Fort Smith
UTILITY DEPARTMENT

Lee Creek Reservoir and Lee Creek

Watershed Management Plan

Prepared for the City of Fort Smith
June 1, 2015

GBM^c & Associates
Strategic Environmental Services

CONTENTS

CONTENTS (cont)

FIGURES

FIGURES (cont)

TABLES

TABLES (cont)

APPENDICES

Executive Summary

This watershed management plan (WMP) has been developed based largely on the 2005 EPA guidance and addresses EPA's nine minimum control measures. The plan complies with AWWA G300 Standard and contains many of the required components of a Source Water Protection strategy. Historical data collected by the Fort Smith Utility (FSU) and new data (water quality and unified stream assessments) collected during this project have been utilized in preparation of this plan.

Total suspended solid (TSS) levels appear to be a principal concern in the watershed at this time and are known to be elevated due to storm water runoff from the numerous unpaved roads in the watershed, and from stream bank erosion. A substantial portion of the watershed is agricultural. Some areas, especially adjacent to agricultural land, lack riparian buffers and have ongoing erosion issues that could export nutrients to the waters. Lee Creek is in the nutrient surplus area, designated by the Arkansas legislature. Nutrient levels have not yet been found to be alarmingly high. However, concerns over increased agricultural activity in the watershed potentially threaten Lee Creek in the years to come if not protected.

This WMP has been developed based primarily on evaluation/analysis of existing watershed monitoring data collected by the FSU over the past several years then integrated with the existing water resource management documents and new data collected during this project to form a comprehensive WMP. The WMP includes identification of critical sub-watersheds at a small scale (~12 digit HUC) and ranked implementation measures to reduce non-point source pollution loading from critical areas.

The Lee Creek watershed (HUC-11110104 (NRCS WBD)) is approximately 447 mi^2 in size. The watershed is located in the Boston Mountains and Arkansas River Valley Ecoregions (Omernick, 1987), 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. The water supply serves a population of approximately 200,000 (US Census, 2000).

Land use in the watershed is mostly forest and pasture. The watershed is dominated by forest land-uses (79%). Agricultural land-uses (mostly pasture) comprise a fairly high percentage (13%) of the watershed.

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. When loading is evaluated on a per unit area basis, it becomes clear which sub-watersheds have land uses that are producing the most pollutants during runoff events.

Results of the Designated Use Assessment and in comparing the similarity of the current Lee Creek Watersheds water quality to least disturbed Boston Mountain Streams indicates that no load reductions are required to meet Arkansas water quality standards. However, 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. Therefore, reductions in TSS loading (of approximately 10%) which will also provide reductions in nutrient, metals and bacterial loading (of approximately 10%) will be targeted in critical areas in an effort to encourage maintenance of Oklahoma’s standards and to improve water quality entering Lee Creek Reservoir. Two Oklahoma agencies, the Oklahoma Water Resource Board and the Oklahoma Conservation Commission, are stakeholders with FSU in this project.

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, focusing attention not just on point source discharges and stream disturbances in the stream corridors, but also on the effects of anthropogenic land uses (non-point sources) in the entire watershed on the waters in that 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). Preparation of this plan was funded by an EPA 319 Grant through the Arkansas Natural Resources Commission. Over the past two years additional data has been collected by the Fort Smith Utility (FSU) and new data has been collected during this Phase 2 project to fill in gaps identified in the draft plan creating a final WMP.

Table 1. EPA Nine Minimum Elements.

EPA Nine Minimum Elements	Location Element Addressed in Watershed Management Plan
Element 1- Identification of causes of impairment and pollutant sources	Section 3.7, 4.0, 5.0
Element 2- Estimate of load reductions expected from management measures	Sections 5.0, 6.0
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	Sections 3.1.1, 3.2, 7.0

The Fort Smith Utility (FSU) is a regional water supplier that produces, delivers and sells potable water to 13 contract users who ultimately provide drinking water, from Lee Creek Reservoir and Lake Fort Smith, to approximately 200,000 people in Western Arkansas and Eastern Oklahoma. The utility strives to provide the best quality water to its users at a reasonable cost. Protection of the watersheds that supply this water not only will reduce pollutant transport to the Arkansas River Basin but will also allow the City to continue providing its users with affordable clean drinking water. This plan complies with the AWWA G300 Standard for source water protection. It includes the bulk of the components recommended by the G300 Standard including; characterization of source water and source water protection area, source water protection goals, an action plan, implementation strategies and a plan for evaluation and revision (Table 2).

Table 2. AWWA G300 Standard.

AWWA G300 Standard Component	Location Component Addressed in Watershed Management Plan
Sec.4.2 -Characterization of Source Water and Source Water Protection Area	Sections 2.0, 3.1, 3.2, 3.3, 3.4, 3.6, 3.7, 4.0, 5.0, 7.0
Sec. 4.3-Source Water Protection Goals	Sections 4.0, 6.0, 8.0
Sec.4.4-Action Plan	Sections 4.0, 6.0, 8.0, 9.0
Sec.4.5-Program Implementation	Sections 6.0, 7.0, 8.0
Sec.4.6-Evaluation and Revision	Section 7.0, 8.0

Total suspended solid (TSS) levels appear to be a principal concern in the watershed at this time and are known to be elevated due to storm water runoff from the numerous unpaved roads in the watershed, and from stream bank erosion. A substantial portion of the watershed is agricultural. Some areas, especially adjacent to agricultural land, lack riparian buffers and have ongoing erosion issues that could export nutrients to the waters. Lee Creek is in the nutrient surplus area, designated by the Arkansas legislature. Nutrient levels have not yet been found to be alarmingly high. However, concerns over increased agricultural activity in the watershed potentially threaten Lee Creek in the years to come if not protected.

Fort Smith has maintained an ongoing watershed monitoring program since 2003. FSU staff conducts extensive water quality sampling and physicochemical analysis on a quarterly basis, under various flow regimes, at multiple creek stations in the watershed. Staff completes annual bioassessments of the fish and macroinvertebrate community in key stream reaches (generally near water quality monitoring sites) in the watershed. In addition, the monitoring program includes weekly lake water quality profiles to assess lake trophic status and raw water intake water quality.

This WMP has been developed based primarily on evaluation/analysis of existing watershed monitoring data collected by the FSU over the past several years, then integrated with the existing water resource management documents and new data collected during Phase 1 and Phase 2 of this project to form a comprehensive WMP. The WMP includes identification of critical sub-watersheds at a small scale (~12 digit HUC) and ranked implementation measures to reduce non-point source pollution loading from critical areas. This WMP will be used to direct watershed protection activities and watershed restoration activities with the ultimate goal being immediate reduction of pollutant loading and protection of the watershed and associated reservoir source water into the future.

2.0 Watershed Description

The Lee Creek watershed (HUC-11110104 (NRCS WBD)) is approximately 447 mi^2 in size (Figure 1). The watershed is located in the Boston Mountains and Arkansas River Valley Ecoregions (Omernick, 1987), 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 serve as a drinking water source for Fort Smith and Van Buren. The area served by the reservoir has a population of approximately 200,000 (US Census, 2000).

Land use in the watershed is mostly forest and pasture. The watershed is dominated by forest land-uses (79%). Agricultural land-uses (mostly pasture) comprise a fairly high percentage (13%) of the watershed (Figure 1.) The soils in the watershed are dominated by Nella-Enders, Enders, Hector-Linker and Hector-Linker-Enders complexes. Slopes are moderately steep and typically range from 3% - 45%, with over half the slopes in excess of 16% (Figure 2.) 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. Lee Creek is designated for the following uses by the Arkansas Department of Environmental Quality (ADEQ):

- Primary contact recreation
- Secondary contact recreation
- Domestic, industrial and agricultural water supply
- Fisheries (Aquatic life), Perennial Boston Mountains
- Extraordinary Resource Water (ERW), from state line upstream to headwaters

Lee Creek in Arkansas is also designated as a nutrient surplus area according to the Arkansas Code 15-20-1104. This designation places controls on the amount of fertilizer that can be applied to the land in the watershed, further protecting the waters from nutrient pollution.

A unique characteristic of Lee Creek, is that it runs out of Arkansas into Oklahoma and then after approximately 16 miles runs back into Arkansas. Since a portion of the Lee Creek watershed is in Oklahoma, Lee Creek must also maintain Oklahoma's designated (or beneficial) uses which are:

- Irrigation/Agricultural
- Industrial/Municipal process and cooling water
- Aesthetics
- Cool Water Aquatic community
- Primary Body Contact
- Public/Private Water Supply

Lee Creek also has a several special "Limitations" placed on it in Oklahoma's water quality standards that provides further protection:

- High Quality Water (Lee Creek downstream of 420 ft elevation)
- Outstanding Resource Water
- Scenic River (Lee Creek upstream of 420ft elevation and Little lee Creek)

The scenic river "limitation" puts Lee Creek under a special phosphorus water quality standard of 0.037 mg/L as total phosphorus. This standard also applies to the Illinois River which borders Lee Creek to the north.

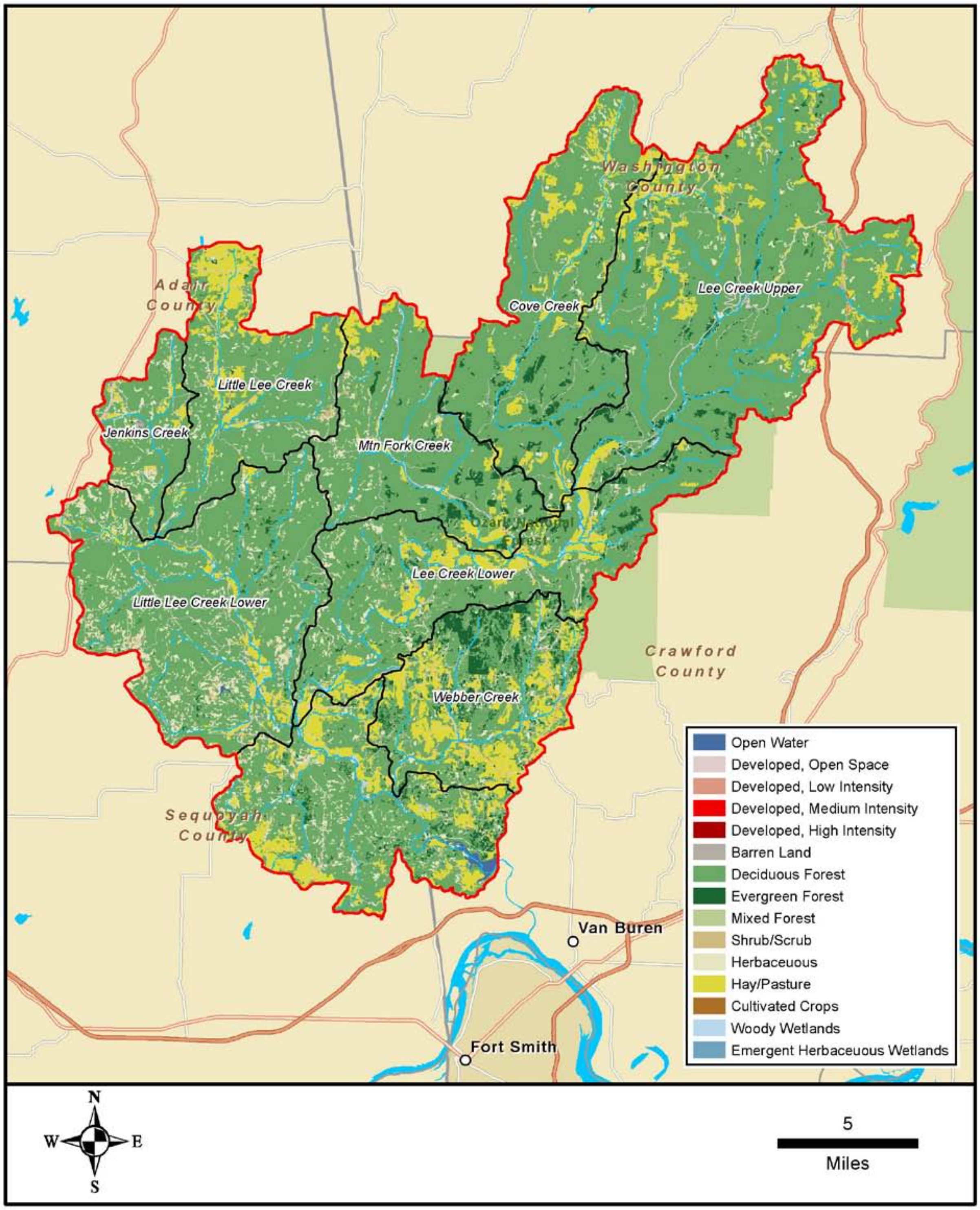

Figure 1. Land-uses in the Lee Creek Watershed.

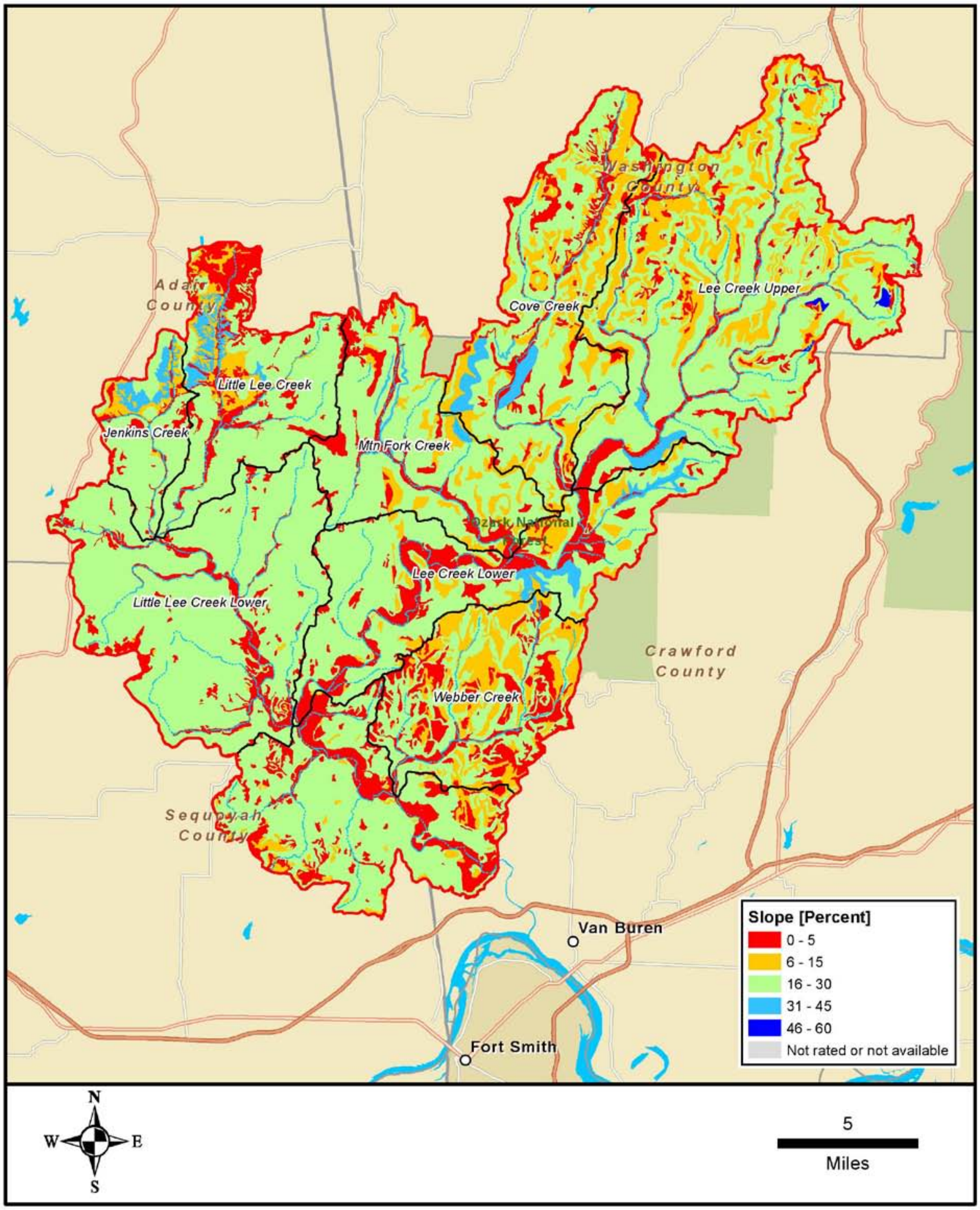

Figure 2. Land Surface Slope in the Lee Creek Watershed.

3.0 Watershed Assessment

A comprehensive assessment was completed on the Lee Creek watershed to evaluate its physical, chemical, ecological and hydrologic condition. Each of the eight sub-watersheds depicted on the map (Figures 1 and 2) were evaluated. The most southern sub-watershed (unlabeled) was not assessed as it is remote and its stream system configuration did not terminate into one main channel draining most of the area (would have to sample several small drainages) making assessment difficult. Historical data collected by FSU's ongoing monitoring program, GIS data and new data collected in the field during Phase 1 and Phase 2 of this project, by GBM^c & Associates, was utilized for the assessment. A description of each assessment component is contained in the following sections. A list of the eight sub-watersheds (defined at approximately a 12-digit HUC level) is provided below.

1. Jenkins Creek (JC-1)
2. Upper Little Lee Creek (LLC-1)
3. Lower Little Creek (LLC-2)
4. Upper Lee Creek (LC-1)
5. Lower Lee Creek (LC-2)
6. Mountain Fork Creek (MFC-1)
7. Webber Creek (WC-1)
8. Cove Creek (CC-1)

3.1 Water Quality

3.1.1 Fort Smith Utility Ongoing Monitoring Program

The FSU has been managing the Lee Creek watershed for over 10 years. They have an ongoing monitoring program that includes baseline and storm flow monitoring of water quality at eight locations in the watershed above Lee Creek Reservoir. Samples have been collected at each of these stations (Figure 3) on several occasions since 2002. Data from the monitoring program (collected primarily between 2006-2013) has been analyzed and summarized in Table 3. All historical data used in this WMP is provided in Appendix A.

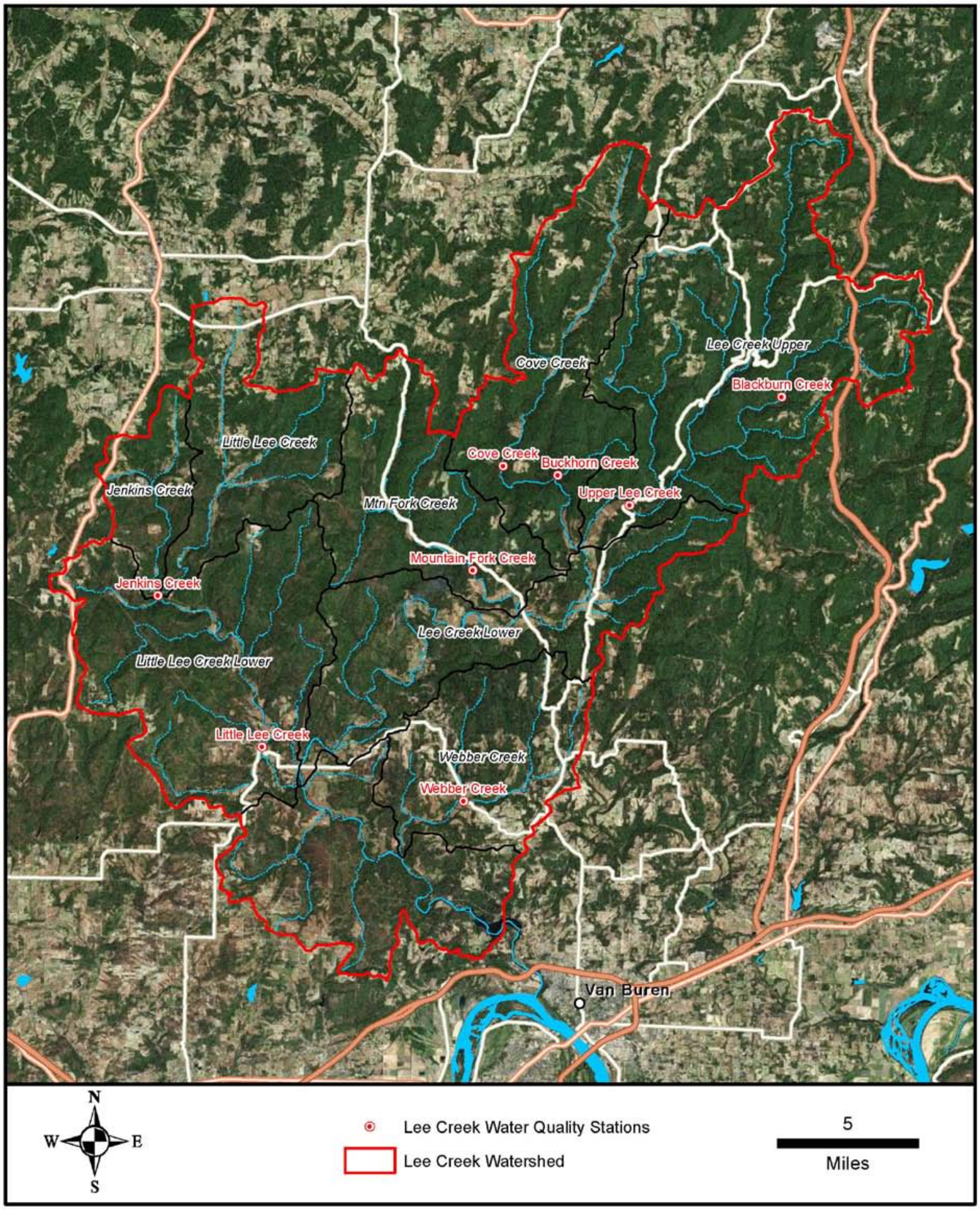

Figure 3. FSU Sample Locations in Lee Creek Watershed.

Table 3. Summary of Historical Monitoring Data Collected by FSU.

