

Lee Creek and Upper Frog Bayou Watershed Management Plans – Phase II 319 Grant Project No. 13-200



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Environmental Manager

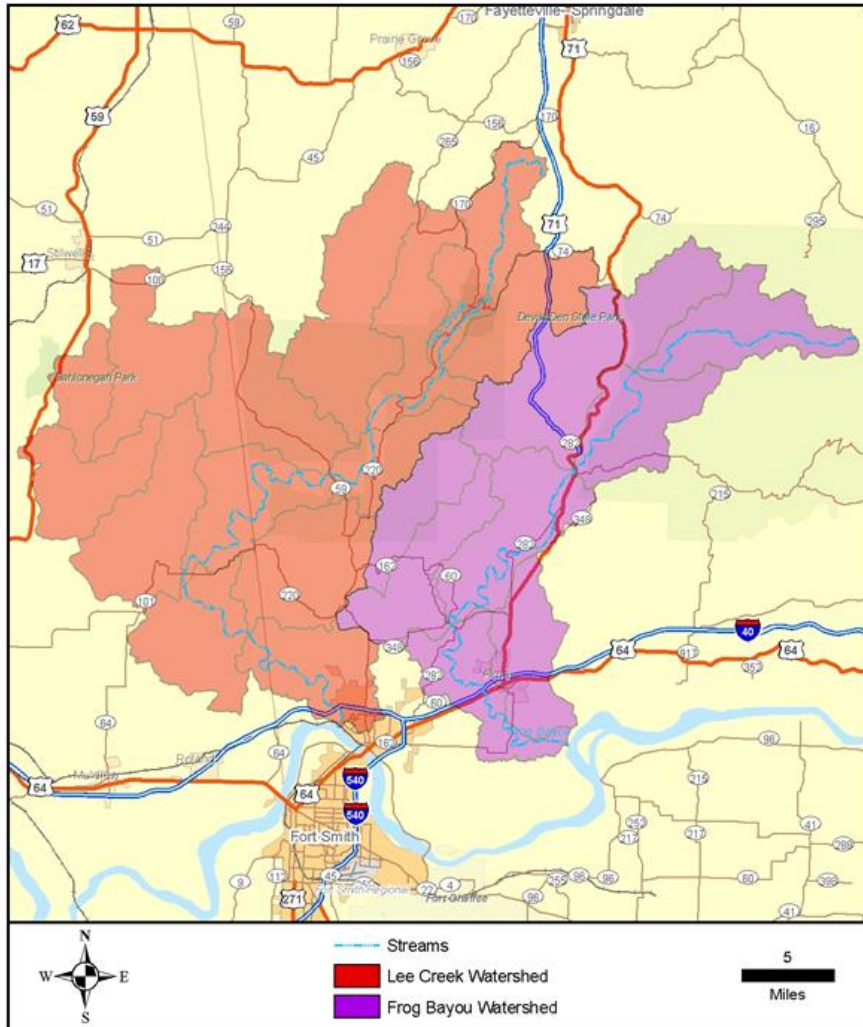
Arkansas Natural Resource Commission 2015 Nonpoint
Source Pollution Stakeholder and Project Review Meeting
September 24, 2015




Project Overview

- Phase I - Recap
- Phase II - Scope & Goals
- Phase II - Watershed Information
- Phase II - Monitoring
- Phase II - Unified Stream Assessments
- Phase II - Stakeholder Development and Public Education
- Phase II - Assessments and Ranking Sub-watershed Implementation Measures
- Phase II - WMPs Status
- Conclusions & Advice

Phase I - Recap



- Purpose:
 - Develop an EPA 9 element WMP for Lee Creek Watershed and Frog Bayou Watershed
 - Have EPA approve/accept/bless... both WMPs



Phase I - Recap

- Work Performed:
 - Data analysis of previous monitoring performed in the watersheds
 - Storm event sampling
 - Baseline sampling
- Outcome:
 - EPA did not accept due to no modeling, load reduction values, little stakeholder interaction/education, adaptive management, more data

Phase I - Recap

- We weren't surprised
- Both plans completed in one (1) year
- Phase I looked at the entire Frog Bayou Watershed
- Never talked to Oklahoma about Lee Creek
- "Overall not a bad plan"
- ANRC willing to help with Phase II





Phase II - Scope & Goals

- Update, revise and finalize the watershed management plan (WMP) for the Lee Creek and Frog Bayou watersheds
- Perform additional high flow (storm event) monitoring
- Perform unified stream assessments in key sub-watersheds
- Include a stakeholder development and public education
- Improve accuracy of loading assessments, assignment of implementation priorities and establishment of load reduction goals
- Identify critical sub-watersheds at a small scale (12 digit HUC and smaller) and rank implementation measures to reduce non-point source pollution loading from key areas



