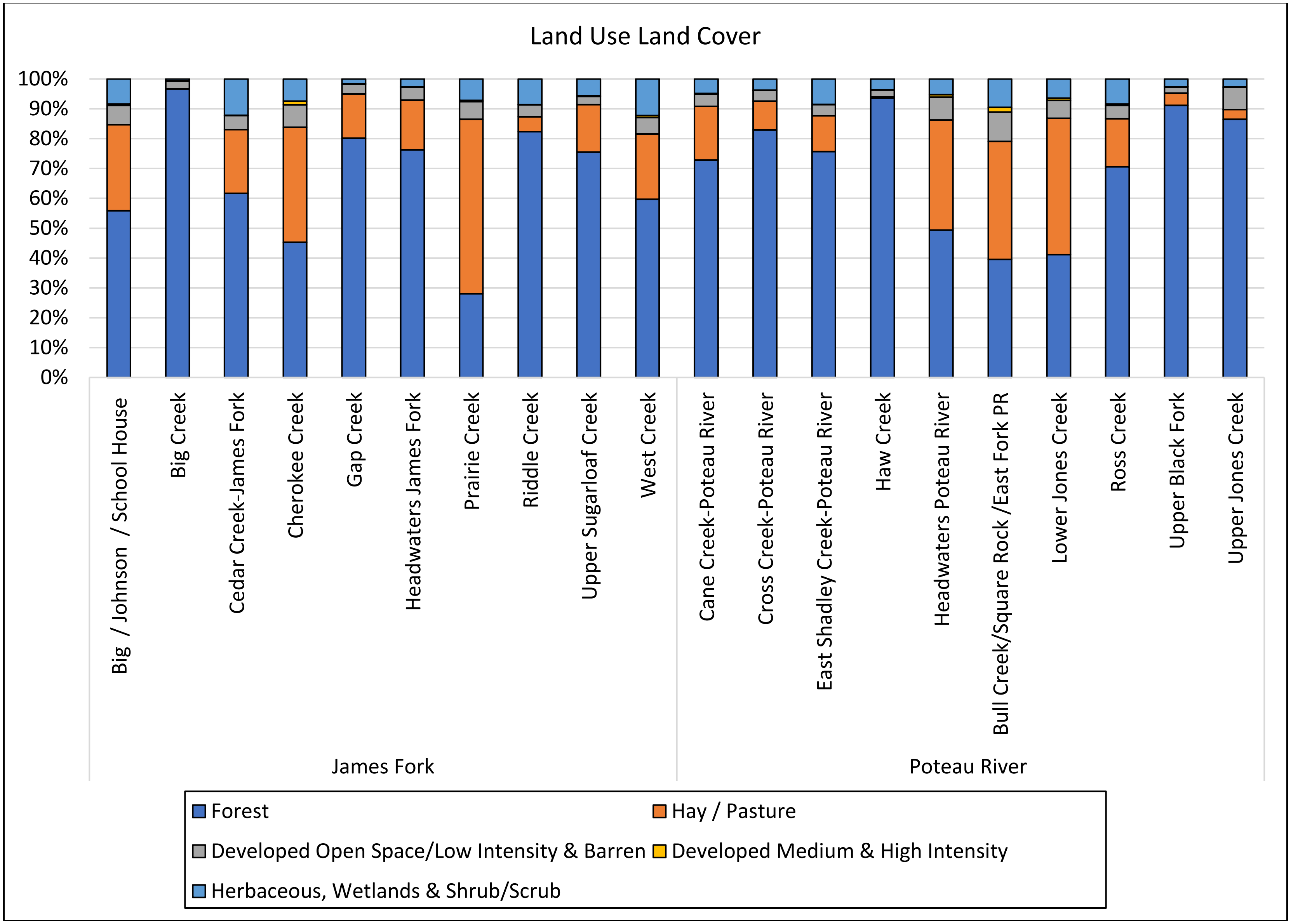

Figure 3.1.1.2 Land use land cover for the Poteau River by subwatershed in 2019.

3.1.2 Oil and Gas Well Density

The Lower Hartshorne Coal Seam is in west Arkansas and has yielded 10 billion cubic feet of natural gas. The western part of the PRW contains the majority of the 395 gas wells (Figure 3.1.2.1) in the watershed. The drilling of natural gas wells and the creation of pipelines to transport and store the gas and access roads to the sites changes the dominant land use in these areas and typically creates additional areas for storm water runoff. These changes could cause an increase in runoff volume and amount of sediment transport originating from the gravel used to build the pads and roads. Therefore, the number of active gas wells was used in the ranking matrix as another potential source for non-point source pollution.

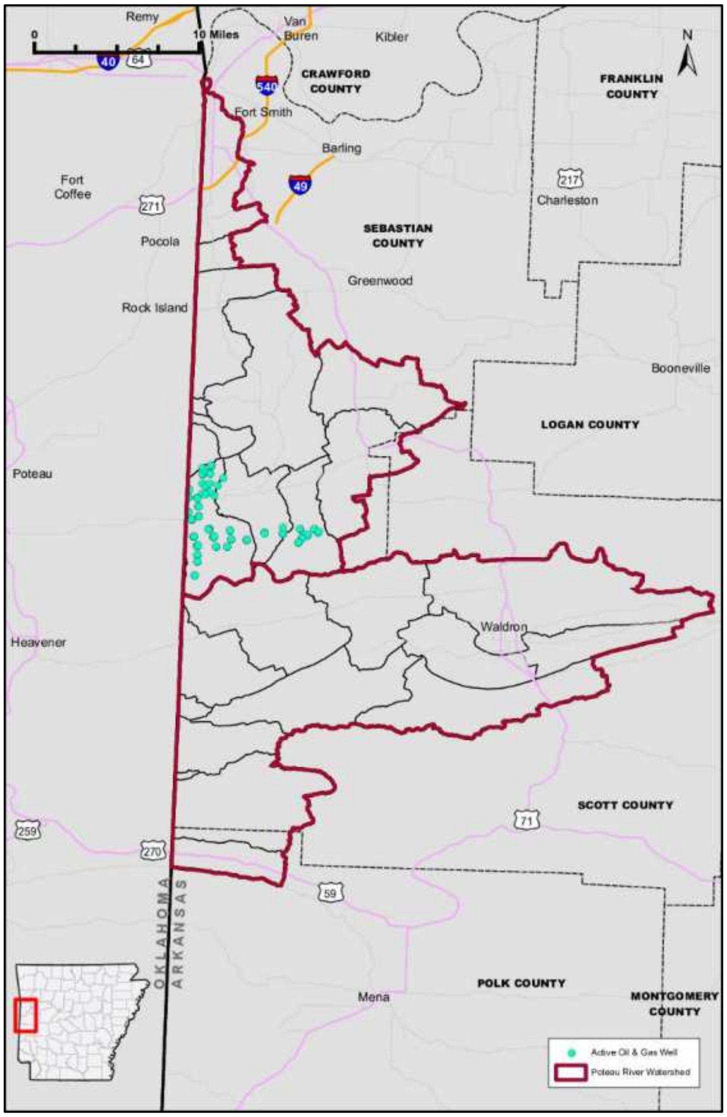

Figure 3.1.2.1. Oil and gas well density in the PRW (Arkansas Oil and Gas commission, 2014).

3.2 Unified Stream Assessment

A variation (modified to address rural streams) of the Unified Stream Assessment (USA) protocol (Kitchel and Schueler, 2004) was completed in the Poteau River subwatersheds in 2018 and 2021 for the in the James Fork subwatersheds. This visual based field assessment protocol consists of breaking the stream into manageable reaches and evaluating, on foot, each defined reach in its entirety. The evaluation is a screening level tool intended to provide a quick characterization of stream corridor attributes that can be used in determining the most significant problems in each stream reach from a physical, ecological, chemical, and hydrologic perspective. General categories of stream corridor characteristics assessed are:

1. Hydrology
2. Channel morphology
3. Substrate
4. Aquatic habitats
5. Land use
6. Riparian buffer
7. Water/sediment observations
8. Stream impacts (non-point source related, including bank erosion)
9. Floodplain dynamics
10. Geomorphic attributes (channel stability)
11. Restoration/retrofit opportunities

Field data forms completed during the survey are included in Appendix A. A summary of the pertinent findings are provided in Table 3.2.1. A 1,500-foot (minimum) representative section in each subwatershed was assessed following the USA protocol. The impacts observed and their frequency of occurrence is assumed to be consistent with additional comparable stream reaches in that subwatershed. That is, stream reaches not assessed on that stream that have similar channel size to the assessed reach are anticipated to have similar characteristics and issues at a similar frequency to those of the reach assessed.

Streambank erosion, riparian impacts, and bank stability were noted as the biggest impacts on the reach at several areas in the subwatersheds. Streambank erosion was noted most frequently and varied in severity from low to very high. Bank erosion was often times associated with pasture and urban land uses where the riparian vegetation had been disturbed or removed. Often these impacted buffer areas are dominated by pasture land use that extended to the streambank edge and the absence of well-developed vegetated buffers (both trees and under story vegetation) along the stream (Figure 3.2.1). Riparian buffers provide several benefits to streams, they provide stabilization to streambanks that prevents erosion, provides shading that helps cool the water and limit periphyton growth, and they provide organic matter inputs which serve as food and habitat for aquatic biota. Well-developed riparian buffers can also filter storm water pollutants and allow for increased rainwater infiltration which aids in protecting the streams hydrology (through decreased peak flows and increased baseflow). However, in some streams, particularly in the James Fork portion of the watershed, even in the presence of DEQuate riparian areas, some stream banks were eroding at an alarming rate. The erosion is partially due to the highly erodible nature of the rocky soil.

Table 3.2.1. Summary of bank erosion and biggest impacts on the reach that was identified during USAs.

Watershed	HUC- 12 Subwatershed	Percent of Moderate Hazard Bank Erosion	Percent of High Hazard Bank Erosion	Percent of Very High Hazard Bank Erosion	Biggest Impacts on Reach
James Fork	Big / Johnson / SH	0	4.4	0	Bank erosion, cattle runoff, stream crossing, and impacted riparian buffer
	Cherokee Creek	2.2	4.7	3.1	Stream bank erosion, stormwater outfalls, impacted riparian buffer, utilities, and trash
	Headwaters James Fork	0	3.6	9.1	Stream bank erosion, impacted riparian buffer, utilities, and cattle runoff
	Prairie Creek	3.2	17.3	15.7	Stream bank erosion, and impacted riparian buffer
	West Creek	5.7	14.9	15.2	Stream bank erosion, stream crossings, impacted riparian buffer, and cattle runoff
Poteau River	BC/SR/EFPR	0	36.1	0	Impacted riparian buffer, urban runoff, and stream bank erosion
	BC/SR/EFPR	14.9	0	0	Cattle runoff, impacted riparian buffer, stream bank erosion, and broiler runoff
	BC/SR/EFPR	14.5	0	0	Cattle runoff and streambank erosion
	BC/SR/EFPR	42.6	0	0	Impacted riparian buffer, urban runoff, and broiler runoff
	Headwaters Poteau River	10.6	2.5	0	Cattle runoff, impacted riparian buffer, broiler runoff, and stream bank erosion
	Lower Jones Creek	2.7	3.9	0	Quarry runoff and cattle runoff

Figure 3.2.1. Comparison of an impacted riparian buffer (Lower James Fork) to a well-developed riparian buffer (Cherokee Creek).

Bank erosion was noted in several areas, particularly in West Creek and Prairie Creek in the James Fork portion of the watershed and BC/SR/EFPR. Each instance of bank erosion was tagged with a GPS coordinate and the length of the affected bank measured or estimated. The severity of bank erosion was then characterized using a bank erosion hazard index (BEHI) developed by Dave Rosgen (Rosgen, 2006). The BEHI uses several characteristics of the eroded bank (height, vegetated protection, bank angle, soil composition, etc) to calculate an overall score that relates to level of erosion hazard. The possible erosion levels are low, moderate, high, very high, and extremely high. Bank erosion observed in the PRW watershed ranged from low active erosion to very high active erosion. Some of the high erosion hazard (Figure 3.2.2) was in areas where the riparian buffers had been removed and the banks were greater than four feet high. Gravel and silt/clay were the dominant stream substrates of these subwatersheds. Gravel is fairly susceptible to erosion; however, silt/clay substrate is the least susceptible to erosion. The soils in the overall PRW are mostly composed of gravelly fine sandy loam, fine sandy loan, and silt loam with a moderate potential for erosion. However, with the amount of pasture land use in the subwatersheds, some banks have eroded more by not being protected by good riparian area.

Streambank erosion can add hundreds of tons of sediment (and nutrients) to a stream system annually. The number and length of eroded banks were calculated using the representative USA reach to scale up to the main tributary stream length in each subwatershed. The main tributary stream length, the percent of USA reach affected by bank erosion, average bank height, dominant substrate and an erosion rate coefficient (from 0.25 ft-3.0 ft based on BEHI scores) was used to determine pounds of sediment/foot of eroded bank (Table 3.2.2). There were 11 USAs completed in the PRW. The USA data that was collected was used in the other similar subwatersheds as a surrogate. That is, the reach erosion percentages from USA locations were used as surrogates for where USAs were not completed. If there was a surrogate used, it’s indicated in the table below in the stream column.

Table 3.2.2. Estimated bank erosion rates for each sub watershed.

Watershed	HUC-12 Watershed	Stream assessment was completed or surrogate"used"	Reach Length (ft)	Bank Erosion Length (LB+RB,ft)	% Reach Eroded	NHD Stream Length (ft)	Stream Length Eroded (ft)	Average Bank Height (ft)	Erosion Rate (ft/yr)	Volume Sediment Eroded (ft3/yr)	% Gravel/Cobble	Sediment Eroded Adjusted for gravel/cobble (ft3/yr)	Sediment Eroded (ft3/mi)
James Fork	Big / Johnson / SH	James Fork (JF-1)	3,376	300	8.89%	453,698	40,317	12.45	2.00	1,003,887	0%	1,003,887	11,683
	Big Creek*	Used Headwaters James Fork	--	846	12.66%	207,946	26,326	8.25	1.72	372,764	58%	156,561	3,975
	Cedar Creek-James Fork*	Used Headwaters James Fork	--	846	12.66%	12,086	1,530	8.25	1.72	21,665	58%	9,099	3,975
	Cherokee Creek	Cherokee Creek (CC-1)	6,738	675	10.02%	111,190	11,139	7.79	1.20	104,126	29%	73,929	3,511
	Gap Creek*	Used Headwaters James Fork	--	846	12.66%	7,098	899	8.25	1.72	12,724	58%	5,344	3,975
	Headwaters James Fork	Upper James Fork (UJF-1)	6,680	846	12.66%	111,262	14,091	8.25	1.72	199,522	58%	83,799	3,977
	Prairie Creek	Prairie Creek (PC-1)	5,504	1,990	36.16%	134,474	48,620	8.44	1.39	570,676	18%	467,955	18,374
	Riddle Creek*	Used Headwaters James Fork	--	846	12.66%	33,880	4,289	8.25	1.72	60,733	58%	25,508	3,975
	Upper Sugarloaf Creek*	Used West Creek	--	2,185	38.40%	52,014	19,973	7.78	1.45	225,977	7%	210,159	21,333
	West Creek	West Creek (WC-1)	5,696	2,185	38.36%	51,518	19,762	7.78	1.45	223,591	7%	207,940	21,311
Poteau River	BC/SR/EFPR	Average	14,532	3,957	27.23%	134,398	36,582	5.68	0.16	33,308	59%	8,525	335
	Cane Creek-Poteau River*	Used Bull Creek	--	3,957	27.23%	60,086	16,361	5.68	0.16	14,897	59%	6,108	537
	Cross Creek - Poteau River	Used Bull Creek	--	3,957	27.23%	88,227	24,024	5.68	0.16	21,874	59%	8,968	537
	East Shadley Creek-Poteau River*	Used Bull Creek	--	3,957	27.23%	83,576	22,757	5.68	0.16	20,720	59%	8,495	537
	Haw Creek*	Used Headwaters James Fork	--	846	12.66%	33,855	4,286	8.25	1.72	60,689	58%	25,489	3,975
	Headwaters Poteau River	Poteau River West	4,800	752	15.67%	111,536	17,474	6.94	0.54	65,247	68%	20,879	988
	Lower Jones Creek	Jones Creek	4,240	339	8.00%	97,570	7,801	6.75	0.70	36,813	0%	36,813	1,992
	Ross Creek*	Used Lower Jones Creek	--	339	8.00%	111,524	8,917	6.75	0.70	42,078	0%	42,078	1,992
	Upper Black Fork*	Used Headwaters James Fork	--	846	12.66%	136,653	17,300	8.25	1.72	244,964	58%	102,885	3,975
	Upper Jones Creek*	Used Lower Jones Creek	--	339	8.00%	146,813	11,745	6.75	0.70	55,425	0%	55,425	1,993

*Bank erosion was estimated using the percent reach eroded and the NHD stream length

Stream bank erosion, impacted riparian buffers, and cattle runoff were the major impacts that were observed while completing the USAs. The two streams with the highest stream bank erosion were in the Big Branch / Johnson / School House and Prairie Creek subwatersheds (Figure 3.2.2). Streambank erosion (lb/year) is a key attribute used in the ranking matrix.

Figure 3.2.2. Streambanks with high bank erosion hazard (left, Prairie Creek; City Main Tributary, Bull Creek).

3.3 Geomorphology and Channel Stability

Fluvial geomorphology refers to the interrelationship between the land surface (topography, geology, and land use) and stream channel shape (morphology). When the force of running water is exerted on the land surface and streambank it can have significant effects on the morphology of stream channels. A stable stream, or one said to be in “equilibrium”, is one where water flows do not significantly alter the channel morphology over short periods of time. The most important flow level in defining the shape of a stream is its bankfull flow (or effective discharge). Bankfull discharge is the stage at which water first begins to enter the active flood plain. A detailed geomorphic assessment of each subwatershed was beyond the scope of this project. However, several geomorphic attributes were estimated during the USA, and are helpful in assessing channel stability (Rosgen, 1996). Table 3.3.1 provides a summary of the channel dimensions estimated (and some measured) during the 11 USAs as well as key stability issues noted.

Table 3.3.1. Summary of geomorphic characteristics observed during the USAs.

Parameter (estimated)	**James Fork**					**Poteau River**					
	Big / Johnson / SH	**Cherokee Creek**	**Headwaters James Fork**	**Prairie Creek**	**West Creek**	**BC/SR/EFPR (CMT-1)**	**BC/SR/EFPR (PR-0.5)**	**BC/SR/EFPR (PR-3)**	**BC/SR/EFPR (PR-0E)**	**Headwaters of Poteau River (PR-0W)**	**Lower Jones Creek**
Watershed area (mi^2)	119.4	28.2	19.3	27.3	17.4	64	64	64	64	16	21.6
Bankfull depth (ft)	6.4	2.1	3.3	2.3	2.7	6.0	5.0	3.0	4.0	4.0	3.5
Bankfull width (ft)	83	28	64	59	43	20	20	75	17	51	185
Substrate size class	Silt/clay	Silt/clay/ gravel	Sand/ gravel/ cobble	Silt/ clay/ gravel	Silt/ clay/ gravel	Silt/clay	Bedrock	Silt/clay	Gravel	Bedrock	Silt/ clay
Width: Depth ratio	13	14	19	26	16	3	4	25	4	13	53
Entrenchment Ratio	1.13	1.16	1.18	1.14	1.06	1.05	1.13	1.17	1.06	1.38	1.11
Overall BEHI	Very High	High	High	High	High	High	Moderate	Low	Moderate	Moderate	Moderate
Channel stability issues	Widening and bank scour	Incision and bank sour	Channelized, aggrading, bank scour	Aggrading, widening and bank scour	Stream Crossing	Bank scour and failure	Minor bank scour	Bank failure	Bank Scour	Bank Scour	Incision and bank scour

Width:Depth Ratio = bankfull width (ft) / bankfull depth (ft)

Entrenchment Ratio= Width of flood prone area (ft) / Width of bankfull (ft)

3.3.1 Riparian Buffer Impacts

Riparian buffers are the vegetated area directly adjacent to the streambank. When riparian buffers are impacted (reduced buffer width and/or quality) they provide a more direct pathway for NPS pollution to enter streams. Riparian buffers were assessed during the USA's and are a part of the desktop assessment. The West Creek reach had the narrowest riparian buffer width noted during the USA, less than 10 feet. On average, the impacted riparian buffers were 11-25 feet for the reaches evaluated (Table 3.3.1.1).

Impacted riparian buffers are often associated with higher streambank erosion because a lesser riparian area can allow an increasing amount of unfiltered storm water to enter the stream. Without sufficient riparian buffer, infiltration into the riparian is not readily occurring and the roots of the riparian buffer, which usually help secure soil, are insufficient to secure the banks to mitigate erosion. At West Creek USA reach, encroachment by cattle was one of the reasons for the small riparian buffer. To account for more than just reach scale (USA based) riparian buffer condition and since USAs were not conducted on all watersheds, each main stem perennial stream (identified per aerial imagery from Google Earth) in each associated subwatershed was examined using aerial photography to determine how many linear feet of stream was affected by impacted riparian buffer (< 50 ft of riparian width). These lengths were then divided by the total length (total length x2 to account for left and right bank riparian) of the perennial stream in that subwatershed to represent percent of stream with impacted riparian buffers to help identify and assess where significant problems might exist (Table 3.2.2).

Table 3.3.1.1. Summary of riparian evaluation from the USAs and desktop analysis (% of impacted riparian buffer).

Watershed	HUC- 12 name	% of Impacted Riparian Buffer (<50 ft)	Riparian Width from USA Evaluation (ft)
James Fork	Big / Johnson / SH	3.1	> 50
	Big Creek	4.5	--
	Cedar Creek-James Fork	5.2	--
	Cherokee Creek	18.1	26 - 50
	Gap Creek	15.9	--
	Headwaters James Fork	2.2	11 - 25
	Prairie Creek	13.5	> 50
	Riddle Creek	3	--
	Upper Sugarloaf Creek	14.1	--
	West Creek	17.1	LB > 50, RB < 10
Poteau River	BC/SR/EFPR	27.9	11 - 25
	Cane Creek-Poteau River	10.6	--
	Cross Creek-Poteau River	0.9	--
	East Shadley	17.3	--
	Haw Creek	15	--
	Headwaters Poteau River	22.6	11 - 25
	Lower Jones Creek	6.6	--
	Ross Creek	39.8	--
	Upper Black Fork	9.2	--
	Upper Jones Creek	12.3	--

According to Table 3.3.1.1, Ross Creek, BC/SR/EFPR , and Headwaters of the Poteau River have the largest percentages of impacted riparian buffer at 39.8%, 27.9%, 22.6%, respectively. Impacted riparian buffer is a key attribute included in the ranking matrix.

3.3.2 Unpaved Roads

Unpaved roads are common in rural Arkansas. Over 85% of Arkansas county roads are gravel. There are over 330 miles of unpaved roads in the watershed. During storm events these roads can transport significant loads of sediment into adjacent streams. The magnitude of the sediment load varies dependent on many factors including proximity to streams, condition of the road, slope and the design of the road. Gravel roads can be designed to include best management practices (BMPs) that reduce erosion of the bed material and the transport of that material into streams.

The unpaved road assessment was completed using GIS road layers for each subwatershed in the PRW. A summary of this data is provided in Table 3.3.2.1. Sediment loading for each mile of unpaved road was estimated based on a recent study completed in Pennsylvania by the Center for Dirt and Gravel Road Studies (Bloser and Scheetz 2012). The study determined the load of sediment transported for several different unpaved road types and conditions that would result from a 0.6-inch rain event occurring over 30 minutes. Unpaved roads in the Pennsylvania study are not unlike unpaved roads in Arkansas.

For purposes of the PRW assessment an average rate of sediment transport was set at 485 lb/mile of unpaved road per rain event. The 485 lb/mi sediment rate was the average runoff rate from roads with average maintenance and traffic levels and roads that had been recently topped with fresh aggregates which produce much lower levels of sediment runoff. Twelve rain events (>1.0 inch) were assumed to occur each year and each rain event would result in 485 lb sediment per mile of road (Table 3.3.2.1) (Bloser and Scheetz, 2012). Potential load of sediment from unpaved roads is a key attribute used in the ranking matrix.

Table 3.3.2.1. Summary of unpaved roads in the PRW and estimates of sediment loads from unpaved roads in the PRW.

Watershed	HUC Number	HUC name	Unpaved Roads (miles)	TSS load per rain event (lbs)	Annual Loads (12 rain events) (lbs)
James Fork	111101050807, 111101050805, 111101050806	Big / Johnson / SH	35.5	17,218	206,610
	111101050201	Big Creek	1.6	755	9,062
	111101050808	Cedar Creek-James Fork	0.5	238	2,860
	111101050803	Cherokee Creek	15.1	7,342	88,103
	111101050610	Gap Creek	3.7	1,787	21,440
	111101050801	Headwaters James Fork	2.6	1,263	15,156
	111101050804	Prairie Creek	5.1	2,466	29,595
	111101050611	Riddle Creek	4.9	2,380	28,560
	111101050605	Upper Sugarloaf Creek	10.1	4,903	58,835
	111101050802	West Creek	6.3	3,053	36,631
Poteau River	111101050107, 111101050101, 111101050106	BC/SR/EFPR	59.8	28,991	347,886
	111101050303	Cane Creek-Poteau River	17.2	8,352	100,222
	111101050301	Cross Creek-Poteau River	18.3	8,896	106,752
	111101050302	East Shadley Creek-Poteau River	34.1	16,546	198,554
	111101050203	Haw Creek	8.9	4,336	52,034
	111101050102	Headwaters Poteau River	21.2	10,297	123,561
	111101050105	Lower Jones Creek	19.4	9,430	113,159
	111101050103	Ross Creek	34.8	16,898	202,781
	111101050202	Upper Black Fork	27.8	13,472	161,664
	111101050104	Upper Jones Creek	18.9	9,169	110,033

3.3.3 Land Slope

A land slope analysis was also completed for the watershed and is provided in Table 3.3.3.1. Slopes are generally homogenous between subwatersheds. On average the slope was low, 6.3%, for our subwatersheds and ranged from 2.7% to 14.6%. High slope (steep) areas have a higher potential for soil loss during high volume rain events and those areas also provide less opportunity for infiltration, allowing more water to runoff into the stream channels which, besides carrying a large sediment load, can cause increased streambank erosion and channel scour compounding the issue. Slope in the majority of the PRW is less than 9%. High slope areas are a key attribute considered in the ranking matrix (NLCD, 2019).

Table 3.3.3.1. Summary of land slope analysis (NLCD, 2019).

Watershed	**HUC Number**	**HUC name**	**Mean Slope (percent rise)**
James Fork	111101050807, 111101050805, 111101050806	Big /Johnson/ SH	4.3
	111101050201	Big Creek	14.6
	111101050808	Cedar Creek-James Fork	3.4
	111101050803	Cherokee Creek	4.2
	111101050610	Gap Creek	8.5
	111101050801	Headwaters James Fork	8.4
	111101050804	Prairie Creek	2.7
	111101050611	Riddle Creek	8.7
	111101050605	Upper Sugarloaf Creek	8
	111101050802	West Creek	5.3
Poteau River	111101050107, 111101050101, 111101050106	BC/SR/EFPR	4.7
	111101050303	Cane Creek-Poteau River	7.3
	111101050301	Cross Creek-Poteau River	8.2
	111101050302	East Shadley Creek-Poteau River	7.9
	111101050203	Haw Creek	7.1
	111101050102	Headwaters Poteau River	5.1
	111101050105	Lower Jones Creek	3.7
	111101050103	Ross Creek	7.5
	111101050202	Upper Black Fork	8.5
	111101050104	Upper Jones Creek	8.1

3.3.4 Soils

Soils on the land surface in the overall PRW are mostly composed of gravelly fine sandy loam, fine sandy loan, and silt loam with a moderate potential for erosion.

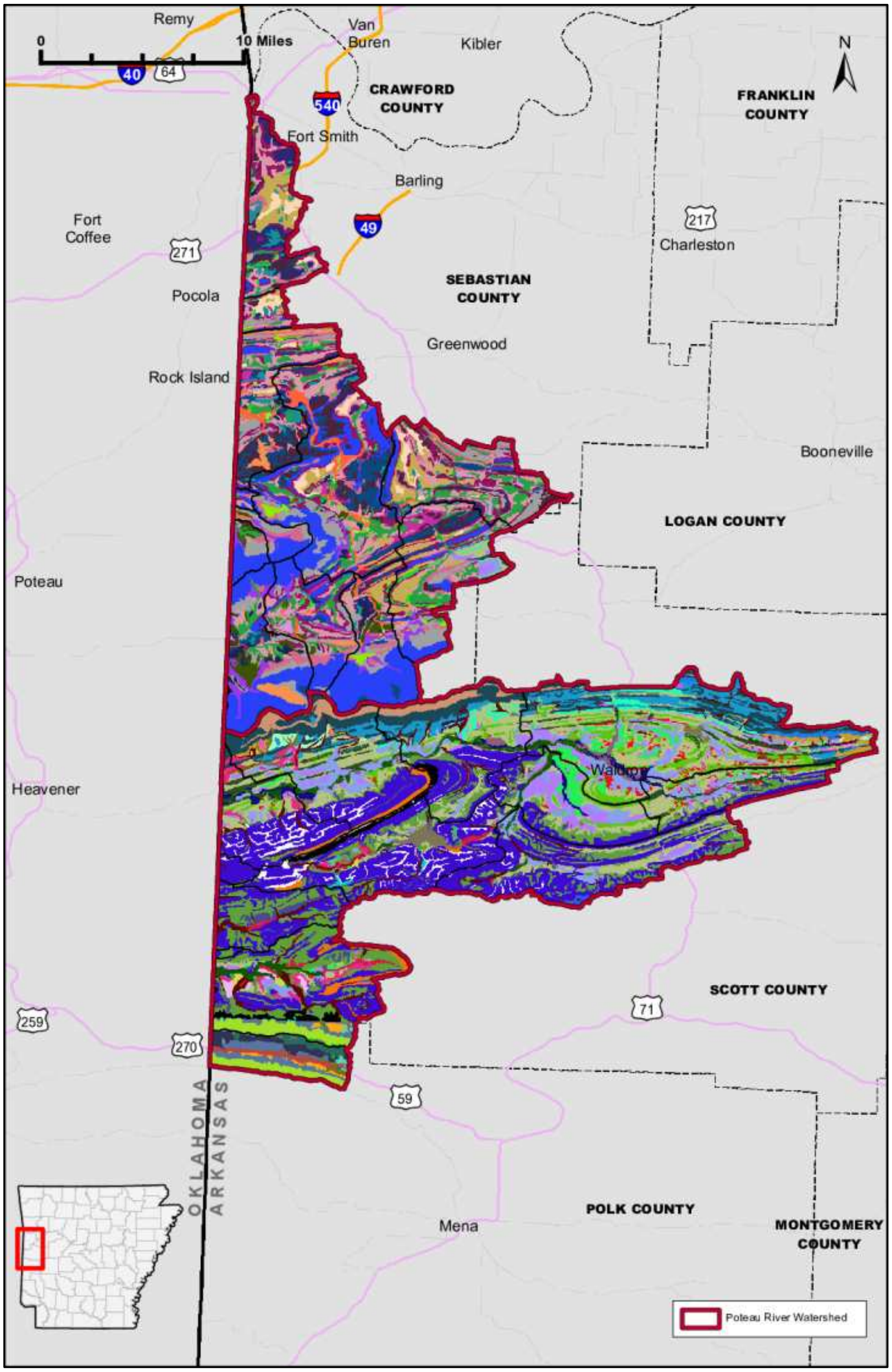

Figure 3.3.4.1 Map of soils in the PRW.

3.3.5 Agricultural Animal Numbers

Numbers of agricultural animals were estimated in the watershed. Poultry house numbers were counted using aerial imagery. Each poultry house was assumed to be managed consistent with industry standards. The industry standard is that houses generally contain approximately 24,000 birds each, have 5-6 batches per year and are cleaned out approximately 2 times per year. Poultry litter (a combination of manure and bedding material) is frequently used as fertilizer on pastures in Arkansas. For cows the number of “all cattle and calves” for each county were used, along with the number of acres of pasture in each county, to calculate number of cows per acre pasture to determine number of cows in each subwatershed unless data was provided by the Poteau River Conservation District (PRCD). Cows were assumed to be evenly spread out over the pastures in the counties affected. A cows/acre number was then assigned to each subwatershed using the number of acres of pasture determined through the land use analysis unless data was provided by the PRCD. More accurate data was provided, primarily in the Poteau River drainage, by the PRCD whose staff estimated cattle numbers while out in the watershed completing their routine visits. Those cattle numbers that PRCD provided are signified in the table below. A summary of the agricultural animal estimates is provided in Table 3.3.5.1.

Table 3.3.5.1. Agricultural animal estimates per subwatershed.

Watershed	HUC name	Cattle/Calves	Chickens (#/mi^2)[1]
James Fork	Big / Johnson / SH	1,412	7,207
	Big Creek	318	0
	Cedar Creek-James Fork	23	0
	Cherokee Creek	690	14,894
	Gap Creek	105	8,392
	Headwaters James Fork	200	11,192
	Prairie Creek	668	21,099
	Riddle Creek	108	0
	Upper Sugarloaf Creek	563	8,348
	West Creek	426	11,724
Poteau River	BC/SR/EFPR	2,975*	37,500
	Cane Creek-Poteau River	75*	5,373
	Cross Creek-Poteau River	75*	3,834
	East Shadley Creek-Poteau River	1,575*	5,326
	Haw Creek	387	0
	Headwaters Poteau River	200*	0
	Lower Jones Creek	2,900*	61,700
	Ross Creek	856	18,514
	Upper Black Fork	100	612
	Upper Jones Creek	450	2,421

[1] Poultry numbers based on total number at a point in time. Chicken numbers are based on 120,000/house/year (24,000 x 5 per year) then divided by watershed area to get chickens per mi^2.

*Data was provided by visual surveys completed by the Poteau River Conservation District.

3.4 Water Quality

3.4.1 319 Grant Efforts

The PRW has had ongoing water quality monitoring in both Arkansas and Oklahoma that has included base and storm flow monitoring. In Oklahoma, there have been three projects funded by the Poteau Valley Improvement Authority (PVIA) that have sampled the PRW with specific interest in water quality and flow data of the middle Poteau River and the Fourche Maline Watershed that drains into Lake Wister. Lake Wister is on the Oklahoma 303(d) list for turbidity, total phosphorus and chlorophyll-a and is a regional drinking water source for Oklahoma residents. A summary of the loading data from the DRAFT Lake Wister Watershed Plan (PVIA & OCC, July, 2021) is provided in Table 3.4.1.1. This data was used by PVIA to develop a TMDL for both sediment and phosphorus with annual loading targets depicted in Table 3.4.1.1

In 2017-2018, GBMc & Associates collected water quality and flow data in the Poteau River Watershed (319 Grant 16-1100). Six base flow and six storm flow samples were collected between January 2017 and May 2018 (Figure 3.4.1). Loading data was also analyzed for the sampling period and is provided in Table 3.4.1.2. The purpose of the monitoring was to identify key subwatersheds with higher-than-average loading of primarily sediment and nutrients. To account for varying watershed sizes and the impact it has on the loading calculation, loading data was divided by watershed size to normalize it and to achieve pounds per acre for each constituent (Figures 3.4.1.1-3.4.1.7). Key contributors based on water quality were found to be CMT-1, PR-0W, the watershed area between PR-2 and PR-3, and JC-1. Potential sources that were identified are agricultural runoff, impacted riparian buffer and developed area runoff. All historical data from this study and others, used in this WMP is provided as a summary in Appendix B.