Station	Parameters											
	TSS (mg/L)		T.Phos (mg/L)		Orthophos. (mg/L)		NO3+NO2-N (mg/L)		TOC (mg/L)		Chloride (mg/L)	
	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range
Baseline Sample Results												
Blackburn	5.0	<5.0	0.030	<0.020 - 0.060	0.035	<0.010 - 0.064	0.20	0.04 - 0.65	1.30	0.50 - 3.03	4.43	1.95 - 12.16
Buckhorn	5.2	<5.0 - 10.0	0.054	<0.020 - 0.460	0.044	<0.010 - 0.123	0.13	0.01 - 0.47	1.38	0.26 - 2.44	1.49	0.93 - 2.08
Cove	5.0	<5.0 - 5.0	0.037	<0.020 - 0.170	0.045	<0.010 - 0.153	0.25	0.02 - 0.86	3.17	0.30 - 11.44	2.73	1.57 - 4.45
Jenkins	5.1	<5.0 - 9.0	0.030	<0.020 - 0.120	0.040	<0.010 - 0.092	0.16	0.01 - 0.36	2.77	0.39 - 6.61	3.37	2.19 - 6.50
Little Lee	5.4	<5.0 - 10.0	0.051	<0.020 - 0.210	0.047	<0.010 - 0.162	0.17	0.01 - 0.79	2.20	0.33 - 6.91	3.92	2.02 - 10.08
Mtn. Fork	5.3	<5.0 - 10.0	0.038	<0.020 - 0.110	0.038	<0.010 - 0.061	0.17	0.03 - 0.97	2.22	0.40 - 5.70	3.67	1.60 - 12.75
Upper Lee	5.5	<5.0 - 11.43	0.050	<0.020 - 0.350	0.042	<0.010 - 0.123	0.27	0.01 - 0.99	1.80	0.76 - 3.01	5.28	1.65 - 36.76
Weber	5.0	<5.0	0.040	<0.020 - 0.100	0.033	<0.010 - 0.065	0.35	0.02 - 1.55	1.76	0.77 - 3.30	4.13	2.60 - 6.87
Storm Flow Sample Results												
Blackburn	--	--	--	--	--	--	--	--	--	--	--	--
Buckhorn	24.0	5.5 - 71.3	0.116	0.038 - 0.230	0.058	<0.010 - 0.214	0.13	0.02 - 0.43	3.46	1.48 - 5.77	1.37	1.06 - 1.83
Cove	85.1	9.5 - 311.8	0.281	0.026 - 1.180	0.121	<0.010 - 0.974	0.19	0.03 - 0.46	4.14	0.40 - 11.38	2.59	1.55 - 4.41
Jenkins	26.0	19.0 - 33.0	0.110	0.090 - 0.130	0.071	0.020 - 0.154	0.25	0.15 - 0.34	6.36	5.88 - 6.85	1.95	1.30 - 2.60
Little Lee	79.0	<5.0 - 225.25	0.196	0.078 - 0.318	0.041	<0.010 - 0.093	0.10	0.02 - 0.23	2.76	0.55 - 5.03	5.27	1.50 - 24.17
Mtn. Fork	54.7	<5.0 - 111.0	0.171	<0.020 - 0.303	0.053	0.040 - 0.095	0.08	0.04 - 0.14	3.39	2.81 - 4.49	5.35	1.49 - 21.67
Upper Lee	79.3	7.8 - 284.5	0.217	0.021 - 0.558	0.060	0.040 - 0.153	0.12	0.02 - 0.24	3.22	1.95 - 4.28	2.57	1.44 - 4.83
Weber	--	--	--	--	--	--	--	--	--	--	--	--

FSU uses Buckhorn Creek as the reference condition (least disturbed) for the watershed. This sub-watershed is relatively undeveloped, over 80% of it is forest (See Section 3.7). Water quality in Buckhorn Creek is very good; sample results reflect the lowest levels of TSS observed during storm flow sampling events. Total phosphorus during storm events was also low compared to other stations (Figure 4).

Under baseflow conditions each streams water quality was generally comparable to that of Buckhorn Creek (Figures 4-6). Under storm flow conditions, phosphorus and TSS were noted to be slightly elevated in most of the other streams, with Cove Creek being the most noticeably elevated for phosphorus and Cove Creek, Mountain Fork Creek, Upper Lee Creek and Little Lee Creek all being noticeably elevated for TSS. Jenkins Creek also displayed elevated TOC values during storm events, though still less than 10 mg/L.

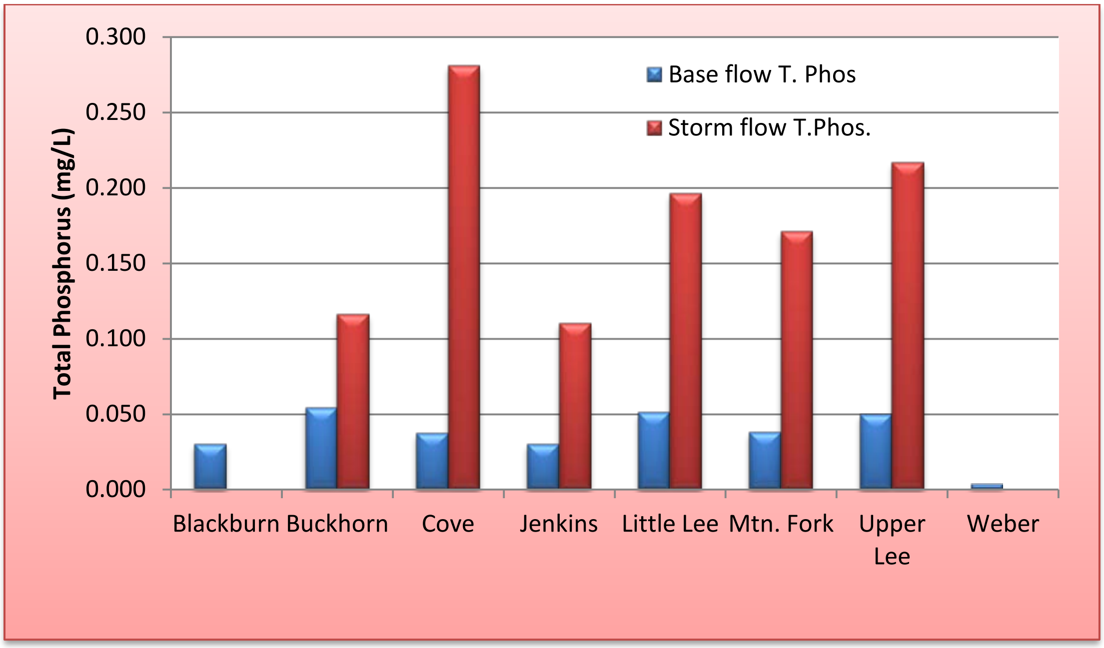

Figure 4. Average FSU Phosphorous Data.

FSU will continue their existing monitoring program to evaluate success of the implementation phase of the management plan.

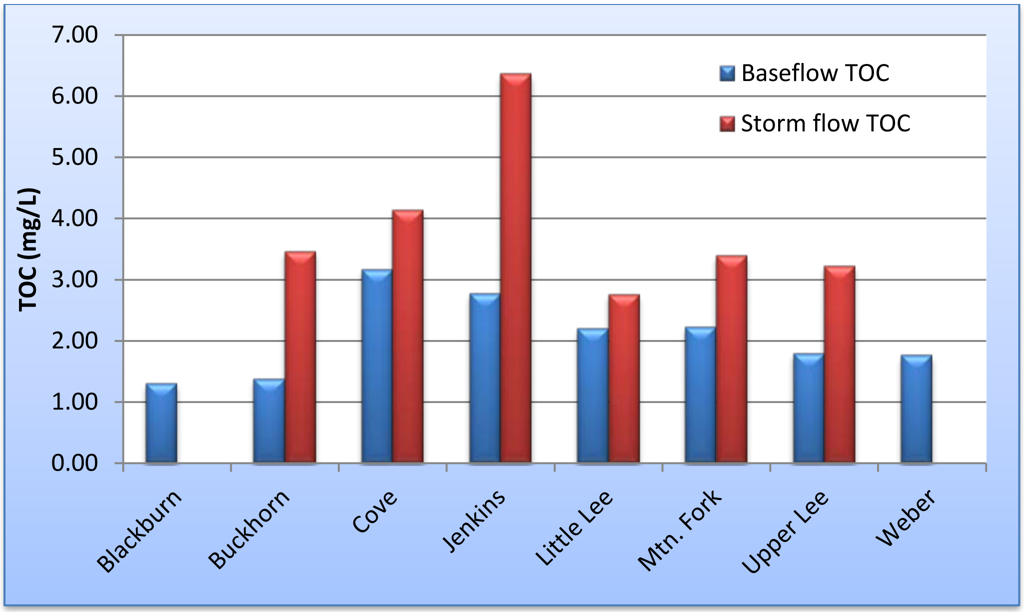

Figure 5. FSU Average TOC Data.

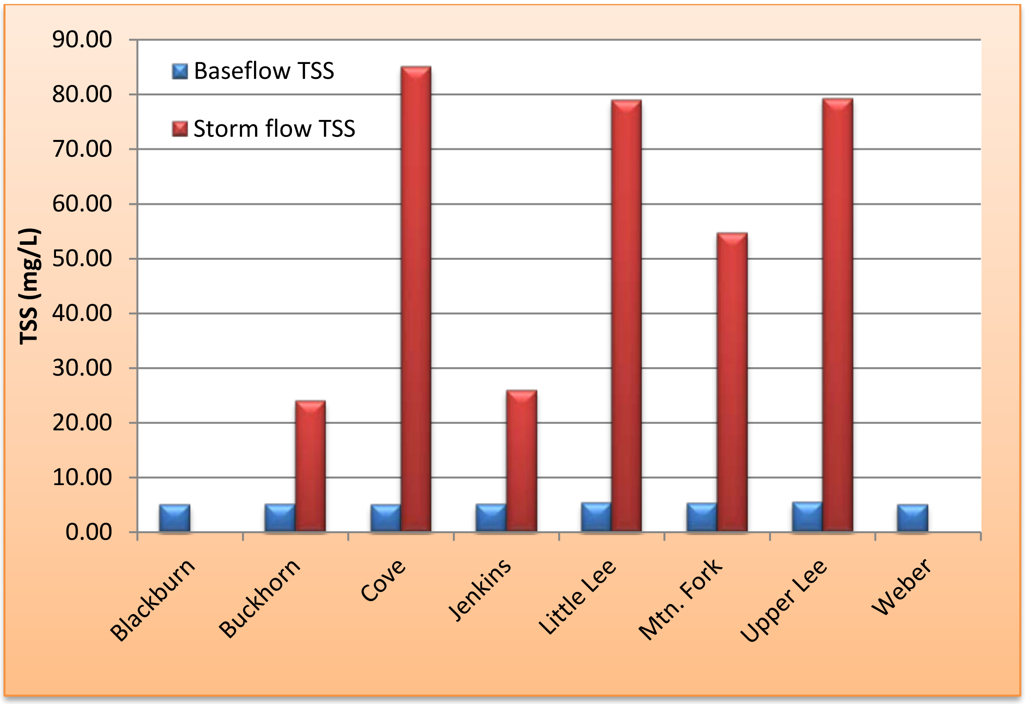

Figure 6. FSU Average TSS Data.

3.1.2 Water Quality Data Collected Specifically for the WMP

As a component of the development of this WMP, additional water quality data was collected to supplement the routine monitoring data collected by FSU. Water samples and *in-situ* data were collected from several points along Lee Creek and its tributaries to determine the water quality during baseflow and storm flow conditions. Sample stations were selected to represent each of the eight sub-watersheds depicted in Figure 7. A total of eight stations were utilized during the study, all stations were sampled during each sampling event. Samples were collected during 2012 and 2014, on two occasions to represent baseflow conditions, and five occasions to represent storm flow conditions. A description of each sample station is provided in Table 4 These stations are close to the same locations as those used by FSU, though often times positioned lower in the watershed, to ensure all loading from the sub-watershed was accounted for. Buckhorn Creek is one of the FSU routine monitoring stations. Buckhorn was omitted from the 2012 Phase 1 study due to its small size and unlikelihood that it would be a significant source for pollutants, but was added to the Phase 2 2013/2014 study to serve as a reference.

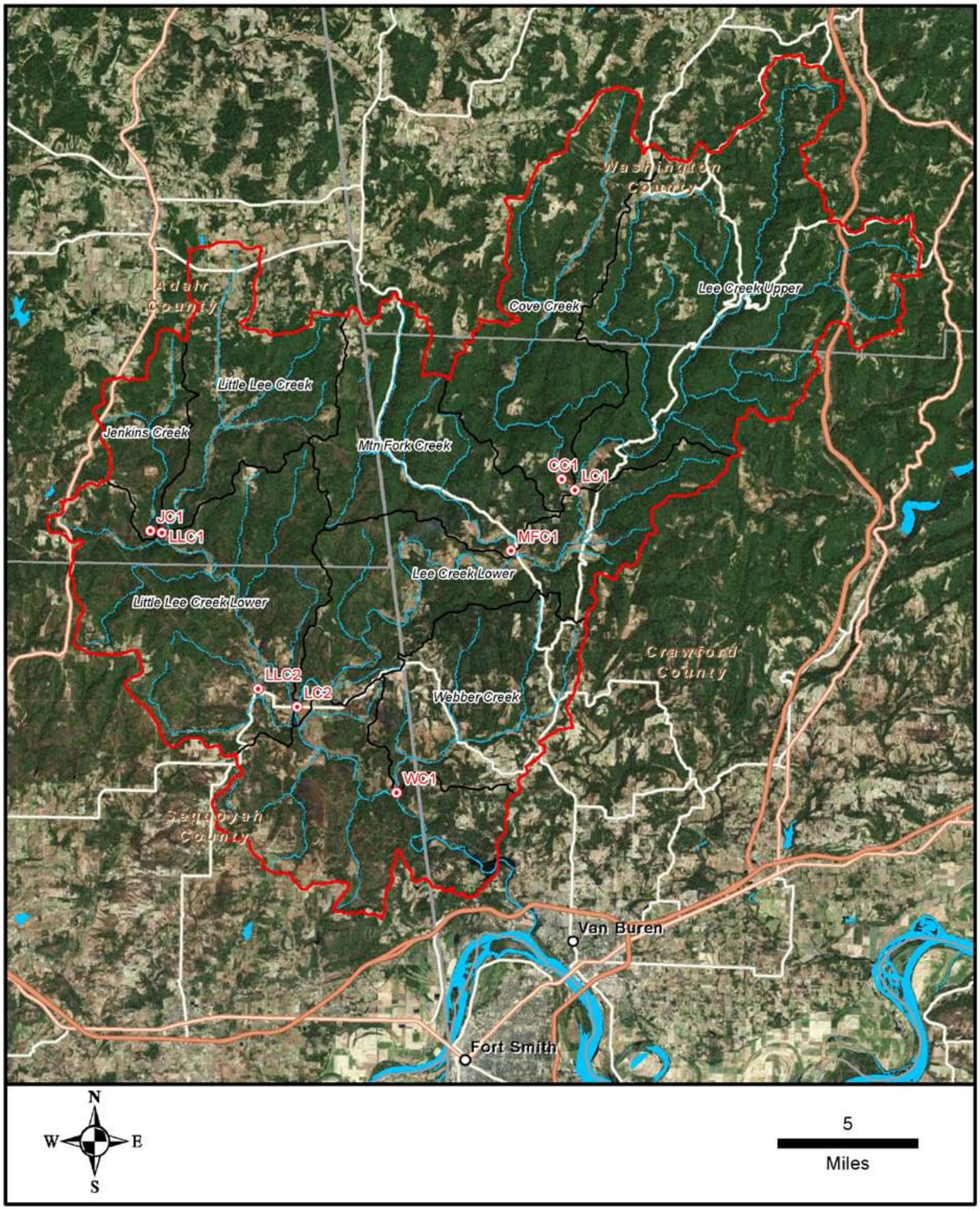

Figure 7. Lee Creek Sub-Watersheds and Sample Stations in each Sub-Watershed utilized during this Study.

Samples were collected according to the Quality Assurance Project Plan (QAPP) approved by the ANRC 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 laboratory for analysis following all chain of custody procedures (see QAPP for project). Samples were collected for analysis of nitrate+nitrite-N, ammonia, total phosphorus, ortho-phosphorus, BOD5[1], TOC[1], and TSS, and Chloride[1]. At the time of sample collection, *in-situ* measurements were taken for pH, specific conductance, dissolved oxygen, temperature, and turbidity. *In-situ* measurements were made following GBM[c] SOP's (Nos.1-4 and 14). Water quality results, including *in-situ* parameters, from each station, are provided in Appendix B.

Table 4. Sample Station Descriptions.

Station Identification	Station Description
JC-1	Jenkins Creek just upstream of Denny Ridge Road in upper watershed.
LLC-1	Little Lee Creek just upstream of Denny Ridge Road crossing in upper watershed.
LLC-2	Little Lee Creek at Hwy 101 road crossing.
LC-1	Lee Creek at Creek Fork Road low water crossing.
LC-2	Lee Creek at Hwy 101 road crossing.
MFC-1	Mountain Fork Creek at Natural Dam, below road crossing.
CC-1	Cove Creek at Creek Fork Road low water crossing.
WC-1	Weber Creek at Weber Creek Road low water crossing.
BH-1	Buckhorn Creek upstream of Cove Creek confluence about ¼ mile.

Water quality during baseflow conditions was found to be good and fairly consistent, in each sub-watershed. Table 5 provides a summary of water quality data for the Lee Creek watershed stations for select constituents. All water quality data collected during the study is provided in Appendix B. Each station is near the outlet of it respective sub-watershed and should be typical of pollutant concentrations (and loads) in that system. Total phosphorus under baseflow conditions averaged no more than 0.035 mg/L and ortho-phosphorus (the dissolved fraction of phosphorus that is generally considered biologically available) was always below the 0.02 mg/L detection level. Nitrate+Nitrite-N levels were very low, all less than 0.60 mg/L. TSS was less than detection (5.0 mg/l) and turbidity was less than 10.0 NTU at all stations during baseflow conditions. TOC and BOD5 levels, which measure carbon based organic material in the water were all very low, BOD5 levels were all less than the 2.0 mg/L detection level and TOC averaged less than 1.50 mg/L in all samples. These data are indicative of water that is very

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[1] BOD5 and TOC were analyzed only in samples collected during Phase 1. Chloride was analyzed during both phases, but on only two occasions during Phase 1.

clear, and free of suspended matter (Figure 8). Chloride levels were very low at all stations, less than 3.0 mg/L. Conductivity measurements were also low at all stations, less than 100 us/cm, with the exception of LLC-1 which was over 150 us/cm on both baseflow occasions. The specific conductance measurements are all representative of waters generally low in dissolved minerals and other materials.

Figure 8. Jenkins Creek at JC-1 and Lee Creek at LC-1 during Baseflow Conditions.

Water quality during storm flow conditions is summarized in Table 5. Five storm events were sampled (two during Phase 1 and three during Phase 2), with each stations samples being collected prior to the peak runoff (per the USGS gauges in the watershed). Storm events varied in size from greater than 2 inches to around 0.5 inches. The concentration of some pollutants increased as flow increased, while others pollutants decreased or remained stable. Most notably TSS (Figure 9) and total phosphorus (Figure 10) increased an order of magnitude (on average) during storm flow events. TSS levels were as high as 244 mg/L, in Little Lee Creek (LLC-2), and total phosphorus was as high as 0.40 mg/l at station LLC-1. BOD5 levels increased notably at stations LLC-1 (6.74 mg/L) and LLC-2 (3.39 mg/L) during the January 25, 2012 storm event. These were the only two stations that exhibited BOD5 levels in excess of 3.0 mg/L. TOC levels did not exhibit increases similar to BOD5. It is unlikely that these elevated BOD5 values would be problematic to long term water quality.

Table 5. Summary of Average Baseflow and Storm Flow Water Quality.

Station[1]	Parameters											
	TSS (mg/L)		T.Phos (mg/L)		Orthophos. (mg/L)		NO3+NO2-N (mg/L)		TOC (mg/L)		Chloride (mg/L)	
	mean	range	mean	range	mean	range	mean	range	mean	range	mean	range
Baseline Sample Results												
JC-1	<5	---[2]	<0.020	---	<0.02	---	0.41	0.32 - 0.50	1.33	0.97 - 1.70	2.0	---
LLC-1	<5	---	0.030	<0.02 - 0.04	<0.02	---	0.48	0.46 - 0.50	0.99	0.21 - 1.77	2.1	---
LLC-2	<5	---	0.030	<0.02 - 0.04	<0.02	---	0.40	0.29 - 0.50	1.29	1.00 - 1.58	1.8	---
LC-1	<5	---	0.035	<0.02 - 0.05	<0.02	---	0.43	0.36 - 0.50	0.86	0.77 - 0.96	2.2	---
LC-2	<5	---	0.035	<0.02 - 0.05	<0.02	---	0.47	0.44 - 0.50	1.12	0.92 - 1.33	1.9	---
WC-1	<5	---	0.030	<0.02 - 0.04	<0.02	---	0.39	0.27 - 0.50	1.25	0.99 - 1.51	2.0	---
CC-1	<5	---	0.035	<0.02 - 0.05	<0.02	---	0.36	0.22 - 0.50	1.48	1.52 - 1.54	1.3	---
MFC-1	<5	---	0.035	<0.02 - 0.05	<0.02	---	0.38	0.26 - 0.50	1.12	0.98 - 1.26	1.5	---
Storm Flow Sample Results												
JC-1	42.2	<5.0 - 112.0	0.06	<0.02 - 0.13	0.03	<0.02 - 0.04	0.30	0.19 - 0.50	3.63	3.18 - 4.09	2.7	2.6 - 2.7
LLC-1	13.6	<5.0 - 36.0	0.10	<0.02 - 0.40	0.02	<0.02 - 0.02	0.25	0.14 - 0.50	3.07	2.67 - 3.47	3.1	2.5 - 3.4
LLC-2	63.2	<5.0 - 244.0	0.12	0.02 - 0.36	0.04	<0.02 - 0.12	0.21	0.12 - 0.50	3.14	1.86 - 4.41	2.5	2.4 - 2.6
LC-1	54.6	<5.0 - 143.0	0.14	<0.02 - 0.32	0.03	<0.02 - 0.06	0.27	0.10 - 0.50	2.02	1.21 - 2.83	4.7	3.7 - 6.4
LC-2	17.0	<5.0 - 65.0	0.05	<0.02 - 0.18	0.03	<0.02 - 0.07	0.24	0.14 - 0.50	2.20	1.46 - 2.93	3.7	2.8 - 5.4
WC-1	16.6	<5.0 - 54.0	0.05	<0.02 - 0.16	0.03	<0.02 - 0.05	0.29	0.14 - 0.50	3.48	1.37 - 5.58	4.2	2.5 - 5.6
CC-1	38.0	<5.0 - 122.0	0.13	<0.02 - 0.29	<0.02	<0.02 - <0.02	0.26	0.07 - 0.50	2.90	1.57 - 4.24	1.9	1.8 - 2.1
MFC-1	37.4	<5.0 - 163.0	0.10	<0.02 - 0.39	0.03	<0.02 - 0.09	0.21	0.12 - 0.50	3.33	1.86 - 4.81	2.3	2.0 - 2.7
BH-1	<5.0	<5.0 - <5.0	0.02	<0.02 - 0.03	<0.02	<0.02 - <0.02	0.22	0.12 - 0.38	---	---	1.4	1.4 - 1.4

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[1] Each station has two baseline samples and five storm samples represented.