Phase II - Watershed Information

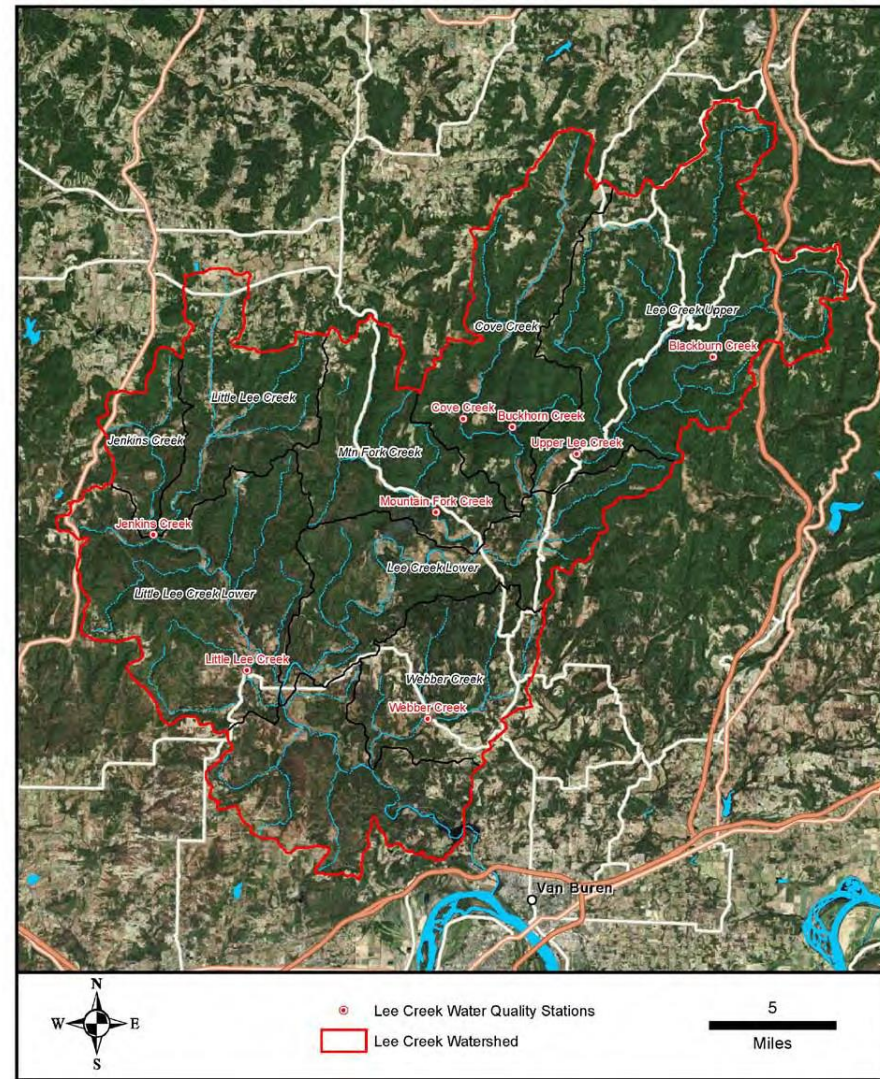
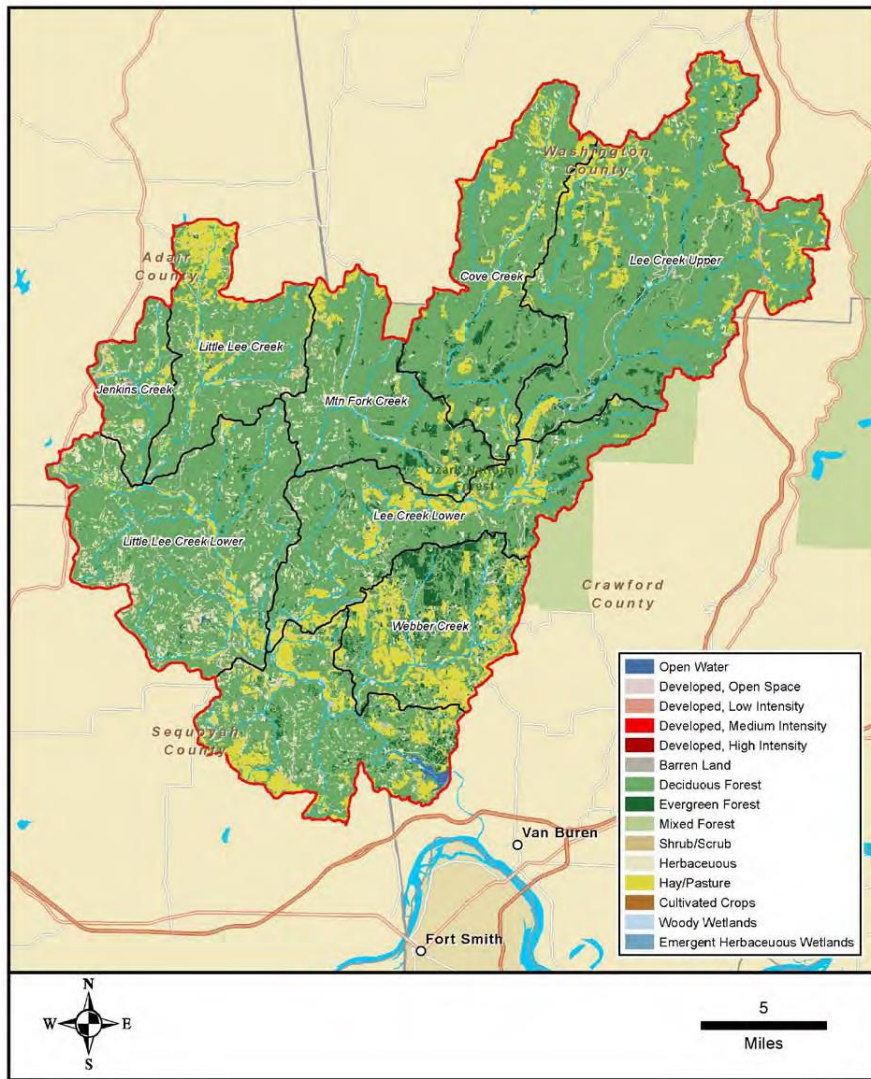
- The Lee Creek watershed (HUC-11110104) is approximately 447 mi² in size. The watershed is located in the Boston Mountains and Arkansas River Valley Ecoregions, primarily in Crawford and Washington Counties in Arkansas and Adair and Sequoyah counties in Oklahoma. The watershed drains directly into the Arkansas River Basin. Lee Creek has an impoundment (Lee Creek Reservoir) just upstream of its confluence with the Arkansas River that serves as a drinking water source for Fort Smith.



Phase II - Watershed Information

- Oklahoma's 303(d) list has a section of Little Lee Creek listed for bacteria and sections of Lee Creek listed for bacteria and metals.