In addition, the University of Arkansas collected water quality and flow data in the PRW (319 Grant 17-300) that has become the primary data assessed for water quality loading. This project had monthly sampling that averaged 47 baseflow samples at each site plus storm flow that averaged 24 per site, totaling on average 71 water quality samples between October 2017 and December 2020. The University of Arkansas's data is the focus of the water quality analysis since their sampling trips captured the widest variety of storm and base flow events and they had the most samples collected consecutively over the longest period of time.

Table 3.4.1.1 Average yearly loads into Lake Wister with reductions and daily load targets for Lake Wister (PVIA & OCC, July, 2021).

Parameter	Average Load 2011-2015 (lb/year)	TMDL (Annual basis) (lb/year)	10% Margin of Safety (lb/year)	Target Annual Load (lb/year)	Target Daily Load (lb/year)
Total Phosphorus	488,957	107,570	10,756	96,814	265
Total Suspended Solids	314,291,118	91,144,315	9,114,433	82,029,885	224,739

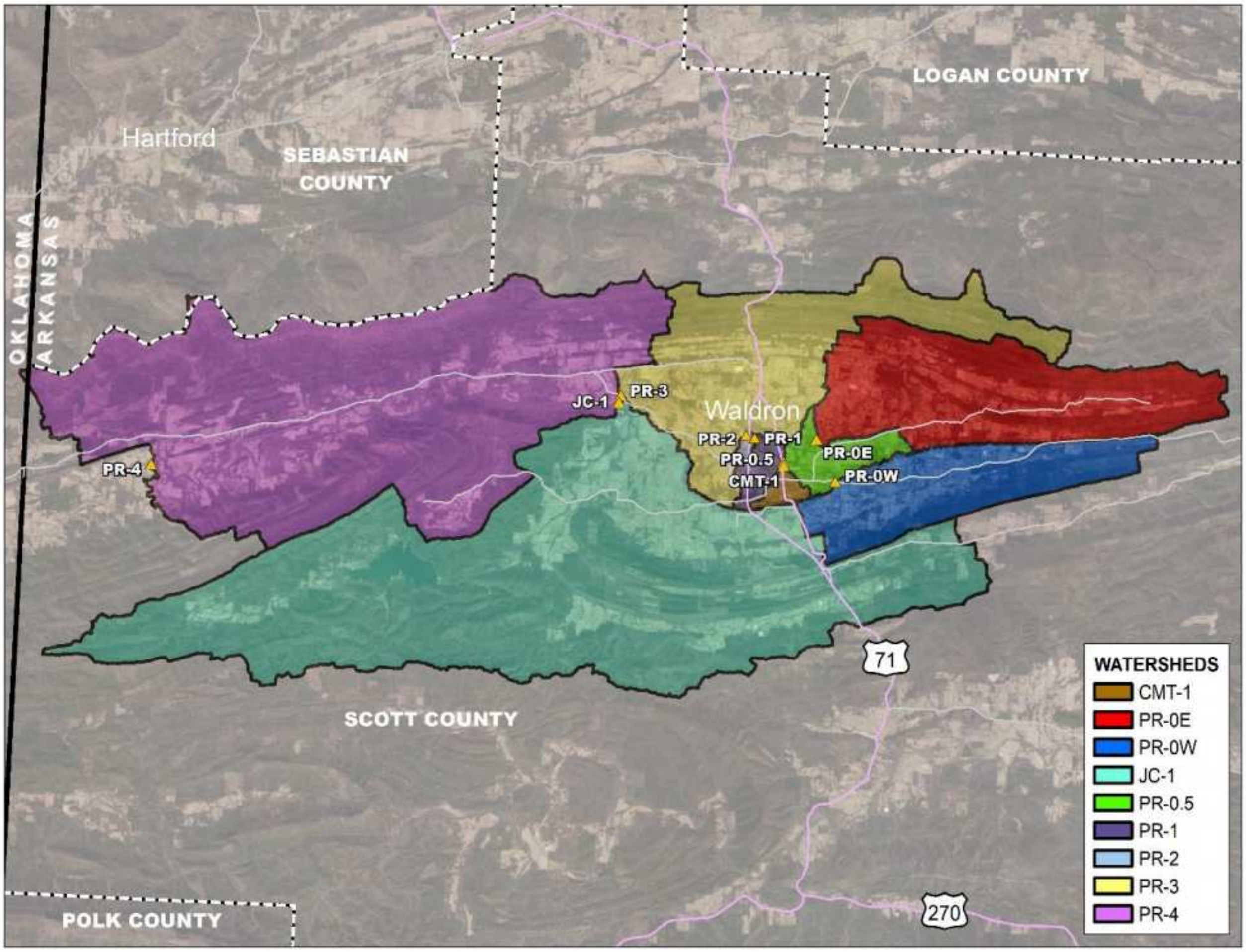

Figure 3.4.1. General overview of the GBMc & Associates Poteau River Watershed Sampling Points and the Subwatersheds Represented by the Sampling. (Grant #17-300).

Table 3.4.1.2 Summary of base and storm loading data collected in January 2017-May 2018 (Grant #17-300).

Monitoring Location	UofA equivalent	Type of Event	Ammonia (lb/acre)	Nitrate-Nitrite (lb/acre)	Total Phosphorus (lb/acre)	Phosphate (lb/acre)	Total Dissolved Solids (lb/acre)	Total Suspended Solids (lb/acre)	Soluble Reactive Phosphorus (lb/acre)
CMT-1	--	Base	0	0	0	0	0.06	0	0
		Storm	0.0515	0.1354	0.05	0.1	15.89	6.22	0.02
JC-1	Upstream of POT-8	Base	0	0.0001	0	0	0.02	0	0
		Storm	0.0067	0.0384	0.05	0.09	8.14	9.38	0.02
PR-0.5	Upstream of POT-9	Base	0	0	0	0	0.01	0	0
		Storm	0.0059	0.0281	0.03	0.05	3.22	1.63	0.01
PR0E	Upstream of POT-9	Base	0	0	0	0	0.02	0	0
		Storm	0.0084	0.0413	0.06	0.14	2.37	7.98	0.04
PR-0W	POT-10	Base	0	0	0	0	0.01	0	0
		Storm	0.0069	0.031	0.01	0.05	3.93	3.78	0.01
PR-1	Upstream of POT-9	Base	0	0	0	0	0.01	0	0
		Storm	0.0069	0.0495	0.05	0.11	6.69	5.8	0.03
PR-2	Upstream of POT-9	Base	0	0.0005	0	0	0.06	0	0
		Storm	0.0086	0.0567	0.04	0.1	5.82	6.63	0.03
PR-3	POT-9	Base	0	0.0003	0	0	0.06	0	0
		Storm	0.0178	0.0777	0.09	0.18	18.1	10.54	0.05
PR-4	--	Base	0	0	0	0	0.02	0	0
		Storm	0.0067	0.0184	0.05	0.05	6.18	16.84	0.01

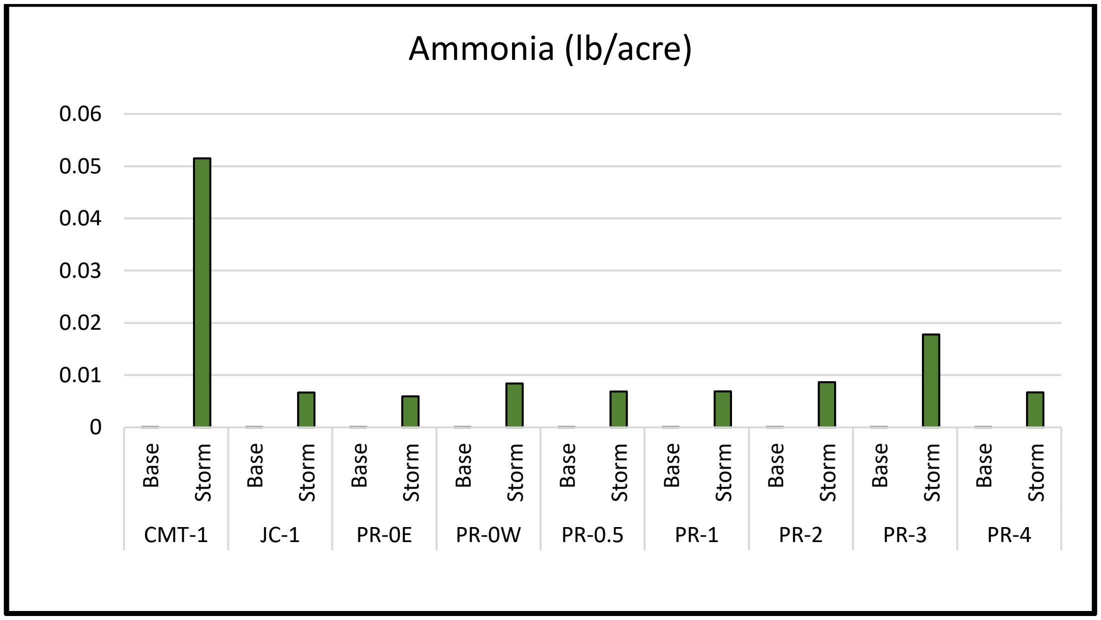

Figure 3.4.1.1. Average ammonia results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

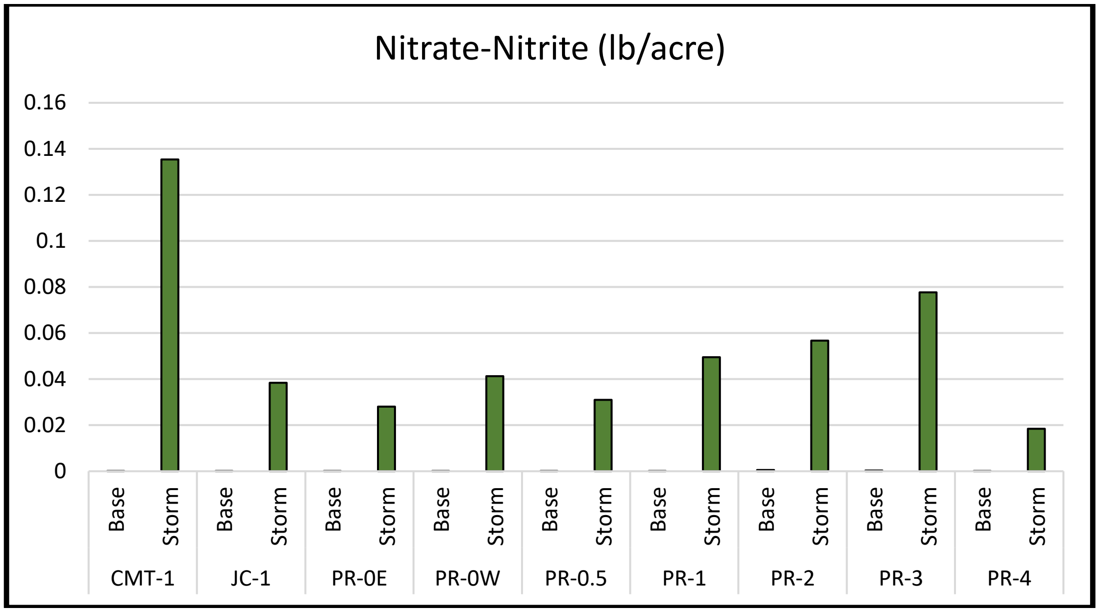

Figure 3.4.1.2. Average nitrate-nitrite results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

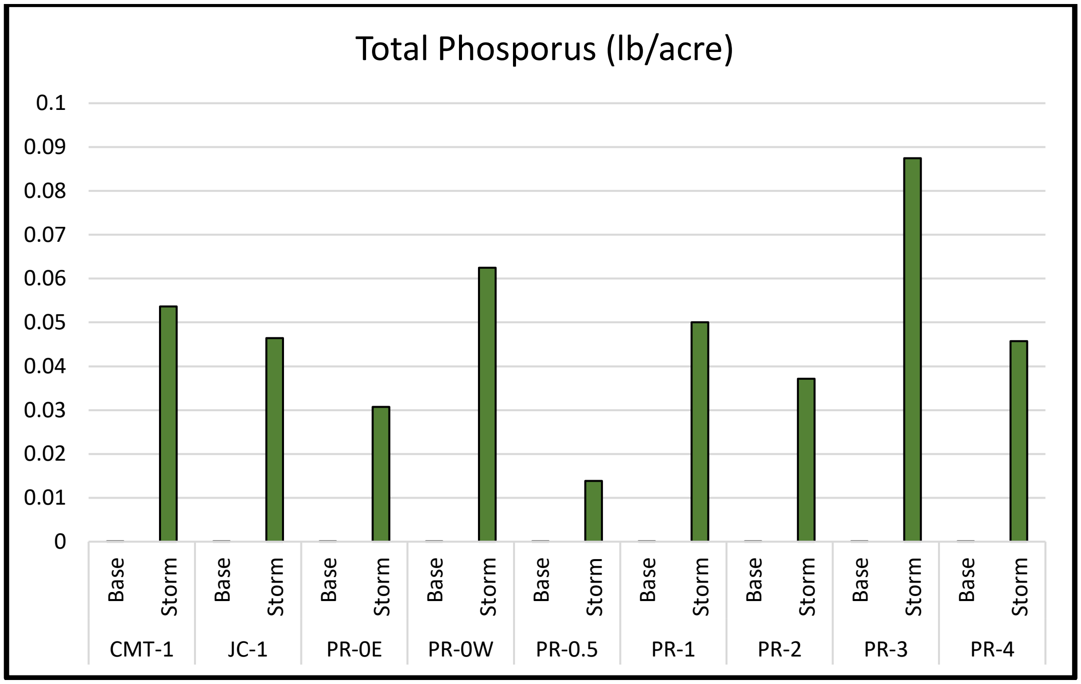

Figure 3.4.1.3. Average total phosphorus results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

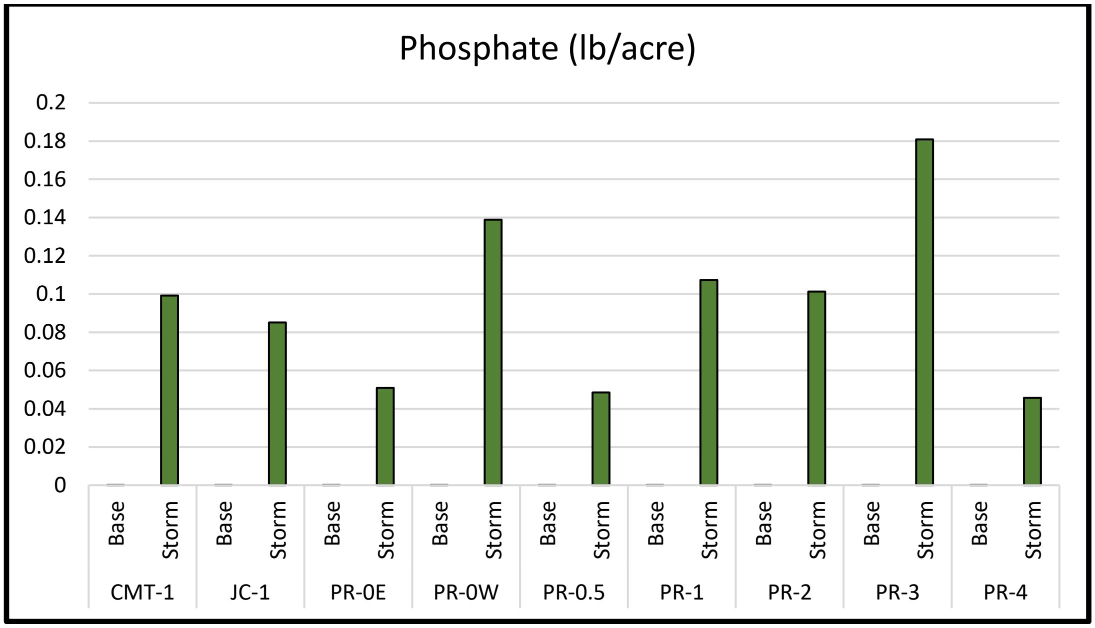

Figure 3.4.1.4. Average phosphate results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

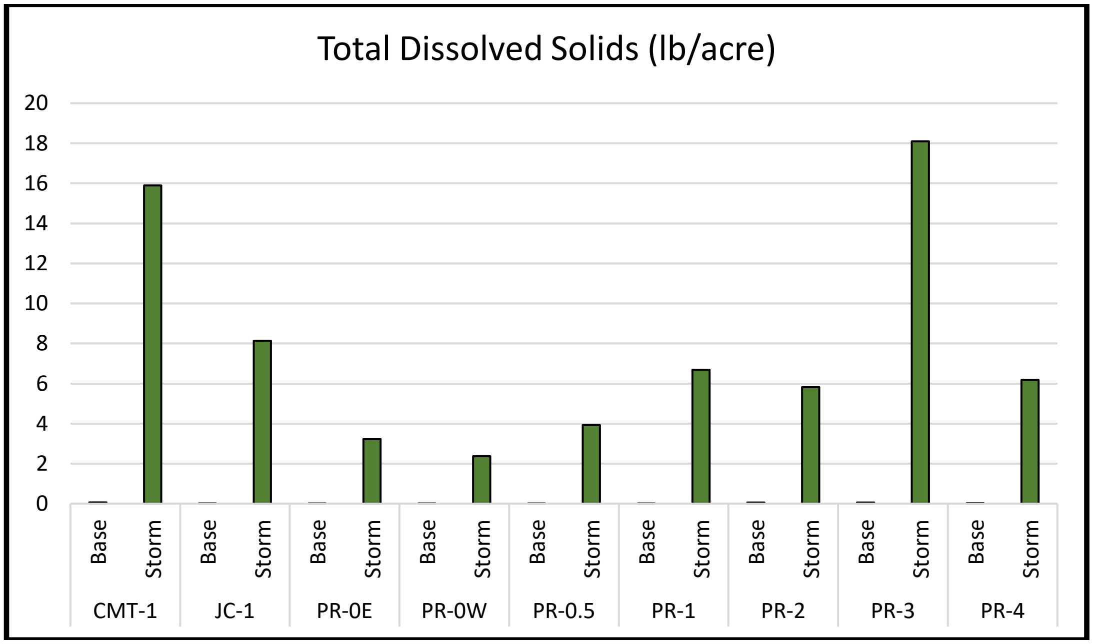

Figure 3.4.1.5. Average total dissolved solids results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

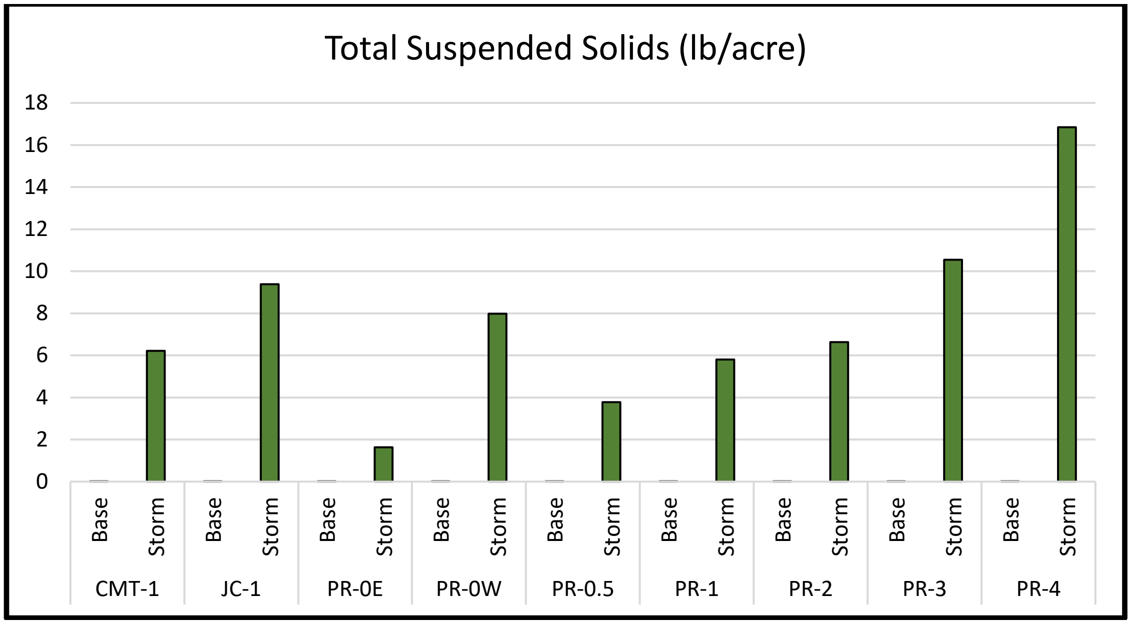

Figure 3.4.1.6. Average total suspended solids results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

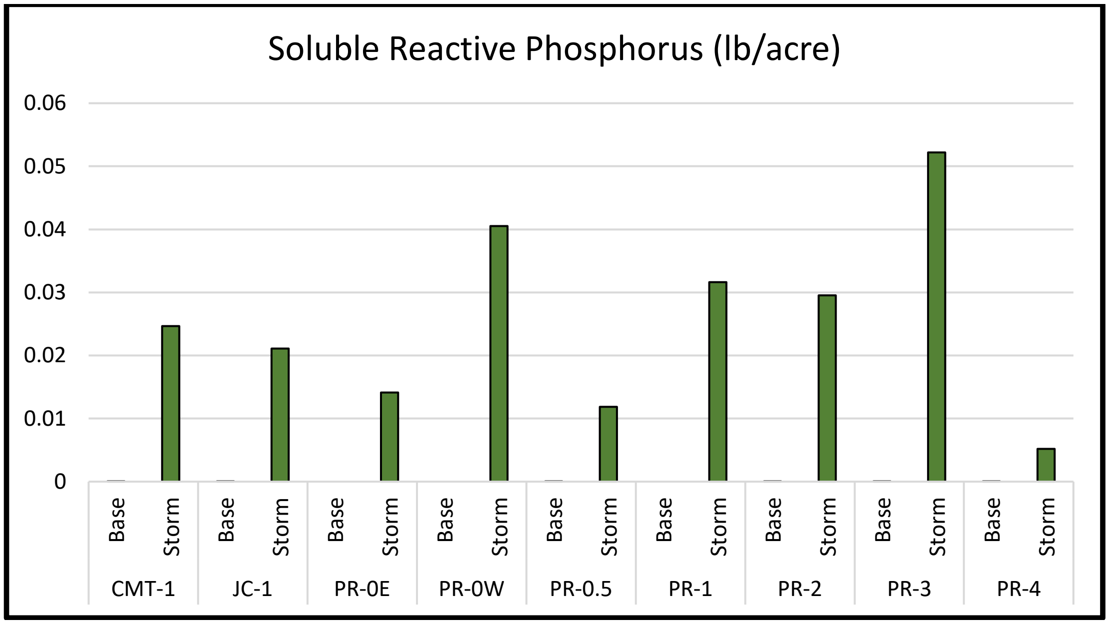

Figure 3.4.1.7. Average soluble reactive phosphorus results (lb/acre) from each sampling site during baseflow and storm flow events collected by GBMc and Associates in January 2017-May 2018.

3.4.2 Water Quality Data Collected Specifically for the WMP

Water quality data was collected by the University of Arkansas (under 319 Grant 17-300) to assess water quality and watershed loading that could later be used to develop a SWAT model and a WMP. Water samples and *in-situ* data were collected from 15 sample locations, representing 14 subwatersheds, in the PRW to determine the water quality during base flow and storm flow conditions (Figure 3.4.2.1). These 15 sampling stations were believed to represent a reasonable transect of the watershed and include key subwatersheds. The fifteen stations, representing 14 subwatersheds, were sampled a varying number of times for both baseflow events and storm flow events. Number of samples collected at each station is provided in Table 3.4.2.1. Three monitoring locations were in Oklahoma but the analysis for these watersheds were cut off at Arkansas state line and then scaled to the smaller watershed size in just Arkansas. Although monitored independently, if any of the 15 HUC- 12 watersheds were not monitored, a representative location that was monitored was used as a surrogate to predict water quality in the subwatershed that was not monitored.

Table 3.4.2.1 Count of base and storm flow samples collected at each of the 15 monitoring locations collected from October 2017 – December 2020 (Lasater and Haggard, 2021).

Sample Station	Count of base samples	Count of storm samples
Pot-1	75	31
Pot-2	37	25
Pot-3	23	14
Pot-4	38	25
Pot-5	39	27
Pot-6	38	28
Pot-7	37	23
Pot-8	74	31
Pot-9	36	26
Pot-10	37	25
Pot-11	36	23
Pot-12	68	23
Pot-13	38	20
Pot-14	77	25
Pot-15	37	20

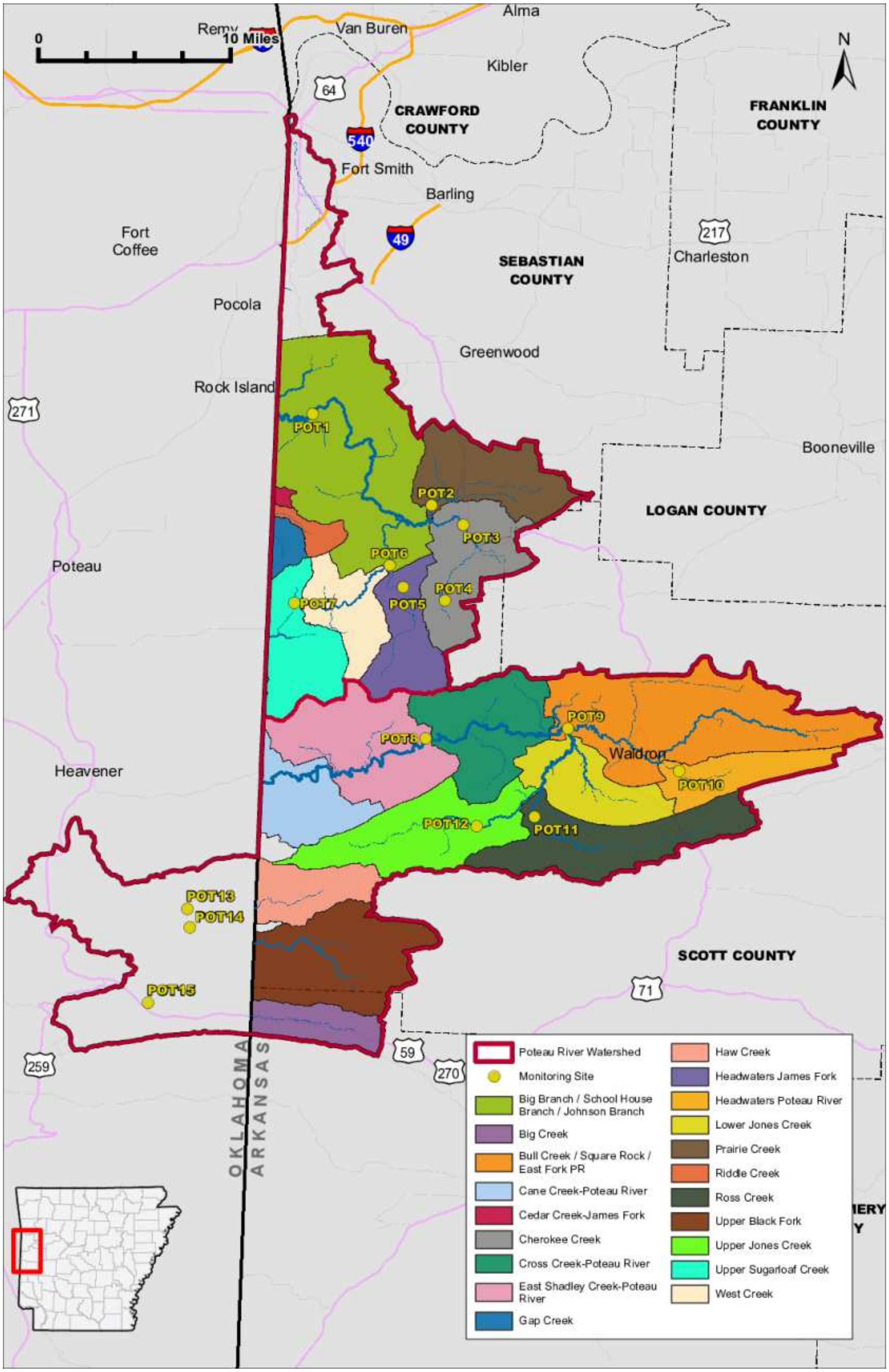

Figure 3.4.2.1. University of Arkansas sample stations in each subwatershed utilized during this study.

All water quality samples collected and focused on in this WMP were handled according to a Quality Assurance Project Plan (QAPP) approved by the NRD and EPA Region 6. In brief, grab samples were collected in clean, labeled containers from within the main area of flow in the channel and delivered to the University of Arkansas Water Resource Laboratory for analysis following all chain of custody procedures (see QAPP for project, University of Arkansas, 2018).

Water quality during baseflow conditions were found to be good and fairly consistent, except at Pot-9 where concentrations of several constituents were elevated. Table 3.4.2.2 provides a summary of water quality data for the PRW stations for select constituents. Each station is near the outlet of its respective subwatershed and should be typical of pollutant concentrations (and loads) in that system. The Pot-9 monitoring location exhibited the highest water quality parameter concentrations. The Pot-9 location is below the Waldron WWTP, the Tyson point source (permit limits provided in Section 5.1) and the majority of the City of Waldron developed areas, which likely accounts for some of the elevated values.

On average during baseflow, total chloride was highest at Pot-9 (18.4 mg/L) and lowest at Pot-15 (1.77 mg/L). Average total nitrogen concentrations were lowest at Pot-15 (0.23 mg/L) and highest at Pot-9 (2.83 mg/L). Average total phosphorus concentrations were highest at Pot-9 (0.207 mg/L) and the next highest average was 0.176 mg/L at Pot-3 with the lowest at Pot-15 (0.007 mg/L). Average total suspended solids under baseflow conditions was highest at Pot-1 (10.11 mg/L) and lowest at Pot-15 (1.9 mg/L).

Figure 3.4.2.2. Samples were collected during storm flow conditions throughout the study.

Water quality during storm flow conditions is summarized in Table 3.4.2.2. Storm events were sampled with the goal of each sample being collected prior to the peak instream flow (Figure 3.4.2.2). The concentration of some pollutants increased as flow increased, while other pollutants decreased or remained stable. Most notably TSS (Figure 3.4.2.8) on average increased at least an order of magnitude (on average) during storm flow events. TSS levels were highest at 191.7 mg/L, at Big Branch / Johnson / School House (Pot-1). Other constituents depended upon the watershed as to whether the stormflow concentration was higher than baseflow (Figures 3.4.2.3-3.4.2.8).

Table 3.4.2.2. Summary of average baseflow and storm flow water quality.

Site	Type of event	Chloride (mg/L)				Nitrogen (mg/L)				Phosphorus (mg/L)				TSS (mg/L)			
		Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count
Pot-1	Base	5.00	2.05	10.02	76	0.61	0.27	1.40	76	0.060	0.011	0.354	76	10.1	2.2	65.2	75
	Storm	3.06	1.14	5.90	31	1.17	0.58	2.53	31	0.369	0.047	0.980	31	191.7	13.2	627.5	31
Pot-2	Base	5.87	2.77	11.64	37	0.66	0.24	1.49	37	0.078	0.000	0.412	37	7.2	0.0	66.4	37
	Storm	3.01	1.16	6.90	25	1.25	0.35	2.18	25	0.374	0.059	0.887	25	107.1	4.5	469.6	25
Pot-3	Base	7.93	0.00	35.53	23	1.98	0.38	15.46	23	0.176	0.041	0.769	23	8.4	1.5	41.7	23
	Storm	2.70	1.04	6.23	14	1.10	0.63	2.11	14	0.248	0.091	0.465	14	58.7	19.2	119.5	14
Pot-4	Base	5.53	2.06	21.48	38	0.30	0.09	0.83	38	0.036	0.006	0.189	38	3.8	0.6	27.8	38
	Storm	3.10	0.96	9.59	25	0.63	0.26	1.85	25	0.125	0.039	0.614	25	18.1	3.6	73.3	25
Pot-5	Base	3.43	1.66	9.07	39	0.30	0.04	1.39	38	0.034	0.000	0.643	39	4.3	0.4	27.6	39
	Storm	2.84	1.02	7.20	27	0.70	0.24	1.79	27	0.187	0.015	0.462	27	64.3	3.1	279.8	27
Pot-6	Base	3.68	0.00	8.97	38	0.45	0.15	1.48	38	0.071	0.007	0.549	38	6.8	0.8	66.4	38
	Storm	2.79	1.03	6.04	28	1.02	0.46	2.35	27	0.324	0.095	1.449	27	139.4	3.6	1,282.0	28
Pot-7	Base	7.00	2.06	14.22	37	0.37	0.06	2.66	37	0.030	0.000	0.074	37	3.5	0.5	24.1	37
	Storm	2.52	0.80	8.71	23	0.51	0.21	1.61	23	0.106	0.037	0.626	23	52.5	0.9	698.5	23
Pot-8	Base	10.57	0.00	81.22	77	0.85	0.41	3.58	77	0.082	0.027	0.646	77	8.2	2.2	56.8	74
	Storm	4.47	0.85	41.67	32	1.06	0.53	1.58	32	0.265	0.051	0.584	32	92.1	5.0	270.4	31
Pot-9	Base	18.41	0.00	78.46	38	2.83	0.50	14.70	38	0.207	0.060	0.709	38	9.5	1.2	36.4	36
	Storm	3.57	0.95	18.70	26	1.36	0.76	2.64	26	0.434	0.162	1.093	26	101.9	2.9	395.8	26
Pot-10	Base	5.31	1.28	10.92	39	0.62	0.17	1.68	39	0.071	0.013	0.323	39	8.2	1.2	103.7	37
	Storm	2.65	0.92	5.16	25	1.05	0.52	1.82	25	0.300	0.081	0.671	25	37.8	3.6	167.7	25
Pot-11	Base	3.47	1.07	7.79	36	0.45	0.21	0.88	35	0.039	0.006	0.173	35	4.5	1.7	28.2	36
	Storm	2.13	0.82	4.50	23	0.79	0.45	1.35	23	0.175	0.047	0.426	23	65.5	9.8	313.3	23
Pot-12	Base	1.82	0.97	2.45	69	0.54	0.32	0.82	69	0.023	0.000	0.059	69	4.1	1.4	16.9	68
	Storm	1.88	1.13	2.32	23	0.51	0.27	0.81	23	0.025	0.013	0.068	23	6.8	2.6	36.0	23
Pot-13	Base	2.48	0.00	3.84	38	0.27	0.08	0.53	38	0.024	0.000	0.078	38	3.5	0.6	12.7	38
	Storm	1.60	0.59	2.96	20	0.41	0.17	0.72	20	0.061	0.017	0.117	20	26.6	2.3	93.7	20
Pot-14	Base	2.12	0.81	3.63	79	0.26	0.13	0.72	79	0.022	0.000	0.093	79	3.4	0.3	20.8	77
	Storm	1.65	0.63	3.17	25	0.55	0.25	1.47	25	0.094	0.017	0.430	25	57.4	2.2	364.3	25
Pot-15	Base	1.77	1.30	2.40	37	0.23	0.07	0.61	37	0.007	0.000	0.041	37	1.9	0.0	10.9	37
	Storm	1.19	0.61	2.62	20	0.49	0.33	0.71	20	0.034	0.000	0.149	20	24.6	6.6	168.1	20

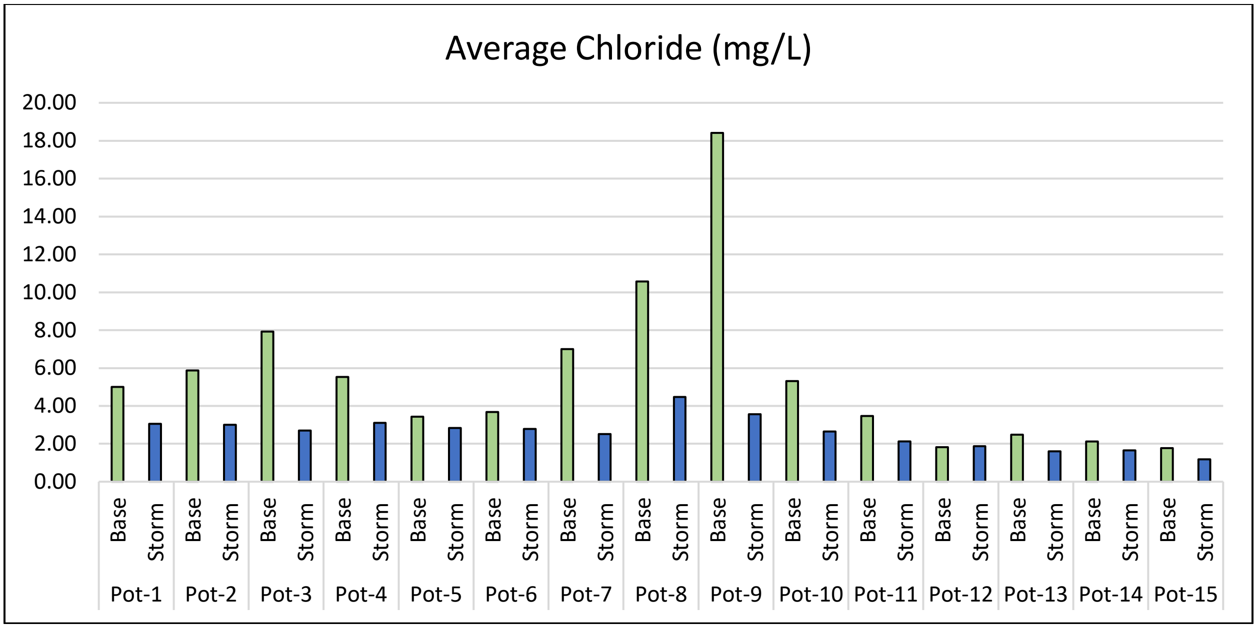

Figure 3.4.2.3. Average chloride base and storm flow concentrations from each subwatershed.