[2] Symbolizes either no data, all data had the same value (SD=0) or only one value represented, as in the case of chloride.

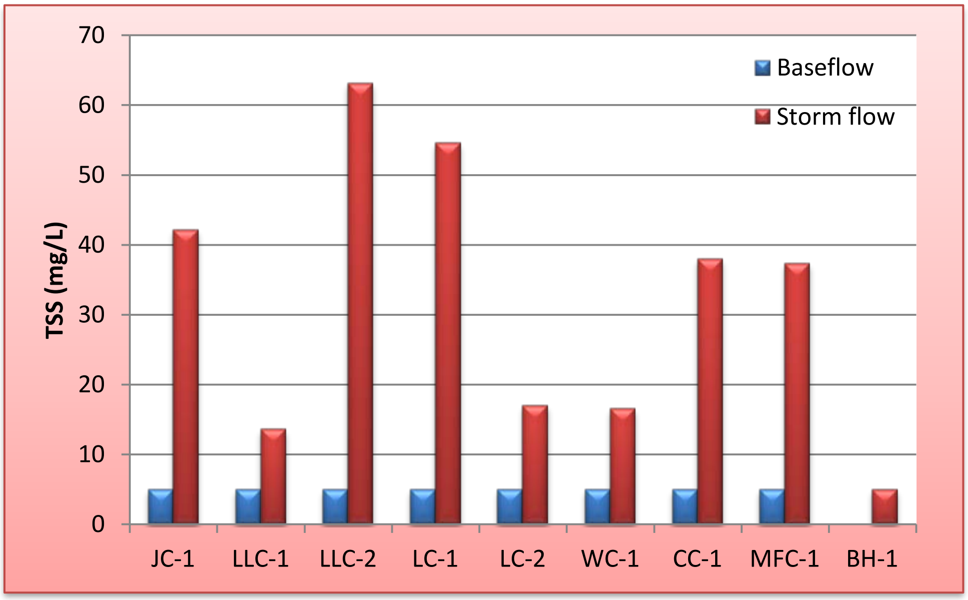

Figure 9. Average TSS, Baseflow versus Storm Flow.

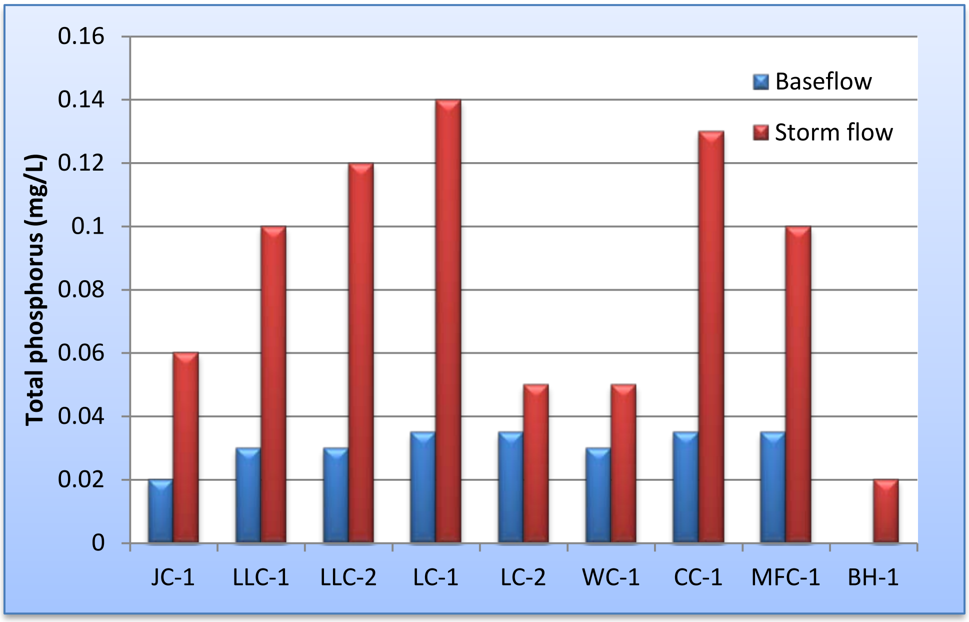

Figure 10. Average Total Phosphorus, Baseflow versus Storm Flow.

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 produce moderate pollutant levels (Figures 11 and 12), that when coupled with high flow volume typical of the Ozark region rain event, are capable of producing significant pollutant loading from each sub-watershed (see Section 4.0).

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Figure 11. MFC-1 during Storm Event.

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Figure 12. LLC-2 during Storm Event.

Designated Use Assessment Criteria

Currently none of the streams in the Lee Creek Watershed in Arkansas are on Arkansas 303(d) list. In order to evaluate the maintenance of Lee Creeks designated uses based on water quality data, the Arkansas Assessment Criteria for the Boston Mountains Ecoregion was utilized. Table 6 provides a summary of the assessment criteria that are pertinent to this WMP study's focus.

Table 6. Boston Mountain Assessment Criteria Standard.

Parameter	Standard	Lee Creek Assessment	Use assessed
Temperature (ºC) Maximum	29	All <29	Aquatic life (fisheries)
Dissolved Oxygen (mg/L) Minimum, watersheds >10mi^2	6	All >6.0	Aquatic life (fisheries)
pH (s.u.)	6 – 9	All in range	All
Turbidity (primary flow) ntu	10	All <10	All
Turbidity (storm flow) ntu	19	Some exceedances (see text)	All
Chloride (mg/L)	250/23[1]	All <23	Drinking water
Nitrate (mg/L)	10	All <1.0	Drinking water
Ammonia (mg/L) (4-d avg/30-d avg)	5.3/2.1	All <0.10	Aquatic life (fisheries)

[1] Chloride is assessed with a general 250 mg/l for drinking water and an ecoregion based value 33% greater than the ecoregion reference value, which in this case is 23 mg/L.

Data collected during the study were compared to the Arkansas assessment criteria. All designated uses are being maintained in each sub-watershed. However, storm flow turbidity was exceeded at some sub-watershed monitoring stations on at least one occasion. According to the assessment criteria for turbidity, if more than 20% of samples collected (with at least 24 samples) exceeds the storm flow value, the stream is listed as impaired for turbidity. Based on the new data collected and the historical data collected by FSU, it does not appear that any of the sub-watersheds are at risk for impairment due to turbidity.

As discussed in Section 2.0, a portion of the Lee Creek watershed is in Oklahoma. Therefore, that portion of Lee Creek and its tributaries located within Oklahoma are required to maintain Oklahoma's designated uses. The water quality stations that represent these reaches are JC-1, LLC-1, LLC-2, LC-2 and WC-1. Oklahoma's Use Assessment Protocols are very similar to Arkansas'. The only criteria that are more stringent in Oklahoma than in Arkansas are: dissolved oxygen (7.0 mg/L) and temperature (22°C) in the spring (Mar 1 – May 31) period, pH (min 6.5 s.u.) and total phosphorus (0.037 mg/L as a 30-day geomean). The 0.037 mg/L total phosphorus criteria applies only in Oklahoma's Scenic Rivers which Little Lee Creek and Lee Creek are designated.

Spring dissolved oxygen levels measured during the study were greater than 7.0 mg/L, temperatures measured were all less than 22°C and pH were all greater than 6.5 s.u. The total phosphorus geometric means for baseflow samples at all stations were less than 0.037 mg/L. However, storm flow means were all in excess of the 0.037 mg/L criteria. In addition to the recent data collected during this study, FSU has collected total phosphorus data over the past several years at LLC-2 (identified as "Little Lee" in Table 3 of this report). The geometric mean of the baseflow data at LLC-2 collected by FSU is 0.037 mg/L. Storm flow data collected at LLC-2 are all above the 0.037 mg/L criteria. Based on the limited data reviewed, it appears that there is a reasonable likelihood that total phosphorus in the Lee Creek watershed in Oklahoma could be in excess of the Oklahoma criteria for Scenic Rivers. Little Lee Creek is on Oklahoma's 303(d) list for unattainment of the primary body contact use. The cause of the impairment is listed as bacteria. Lee Creek is on the Oklahoma 303(d) list for unattainment of the cool water aquatic community use and the primary body contact use. Causes are noted as copper, lead, and bacteria, respectively.

3.2 Lee Creek Reservoir

Water Quality

Water samples were collected by Fort Smith Utility from seven sampling locations situated throughout Lee Creek Reservoir to characterize the water quality of the reservoir as part of the Fort Smith Utility monitoring program. Monitoring data reviewed for this analysis were from samples collected once a week beginning in January 2009 and ending in February 2014. For this analysis, we focused on only two sampling locations, one shallow sampling location (L1) which is in the middle of the reservoir and a deeper sampling location (L2) which is located just above the dam. We only considered data from the summer months (July-August) and winter months (January and February) from the two sampling locations to best depict contrasting conditions in Lee Creek Reservoir.

Grab samples were collected by Fort Smith Utility in clean, labeled containers at approximately 1.5 (or one and one-half) feet deep within the water column of the reservoir. Samples were stored in ice filled coolers and delivered to the laboratory for analysis following all chain of custody procedures. Samples were collected routinely for analysis of total phosphorus (TP), and total dissolved solids (TDS). Samples were also collected at station L2 from one quarter the photic zone (or one half the secchi depth) for the analysis of chlorophyll-α (Chl-α). Chlorophyll-α samples were maintained in the dark, filtered within 24 hours of collection and frozen prior to laboratory analysis to prolong the holding time. While collecting samples for analysis, *in-situ* measurements pH, dissolved oxygen, specific conductivity, temperature, and turbidity were taken at one meter increments from the water's surface to the bottom of the reservoir. We considered only the data collected from within the top one meter at the two sampling locations. Table 7 summarizes the averages of these data at the two sampling locations within the reservoir in the summer and winter months.

Table 7. Averages of Summary Data (1± stdev) from Lee Creek Reservoir.

Site	Season	Temperature (˚C)	Dissolved oxygen (mg/L)	pH	Specific Conductivity (µs/cm)	Total dissolved solids (g/L)	Turbidity (NTU)	Total Phosphorus (mg/L)	Chlorophyll-α (µg/L)
L1	Summer	29.53 ± 2.08	6.13 ± 1.02	7.78 ± 0.50	106.02 ± 14.23	0.06 ± 0.02	7.15 ± 2.98	0.08 ± 0.06	-
L1	Winter	5.80 ± 2.32	11.95 ± 0.89	7.69 ± 0.57	80.12 ± 8.51	0.05 ± 0.01	14.60 ± 10.70	0.06 ± 0.05	-
L2	Summer	29.46 ± 2.06	6.18 ± 1.09	7.72 ± 0.61	105.46 ± 13.67	0.06 ± 0.02	5.08 ± 1.85	0.06 ± 0.04	12.58 ± 4.77
L2	Winter	5.80 ± 2.31	11.90 ± 0.87	7.70 ± 0.43	80.00 ± 8.88	0.10 ± 0.01	15.00 ± 10.72	0.10 ± 0.04	34.20 ± 9.01

Lee Creek Reservoir is classified as a type B lake in Arkansas according to Arkansas Department of Environmental Quality (ADEQ). The ADEQ considers small lakes in mountainous terrain to be type B. A comparison was made between Lee Creek Reservoir water quality and that of Arkansas type B lakes. ADEQ collected most of their lake samples between July 12, 1999 to August 26, 1999; therefore we will only compare Lee Creek Reservoir in the summer months with other type B lakes in Northwest Arkansas. Compared to other type B lakes in Arkansas, Lee Creek Reservoir's water temperature on average (29.5 ˚C), is slightly lower than the average, 29.7˚C, found in other type B lakes in Northwest Arkansas (Figure 13). Turbidity in Lee Creek Reservoir, 6.11 NTU, is higher than the average, 4.30 NTU, found in type B lakes in Northwest Arkansas (Figure 13). Average chlorophyll-α in Lee Creek Reservoir, 12.58 µg/L, is higher than the average, chlorophyll-α (7.60 mg/L) found in other type B lakes in Northwest Arkansas (Figure 13). Average total phosphorus in Lee Creek Reservoir, 0.07 mg/L, is higher than the average, 0.04 mg/L, found in other type B lakes in Northwest Arkansas (Figure 13). Turbidity, chlorophyll-α, total phosphorus were higher, and temperature was lower on average in Lee Creek Reservoir than other type B lakes in the Northwest Arkansas in the summer months. Elevated turbidity and chlorophyll-α levels are likely due to the shallow nature of the reservoir which allows sunlight to take its full affect on water temperature and algal growth.

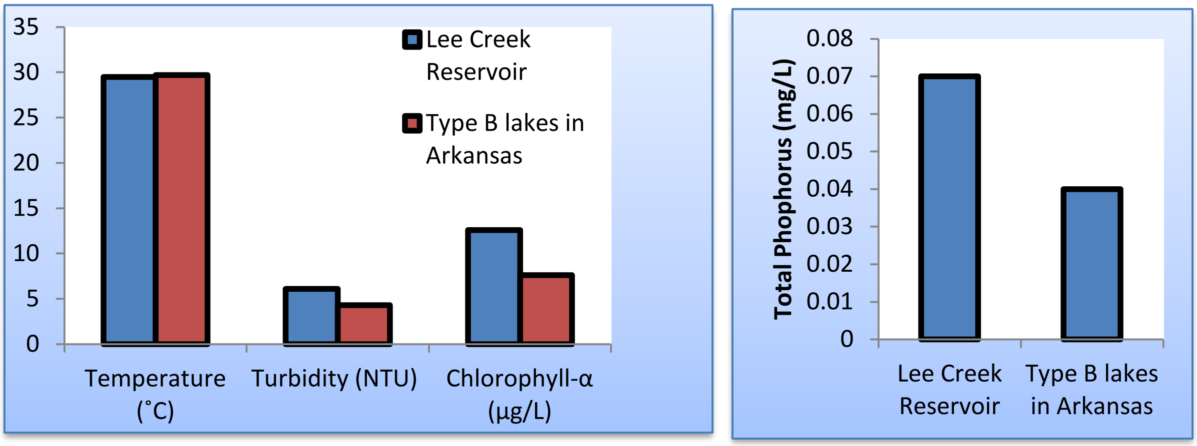

Figure 13. Comparison of Lee Creek Reservoir and other Type B Lakes in Northwest Arkansas.

Trophic Status

Lakes and reservoirs are often classified according to their trophic state index. A lake's trophic status (or trophic state index) is a measurement of how productive a lake's biota are, particularly in regard to its primary producers such as algae and aquatic plants that are found on the bottom end of the food chain. The index is based on changes in nutrient levels, which cause changes in algal biomass, in turn changing the clarity of the water. Dr. Robert Carlson developed a trophic state index for classifying lakes based on nutrient concentrations and productivity (Table 8) (Carlson, 1977). Oligotrophic lakes contain very low concentrations of nutrients that are required for plant growth; therefore oligotrophic lakes have low productivity. Newly built lakes are often classified oligotrophic as their nutrient concentrations have not yet been influenced by land use practices such as agriculture or urbanization. Oligotrophic lakes are clear watered lakes that are well-oxygenated and characterized by having low productivity. An oligotrophic lake may also be a high quality drinking water source. Mesotrophic lakes have an intermediate level of productivity, have enough nutrients within them to support submerged aquatic plants beds, and usually have clear water. Eutrophic lakes have a high productivity level that can support an abundant amount of aquatic plants and algae. If aquatic plants dominate the lake, the water tends to be clear, and if algae dominates the lake, the water tends to be more turbid. Hypereutrophic lakes are very nutrient-rich lakes; algal blooms occur often and can cause low water clarity within the lake. Hyperteurophic lakes support the most aquatic plants, fish, and other biota compared to other types of lakes in the classification system. However, these excess nutrient and plant/algae biomass may reduce oxygen levels periodically and prevent life from occurring at lower levels in the lake. Table 9 shows the Carlson trophic state index for Lee Creek Reservoir using chlorophyll-α, secchi depth, and total phosphorus.

Table 8. Carlson's Trophic State Index.

Trophic State	Oligotrophic	Mesotrophic	Eutrophic	Hypereutrophic
Range	<40	40-50	50-70	>70

We calculated trophic state index for Lee Creek Reservoir at two different sampling locations in the reservoir, during the summer (July-August) and winter (January-February) months. Lee Creek Reservoir sampling location L1 averaged, 61.78 during the summer months, which classifies the reservoir as eutrophic (Table 9 and Figure 14). At sampling location L2, the average trophic state index was 57.81 during the summer months and classifies the reservoir as eutrophic (Table 9 and Figure 14). L1 in the winter months averaged 59.06 which again classifies the reservoir as eutrophic. Data from L2 in the winter months had an average trophic state index of 51.00, classifying this location as the lower end of eutrophic (Table 9 and Figure 14). The trophic state index scored higher for total phosphorus and secchi depth but lower for chlorophyll-α (Table 9). Lee Creek Reservoir, overall, can be classified as eutrophic based on trophic state index values from the two sampling locations, L1 and L2, in both the summer and winter months. Considering the high quality of the source water into Lee Creek reservoir it is a concern that the lake is eutrophic.

Table 9. Summary of Carlson's Trophic Index Scores for L1 and L2 in the Summer and Winter Months in Lee Creek Reservoir.

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

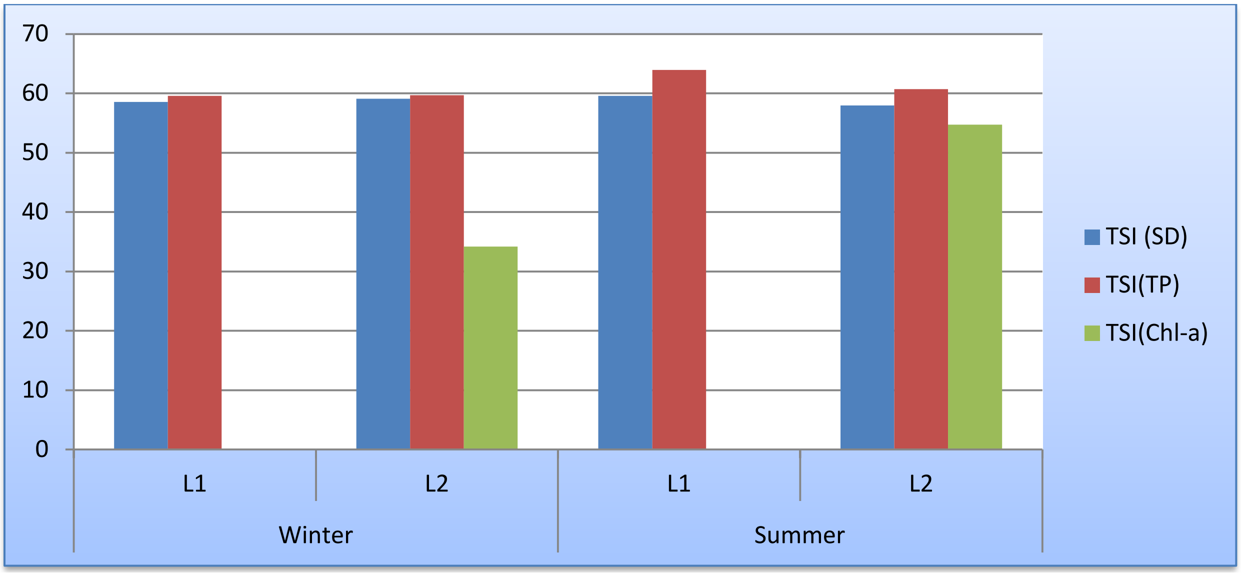

Figure 14. Average Trophic State Index in Lee Creek Reservoir in two Sampling Locations in the Summer (July-August) and Winter (January-February) Months. TSI= Trophic State Index, SD= Secchi Depth, TP= Total Phosphorus, Chl-α= chlorophyll-α.

3.3 Unified Stream Assessment

A variation of the Unified Stream Assessment (USA) protocol (Kitchel and Schueler, 2004) was completed on Lee Creek in 2012 and in each sub-watershed in 2014. This visual based field assessment protocol consists of breaking the stream into manageable reaches and evaluating, on foot or by canoe, each 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
11. Restoration/retrofit opportunities

Field data forms completed during the survey are included in Appendix C. A summary of the pertinent findings are provided in Table 10. Figures depicting impacts in the reaches assessed are provided in Appendix C. The upstream starting point of the Lee Creek assessment was at the canoe access area off Hwy 220 then downstream to the HWY 101 crossing. During 2014 a section of each major creek in each sub-watershed was assessed. In the larger sub-watersheds USA's were completed in 2 reaches and in the smaller sub-watershed a minimum of one reach was assessed. The impacts observed and their frequency of occurrence is assumed to be consistent with other comparable stream reaches in the sub-watershed. That is, stream reaches not assessed that have similar channel size to the assessed reach is anticipated to have similar characteristics and issues at a similar frequency to those of the reaches assessed. Figures 15 provides a color aerial photograph depicting the location of some of the impacts identified in reach LC-1.

Stream bank erosion, stream crossings, impacted buffers, and storm water outfalls were noted at several areas in the Lee Creek Watershed. Stream bank erosion was noted most frequently and varied in severity from moderate to excessive. Bank erosion was often times associated with pasture land uses where the riparian vegetation had also been disturbed or removed. Impacted riparian buffers (the vegetated area directly adjacent to the stream bank) were not always noted during this USA. However, riparian buffers devoid of vegetation were identified using aerial photography and were prominent in some stream reaches, particularly in Reach LC-2, WC-1, MFC-1 and CC-1. Often these impacted buffer areas are dominated by hay grasses that extended to the stream bank edge and the absence of well developed vegetated buffers (both trees and under story vegetation) along the stream (Figure 16). Riparian buffers provide streams with shading that helps cool the water and limit periphyton growth, they provide organic matter inputs which serve as food and habitat for aquatic biota, and they provide stabilization to stream banks that prevents erosion. 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).