Lee Creek Basin, Sub-Watersheds, & Sample Sites

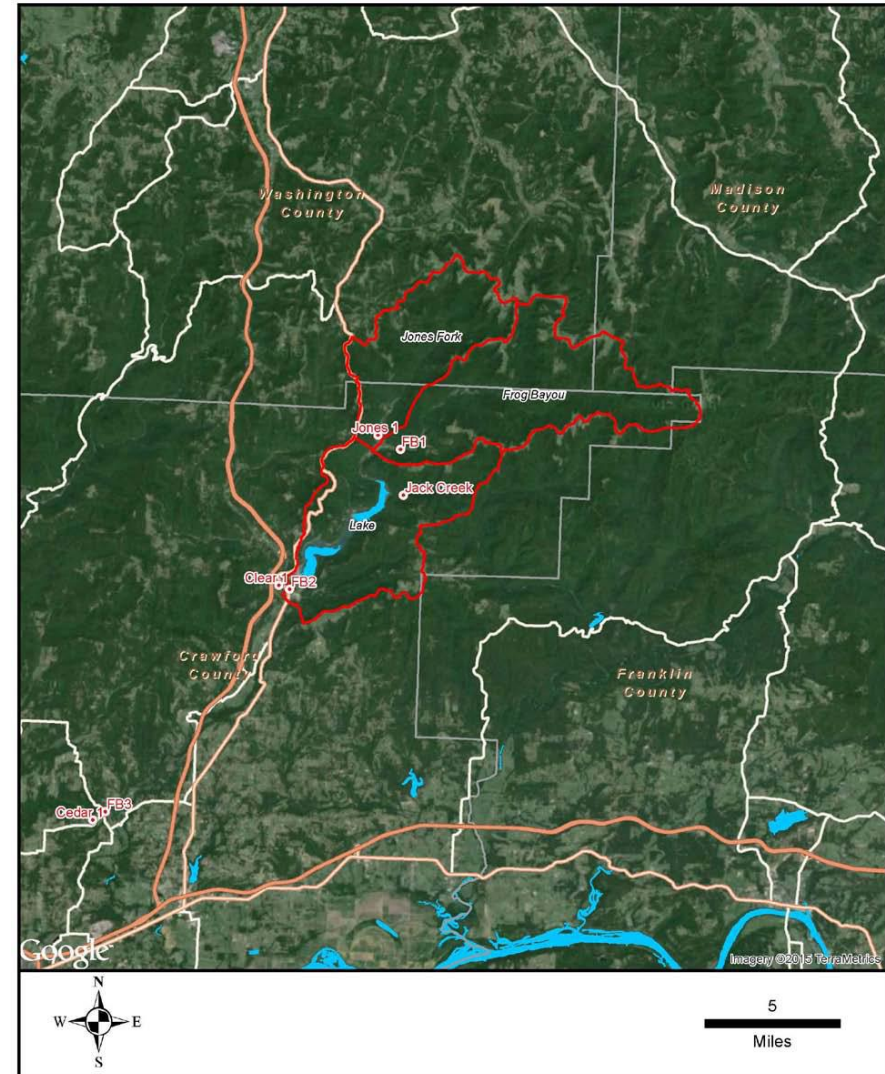
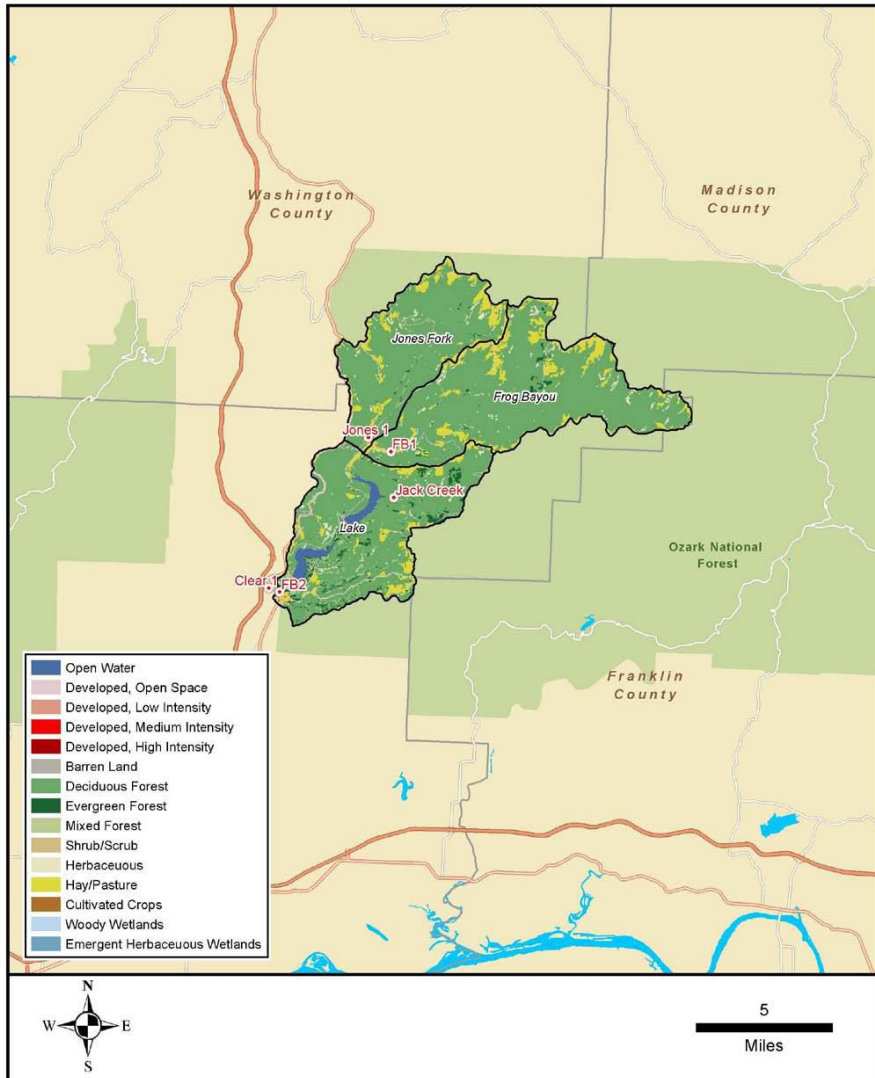