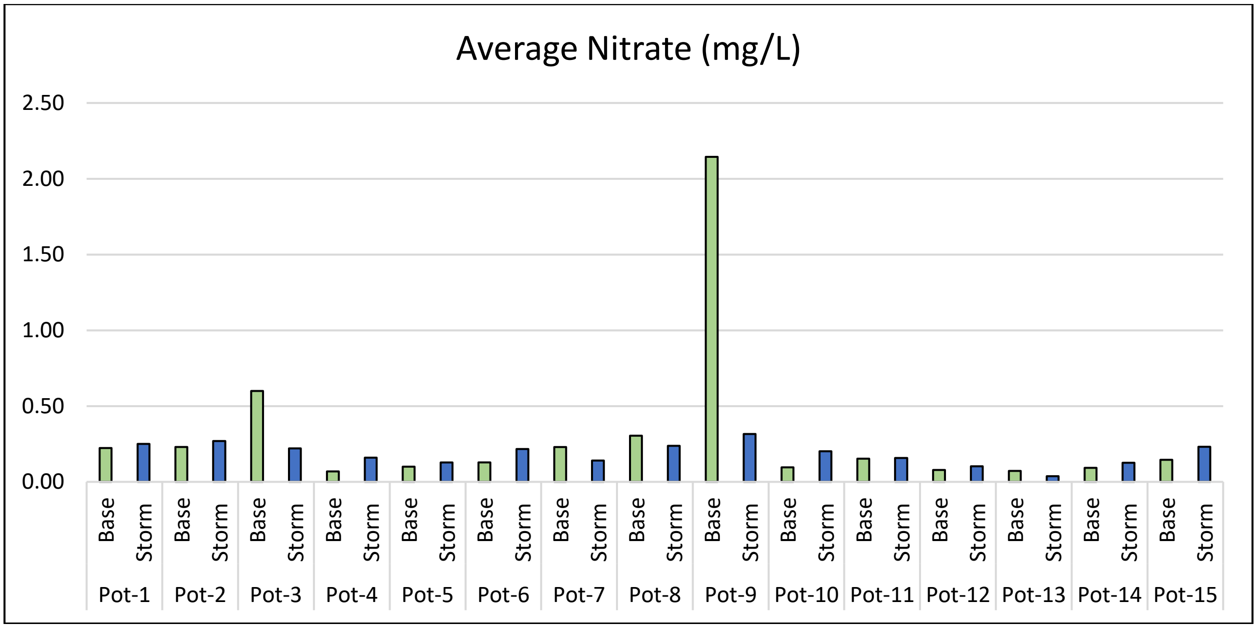

Figure 3.4.2.4. Average nitrate base and storm flow concentrations from each subwatershed.

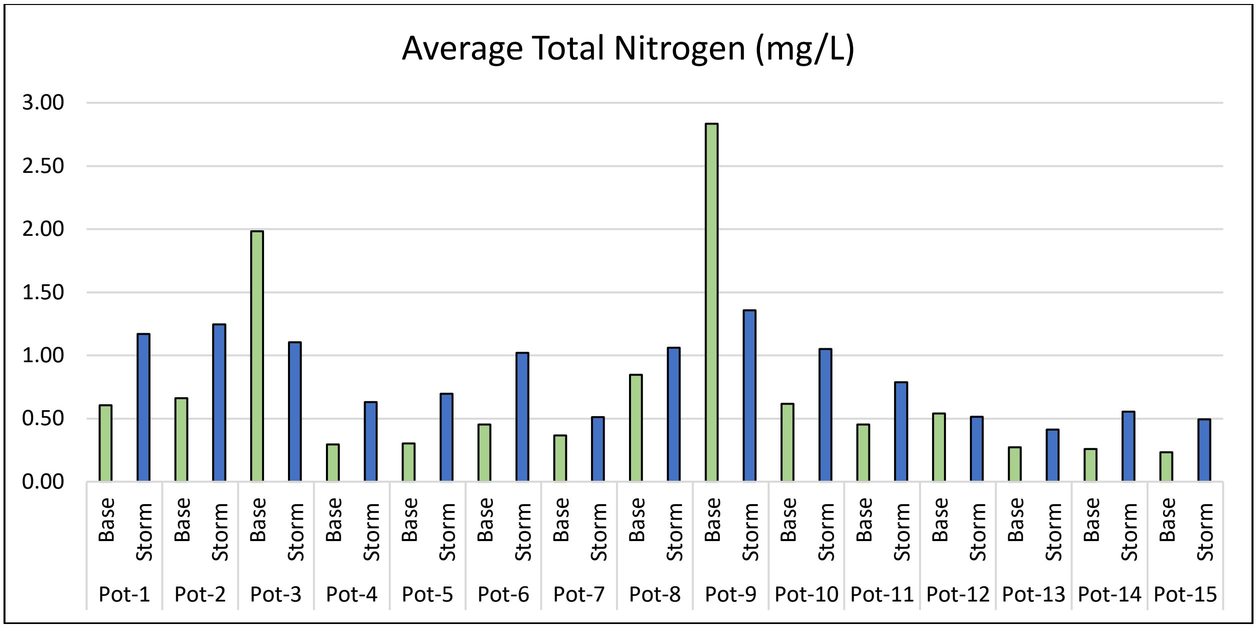

Figure 3.4.2.5. Average total nitrogen base and storm flow concentrations from each subwatershed.

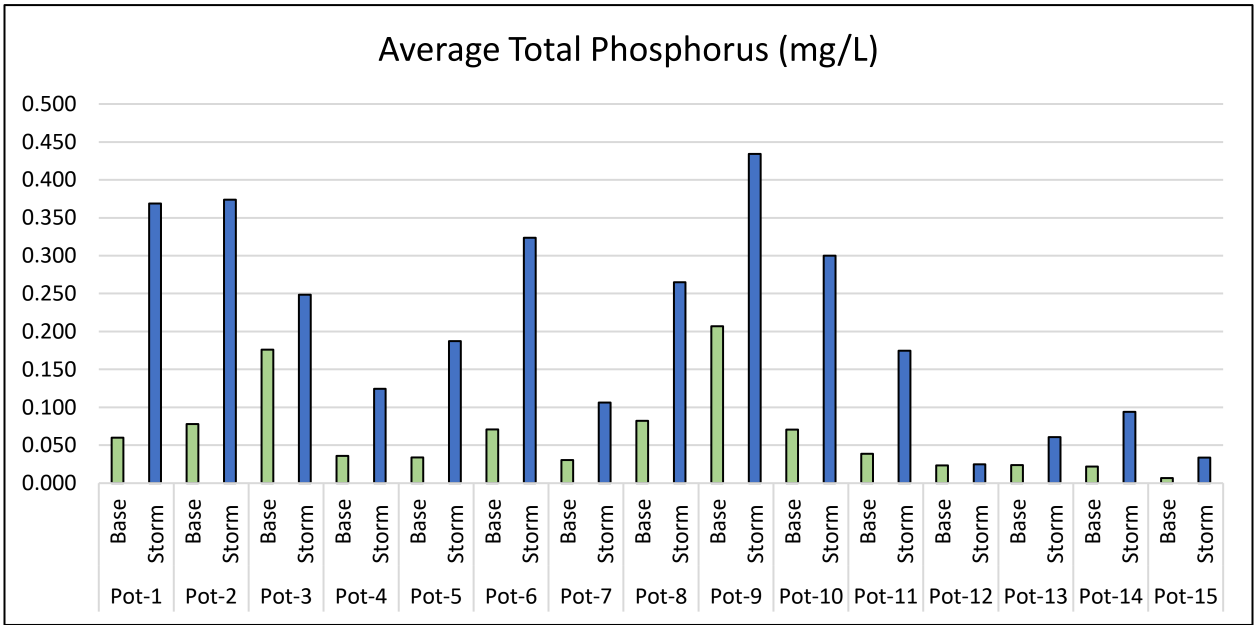

Figure 3.4.2.6. Average total phosphorus base and storm flow concentrations from each subwatershed.

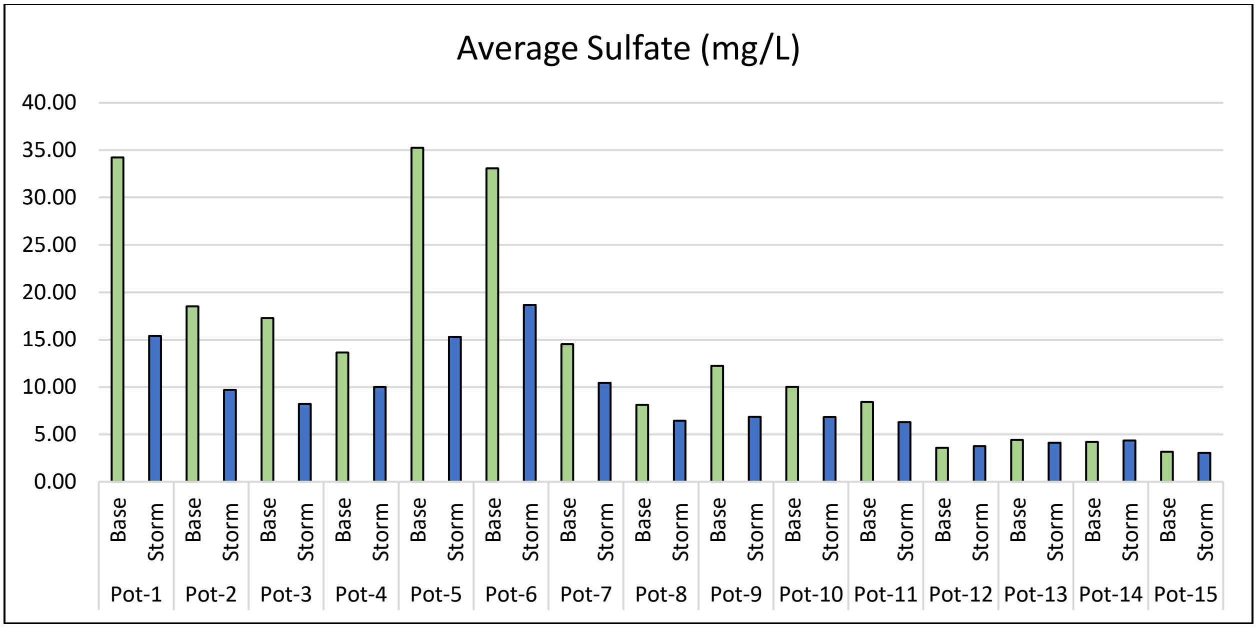

Figure 3.4.2.7. Average sulfate for base and storm flow concentrations from each subwatershed.

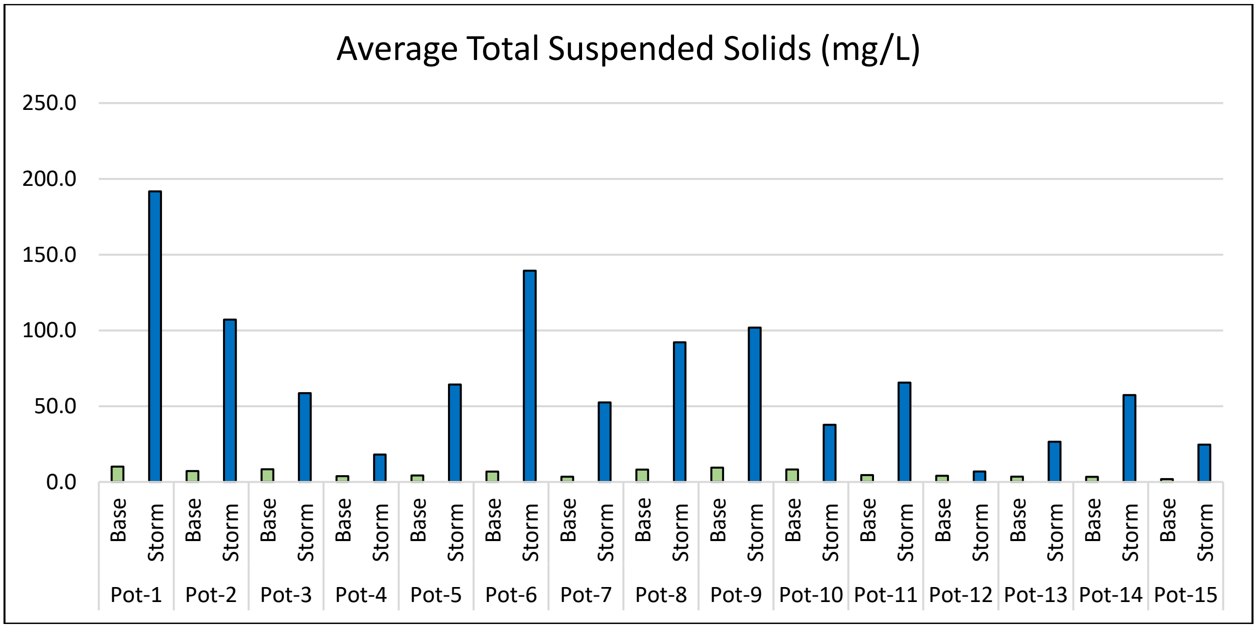

Figure 3.4.2.8. Average TSS base and storm flow concentrations from each subwatershed.

3.4.3 Designated Use Assessment Criteria

The approved Arkansas 2018 303(d) list contains 4 assessment units (stream segments) of the PRW and one segment of an unnamed tributary of the Poteau River. There are 2 assessment units of the Poteau River that are on the Category 4a list. The 4a list indicates that water quality criteria are not being met but a TMDL has been written for the listed parameters. The parameters not in attainment include turbidity and total phosphorus. The other 2 assessment units are on the Category 5 list as those parameters are not meeting water quality criteria for one or more designated uses and have been prioritized. The Unnamed Tributary of the Poteau River is listed for chloride, and total dissolved solids (TDS), however, water quality criteria were changed in 2020 and that stream should now be in attainment (GBMc & Associates, 2016). The causes for the 2 Poteau River assessment units on the Category 5 list include dissolved oxygen, turbidity and sulfate also addressed by the 2019 study with sources listed as industrial point source, municipal point source, surface erosion and unknown with a medium priority. The medium priority indicates that the waterbody is not meeting water quality criteria but may be de-listed in the future with permit revisions to correct the problem.

The draft Arkansas 2020 303 (d) list is currently still under review but the list contains four additional streams in the PRW, Cherokee Creek, James Fork, Prairie Creek, and Upper Sugarloaf Creek. Cherokee Creek (Pot-3) is listed for turbidity with unknown cause and agriculture as the source and with a low TMDL development priority. James Fork (Pot-1) is listed for base flow turbidity and dissolved oxygen with agriculture and unknown listed as the source. Prairie and Upper Sugarloaf Creek were added for storm flow turbidity, not meeting water quality criteria with sources listed as unknown and urban runoff with a low priority.

In order to evaluate the maintenance of PRW designated uses based on water quality data collected for this plan, the Arkansas Assessment Criteria for the Arkansas River Valley (ARV) and Ouachita Mountains (OM) Ecoregions were utilized. Table 3.4.3.1 provides a summary of the assessment criteria that are pertinent to this WMP study’s focus. Constituents analyzed for this study that have water quality criteria were compared to those criteria. Turbidity was the only constituent that was measured with consistency. According to the assessment criteria, when turbidity measurements exceed 20% of the base flow or 25% storm flow measurements (minimum of 24 measurements) then the stream is listed as impaired. Big / Johnson / School House, Prairie Creek, Cherokee Creek, West Creek, Upper Sugarloaf Creek, Headwaters of James Fork, and BC/SR/EFPR all indicated non-support of the base flow turbidity criteria (Table 3.4.3.2). Storm flow turbidity was exceeded at all stations except Pot-12 and Pot-15 which are the Big Creek and Upper Jones Creek watersheds. The Pot-3 station only had 14 storm flow measurements, so it technically supporting according to the assessment criteria. The turbidity exclusions will be addressed by TSS reduction goals in this WMP.

Table 3.4.3.1 Water quality standards assessment criteria.

Parameter	Standard		Support	Non-Support
ARV Temperature[1]	31°C		≤10 %	>10 %
OM Temperature[1]	30°C			
ARV Dissolved Oxygen[1] (mg/L)	Primary	Critical		
<10 mi^2	5	2		
10-150 mi^2	5	3		
OM Dissolved Oxygen[1] (mg/L)	Primary	Critical		
<10 mi^2	6	2		
10-150 mi^2	6	6		
ARV and OM pH	6.0-9.0 S.U.			
ARV and OM Cl/SO_4/TDS	250/250/500			
ARV and OM Ammonia				
Acute (Salmonids absent, pH=6.5)	48.8 mg/L		I-hour average not exceeded more than once every 3 years	
Chronic (using 14°C and pH=6.5)	6.5 mg/L		Monthly average shall not exceed	
ARV Turbidity				
Base flows	21 NTU		≤20 %	>20 %
All flows	40 NTU		≤25%	>25 %
OM Turbidity				
Base flows	10 NTU		≤20 %	>20 %
All flows	18 NTU		≤25%	>25 %

[1]Except for site specific standards/criteria approved in water quality standards.

Table 3.4.3.2 Turbidity exceedances at base and storm flow during the most recent water quality collections.

Subwatershed	Site Location	Number of Base flow Turbidity Exceedances	Total Base flow measurements	Percent Exceedance	Number of Storm flow Turbidity Exceedances	Total Storm flow measurements	Percent Exceedance
Big / Johnson / SH	Pot-1	58	76	76.3	30	31	96.8
Prairie Creek	Pot-2	14	37	37.8	24	25	96.0
Cherokee Creek	Pot-3	10	23	43.5	14	14	100.0
Cherokee Creek	Pot-4	27	38	71.1	24	25	96.0
Headwaters James Fork	Pot-5	17	39	43.6	25	27	92.6
West Creek	Pot-6	24	38	63.2	27	28	96.4
Upper Sugarloaf Creek	Pot-7	27	37	73.0	23	23	100.0
Cross Creek - Poteau River	Pot-8	11	77	14.3	26	31	83.9
BC/SR/EFPR	Pot-9	14	38	36.8	22	26	84.6
Headwaters of Poteau River	Pot-10	5	39	12.8	18	25	72.0
Ross Creek	Pot-11	2	36	5.6	18	23	78.3
Upper Jones Creek	Pot-12	0	69	0.0	0	23	0.0
Haw Creek	Pot-13	4	38	10.5	9	20	45.0
Upper Black Fork	Pot-14	3	79	3.8	14	25	56.0
Big Creek	Pot-15	1	37	2.7	4	20	20.0

3.5 Hydrologic Analysis

The hydrologic regime of a stream (magnitude and frequency of flow levels) influences the shape of the stream channel, the type and abundance of habitat available to biota, and the type and load of pollutants transported in the system. Geology, land use, weather patterns and seasons affect the hydrologic regime of a stream. In more recent years there is a trend with increasing intensity of rain (i.e. more rain in a short period of time). High intensity events create more runoff as it doesn’t allow as much time for infiltration (EPA, 2016). Understanding a stream’s hydrology, including regional climatic shifts, is integral to the assessment of stream stability, ecology, and water quality.

For the 2020 University of Arkansas study, automated level measuring loggers made by Onset Computer Corporation, (HOBO loggers) were installed at the monitoring locations. Each level logger was maintained, and data was downloaded monthly throughout the year. These automatic level measuring gages continuously measured stream level (stage) every 15 minutes.

SonTek-IQ Doppler instruments were also rotated among eight stations to measure discharge during high flow events. Base flow measurements were completed through use of a flow meter while wading during the monthly sampling with flows calculated according to the velocity-area method.

Rating curves were developed using the high flow data captured during the SonTek deployments (see Lasater and Haggard, 2021; Lasater, 2022). Not all instantaneous flow measurements were utilized, instead various points along the hydrograph were used in the curve development. Linear regression was used to develop rating curves and 2-point regression was applied to the estimated low flows, and nonparametric LOESS regression was used to fit the range of measured flow and stage data with a sampling proportion of 0.5. Manning's equation was used for flow estimations above the measured range of data (Lasater and Haggard, 2021). This flow data allows pollutant loading to be estimated more effectively for each subwatershed (Lasater and Haggard, 2021). When graphing the flow data over time, hydrologic dynamics such as flashiness can be seen visually. For rain events, the rise and fall can be dramatically different across the subwatersheds (Figure 3.5.1) dependent on event size and watershed land uses.

There were four watersheds that did not have continuous flow data collected, Pot-2, Pot-3, Pot-7, and Pot-13. In these cases, a surrogate site was used to calculate a flow on a per mi^2 basis. Sampling dates mostly matched dates water quality was collected. Once the flow/mi^2 was calculated, the missing watershed's area was multiplied by the flow/mi^2 for loading to be calculated.

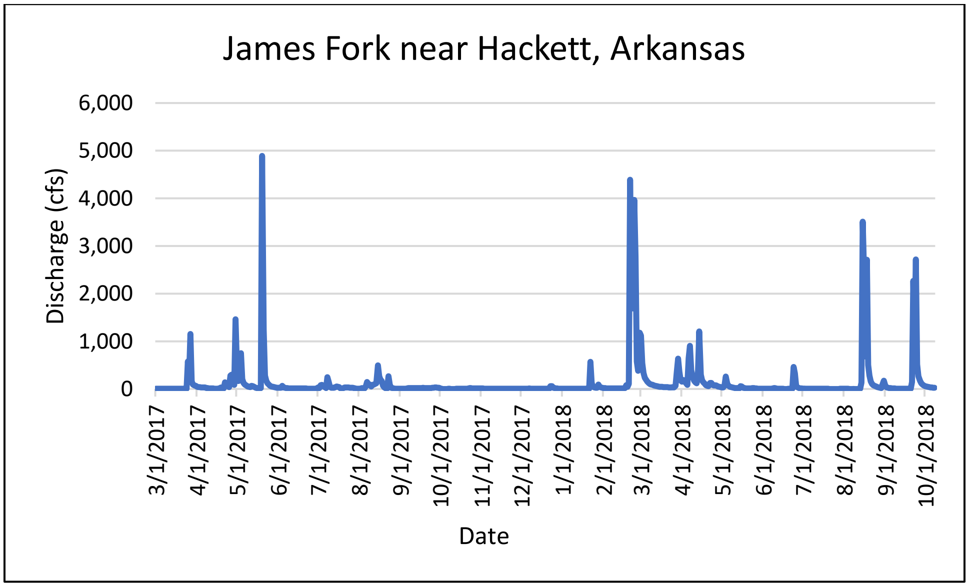

Figure 3.5.1. The USGS discharge data from the James Fork near Hackett, AR (Pot-1).

3.6 SWAT Modeling

The soil and water assessment tool (SWAT) is a widely used land use based watershed model that can evaluate point source and non-point source loading of pollutants, transport, and their effect on water quality. SWAT was used in this report to calculate subwatershed loading and to evaluate BMP removal rates from various practices and land uses in the PRW. The model addresses load reductions from BMPs on a land use by land use basis. Each BMP is set-up in the model with BMP type, type of land use the BMP is effective for, and the percentage of that land use area (acres) that it is applied to.

To assess and manage NPS pollution, the NRD recommends evaluating pollutant loading and implementing mitigation efforts on the subwatershed scale. Watershed models, particularly SWAT, are often used for assessing, planning, and prioritizing NPS mitigation efforts and watershed management activities (Ghafari et al., 2017). The SWAT model can be used to predict the impacts of differing land uses and land management practices under various climatic conditions on water, sediment, and nutrient yields on the watershed scale over long periods of time.

A QSWAT (QGIS interface for SWAT) model was developed for the PRW by the University of Arkansas Division of Agriculture and GBMc & Associates to prioritize subwatersheds and simulate BMP impacts. The SWAT model was developed using a variety of datasets including topography, land use/land cover, soil, weather, point sources, and existing management practices. The entire PRW (in Arkansas and Oklahoma) was simulated in QSWAT, since an individual ultimate outlet must be selected to delineate the watershed, but the focus of this study was on the Arkansas portion of the watershed. The elevation dataset was used to delineate the PRW into 1,313 subwatersheds, which are further delineated into smaller hydrologic response units (HRUs) based on unique combinations of soil, land cover, and slope within each subwatershed.

Weather data was obtained from the National Oceanic and Atmospheric Administration (NOAA) for years 2012 through 2020. Weather stations used were in Abbott, Waldron, and Fort Smith, Arkansas, where Waldron and Fort Smith contained precipitation and temperature data, while Abbott only contained precipitation data. Other climatic inputs including solar radiation, relative humidity, and wind velocity were simulated by QSWAT's weather generator.

Point sources identified and operating in the PRW between 2011 and 2020 included municipal wastewater treatment plants (WWTPs) in Waldron, Huntington, and Mansfield, and an industrial WWTP (Tyson Poultry, Inc.) in Waldron. Sediment and nutrient data were aggregated on an annual scale and integrated into the model. Pasture management practices for grazing and poultry litter application were adapted for the PRW using cattle data from Sebastian and Polk counties, and cattle counts in Scott County from the Poteau River

Conservation District. Some studies suggest that litter is generally applied in close proximity to the poultry houses. A uniform litter application rate of 2.6 Mg ha^{-1} year^{-1} was used across the pastures in the watershed.

The model was ran from 2011 to 2020, with the first 5 years as warmup, and then was calibrated using SWAT- Calibration and Uncertainty Program (SWAT-CUP). Monitoring data between 2016 and 2020 from the USGS gages on the James Fork (USGS 07249400) and Poteau River (USGS 07247000) were used for calibration, with constituents including flow, total suspended solids (TSS), total nitrogen (TN), and total phosphorus (TP). The model calibration produces Nash-Sutcliffe Efficiency (NSE) statistics between 0.20 and 0.72. Values for NSE between 0.0 and 1.0 are generally considered acceptable model performance (Moriasi, et.al, 2007). The majority of the calibration NSE values were between 0.41 and 0.75, which indicates the model has an acceptable ability to predict loading as compared to known values. That is, its predictions compare reasonably to actual measured stream loading.

Once the model was calibrated, it was used to predict annual loading of key constituents, and flow weighted sediment and nutrient concentrations simulated from SWAT on the 12-digit HUC scale were used to determine priority areas (i.e., those with the greatest loading of key constituents in the overall watershed). Unlike the assessment sections, the SWAT model estimated loads for all 30 HUC- 12 watersheds within the HUC- 8 PRW in Arkansas.

The highest priority subwatersheds (i.e., 81-100 percentiles) based on sediment loads were Big Branch-James Fork, Cedar Creek-Poteau River, Cherokee Creek, Johnson Branch-James Fork, Prairie Creek, and Upper Sugarloaf Creek (Figure 3.6.1). These six subwatersheds make up about 28% of the PRW but contributed 43% of the sediment loads. The highest priority subwatersheds based on total phosphorus flow-weighted concentrations were Big Branch-James Fork, Cedar Creek-Poteau River, Cherokee Creek, East Fork Poteau River, Lower Jones Creek, and Prairie Creek (Figure 3.6.2). These six subwatersheds make up about 27% of the PRW but contributed 50% of the total phosphorus loads. Finally, the highest priority subwatersheds based on total nitrogen flow-weighted concentrations were Big Branch-James Fork, Cedar Creek-Poteau River, Johnson Branch- James Fork, Lower Jones Creek, Prairie Creek, and Ross Creek (Figure 3.6.3). These six subwatersheds make up about 57% of the PRW but contributed 50% of the total phosphorus loads.

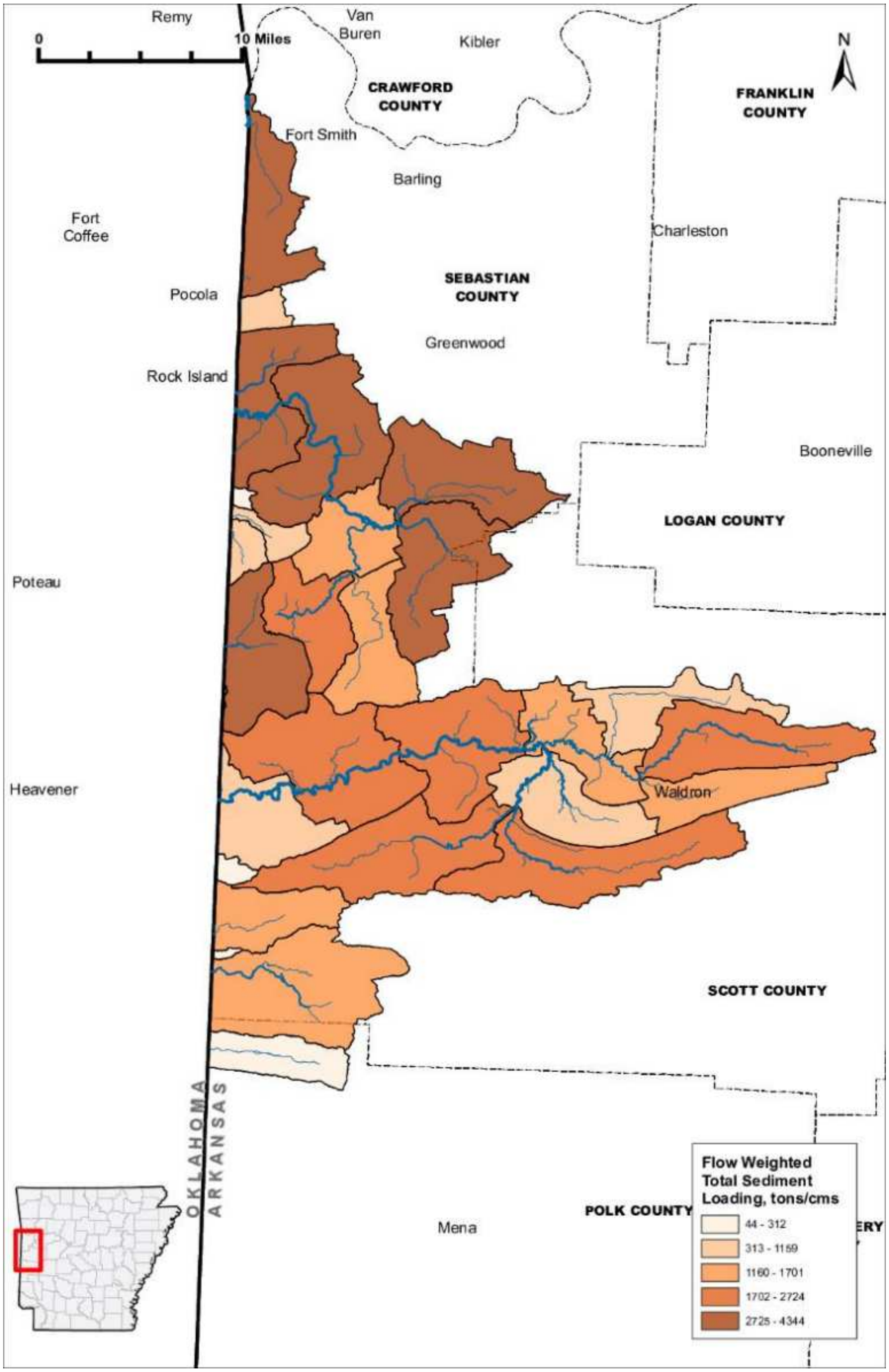

Figure 3.6.1. Priority subwatersheds within the Poteau River Watershed based on flow-weighted loads of sediments.