Table 10. Summary of Pertinent Findings from the USA.

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

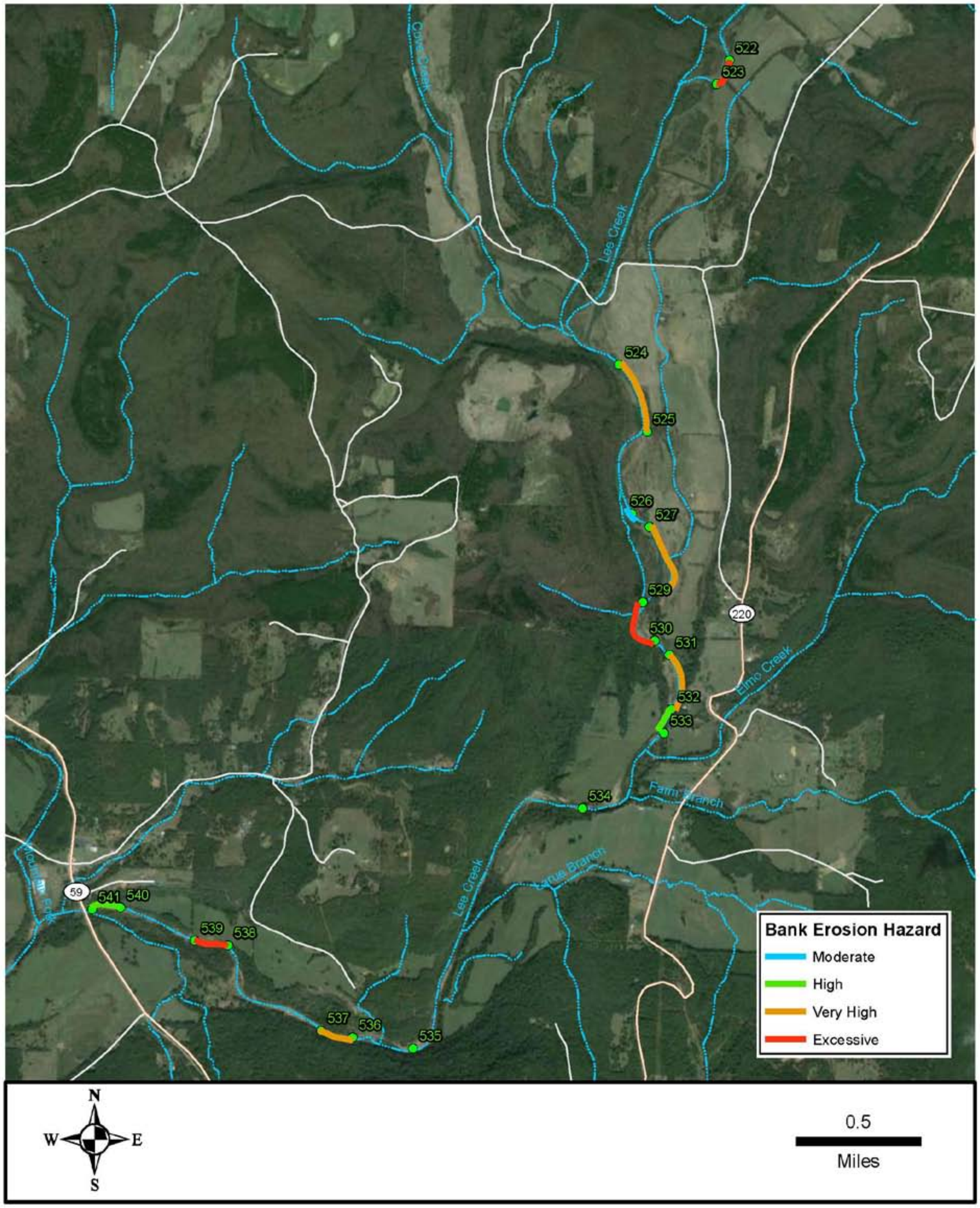

Figure 15. Locations of Selected Stream Impacts Identified During the USA in Upper Lee Creek.

Figure 16. Comparison of an Impacted Riparian Buffer (little to none) to a well developed Riparian Buffer.

Bank erosion was noted in several areas, particularly in LC-2, LLC-2, JC-1 and MFC-1. Each instance of bank erosion perceived as moderate risk or greater 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 levels are low, moderate, high, very high, and extremely high. Bank erosion observed in the Lee Creek watershed ranged from moderate active erosion and erosion hazard to extremely high (excessive) active erosion and erosion hazard. Some of the high to extremely high erosion hazard (Figure 17) was in areas where the riparian buffers had been removed and the banks were greater than seven feet high. Moderate to high stream slopes, and the gravel/cobble content of the bank soils in the Lee Creek watershed make the banks susceptible to erosion when not protected by good riparian areas. Stream bank erosion can add hundreds of tons of sediment (and nutrients) to a stream system annually. Five of the eight sub-watersheds in Lee Creek had greater than 20% of their major stream length experiencing active erosion at a moderate level or greater.

The other issues identified most frequently during the USA were storm water outfalls and stream crossings. Storm water outfalls mostly included culverts entering the creek from road side ditches or obvious drainage pathways exiting pastures (Figure 18) directly into the creek. Both types of outfalls allow for direct transport of sediment and nutrients into the stream system. Stream crossings were typically ATV/Jeep trails and can also serve as a conduit for storm water much like a storm water outfall. Stream crossings also can be sites of active channel erosion due to the crossing of motorized vehicles that impact the stream banks and channel substrates.

Figure 17. Stream Banks with Very High Bank Erosion Hazard in Lower Lee Creek.

Figure 18. Typical Storm Water Outfall from Pasture in Lee Creek.

3.4 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 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 the entire Lee Creek Watershed 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 11 provides a summary of the channel dimensions estimated (and some measured) during the USA as well as key stability issues noted.

Table 11. Summary of Geomorphic Characteristics.

Parameter (approximate/estimated)	Station Identification								
	LC-1	LC-1.5[1]	LC-2	LLC-1	LLC-2	WC-1	JC-1	MFC-1	CC-1
Watershed size (mi^2)	97.2	191.0	216.0	36.2	119.0	37.9	14.9	39.6	53.7
Bankfull depth (ft)	2.8	3.5	4.0	1.4	4.0	1.8	1.4	2.0	2.4
Bankfull width (ft)	128	110	195	75	150	80	57	68	58
Substrate size class	Cobble	Cobble	Cobble	Cobble	Cobble/ Gravel	Cobble/ Gravel	Cobble	Cobble/ bedrock	Cobble
Width: Depth ratio	46	31	49	54	38	44	41	34	24
Overall stream bank erosion hazard	Moderate	Moderate	Moderate-High	Moderate	High	Moderate	High	Moderate-High	Minor-Moderate
Channel stability issues	Minor bank scour and failure	Minor bank scour and failure	Minor bank scour and failure, sediment deposition	Widening	Widening Scour	Widening	Widening Headcut Scour	Widening Headcut Scour Bank Failure	Minor Widening

[1] Station LC-1.5 is not a sub-watershed or sample station utilized in the majority of this report. It is typically combined into LC-2.

Lee Creek's main channel was found to have a moderate level of bank erosion overall. The lower reach (LC-2) displayed more pronounced bank erosion than the upper reaches. The channel displayed some minor signs of channel widening, bank scour, bank failure, and sediment deposition but no major problems with degradation (channel deepening) or aggradation (channel filling, shallowing) were noted.

3.5 Ecological Condition

Monitoring of aquatic communities is a vital component to understanding potential perturbations to water and habitat quality. The condition of aquatic communities (abundances, diversity, richness, sensitivity, and biological index, etc.) provides important insight regarding water body health and is useful when assessing the aquatic life (fisheries) status of a water body. Macroinvertebrate communities have been sampled by FSU personnel since 2003 at multiple locations in the Lee Creek watershed as part of their routine watershed monitoring program. Collection and analysis methods generally followed EPA's Rapid Bioassessment (RBA) protocols (Barbour et al. 1999). Samples are collected using surber samplers and three sub-samples are collected at each sample station, composited in the laboratory, and analyzed to determine community metrics. Fish communities were sampled in the Lee Creek watershed from 2002 to 2013 using electroshocking methodology based on EPA's RBA protocols (Barbour et al. 1999). Fish samples were analyzed to determine community metrics typically associated with fish bioassessment and to calculate an index of biotic integrity (Plafkin, 1989). Data from the more recent collections of both macroinvertebrates and fish will be the focus of this evaluation.

3.5.1 Macroinvertebrate Community

Benthic macroinvertebrates inhabit the sediment or live on the bottom substrates of streams, rivers and lakes. The presence of these organisms and their diversity and tolerance to environmental perturbation at an expected level reflects the maintenance of a systems biological integrity. Monitoring these assemblages is useful in assessing the aquatic life status of the water body and detecting trends in ecological condition.

Several macroinvertebrate metrics are calculated for the collections completed by FSU. These metrics include: taxa richness and Ephemeroptera, Plecoptera, Trichoptera (EPT) richness, average tolerance, and percent clingers. Several of the metrics calculated are used to determine a stream condition index (SCI) originally developed by the National Park Service (NPS) for National Scenic Riverways (Bowles, 2007).

Taxa richness and EPT richness of Lee Creek stations have shown a general trend for increasing from 2003 to 2011. Taxa richness has increased from 17-24 species in 2003 to 24-40 species in 2013. In 2003, EPT richness ranged from 5-13 species, increasing to an EPT richness of 12-16 species in 2013 (Table 12). All of the taxa and EPT richness values score above the quartile of the NPS SCI data. Higher taxa richness indicates good water quality and sufficient habitat diversity. High numbers of EPT taxa are sensitive to pollutants, therefore, high richness of these taxa indicate higher water quality. Rather than using the NPS SCI for routine monitoring, FSU developed their own SCI using the same methodology that the NPS used. The FSU SCI uses four metrics (taxa richness, EPT richness, tolerance and percent clingers) are each scored independently as either a 5, 3, or 1 depending it's comparison to the reference condition (Table 13). A total score (sum of all four metric scores) between 16 and 20 indicates a community that is unimpaired and is fully maintaining all designated uses. The SCI scores calculated for Lee Creek stations ranged from 12 to 20. The majority of years and streams were in the unimpaired range, 16-20. The year 2012 scored low when compared to other years but the communities seemed to have recovered in 2013. The scores in 2013 ranged from 14-20, with only one stream, Buckhorn Creek, scoring 14, all other streams are considered unimpaired and maintain designated uses. Buckhorn Creek is a water quality reference station in the Lee Creek Watershed. However, it is a first order stream and is also a very small watershed that dries up each year and does not have as developed habitat as does the larger streams. Climatic conditions could have had a large impact on the biotic communities in 2012. In May and June of 2011, very high flood events occurred. Following what is assumed to be a 100 year storm event which resulted in a large scour to the biota was an extreme drought period. These climatic conditions could have been detrimental to the macroinvertebrate communities, explaining the low SCI scores for 2012. However, in 2013 the communities seem to be recovering and future sampling periods will hopefully show a return to the conditions prior to 2012 (Table 13).

Table 12. Comparison of SCI Metrics for First Quarter Samples from Lee Creek Watershed.

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

Table 13. Comparison of SCI Scores for First Quarter Samples from Lee Creek Watershed.

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

3.5.2 Fish Community

Fish communities of Lee Creek watershed were examined using community tolerance structure, percent dominant functional feeding groups, and IBI scores for fishes collected by FSU from 2008 to 2013. Based on available data, fish communities were dominated by species intermediate and intolerant to pollution perturbation (Table 14). Data indicate community tolerance structure may represent relatively sensitive fish communities within the Lee Creek watershed. Fish communities of Lee Creek have been consistently dominated by insectivores (50%-82%; Table 14). Fish communities are typically dominated by insectivorous fishes in most North American waters (Barbour et al. 1999). Using percent insectivorous fishes in a community provides information regarding the condition of the fish food base. As the fish food base responds to changes in the quality and quantity of available resources (natural or anthropogenic), changes in the functional feeding structure of fish communities are expected to occur (Barbour et al. 1999). Index of biotic integrity (IBI) scores were calculated using 12 metrics taken from Rapid Bioassessment Protocols for Use in Stream and Rivers (Plafkin, 1989) Metrics included: percent native fishes, percent darters and madtoms, percent sunfish, percent cyprinids, percent tolerant fish, percent omnivores, percent insectivores, percent carnivores, number of individuals, percent hybrids, and percent diseased. Scores for all 12 metrics are then added and results ranged from a possible maximum IBI score of 60 (excellent) to a possible minimum of 12 (very poor).

IBI scores from the watershed varied across sites and across years and ranged between a minimum of 38 to a maximum of 50. Using Fort Smith’s IBI criteria, which is based on the criteria developed by EPA (Plafkin, et.al., 1989), fish communities of Lee Creek watershed fluctuate within the fair to good range (48 points is the threshold for the good category), and have remained relatively stable over time (Table 14). Generally the smaller streams in headwater areas of the watershed have scored lower than the larger more developed streams in the watershed. This is typical of small streams in smaller drainage areas where there is less perennial flow and less diverse habitat to support high quality perennial fisheries.

Table 14. Comparison of Fish Community Tolerance Structure, Functional Feeding Groups, and IBI Scores Among Stations within Lee Creek and Lee Creek Watershed for 2008-2013.

Sites	Year	% Intolerant Taxa	% Intermediate Taxa	% Tolerant Taxa	% Insectivore	% Herbivore	% Other	IBI
Fall Creek	2008	23.1	61.5	15.4	69.2	7.7	23.1	48.0
	2010	46.2	46.2	7.7	69.2	15.4	15.4	50.0
	2011	20.0	60.0	20.0	70.0	10.0	20.0	44.0
	2012	33.3	50.0	16.7	75.0	8.33	8.33	48.0
	2013	30.0	40.0	30.0	70.0	10.0	20.0	44.0
Buckhorn Creek	2008	16.7	50.0	33.3	50.0	16.7	33.3	40.0
	2010	21.4	35.7	7.1	57.1	7.1	35.7	42.0
	2011	33.3	44.4	22.2	77.8	11.1	11.1	44.0
	2012	30.0	50.0	20.0	80.0	10.0	10.0	42.0
	2013	28.6	28.6	42.9	57.0	14.3	14.3	38.0
Cove Creek	2008	---	---	---	---	---	---	---
	2010	27.3	45.4	9.1	72.7	9.1	18.2	46.0
	2011	40.0	50.0	10.0	80.0	10.0	10.0	48.0
	2012	40.0	40.0	20.0	80.0	10.0	10.0	46.0
	2013	27.3	54.5	18.2	72.7	9.1	18.2	46.0
Mtn. Fork Creek	2008	30.1	46.2	23.1	76.9	7.7	15.4	44.0
	2010	45.5	36.4	18.2	72.3	18.2	9.1	44.0
	2011	38.5	38.5	23.1	61.5	15.4	23.1	48.0
	2012	33.3	41.6	25.0	75.0	8.3	16.6	.0
	2013	36.4	45.5	18.2	81.7	9.1	27.3	46.0
Jenkins Creek	2013	22.2	56.1	11.0	66.7	11.0	11.0	44.0
Upper Lee	2013	26.7	46.7	26.7	73.3	6.7	26.7	44.0

Summary

Overall, macroinvertebrate and fish communities within Lee Creek watersheds seem to be relatively diverse and stable compared to reference conditions. Although community metrics varied across sites and years, all macroinvertebrate communities have either remained stable or shown a general trend for increased quality. Over the years, all fish communities have been dominated by intermediate and intolerant species, insectivorous fishes, and calculated IBI scores were within the fair to good range. Based on fish and macroinvertebrate metrics evaluated the aquatic community appears to be maintaining its biological integrity with relatively sensitive and diverse communities throughout the Lee Creek watershed.

3.5.3 Periphyton Community

Periphyton are algae that live attached to bottom substrates in streams, rivers and lakes. They are the foundation of the food web in most aquatic systems and as such are referred to as primary producers. The abundance and diversity of periphyton may serve as an indicator of habitat suitability and water quality, particularly in regards to nutrient enrichment and energy availability.

The periphyton community was assessed in a qualitative fashion as part of the USA. Estimates of algal coverage were made in each reach for three groups of algae; filamentous, prostrate and floating. The results of the qualitative observations are provided in Table 15.

Table 15. Summary of Periphyton Abundance (coverage) Assessment.

Station	Filamentous	Prostrate	Floating
LC-1	None	Moderate	None
LC-1.5	None	Sparse	None
LC-2	None	Sparse	None
LLC-1	Sparse	Moderate	None
LLC-2	Sparse	Moderate	None
WC-1	None	Moderate	None
JC-1	None	Moderate	None
MFC-1	Abundant	Abundant	None
CC-1	Sparse	Abundant	None

Periphyton (filamentous and prostrate) requires four main things to grow, light, nutrients, warmth, and a suitable substrate. Nutrient levels are fairly low in the Lee Creek Watershed; however, there is still ample phosphorus and nitrogen for algal growth. The water is clean and clear allowing for plenty of light penetration. Arkansas' mild climate allows for algal growth nearly anytime during the year, but the hot summers are still expected to create the best conditions for proliferation of periphyton. The cobble streambed that dominates in the Lee Creek watershed are a good substrate for growth of these algae. In spite of the sufficient nutrient levels and good habitat, periphyton growth was not found to be excessive in any sub-watershed, with the exception of MFC, where both filamentous and prostrate algae were abundant. MFC has a large amount of bedrock substrate and more open areas for sunlight penetration resulting in ideal conditions for periphyton growth (Figure 19.)

Figure 19. MFC Bedrock Stream Bottom Promotes Algal Growth.

3.5.4 Habitat for Aquatic Biota

Physical habitat in streams includes all those physical characteristics that influence or provide sustenance to biological attributes, both botanical and zoological. Stream physical habitat varies naturally, as do biological characteristics; thus, habitat conditions differ even in the absence of point and anthropogenic non-point disturbance. Within a given ecoregion, factors such as stream drainage area, stream gradient, and geology (geomorphology) are likely to be strong natural determinants of many aspects of stream habitat, because of their influence on discharge, flood stage, and stream energy (both static and kinetic). In addition, land-use activities or in-stream physical modifications, such as channelization, channel diversion or dam construction directly or indirectly impact the habitat in a stream. Habitat for aquatic biota was visually evaluated as part of the USA. The stream reaches assessed during the USA appeared to offer good habitat for aquatic biota. Riffles accounted for a significant portion (>15%) of each reach and pools dominated in the lower reaches while runs dominated in the upper reaches. Cobble substrate was generally dominate in all reaches assessed and offers good refugia for macroinvertebrates and benthic fish species. Boulders and woody debris was also common and offers additional habitat for larger fish. Riparian areas were generally forested with a significant amount of pasture in some areas particularly in lower Lee Creek. The habitat in Lee Creek and in each of its major sub-watersheds is sufficient to maintain biological diversity and a good quality perennial fishery.

3.6 Hydrologic Analysis

The hydrologic regime of a stream (magnitude and frequency of flow) 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. Understanding a stream's hydrology is integral to the assessment of stream stability, ecology and water quality.

Historical Streamflow Analysis at USGS Gauges

Streamflow in the Lee Creek watershed was analyzed using data from the United States Geological Survey (USGS) website (http://waterdata.usgs.gov/nwis/rt). USGS has gauging stations at three stream locations in the Lee Creek watershed, Lee Creek at Short (USGS No. 07249800, Lee Creek near Short (USGS No. 07249985) and Little Lee Creek near Nicut (USGS No. 07249920). Lee Creek at Short, is at monitoring station LC-2, Little Lee Creek near Nicut is at monitoring station LLC-2. Lee Creek near Short is below all monitoring stations and represents the majority of flow entering Lee Creek Reservoir. We compiled and analyzed the most recent 10 years of annual summary and daily data from the USGS for each of the three locations of interest in the Lee Creek watershed (Table 16). The annual summary and daily data from USGS provides the annual average discharge (cfs), lowest average monthly discharge (cfs), highest average monthly discharge (cfs), the seven-day average low flow (cfs), 90 percent exceedance (cfs), and the peak flow (cfs). The 90 percent exceedance statistic is the discharge that has been exceeded 90 percent of the time for the designated period, which in this case is 10 years.

Each stream gauge in the Lee Creek watershed displayed a seven-day low flow of zero, indicating that for at least seven consecutive days the streams average flow was 0 cfs at one point during the last 10 years (Table 16). Stream water becomes shallow when flows get low, increasing water temperatures, and decreasing dissolved oxygen levels which has the potential to impact fish and some macroinvertebrates. Studies have found that longer-lived more sensitive taxa such as stoneflies, and free-living caddisflies are less likely to proliferate in streams that dry seasonally. Taxa that are highly mobile or can withstand drying can recolonize a stream more quickly and can be found in seasonally dry streams. Adequate water levels are essential to maintenance of healthy fish communities. Streams that have a history of drying seasonally have biotic communities that are adapted to drying, living in intermittent pools, or finding refugia in the hyporheic zone. Streams that dry seasonally may have less diverse, less sensitive taxa depending on the longevity and severity of the drying compared to streams that flow year around (Boulton, 2003).

Table 16. Summary of Discharge Data from September 2004-2014, Collected from USGS Gauge Data.