Phase II - Watershed Information

- The Frog Bayou watershed is a part of the Frog-Mulberry Watershed (HUC- 11110201), and is approximately 271 mi² in size.
- The Upper Frog Bayou watershed (HUC-1111020104) has an impoundment (Lake Fort Smith) that serves as a drinking water source for Fort Smith. The upper portion of the watershed above Lake Fort Smith which drains directly into the lake is approximately 84 mi² in size, and is located in the Boston Mountains Ecoregion (Omernick, 1987), primarily in Crawford County, Arkansas.

Upper Frog Bayou, Sub-Watersheds, & Sample Sites



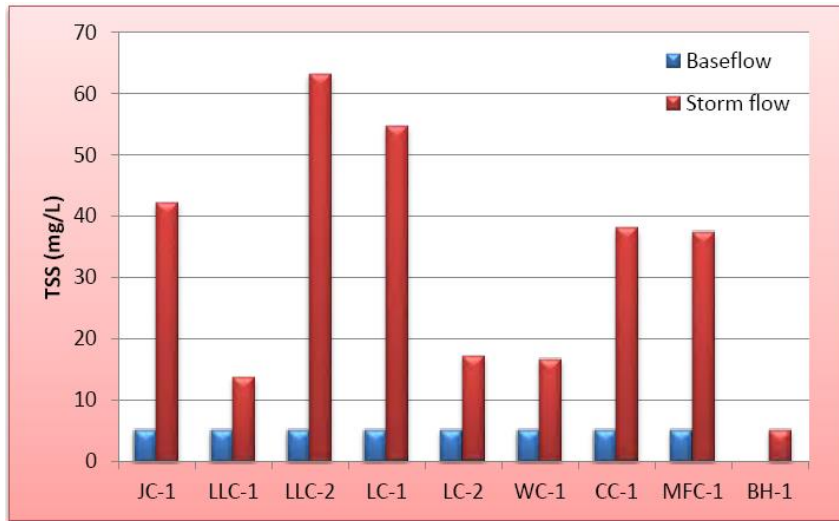


Phase II - Monitoring

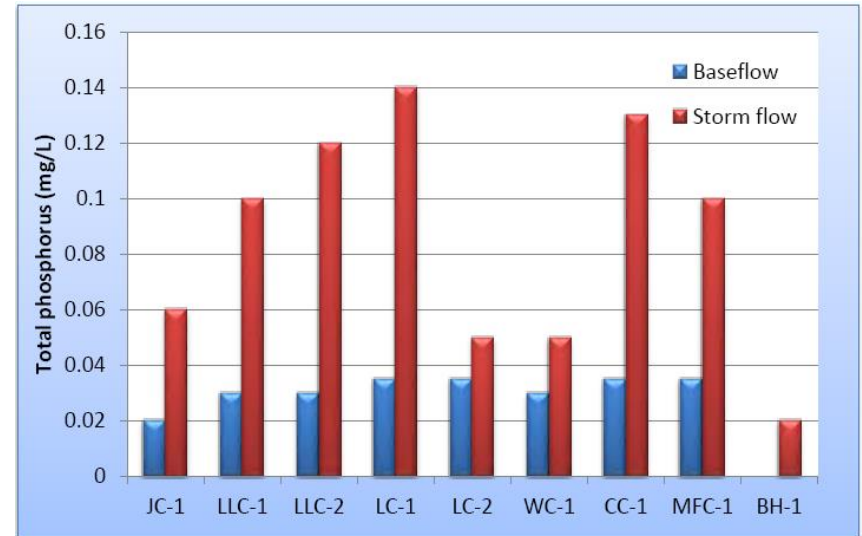
- Monitoring of the watershed have been ongoing since the 1990's
 - Monitored both baseline and storm flows in streams.
 - Monitored macroinvertebrates in streams
 - Monitored fish population and diversity in streams
 - Monitored nutrients in lake/reservoir
 - Monitored Chlorophyll-a in lake/reservoir
 - Monitored fish population and diversity in lake/reservoir
- This project included additional baseline and storm flows in streams as well as flow data to determine loading of pollutants during storm flow events.