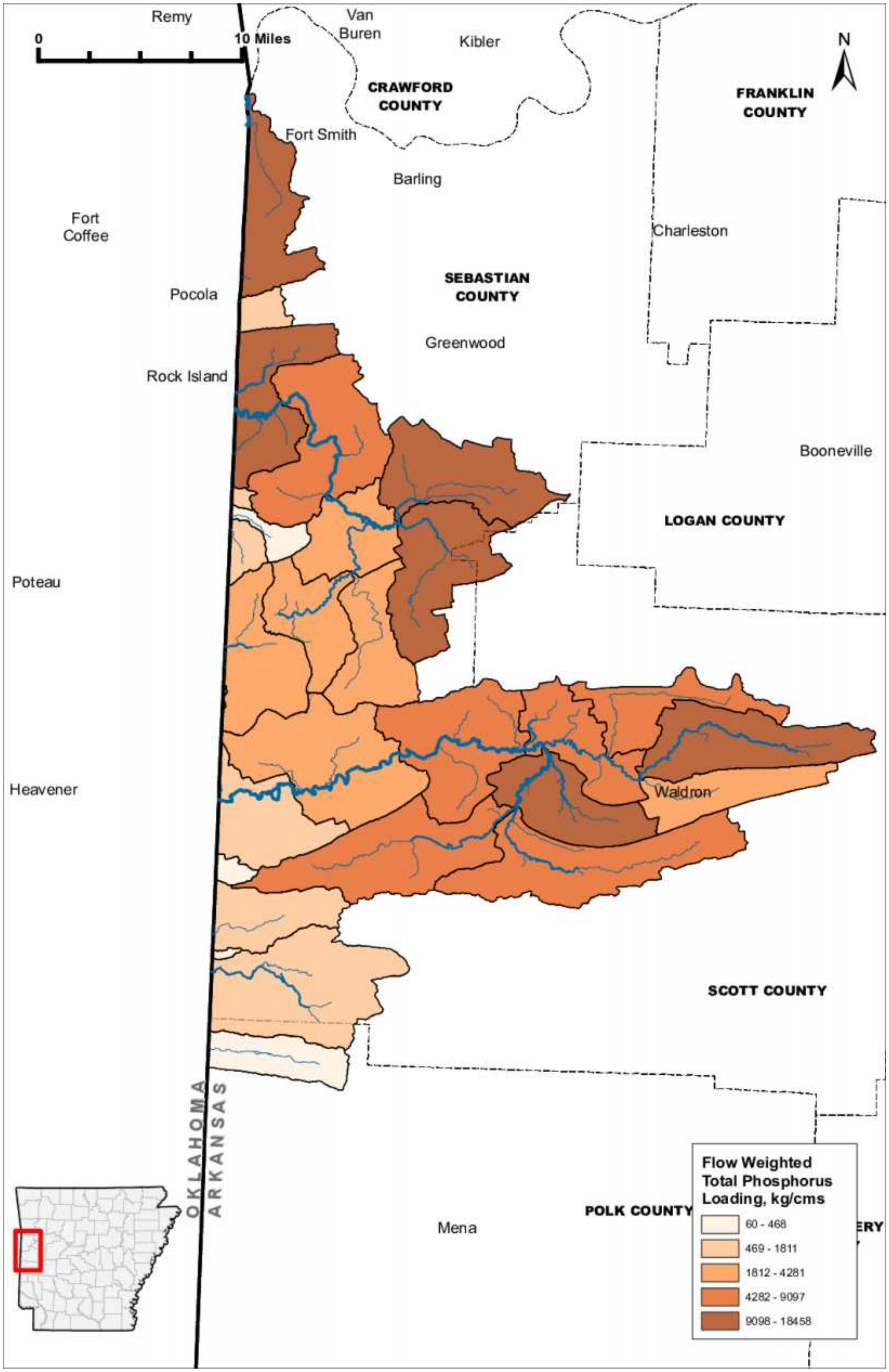

Figure 3.6.2. Priority subwatersheds within the Poteau River Watershed based on flow-weighted loads of total phosphorus.

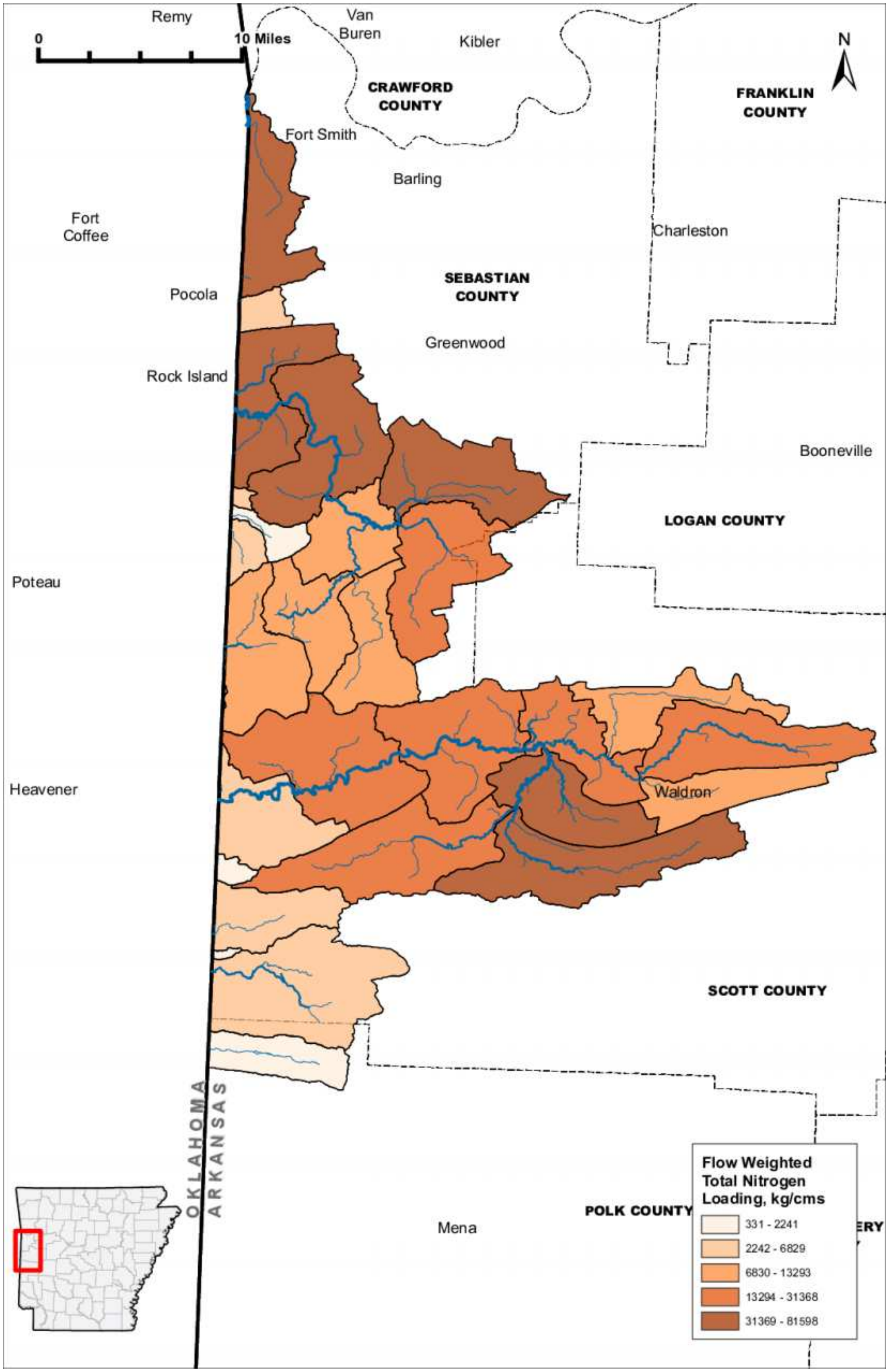

Figure 3.6.3. Priority subwatersheds within the Poteau River Watershed based on flow-weighted loads of total nitrogen.

4.0 LOADING ANALYSIS

4.1 Pollutant Loading From Key Recent Monitoring Studies

Water quality data used in this section was collected by the University of Arkansas (Grant # 17-300) during 2017-2020. Loading of pollutants in the PRW was calculated from the base and storm flow data collected and the flow estimations from the rating curves and USGS gages. A summary of the loading for key constituents is provided in Table 4.1.1.

For most constituents, loads appear to be greatest in Big Branch/ Johnson / School House and Cedar Creek in the James Fork and East Shadley and Cross Creek from the Poteau River. Loading viewed in this fashion is misleading when used to assess critical NPS pollution that needs to be addressed, as some of the subwatersheds are much larger than others and thus will have greater flows and loads. In order to account for watershed size, loads from each of the subwatersheds were normalized according to watershed area (in mi^2) to arrive at a loading in each watershed on a per mi^2 basis (Table 4.1.2).

Table 4.1.2. Loading of key storm flow constituents normalized on a per mi^2 basis. For some subwatersheds with monitoring locations upstream of one another, loads were subtracted resulting in some negative values.

Watershed	HUC- 12	Type of Event	HUC- 12 Average of Chloride (lb/mi^2)	HUC- 12 Average of Total Nitrogen (lb/mi^2)[1]	HUC- 12 Average of Total Phosphorus (lb/mi^2)[1]	HUC- 12 Average of Sulfate (lb/mi^2)	HUC- 12 Average of TSS (lb/mi^2)
James Fork	Big / Johnson / SH	Base	4	-1	-1	64	39
		Storm	139	57	21	703	19,790
	Cedar Creek-James Fork	Base	177	12	2	537	193
		Storm	1,036	277	59	5,189	28,014
	Cherokee Creek	Base	54	18	4	167	498
		Storm	415	234	59	1,602	21,036
	Gap Creek	Base	41	3	0	125	45
		Storm	259	69	15	1,297	7,003
	Headwaters James Fork	Base	33	7	2	159	258
		Storm	386	139	54	1,917	39,255
	Prairie Creek	Base	72	25	7	209	975
		Storm	444	218	72	1,584	23,079
	Riddle Creek	Base	40	3	0	122	44
		Storm	259	69	15	1,297	7,003
	Ross Creek	Base	74	15	2	230	250
		Storm	629	299	80	2,026	36,968
	Upper Black Fork	Base	6	1	0	19	39
		Storm	233	120	28	768	20,081
	Upper Sugarloaf Creek	Base	8	1	0	23	8
		Storm	45	12	3	226	1,218
	West Creek	Base	24	11	4	256	517
		Storm	297	201	78	2,568	33,907
Poteau River	Big Creek	Base	99	17	1	219	158
		Storm	837	502	63	2,958	63,267
	BC/SR/EFPR	Base	85	18	2	109	344
		Storm	484	272	95	1,111	27,090
	Cane Creek-Poteau River	Base	-22	-4	0	-52	16
		Storm	39	23	5	110	3,958
		Base	-22	-4	0	-52	16

Watershed	HUC- 12	Type of Event	HUC- 12 Average of Chloride (lb/mi^2)	HUC- 12 Average of Total Nitrogen (lb/mi^2)[1]	HUC- 12 Average of Total Phosphorus (lb/mi^2)[1]	HUC- 12 Average of Sulfate (lb/mi^2)	HUC- 12 Average of TSS (lb/mi^2)
	Cross Creek - Poteau River	Storm	39	23	5	109	3,948
	East Shadley Creek-Poteau River	Base	-64	-11	-1	-150	46
		Storm	111	66	13	314	11,315
	Haw Creek	Base	112	12	1	246	171
		Storm	844	340	56	2,730	30,753
	Headwaters Poteau River	Base	71	10	1	142	91
		Storm	572	299	94	1,518	22,673
	Lower Jones Creek	Base	44	12	1	87	104
		Storm	106	29	1	186	271
	Upper Jones Creek	Base	27	7	0	54	64
		Storm	67	18	1	118	172

[1] Negative values are a result of subtracting upstream loads from a downstream load to focus on specific subwatershed(s) lower in the system.

Figures 4.1.4-4.1.7 depict the portion of pollutant loading attributed to each subwatershed for average chloride, total nitrogen, total phosphorus and TSS base and storm flow loads. Big Creek (Pot-15), Headwaters James Fork (Pot-5), Ross Creek (Pot-11) and West Creek (Pot-6) were identified with the highest loading of TSS and will receive higher priority for management. Load reductions will be accomplished accordingly for these key subwatersheds as well as other subwatersheds according to the plan outlined in Sections 5 and 6. TSS and nutrient loading in subwatersheds was used in the ranking matrix.

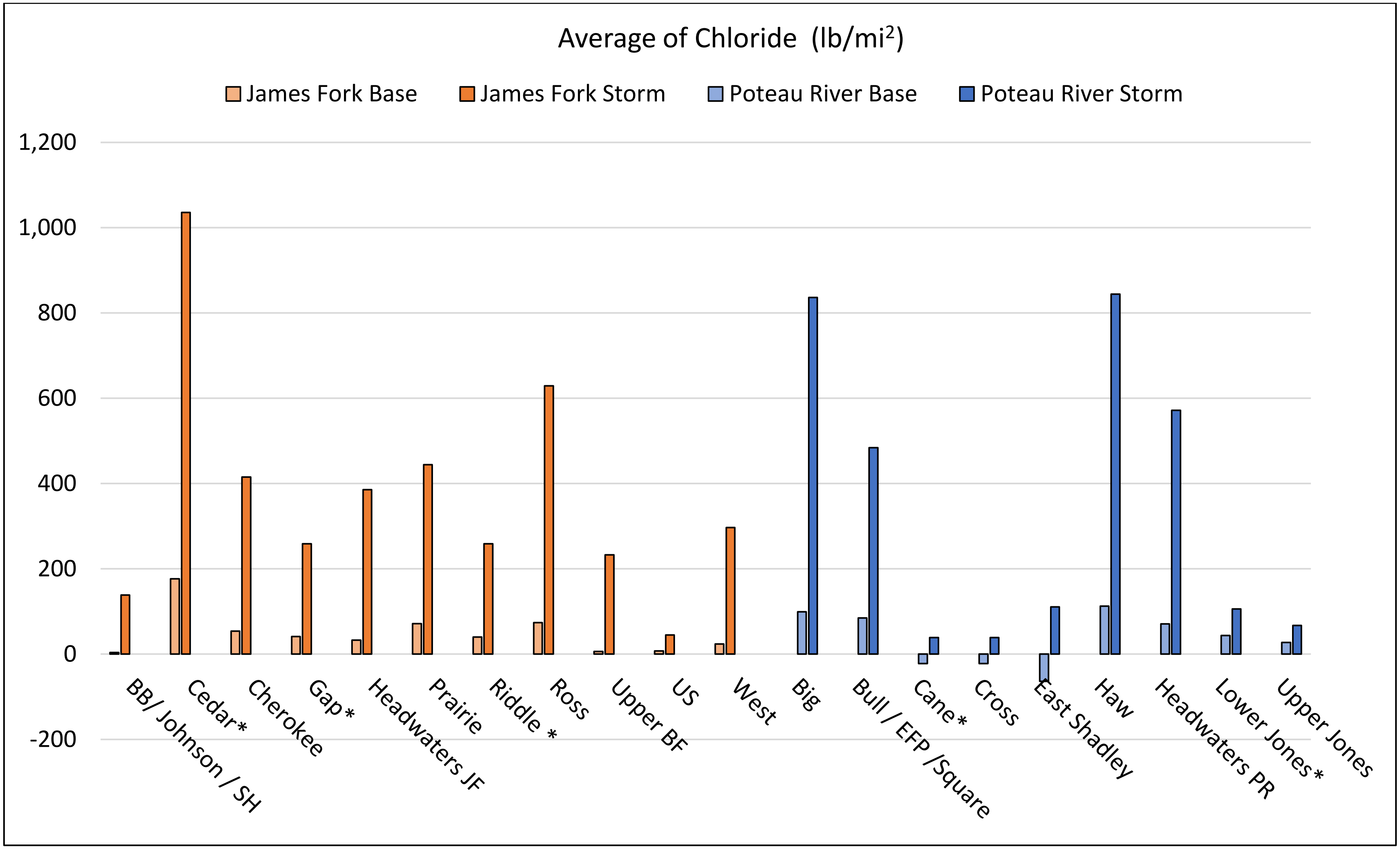

Figure 4.1.1. Base and storm flow average loads of chloride (lb/mi^2)

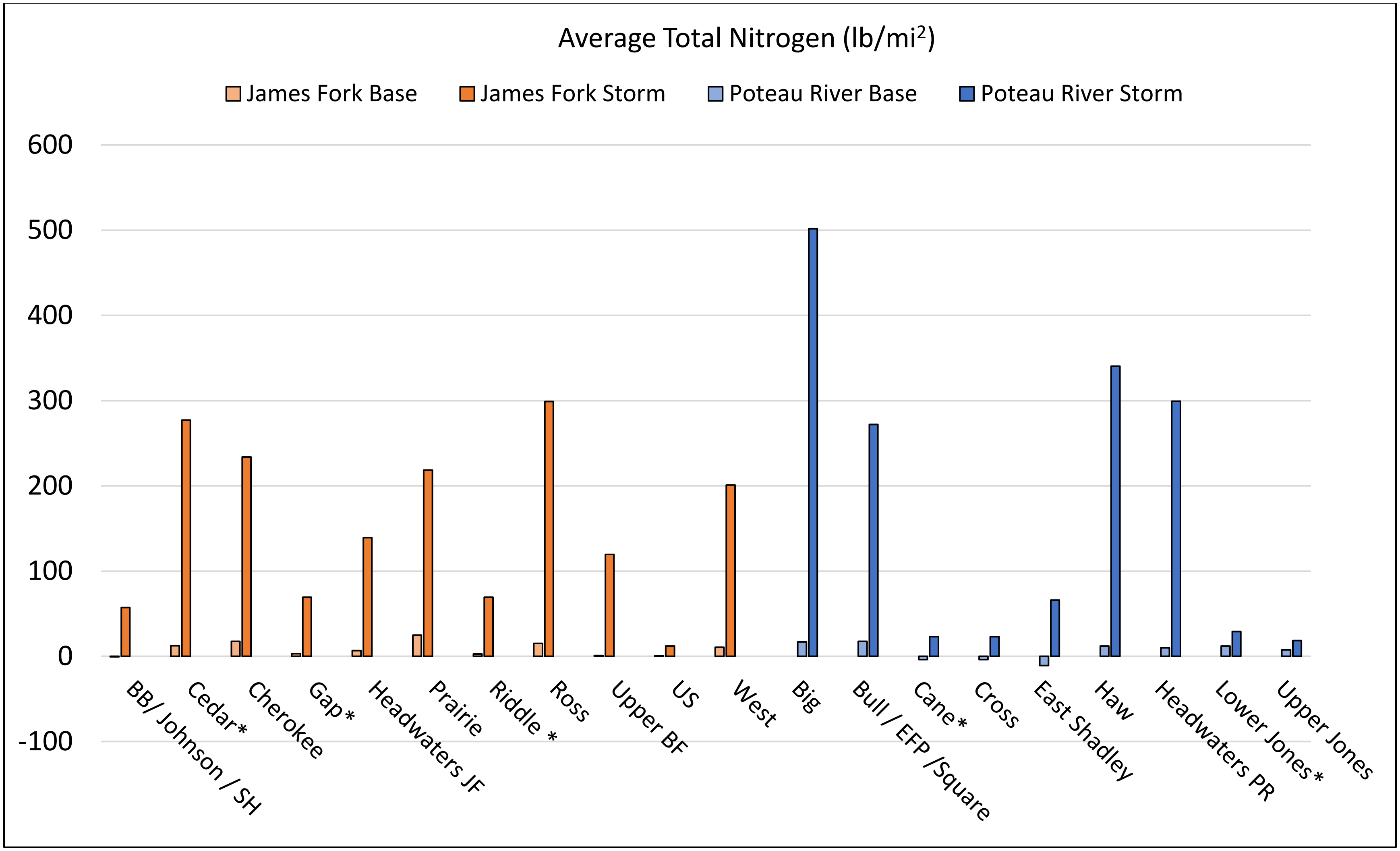

Figure 4.1.2. Base and storm flow average loads of total nitrogen (lb/mi^2).

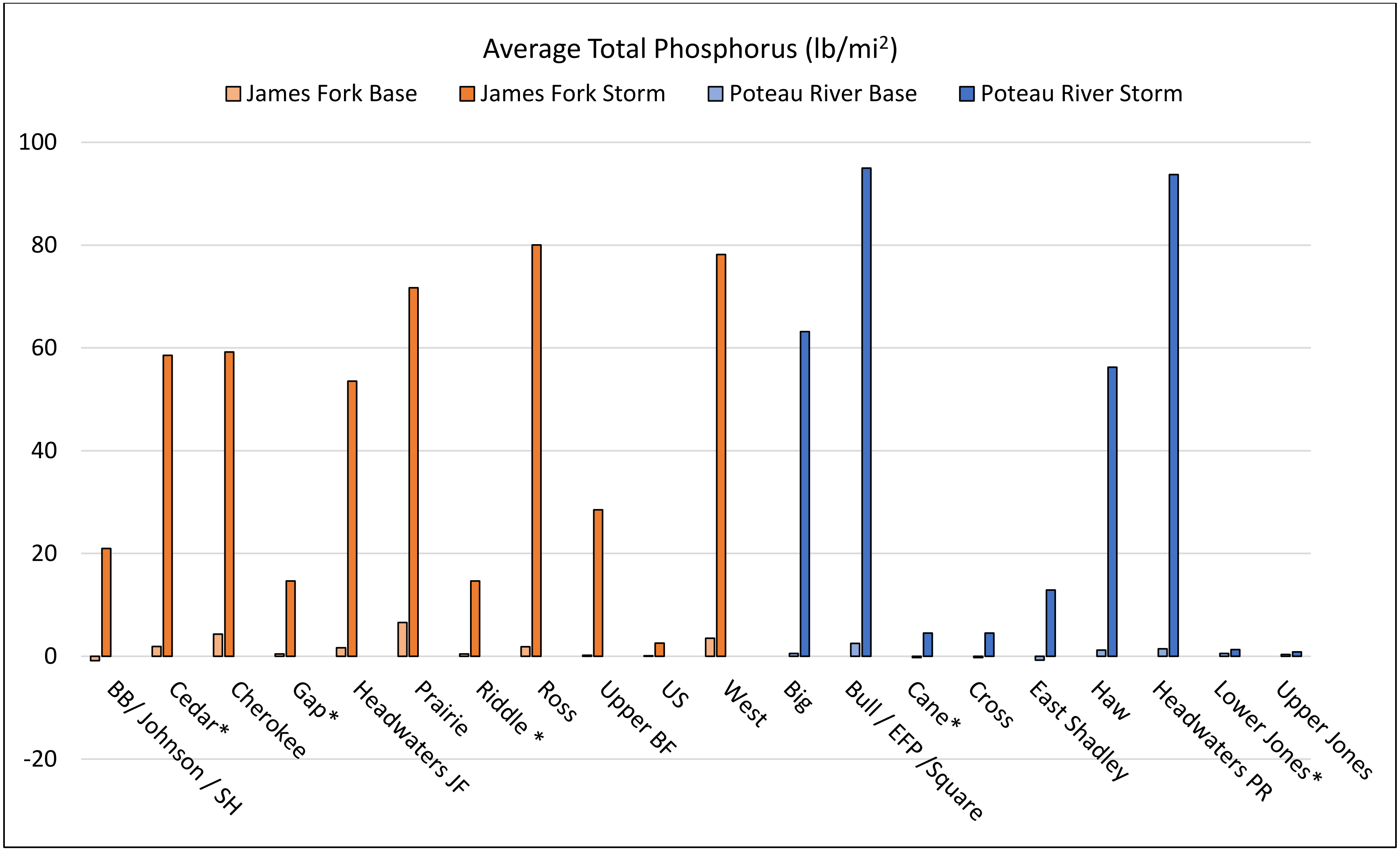

Figure 4.1.3. Base and storm flow average loads of total phosphorus (lb/mi^2).

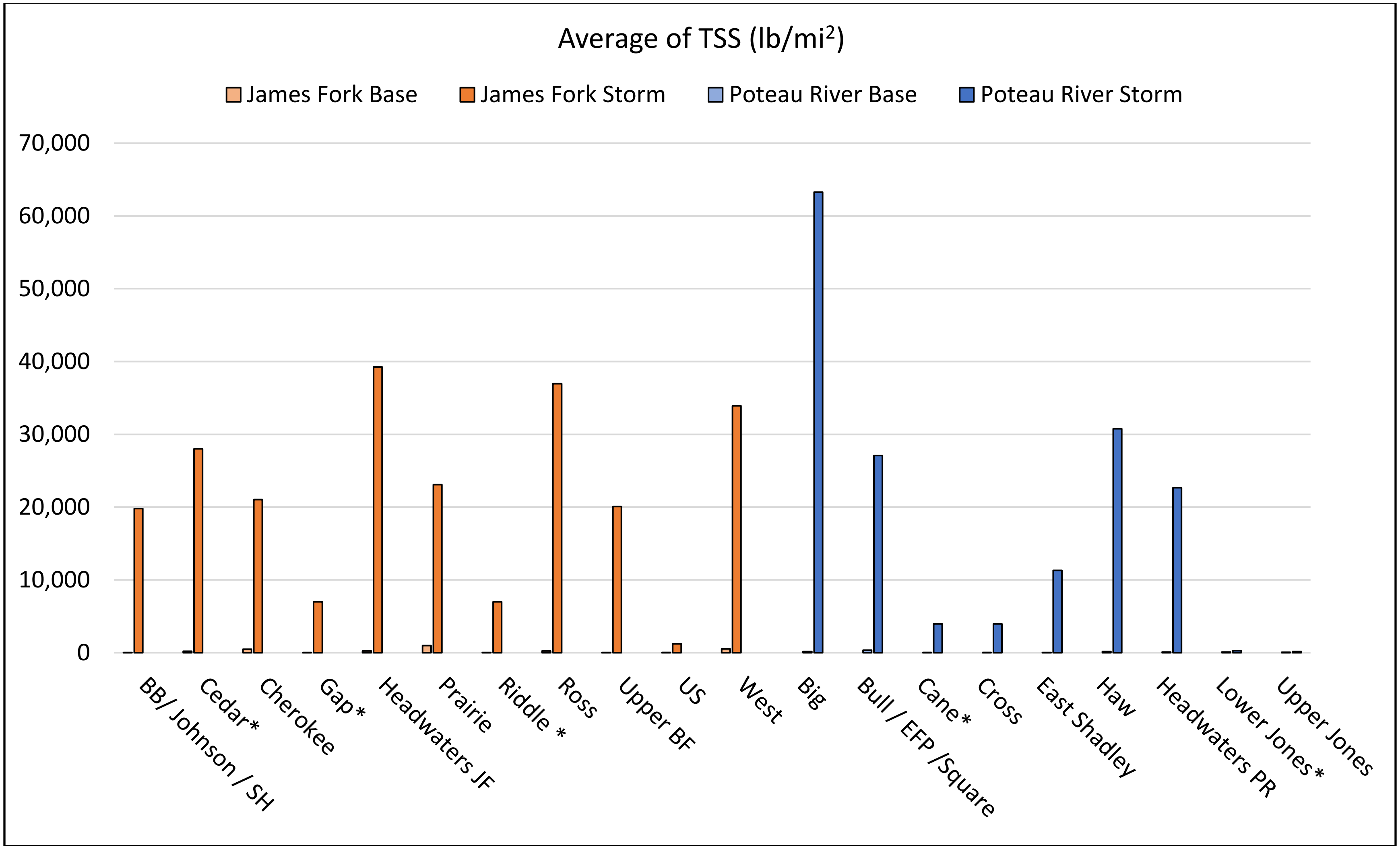

Figure 4.1.4. Base and storm flow average loads of total suspended solids (lb/mi^2).

4.2 Historical Reports Related to Watershed Pollutant Loading

The Poteau River watershed has been the subject of several studies over the years. Studies have varied greatly from those focused on Lake Wister in Oklahoma to special studies completed to address mineral levels in Arkansas. The most relevant reports and data are:

- Water Quality Monitoring of the Poteau River Watershed - 319 grant project No. 16-1100 (City of Waldron and GBMc & Associates 2018)
- Watershed assessment of the of the PRW near Waldron that included water quality, habitat, and macroinvertebrates collections and was funded by Tyson-Waldron. (GBMc & Associates, 2016).
- Watershed Investigative Support to the Poteau Valley Improvement Authority. Stream Water Quality to Support HUC- 12 Prioritization in the Lake Wister, Oklahoma. Funding provided by Poteau River Valley Improvement Authority (PVIA) and work completed by Arkansas Water Resource Center (AWRC) (Austin et al., 2018).
- Watershed Investigative Support to the Poteau Valley Improvement Authority. Stream Water Quality to Support HUC- 12 Prioritization in the Lake Wister Watershed, Oklahoma: August 2017 through May 2019. Funding provided by PVIA and work completed by AWRC (Austin et al., 2018).
- Lake Wister Water Quality Modeling in Support of Nutrient and Sediment TMDL Development (Scott and Patterson, 2019).

A brief summary of the 2019 TMDL report is provided below. The other reports were in reference to the data presented previously in this WMP.

Lake Wister's water quality was modeled in support of nutrient and sediment TMDL development. The model used was ELCOM-CAEDYM which is a three-dimensional hydrodynamic and water quality model. Data included in the model was lake morphometry data provided by the Oklahoma Water Resources Board (OWRB), meteorological data from Oklahoma's MESONET network, USGS gage data, outputs and withdraws from the U.S Corp of Engineers (USACE), and water quality data from Lake Wister that was collected from 2011-2015 by PVIA. The model was calibrated within limits set forth by Oklahoma Department of Environmental Quality (ODEQ). Lake modeling results show that a 1% reduction in total phosphorus could decrease the long-term average of chlorophyll-α by 0.12 µg/L. Also, that the external phosphorus concentration will need to be reduced by 78% for the long-term average chlorophyll-α concentrations in Lake Wister to get below 10 µg/L which is the water quality standard for public water supply designation. The TMDL concluded that total phosphorus concentrations should be 1 mg/L or less for all point source (wastewater) dischargers. Reducing all point dischargers down to 1 mg/L will result in a decrease of 8% of the total sediment load. TSS was not included in the waste load allocations, as dischargers make up only 0.1% of the total load to Lake Wister. The TSS load comes almost entirely from non-point source (storm water driven) discharges within the watershed. Table 4.2.1 displays load allocations for the recommended TMDLs for Lake Wister (Patterson and Scott, 2019).

Table 4.2.1. Load allocations for recommended TMDLs for Lake Wister (Patterson and Scott, 2019).

	Total Phosphorus TMDL (lb/year)	% Total Phosphorus TMDL	Total Suspended Solids TMDL (lb/year)	Percent of Total Load
Waste Load Allocation (point sources)	7,725.0	8	0.0	0
Load Allocation (nonpoint sources)	88,837.4	92	82,029,721.4	100
Total	96,562.4	100	82,029,721.4	100

5.0 POLLUTION SOURCE ASSESSMENT

The PRW was broken down into 30 HUC-12 subwatersheds to create watershed sizes that were manageable, for assessment, planning, and implementation. Of the 30 subwatersheds, 20 (some watersheds are grouped together) form the basis for how the findings from the assessment phase will be utilized to identify and prioritize pollutant sources for management. Some of the HUC-12 sub-basins were not monitored as they were believed to be of either lesser loading concern or were represented by one of the other monitored sub-basins. That is, the LULC were similar enough to another sub-basin that it could serve as a surrogate in regard to source assessment and management prioritization. For the unmonitored HUC-12 sub-basins the surrogate stations utilized are noted in Table 5.1 by the word "used".

Table 5.1. Watersheds that had data or data was used as a surrogate for the unmonitored subwatershed.

Watershed	HUC- 12	Site Name
James Fork	Big / Johnson / SH	Pot-1
	Cedar Creek-James Fork	Used Pot-7
	Cherokee Creek	Pot-3
	Gap Creek	Used Pot-7
	Headwaters James Fork	Pot-5
	Prairie Creek	Pot-2
	Riddle Creek	Used Pot-7
	Upper Sugarloaf Creek	Pot-7
	West Creek	Pot-6
Poteau River	Big Creek	Pot-15
	BC/SR/EFPR	Pot-9
	Cane Creek-Poteau River	Used Pot-8
	Cross Creek - Poteau River	Pot-8
	East Shadley Creek-Poteau River	Used Pot-8

Watershed	HUC- 12	Site Name
Poteau River	Headwaters Poteau River	Pot-10
	Lower Jones Creek	Used Pot-12
	Ross Creek	Pot-11
	Upper Black Fork	Pot-14
	Upper Jones Creek	Pot-12
	Haw Creek	Pot-13

5.1 Point Sources

Figure 5.1.1 depicts where all the NPDES permits are within the PRW. Within the PRW there are 66 active NPDES permits. There is one major permitee (design flow > 1.0 MGD) and 65 non-major permitees (design flow < 1.0 MGD).

The majority of these discharges are storm water related and not continuous discharges. Tyson Waldron (NPDES Permit No. AR0038482) is the only major discharger with a design flow of 1.25 MGD. Tyson's facility discharges to an unnamed tributary then to the Poteau River above monitoring location Pot-9 and is in the Bull Creek/Square Rock/East Fork of the Poteau River subwatershed. The next largest discharger in the watershed is the City of Waldron with a design flow of 0.85 MGD and is also captured by the Pot-9 monitoring location and is within the subwatershed grouping of BC/SR/EFPR.

The other two permitees included in the table below had the next largest flow, and all other dischargers had a design flow of less than 0.11 MGD. City of Mansfield Wastewater Treatment Plant (WWTP) (NPDES Permit No. AR0036293) has a design flow of 0.45 MGD and the outfall is captured by monitoring location Pot -3 of the Cherokee Creek watershed.

The city of Huntington has a design flow of 0.11 MGD and the outfall is captured by monitoring location Pot-2 in the Prairie Creek subwatershed. Effluent limits for each of these entities are presented in Table 5.1.1. It should be noted that the Tyson Poultry discharge (phosphorus limit 1.5 mg/L) and the City of Waldron (phosphorus limit 1.0 mg/L) discharge which go to the Poteau River are both already close to, or in attainment, of the 1.5 mg/L phosphorus goal for PS dischargers recommended by the Lake Wister TMDL.