Site	Annual average discharge (cfs)	Lowest monthly discharge (cfs)	Highest monthly discharge (cfs)	7 day low flow (cfs)	90% exceed	Peak flow (cfs)
Lee Creek near Short (LC-1)	553.8	0.15	4047.8	0	2.5	13,969
Lee Creek at Short (LC-2)	298.5	0.00	2527.6	0	1.3	8,903
Little Lee Creek 2	114.8	0.03	654.7	0	1.0	6,160

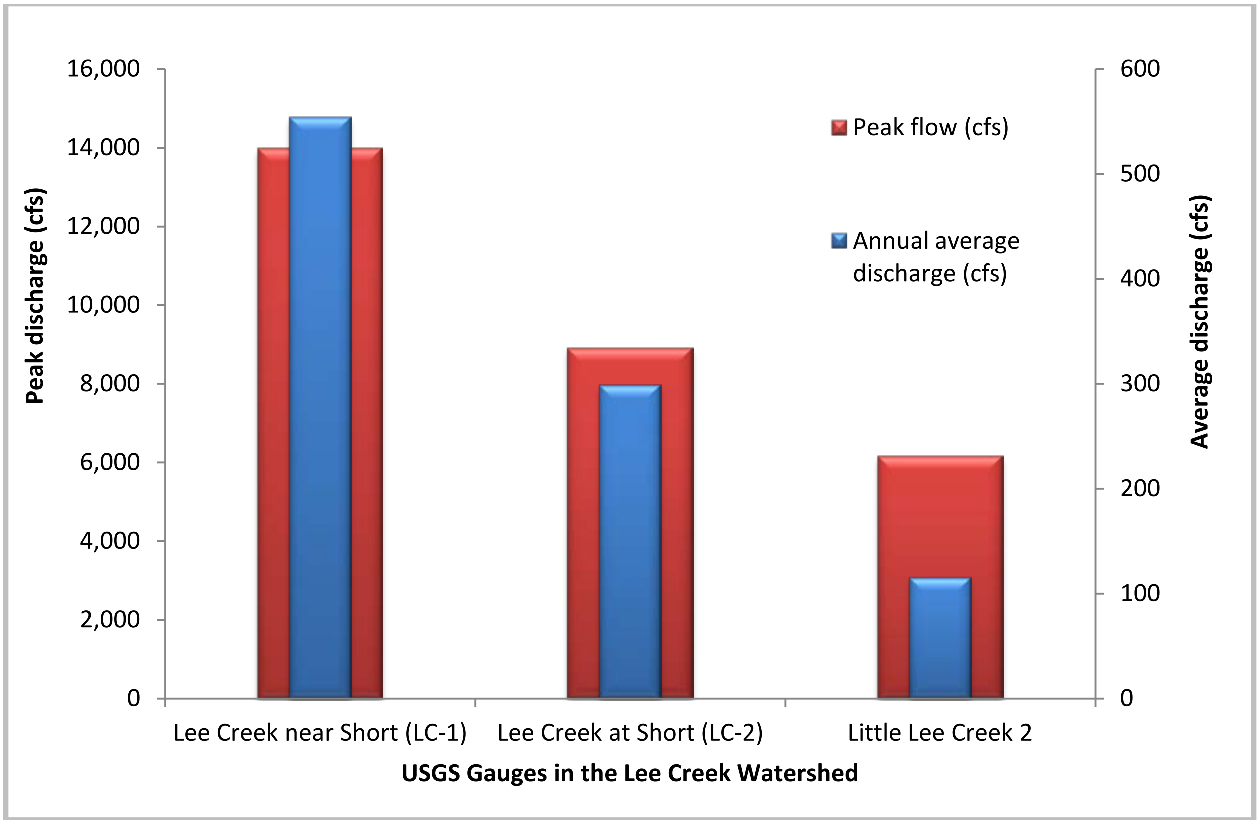

Figure 20. Comparison of the Annual Average and Peak Flows of the Study Sites in the Lee Creek Watershed.

All three study streams have a peak flow at least an order of magnitude higher than the annual average discharge (Figure 20). The Lee Creek watershed has a moderate level of pasture land use with the majority of the land being forested. Pasture land use can typically influence streamflow through an increase in runoff from the pasture compared to runoff from forest. Although streams in the Lee Creek watershed have a notable level of pasture land use surrounding the streams, the majority of the watershed is mountainous-forested land. The topography may be influencing the hydrologic regime more than pasture land use. Mountain streams are usually considered to be flashy systems or systems that have rapid rates of change (Allan, 1995, Poff et. al, 1997). Figure 21 shows the flashy hydrograph of Little Lee Creek at Nicut, Oklahoma during a storm event. Streamflow increases by an order of magnitude in less than one day. Little Lee Creek rises quickly but the hydrograph shows that it drops slower than it rose and could be a consequence of the steep terrain and well drained soils. This hydrograph is fairly typical of Boston Mountain streams during runoff events.

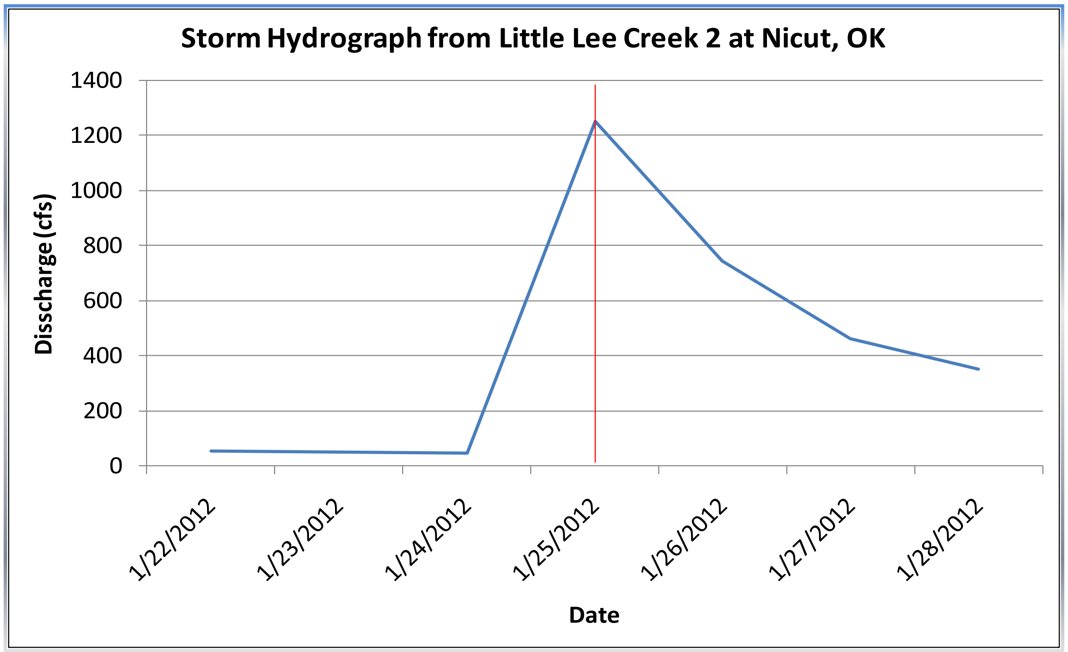

Figure 21. Storm Hydrograph from Little Lee Creek at Nicut, Oklahoma (LLC2) on January 25, 2012. Hydrograph Data was Collected from USGS.

Hydrologic regime is a major determinant of physical form in streams and physical form is a major determinant in biotic diversity in streams (Bunn and Arthington, 2002). Biological communities are adapted to the historical flow conditions and these conditions should be considered when analyzing biological data in any watershed.

Stream Flow Analysis at Newly Installed Gauges on Major Tributaries

Five new gauging stations were installed in key sub-watersheds Weber Creek, Upper Lee Creek, Jenkins Creek, Cove Creek, and Mountain Fork Creek in October 2013. The gauging instrument installed was an In-situ Level Troll 500 which automatically records stream level at 15 minute intervals. Telemetry stations were also installed at three of the gauges at varied locations in the overall watershed. Each level Troll was maintained and data was downloaded throughout the year.

Instream flow measurements were manually collected at the gauging station by a field crew during baseflow and stormflow events as part of an effort to develop a relationship between stream level and rate of flow. Instream velocity was measured using a Marsh McBirney model 201 water current meter. Measurements were taken following protocols outlined in the GBM^c & Associates Quality Assurance Plan (GBM^c QAP, 2008). Flow calculations were completed using the velocity-area method. Three to five flow readings were collected at each gauging station for use in development of the rating curve (Figure 22). The curve will continually be updated as additional data is collected in subsequent monitoring years.

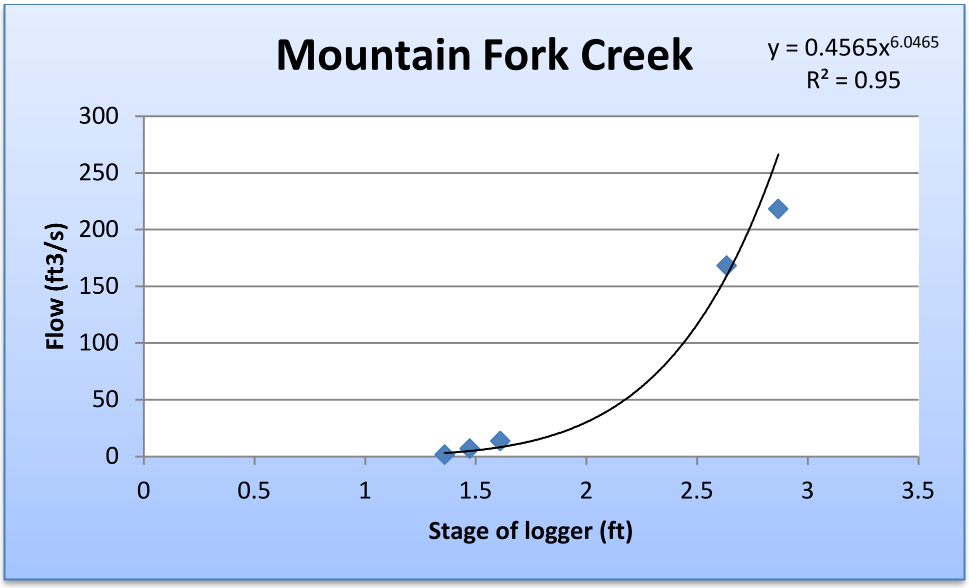

Figure 22. Relationship of Stage versus Flow at Mountain Fork Creek Gauging Station.

Once the rating curves were established at each site, the equation from each rating curve was used to calculate the flow from the level measurements collected every 15 minutes at the five sites. This flow data allows pollutant loading to be calculated more effectively for each sub-watershed. When graphing the flow data over time, hydrologic dynamics such as flashiness can be seen visually. For specific rain events, the rise and fall can be dramatically different across the sub-watersheds (Figure 23). For Figure 23, flow was averaged for each day and plotted.

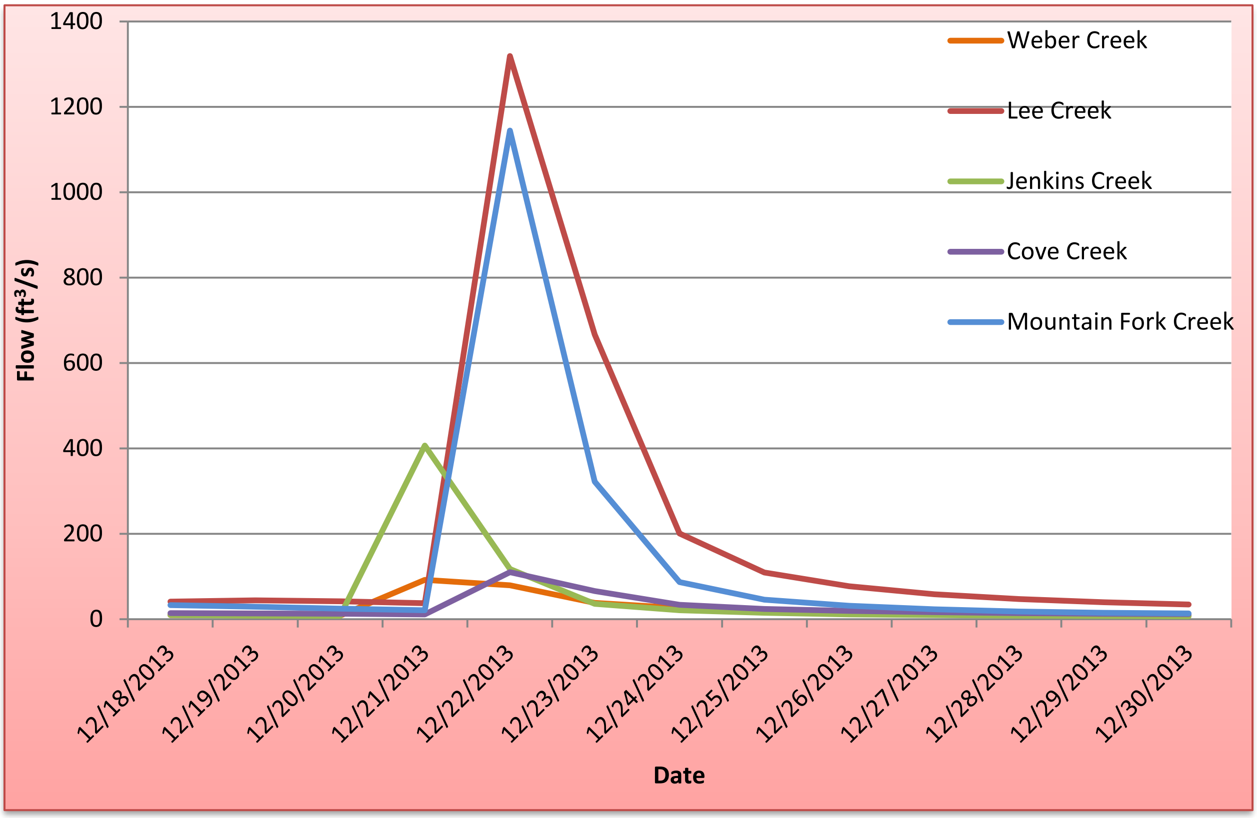

Figure 23. Daily Average Flow for the Five Sub-Watersheds.

3.7 GIS Non-point Source Assessment

An assessment of the Lee Creek watershed was completed using GIS resources including soils maps, land surface slope (DEM), land use, aerial photographs, etc. The assessment was focused on identifying possible non-point sources of pollutants that could be transported to the stream system during storm runoff events. The assessment was completed on a sub-watershed basis.

3.7.1 Land Use by Watershed

Land use was evaluated using 2006 land-use land cover data from the United States Geological Survey. Land use is an important attribute in a watershed analysis. The percent of pasture, row crops, and developed areas can provide great insight into a watersheds potential for NPS pollution. A summary of the land use assessment is provided in Table 17.

Table 17. Percent Land Use by Sub-Watershed.

Land use	Sub-watershed (Percent land use)							
	JC-1	LLC-1	LLC-2	LC-1	LC-2	CC-1	MFC-1	WC-1
Watershed Size (mi^2)	14.90	36.20	119.00	97.20	242.00	53.70	39.60	37.90
Water	0.04	0.02	0.08	0.06	0.59	0.01	0.01	0.08
Open space (developed)	3.08	3.32	2.34	2.63	2.07	2.24	2.57	4.01
Developed (urban/suburban)	0.05	0.09	0.06	0.07	0.03	0.02	0.04	0.44
Forest	78.28	73.14	80.43	84.78	77.60	84.02	84.40	65.82
Herbaceous/Scrub/Shrub	12.09	5.02	12.36	2.20	4.92	2.09	4.23	2.40
Pasture	6.46	18.39	4.40	9.97	13.57	11.54	8.62	27.27
Crops	0.00	0.00	0.00	0.02	0.03	0.00	0.00	0.01
Wetlands	0.00	0.02	0.33	0.28	1.18	0.09	0.13	0.05

None of the sub-watersheds have significant levels of row crops (all less than 0.05%) or development (less than 0.5%). Four of the sub-watersheds (JC-1, LLC-2, LC-1 and MFC-1) have low percentages of pasture (less than 10%). Pastures are generally associated with cattle use, commercial fertilizer, poultry litter use as fertilizer, or any combination of the three. Each association can be a source of nutrients to the stream system. The portions of the watershed having the highest percentage of pasture are LLC-1 and WC-1, at 18.39% and 27.27%, respectively.

3.7.2 Riparian Buffer Impacts

Often times pasture land use can be associated with impact to riparian buffers as farmers clear forest to create larger pastures and as cattle grazing encroaching on the stream banks. Impacts from cattle overgrazing and frequent stream access was assessed during the USA’s and were not found to be an obvious problem in the watershed. However, impacted riparian buffers from pasture creation (and loss of buffer from bank erosion) were found to be a common problem. Therefore, each main stem perennial stream (identified per USGS maps) in the associated sub-watershed was examined through aerial photography to determine how many linear feet of stream was affected by loss of riparian buffer. These lengths were then divided by the total length of perennial stream in that sub-watershed to represent percent of stream with impacted riparian buffers and assess where significant problems might exist (Table 18).

Table 18. Summary of Impacted Riparian Buffer Analysis.

Parameter	Sub-watershed							
	JC-1	LLC-1	LLC-2	LC-1	LC-2	CC-1	MFC-1	WC-1
Length impacted buffer (ft)	626	3662	4085	3240	20,122	11,429	7875	7603
Total stream length (ft)	28,987	64,776	52,318	121,434	115,737	99,000	66,685	51,215
Percent stream affected	2.2	5.7	7.8	2.7	17.4	11.5	11.8	14.8

Jenkins Creek (JC-1) and upper Lee Creek (LC-1) have small percentages of impacted riparian buffer (<3%) while the lower reaches of Lee Creek (LC-2) and Webber Creek (WC-1) have considerably higher percentages, at 17.4% and 14.8%, respectively. This is fairly common in watersheds that have greater percentages of pasture and riparian disturbance in their lower reaches, where the land begins to flatten allowing for more land suitable for pasture.

3.7.3 Land Slope

A land slope analysis was also completed for the watershed, and is provided in Table 19. Slopes are generally homogenous between sub-watersheds. Weber Creek has the flattest slope and the highest percentage of pasture and impacted buffer, supporting the concept that pasture abundance and size increases along with the associated riparian disturbance in flatter slope areas lower in the watershed. In addition to the connection between flatter slopes and increased pasture land use, there is a connection between steeper slopes and increased erosion potential, both on the land and stream banks. 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 run-off into the stream channels which can cause increased stream bank erosion and channel scour. Slope in the majority of the headwaters of Lee Creek are moderately high, providing the potential for rainfall to be highly erosive and stream channels to scour during large rain events.

Table 19. Summary of Land Slope Analysis.

Slope (percent)	Sub-watershed							
	JC-1	**LLC-1**	**LLC-2**	**LC-1**	**LC-2**	**CC-1**	**MFC-1**	**WC-1**
0-5	12.9	23.4	12.2	12.6	23.5	15.4	21.3	25.9
6-15	10.8	11.0	0.3	23.8	13.6	25.5	17.9	29.8
16-30	66.2	59.9	87.5	62.0	56.9	54.8	58.2	44.1
31-45	10.1	5.8	0.0	1.2	6.1	4.4	2.6	0.3
46-60	0.0	0.0	0.0	0.4	0.0	0.0	0.0	0.0

3.7.4 Soils

Soils on the land surface in the watershed are primarily dominated by the Nella, Enders, Hector and Linker soil series. These soils are composed mostly of a gravely sandy loam, and have a moderate overall potential for erosion. However, when linked with the steep slopes in some of the sub-watersheds, significant soil loss can occur during heavy rain events.

3.7.5 Agricultural Animal Numbers

Numbers of agricultural animals were estimated in the watershed using active poultry house counts from a field survey and the county agricultural census data for cattle. In the case of poultry houses, each broiler house is assumed to be managed consistent with industry standards. 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 and Oklahoma and its use was observed in the Lee Creek watershed during the USA. 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. Cows were assumed to be evenly spread out over the pastures in the counties affected. A cows/acre number was then applied to each sub-watershed using the number of acres of pasture determined through the land use analysis. Where a sub-watershed occupied more than one county the value for cows/acre was weighted proportional to the amount of the sub-watershed in each county. Agricultural animal estimates is provided in Table 20.

Table 20. Agricultural Animal Estimates per Sub-Watershed.

Animal	Sub-watershed							
	JC-1	LLC-1	LLC-2	LC-1	LC-2	CC-1	MFC-1	WC-1
All Cattle/Calves	226	1,561	516	3,284	1,738	2,022	940	2,979
Poultry-Broilers[1]	0	0	0	48,000	0	288,000	0	120,000

[1] Poultry numbers based on total number on active farms at a point in time, not total produced annually. Cattle numbers are typical for this region. Poultry counts under 200,000 are low for Crawford County, while counts in excess of 200,000 are more typical.

3.7.6 Unpaved Roads

Unpaved roads (gravel forest roads and OHV trails) are common in the Lee Creek Watershed. There are over 300 miles of unpaved roads in the watershed. During storm events these roads can transport significant loads of sediment into adjacent streams (Figure 24). 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. Forest roads can be designed to include BMPs that reduce erosion and transport of sediment.

Figure 24. Sediment Plume entering Cove Creek from Unpaved Road Runoff.

Miles of unpaved road were determined from GIS road layers for each sub-watershed in Arkansas. Similar data could not be identified for Oklahoma so the miles of unpaved roads in Oklahoma was estimated based on density encountered in Arkansas. A summary of this data is provided in Table 21. 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 (Penn State University). 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. For purposes of the Lee Creek Watershed 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 of the 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 21).

Table 21. Summary of Unpaved Roads in Lee Creek Watershed.

	JC-1	LLC-1	LLC-2	LC-1	LC-2	CC-1	MFC-1	WC-1
Unpaved Roads (mi)	13.7	33.3	110.0	51.3	140.5	25.6	31.6	63.9
TSS Load Annually (lbs)	79,877	194,063	640,087	298,765	817,594	148,701	183,380	371,612
Adjusted Load[1] (1000s lbs)	79.9	194.0	446.0	298.8	518.8	148.7	183.8	371.6

[1] Adjusted load in 1000s lbs better represents the larger watersheds portion by subtracting out the load form the upper watershed (i.e. LLC-2 minus LLC-1, and LC-2 minus LC-1).

4.0 Loading Analysis

4.1 Delineation of Lee Creek Loads

Loading of pollutants in the Lee Creek watershed was calculated from the baseline and storm flow data collected during the study. Loading was also calculated from the historical data collected by the FSU at monitoring stations where USGS gauge data was available. However, only three sub-watersheds of the eight in the Lee Creek watershed are represented by USGS gauge stations (LC-2, LLC-2 and WC-1). Therefore, the focus of the loading analysis will be the new data collected during this study. A summary of the load for key constituents is provided in Table 22.

Table 22. Average Loading of key constituents.