Phase II - Monitoring

Lee Creek - TSS



Lee Creek – T. Phosphorous



Phase II - Monitoring

Date	Upper Lee	Buckhorn	Cove	Jenkins	Mountain Fork	Little Lee
	Taxa Richness					
3/7/2003	17	16	24	24	17	23
2/20/2004	19	25	21	22	28	21
3/2/2005	23	23	29	28	30	22
3/9/2007*	37	32	39	44	48	48
3/20/2010*	30	35	53	42	--	--
3/3/2011*	32	36	58	36	61	--
3/6/2012*	38	21	46	42	33	--
3/21/2013*	30	24	40	28	29	--
EPT Richness						
3/7/2003	7	5	13	10	11	11
2/20/2004	10	14	11	12	14	14
3/2/2005	15	14	18	18	18	13
3/9/2007*	19	16	20	20	22	25
3/20/2010*	15	18	23	19	--	--
3/3/2011*	12	17	23	13	26	--
3/6/2012*	15	11	17	19	18	--
3/21/2013*	13	12	16	15	14	--
Average Tolerance						
3/7/2003	4.67	4.57	4.35	4.50	4.36	4.66
2/20/2004	4.46	3.87	4.21	4.20	4.67	4.42
3/2/2005	3.86	4.11	4.06	4.00	4.20	3.84
3/9/2007*	3.25	4.13	3.51	3.59	4.21	4.03
3/20/2010*	3.73	4.26	4.50	4.05	--	--
3/3/2011*	3.96	3.45	3.96	3.68	4.18	--
3/6/2012*	5.13	5.03	5.56	5.25	5.19	--
3/21/2013*	4.42	4.85	5.10	4.40	4.22	--
% Clingers						
3/7/2003	35.3	21.4	42.9	39.1	41.2	45.5
2/20/2004	31.6	43.5	47.6	40.0	42.9	36.8
3/2/2005	50.0	28.6	44.8	51.9	50.0	52.4
3/9/2007*	27.0	18.8	33.3	27.3	30.8	47.9
3/20/2010*	48.1	25.7	24.5	28.6	--	--
3/3/2011*	25.7	30.6	19.0	55.1	34.9	--
3/6/2012*	26.3	28.6	19.6	23.8	30.3	--
3/21/2013*	40.0	33.3	45.0	42.9	48.3	--

*Pennington and Associates composite method

Date	Upper Lee	Buckhorn	Cove	Jenkins	Mountain Fork	Little Lee
	Stream Condition Index					
3/7/2003	12	12	20	18	16	16
2/20/2004	14	20	18	20	16	20
3/2/2005	20	18	20	20	20	20
3/9/2007*	18	16	18	18	18	20
3/20/2010*	20	18	18	18	--	--
3/3/2011*	18	18	16	20	18	--
3/6/2012*	14	12	12	14	14	--
3/21/2013*	20	14	16	20	20	--

*Pennington and Associates composite method

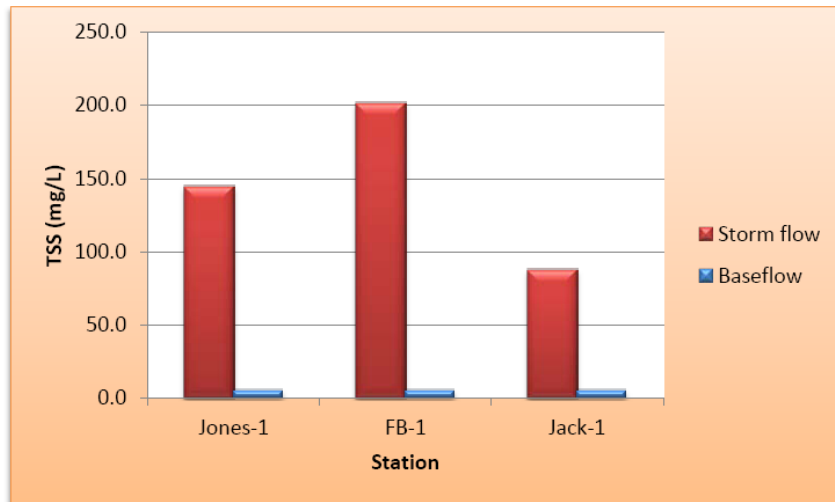
Phase II - Monitoring

Site	Season	TSI (SD)	TSI (TP)	TSI (Chl-a)
L1	Winter	58.55	59.57	---
		30.91-77.12	47.35 - 79.04	---
		Eutrophic	Eutrophic	---
L1	Summer	59.59	63.96	---
		53.93 - 67.13	47.35 - 90.91	---
		Eutrophic	Eutrophic	---
L2	Summer	57.98	60.72	54.73
		52.56 – 67.13	47.35 – 80.56	46.21-60.80
		Eutrophic	Eutrophic	Eutrophic
L2	Winter	59.10	59.70	34.20
		32.30 - 77.10	47.40 - 83.20	0 – 47.80
		Eutrophic	Eutrophic	Oligotrophic

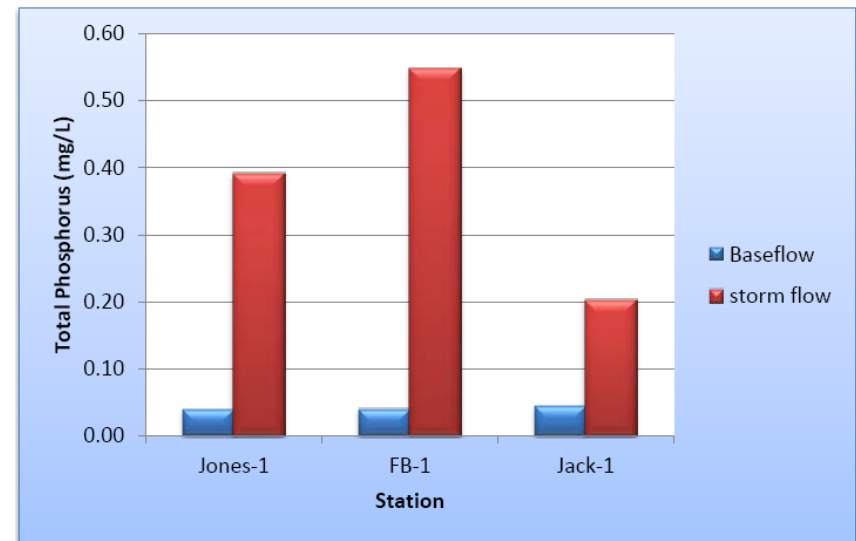
Lee Creek Reservoir Monitoring Results

Phase II - Monitoring

Upper Frog Bayou - TSS



Upper Frog Bayou – T. Phos.