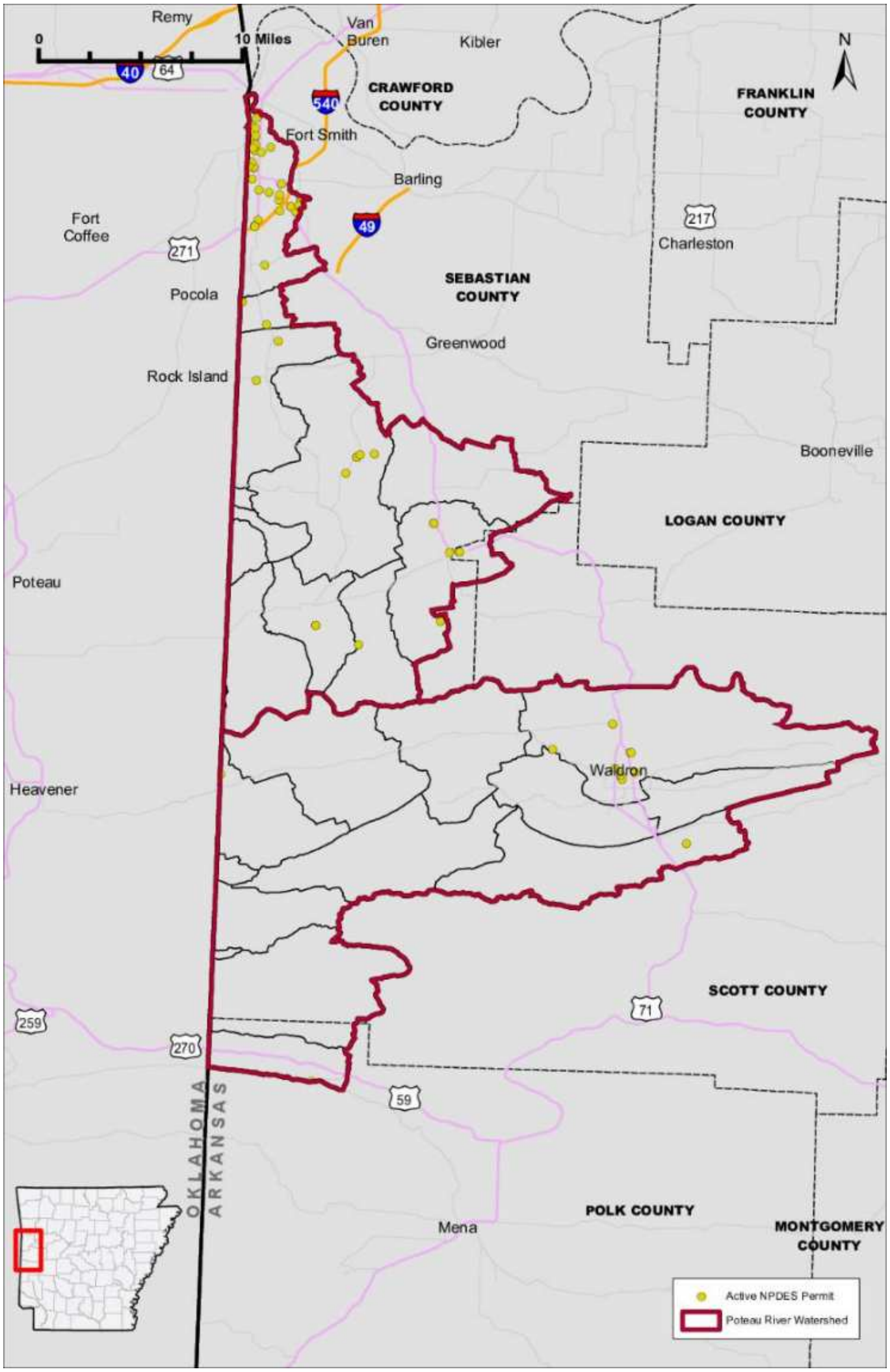

Figure 5.1.1. Active NPDES permits in the PRW.

Table 5.1.1 NPDES permit limits for major NPDES discharges in the watershed.

Parameter	Mass Monthly Average (lb/day)				Concentration Monthly Average (mg/L)				7 day Average (mg/L)			
	Mansfield	City of Huntington	City of Waldron	Tyson Waldron	City of Mansfield	City of Huntington	City of Waldron	Tyson Waldron	City of Mansfield	City of Huntington	City of Waldron	Tyson Waldron
Design Flow	0.45 MGD	0.11 MGD	0.85 MGD	1.25 MGD	0.45MGD	0.11 MGD	0.85 MGD	1.25 MGD	0.45MGD	0.11 MGD	0.85 MGD	N/A
CBOD5 (May-October)	37.5	18.3	106.3	156.4	10	20	15	15	15	30	23	
CBOD5 (November-April)	56.3	22.9	106.3	156.4	15	25	15	15	22.5	40	23	
BOD5	N/A	N/A	N/A	166.8	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
BOD5 (November-April)				N/A				16				
Total Suspended Solids (TSS)			106.3	156.4			15	15			22.5	
TSS (May-October)	56.3	18.3	N/A	N/A	15	20	N/A	N/A	22.5	30	N/A	
TSS (November-April)	75.0	27.5	N/A	N/A	20	30			30	45		
Ammonia Nitrogen (April)	21.0	N/A	39.7	41.7	5.6	N/A	5.6	4	5.6	5.6	5.6	
Ammonia Nitrogen (May-October)	15.0	3.7	35.4	41.7	4.0	4.0	5.0	4.0	6.0	5.6	5.6	
Ammonia Nitrogen (November-March)	22.5	3.7	56.7	41.7	6.0	4.0	8.0	4.0	9.0	6.0	12.0	
Dissolved oxygen (DO)	N/A	N/A	N/A	N/A		N/A	N/A	5.0	N/A	N/A	N/A	
DO (May-October)					4.0	4.0	5.0	N/A	4.0	4.0	5.0	
DO (November-April)					5.0	3.0	6.0		5.0	3.0	6.0	
Fecal Coliform Bacteria (FCB) (colonies/mL)					1,000	N/A	N/A	400	2,000	N/A	N/A	
FCB (May-September)					N/A	200	200	N/A	N/A	400	400	
FCB (October-April)						1,000	1,000			2,000	2,000	
Oil & Grease (O&G)				83.4		N/A	N/A	8		N/A	N/A	
Copper, total recoverable			0.065	0.096			9.2 ug/L	9.2 ug/L			18.5 ug/L	
Zinc, total recoverable			0.606	0.891			85.5 ug/L	85.5 ug/L			171.6 ug/L	

Parameter	Mass Monthly Average (lb/day)				Concentration Monthly Average (mg/L)				7 day Average (mg/L)			
	Mansfield	City of Huntington	City of Waldron	Tyson Waldron	City of Mansfield	City of Huntington	City of Waldron	Tyson Waldron	City of Mansfield	City of Huntington	City of Waldron	Tyson Waldron
Total Phosphorus			7.09	15.64			1.0	1.5			1.5	
Total Nitrogen			N/A	1,073.80			N/A	103			N/A	
Chlorides			1063	1,878.90			150	180.2			225	
Sulfates			496	2,087.60			70	126.1			105	
Total dissolved solids (TDS)			4,679	9,080.80			660	871.1			990	
Total Residual Chlorine (TRC)			N/A	N/A		0.011	N/A	N/A		0.011	N/A	
pH			N/A	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	6.0-9.0	

5.2 Non-point Sources

Based on the results of the assessment work completed in the watershed, the following is a summary of what are believed to be the top three sources of pollutants in each subwatershed evaluated (Table 5.2.1).

Table 5.2.1 Three largest non-point source impacts for each subwatershed assessed in the PRW.

Watershed	Subwatershed	Unpaved roads	Urban land use	Pasture land use	Poultry houses	Cattle runoff	Stream-bank erosion	Riparian buffer <50 ft	Quarry runoff	Stream Crossings	Impacted buffer
James Fork	Big / Johnson / SH			X		X	X				
	Big Creek						X	X			X
	Cedar Creek-James Fork		X	X							X
	Cherokee Creek						X	X			X
	Gap Creek						X	X			X
	Headwaters James Fork					X	X				X
	Prairie Creek			X		X	X				
	Riddle Creek		X	X							X
	Upper Sugarloaf Creek			X			X				X
	West Creek						X	X		X	
Poteau River	BC/SR/EFPR			X	X						X
	Cane Creek-Poteau River	X						X			
	Cross Creek - Poteau River	X				X	X				
	East Shadley Creek-Poteau River	X					X	X			
	Haw Creek						X	X			X
	Headwaters Poteau River	X			X			X			
	Lower Jones Creek				X	X			X		
	Ross Creek				X			X			X
	Upper Black Fork	X					X				
	Upper Jones Creek	X				X		X			

5.3 Priority Subwatershed Ranking

Many factors play into determining which subwatersheds are priority to address with implementation efforts and what impacts need to be addressed first. To aid in this analysis a matrix was developed to consider each of the impact assessment categories including oil and gas well numbers, developed and hay/pasture land use percent, total nitrogen, total phosphorus and TSS loads, concentration of agricultural animals, slope of the watershed, amount of impacted riparian buffers, miles of unpaved roads, SWAT model load predictions, percent of reach eroded and amount of bank erosion, if available. There were three water quality loading parameters that were included in the matrix giving water quality more weight in the ranking. Scores were assigned to subwatersheds that ranked either first (10 points), second (9 points), third (8 points), fourth (7 points), fifth (6 point), sixth (5 point), seventh (4 point), eighth (3 point), nineth (2 point), and ten (1 point) worst in a given impact category. Maximum possible score was 140. The higher the score the higher the priority. Table 5.3.1 provides a summary of the score totals for each subwatershed. As noted previously, not all subwatersheds had monitoring stations or were the focus of assessment efforts. The unmonitored HUC-12 sub-basins are represented in this assessment by other subwatersheds with similar land use (i.e. East Shadley Creek is represented by POT-8 since they were similar).

Table 5.3.1 Ranking of each impact category for each subwatershed.

HUC 12 name	BC/SR/EFPR	Prairie Creek	Ross Creek	Cherokee Creek	Big / Johnson / SH	West Creek	Headwaters Poteau River	Lower Jones Creek	Upper Sugarloaf Creek	Big Creek	Headwaters James Fork	East Shadley Creek-Poteau River	Upper Jones Creek	Upper Black Fork	Cross Creek-Poteau River	Haw Creek	Gap Creek	Cedar Creek-James Fork	Cane Creek-Poteau River	Riddle Creek
Chicken houses (#/mi2)	9	8	7	6	1	5		10	2		4						3			
All Cattle/Calves	10	4	6	5	7	1		9	3			8	2							
% of Impacted Riparian Buffer (<50 ft)	9	1	10	7		5	8		2			6				3	4			
Mean Slope (percent rise)			1						3	10	6	2	4	7	5		8			9
Number of Oil & Gas Wells	3	8		9	10	5			7	1	6							1	4	2
Unpaved Roads (miles)	10		9		6		5	4				8	3	7	2				1	
Storm Average of Total Nitrogen (lb/mi2)	5	3	7	4		2	8			10	1					9		6		
Average of Total Phosphorus (lb/mi2)	10	6	8	3		7	9			5	1					2		4		
Average of TSS (lb/mi2)	4	3	8	1		7	2			10	9					6		5		
Developed	7	4	2	10	6	3	9	5			1		8							
Hay/Pasture	5	10	1	8	6	4	7	9			2								3	
% Reach Eroded	7	8				9	4		10			5		2	5		3	1	6	
Sediment Eroded Adjusted for gravel/cobble (lb/yr)		9	1	3	10	7			8	,	4		2	5						
SWAT Sediment (lb)	7	4	6	5	10	1		3	2	,			8		9					
Tottal	86	68	66	61	56	56	52	40	37	36	34	29	27	21	21	20	18	17	14	11

According to the matrix ranking, the three key subwatersheds in most need of land use management and source reductions in the James Fork portion of the PRW are Big Branch / Johnson Branch / School House Branch, Cherokee Creek, and Prairie Creek. The three key subwatersheds in most need of land use management and source reductions in the Poteau River portion of the PRW are Bull Creek / Square Rock / East Fork of Poteau River, Ross Creek, and East Shadley Creek. A visualization of the matrix rankings in each of the watersheds is provided below in Figure 5.3.1.

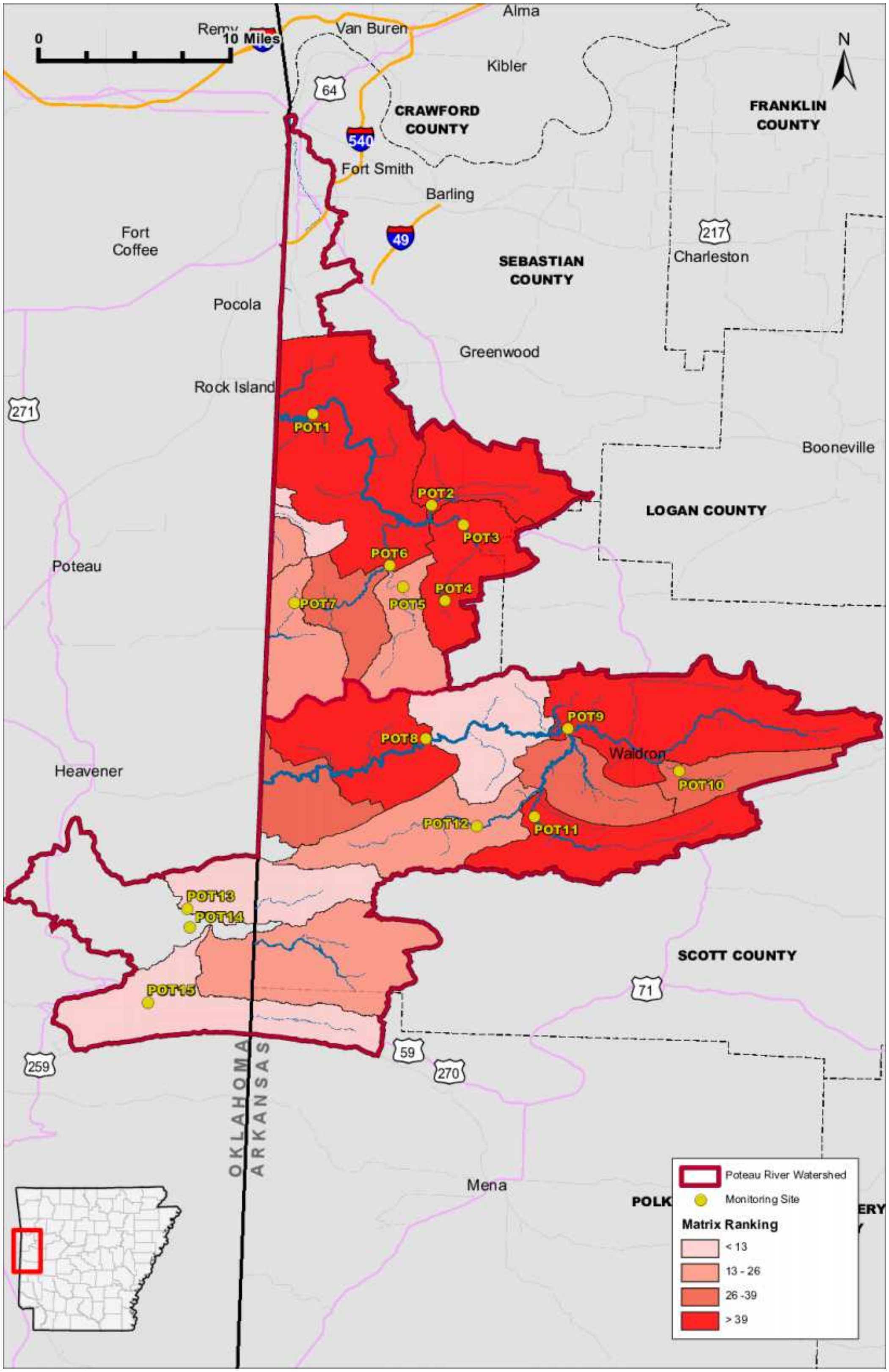

Figure 5.3.2. Matrix rankings of top watershed concerns in the PRW.

6.0 RECOMMENDATIONS FOR WATERSHED MANAGEMENT

The following sections provide recommendations for management of the PRW through protection, enhancement, and restoration. Ideally all recommendations could be easily implemented. However, this not being the case, the final portion of this section provides a ranked list of recommendations based on priority and necessity. The recommendations for watershed management are designed to address and remedy the critical problem areas/sources discussed in the previous sections. In many circumstances management practices recommended to reduce pollutants will also have some positive impact on flooding. This is particularly true for stormwater management recommendations for developed areas (Sections 6.2.2/6.2.3). Even the practice of preserving or restoring natural lands, such as riparian buffers, can help attenuate flood waters.

6.1 Recommended Load Reductions

Based on the Arkansas 303(d) list, the Designated Use Assessment Criteria (Section 3.4.3) and/or the data collected by University of Arkansas during the most recent watershed study some subwatersheds failed to meet certain (turbidity, etc.) Arkansas Assessment Criteria (Section 3.4.3).

Therefore, reductions in TSS (sediment), which will also garner reductions in nutrients and improve dissolved oxygen levels should be targeted in an effort to ensure maintenance of the standards and to improve water quality in all subwatersheds affected. The 2006 TMDL concluded that a 35% reduction in total phosphorus from non-point sources was necessary for improved water quality. A reduction of 35% for TSS loading (and 35% for N & P) will be targeted for the PRW. This is a reasonable beginning point for water quality in the watershed, and should sufficient to meet the Lake Wister reduction targets in the Poteau River. The three key subwatersheds in most need of land use management and source reductions in the Poteau River portion of the PRW are Bull Creek / Square Rock / East Fork of Poteau River, Ross Creek, and East Shadley Creek. Big Branch / Johnson Brach/ School House Branch, Prairie Creek, and Cherokee Creek in the James Fork need the most land use management and source reductions.

Annual loading for each of the assessed subwatersheds was evaluated using the SWAT model. Annual loading predictions from SWAT were most similar (in scale) to the loading projected by the Lake Wister TMDL, so loads from SWAT were used to assess load reduction targets. The resulting annual loads for TSS, nitrogen, and phosphorus (Table 6.1.1) were then used to establish a load reduction target for each constituent, based on the 35% reduction goal.

Table 6.1.1. Comparison of loading calculated by modeling and from monitoring.

Loading Source	TSS (lb/yr)	N (lb/yr)	P (lb/yr)
SWAT	213,731,814	2,208,786	523,486
A 35% reduction in the load based on SWAT data			
Target Load Reduction	74,806,135	773,075	183,220
Loading Goal	138,925,679	1,435,711	340,266

6.1.1 SWAT Modeling Non-Point Source (NPS) Load Reduction Potential

The soil and water assessment tool (SWAT) is a widely used watershed model based on hydrologic response units that can evaluate point source and non-point source loading of pollutants, transport, and their effect on water quality. The hydrologic response units group areas of similar land use, soils, etc. SWAT was used in this report to evaluate BMP removal rates from various land uses in the watershed. The model addresses load reductions from BMPs on a land use by land use basis. Each BMP is set-up in the model with BMP type, type of land use the BMP is effective for, and the percentage of that land use area (acres) that it is applied to.

To assess and manage NPS pollution, the NRD recommends evaluating pollutant loading and implementing mitigation efforts on the subwatershed scale. Watershed models, particularly SWAT, are often used for assessing, planning, and prioritizing NPS mitigation efforts and watershed management activities (Ghafari et al., 2017). The SWAT model can be used to predict the impacts of differing land uses and land management practices under various climatic conditions on water, sediment, and nutrient yields on the watershed scale over long periods of time.

To evaluate the effect that implementation of management practices could have on pollutant loadings, several feasible BMPs were evaluated. Best management practices were simulated across 25% of the watershed and loadings of sediments, total nitrogen, and total phosphorus were compared to the base model to assess changes. The BMPs simulated in SWAT include:

1. A 25-foot riparian buffer in pasture/hay land uses.
2. A 25% reduction in cattle stocking rates in pasture/hay land uses.
3. Rotational grazing, which was simulated as a 25% reduction in grazing days in pasture/hay land uses.
4. A 25-foot riparian buffer in row crop land uses.
5. A winter wheat cover crop in hay land uses.

6. A rye cover crop in hay land uses.
7. A 25-foot riparian buffer in urban land uses.
8. Green area enlargement, which was simulated as a 10% reduction in curve numbers in urban land uses.
9. Storm water treatment features (bioswales, detention, etc.) were applied to 25% of developed land uses (modeled using SWAT and/or WTM) (Caraco/Cup, 2013)

Based on the results of the modeling, the most effective BMP applied to the watershed was a 25-foot riparian buffer in pasture/hay land uses (Table 6.2.1.1), which is one of the dominant land uses in the watershed. Riparian buffers protect the streambanks from erosion and provides a filtration mechanism for sediments and pollutants in runoff. The next most effective BMP was a 25-foot riparian buffer in urban areas. The greater reduction in loads with riparian buffers on pasture/hay land uses can be attributed to the greater area of pasture/hay land uses in the watershed compared to urban.

The winter cover crops (winter wheat and rye) in the hay land use did not provide any reduction in pollutant loads. This is likely due to the base model including fescue grass during the winter season; therefore the hay areas already had some protection against soil erosion and runoff, and the type of plant made little impact.

6.2 Land Use and Runoff Management

The following sections are best management practices recommended to protect water quality and/or the hydrologic regime of the major tributaries of the PRW. Practices are recommended according to land use type. The listings are not comprehensive but provide those typically applied successfully to such land uses as those found in this watershed. Reduction estimates (below) are from modeling or assessments described in this report, and costs (Section 9.0) are based on a survey of literature values.

6.2.1 Agricultural Land Use

Agricultural producers should be encouraged to implement BMPs appropriate to their land use habits. This encouragement probably needs to occur as some form of educational material mail out, forums and face to face meetings. Assistance (including financial) with these types of efforts is available through the National Resource Conservation Service (NRCS), the Arkansas Department of Agriculture NRD, the University of Arkansas Cooperative Extension Service and others. Frequently farmers can enter cost share agreements with one of these federal or state entities that provide the majority of funds to accomplish some of these BMPs.

A voluntary survey was sent in 2022 to poultry farmers in the watershed by Tyson Poultry. Several surveys were returned and the results are in the table below (Table 6.2.1.1). Based on the surveys, farmers are not currently implementing many voluntary BMPs, however, all responded ‘yes’ when asked if they would be willing to implement BMPs, and all noted interest in cost share programs.

Table 6.2.1.1. Results of Tyson grower voluntary survey.

Number of houses managed	Primary Location	Annual Litter application (on average) (acres)	Primary use of land	Hay cut from where litter is applied?	where is the hay used?	Are cattle on the land litter is applied?	Participation in cost sharing in the last 5 years?	Would you consider implementation of BMPs	Do cattle have access to streams on the property?	Do you have an alternative water source?
8	Mansfield	500	hay	yes	off-site	no	no	yes	no	yes
5	Heavener	200	other	yes	sold	no	no	yes	N/A	not answered
8	Waldron	yes	pasture	no	N/A	no	no	yes	N/A	N/A
2	Waldron	100	hay	yes	on-site	yes	no	yes	no	yes
4	Waldron	0	hay and cattle pasture	yes	on-site	yes	no	yes	yes	yes

Pasture - It is likely that many farmers in the watershed already implement some BMPs to enhance hay and cattle production. However, experience has shown that these are not as widespread and/or consistent as needed. In each subwatershed, and particularly in subwatersheds Prairie Creek, Lower Jones Creek, and Cherokee Creek, where pasture is the most prevalent, and in Bull Creek/ Square Rock/ East Fork Poteau River where cattle and poultry numbers are high, it is recommended that landowners be encouraged to consider implementation of pasture management practices. For pasture with on-going grazing operations the following BMPs should be considered in all subwatersheds:

- Riparian buffers along stream corridors. Minimum of 25 feet forest and 25 feet native grasses. This protects the streambanks from erosion and provides filtration of sediment and associated pollutants in the runoff.
- Alternative water sources (away from stream) for cattle use. This helps keep the cattle out of the stream and away from the banks where they contribute to erosion.
- Fencing cattle out of stream.
- Rotating pasture usage (rotational/prescribed grazing). This helps prevent over grazing, preventing grasses from becoming too thin or trampled, allowing them to help buffer the stream. It also helps prevent soil compaction.
- Control/reduce stocking rate, number of head per acre of pasture.

Hay - For agricultural land being used for hay operations in all subwatersheds the following BMPs should be considered:

- Riparian buffers/filter strips along stream corridors (see detail above).
- Though required by Nutrient Management Plans it should be emphasized to control fertilizer applications (magnitude, timing and method) according to soil tests and USDA or NRCS recommendations to maximize productivity yet protect water quality.
- Use of cover crops during off season, i.e. use perennial and seasonal grasses to maximize grass density throughout all seasons. Prevents top soil erosion, and utilizes remaining nutrients.

Potential load reductions (in pounds and % of target reduction) from use of the two primary agricultural BMPs rotational/prescribed grazing and reduction of the cattle stocking rate (riparian buffers are addressed in Section 6.3.1), in key subwatersheds are:

- **TSS – 2, 541,088 (3.4%)**
- **N – 62,038 (8.0%)**
- **P – 34,167 (19%)**

6.2.2 Developed - Commercial and Industrial Land Uses

Overall, the PRW is not a highly developed area of the state. However, there are over 65 NPDES permits in this watershed, most of which are stormwater related. Many of the NPDES permits are concentrated in the northern portion of the watershed near the urban areas of Fort Smith, Arkansas. Although the subwatershed containing some of Fort Smith has not been a focus of the watershed assessment, recommendations in this section are still applicable to that area. Ensuring these entities are in compliance with their permits is an important component of managing the water quality and quantity in those subwatersheds. Besides the industry, these areas also contain more commercial development.

Several subwatersheds, particularly in the Big Branch / Johnson Branch / School House Branch, Upper Sugarloaf Creek, and Prairie Creek, also contain natural gas well pads or transfer stations. Well pads and their associated infrastructure can be a significant source of sediments during construction, but this risk diminishes dramatically after soil stabilization with vegetation. The Cedar Creek-Poteau River, Bull Creek / Square Rock/ East Fork Poteau River, Headwaters Poteau River and Cherokee Creek should be the target subwatersheds for the BMPs listed below.

The following BMPs should be considered:

- Riparian buffers along stream corridors. In addition to the benefits discussed previously, buffers help control storm flow hydrographs. Riparian buffers with a width of 50-100 ft (minimum 25 feet) on each side of streams.
- Encourage green area enlargement and enhancement and reduce impervious surfaces on new and existing developments.
- Encourage good housekeeping practices. Keep outside storage areas covered, immediately clean up spills of liquid or dry materials, etc.
- Enforce construction storm water management plans.
- Encourage and/or implement stormwater detention/retention/treatment requirements for large impervious areas. In some cases, particularly in commercial and institutional areas, bioswale/bioretention may be appropriate (Figure 6.2.1).
- Land conservation. Where possible attain land or establish easements in areas critical to the stream (i.e. buffer zones, wetlands, etc.) and maintain these as green areas.

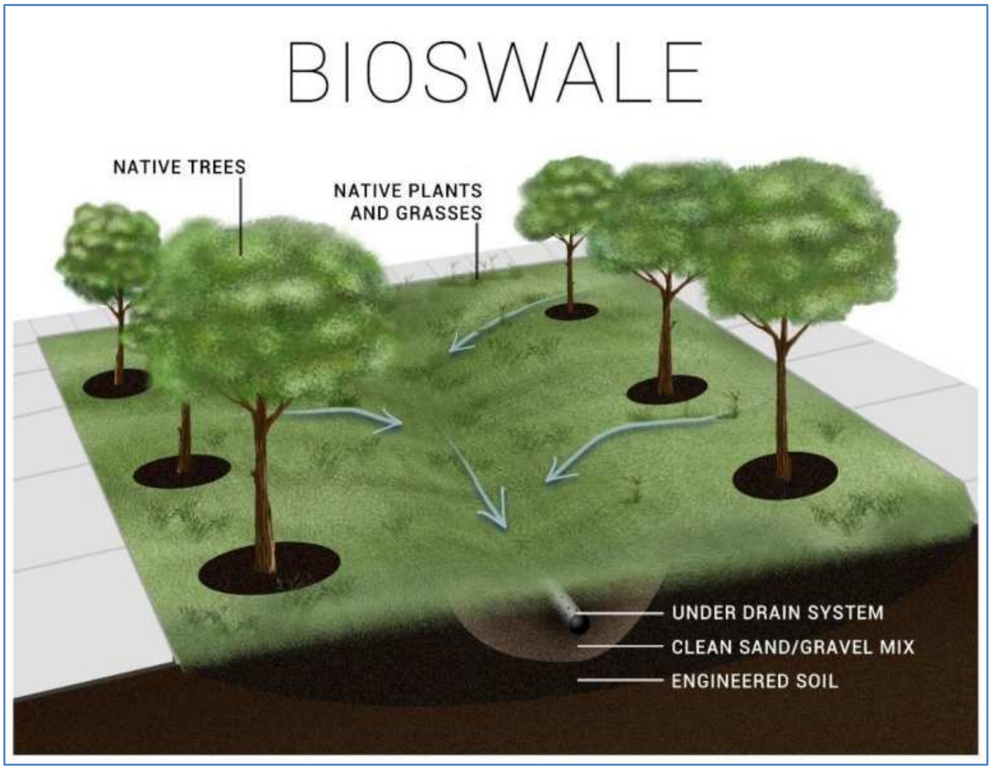

Figure 6.2.1. A bioswale (bioretention) that is effective in reducing pollutant load in stormwater run-off from commercial and institutional areas.

6.2.3 Developed - Residential Land Uses

As mentioned, overall PRW is not highly developed but rural residential areas occur throughout the watershed with a higher concentrations near Waldron, Mansfield, and Fort Smith. Therefore in subwatersheds Cedar Creek, BC/SR/EFPR , Upper Jones Creek, and Headwaters of the Poteau River recommended implementation of best management practices by developers and residents should be encouraged and in some areas required.

For residential developments the following BMPs should be considered:

- Riparian buffers along stream corridors. Riparian buffers with a width of 50-100 ft (minimum 25 feet) on each side of streams.
- Encourage green area enlargement and enhancement and reduce impervious surfaces on new and existing developments.
- Encourage good neighbor practices. Keep yard free of junk and garbage, proper disposal of pet waste, proper disposal of household chemicals, etc.
- Strictly enforce construction storm water management plans.

- Encourage and/or implement stormwater detention/retention/treatment requirements for development.
- Encourage (through incentives) or require use of low impact development techniques (LID) in new developments in critical areas or on steep slopes. Encourage current homeowners to install raingardens or similar small on-site stormwater retrofits (Figure 6.2.2). Most of these features also serve to help reduce flooding.
- Limit and manage fertilizer application.
- Encourage watershed stewardship through education.

Potential load reductions (in pounds and % of target reduction) from use of urban/developed land management practices such as green area enlargement and stormwater treatment features in urban areas (riparian buffers are addressed in Section 6.3.1), in key subwatersheds are:

- **TSS – 1,052,218 (1.4%)**
- **N – 182,576 (24%)**
- **P – 2,952 (1.6%)**

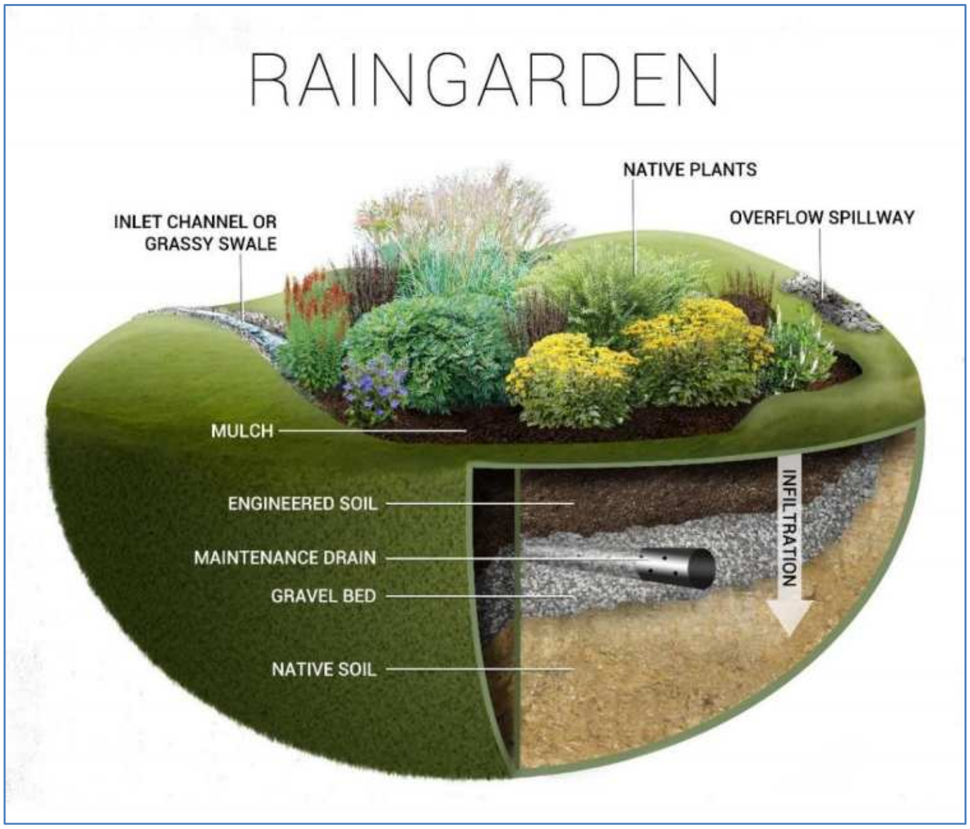

Figure 6.2.2. Example of a raingarden that can be easily and inexpensively installed in most yards and/or commercial areas to improve stormwater quality.

6.2.4 Unpaved Roads Management

Several BMPs are available to decrease sediment transport from unpaved roads. Key subwatersheds where there is a high concentration of unpaved roads are Ross Creek, East Shadley Creek, and BC/SR/EFPR. The following BMPs are believed to be appropriate to the forest roads and dirt roads in the watershed:

- Aggregates replacement
- Water bars in steep sections
- Roadside ditch maintenance and check dams
- Proper road surface stabilization/road grading/maintenance
- Turnouts

Table 6.2.4. Potential load reductions from implementation of unpaved road BMPs.

Parameter	Total Current Load (lbs)	50% Reduction (lbs)
TSS (12 rain events)	2,033,334	1,106,667
N load	1,133	566
P Load	596	298

Potential load reductions (in pounds and % of target reduction) from use of a combination of these management practices on approximately 50% of unpaved roads in key subwatersheds, based on info from Bloser, S.M. and Sheets B.E., 2012 are:

- **TSS – 1,106,667 (1.5%)**
- **N – 566 (0.07%)**
- **P – 298 (0.16%)**

6.3 Stream Corridor Restoration/Enhancement

6.3.1 Riparian Buffers

Riparian vegetated buffers are lacking or limited in several reaches in the PRW. As discussed previously in this report (Section 3.0) riparian buffers are critical to the health of a stream system. The following areas are indicated as having impacted riparian buffers and should be targeted for establishment or enhancement of vegetative riparian buffers: Ross Creek, BC/SR/EFPR, and Headwaters Poteau River.

Buffer widths should be planted as wide as possible on each side of the stream. A width of at least 25 ft on each side of the stream should be targeted. When riparian buffers are considered, more is always better. Buffers should be composed of native vegetation including trees, shrubs, herbaceous plants, and grasses. Figure 6.3.1 presents a representation of how buffers are designed.