Station	Baseline Load (lb/d)			Storm Flow Load (lb/d)		
	TSS	NO3+NO2-N	TP	TSS	NO3+NO2-N	TP
JC-1	540	40.7	2.2	37,312	172	38.7
LLC-1	1,184	112	7.9	11,470	181	103
LLC-2	3,946	278	26.9	609,407	1,318	931
LC-1	3,739	299	31.0	330,388	1117	772
LC-2	5,940	531	55.4	241,026	2,030	675
WC-1	1,177	82.7	7.8	31,567	372	94
CC-1	2,344	143	19.2	76,655	572	352
MFC-1	1,416	101	10.8	276,478	895	666
BH-1	---	---	---	706	44	3.84

The load of TSS appears to be greatest in the sub-watersheds LC-1, MFC-1 and LLC-2. Loading of Nitrate+Nitrite-N and phosphorus appears to be greatest in the LC-2, LC-1 and LLC-2 sub-watersheds. However, loading viewed in this fashion is misleading when used to assess critical NPS that need to be addressed, as some of the sub-watersheds are much larger than others and thus will have greater flows which have a direct influence on load. In order to account for watershed size, loads from each of the sub-watersheds were normalized according to watershed area (in acres) to arrive at a loading in each watershed on a per acre basis (Table 23).

Table 23. Loading of key storm flow constituents on a per acre basis.

Station	TSS (lb/acre)	NO3+NO2-N (lb/acre)	TP (lb/acre)
JC-1	3.913	0.0181	0.0041
LLC-1	0.495	0.0078	0.0045
LLC-2	7.9749	0.0172	0.0122
LC-1	5.311	0.0180	0.0124
LC-2	1.557	0.0131	0.0044
WC-1	1.301	0.0153	0.0039
CC-1	2.23	0.0167	0.0097
MFC-1	10.909	0.0353	0.0263
BH-1	0.19	0.0120	0.0010

When loading is evaluated on a per unit area basis, then it becomes clear which sub-watersheds have land uses that are producing the most pollutants during runoff events. Sub-watersheds MFC-1, LLC-2, and LC-1 have the highest TSS storm flow load and sub-watersheds MFC-1, LC-1, and LLC-2 have the highest nutrient loads per acre of land (Figures 25 and 26).

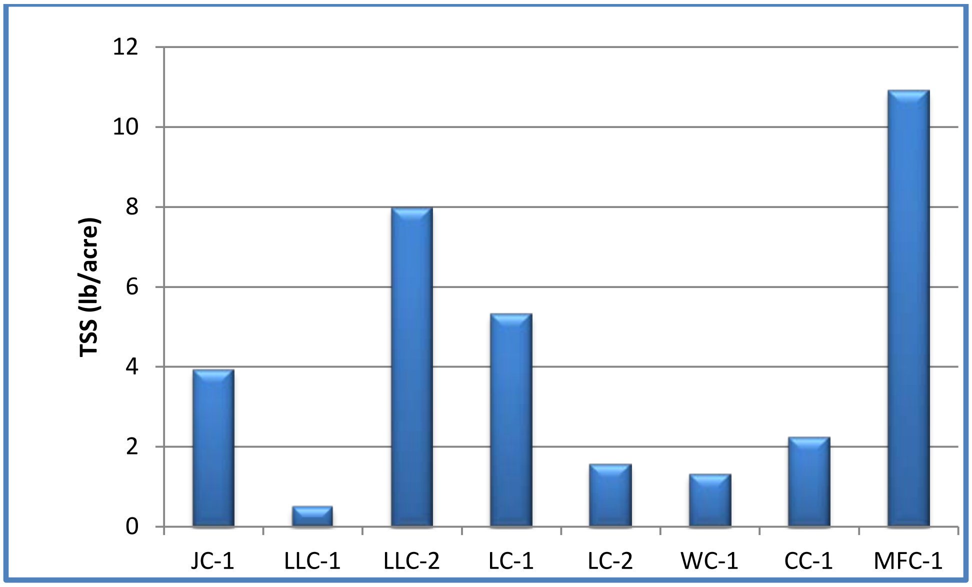

Figure 25. Storm flow load of TSS in pounds/acre.

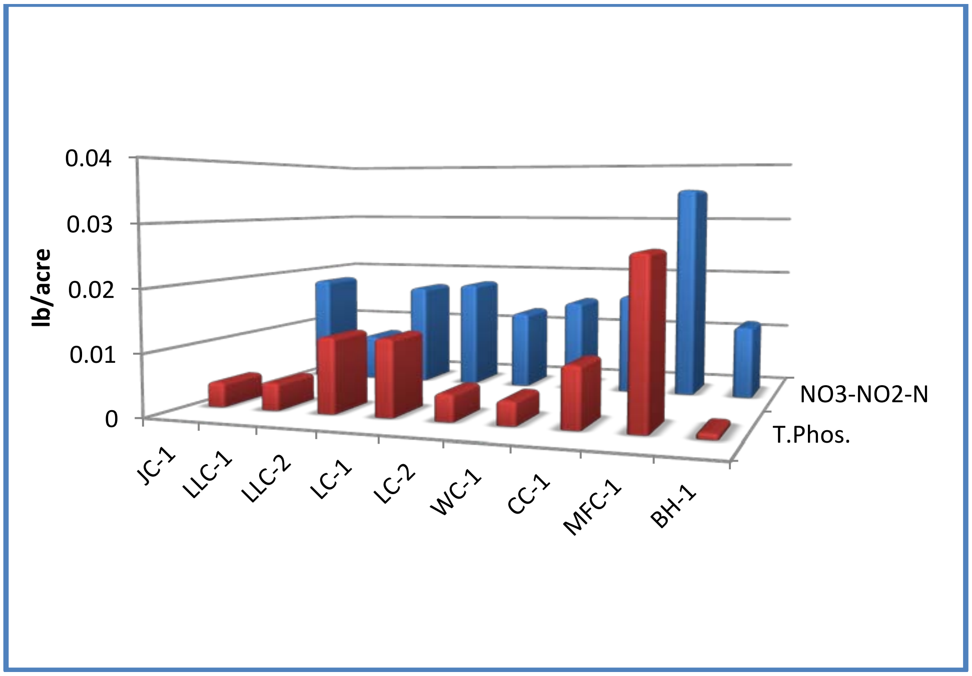

Figure 26. Pounds of storm flow nutrients on a per acre basis.

Figure 27 provides a breakdown of the portion of TSS load attributed to each sub-watershed. Load reductions will be targeted for the sub-watersheds identified (LC-1, LLC-2 and MFC-1). Load reductions will be accomplished accordingly for these key sub-watersheds as well as other sub-watersheds according to the plan outlined in Sections 5 and 6.

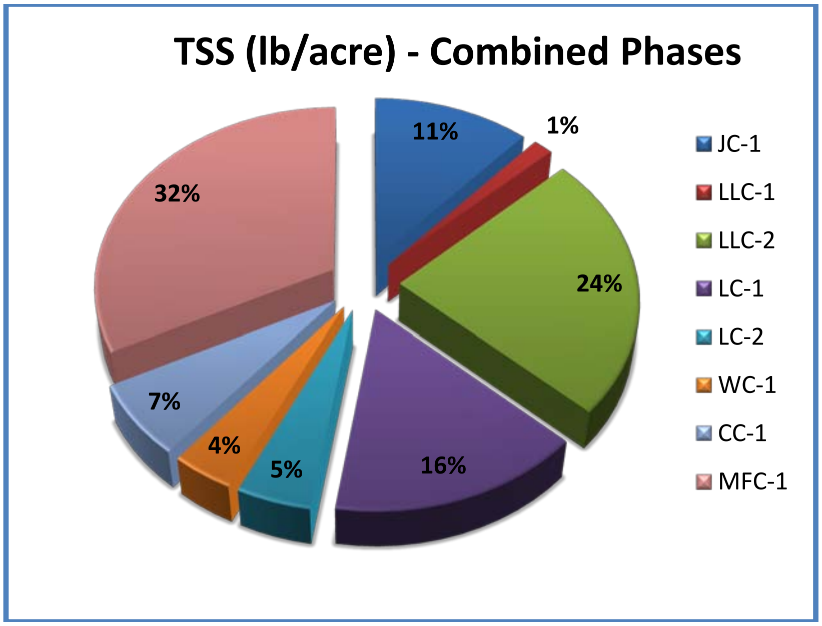

Figure 27. TSS storm flow loading proportional to entire watershed.

4.2 Recommended Load Reductions

Based on the Designated Use Assessment Criteria (Section 3.1) all sub-watersheds in the Lee Creek watershed appear to be maintaining their Arkansas designated uses and are producing high quality water, consistent with their designation as Extraordinary Resource Waters. The Oklahoma Use Assessment Criteria are also being maintained (according to the data presented in this study), with the exception of the Scenic Rivers total phosphorus criteria in the Oklahoma portion of the watershed (specifically Little Lee Creek and Lee Creek) which exhibits the potential for exceedance of the criteria. Additional phosphorus data is necessary to verify the exceedance of the total phosphorus criteria as the concentrations under baseflow conditions appear to be very close to the 0.037 mg/l criteria.

To further emphasize the high quality of the water in the Lee Creek watershed, the data collected by the FSU over the past several years was compared to ambient water quality data collected by the Arkansas Department of Environmental Quality from the least disturbed streams in the Boston Mountain Ecoregion of Arkansas. Figures 28-30 present the comparisons of the sites water quality for total phosphorus, TSS and Nitrate+Nitrite-N. Note, different detection levels were used by the two reporting entities and had to be normalized in order to compare this data. This was done by using the FSU detection levels for all data. These charts depict the mean and 95% confidence interval as diamonds and also represent the mean plus or minus two standard deviations (dotted lines). ADEQ reference stations are identified with a “Ref” in the site name. As can be seen the water quality in the Lee Creek watershed for these key constituents is fairly typical for high quality Boston Mountain streams.

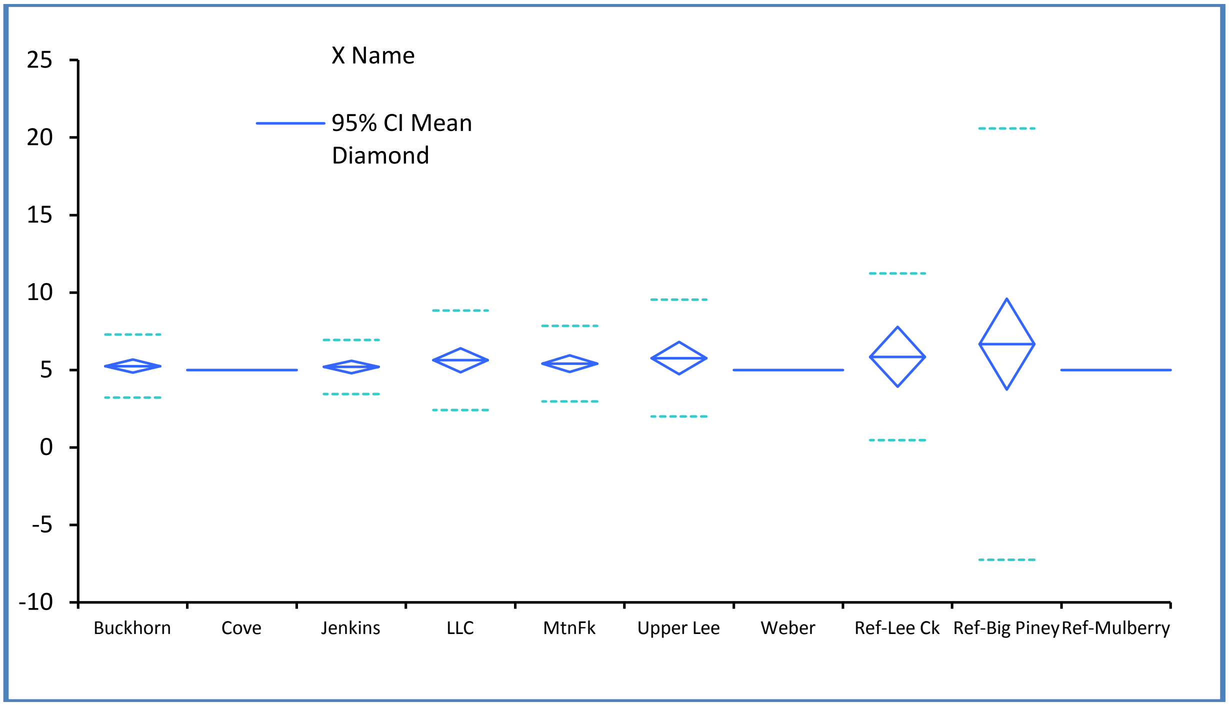

Figure 28. Comparison of TSS levels in Lee Creek WS to Boston Mountain least disturbed streams.

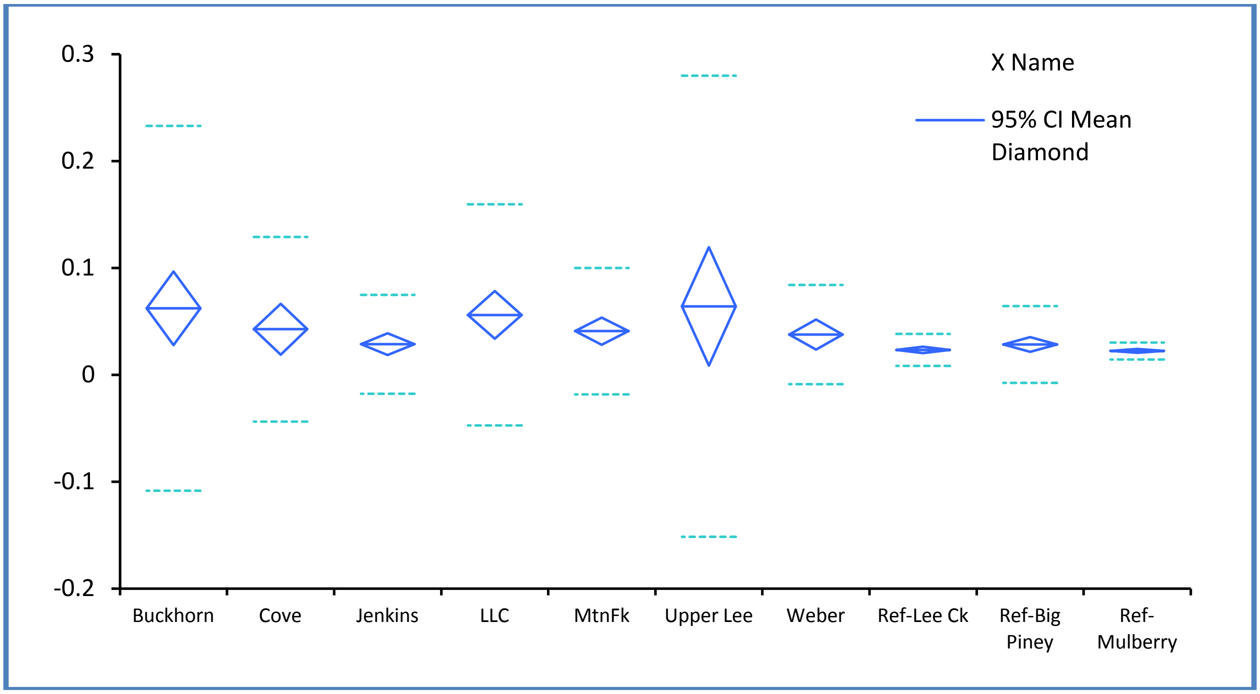

Figure 29. Comparison of total phosphorus levels in Lee Creek WS to Boston Mountain least disturbed streams.

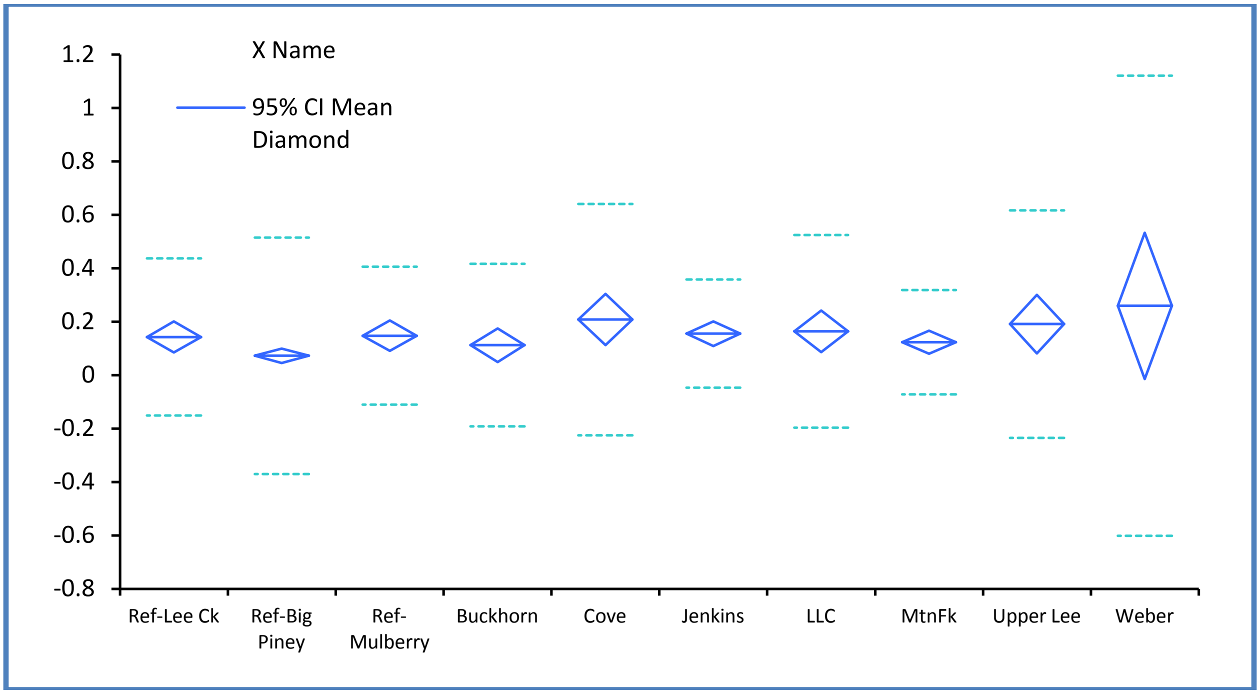

Figure 30. Comparison of NO3+NO2-N levels in Lee Creek WS to Boston Mountain least disturbed streams.

Based on the results of the Designated Use Assessment and the similarity of the water quality to least disturbed Boston Mountain Streams no load reductions are required to meet Arkansas and Oklahoma general water quality standards. However, considering Oklahoma 303(d) listing of Little Lee Creek and Lee Creek for bacteria and metals and due to the potential for exceedance of Oklahoma's special phosphorus standard for Scenic Rivers, reductions in TSS (which will also carry along with it reductions in phosphorus, metals and bacteria loading) should be targeted in an effort to ensure maintenance of the standard and to improve water quality entering Lee Creek Reservoir. A proactive goal of 10% reduction of TSS loading will be targeted for the key sub-watersheds, LC-1, LLC-2 and MFC-1.

5.0 Pollution Source Assessment

The Lee Creek watershed was broken down into eight sub-watersheds to create watershed sizes that were manageable, to simplify the identification of potential sources of pollution from point sources and non-point sources associated with storm water runoff, and to ease the analysis process. The critical sub-watersheds where the most TSS and nutrients originate were discussed in Section 4.0. Figure 31 provides a map of the ranking of critical sub-watersheds producing TSS, which will be the main focus of load reduction goals for the watershed. Potential sources of pollution in each of the eight sub-watersheds delineated and analyzed are presented below.

5.1 Point Sources

Lee Creek has two wastewater dischargers in the watershed area assessed for this plan, Devils Den State park (NPDES Permit No. AR0037940) and Cedarville Public Schools (NPDES Permit No. AR0041289). Devils Den State park discharges treated wastewater into Lee Creek in sub-watershed LC-1. Cedarville Public Schools discharges treated wastewater into Lee Creek in sub-watershed WC-1. Both dischargers have design flows less than 0.1 mgd. Effluent limits are presented in Table 24. There are no limits for phosphorus or nitrate, however, Devils Den has a monitor and report requirement for total phosphorus.

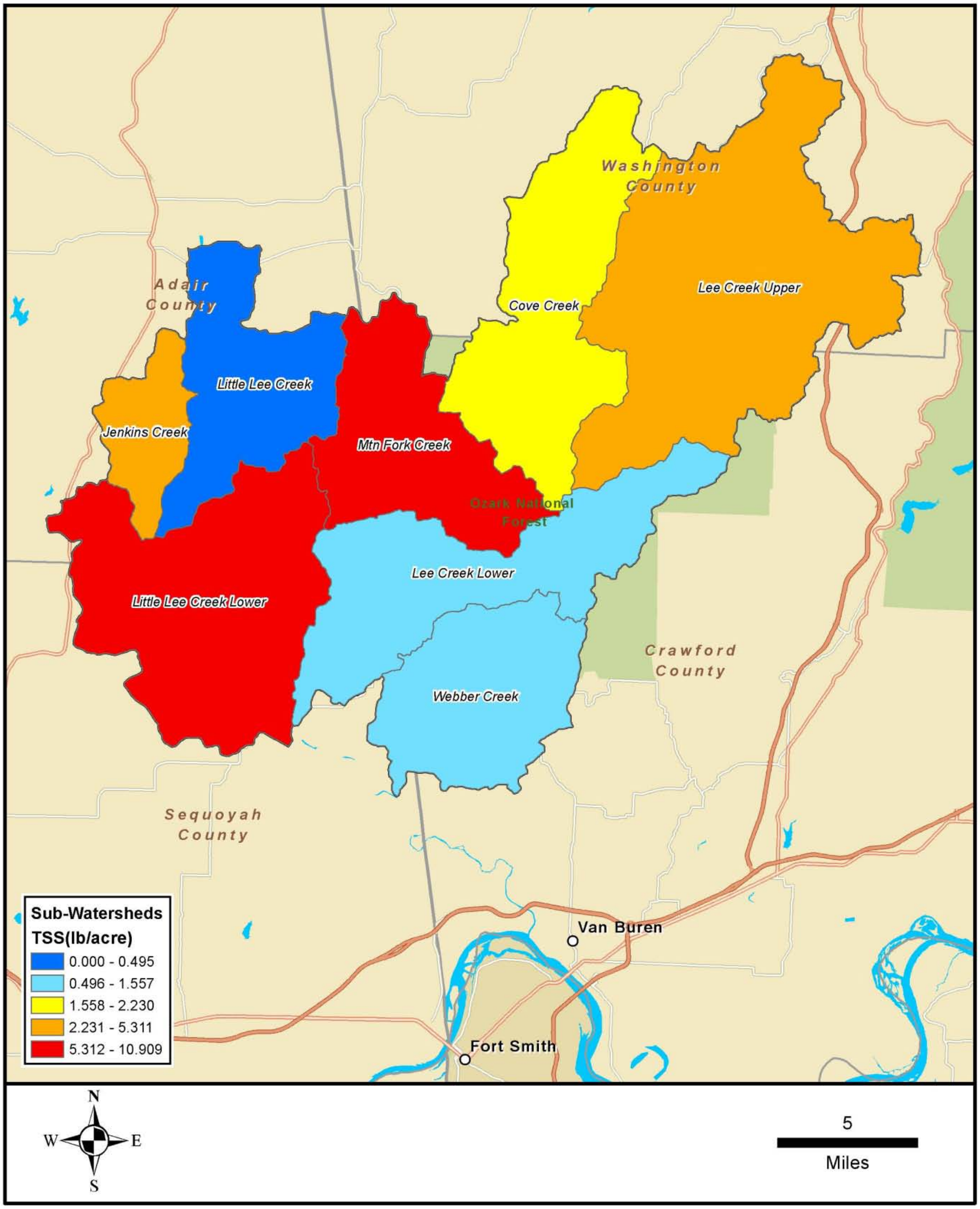

Figure 31. Ranking of critical sub-watersheds producing TSS.