Phase II - Monitoring

Date	Frog Bayou -1	Jack -1	Jones -1
	Taxa Richness		
3/6/2003	24	22	28
2/20/2004	25	28	33
3/10/2005	30	29	32
3/20/2010	--	--	41
3/3/2011*	40	36	36
3/28/2012*	46	53	34
3/4/2013*	19	25	28
EPT Richness			
3/6/2003	13	10	14
2/20/2004	14	15	18
3/10/2005	17	17	18
3/20/2010	--	--	21
3/3/2011*	17	15	12
3/28/2012*	16	18	18
3/4/2013*	9	10	12
Average Tolerance			
3/6/2003	4.52	4.14	4.26
2/20/2004	4.72	4.22	4.25
3/10/2005	4.18	4.16	4.11
3/20/2010	--	--	3.66
3/3/2011*	3.45	3.82	4.33
3/28/2012*	5.49	5.62	4.67
3/4/2013*	4.45	4.40	4.30
% Clingers			
3/6/2003	34.8	30.0	42.3
2/20/2004	37.5	30.8	45.2
3/10/2005	39.3	40.7	40.0
3/20/2010	--	--	31.7
3/3/2011*	38.9	13.2	46.1
3/28/2012*	17.4	22.6	35.3
3/4/2013*	31.6	20.0	35.7

*Pennington and Associates composite method.

Date	Frog Bayou -1	Jack -1	Jones -1
	Stream Condition Index		
3/6/2003	12	14	16
2/20/2004	12	18	20
3/10/2005	20	20	20
3/20/2010*	--	--	18
3/3/2011*	20	16	16
3/28/2012*	12	12	14
3/4/2013*	8	10	16

*Pennington and Associates composite method.

Phase II - Monitoring

Site	Season	TSI (SD)	TSI (TP)	TSI (Chl-a)
LFS 01	Summer	44.5	58.9	41.6
		28.1 – 84.5	47.4 – 83.8	24.7 – 52.3
		Mesotrophic	Eutrophic	Mesotrophic
LFS 01	Winter	45.0	56.4	37.4
		19.2 – 65.4	47.4 - 77.3	29.7 – 45.4
		Mesotrophic	Eutrophic	Oligotrophic
LFS 04	Summer	48.7	56.4	---
		27.7 – 67.1	47.4 – 77.3	---
		Mesotrophic	Eutrophic	---
LFS 04	Winter	52.2	57.1	---
		23.6 – 71.3	47.4 – 75.4	---
		Eutrophic	Eutrophic	---

Lake Fort Smith Monitoring Results

Phase II - Monitoring

Frog Bayou Baseline Flow



Frog Bayou Storm Flow

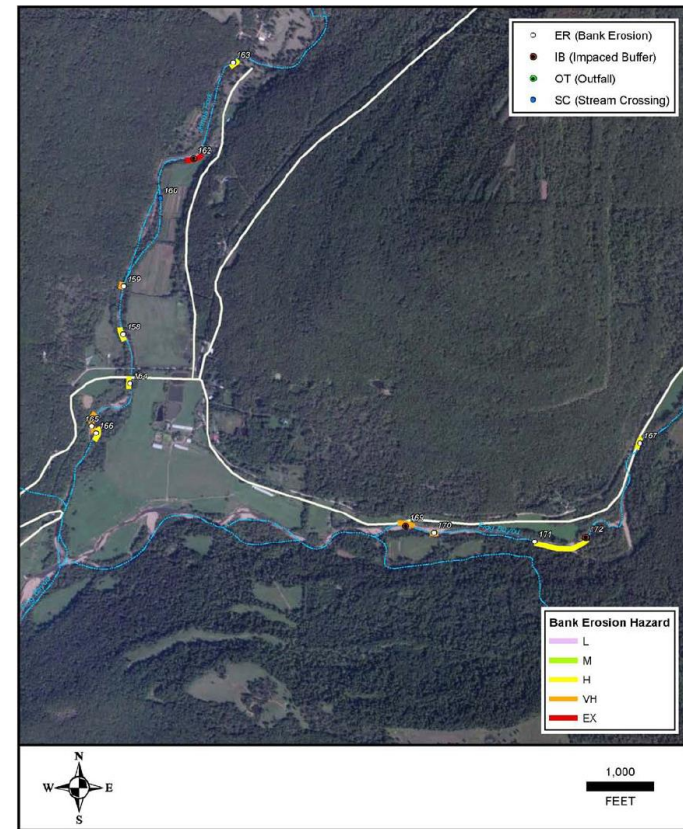


Phase II - Unified Stream Assessments

Lee Creek



Upper Frog Bayou



Phase II - Unified Stream Assessments

Lee Creek

USA Stream Reach	Significant Problem/Issue	Percent of Stream Length Affected/# instances
LC-1 – from canoe access off HWY 220 to HWY 59 at Natural Dam	1. Stream bank erosion	1. 22%
LC-2 – from HWY 59 to HWY 101 Bridge	1. Stream bank erosion 2. Storm water outfalls 3. Channel alteration	1. 23% 2. 8 Outfalls 3. Overall reach
LLC-1	1. Stream bank erosion 2. Stream Crossings	1. 14% 2. 2 crossings
LLC-2	1. Stream bank erosion 2. Utility crossing	1. 39% 2. (2 in each reach)
WC-1	1. Stream bank erosion	1. 19%
JC-1	1. Stream bank erosion	1. 37%
MFC-1	1. Stream bank erosion 2. Impacted buffers	1. 28% 2. 6 areas
CC-1	1. Stream bank erosion 2. Impacted buffers	1. 12% 2. 4 areas

Upper Frog Bayou

Stream Reach	Significant Problem/Issue	Percent of Stream Length Affected by Number Issue
Jones-1 - Starting near confluence of Frog Bayou upstream to Jones Fork Rd. crossing (1.3 mi)	1- Stream bank erosion 2- Impacted riparian buffers	1- 20% 2- 3.3%
FB-1 – Starting at Bidville Rd crossing downstream approximately 1.5 mi.	1- Stream bank erosion 2- Impacted riparian buffers	1- 17% 2- 7.6%
FB-2 – Beginning at Ash Rd. (CR 333) and downstream to confluence with Hurricane Creek (3.3 mi.)	1- Stream bank erosion 2- Impacted riparian buffer 3- Outfall - Field drain 4- Stream crossings (roads, railroad)	1- 19% 2- 0% ¹ 3- n/a 4- n/a

¹Impacted riparian areas did occur in reach FB-2, but were very minor or only associated with road/railroad crossings.