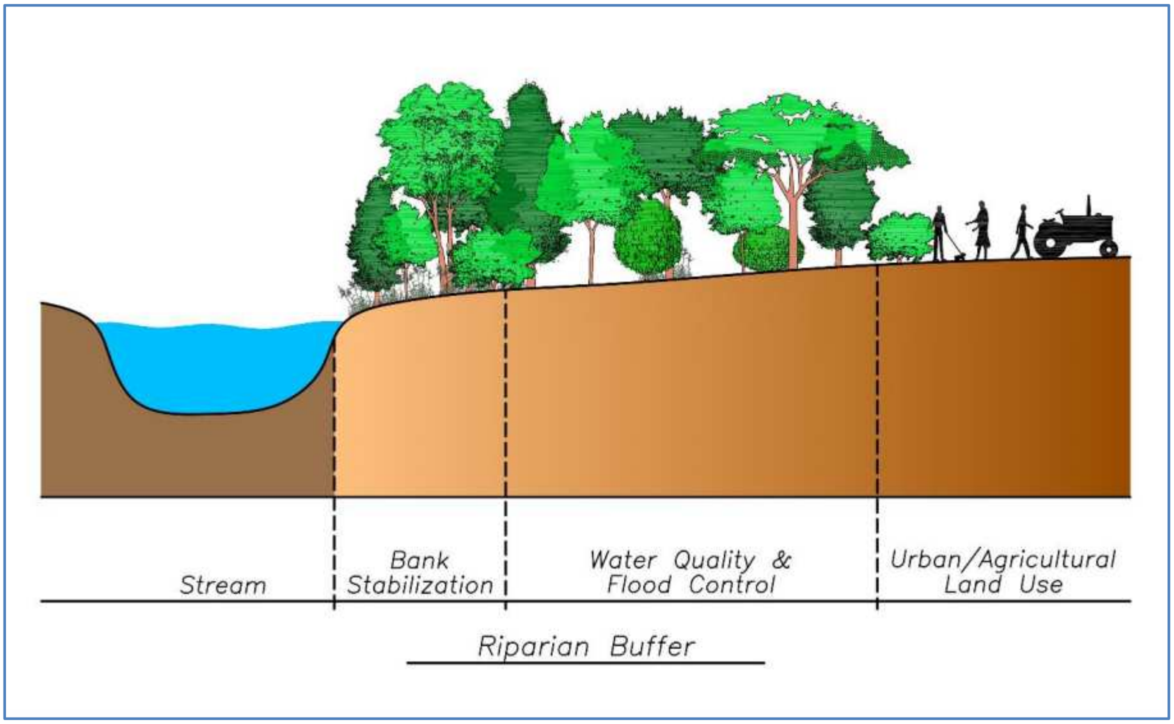

Figure 6.3.1. Generic Representation of the ideal Riparian Buffer Zone.

Potential load reductions from use of these management practices (25-foot forest riparian buffer in pasture and developed land and 25 foot native grasses in pasture) were evaluated using the SWAT model. The SWAT model focused a design capable of more water filtration for pasture land uses, as developed land uses were less prevalent and nearly no row crops occur in the watershed. Results (in pounds and % of target reduction) of the analysis are below:

- **TSS – 17,401,400 (23%)**
- **N – 509,363 (66%)**
- **P – 188,078 (100%)**

6.3.2 Streambank and Channel Stabilization

Several of the streams in the PRW are exhibiting significant streambank erosion at several locations. Streambanks should be stabilized in as many of the locations as possible and particularly in the critical areas that are easily accessible for the required heavy construction equipment. Big Branch / Johnson Branch / School House Branch, Upper Sugarloaf, Prairie Creek, and West Creek should be the primary target of these efforts. Potential load reductions from bank stabilization alone exceed 250 lb sediment/foot of eroded bank restored (Table 6.3.2.1). Root causes of streambank instability should be evaluated in each reach and necessary measures taken to reduce the risk of bank erosion. These measures frequently include reduction in stormwater run-off peak flows to the system including riparian restoration/enhancement and changes in land uses throughout the watershed to slow down stormwater run-off and increase infiltration. Measures can also include completion of channel restoration features (i.e. installation of grade control, flow training and key habitat features, etc.).

Each streambank and channel stabilization project come with its own individual challenges and opportunities. Each stream stretch will need to be evaluated to determine what restoration techniques work best and meet the needs for sediment and nutrient reduction. Where possible, preference should be given to techniques that focus on bioengineering.

- Bank re-sloping (to flatten slope) and creation of bankfull benches
- Toe protection in conjunction with various vegetative protection measures (such as live stakes, live cribwalls, etc.)
- Stone armoring (such as the use of boulder toes/revetments, vegetated riprap, etc.)
- Use of bioengineered materials (coir, jute, excelsior™, etc) including erosion control blankets, wattles, fiber rolls, soil wraps, etc.
- Engineered structures for grade control, energy dissipation and flow guidance, (cross veins, J-hooks, step pools, riffles, etc.)
- Revegetation of the streambanks and riparian area using native grasses and trees.

The projects would generally utilize natural channel design techniques (Rosgen, 1996) and be supplemented with other guidance including *The WES Stream Investigation and Streambank Stabilization Handbook and USDA Engineering Field Handbook* “Chapter 16: Streambank and Shoreline Protection” as guidance for the projects in the watershed. Additional help may come from contract engineering companies who have additional experience with streambank stabilization.

Table 6.3.2.1. Yearly loads from streambank erosion and load reductions possible from streambank stabilization.

Watershed	HUC-12 Watershed	Stream assessment was completed or surrogate"used"	Sediment (lb/yr)	Phosphorus (lbs/yr)	Nitrogen (lbs/yr)
James Fork	Big Branch / Johnson/ SH	James Fork (JF-1)	92,186,985	27,011	51,348
	Big Creek	Used Headwaters James Fork	14,377,003	4,212	8,008
	Cedar Creek-James Fork	Used Headwaters James Fork	835,604	245	465
	Cherokee Creek	Cherokee Creek (CC-1)	6,788,911	1,989	3,781
	Gap Creek	Used Headwaters James Fork	490,743	144	273
	Headwaters James Fork	Upper James Fork (UJF-1)	7,695,287	2,255	4,286
	Prairie Creek	Prairie Creek (PC-1)	42,972,281	12,591	23,936
	Riddle Creek	Used Headwaters James Fork	2,342,401	686	1,305
	Upper Sugarloaf Creek	Used West Creek	19,298,908	5,655	10,749
	West Creek	West Creek (WC-1)	19,095,090	5,595	10,636
Poteau River	BC/SR/EFPR	Average	782,848	229	436
	Cane Creek-Poteau River	Used Bull Creek	560,866	164	312
	Cross Creek - Poteau River	Used Bull Creek	823,544	241	459
	East Shadley Creek-Poteau River	Used Bull Creek	780,130	229	435
	Haw Creek	Used Headwaters James Fork	2,340,672	686	1,304
	Headwaters Poteau River	Poteau River West	1,917,336	562	1,068
	Lower Jones Creek	Jones Creek	3,380,548	991	1,883
	Ross Creek	Used Lower Jones Creek	3,864,018	1,132	2,152
	Upper Black Fork	Used Headwaters James Fork	9,447,936	2,768	5,263
	Upper Jones Creek	Used Lower Jones Creek	5,089,692	1,491	2,835
		Total	235,070,803	68,876	130,934
		35% Reduction	82,274,781	24,107	45,827

Potential load reductions from use of these management practices on 25% of eroded banks in all subwatersheds affected:

- **TSS – 58,767,701 (78%)**
- **N – 32,734 (4.2%)**
- **P – 17,219 (9.4%)**

6.3.3 Critical Area Conservation

Land conservation should become a priority. Where possible, attainment of land and/or establishment of conservation easements should be considered in areas critical to the stream (i.e. buffer zones, wetlands, etc.) and maintain these as green areas. This practice typically helps to reduce localized flooding as well as serving to improve water quality. First place to begin this effort is typically in developed land use areas where support from the local municipality may be garnered. Key elements that should be developed in stream corridors and key area that drain to them are provided in Table 6.3.3.1.

Table 6.3.3.1. Key management measures to encourage, develop and manage.

Technique	Description of Technique
Construction storm water protection plans	Require for all new developments to reduce site run-on and reduce sediment and other pollutants leaving the work site. Includes diversion ditches/berms, silt fences, temporary detention ponds, hay bales, mulch, grass covers, synthetic erosion control blankets, etc. **These requirements must be enforced.**
Natural area conservation	Minimize lot clearing to that essential for the home and a small yard, maintain as many trees as possible. Riparian vegetated buffers will be along all stream corridors and be protected by local ordinance or easement where possible.
Avoid septic system use	All homes should be connected to local sewers and wastewater treatment facilities when possible.

6.4 Priority Recommendations and Implementation Schedule

Based on the load reductions projected in Section 6.2 for various BMPs, the most effective for sediment appear to be streambank stabilization and vegetated filter Strips/riparian buffers (Figure 6.4.1). The most effective for N and P removal appear to be streambank stabilization, lowered cattle stocking rate, and 25 feet riparian buffers (Figures 6.4.2 and 6.4.3).

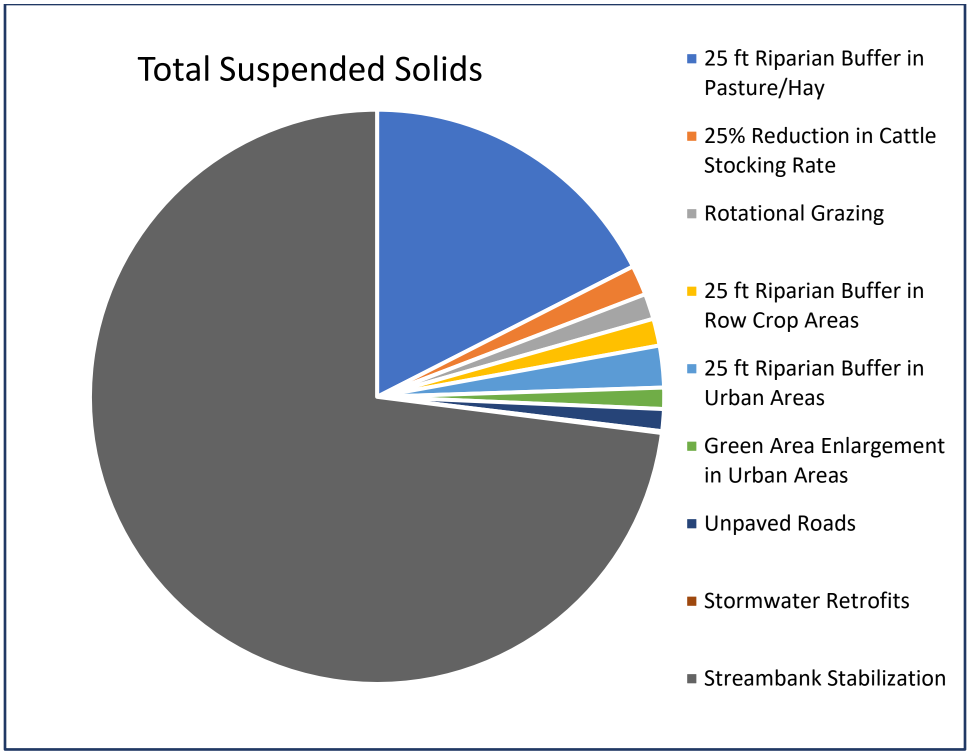

Figure 6.4.1. Source and scale of Total Suspended Solids (TSS) load reductions.

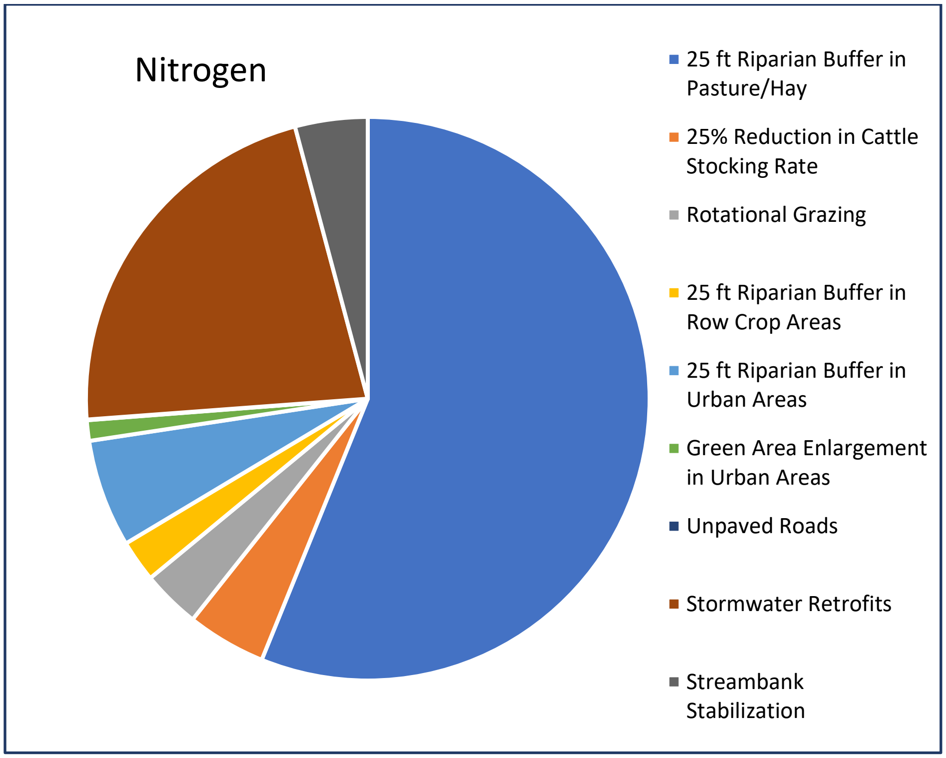

Figure 6.4.2. Source and scale of Nitrogen (N) load reductions.

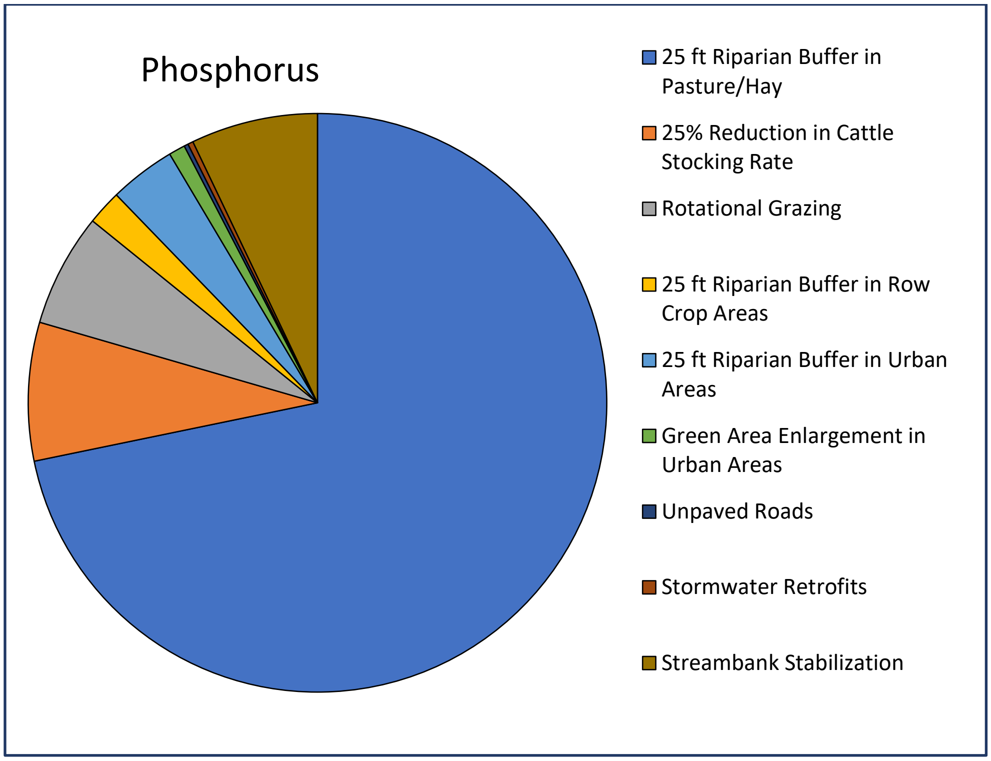

Figure 6.4.3. Source and scale of Phosphorus (P) load reductions.

Table 6.4.1 provides a ranking of the watershed management practices recommended as a result of the assessment and the matrix scores. Each management action is ranked based on its ability to move the watershed towards attainment of the goals expressed.

Table 6.4.1. Prioritization of recommended Watershed Management Practices.

Rank	Poteau River	James Fork	Management Action (Practice)
1	Bull/Square/EF, Lower Jones, & Ross	Cherokee Creek & Prairie Creek	Implementation of pasture BMPs (rotational grazing, lower cattle stocking rate, & improve riparian buffers)
2	Ross, Bull/Square/EF, & Headwaters Poteau River	Cherokee	Riparian buffer/Vegetated filter Strips
3	--	Upper Sugarloaf, Prairie Creek, & West Creek	Streambank stabilization
4	Bull/Square/EF, Ross,& East Shadley	--	Unpaved road maintenance and upgrades
5	--	BB/Johnson/SH, Headwaters James Fork, & Gap Creek	Streambank stabilization

Rank	Poteau River	James Fork	Management Action (Practice)
6	Headwaters Poteau River	BB/Johnson/SH	Implementation of pasture BMPs (rotational grazing, lower cattle stocking rate, & improve riparian buffers)
7	Headwaters Poteau River, Upper Jones, & Bull/Square/EF	Cherokee Creek	Implementation of residential/commercial BMPs
8	--	Riddle Creek & Gap Creek	Streambank stabilization
9	Upper Black Fork, & Headwaters Poteau River	BB/Johnson/SH	Unpaved road maintenance and upgrades
10	East Shadley	West Creek	Implementation of pasture BMPs

A watershed management plan should be a living and active document that serves as the guide to direct watershed management activities, including implementation projects to achieve load reductions, monitoring water quality and biota to gauge goal attainment, continuing education efforts, etc. The plan should be updated at least every 5 years to ensure it is still relevant to the current conditions of the watershed. In order to help ensure all these action items are completed it is necessary to have a schedule listing the tasks that need to be accomplished. A summary of the action items that resulted from this WMP are provided in Table 6.4.2. The schedule provides ten years for actions to be accomplished that will result in a 10% reduction of sediment and nutrients in the watershed.

Table 6.4.2. Implementation Schedule[1].

Action Item	Target Date for completion
Establish a permanent watershed management/stakeholder group to oversee implementation.	30-Aug-23
Meet with stakeholder group to coordinate implementation projects and monitoring and plan for future funding	15-Oct-23
Apply for grants to fund future monitoring and implementation projects	30-Dec-23
Implement a pasture management education effort and invite all farmers in the watershed[1]	30-Dec-24
Meet with county judges and US Forest Service to discuss unpaved road maintenance	30-Jun-23
See 50% of unpaved roads in Bull/Square/EF, East Shadley, & Ross receive new BMP application	30-Dec-24
Achieve new pasture management BMPs utilized in 25% of pastures in Lower Jones, Bull/Square/EF, BB/Johnson/SH, Prairie & Cherokee	30-Dec-25

Action Item	Target Date for completion
Bank stabilization of 15% of eroded banks in BB/Johnson/SH, Headwaters James Fork, & Gap Creek	30-Dec-26
Achieve new pasture management BMPs utilized in 25% of pastures in Headwaters Poteau River, & BB/Johnson/SH	30-Dec-27
Bank stabilization of 15% of eroded banks Riddle Creek & Gap Creek	30-Dec-28
See 50% of the remaining unpaved roads in Upper Black Fork, BB/Johnson/SH & Headwaters Poteau River receive new BMPs	30-Dec-31
See remaining 10% of streambanks stabilized in key subwatersheds	30-Dec-32

[1] Participation by landowners and funding are an unknown and could have a significant effect on the schedule and implementation success.

6.5 Interim Milestones

In order to monitor progress, it is necessary to have measurable milestones that can be easily interpreted. The milestones that will be used for gauging progress on of this WMP are provided in Table 6.5.1.

Table 6.5.1. Interim Measurable Milestones.

Milestone	Measurement method
Stakeholder group success	Meetings at least 2/year and attendance of at least 40% of group on average
Monitoring program initiated	First round of routine samples collected
Pasture BMP meetings	Meeting occurred on schedule
Unpaved road BMP meeting	Meeting occurred on schedule
Bank stabilization	Stabilization completed on schedule Length of stream completed as planned
Monitoring shows TSS and TP loading is stable or decreasing	Data analysis (per Section 7.0) of first three-year monitoring cycle (2024/25-2027)
Pasture management practice implemented	Completed on schedule and attaining percentage goals
WMP reviewed and updated every five years	Plan review is completed in 2028 and needed updates included

Success will be achieved if the above tasks are completed according to schedule. Future success will be measured by number of implementation projects that are completed.

6.6 Adaptive Management

As with any undertaking of this magnitude, obstacles will arise, and plans change. Therefore, every effort will be made to make this management plan dynamic, so that it can be easily adapted and adjusted to the needs of the watershed to benefit water quality, aesthetics, biotic communities, and the public.

Every five years the plan will be reviewed to evaluate the effectiveness of:

1. BMPs/Management practices,
2. Monitoring of loading,
3. Interim milestone completion, and
4. Education Outreach

Should any one of these components be found to be ineffective or insufficient then the plan will be revised accordingly to improve that component. After every 10 years the WMP will be updated. The update will include goals, revisions to key components that have changed over time as well as revisions needed to improve accomplishment of its goals.

7.0 WATER QUALITY TARGETS (SUCCESS CRITERIA) AND MONITORING

A load reduction target of 35% (Section 6.1) for sediment and nutrients has been established to ensure continued maintenance of the water quality criteria and the overall integrity of these waters and reduce sediment and phosphorus loading to Lake Wister. In preparation for this WMP, a Poteau River WMP stakeholder group has been established by the City of Waldron. The Poteau River WMP stakeholders group will be formalized and will lead efforts in the watershed. Once BMPs begin to be implemented, a watershed monitoring program should be implemented to track reductions within the PRW. Any new monitoring data collected will be compared to historical data collected by GBMc & Associates and University of Arkansas.

The first year and possibly even the second year of WMP implementation (2023 and 2024) will not be assessed through monitoring. Those years will be assumed to be “building” years for the implementation measures. That is, it is unlikely that many new BMPs will have been implemented within the first year and those implemented during the second year will need time to stabilize prior to producing their maximum benefits. After the first five years of post WMP approval the assessment of loading status will be completed for the most recent three years of data. That is, monitoring will begin on or around January 2024 and continue for 3 years until 2027. This cycle of monitoring and evaluation will then continue forward until what time as revisions are needed.

In addition to load monitoring, BMP effectiveness will also be monitored in two of three ways:

1. Implementation of BMPs on the ground, and
2. Modeling of reductions from BMPs implemented, or
3. Monitoring of runoff above and below BMPs.

The BMP monitoring provides a good measure of which BMPs are the most effective and which are lacking or need adjustment.

8.0 PUBLIC INVOLVEMENT, EDUCATION AND STAKEHOLDERS

8.1 Stakeholder Involvement

The PRW stakeholder group is being created out of a series of meetings concerning this WMP. The stakeholder group began working at the first meeting held on April 6th, 2022. The stakeholder group at that time was made up of county judges, City of Waldron staff, including the mayor, Farm Bureau, Tyson Poultry, Oklahoma Conservation Commission, Bio X Design (associated with the PVIA) and the Poteau River Conservation District. The stakeholders should meet at a minimum, once per year (2/year is the goal), to discuss new concerns, coordinate watershed efforts and work on the WMP.

8.2 Educational Outreach

The PRW and the City of Waldron would benefit from educating the public concerning relevant environmental and watershed issues. A public meeting was held on July 19, 2022. The meeting included key stakeholders and citizens living in the watershed potentially impacted by activities in the watershed and allowed stakeholders to express issues concerning the watershed. Through these meetings, and other communications with stakeholders plans can be formulated to address these issues. Key stakeholders were given the opportunity to provide feedback on the WMP and suggestions concerning sources of pollutants in the watershed. This information was evaluated and used to set priorities in the action plan. The final draft of the watershed management plan will be made available electronically to all the key stakeholders for review and comment prior to it being submitted for acceptance. Future proposed revisions of the watershed management plan and schedules will be sent to all key stakeholders that are involved in the stakeholder group. Key issues or needs identified in the past stakeholder meeting(s) are in the Table 8.2.1 below.

Table 8.2.1. Stakeholder feedback on nonpoint issues in the PRW.

Good Quality	Legacy Nutrients	Streambank Erosion
Flooding	Urbanization	Industry
Streambank Erosion	Land Burned	Illegal Dumping
Road Crossing Erosion	High Poultry House Concentration	Private Silviculture
Storm Runoff		Municipal Stormwater
Supply Of Potable Water		Development
Prescribed Burns		Gas Drilling In The James Fork
		Sale Barn
		Agriculture

Key details pertaining to this WMP are being transferred to an educational brochure that will be posted online and made available at City Hall for interested public to learn more about this important effort.

8.3 Continuing Education

The stakeholders should continue educating the residents of the PRW on implementation of BMPs and what programs can assist residents financially to implement BMPs. A series of meetings will be held in the first 2 years post WMP approval to educate landowners on a series of BMP related activities and how to fund such efforts. Once every 3 years, and during years the WMP is reviewed a public meeting will be held to receive comment in regards to issues that still need to be addressed and success of programs.

9.0 TECHNICAL AND FINANCIAL ASSISTANCE

The projected costs to accomplish a 35% reduction in sediment in the PRW is summarized in the table below.

Table 9.0.1 Sediment load reductions for the PRW.

Management Measure	TSS Reduced	Cost per lb reduced	Cost Estimate
25 ft Riparian Buffer in Pasture/Hay	14,251,049	$0.35	$4,987,867.15
Rotational Grazing and 25% Reduction in Cattle Stocking Rate	2,541,088	$8.60	$21,853,356.80
25 ft Riparian Buffer in Row Crop Areas	1,239,022	$0.35	$433,657.70
25 ft Riparian Buffer in Urban Areas	1,911,329	$0.35	$668,965.15
Green Area Enlargement in Urban Areas	972,277	$18.00	$17,500,986.00
Unpaved Roads	1,006,750	$3.80	$3,825,650.00
Stormwater Retrofits	79,941	$18.00	$1,438,935.74
Streambank Stabilization	58,767,701	$0.60	$35,260,620.49

[1] Stormwater retrofits are BMPs designed to be implemented in urban, suburban and commercial/industrial areas. In this case the focus is on detention and bioretention (including rain gardens)

[2] These costs are for BMP implementation in row crops.

A vast array of federal funding opportunities exists for developing and implementing effective watershed management activities. A number of incentives and grants are available for landowners to implement agricultural BMPs; and grants are available to communities to install stormwater treatment practices and replant riparian areas. Some grants will be more easily obtained by non-profit or community groups, such as the PRCD, which has already successfully leveraged federal funding for some watershed related activities. The majority of grant applications cycle on an annual basis with applications due the same time each year. Many of the grants listed in Table 38 require matching funds from the applicant. Awards are usually distributed within a few months of the application deadline. Many grants require recommendations by the Governor or a state/federal agency of the respective state in which a project will be completed. Grants highlighted in yellow are those which best fit the overall goals of the assessment findings and recommendations. It is anticipated that approximately 1/3 of the funding will come from a combination of these programs. The cost-share programs in Arkansas that are managed by the USDA/NRS and the NRD are anticipated to be a good and readily available source to fund agriculture BMPs in the watershed. The remainder of the funding will come from local landowners and investors/doners.

Table 9.0.2. Private/Match Funding Entities for Watershed Management.

Entity
Scott County (Unpaved roads)
Sebastian County (Unpaved roads)
Tyson Waldron
City of Waldron
City of Fort Smith
City of Mansfield
State Conservation Districts in each county
AGFC
Local Land Owners

Table 9.0.3. Federal Funding Opportunities for Watershed Management.

Grant Name	Source	Type/Purpose
American Rescue Plan (ARP)	EPA/States	Non-point source reduction, stormwater drainage improvements related to watershed management and climate change
Conservation Reserve Program (CRP)	USDA	Agricultural BMPs
Cooperative Forestry Assistance	US Forest Service	Preservation of forested land
Environmental Education Grants	EPA	Community education
Environmental Quality Incentives Program (EQIP)	USDA (NRCS)	Agricultural BMPs
Five Star Restoration Matching Grants Program	EPA and National Fish and Wildlife Foundation	Restoration of riparian and aquatic habitats
Flood Mitigation Assistance Program	FEMA	Flood mitigation
National Fish and Wildlife Service General Matching Grants	National Fish and Wildlife Foundation	Fish, wildlife, habitat conservation
Native Plant Conservation Initiative	National Fish and Wildlife Foundation	Protect/enhance/restore native plant communities
Non-point Source Implementation Grants (319 Program)	EPA (NRD in Arkansas)	Non-point source reduction and watershed protection
Targeted Watershed Grants	EPA	Watershed protection and management
Urban and Community Forestry Challenge Cost-Share Grants	US Forest Service	Forest conservation and restoration in urban settings
Water Quality Cooperative Agreements	EPA	Watershed protection and pollution prevention
Watershed Processes and Water Resources Program	Cooperative State Research, Education and Extension Service	Watershed management
Watershed Protection and Flood Protection Program	USDA (NRCS)	Watershed protection and management
Conservation Innovation Grants	USDA (NRCS)	Conservation related to agriculture

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ARKANSAS DEPARTMENT OF AGRICULTURE

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY

Appendix A

USA Field Data Sheets

Unified Stream Assessment (USA)

REACH ID: PR-0E
STREAM: Poteau River
DATE/TIME: 4/11/18 1630
INITIALS: ENS/JCN

REACH START
LAT:
LONG:

REACH END
LAT:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / [✓ n]
☐ Heavy rain ☐ Steady rain ☐ Showers ☑ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Weather – Current conditions
☐ Heavy rain ☐ Steady rain ☐ Showers ☑ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Stream Classification
☑ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other________

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐ 0-25% ☐ 50-75% ☐ 25-50% ☑ 75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi) ~Slope: ________ft/mi
Sinuosity: ☐ High ☑ Moderate ☐ Low

Channel Morphology **System:** Step/Pool - Riffle/Pool - Pool (circle)
☐ Riffle 30 % ☐ Run 60 % ☐ Pool 10 % ☐ Steps ______%

Dominant Substrate
☐ Silt/clay (fine or slick) ☐ Cobble (2.5-10")
☐ Sand (gritty) ☐ Boulder (>10")
☑ Gravel (0.1-2.5") ☐ Bed Rock

Dominant In-Stream Habitats
☑ Woody Debris ☑ Root Wads ☐ Leaf Packs
☐ Deposition ☑ Undercut Bank
☐ Aquatic Plants ☐ Overhanging Vegetation
Habitat Quality: ☐ Poor ☐ Fair ☐ Good ☐ Optimal

Land use
☑ Forest 10 % ☑ Pasture 85 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☑ Hay 5 % ☐ Industrial_____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☑ Cattle ☐ Other____________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest ~~20~~ 15 JCN % ☑ Shrub/Sapling 80 % ☐ Herbs/Grasses 5 % ☐ Turf/Crops ____%
Riparian Width: ☐ <10 ft ☐ 11-25 ft ☐ 26-50 ft ☑ > 50 ft

Stream Shading (water surface)
☐ Mostly shaded (≥75% coverage) ☐ Partially shaded (≥25% coverage)
☑ Halfway shaded (≥50% coverage) ☐ Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other___________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______________

Sediment Deposits: ☑ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	Date:	Initials:
PR-0E	4/11/18 1630	ENJ/JCM

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
I-1 ~~LB~~	N34°54.193 W94°05.068	1	1	Power line ROW Little Buffer

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	End point 34°54.192 94°05.053 Bank information for BEHI
714ft ER 1 LB	N. 34°54.137 W 94°05.096	L [✓ M] H VH EX (circle one)	see point	1	Bank: Height 8 ft, Angle 90 Deg Protection: Roots 40 %, Root Depth 2 ft Vegetation 20 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 15
189ft ER 2 RB	34° 54.192 94° 05.053 34°54.217 94.05.063	L [✓ M] H VH EX (circle one)	see points	1	Bank: Height 6 ft, Angle 80 Deg Protection: Roots 70 %, Root Depth 3 ft Vegetation 50 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 90
128ft= ER 3 LB	34°54.292 94°05.059 ~~34°54.292~~	L [✓ M] H VH EX (circle one)	80 yds +49 129 yds	1	Bank: Height 7 ft, Angle 95 Deg Protection: Roots 60 %, Root Depth 4 ft Vegetation 30 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 80
127ft= ER 4 RB	34°54.~~3~~92 94°05.057 34° 54.305 94° 05.069	L [✓ M] H VH EX (circle one)		1	Bank: Height 5 ft, Angle 85 Deg Protection: Roots 40 %, Root Depth 2.5 ft Vegetation 15 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 80
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: PR-0E P
STREAM: Poteau River
DATE/TIME: 4/11/18 1630
INITIALS: ENJ/JCM
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☑ Poor ☐ Fair ☐ Good
Habitat: ☐ Poor ☑ Fair ☐ Good
Vegetation: ☑ Forest ☑ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☐ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☐ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☐ Fish ☐ Snails ☐ Crawfish ☑ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☑ Beaver ☑ Deer ☐ Other______________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☑ Bank Erosion(ER) : 1 [✓ 2] 3 Wpt________
☐ Channel Modification(CM) : 1 2 3 Wpt________
☑ Impacted Buffers(IB): [✓ 1] 2 3 Wpt________
☐ Trash(TR): 1 2 3 Wpt________
☑ Utilities(UT): [✓ 1] 2 3 Wpt________
☐ Other______________: 1 2 3 Wpt________

Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading) ☐ Widening ☐ Headcutting
☐ Channelized ☐ Aggrading ☑ Bank scour
☐ Bed Scour ☑ Bank Failure ☐ Slope failure
☐ Sediment Deposition ☐ Culvert Scour (upstream / downstream / top) ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 6 (ft) Bankfull Depth 4 (ft) Wetted Width: 15 (ft) Riffle/Run Depth 0.5/1.5 (ft)
Rt bank Ht: 5 (ft) Bankfull Width 17 (ft)) TOB Width: 19 (ft) Pool Depth 2.5 (ft)

Channel Stability:
Lt Bank: Angle 80 degrees
LtBank Vegetation protection: 30 % cover
LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Lt Bank Affected:______________
Wpt(s):______________
Rt Bank: Angle 70 degrees
RtBank Vegetation protection 40 % cover
RtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Rt Bank Affected:______________
Wpt(s):______________

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.	**Fair:** Forested or developed near stream. Vehicle access limited.	**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.

5 4 3 [✓ 2] 1

Notes: (biggest problem(s) you see in survey reach)
Bank stability

Place sketch of reach on back of page.