Table 24. NPDES Permit Limits for Cedarville Public Schools and Devils Den State Park.

Parameter	**Load, Monthly Average (lb/day)**		**Concentration, Monthly Average (mg/L)**		**Daily Max (mg/L)**	
	Cedarville	Devils Den	Cedarville	Devils Den	Cedarville	Devils Den
CBOD5 (May-Oct)	1.5	3.3	20.0	10.0	30.0	15.0
CBOD5 (Nov-Apr)	1.9	3.3	25.0	10.0	37.5	15.0
TSS (May-Oct)	1.5	5.0	20.0	15.0	30.0	22.5
TSS (Nov-Apr)	2.3	5.0	30.0	15.0	45.0	22.5
Ammonia-N (April)	0.4	1.8	5.3	5.3	5.3	5.3
Ammonia-N (May-Oct)	0.4	1.7	5.0	5.0	7.5	7.5
Ammonia-N (Nov-Mar)	1.1	3.3	15.0	10.0	15.8	15.0
Dissolved Oxygen	5.0 mg/L minimum Cedarville, 2.0 mg/L minimum Devils Den					
Fecal coliform (col/100mL)	---	---	1000	200	2000	400
Oil and Grease	0.8	3.3	10.0	10.0	15.0	15.0
pH (su)	6.0-Min, 9.0-Max					

5.2 Non-point Sources

JC-1 Sub-Watershed – this is in the headwaters portion of the watershed in Oklahoma and is mostly composed of forest. Cattle pasture is the dominate land use with potential for non-point source pollution. A list of all potential non-point sources identified in the sub-watershed are listed below:

Non-point source	**Severity/Risk**
Cherokee nation landfill	Moderate
Cattle (226)	Low
Fertilized pastures (poultry litter or commercial fertilizer)	Low
Stream bank erosion	Moderate-High
Septic tanks	Low
Un-paved roads	Moderate

LLC-1 Sub-Watershed – this sub-watershed is also in the headwaters portion of the watershed in Oklahoma and is mostly composed of forest. Cattle pasture is more prominent in this sub-watershed than in JC-1 and is the dominate land use with potential for non-point source pollution. A list of all potential non-point sources identified in the sub-watershed are listed below:

Non-point source	Severity/Risk
Cattle (1561)	Moderate
Fertilized pastures (poultry litter or commercial fertilizer)	Moderate
Stream bank erosion	Moderate
Septic tanks	Low
Un-paved roads	Moderate

LC-1 Sub-Watershed – is in the headwaters portion of the watershed in Arkansas and is mostly composed of forest. Cattle pasture is the dominate land use with potential for non-point source pollution. A list of all potential non-point sources identified in the sub-watershed are listed below:

Non-point source	Severity/Risk
2 poultry houses	Low
Cattle (3284)	Moderate
Fertilized pastures (poultry litter or commercial fertilizer)	Moderate
Septic tanks	Low
Un-paved roads	Moderate
Stream bank erosion	Moderate-High
Natural gas well (1)	Low

CC-1 Sub-Watershed - this sub-watershed drains the north central portion of the watershed. The land-use is primarily forest with about 12% pasture. Potential non-point sources are listed below:

Non-point source	Severity/Risk
12 poultry houses	Moderate
Cattle (2022)	Moderate
Fertilized pastures (poultry litter or commercial fertilizer)	Moderate
Stream bank erosion	Minor-Moderate
Septic tanks	Low
Un-paved roads	Moderate

MFC-1 Sub-Watershed – this sub-watershed drains the west central portion of the watershed along the Oklahoma border and drains into Lee Creek at Natural Dam, Arkansas. HWY 59 runs very close to the main channel of the Mountain Fork Creek for several miles. Potential non-point sources are listed below:

Non-point source	Severity/Risk
Cattle (940)	Low
Fertilized pastures (poultry litter or commercial fertilizer)	Low
Stream bank erosion	Moderate-High
Septic tanks	Low
Un-paved roads	Moderate
Paved roads (HWY 59)	Moderate
Developed areas along HWY 59.	Low-Moderate

WC-1 Sub-Watershed – this sub-watershed drains the southwest portion of the Lee Creek watershed in Arkansas and drains into Lee Creek southeast of Short, Oklahoma. The land-use is primarily forest but contains the largest portion of pasture in the watershed (27%). Potential non-point sources are listed below:

Non-point source	Severity/Risk
5 poultry houses	Low-Moderate
Cattle (2979)	Moderate
Fertilized pastures (poultry litter or commercial fertilizer)	Moderate
Stream bank erosion	Moderate
Septic tanks	Low
Un-paved roads	Moderate
Natural gas well (1)	Low

LLC-2 Sub-Watershed - this sub-watershed drains the lower portion Little Lee Creek in Oklahoma and enters Lee Creek near Short, OK. The land-use is primarily forest with about 4% pasture. Potential non-point sources are listed below:

Non-point source	Severity/Risk
Cattle (516)	Low
Fertilized pastures (poultry litter or commercial fertilizer)	Low
Stream bank erosion	High
Septic tanks	Low
Un-paved roads	High

LC-2 Sub-Watershed - this sub-watershed drains the south central portion of the watershed in Arkansas and Oklahoma and ends near the confluence with Little Lee Creek. The land-use is primarily forest with about 14% pasture. Potential non-point sources are listed below:

Non-point source	Severity/Risk
Cattle (1738)	Low-Moderate
Fertilized pastures (poultry litter or commercial fertilizer)	Low-Moderate
Stream bank erosion	High
Septic tanks	Low
Un-paved roads	High

5.3 Source Water Assessment by ADH

In 2000 a Source Water Assessment was completed for Lee Creek Reservoir by the Arkansas Department of Health. This assessment evaluated the vulnerability and susceptibility of the reservoir to potential sources of contamination (PSOC) in the watershed. The assessment ranked each PSOC based on where it was located in proximity to the intake structure and what its potential was for health concerns. Lee Creek Reservoir was classified with a medium susceptibility rating based primarily on its small size and large intake volume. The top three PSOC's identified that affected the rating were:

1. Multiple road crossings
2. Chicken houses
3. Septic systems

The findings of the pollution source assessment in this study are somewhat consistent with the findings of the Source Water Assessment. One minor exception is that the number of active poultry houses has decreased in recent years and may no longer be a top concern.

5.4 Priority Sub-Watershed Ranking

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 (Appendix D) to consider each of the impact assessment categories including; storm water TSS loading, storm water nutrient loading, %pasture, amount of impacted riparian buffers, amount of bank erosion, miles of unpaved roads and concentration of agricultural animals. Scores were assigned to sub-watersheds that ranked either first (3 points), second (2 points) or third (1 point) worst in a given impact category (Table 25). Maximum possible score was 21. The higher the score the higher the priority. Table 26 provides a summary of the score totals for each sub-watershed.

Table 25. Ranking of each Impact Category for Each Sub-Watershed.

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

Table 26. Total Scores and Matrix Ranking.

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

According to the matrix ranking, the three key sub-watersheds in need of source reductions are LLC-2, MFC-1 and WC-1 (Figure 32). In addition, LC-2 and LC-1 were shown in the monitoring to have higher TSS and nutrient loads than did WC-1 and should also be a focus of reduction efforts.

5.5 Modeling NPS Loads and Reduction Potential

A simple water quality model was used to determine the potential of different management practices to reduce TSS and nutrients in the watershed. The Center for Watershed Protections Watershed Treatment Model (WTM) was used for this purpose. Each sub-watershed was modeled independently to arrive at a predicted total load without management measures. Then appropriate management measures were implemented in the model to assess their potential to reduce TSS and nutrients.

The WTM is a land-use based model that utilizes annual rainfall, soil hydrologic groups and land-use categories to calculate primary pollutant loading in a watershed. Additional inputs for secondary pollutant loading can be added to fine tune the loading estimates. Secondary inputs utilized for this study include: septic systems, unpaved roads, stream channel erosion and livestock.

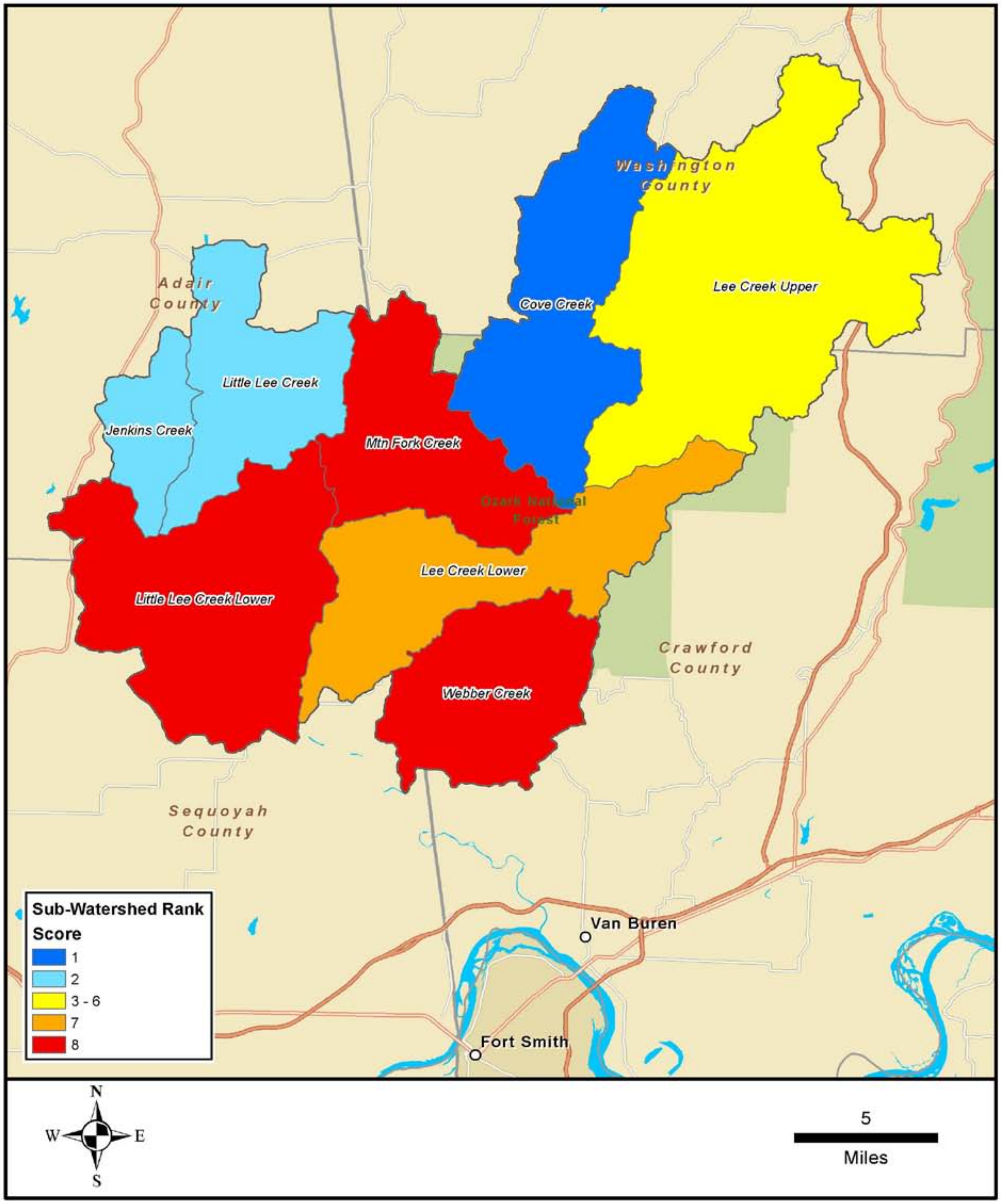

Figure 32. Non-point source scoring and priority ranking by sub-watershed.

Management practices evaluated with the WTM model include: septic system education (Section 6.1) and repair programs, stream restoration (Section 6.2), riparian buffer restoration (Section 6.2) and urban storm water BMPs (SW retrofits) (Section 6.1).

The WTM model is used in this study exclusively as a tool to determine which sources of sediment and nutrients appears to be having the most affect, and from a management perspective, which practices will achieve the load reduction goals of the WMP. A summary of the model load estimates is provided in Table 27 and 28, for TSS and phosphorus, respectively. Model excerpts are provided in Appendix E.

Table 27. Summary of Model Predicted TSS Loading.

	Sub-watershed (TSS lb/year)								
Source	**JC-1**	**LLC-1**	**LLC-2**	**LC-1**	**LC-2**	**CC-1**	**MFC-1**	**WC-1**	**Total**
LDR[1]	38,050	100,051	245,800	218,706	421,978	100,083	84,452	133,719	1,342,839
MDR[1]	813	3,429	7,815	7,326	7,575	1,142	1,629	18,175	47,904
Unpaved Roads	79,910	194,115	639,963	817,617	298,718	148,845	183,827	371,769	2,734,764
Forest	743,470	1,688,840	6,127,440	5,250,160	12,004,990	2,883,260	2,133,640	1,584,660	32,416,460
Rural[2]	177,500	542,400	1,280,700	758,300	2,867,200	468,400	325,700	718,900	7,139,100
Water	620	1,395	48,670	31,775	427,180	4,805	5,580	4,960	524,985
Septic Systems	229	543	2,449	5,405	2,256	2,208	1,448	7,457	21,995
Channel erosion	1,800,000	2,898,000	3,606,000	5,534,000	6,996,000	1,786,000	3,704,000	814,000	27,138,000
Livestock	0	0	0	0	0	0	0	0	0
Total	2,840,592	5,428,773	11,958,837	12,623,289	23,025,897	5,394,743	6,440,276	3,653,640	71,366,047

[1] LDR stands for low density residential and MDR stands for medium density residential (which also includes commercial areas in this model).

[2] Rural land loading calculations are the default rates in the model, they include pollutants from grazed cattle, fertilizer used for hay and other common uses of rural land.

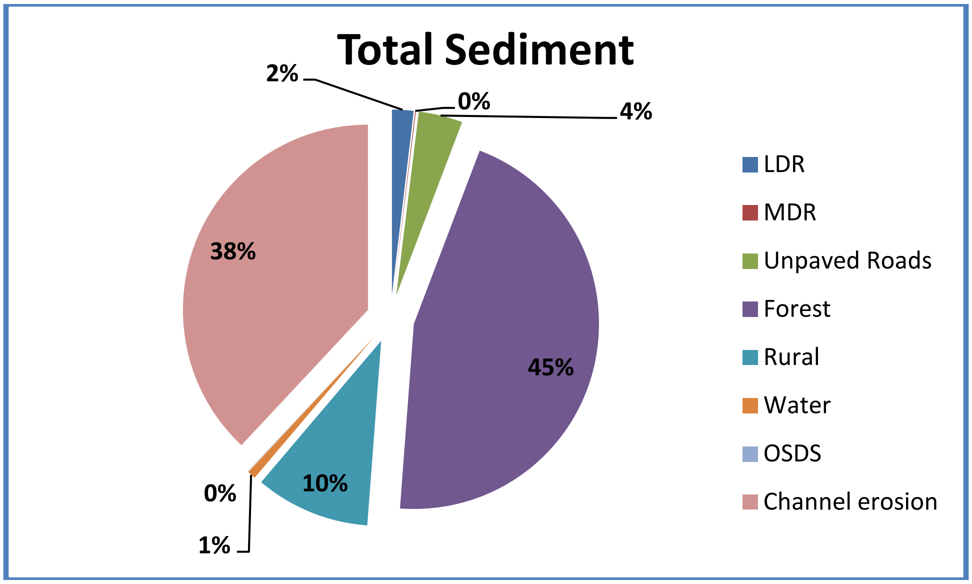

Figure 33. Overall sources of sediment.

Table 28. Summary of Model Predicted Phosphorus Loading.

Source	**Sub-watershed (TP lb/year)**								
	JC-1	**LLC-1**	**LLC-2**	**LC-1**	**LC-2**	**CC-1**	**MFC-1**	**WC-1**	**Total**
LDR	241	633	1,555	1,384	2,670	633	534	846	8,496
MDR	5	22	49	46	48	7	10	115	302
Unpaved Roads	12	29	96	123	45	22	28	56	411
Forest	1,487	3,378	12,255	10,500	24,010	5,767	4,267	3,169	64,833
Rural	1,243	3,797	8,965	5,308	20,070	3,279	2,280	5,032	49,974
Water	2	5	157	103	1,378	16	18	16	1,695
Septic Systems	6	14	61	135	56	55	36	186	549
Channel erosion	1,260	2,029	2,524	3,874	4,897	1,250	2,593	570	18,997
Livestock	0	0	0	144	0	864	0	360	1,368
Total	4,256	9,907	25,662	21,617	53,174	11,893	9,766	10,350	146,625

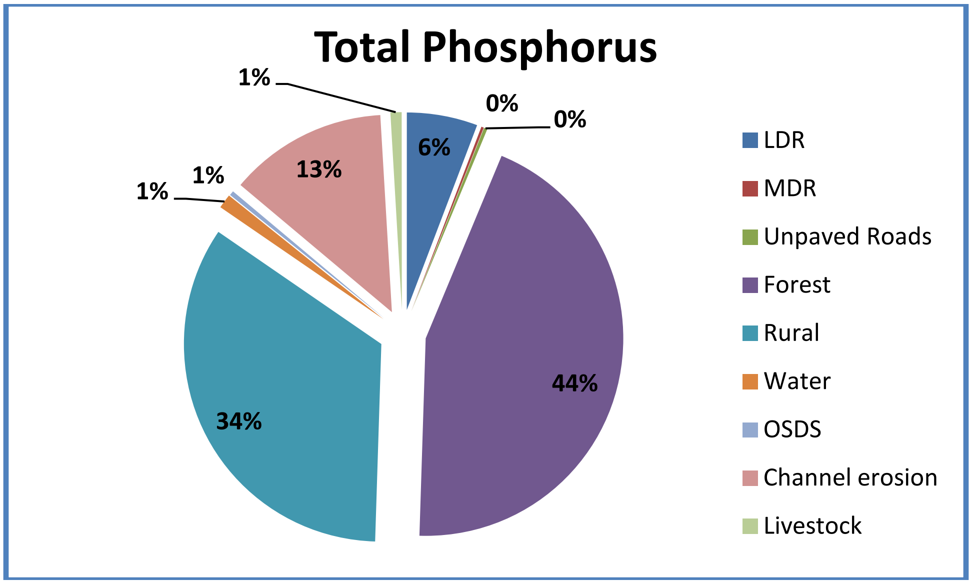

Figure 34. Overall sources of Phosphorus.

The largest source of TSS and phosphorus is shown by the modeling to be from forested land-uses. However, pollutant loading from forest can generally be considered to be naturally occurring (background) load that is not practically targeted for reductions.

Based on the results of the modeling it appears that the key sources of TSS that need to be addressed for sediment reduction are:

- Stream channel erosion
- Pasture management
- Unpaved roads

Nutrient loads were assessed in the model primarily looking at phosphorus which is the key nutrient of concern in the watershed. Based on the modeling of phosphorus loading the key sources that need to be addressed are:

- Pasture management
- Stream channel erosion
- Residential/commercial

The portion of sediment and nutrients coming from each sub-watershed varies as does the load from each source. For example, some sub-watersheds will benefit more from stream bank restoration and other watersheds will benefit more from pasture management. However, overall the key sources noted above are those that need to be addressed first in the Lee Creek watershed.

5.6 Discussion of Priority Ranking

A ranking of the stream impacts/disturbances identified in the watershed was compiled, consistent with the matrix and modeling results, and are presented in Table 29. Rankings are based on which impacts could be expected to provide the most load reduction of sediment and nutrients to the system if appropriate management measures were implemented. The most critical problem area is ranked first and the least critical, last.

Stream bank erosion is fairly prominent in the Lee Creek Watershed (Figure 35). Bank erosion is believed to be a major source of sediment and nutrients in each of the sub-watersheds that had high percentages of stream bank length instability (LLC-2, LC-2, JC-1 and MFC-1). Active bank erosion can add thousands of tons of sediment and nutrients to the stream system during high flow events. These sediment and nutrient loads will ultimately end up at the bottom of the Lee Creek Reservoir or in the drinking water treatment plant. It is costly to remove sediment/turbidity from drinking water. Therefore, reduction and prevention of stream bank erosion should be an immediate goal in the watershed.

Figure 35. Streambank erosion on CC and the MFC.

The lack of adequate riparian vegetated buffers in several reaches of the stream is a potentially a problem. Well developed riparian buffers serve to shade the stream, reducing solar energy inputs and decreasing water temperature; and they serve to stabilize the stream banks, protecting them from erosion and providing habitat for aquatic biota. Riparian buffers also serve to filter out pollutants in storm water runoff and help to regulate the stream hydrograph during runoff events (see Section 3.6). All sections of stream lacking riparian buffers should be considered for re-vegetation with native trees and under story plants as a pasture BMP.