Phase II - Unified Stream Assessments



Phase II - Stakeholder Development and Public Education



LEE CREEK WATERSHED
MANAGEMENT PLAN
PUBLIC & STAKEHOLDER MEETING
Tuesday, July 29, 2014
6:00 pm - 7:30 pm
Van Buren Public Library
1409 Main St, Van Buren, AR 72956

Everyone who lives, plays, or works in the watershed and cares about clean drinking water is a stakeholder and welcome. Come and have a voice in protecting the Lee Creek Watershed. Together we can make a difference!!!

For More Information: Call 478-784-2337 or email LeeCreekWM@FortSmithAR.gov



FROG BAYOU WATERSHED
MANAGEMENT PLAN
PUBLIC & STAKEHOLDER MEETING
Wednesday, July 30, 2014
6:00 pm - 7:30 pm
Lake Fort Smith State Park
15458 Shepard Springs Rd, Mountainburg, AR 72946

Everyone who lives, plays, or works in the watershed and cares about clean drinking water is a stakeholder and welcome. Come and have a voice in protecting the Frog Bayou Watershed. Together we can make a difference!!!

For More Information: Call 478-784-2337 or email FrogBayouWM@FortSmithAR.gov





Phase II - Stakeholder Development and Public Education

- Hardest part of the project.
- Needed to be done as part of Phase I.
- Some citizen groups did attend as well as private citizens
 - Arkansas Master Naturalist
 - The Nature Conservancy
 - Arkansas Canoe Club
- Most just wanting information, some stated they had nothing better to do that night.



Phase II - Stakeholder Development and Public Education

- Mostly state agencies showed up.
 - Arkansas Department of Health
 - Arkansas Game & Fish
 - Arkansas Department of Environmental Quality
 - Arkansas State Parks
 - US Forest Service
 - Oklahoma Water Resource Board
 - Oklahoma Conservation Commission
 - Oklahoma Scenic Rivers Commission



Phase II - Stakeholder Development and Public Education

- Still ongoing
 - Web Site
 - Class Presentations
 - Signage
 - Brochures
 - Radio
 - TV
 - Meetings
 - Tours
 - Anything we can think of and afford to do.....



Phase II - Assessments and Ranking Sub-watershed Implementation Measures

- In general, water quality during baseline flow events, when the streams were not directly influenced by storm water runoff, was good. However, storm water runoff events did result in moderate TSS and nutrient levels that when coupled with high flow volume, as is typical of Ozark rain events, are capable of delivering significant sediment loading from each sub-watershed.
- It is the goal to continually improve upon the drinking water quality and to protect the watershed from water quality degradation. In order to meet this goal a proactive target for 10% reduction of sediment and phosphorus loading.



Phase II - Assessments and Ranking Sub-watershed Implementation Measures

- Many factors play into determining which sub-watersheds 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;
 - Storm water TSS loading,
 - Storm water nutrient loading,
 - Percent pasture,
 - Amount of impacted riparian buffers,
 - Amount of bank erosion,
 - Miles of unpaved roads, and
 - Concentration of agricultural animals.

Phase II - Assessments and Ranking Sub-watershed Implementation Measures

Lee Creek

Rank #	TSS Loading	Nutrient Loading	%pasture	Impacted riparian	Bank erosion	Cattle	Unpaved Roads
1	MFC-1	MFC-1	WC-1	LC-2	LLC-2	LC-1	LC-2
2	LLC-2	LC-1	LLC-1	WC-1	JC-1	WC-1	LLC-2
3	LC-1	LLC-2	LC-2	MFC-1	MFC-1	CC-1	WC-1
4	JC-1	CC-1	CC-1	CC-1	LC-2	LC-2	LC-1
5	CC-1	LLC-1	LC-1	LLC-2	LC-1	LLC-1	LLC-1