Restoration Potential:
☑ Riparian reforestation ☑ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other ______________

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: CMT-1
STREAM: City Trib
DATE/TIME: 4/12/18
INITIALS: ENJ/JLM
REACH START at confluence
REACH END ended downtown @ culvert crossing
LAT:
LAT: see pics
LONG:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / [✓ n]
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Stream Classification
☐ Perennial ☑ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other________

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☑50-75% ☐25-50% ☐75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi) ~Slope: ________ft/mi
Sinuosity: ☐ High ☐ Moderate ☑ Low

Channel Morphology **System:** Step/Pool - Riffle/Pool - Pool (circle)
☑ Riffle 60 % ☑ Run 10 % ☑ Pool 40 % ☐ Steps _____%

Dominant Substrate
☑Silt/clay (fine or slick) ☐Cobble (2.5-10")
☐Sand (gritty) ☐Boulder (>10")
☑Gravel (0.1-2.5") ☐Bed Rock

Dominant In-Stream Habitats
☐Woody Debris ☐Root Wads ☐Leaf Packs
☐Deposition ☐Undercut Bank
☑Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☑Poor ☐Fair ☐Good ☐ Optimal

Land use
☐ Forest _____% ☐ Pasture _____% ☑ Urban 100 %
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☑ Urban/Sub-Urban Storm Water ☐ Row crops
☐ Cattle ☐ Other____________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest 5 % ☑ Shrub/Sapling 65 % ☑ Herbs/Grasses 30 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☑11-25 ft ☐ 26-50 ft ☐ > 50 ft

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☐Partially shaded (≥25% coverage)
☑Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other____________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_______________

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	Date:	Initials:
CMT-1	4/12/18	ENJ/JCM

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
1	LB + RB from confluence to box culvert = 548 ft on both sides	2	3	tires were used to build banks up
2	Car wash series of box culverts	2	1	Series of box culverts from storm to Railroad
3	pipe crossing 34°54.022 94°05.433	1	3	needs armoring getting eroded on either side
4	~~RB~~ armored wl ~~Br~~ starts at brake building	3	3	Big rocks and concrete armored wall 154 long stretch on LB but mostly brake

LB-548
RB-118

80 ft of LB

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER 1	LB + RB from confluence to box culvert	L M [✓ H] VH EX (circle one)		3	Bank: Height 2.5 ft, Angle 70 Deg Protection: Roots 15 %, Root Depth 1.5 ft Vegetation 30 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER 2	start LB 34°54.041 to 34°54.013 94°05.441 to 94°05.434	L M [✓ H] VH EX (circle one)		3	Bank: Height 5.5 ft, Angle 60 Deg Protection: Roots 50 %, Root Depth 2.5 ft Vegetation 55 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ____ft, Angle ____Deg Protection: Roots____%, Root Depth ____ft Vegetation ____% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ____ft, Angle ____Deg Protection: Roots____%, Root Depth ____ft Vegetation ____% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ____ft, Angle ____Deg Protection: Roots____%, Root Depth ____ft Vegetation ____% [4]Material: Silt/Clay Sand / Gravel Cobble - %____

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: CUT-1
STREAM: City Trib
DATE/TIME: 4/12/18
INITIALS: ENJ/JCM
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☑ Poor ☐ Fair ☐ Good
Habitat: ☑ Poor ☐ Fair ☐ Good
Vegetation: ☑ Forest ☑ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops
Encroachment: ☑ Poor ☐ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☐ Sparse ☑ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☑ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☑ None ☑ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☑ Fish ☐ Snails ☐ Crawfish ☐ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☑ Beaver ☐ Deer ☑ Other Dogs

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☑ Outfalls(OT): 1 2 [✓ 3] Wpt________
☑ Stream Crossing(SC): 1 2 [✓ 3] Wpt________
☑ Bank Erosion(ER): 1 2 [✓ 3] Wpt________
☑ Channel Modification(CM): 1 2 [✓ 3] Wpt________
☑ Impacted Buffers(IB): 1 2 [✓ 3] Wpt________
☑ Trash(TR): 1 [✓ 2] 3 Wpt________
☑ Utilities(UT): 1 [✓ 2] 3 Wpt________
☐ Other________________: 1 2 3 Wpt________

Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading) ☐ Widening ☐ Headcutting
☑ Channelized ☐ Aggrading ☑ Bank scour
☐ Bed Scour ☑ Bank Failure ☐ Slope failure
☐ Sediment Deposition ☑ Culvert Scour (upstream / downstream / top) ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 5 (ft) Bankfull Depth 6 (ft) Wetted Width: 5.5 (ft) Riffle/Run Depth 0.83 (ft)
Rt bank Ht: 5 (ft) Bankfull Width 20 (ft)) TOB Width: 22 (ft) Pool Depth 1.5 (ft)

Channel Stability:
Lt Bank: Angle 85 degrees
LtBank Vegetation protection: 50 % cover
LtBank Erosion Hazard: L M [✓ H] VH EX (circle one)
Length Lt Bank Affected:________________
Wpt(s):________________
Rt Bank: Angle 85 degrees
RtBank Vegetation protection 20 % cover
RtBank Erosion Hazard: L M [✓ H] VH EX (circle one)
Length Rt Bank Affected:________________
Wpt(s):________________

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)

Place sketch of reach on back of page.

Restoration Potential:
☑ Riparian reforestation ☑ Bank stabilization
☑ Stormwater retrofit ☑ Outfall stabilization
☑ Channel modification ☑ IPS investigation
☑ Culvert rehab. ☐ Other ________

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: PR - OW	**STREAM:** Poteau River	**DATE/TIME:** 4/11/18 1030	**INITIALS:** ENJ/JCH

REACH START	**REACH END**
LAT:	**LAT:**
LONG:	**LONG:**

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / [✓ n]
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Stream Classification
☑ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☑ Montane (non-glacial) ☐ Swamp/bog ☐ Other________

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☐50-75% ☐25-50% ☑75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi) ~Slope: ________ft/mi
Sinuosity: ☐ High ☐ Moderate ☑ Low

Channel Morphology **System:** Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☑ Riffle 12 % ☑ Run ~~65~~ 70 % ☑ Pool 17 % ☐ Steps ______%
77
23

Dominant Substrate
☐Silt/clay (fine or slick)
☐Sand (gritty)
☐Gravel (0.1-2.5")
☐Cobble (2.5-10")
☐Boulder (>10")
☑Bed Rock

Dominant In-Stream Habitats
☐Woody Debris ☑Root Wads ☐Leaf Packs
☐Deposition ☐Undercut Bank
☐Aquatic Plants ☑Overhanging Vegetation
Habitat Quality: ☐Poor ☑Fair ☐Good ☐ Optimal

Land use
☑ Forest 10 % ☑ Pasture 85 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☑ Hay 5 % ☐ Industrial_____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☑ Cattle ☐ Other_____________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest 10 % ☑ Shrub/Sapling 80 % ☑ Herbs/Grasses 10 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☑11-25 ft ☐ 26-50 ft ☐ > 50 ft

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☑Partially shaded (≥25% coverage)
☐Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☑ Other Every now & then Effluenty

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other____________

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☑ Sand/Silt ☐ Relict shells

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: PR-aw	Date: 4/11/18 1030	Initials: ENTJCM

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
Spill way	65	2	3	Concrete spillway just upstream of [illegible] utility pipe bridge crossing JCM pics
SC	68	1	1	Old 4-wheeler crossing w/ rd no tracks looks like it hasn't been used in a while
Inflow trib ROW crossing	73	2	2	Tributary coming in w/ a lot of flow walked it out to find grass swale, maybe city main break? Transmission line that's been riding the Rt bank crossed stream

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	66 wypt Right bank less severe wypt 69 end	L [✓ M] H VH EX (circle one)	95yds Rt =285ft	1	Bank: Height Lt 4.5 Rt 4 ft, Angle 90 both Deg Protection: Roots 75 %, Root Depth 3.5 ft Vegetation 95 % [4]Material: Silt/Clay Sand / Gravel Cobble - % Bedrock 100
ER	Rt bank 70 wypt in ROW-Transmission	L [✓ M] H VH EX (circle one)	70ft	2	Bank: Height 7.5 ft, Angle 80 Deg Protection: Roots 60 %, Root Depth 5 ft Vegetation 50 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 70
ER	wypt 71 Rt bank still in ROW	L [✓ M] H VH EX (circle one)	50ft	2	Bank: Height 8 ft, Angle 100 Deg Protection: Roots 45 %, Root Depth 4 ft Vegetation 45 % [4]Material: Silt/Clay Sand / Gravel Cobble - % BR 10
ER	72 Rt bank left bank still in ROW	L [✓ M] H VH EX (circle one)	38yds=114ft of Lt bank	2	Bank: Height 7 ft, Angle 100 Deg Protection: Roots 85 %, Root Depth 4.5 ft Vegetation 40 % [4]Material: Silt/Clay Sand / Gravel Cobble - % BR 65
ER	73	L [✓ M] H VH EX (circle one)	~~80~~ 63ft 21yds of Rt bank	2	Bank: Height 6.0 ft, Angle 70 Deg Protection: Roots 40 %, Root Depth 2 ft Vegetation 20 % [4]Material: Silt/Clay Sand / Gravel Cobble - % 7 cm oblong

Continued on pg 1

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[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: PR-0W
STREAM:
DATE/TIME: 4/11/18 1030
INITIALS: EN/TJ/CM
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☑ Poor ☐ Fair ☐ Good
Habitat: ☑ Poor ☐ Fair ☐ Good
Vegetation: ☐ Forest ☑ Shrub/Sapling ☐ Tall grasses ☑ Turf/crops
Encroachment: ☑ Poor ☐ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☐ Sparse ☑ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☑ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☑ Fish ☐ Snails ☑ Crawfish ☐ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☑ Beaver ☐ Deer ☐ Other________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt________
☑ Stream Crossing(SC): [✓ 1] 2 3 Wpt________
☑ Bank Erosion(ER) : 1 [✓ 2] 3 Wpt________
☐ Channel Modification(CM) : 1 2 3 Wpt________
☑ Impacted Buffers(IB): 1 2 [✓ 3] Wpt little riparian-cleared up to 30ft
☑ Trash(TR): [✓ 1] 2 3 Wpt________
☐ Utilities(UT): 1 2 3 Wpt________
☐ Other________: 1 2 3 Wpt________
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading)
☐ Widening
☑ Headcutting
☐ Channelized
☐ Aggrading
☑ Bank scour
☐ Bed Scour
☑ Bank Failure
☐ Slope failure
☐ Sediment Deposition
☐ Culvert Scour (upstream / downstream / top)
☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 4.5 (ft) Bankfull Depth 4 (ft) Wetted Width: 030 (ft) Riffle/Run Depth 1.0 (ft)
Rt bank Ht: 7 (ft) Bankfull Width 7yds (ft)) TOB Width: 90 (ft) Pool Depth 1.5 (ft)

Channel Stability:
Lt Bank: Angle 60 degrees
LtBank Vegetation protection: 75 % cover
LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________
Rt Bank: Angle 75 degrees
RtBank Vegetation protection 50 % cover
RtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Rt Bank Affected: refer to wpts
Wpt(s):________

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)
ended reach @ 76

Place sketch of reach on back of page.

Restoration Potential:
☑ Riparian reforestation ☑ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other________

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: PR-0.5
STREAM: Poteau River
DATE/TIME: 4/11/18 1435
INITIALS: EnJ / JCm

REACH START
LAT:
LONG:

REACH END
LAT:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / [✓ n]
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Stream Classification
☑ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other_________

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☐50-75% ☐25-50% ☑75-100% **Flows Measured:** Yes [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi) ~Slope: ________ft/mi
Sinuosity: ☐ High ☑ Moderate ☐ Low

Channel Morphology **System:** Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☑ Riffle 15 % ☐ Run ______% ☑ Pool 85 % ☐ Steps ______%

Dominant Substrate
☐Silt/clay (fine or slick) ☐Cobble (2.5-10")
☐Sand (gritty) ☐Boulder (>10")
☐Gravel (0.1-2.5") ☑Bed Rock

Dominant In-Stream Habitats
☑Woody Debris ☑Root Wads ☐Leaf Packs
☐Deposition ☑Undercut Bank
☐Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☐Poor ☑Fair ☐Good ☐ Optimal

Land use
☐ Forest 5 % ☐ Pasture 65 % ☐ Urban 25 %
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay 5 % ☐ Industrial_____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☑ Cattle ☐ Other____________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest 15 % ☑ Shrub/Sapling 80 % ☑ Herbs/Grasses 5 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☐ 26-50 ft ☐ > 50 ft

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☐Partially shaded (≥25% coverage)
☑Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other____________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other______________

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☑ Sand/silt ☐ Relict shells

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	Date:	Initials:
PR-0.5 Potran River	4/11/18	JCM/ENJ

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
				Jcm
I-1	~~79~~ LB	Jcm ~~2~~ 1	2	~~Bank Eroded~~ scattered ~80yds Sheet metal dumped along bank w/ other trash. see pic

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER 1 RB	WPT 79	L [✓ M] H VH EX (circle one)	80yds	1	Bank: Height 5.5 ft, Angle 80 Deg Protection: Roots 25 %, Root Depth 2 ft Vegetation 40 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 80
ER 2 RB	34°54.170 94° 05.274	[✓ L] M H VH EX (circle one)	43yds	1	Bank: Height 7 ft, Angle 90 Deg Protection: Roots 70 %, Root Depth 5.5 ft Vegetation 40 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel] Cobble - % 50
LB ER 3	34° 54.167 94° 05.183	L [✓ M] H VH EX (circle one)	100 yds ~~30~~ yds	1	Bank: Height ~~8~~ 9.5 ft, Angle 86 Deg Protection: Roots ~~15~~ % ↖20, Root Depth 2 ft Vegetation 10 % Bedrock 85% [4]Material: Silt/Clay Sand / Gravel Cobble - %
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - %
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - %

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: PR-0.5	STREAM: Poteau River	DATE/TIME: 4/11/18 1455	INITIALS: JCM/ENJ
OTHER INFO:			

Average Conditions (check applicable)

Flood Plain Dynamics

Connection: ☐ Poor ☑ Fair ☐ Good

Habitat: ☐ Poor ☑ Fair ☐ Good

Vegetation: ☐ Forest ☑ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops

Encroachment: ☑ Poor ☐ Fair ☐ Good

Periphyton (attached algae):

Filamentous: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant

Prostrate: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant

Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:

☑ None noticeable (water basically clear)

☐ Moderate (water slightly green tinted)

☐ Abundant (water appears green)

Aquatic Plants In Stream:

Submerged: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant

Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:

☑ Fish ☐ Snails ☑ Crawfish ☑ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):

☐ Cattle ☑ Beaver ☑ Deer ☐ Other________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)

☐ Outfalls(OT): 1 2 3 Wpt________

☐ Stream Crossing(SC): 1 2 3 Wpt________

☑ Bank Erosion(ER): 1 [✓ 2] 3 Wpt________

☐ Channel Modification(CM): 1 2 3 Wpt________

☑ Impacted Buffers(IB): [✓ 1] 2 3 Wpt________

☑ Trash(TR): 1 [✓ 2] 3 Wpt________

☐ Utilities(UT): 1 2 3 Wpt________

☐ Other________: 1 2 3 Wpt________

Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:

☐ Incised (degrading) ☐ Channelized ☐ Bed Scour ☑ Sediment Deposition

☐ Widening ☐ Aggrading ☑ Bank Failure ☐ Culvert Scour (upstream / downstream / top)

☐ Headcutting ☑ Bank scour ☐ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):

Lt bank Ht: 6 (ft) Bankfull Depth 5 (ft) Wetted Width: 12 (ft) Riffle/Run Depth 0.8 (ft)

Rt bank Ht: 5 (ft) Bankfull Width 20 (ft)) TOB Width: 25 (ft) Pool Depth 4.5 (ft)

Channel Stability:

Lt Bank: Angle 45 degrees

LtBank Vegetation protection: 70 % cover

LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)

Length Lt Bank Affected: 100 yds

Wpt(s):________

Rt Bank: Angle 30 degrees

RtBank Vegetation protection 60 % cover

RtBank Erosion Hazard [✓ L] M H VH EX (circle one)

Length Rt Bank Affected: 123 yds

Wpt(s):________

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)

under cuts bank & trash

Place sketch of reach on back of page.

Restoration Potential:

☑ Riparian reforestation ☑ Bank stabilization

☐ Stormwater retrofit ☐ Outfall stabilization

☐ Channel modification ☐ PS investigation

☐ Culvert rehab. ☐ Other ________

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: JC-1
STREAM: Jones Creek
DATE/TIME: 4/12/18
INITIALS:
REACH START at bridge
REACH END
LAT:
LONG:
LAT:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / [✓ n]
☐ Heavy rain ☐ Steady rain ☐ Showers ☑ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Weather – Current conditions
☐ Heavy rain ☐ Steady rain ☐ Showers ☑ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Stream Classification
☑ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other_____

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐ 0-25% ☐ 50-75% ☐ 25-50% ☑ 75-100%
Flows Measured: Yes / No
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi)
~Slope: _____ft/mi
Sinuosity: ☐ High ☑ Moderate ☐ Low

Channel Morphology
System: Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☑ Riffle 40 % ☑ Run 40 % ☑ Pool 20 15 % ☐ Steps _____%

Dominant Substrate
☐ Silt/clay (fine or slick)
☐ Sand (gritty)
☑ Gravel (0.1-2.5")
☑ Cobble (2.5-10")
☐ Boulder (>10")
☐ Bed Rock

Dominant In-Stream Habitats
☑ Woody Debris ☑ Root Wads ☐ Leaf Packs
☐ Deposition ☐ Undercut Bank
☐ Aquatic Plants ☐ Overhanging Vegetation
Habitat Quality: ☐ Poor ☑ Fair ☐ Good ☐ Optimal

Land use
☐ Forest _____% ☑ Pasture 100 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban_____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☑ Cattle ☐ Other__________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest 35 % ☐ Shrub/Sapling 35 % ☐ Herbs/Grasses 30 % ☐ Turf/Crops ____%
Riparian Width: ☐ <10 ft ☐ 11-25 ft ☐ 26-50 ft ☑ > 50 ft

Stream Shading (water surface)
☐ Mostly shaded (≥75% coverage) ☐ Partially shaded (≥25% coverage)
☑ Halfway shaded (≥50% coverage) ☐ Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other__________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

Sediment Deposits: ☑ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: JC-1	**Date:** 4/12/18	**Initials:**

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
1	34°52.970 ~~94°11.481~~ 94° 11.481	1	1	old Stream crossing. Not very active

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Bank Erosion Hazard**	**Bank Lth. (ft)**	**Rest. Opp. (1-3)**[3]	**Bank information for BEHI**
ER 1 RB	90yds from bridge on RB,	[✓ L] M H VH EX (circle one)	30ft	3	Bank: Height 2.5 ft, Angle 80 Deg Protection: Roots 25 %, Root Depth 0.5 ft Vegetation 60 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER 2	LB @1014 34°53.059 94°11.496	[✓ L] M H VH EX (circle one)	30ft	3	Bank: Height 4 ft, Angle 75 Deg Protection: Roots 65 %, Root Depth 3 ft Vegetation 35 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER 3	LB @ 1022 34°53.012 94° 11.512	L M [✓ H] VH EX (circle one)	55yds	2	Bank: Height 12.5 ft, Angle 85 Deg Protection: Roots 35 %, Root Depth 4 ft Vegetation 75 % 70 [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] 30 Cobble - %____
ER 4	RB 34°52.947 94°11.455	L [✓ M] H VH EX (circle one)	38 yds	3	Bank: Height 8 ft, Angle 80 Deg Protection: Roots 75 %, Root Depth 6 ft Vegetation 40 % 60 [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ____ ft, Angle ____ Deg Protection: Roots ____ %, Root Depth ____ ft Vegetation ____ % [4]Material: Silt/Clay Sand / Gravel Cobble - %____

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: JC-1
STREAM: Jones Creek
DATE/TIME: 4/12/18
INITIALS:
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☐ Poor ☐ Fair ☑ Good
Habitat: ☐ Poor ☐ Fair ☑ Good
Vegetation: ☑ Forest ☑ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☑ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☑ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed: ☑ Mollusk
☑ Fish ☐ Snails ☑ Crawfish ☑ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☑ Cattle ☑ Beaver ☑ Deer ☐ Other

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt
☑ Stream Crossing(SC): [✓ 1] 2 3 Wpt
☑ Bank Erosion(ER): [✓ 1] 2 3 Wpt
☐ Channel Modification(CM): 1 2 3 Wpt
☐ Impacted Buffers(IB): 1 2 3 Wpt
☑ Trash(TR): [✓ 1] 2 3 Wpt appears that someone has used it as their trashcan. Varying size trash
☐ Utilities(UT): 1 2 3 Wpt
☐ Other: 1 2 3 Wpt
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☑ Incised (degrading) ☐ Widening ☐ Headcutting
☐ Channelized ☐ Aggrading ☑ Bank scour
☐ Bed Scour ☑ Bank Failure ☐ Slope failure
☐ Sediment Deposition ☐ Culvert Scour (upstream / downstream / top) ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 3.5 (ft) Bankfull Depth 3.5 (ft) Wetted Width: 45 (ft) Riffle/Run Depth 1.0 (ft)
Rt bank Ht: 4 (ft) Bankfull Width 185 (ft)) TOB Width: 225 (ft) Pool Depth 4.5 (ft)

Channel Stability:
Lt Bank: Angle 50 degrees
LtBank Vegetation protection: 80 % cover
LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Lt Bank Affected:
Wpt(s):
Rt Bank: Angle 40 degrees
RtBank Vegetation protection 85 % cover
RtBank Erosion Hazard: [✓ L] M H VH EX (circle one)
Length Rt Bank Affected:
Wpt(s):

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.	**Fair:** Forested or developed near stream. Vehicle access limited.	**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.

5 4 [✓ 3] 2 1

Notes: (biggest problem(s) you see in survey reach)

Riparian / Pasture land use
oerall looks a lot better than potean

Restoration Potential:
☑ Riparian reforestation ☑ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other

Place sketch of reach on back of page.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: PR-3
STREAM: Pokan River
DATE/TIME: 4/12/18 800
INITIALS: ENJ/JCM
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☑ Poor ☐ Fair ☐ Good
Habitat: ☑ Poor ☐ Fair ☐ Good
Vegetation: ☑ Forest ☑ Shrub/Sapling ☑ Tall grasses ☐ Turf/crops
Encroachment: ☑ Poor ☐ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☑ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☑ Sparse ☐ Moderate ☐ Abundant
Floating: ☑ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed: ☑ Mollusk
☐ Fish ☐ Snails ☐ Crawfish ☐ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☑ Beaver ☐ Deer ☐ Other______

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt______
☑ Stream Crossing(SC): [✓ 1] 2 3 Wpt______
☑ Bank Erosion(ER): 1 [✓ 2] 3 Wpt______
☑ Channel Modification(CM): 1 [✓ 2] 3 Wpt______
☑ Impacted Buffers(IB): [✓ 1] 2 3 Wpt______
☐ Trash(TR): 1 2 3 Wpt______
☑ Utilities(UT): [✓ 1] 2 3 Wpt______
☐ Other______: 1 2 3 Wpt______

Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☑ Incised (degrading) ☐ Channelized ☐ Bed Scour ☐ Sediment Deposition
☐ Widening ☐ Aggrading ☑ Bank Failure ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☑ Bank scour ☐ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 10 (ft) Bankfull Depth 3 (ft) Wetted Width: 45 (ft) Riffle/Run Depth 1 (ft)
Rt bank Ht: 7 (ft) Bankfull Width 75 (ft)) TOB Width: 100 (ft) Pool Depth 4.5 (ft)

Channel Stability:
Lt Bank: Angle 60 degrees
LtBank Vegetation protection: 75 % cover
LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Lt Bank Affected:______
Wpt(s):______

Rt Bank: Angle 70 degrees
RtBank Vegetation protection 70 % cover
RtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Rt Bank Affected:______
Wpt(s):______

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)
Bank stability + Drive way along stream

Restoration Potential:
☑ Riparian reforestation ☑ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other______

Place sketch of reach on back of page.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: PR-3	**STREAM:** Poteam	**DATE/TIME:** 4/12/18 800	**INITIALS:** ENS/JCM

REACH START at bridge	**REACH END**
LAT:	**LAT:**
LONG:	**LONG:**

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y [✓ n]
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☑Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Stream Classification
☑ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order____

Stream Origin
☐ Spring-fed ☑ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other_______

Hydrology
Flow: ☐ High ☑ Moderate ☐ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☐50-75% ☐25-50% ☑75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☑ Low (<10 ft/mi) ~Slope: ________ft/mi
Sinuosity: ☐ High ☑ Moderate ☐ Low

Channel Morphology **System:** Step/Pool - Riffle/Pool - Pool (circle)
☑ Riffle 30 % ☑ Run 50 % ☑ Pool 20 % ☐ Steps _____%

Dominant Substrate
☐Silt/clay (fine or slick) ☐Cobble (2.5-10")
☐Sand (gritty) ☑Boulder (>10") more upstream from alteration
☑Gravel (0.1-2.5") ☐Bed Rock

Dominant In-Stream Habitats
☐Woody Debris ☑Root Wads ☐Leaf Packs
☐Deposition ☑Undercut Bank
☑Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☐Poor ☑Fair ☐Good ☐ Optimal

Land use
☐ Forest _____% ☑ Pasture 100 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☑ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☐ Cattle ☑ Other Horses ☐ No evidence

Riparian Buffer
Vegetation Type: ☑ Forest 70 % ☑ Shrub/Sapling 20 % ☐ Herbs/Grasses 10 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☑ 26-50 ft ☐ > 50 ft

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☐Partially shaded (≥25% coverage)
☑Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☑ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other__________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☑ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☑ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____________

Sediment Deposits: ☑ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	**Date:**	**Initials:**
PR-3 Poteau River	4/12/18	JCM/EMT

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
1	at bend	2	3	Road crossing through the stream
2	34°55.711 94°09.917	1	1	Utility crossing, either phone or entergy line

talking

Realized its also bank material here. Need to go back & change all bank material

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER 1 LB	34° 55.678 94° 10.083 34°55.078 94°10.032 end taken in btwn	[✓ L] [✓ M] H VH EX (circle one)	[illegible] 55.078 94° 10.032 15	2	Bank: Height ~~10~~ ~~5~~ 6.5 ft, Angle 80 Deg Protection: Roots 80 %, Root Depth 6.5 ft Vegetation 65 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 80
ER 2 RB	34° 55.691 94° 10.068 taken on D/S	[✓ L] M H VH EX (circle one)	~~30ft~~ 61 yds	1	Bank: Height ~~5~~ ~~5~~ 4.5 ft, Angle 85 Deg Protection: Roots 75 %, Root Depth 3.5 ft Vegetation 40 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - % 100
ER 3 RB	34° 55.~~[illegible]~~ 741 94° [illegible] 9.933	L [✓ M] H VH EX (circle one)	~~20ft~~ 45yds	1	Bank: Height 4 ft, Angle 110 Deg Protection: Roots 50 %, Root Depth 3.5 ft Vegetation 30 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %
ER RB 4	start 34° 55.751 94° 09.953 end 34°55.711 94° 09.917	L [✓ M] H VH EX (circle one)	starts in bend ends at next bend	2	Bank: Height 4.5 ft, Angle 75 Deg Protection: Roots 75 %, Root Depth 4 ft Vegetation 70 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___

Prettymuch is crocked up til bend

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4]Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: JF-1
STREAM: James Fork
DATE/TIME: 10/26/21/1345
INITIALS: GLP/DMB/AL

REACH START WP701 (DMB)
LAT:
LONG:

REACH END WP706 (DMB)
LAT:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: [✓ y] / n
☐ Heavy rain ☐ Steady rain ☐ Showers ☒ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Weather – Current conditions
☐ Heavy rain ☐ Steady rain ☐ Showers ☒ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy

Stream Classification
☒ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☒ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other_______

Hydrology
Flow: ☐ High ☐ Moderate ☒ Low ☐ None
Base Flow as %Channel Width: ☐ 0-25% ☐ 50-75% ☐ 25-50% ☒ 75-100%
Flows Measured: Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)
~Slope: <5 ft/mi
Sinuosity: ☐ High ☐ Moderate ☒ Low

Channel Morphology
System: Step/Pool [✓ Riffle/Pool] Pool (circle)
☒ Riffle 10 % ☐ Run ______% ☒ Pool 90 % ☐ Steps ______%

Dominant Substrate
☐ Silt/clay (fine or slick) ☐ Cobble (2.5-10")
☐ Sand (gritty) ① ☒ Boulder (>10")
② ☒ Gravel (0.1-2.5") Shale ☒ Bed Rock

Dominant In-Stream Habitats
☒ Woody Debris ☒ Root Wads ☒ Leaf Packs
☒ Deposition ☐ Undercut Bank ☒ Boulders
☐ Aquatic Plants ☒ Overhanging Vegetation
Habitat Quality: ☐ Poor ☐ Fair ☒ Good ☐ Optimal

Land use
☒ Forest 50 % ☒ Pasture 50 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban_____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☒ Cattle ☐ Other____________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☒ Forest 80 % ☒ Shrub/Sapling 10 % ☒ Herbs/Grasses 10 % ☐ Turf/Crops ____%
Riparian Width: ☐ <10 ft ☐ 11-25 ft ☐ 26-50 ft ☒ > 50 ft

Stream Shading (water surface)
☐ Mostly shaded (≥75% coverage) ☒ Partially shaded (≥25% coverage) Wide channel
☐ Halfway shaded (≥50% coverage) ☐ Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☒ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other__________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells ☒ Shale

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: JF -1	**Date:** 10/26/21	**Initials:** GLP/DMB/ALL

BEHI I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	WP 703 RB	L M H VH [✓ EX] (circle one)	150	2 (private)	Bank: Height 13 ft, Angle 85 Deg Protection: Roots 50 %, Root Depth 4.5 ft Vegetation 25 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER	WP 705 LB	L [✓ M H] [✓ VH] EX (circle one)	150	2	Bank: Height 15 ft, Angle 80 Deg Protection: Roots 15 %, Root Depth 3 ft Vegetation 45 % [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____
ER		L M H VH EX (circle one)			Bank: Height ______ft, Angle ______Deg Protection: Roots______%, Root Depth ______ft Vegetation ______% [4]Material: Silt/Clay Sand / Gravel Cobble - %____

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	**Date:**	**Initials:**
JF-1	10/26/21	GLD/DMB/ALL

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
Trib	WP 702 LB	3	2	VERY incised trib entering Creek LB, 12 ft high, 6 ft wide
Bank Surf	WP 704 RB	3	2	Bank failure 100ft × 20ft × 7ft (L, H, W) See photos
SC	WP 706 RB	2	2	man-made stream crossing/entrypoint made of river rock

USA, Cont.

REACH ID: JF-1
STREAM: James Fork
DATE/TIME: 10/26/21
INITIALS: GLP/DRB/ALL
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☒ Poor ☐ Fair ☐ Good
Habitat: ☐ Poor ☐ Fair ☒ Good
Vegetation: ☒ Forest ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☒ Fair ☐ Good ☒ pasture

Periphyton (attached algae):
Filamentous: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☒ Sparse ☐ Moderate ☐ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☒ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☒ Sparse ☐ Moderate ☐ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☒ Fish ☐ Snails ☐ Crawfish ☒ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☒ Cattle ☒ Beaver ☐ Deer ☐ Other____________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☒ Bank Erosion(ER): [✓ 1 2] 3 Wpt see notes
☐ Channel Modification(CM): 1 2 3 Wpt________
☒ Impacted Buffers(IB): [✓ 1] 2 3 Wpt see n.
☐ Trash(TR): 1 2 3 Wpt________
☐ Utilities(UT): 1 2 3 Wpt________
☒ Other Cattle: [✓ 1] 2 3 Wpt________
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics: Areas noted on Right bank
☐ Incised (degrading) ☐ Channelized ☐ Bed Scour ☐ Sediment Deposition
☐ Widening ☐ Aggrading ☒ Bank Failure ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☐ Bank scour ☒ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream): – pool ≈6ft, up from bank ≈4 ft
Lt bank Ht: 25/15/ (ft) Bankfull Depth 9/3.7/ (ft) Wetted Width: 95/18/ (ft) Riffle/Run Depth 0.5 (ft)
Rt bank Ht: 15/10/ (ft) Bankfull Width 100/66/ (ft)) TOB Width: 130/80 (ft) Pool Depth ?~5-8 (ft)

Channel Stability: – overall see BEHI's
Lt Bank: Angle 65 degrees
LtBank Vegetation protection: 70 % cover
LtBank Erosion Hazard: [✓ L M] H VH EX (circle one)
Length Lt Bank Affected: n/a
Wpt(s):____________
Rt Bank: Angle 80 degrees
RtBank Vegetation protection 65 % cover
RtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Rt Bank Affected: N/A
Wpt(s):____________

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)
#1 Bank/slope sloughing/failure
#2 Cattle in riparian

Place sketch of reach on back of page.

Restoration Potential:
☒ Riparian reforestation ☒ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☒ Other Keep cattle out of riparian

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: ~~LJF-1~~ WC-1	**STREAM:** Lower James Fork/West Creek	**DATE/TIME:** 10/26/21	**INITIALS:** GLP/DMB/ALL
REACH START DMB 684		**REACH END** GLP 1721	
LAT:		**LAT:**	
LONG:		**LONG:**	

* NOTE: All data for WC, with exception of first few Impacts.

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: y / n
☐Heavy rain ☐Steady rain ☐Showers ☒Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☐Clear/sunny
☐Mostly cloudy ☒Partly cloudy

Stream Classification
☒ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☒ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other_____

Hydrology
Flow: ☐ High ☐ Moderate ☒ Low ☒ None — Lower JF has some flow, WC does not.
Base Flow as %Channel Width: ☐0-25% ☒50-75% ☐25-50% ☐75-100% **Flows Measured:** Yes [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi) ~Slope: 5-7 ft/mi
Sinuosity: ☐ High ☒ Moderate ☐ Low

Channel Morphology **System:** Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☒Riffle 30 % ☒Run 10 % ☒Pool 60 % ☐ Steps _____%

Dominant Substrate pools
(2) ☒Silt/clay (fine or slick) (3) ☒Cobble (2.5-10") riffles
☐Sand (gritty) ☐Boulder (>10")
(1) ☒Gravel (0.1-2.5") shale ☐Bed Rock

Dominant In-Stream Habitats
☒Woody Debris ☒Root Wads ☒Leaf Packs
☒Deposition ☒Undercut Bank
☐Aquatic Plants ☒Overhanging Vegetation
Habitat Quality: ☐Poor ☐Fair ☒Good ☐ Optimal

Land use
☒ Forest 55 % ☒Pasture 45 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban_____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☒ Cattle ☐ Other_____ ☐ No evidence

Riparian Buffer
Vegetation Type: ☒ Forest 30 % ☒ Shrub/Sapling 15 % ☒ Herbs/Grasses 10 % ☐ Turf/Crops ____% ☒ pasture 45 %
Riparian Width: ☒<10 ft RB ☐11-25 ft ☐ 26-50 ft ☒ > 50 ft LB
RB = <10 ft LB = >100 ft

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☐Partially shaded (≥25% coverage)
☒Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations
Odors Noted:
☒ Normal/None ☐ Sewage ☒ Anaerobic – few spots
☐ Petroleum ☐ Chemical ☐ Fishy ☒ Other manure minimal (one area)

Water Surface Appearance:
☐ Slick ☒ Sheen minimal ☐ Globs
☐ Flecks ☐ None ☐ Other_____

Turbidity/Water Clarity:
☐ Clear ☒ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other_____

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells ☒ Shale deposits/deposition.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: ④ ~~UJF-1~~ WC-) West Ck.	**Date:** 10/26/21	**Initials:** GLP/DMB/ALL

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
other/ SC	WP 686 RB	1	2	cattle activity / stream crossing during lowflow, private land
SC	WP 689 LB/RB	2	2	trail/crossing on riffle @ confluence w/ West Creek
SC/ other	WP 699 RB	3	2	cattle crossing, signs of activity in creek, lots of erosion

BEHI I.D.	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	WP 685 RB	L M [✓ H] [✓ VH] EX (circle one)	~200	2	Bank: Height 8 ft, Angle 90 Deg Protection: Roots 50 %, Root Depth 3 ft Vegetation 25 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 10
ER	WP 687 RB	L [✓ M] H VH EX (circle one)	~100	2	Bank: Height 6 ft, Angle 90 Deg Protection: Roots 50 %, Root Depth 2 ft Vegetation 20 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5
ER	WP 688 LB	L M [✓ H] VH EX (circle one)	~300	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 25 %, Root Depth 1 ft Vegetation 80 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5
ER	WP 692 RB	L M [✓ H] VH EX (circle one)	~250	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 40 %, Root Depth 1 ft Vegetation 15 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 10
ER	WP 693	L M H [✓ VH] EX (circle one)	230	2	Bank: Height 10 ft, Angle 85 Deg Protection: Roots 30 %, Root Depth 2 ft Vegetation 10 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: ~~WF-1~~ WC-1 West Ck.	Date: 10/26/21	Initials: DMB / GLP / ALL

BEHI I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	WP694 LB	L [✓ M] H VH EX (circle one)	225`	2	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 30 %, Root Depth 2 ft Vegetation 15 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Shale Cobble - % 5
ER	WP697 RB	L M H [✓ VH] EX (circle one)	435'	2	Bank: Height 7 ft, Angle 90 Deg Protection: Roots 40 %, Root Depth 2 ft Vegetation 5 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Shale Cobble - % 5
ER	WP698 LB	L M H [✓ VH] [✓ EX] (circle one)	145'	2	Bank: Height 8 ft, Angle 95 Deg Protection: Roots 100 %, Root Depth 3 ft Vegetation 15 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5
ER	WP700 RB	L M [✓ H] VH EX (circle one)	300'	2	Bank: Height 6 ft, Angle 90 Deg Protection: Roots 45 %, Root Depth 2 ft Vegetation 5 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Shale Cobble - % 10
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___

USA, Cont.

REACH ID: LJF WC-1
STREAM: Lower James Fork / West Creek
DATE/TIME: 10/26/21
INITIALS: GLP/DMB/ALL
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☐ Poor ☒ Fair ☐ Good
Habitat: ☐ Poor ☐ Fair ☒ Good
Vegetation: ☒ Forest ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☒ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☒ Sparse ☒ Moderate ☐ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☐ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☒ Sparse ☒ Moderate ☐ Abundant less than other creeks, lots of pools
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☒ Fish ☒ Snails ☐ Crawfish ☒ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☒ Cattle ☒ Beaver ☒ Deer ☐ Other

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt
☒ Stream Crossing(SC): 1 [✓ 2] 3 Wpt See notes
☒ Bank Erosion(ER): 1 2 [✓ 3] Wpt see notes
☐ Channel Modification(CM): 1 2 3 Wpt
☒ Impacted Buffers(IB): 1 [✓ 2] 3 Wpt see notes all RB on West creek
☐ Trash(TR): 1 2 3 Wpt
☐ Utilities(UT): 1 2 3 Wpt
☒ Other Cattle access: [✓ 1 2] 3 Wpt
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading) ☐ Channelized ☐ Bed Scour ☒ Sediment Deposition
☒ Widening ☐ Aggrading ☒ Bank Failure min. ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☒ Bank scour ☐ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 8/7/4 (ft) Bankfull Depth 3.5/2.2/2.4 (ft) Wetted Width: 24/0/13 (ft) Riffle/Run Depth 0 no flow (ft)
Rt bank Ht: 10/10/6 (ft) Bankfull Width 42/36/50 (ft)) TOB Width: 45/42/57 (ft) Pool Depth 2-3+ (ft)

Channel Stability:
Lt Bank: Angle 50 degrees
LtBank Vegetation protection: 70 % cover
LtBank Erosion Hazard: L [✓ M] H VH EX (circle one)
Length Lt Bank Affected: See notes
Wpt(s):
Rt Bank: Angle 85 degrees
RtBank Vegetation protection 55 % cover
RtBank Erosion Hazard: L M [✓ H VH] EX (circle one)
Length Rt Bank Affected: See notes
Wpt(s):

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.	**Fair:** Forested or developed near stream. Vehicle access limited.	**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5 4	[✓ 3] 2.5 [✓ 2]	1

Notes: (biggest problem(s) you see in survey reach)
Private / Steep banks
Cattle access #2
Bank erosion #1
Riparian Buffer

Restoration Potential:
☒ Riparian reforestation ☒ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☒ Other Cattle access points

Place sketch of reach on back of page.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: PC-1
STREAM: Prairie Cr.
DATE/TIME: 10/26/21/0810
INITIALS: GLP/DMB/ALL

REACH START
LAT: Wpt. 1708 (GLP)
LONG:

REACH END
LAT: WP1719 (GLP)
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: [✓ y] / n
☐Heavy rain ☐Steady rain ☐Showers ☒Clear/sunny
☐Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☐Clear/sunny
☒Mostly cloudy ☐Partly cloudy

Stream Classification
☒ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order_____

Stream Origin
☐ Spring-fed ☒ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other________

Hydrology
Flow: ☐ High ☐ Moderate ☒ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☐50-75% ☒25-[✓ 50%] ☐75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi) ~Slope: ~5-10 ft/mi
Sinuosity: ☐ High ☒ Moderate ☐ Low

Channel Morphology **System:** Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☐ Riffle 20 % ☐ Run 50 % ☐ Pool 30 % ☐ Steps _____%

Dominant Substrate
☐Silt/clay (fine or slick) ☐Cobble (2.5-10")
☐Sand (gritty) ☐Boulder (>10")
① ☒Gravel (0.1-2.5") shale - lots of shale ☒Bed Rock ② slate/hard shale

Dominant In-Stream Habitats
☐Woody Debris ☒Root Wads ☒Leaf Packs
☐Deposition ☐Undercut Bank
☐Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☒Poor ☐Fair ☐Good ☐ Optimal

Land use
☒ Forest 80 % ☒ Pasture 20 % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban_____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☐ Cattle ☐ Other___________ ☒ No evidence

Riparian Buffer
Vegetation Type: ☒ Forest 60 % ☒ Shrub/Sapling 20 % ☒ Herbs/Grasses 20 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☐ 26-50 ft ☒ > 50 ft 50 on LB >100 RB

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☒Partially shaded (≥25% coverage) ~40% very wide channel
☐Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☒ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other___________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☐ None ☒ Other 5 sqft of sheen total

Turbidity/Water Clarity:
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

Sediment Deposits: ☐ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells ☒ Shale Deposition

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: PC-1 / Pawnee Ck.	**Date:** 10/26/21	**Initials:** GLP / DMB / ALL

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description

BEHI I.D.	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	WP 1709 LB	L M [✓ H] VH EX (circle one)	200'	2	Bank: Height 9 ft, Angle 90 Deg Protection: Roots 70 %, Root Depth 3 ft Vegetation 30 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 5
ER	WP1711 RB	L M [✓ H] [✓ VH] EX (circle one)	265'	2	Bank: Height 10 ft, Angle 80 Deg Protection: Roots 60 %, Root Depth 3.5 ft Vegetation 50 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 10 Shale
ER	WP1712 LB	L M H [✓ VH] EX (circle one)	240'	2	Bank: Height 8.5 ft, Angle 85 Deg Protection: Roots 40 %, Root Depth 3 ft Vegetation 20 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5 Shale
ER	WP 1713 RB	L M H [✓ VH] EX (~~circle~~ one)	150'	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 70 %, Root Depth 3 ft Vegetation 30 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5 Shale
ER	WP1714 LB	L [✓ M] H VH EX (circle one)	175'	2	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 65 %, Root Depth 4 ft Vegetation 50 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 5 Shale

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: PC-1	**Date:** 10/26/21	**Initials:** GLP | DMB | ALL

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description

BEHI I.D.	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	WP1715 RB	L [✓ M H] VH EX (circle one)	150'	2	Bank: Height 7 ft, Angle 80 Deg Protection: Roots 50 %, Root Depth 2 ft Vegetation 45 % [4]Material: [✓ Silt/Clay] Sand / Shale [✓ Gravel] Cobble - % 5
ER	WP1716 LB	L M [✓ H] VH EX (circle one)	180'	2	Bank: Height 8 ft, Angle 85 Deg Protection: Roots 50 %, Root Depth 3 ft Vegetation 15 % [4]Material: [✓ Silt/Clay] Sand / Shale [✓ Gravel] Cobble - % 60
ER	WP1717 RB	L M [✓ H] [✓ VH] EX (circle one)	210'	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 70 %, Root Depth 4 ft Vegetation 20 % [4]Material: [✓ Silt/Clay] Sand / Shale Gravel Cobble - % 20
ER	WP1718 LB	L M [✓ H] VH EX (circle one)	420'	2	Bank: Height 8.5 ft, Angle 85 Deg Protection: Roots 50 %, Root Depth 3 ft Vegetation 20 % [4]Material: [✓ Silt/Clay] Sand / Shale Gravel Cobble - % 45
ER		L M H VH EX (circle one)			Bank: Height ____ ft, Angle ____ Deg Protection: Roots ____ %, Root Depth ____ ft Vegetation ____ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ____

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: Pl-1	STREAM: Prairie Ck.	DATE/TIME: 10/26/21	INITIALS: GLP/DMB/ALL
OTHER INFO:			

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☒ Poor ☐ Fair ☐ Good
Habitat: ☐ Poor ☐ Fair ☒ Good
Vegetation: ☒ Forest ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☐ Fair ☒ Good

Periphyton (attached algae):
Filamentous: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☒ Sparse ☐ Moderate ☐ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☒ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☒ Sparse ☒ Moderate ☐ Abundant around ~~bends~~ bars (GLP) close to water
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☒ Fish minimal ☐ Snails ☐ Crawfish ☒ Macroinvertebrates sparse

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☒ Beaver ☒ Deer ☐ Other________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☒ Bank Erosion(ER): 1 2 [✓ 3] Wpt see notes
☐ Channel Modification(CM): 1 2 3 Wpt________
☒ Impacted Buffers(IB): [✓ 1] 2 3 Wpt________
☐ Trash(TR): 1 2 3 Wpt________
☐ Utilities(UT): 1 2 3 Wpt________
☐ Other________: 1 2 3 Wpt________
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading) ☐ Channelized ☐ Bed Scour ☒ Sediment Deposition (Shale)
☒ Widening ☒ Aggrading ☒ Bank Failure ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☒ Bank scour ☒ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 8/9/8 (ft) Bankfull Depth 2.2/2.6/2.0 (ft) Wetted Width: 18/23/28 (ft) Riffle/Run Depth 0.5 (ft)
Rt bank Ht: 9/8/9 (ft) Bankfull Width 40/70/62 (ft)) TOB Width: 70/85/70 (ft) Pool Depth 2-3 (ft)

Channel Stability:
Lt Bank: Angle 75 degrees
LtBank Vegetation protection: 60 % cover
LtBank Erosion Hazard: L M [✓ H] VH EX (circle one)
Length Lt Bank Affected: see notes
Wpt(s): ↓

Rt Bank: Angle 75 degrees
RtBank Vegetation protection 60 % cover
RtBank Erosion Hazard: L M [✓ H] VH EX (circle one)
Length Rt Bank Affected: see notes
Wpt(s): ↓

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.	Fair: Forested or developed near stream. Vehicle access limited.	Difficult: Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5 4	[✓ 3 2]	1

Notes: (biggest problem(s) you see in survey reach)
very forestes/private
* * Bank erosion #1
* widening

Place sketch of reach on back of page.

Restoration Potential:
☒ Riparian reforestation ☒ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other________
→ minimal

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* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: CC-1
STREAM: Cherokee OK.
DATE/TIME: 10/25/21/1150
INITIALS: GLP/DMB/ALL
REACH START wet. 1686 (GLP)
REACH END 1699
LAT:
LONG:
LAT:
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: [✓ y] / n
☐ Heavy rain ☐ Steady rain ☒ Showers ☐ Clear/sunny
☐ Mostly cloudy ☒ Partly cloudy

Weather – Current conditions
☐ Heavy rain ☐ Steady rain ☐ Showers ☒ Clear/sunny
☐ Mostly cloudy ☐ Partly cloudy mild

Stream Classification
☒ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order____

Stream Origin
☐ Spring-fed ☒ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other______

Hydrology
Flow: ☐ High ☐ Moderate ☒ Low ☐ None
Base Flow as %Channel Width: ☐ 0-25% ☐ 50-75% ☐ 25-50% ☒ 75-100%
Flows Measured: Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi)
~Slope: 5 ft/mi
Sinuosity: ☐ High ☒ Moderate ☐ Low

Channel Morphology
System: Step/Pool - [✓ Riffle/Pool] - Pool (circle)
☒ Riffle ~~25~~ 30 % ☐ Run ____% ☒ Pool ~~75~~ 70 SVR % ☐ Steps ____%

Dominant Substrate some in pools
☒ Silt/clay (fine or slick) ☒ Cobble (2.5-10")
☐ Sand (gritty) ☐ Boulder (>10")
☒ Gravel (0.1-2.5") ☐ Bed Rock

Dominant In-Stream Habitats
☒ Woody Debris ☒ Root Wads ☐ Leaf Packs
☒ Deposition ☐ Undercut Bank
☒ Aquatic Plants ☒ Overhanging Vegetation
Habitat Quality: ☐ Poor ☒ Fair ☒ Good ☐ Optimal

Land use
☒ Forest 40 % ☒ Pasture 15 % ☐ Urban ____%
☒ Commercial 10 % ☐ Row Crops ____%
☐ Hay____% ☐ Industrial____% ☒ Sub-Urban 35 %

Local Watershed NPS Pollution
☐ Industrial Storm Water
☒ Urban/Sub-Urban Storm Water ☐ Row crops
☐ Cattle ☐ Other__________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☒ Forest 5 % ☒ Shrub/Sapling 75 % ☒ Herbs/Grasses 20 % ☐ Turf/Crops ____%
Riparian Width: ☐ <10 ft ☐ 11-25 ft ☒ 26-50 ft ☐ > 50 ft

Stream Shading (water surface)
☐ Mostly shaded (≥75% coverage) ☐ Partially shaded (≥25% coverage)
☒ Halfway shaded (≥50% coverage) ☐ Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☐ Normal/None ☐ Sewage ☒ Anaerobic mild at spots
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other__________

Water Surface Appearance:
☐ Slick ☒ Sheen in areas ☐ Globs
☐ Flecks ☐ None ☐ Other__________

Turbidity/Water Clarity:
☐ Clear ☒ Slightly turbid – recent run-off?? ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

Sediment Deposits: ☒ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells
but some natural silt deposition.

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream:	Date:	Initials:
CC-1 Cherokee Creek	10/25/21	GLP/DMB/ALL

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
OT	wpt.1680	1	0	LB 18" pipe posibly from wwTP
ot SW Drain	w 1687	1	0	Drain off Hwy has flow RB
OT	w1688	1	0 ?	pipe from RB In channel
other	w 1689	1	1	Beaver dam 10-12" altered

BEHI I.D.	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI
ER	w1690 RB	L M [✓ H] VH EX (circle one)	60'	2	Bank: Height 7 ft, Angle 80 Deg Protection: Roots 10 %, Root Depth 1.0 ft Vegetation 50 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 10
ER	w1691 LB	L [✓ M] [✓ H] VH EX (circle one)	50'	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 60 %, Root Depth 4.0 ft Vegetation 75 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % [illegible]
ER	WP1692 LB	L [✓ M] H VH EX (circle one)	150'	2	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 50 %, Root Depth 3 ft Vegetation 80 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 20
ER	WP1693 LB	L M [✓ H] [✓ VH] EX (circle one)	90'	2	Bank: Height 7 ft, Angle 90 Deg Protection: Roots 10 %, Root Depth 1 ft Vegetation 10 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel Cobble] - % 50
ER	WP1694 RB	L [✓ M] [✓ H] VH EX (circle one)	75'	2	Bank: Height 6.5 ft, Angle 85 Deg Protection: Roots 50 %, Root Depth 2 ft Vegetation 20 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel Cobble] - % 50

→

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

WP1695 LB H/VH 260, 2 BH - [illegible] ft
Angle - 85°
Root - 60%
depth - 4 ft
Veg - 35%
Silt/clay, Grav/cob 50%

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

See more on Back →

CC-1 / 10/25/21

WP1696 RB	VH	120'	2	BH - 9 ft Root - 20% Veg - ⑤-10%	Angle - 85° Root depth - 3 ft siltclay grav/cob - 20%
WP1697 LB	H	130'	2	BH - 9 ft Root - 70% Veg - 50%	Angle - 80° Root depth - 3.5 ft silt/clay grav/cob - 30%

USA, Cont.

REACH ID: CC-1
STREAM: Cherulle Ck
DATE/TIME: 10/25/21
INITIALS: ALI / DMB / ALL
OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☒ Poor ☐ Fair ☐ Good
Habitat: ☐ Poor ☒ Fair ☐ Good
Vegetation: ☒ Forest ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Encroachment: ☒ Poor ☒ Fair ☐ Good

Periphyton (attached algae):
Filamentous: ☒ None ☒ Sparse ☐ Moderate ☐ Abundant
Prostrate: ☐ None ☐ Sparse ☒ Moderate ☐ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☒ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☐ Sparse ☐ Moderate ☒ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed: frogs
☒ Fish ☐ Snails ☐ Crawfish ☒ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☐ Cattle ☒ Beaver ☐ Deer ☐ Other________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☒ Outfalls(OT): 1 [✓ 2] 3 Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☒ Bank Erosion(ER): 1 [✓ 2] 3 Wpt________
☐ Channel Modification(CM): 1 2 3 Wpt________
☒ Impacted Buffers(IB): 1 [✓ 2] 3 Wpt________
☒ Trash(TR): [✓ 1] 2 3 Wpt________ Bricks / Rubble in one short reach.
☒ Utilities(UT): [✓ 1 2] 3 Wpt________
☐ Other________: 1 2 3 Wpt________
Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☒ Incised (degrading) ☐ Widening ☐ Headcutting
☐ Channelized ☐ Aggrading ☒ Bank scour
☐ Bed Scour ☐ Bank Failure ☐ Slope failure
☒ Sediment Deposition
☐ Culvert Scour ([✓ upstream] / downstream / top)
☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 8/7/9 (ft) Bankfull Depth 1.4/1.8/3 (ft) Wetted Width: 9/8/27 (ft) Riffle/Run Depth 0.5 (ft)
Rt bank Ht: 7/6/6 (ft) Bankfull Width 20/32/33 (ft)) TOB Width: 33/42/38 (ft) Pool Depth 2-3+ (ft)

Channel Stability:
Lt Bank: Angle 60 degrees
LtBank Vegetation protection: 80 % cover
LtBank Erosion Hazard: L M [✓ H] VH EX (circle one)
Length Lt Bank Affected: ~680 ft see notes
Wpt(s): 1691, 92, 93, 95, 97

Rt Bank: Angle 60 degrees
RtBank Vegetation protection 75 % cover
RtBank Erosion Hazard: L [✓ M H] VH EX (circle one)
Length Rt Bank Affected: ~200
Wpt(s): 1690, 94, 96

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)
encroachment on upper end
privet jungle
#2 needs bank stabilization in spots /
#1 + riparian restoration.

Place sketch of reach on back of page.

Restoration Potential:
☒ Riparian reforestation ☒ Bank stabilization
☒ Stormwater retrofit ☒ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other________
Privet erradification

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Unified Stream Assessment (USA)

REACH ID: UJF-1	**STREAM:** Upper James Fork.	**DATE/TIME:** 10/25/21 1525-	**INITIALS:** GLP/ALL/DmB
REACH START		**REACH END** 1725	
LAT: wpt 1700 (GLP)		**LAT:** WP 1707	
LONG:		**LONG:**	

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-h: [✓ y] / n
☐Heavy rain ☐Steady rain ☒Showers ☐Clear/sunny
☒Mostly cloudy ☐Partly cloudy

Weather – Current conditions
☐Heavy rain ☐Steady rain ☐Showers ☒Clear/sunny
☐Mostly cloudy ☐Partly cloudy mild

Stream Classification
☒ Perennial ☐ Intermittent ☐ Ephemeral ☐ Tidal
☐ Coldwater ☐ Coolwater ☐ Warmwater Order____

Stream Origin
☐ Spring-fed ☒ Mixture of origins ☐ Glacial
☐ Montane (non-glacial) ☐ Swamp/bog ☐ Other________

Hydrology
Flow: ☐ High ☐ Moderate ☒ Low ☐ None
Base Flow as %Channel Width: ☐0-25% ☐50-75% ☐25-50% ☒75-100% **Flows Measured:** Yes / [✓ No]
Stream Gradient: ☐ High (≥25ft/mi) ☐ Moderate (10-24 ft/mi) ☒ Low (<10 ft/mi) ~Slope: 5-10 ft/mi
Sinuosity: ☐ High ☒ Moderate ☒ Low Pasture stream

Channel Morphology **System:** [✓ Step/Pool] - [✓ Riffle/Pool] - Pool (circle)
☒ Riffle 20 % ☒ Run 15 % ☒ Pool 60 % ☒ Steps 25 %

Dominant Substrate
☐Silt/clay (fine or slick) ☒Cobble (2.5-10") 10%
☐Sand (gritty) ☒Boulder (>10") 5 %
☒Gravel (0.1-2.5") 25% ☒Bed Rock 60%

Dominant In-Stream Habitats
☐Woody Debris ☒Root Wads ☒Leaf Packs
☐Deposition ☐Undercut Bank Boulder ☒
☒Aquatic Plants ☒Overhanging Vegetation
Habitat Quality: ☐Poor ☒Fair ☐Good ☐ Optimal

Land use
☒ Forest 5 % ☒ Pasture 95 % ☐ Urban ____%
☐ Commercial____% ☐ Row Crops ____%
☐ Hay____% ☐ Industrial____% ☐ Sub-Urban____%

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☒ Cattle ☐ Other__________ ☐ No evidence

Riparian Buffer
Vegetation Type: ☒ Forest 10 % ☒ Shrub/Sapling 5 % ☒ Herbs/Grasses (pasture) 85% ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☒11-25 ft ☐ 26-50 ft ☐ > 50 ft
forest, the rest is pasture

Stream Shading (water surface)
65 70 ☒Mostly shaded (≥75% coverage) ☐Partially shaded (≥25% coverage)
☒Halfway shaded (≥50% coverage) ☐Unshared (<25% coverage)

Water Quality Observations

Odors Noted:
☒ Normal/None ☐ Sewage ☐ Anaerobic
☐ Petroleum ☐ Chemical ☐ Fishy ☐ Other__________

Water Surface Appearance:
☐ Slick ☐ Sheen ☐ Globs
☐ Flecks ☒ None ☐ Other__________

Turbidity/Water Clarity: cattle impacts in areas
☒ Clear ☐ Slightly turbid ☐ Turbid
☐ Opaque ☐ Stained ☐ Other__________

Sediment Deposits: ☒ None ☐ Sludge ☐ Sawdust ☐ Oils ☐ Sand ☐ Relict shells

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: UTF-1 Upper James Fork	**Date:** 10/25/21	**Initials:** GLP/ALL/DMB

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
UT	WP 1702	2	1	T-line cuts across creek, erosion & cutting on L bank
other	WP1705	2	2	Heavy cattle impact, cattle trampled riparian, increased erosion

BEHI I.D.	**Coordinates (Lat / Long) or Waypoint**	**Bank Erosion Hazard**	**Bank Lth. (ft)**	**Rest. Opp. (1-3)**[3]	**Bank information for BEHI**
ER	WP 1701 RB	L M H [✓ VH] EX (circle one)	300'	2	Bank: Height 10 ft, Angle 85 Deg Protection: Roots 60 %, Root Depth 2 ft Vegetation 10 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 60
ER	WP 1703 LB	L M H [✓ VH] EX (circle one)	210'	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 40 %, Root Depth 3 ft Vegetation 5 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 40
ER	WP 1704 RB	L M [✓ H] VH EX (circle one)	240'	2	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 60 %, Root Depth 4 ft Vegetation 10 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 65
ER	WP1706 LB	L M H [✓ VH] EX (circle one)	96'	2	Bank: Height 7 ft, Angle 90 Deg Protection: Roots 20 %, Root Depth 3 ft Vegetation 2 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 65
ER		L M H VH EX (circle one)			Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___

[1] Impacts: Outfall(OT), Bank Erosion(ER), Impacted buffer(IB), Utilities in channel(UT), Stream crossing(SC), Channel modification(CM), Trash in stream(TR), other.

[2] Severity: 1=minor, 2=moderate, 3=severe

[3] Restoration Potential: 1=minimal, 2=moderate, 3=high

[4] Bank material: circle base type, silt/clay or sand and if present circle rock type and note %.

[*] Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

USA, Cont.

REACH ID: UTF-1	**STREAM:** Upper James Fork	**DATE/TIME:** 10/25/21 1525 - 1725	**INITIALS:** GLP / ALL / DMB
OTHER INFO:			

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☐ Poor ☒ Fair ☐ Good
Habitat: ☒ Poor ☐ Fair ☐ Good
Vegetation: ☒ Forest 5% ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Encroachment: ☐ Poor ☒ Fair ☐ Good pastureland

Periphyton (attached algae):
Filamentous: ☐ None ☐ Sparse ☐ Moderate ☒ Abundant
Prostrate: ☐ None ☐ Sparse ☐ Moderate ☒ Abundant
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Suspended Algae (phytoplankton) abundance:
☒ None noticeable (water basically clear)
☐ Moderate (water slightly green tinted)
☐ Abundant (water appears green)

Aquatic Plants In Stream:
Submerged: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant
Emergent: ☐ None ☒ Sparse ☒ Moderate ☐ Abundant waterwillow on gravelbar
Floating: ☒ None ☐ Sparse ☐ Moderate ☐ Abundant

Aquatic Life Observed:
☒ Fish ☐ Snails ☒ Crawfish ☒ Macroinvertebrates

Wildlife/Livestock In or Around Stream (evidence of):
☒ Cattle ☒ Beaver ☐ Deer ☐ Other ____________

Reach Impacts: (circle impact level 1=minor, 2=moderate, 3=major, and tag with a GPS waypoint(s) (Wpt) ID)
☐ Outfalls(OT): 1 2 3 Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☒ Bank Erosion(ER): 1 [✓ 2] 3 Wpt________
☐ Channel Modification(CM): 1 2 3 Wpt________
☒ Impacted Buffers(IB): 1 [✓ 2] 3 Wpt________
☐ Trash(TR): 1 2 3 Wpt________
☒ Utilities(UT): [✓ 1] 2 3 Wpt 1702
☒ Other cattle access: [✓ 1] 2 3 Wpt 1705 2 areas

Notes:

If any of these impacts are significant use back of page 1 (pg. 2) for detailed description.

Channel Dynamics:
☐ Incised (degrading) ☐ Widening ☐ Headcutting
☐ Channelized ☒ Aggrading ☒ Bank scour
☐ Bed Scour ☒ Bank Failure ☐ Slope failure
☐ Sediment Deposition ☐ Culvert Scour (upstream / downstream / top) ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 5/ 9/ 2 (ft) Bankfull Depth 3/4.5/2.5 (ft) Wetted Width: 9/27/36 (ft) Riffle/Run Depth________(ft)
Rt bank Ht: 8/ 4/ 4 (ft) Bankfull Width 65/60/66 (ft) TOB Width: 80/95/86 (ft) Pool Depth ________(ft)

Channel Stability: ↳ Bluff line adjacent
Lt Bank: Angle 45 degrees
LtBank Vegetation protection: 70 % cover
LtBank Erosion Hazard: L M H [✓ VH] EX (circle one)
Length Lt Bank Affected: ~300 ft
Wpt(s): 1703, 1706

Rt Bank: Angle 45 degrees
RtBank Vegetation protection 65 % cover
RtBank Erosion Hazard: L M [✓ H] [✓ VH] EX (circle one)
Length Rt Bank Affected: ~550 ft
Wpt(s): 1701, 1704

Reach Accessibility For Restoration

Good: Open area in public ownership. Easy stream channel access by vehicle.		**Fair:** Forested or developed near stream. Vehicle access limited.		**Difficult:** Must cross wetland, steep slope, heavy forest or sensitive areas to get to stream. Access by foot/ATV only.
5	4	[✓ 3]	2	1

Notes: (biggest problem(s) you see in survey reach)
Private pasture land
#1 Bank erosion
#2 Riparian Impacts
#3 Cattle access

Place sketch of reach on back of page.

Restoration Potential:
☒ Riparian reforestation ☒ Bank stabilization
☐ Stormwater retrofit ☐ Outfall stabilization
☐ Channel modification ☐ PS investigation
☐ Culvert rehab. ☐ Other ____________

* Modified from *Unified Stream Assessment: A Users Manual*, (Kitchall & Schuller, 2004)

Appendix B

Data

Site	Type of event	Chloride (mg/L)				Nitrate (mg/L)				Nitrogen (mg/L)				Phosphorus (mg/L)				Sulfate (mg/L)				TSS (mg/L)			
		Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count	Mean	Min	Max	Count
Pot-1	Base	5.00	2.05	10.02	76	0.22	0.00	1.01	75	0.61	0.27	1.40	76	0.060	0.011	0.354	76	34.23	11.75	80.26	76	10.1	2.2	65.2	75
	Storm	3.06	1.14	5.90	31	0.25	0.07	0.61	31	1.17	0.58	2.53	31	0.369	0.047	0.980	31	15.38	6.54	46.93	31	191.7	13.2	627.5	31
Pot-2	Base	5.87	2.77	11.64	37	0.23	0.00	0.89	36	0.66	0.24	1.49	37	0.078	0.000	0.412	37	18.51	7.72	37.12	37	7.2	0.0	66.4	37
	Storm	3.01	1.16	6.90	25	0.27	0.06	0.81	25	1.25	0.35	2.18	25	0.374	0.059	0.887	25	9.68	3.40	23.22	25	107.1	4.5	469.6	25
Pot-3	Base	7.93	0.00	35.53	23	0.60	0.00	5.13	23	1.98	0.38	15.46	23	0.176	0.041	0.769	23	17.25	6.34	37.60	23	8.4	1.5	41.7	23
	Storm	2.70	1.04	6.23	14	0.22	0.07	0.74	14	1.10	0.63	2.11	14	0.248	0.091	0.465	14	8.20	4.61	12.56	14	58.7	19.2	119.5	14
Pot-4	Base	5.53	2.06	21.48	38	0.07	0.01	0.45	37	0.30	0.09	0.83	38	0.036	0.006	0.189	38	13.64	4.54	23.63	38	3.8	0.6	27.8	38
	Storm	3.10	0.96	9.59	25	0.16	0.00	1.55	25	0.63	0.26	1.85	25	0.125	0.039	0.614	25	10.01	4.31	24.54	25	18.1	3.6	73.3	25
Pot-5	Base	3.43	1.66	9.07	39	0.10	0.00	0.33	38	0.30	0.04	1.39	38	0.034	0.000	0.643	39	35.26	7.26	70.95	39	4.3	0.4	27.6	39
	Storm	2.84	1.02	7.20	27	0.13	0.02	0.44	27	0.70	0.24	1.79	27	0.187	0.015	0.462	27	15.30	3.22	68.38	27	64.3	3.1	279.8	27
Pot-6	Base	3.68	0.00	8.97	38	0.13	0.00	0.49	37	0.45	0.15	1.48	38	0.071	0.007	0.549	38	33.08	13.24	77.81	37	6.8	0.8	66.4	38
	Storm	2.79	1.03	6.04	28	0.22	0.05	0.69	28	1.02	0.46	2.35	27	0.324	0.095	1.449	27	18.67	6.82	41.50	28	139.4	3.6	1,282.0	28
Pot-7	Base	7.00	2.06	14.22	37	0.23	0.00	2.35	36	0.37	0.06	2.66	37	0.030	0.000	0.074	37	14.51	9.99	20.74	37	3.5	0.5	24.1	37
	Storm	2.52	0.80	8.71	23	0.14	0.00	1.28	23	0.51	0.21	1.61	23	0.106	0.037	0.626	23	10.42	3.77	18.06	23	52.5	0.9	698.5	23
Pot-8	Base	10.57	0.00	81.22	77	0.30	0.00	2.65	75	0.85	0.41	3.58	77	0.082	0.027	0.646	77	8.11	0.00	24.71	77	8.2	2.2	56.8	74
	Storm	4.47	0.85	41.67	32	0.24	0.02	0.78	32	1.06	0.53	1.58	32	0.265	0.051	0.584	32	6.43	2.27	14.66	32	92.1	5.0	270.4	31
Pot-9	Base	18.41	0.00	78.46	38	2.14	0.12	13.47	37	2.83	0.50	14.70	38	0.207	0.060	0.709	38	12.24	2.69	27.27	38	9.5	1.2	36.4	36
	Storm	3.57	0.95	18.70	26	0.32	0.07	1.96	26	1.36	0.76	2.64	26	0.434	0.162	1.093	26	6.85	1.66	14.38	26	101.9	2.9	395.8	26
Pot-10	Base	5.31	1.28	10.92	39	0.10	0.00	0.45	36	0.62	0.17	1.68	39	0.071	0.013	0.323	39	10.01	2.39	21.02	39	8.2	1.2	103.7	37
	Storm	2.65	0.92	5.16	25	0.20	0.03	0.67	25	1.05	0.52	1.82	25	0.300	0.081	0.671	25	6.82	1.55	12.44	25	37.8	3.6	167.7	25
Pot-11	Base	3.47	1.07	7.79	36	0.15	0.02	0.41	35	0.45	0.21	0.88	35	0.039	0.006	0.173	35	8.41	2.02	49.99	36	4.5	1.7	28.2	36
	Storm	2.13	0.82	4.50	23	0.16	0.06	0.50	23	0.79	0.45	1.35	23	0.175	0.047	0.426	23	6.29	2.26	14.74	23	65.5	9.8	313.3	23
Pot-12	Base	1.82	0.97	2.45	69	0.08	0.00	0.20	68	0.54	0.32	0.82	69	0.023	0.000	0.059	69	3.58	1.69	6.13	69	4.1	1.4	16.9	68
	Storm	1.88	1.13	2.32	23	0.10	0.00	0.22	23	0.51	0.27	0.81	23	0.025	0.013	0.068	23	3.74	2.16	5.85	23	6.8	2.6	36.0	23
Pot-13	Base	2.48	0.00	3.84	38	0.07	0.00	0.24	37	0.27	0.08	0.53	38	0.024	0.000	0.078	38	4.41	2.27	6.15	38	3.5	0.6	12.7	38
	Storm	1.60	0.59	2.96	20	0.04	0.00	0.09	20	0.41	0.17	0.72	20	0.061	0.017	0.117	20	4.11	1.80	5.77	20	26.6	2.3	93.7	20
Pot-14	Base	2.12	0.81	3.63	79	0.09	0.00	0.40	77	0.26	0.13	0.72	79	0.022	0.000	0.093	79	4.19	1.36	27.74	79	3.4	0.3	20.8	77
	Storm	1.65	0.63	3.17	25	0.13	0.03	0.26	25	0.55	0.25	1.47	25	0.094	0.017	0.430	25	4.34	1.77	12.03	25	57.4	2.2	364.3	25
Pot-15	Base	1.77	1.30	2.40	37	0.15	0.02	0.50	36	0.23	0.07	0.61	37	0.007	0.000	0.041	37	3.17	1.79	7.02	37	1.9	0.0	10.9	37
	Storm	1.19	0.61	2.62	20	0.23	0.08	0.35	20	0.49	0.33	0.71	20	0.034	0.000	0.149	20	3.03	1.95	4.78	20	24.6	6.6	168.1	20