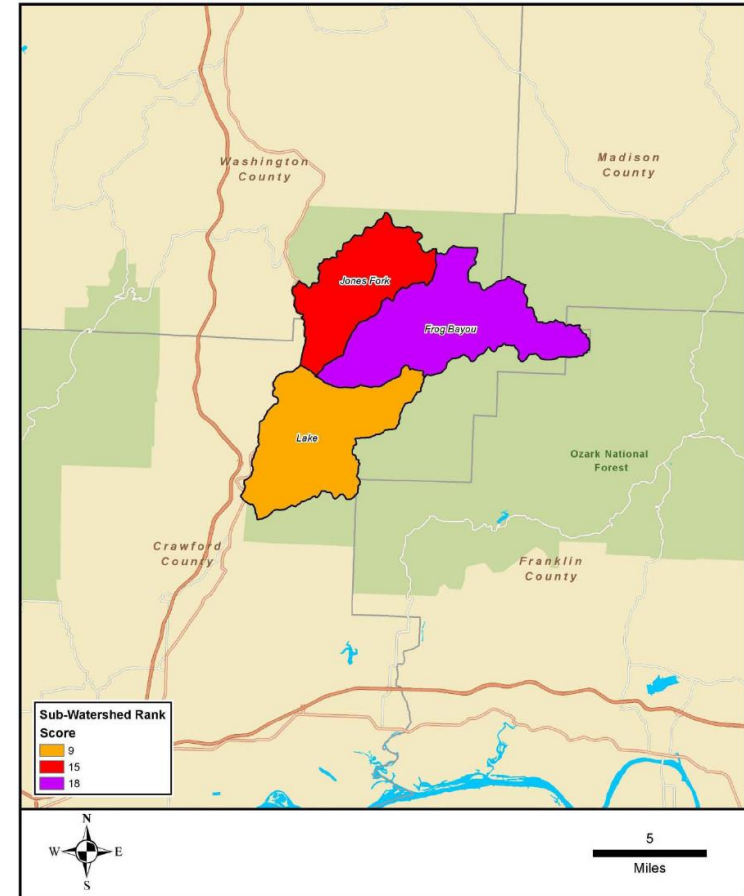
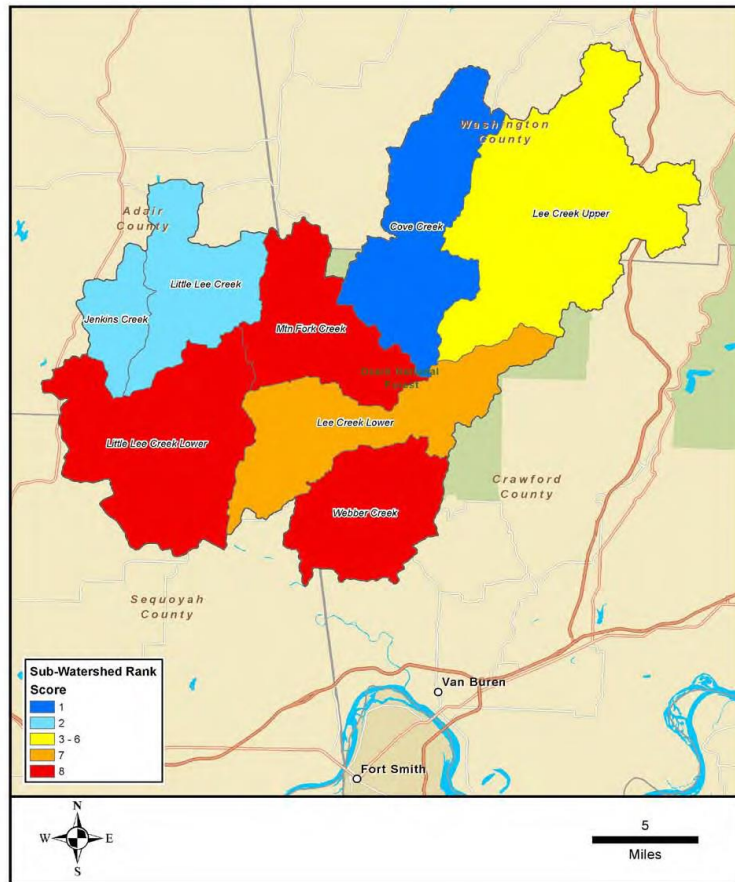
Sub-watershed	Score
LLC-2	8
MFC-1	8
WC-1	8
LC-2	7
LC-1	6
LLC-1	2
JC-1	2
CC-1	1

Upper Frog Bayou

Rank #	TSS Loading	Phosphorus Loading	% Pasture	Impacted Riparian	Bank Erosion	Cattle	Unpaved Roads
1	FB-1	FB-1	Jones-1	Lake	FB-1	FB-1	Lake
2	Jones-1	Jones-1	FB-1	Jones-1	Jones-1	Jones-1	Jones-1
3	Lake	Lake	Lake	FB-1	Lake	Lake	FB-1

Sub-watershed	Score
FB-1	18
Jones-1	15
Lake (FB-2)	9

Phase II - Assessments and Ranking Sub-watershed Implementation Measures



Phase II - Assessments and Ranking Sub-watershed Implementation Measures

Lee Creek

Rank	Location	Impact/Disturbance
1	MFC-1	Stream bank erosion
2	LLC-2	Stream bank erosion
3	LC-2	Stream bank erosion
4	LC-1	Stream bank erosion
5	WC-1	Pasture run-off
6	LC-2	Pasture run-off
7	LLC-2	Pasture run-off
8	MFC-1	Hwy 59 corridor storm water runoff
9	LC-2	Urban run-off
10	WC-1	Urban run-off
11	LC-1	Unpaved Roads
12	LLC-2	Unpaved Roads

Upper Frog Bayou

Rank	Sub-watershed	Management Type	Management Action (Practice)
1	FB-1	Restoration	Stream bank stabilization
2	Jones-1	Restoration	Stream bank stabilization
3	Lake (FB-2)	Restoration	Stream bank stabilization
4	FB-1	BMP	Pasture management BMPs
5	Jones-1	BMP	Pasture management BMPs
6	Jones-1	BMP	Unpaved roads maintenance/upgrade
7	FB-1	BMP	Unpaved roads maintenance/upgrade
8	Lake (FB-2)	BMP	Unpaved roads maintenance/upgrade
9	Lake (FB-2)	BMP	Urban (developed areas) storm water BMPs
10	FB-1/Jones-1	Restoration	Restoration of riparian buffers on rural and urban land

Phase II - WMPs Status

- The plans are done and EPA has accepted them!!!!!!!!!!!!!!





Conclusions & Advice

Advice

- Start the public education & stakeholder process as early as possible.
- Assemble a good team and have clearly defined goals.
- Don't take on more than you can handle or areas outside of your control.
- If it is unimpaired, do a WMP now before it is too late.

Conclusion

- WMP process is very rewarding.
- There are many people who have gone before, use their knowledge.
- Protection is better than correction.

Thank You and...



ANRC (Tony Ramick and Dusty Rains)



US EPA



GBM^c & Associates (Greg Phillips & Crew)



Arkansas State Parks, Lake Fort Smith State Park



City of Fort Smith Watershed Management Team
(Tim Smith, Don Clover, Katie Yoder, Dax Dupire)