Table 29. Priority ranking of Lee Creek impacts/disturbances from worst to least.

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

Mountain Fork Creek poses a unique circumstance in the watershed. The monitoring data indicates it carries the largest load of sediment. It has one of the smallest amounts of pasture and developed land. However, the USA indicates it has one of the highest bank erosion rates in the watershed. These seemingly contradicting attributes are believed to be caused by Hwy 59 corridor which parallels the main stem of MFC for nearly its entire length, never being more than about 0.5 miles from it. The proximity of the highway also concentrates all the developed land up and down the highway corridor, and puts much of the agriculture in the same area. Therefore, all types of BMPs recommended in this WMP are recommended for use in the MFC sub-watershed.

6.0 Recommendations for Watershed Management

The following sections provide recommendations for management of the Lee Creek watershed 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 section and listed in Table 29. It is assumed that a reduction in sediment (TSS) will also bring a parallel reduction in phosphorus in a similar proportion. Therefore, only sediment reduction loading is provided in this section.

6.1 Land-Use and Runoff Management

The following are a list of best management practices recommended to protect water quality and/or the hydrologic regime of Lee Creek. 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 the Lee Creek watershed. Reduction estimates and costs (Section 9.0) are based on a survey of literature values from documents cited in Section 10.0.

Agricultural Land-Use

In each sub-watersheds, and particularly in sub-watersheds WC-1, LLC-2 and LC-2, where pasture is the most prevalent, it is recommended that landowners be encouraged to consider implementation of pasture management practices. This encouragement probably needs to occur as some form of educational materials mail out or forum. Assistance with these types of efforts is available through the National Resource Conservation Service, the Arkansas Natural Resources Commission, the University of Arkansas Cooperative Extension Service and others.

For pasture with on-going grazing operations the following BMPs should be considered in all sub-watersheds:

- Riparian buffers along stream corridors. Minimum of 25 feet forest and 25 feet native grasses. This protects the stream banks 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. 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 stocking rate, number of head per acre of pasture.

➢ Potential load reductions from use of these management practices in key sub-watersheds are: 231,557 lbs. annually. Estimate based on implementation of alternate water sources (Evans, B.M. 2001).

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

- Riparian buffers along stream corridors (see detail above).
- 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. Prevents top soil erosion, and utilizes remaining nutrients.
- Crop rotation. Maintains cover on soils and improves soils.

➢ Potential load reduction from use of cover crops or fertilizer management is: 231,557 lbs annually (Evans, B.M. 2001) .

Rural Residence On-Site Treatment Systems (Septic Systems)

For rural residences that use septic systems the following BMPs are recommended to ensure nutrient loading is minimized::

- Septic system education.
- Septic system inspection and repair program.
- Septic system upgrades.
- Septic system retirement (convert to city sewer where available).

➢ Reduction potential not assessed as it is not a significant source (see Section 5.0).

Developed - Commercial and Industrial Land-Uses

In all sub-watersheds and particularly in LC-2, WC-1 and MFC-1 it is recommended that facilities and commercial establishments be encouraged to adopt industry specific BMPs. Sub-watersheds WC-1 and LC-1 each contain one natural gas well pad (Figure 36). There is also one well pad in a lateral drainage from the south to Lee Creek Reservoir. Well pads can be a significant source of sediments during construction, but this risk diminishes dramatically after soil stabilization with vegetation.

The following BMPs should be considered:

- Riparian buffers along stream corridors. In addition to the benefits discussed previously, buffers help control the storm flow hydrograph. Minimum 50 feet.
- 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.
- 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.

- ➢ Potential load reductions from use of these management practices in key sub-watersheds are: 19,430 lbs annually. Reduction based on implementation of 6 storm water control features (one of each) including drainage to open space, water quality swales, wet ponds, grass filter strips, grass channels and bioretention (WTM Model).

Developed - Residential Land-Uses

In the overall watershed and particularly in sub-watersheds MFC-1 it is recommended implementation of best management practices by residents be encouraged.

For residential developments the following BMPs should be considered:

- Riparian buffers along stream corridors. Minimum 50 feet.

- 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 (through incentives) or require use of low impact development techniques (LID) in new developments in critical areas or on steep slopes.
- Limit and manage fertilizer application
- Encourage watershed stewardship through education.

➢ Potential load reductions from use of these management practices in key sub-watersheds are: 10,000 lbs annually. Reduction based on implementation of 6 storm water control features (one of each) including drainage to open space, water quality swales, wet ponds, grass filter strips, grass channels and bioretention (WTM Model).

Unpaved Roads Management

Several BMPs are available to decrease sediment transport form unpaved roads. The following BMPs are believed to be appropriate to the forest roads and dirt roads in the Lee Creek watershed:

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

➢ Potential load reductions from use of a combination of these management practices on approximately 50% of unpaved roads in key sub-watersheds are: 457,337 lbs annually (Bloser, S.M. and Sheets B.E., 2012).

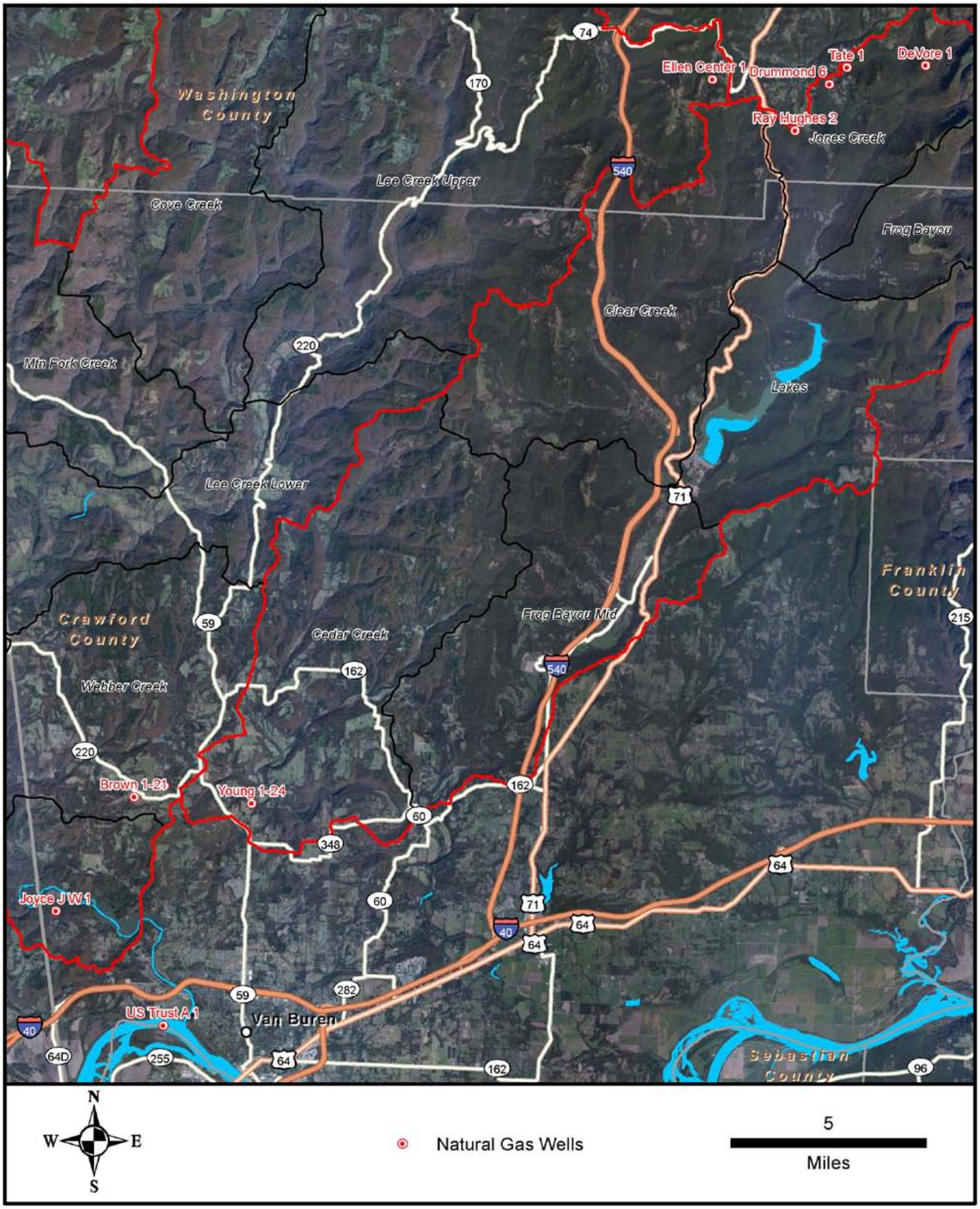

Figure 36. Natural gas wells in the watershed.

6.2 Stream Corridor Restoration/Enhancement

Riparian Buffers

Riparian vegetated buffers are lacking or limited in several reaches of Lee Creek. As discussed previously in this report (Section 4.0) riparian buffers are critical to the health of a stream system. The following areas should be targeted for establishment or enhancement of vegetative riparian buffers: MFC-1, LLC-2, LC-2, LC-1 and CC-1, in order of priority.

Buffer widths should be planted as wide as possible on each side of the stream. A width of at least 50 ft on each side of the stream should be targeted as a minimum in areas. When riparian buffers are considered, more is always better. Buffers should be composed of native vegetation including trees, shrubs, herbaceous plants, and grasses. Figure 37 presents a representation of how buffers are designed.

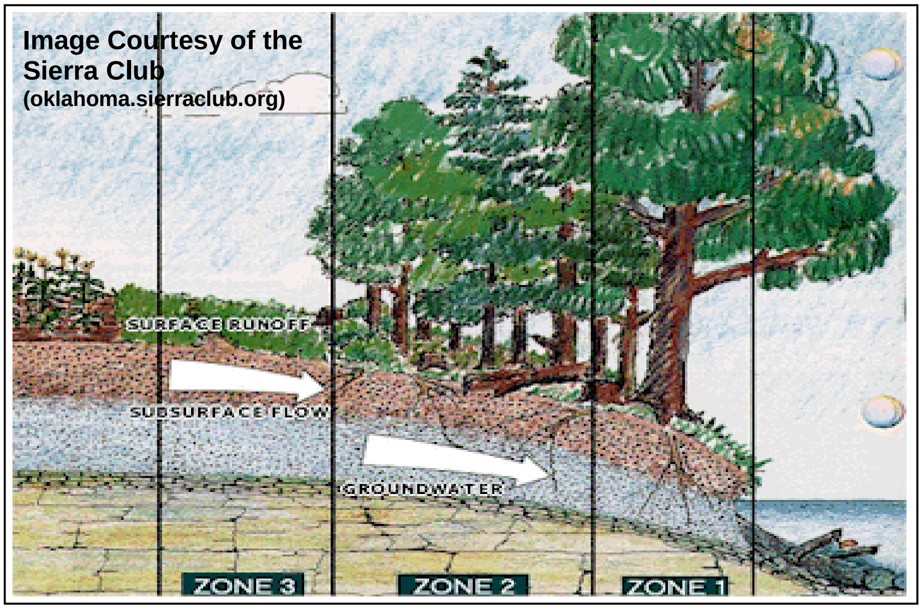

Image Courtesy of the Sierra Club (oklahoma.sierraclub.org)

Figure 37. Generic representation of riparian buffer zone.

- Potential load reductions from use of these management practices on 50% of impacted buffers in all watersheds 99,603 lbs annually (WTM Model).

Stream Bank and Channel Stabilization

Several of the streams in the Lee Creek Watershed are exhibiting significant stream bank erosion at several locations. Stream banks 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. MFC-1, LLC-2, LC-2 and LC-1 should be the primary target of these efforts. Potential load reductions from bank stabilization alone exceed 100 lb sediment/foot of eroded bank restored. In addition to bank stabilization, root causes of stream bank instability should be evaluated in each reach and necessary channel restoration also be completed (i.e. installation of grade control, flow training and key habitat features, etc.).

Each stream bank and channel stabilization project comes 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 will be given to techniques that focus on bioengineering.

- Toe protection in conjunction with various vegetative protection measures (such as live stakes, live cribwalls, etc.)
- Stone armoring (such as the use of riprap, windrowing, etc.)
- Use of bioengineered materials including erosion control blankets, wattles, soil wraps, etc.
- Flexible mattresses (such as concrete block mattress, gabion mattress, wooded mattress, etc.)
- Engineered structures for grade control, energy dissipation and flow guidance, (cross veins, J-hooks, step pools, riffles, etc.).

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 stream bank stabilization.

- ➢ Potential load reductions from use of these management practices on 25-40% of highly eroded banks in key sub-watersheds 6,333,526 lbs annually (Calculated from site specific data).

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. The FSU has established a 300 foot buffer zone around Lee Creek Reservoir to protect its shoreline and provide a zone for storm water to infiltrate before it reaches the lake. A wildlife habitat management plan was developed and is utilized to oversee the 809 acre buffer zone. The buffer zone includes several habitat types that are protected including 476 acres of upland forest and 125 acres of bottomland forest. FSU has developed watershed management areas that are critical to the City's drinking water resources. In addition, much of the land adjacent to the lake is under conservation easements to protect the water resource. Other key elements that should be developed in tributaries in close proximity to the lake are provided in Table 30.

Table 30. 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.
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.
Avoid septic system use	All homes should be connected to local sewers and wastewater treatment facilities when possible.

Table 31 provides a ranking of the watershed management practices recommended as a result of the assessment. Each management action is ranked based on its ability to move the watershed towards attainment of the goals expressed.

Table 31. Recommend watershed management practices.

Rank	Sub-watershed	Management Type	Management Action (Practice)
1	MFC-1	Restoration	Stream bank stabilization
2	LLC-2	Restoration	Stream bank stabilization
3	LC-2	Restoration	Stream bank stabilization
4	LC-1	Restoration	Stream bank stabilization
5	WC-1	BMP	Implementation of Pasture BMPs
6	LC-2	BMP	Implementation of Pasture BMPs
7	LLC-2	BMP	Implementation of Pasture BMPs
8	MFC-1	BMP	Hwy 59 corridor storm water run-off control
9	LC-2	BMP	Implementation of residential/commercial BMPs
10	WC-1	BMP	Implementation of residential/commercial BMPs
11	LC-1	BMP	Unpaved road maintenance and upgrades
12	LLC-2	BMP	Unpaved road maintenance and upgrades

6.3 Implementation Schedule

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 32. The schedule provides ten years for actions to be accomplished that will result in a 10% reduction of sediment and phosphorus in the watershed.

Table 32. Implementation Schedule[1].

Action Item	Target Date for completion
Meet with stakeholder group to coordinate implementation projects	October 5, 2015
Implement a pasture management education effort and invite all farmers in the watershed	March 1, 2016
Meet with county judges and US Forest Service to discuss unpaved road maintenance	December 30, 2016
Bank stabilization of 15% of eroded banks in MFC-1 (moderate or worse rating)	December 30, 2018
Bank stabilization of 20% of eroded banks LLC-2 (moderate or worse rating)	December 30, 2020
See 20% of pastures in WC-1 and LLC-2 have management measures implemented.	August 15, 2021
Bank stabilization of 10% of eroded banks in LC-2 (moderate or worse rating)	December 2022
Install SW retrofits in 6 MFC-1, WC-1 and LC-2 locations	December 30, 2023
Bank stabilization of 20% of eroded banks in LC-1	December 30, 2026

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

6.4 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 33.

Table 33. Interim Measurable Milestones.

Milestone	Measurement method
Stakeholder group success	Meetings at least 2/year and attendance of at least 40% of group on average
Pasture BMP meetings	Meeting occurred on schedule
Unpaved road BMP meeting	Meeting occurred on schedule
Bank stabilization (MFC-1)	Stabilization completed on schedule Length of stream completed as planned
Future Watershed loading is monitored and assessed	FSU completes annual monitoring as planned, per the plan in Section 7.0
First two years of monitoring complete and complied with historical data to set a baseline	Monitoring baseline established
Monitoring shows TSS and TP loading is stable or decreasing	Data analysis (per Section 7.0) of first three-year monitoring cycle (2017-2019)
Pasture management practice implemented	Completed on schedule and attaining percentage goals
SW retrofits installed	Completed on schedule and attaining percentage goals
WMP reviewed and updated every five years	Plan review is completed in 2020 and needed updates included
Bank stabilization in (LLC-2)	Stabilization completed on schedule with length of stream completed as planned

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. In addition, the FSU will continue their watershed monitoring program and continue to evaluate sediment and nutrient loading to Lee Creek Reservoir.

6.5 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 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

FSU will continue its current monitoring program supplemented by additional grab sampling in key sub-watersheds, where appropriate. The FSU currently monitors water quality through sample collection, physio-chemical measurement and bioassessment. See Section 3.1.1, 3.2 and 3.5 for a summary of the FSU monitoring program. The new gauges that were installed in key sub-watersheds as part of this study will be used in the future to calculate loading in those sub-watersheds. The addition of the new gauges, with the three existing USGS gauge stations in the watershed, should allow fairly accurate loading to be calculated for the entire Lee Creek watershed. FSU will use loading data (TSS, TP) collected in the future to compare to the loading data collected historically in their program and data collected during this watershed assessment. Load reductions or increases will be determined using the loading data, control charts and trend analysis. FSU will use control charts and trend analysis to gauge if the watershed loading is responding positively or negatively to load reduction efforts. A predictive trend line will be used to quantify load reductions in key sub-watersheds. Bioassessment data will also be used as it has been used historically and is depicted in this WMP (see Section 3.5). Should the bioassessment metrics and stream condition indices vary from the historical norms (as observed in control charts) then it will be evidence of either positive affects or negative within the watershed. If the monitoring results, both water and bioassessment, indicate that loading has not been decreasing on three consecutive years then additional monitoring will be completed to assess the problem and determine if loading had remained constant or if new load sources could be to blame. The first two years of WMP implementation (2015 and 2016) will not be assessed in the first three year assessment cycle. Those years will be assumed to be “building” years for the database. After the first five years of post WMP monitoring the assessment of loading status will be completed for the most recent three years of data (2017-2019). This cycle of monitoring and evaluation will then continue forward until what (three year cycles) time as revisions needed.

BMP effectiveness will 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.

8.0 Public Involvement, Education and Stakeholders

The FSU is active in educating the public concerning relevant environmental and watershed issues. The City currently conducts a Citizens Academy which provides facility tours and educates public groups on water related issues. Fort Smith’s Environmental Management Group also serves as a science fair resource for the Fort Smith School District and other nearby districts, providing project guidance and science fair judges.

As with any major public undertaking the support of the general public and key local personalities and stakeholders is critical. The stakeholder group, should be composed of key individuals, stakeholders (those with property in the watershed, and/or those who are affected by management decisions in the watershed) and local partners who would review recommendations for management, help determine what management measures would be adopted, and help implement the plan. Advantages of utilizing such groups are multifaceted, they include; a broader perspective on the issues, a higher level of public comfort with decisions, and a better platform for informing the public, to mention a few. Watershed advisory groups illicit a spirit of sharing and cooperation that can energize the management process. Historically, watershed management has been more successful when such advisory groups have been involved in the process.

The FSU and other stakeholder groups have taken large steps towards protecting and enhancing the Lee Creek watershed and in educating the public about drinking water quality. The continued development of a strategy to educate the public about Lee Creek watershed management is a priority. The general public must begin to understand ways their activities affect waters in the watershed. They must also begin to see the ways the waterways enhances their lives so they begin to value it more. This effort could include actions such as public meetings, informational brochures, workshops, field trips and information sessions. Several stakeholder groups continue to host Lee Creek clean-ups or restoration days, where the public, including students, become engaged in watershed management activities.

Educational Outreach

A public and stakeholder meeting was held for the Lee Creek Watershed on Tuesday June 29th, 2014. The meeting was held to increase awareness and knowledge of the efforts being made to improve and preserve the Lee Creek Watershed across the four (4) counties in Arkansas and Oklahoma. The meeting was advertised by posting flyers, sending mail-outs, e-mailing announcements to organizations/agencies, announcements on the radio and local news stations. For those who are interested and could not attend, a specific e-mail address (LeeCreekWMP@FortSmithAR.gov) was set-up and is still currently operational for those wanting more information or to participate in the development and execution of the watershed management plan. The meeting was a success as there were 27 people in attendance for the meeting with 12 stakeholders signing on to continue helping with the management of Lee Creek watershed. Stakeholders include: U.S. Forest Service, Arkansas Master Naturalist, Arkansas Canoe Club, Oklahoma Water Resource Board, The Nature Conservancy, Arkansas Department of Health, Oklahoma Scenic Rivers Commission, and Oklahoma Conservation Commission. An informational brochure was prepared and given to everyone in attendance that included a summary of the Phase 1 Draft WMP and key points of the meeting and contact information. Brochures will be left at key locations in the watershed to encourage continued education.

Goals of the meeting were to identify water quality concerns in the watershed, increase education and involvement, coordinate efforts with the public and develop a stakeholder holder group. The initial draft of watershed management plan was covered in the meeting explaining data that have been collected in the past. Citizens and stakeholders gave feedback on the plan and suggestions concerning major sources of pollutants in the watershed. The main concern noted was that unpaved roads have been observed to be big transporters of sediment. Unpaved roads could be contributing to the amount of TSS measured in water quality samples collected from the watershed. For this final version of the WMP unpaved roads and sediment loading from the roads were estimated and incorporated into the plan as a key impact. Stakeholders were given the opportunity to review information in the draft WMP and will be sent future drafts of the plan for review until the watershed management plan is finalized. Key stakeholders involved in this process include the Oklahoma Water Resource Board, the Oklahoma Conservation Commission, the Arkansas Natural Resources Commission and the Arkansas Department of Environmental Quality.

Stakeholder Involvement

As stated earlier, stakeholders gave feedback on the plan 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 was sent via e-mail to all the 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 stakeholders.

Stakeholders have already been involved in scheduling clean-up events and discussions about improvements to the watershed.

Continuing Education

Fort Smith Utility is working with schools to educate students on the importance of watersheds and watershed management. These educational sessions include allowing students to collect macroinvertebrates from a small stream located inside park under the direction of the FSU biologists, collection of fish, a discussion on birds and frogs. This is all tied into a closing lesson on the impact of humans on the health of the watershed, and the possible consequences if the watershed is not protected through conservation and BMPs such as not littering, properly disposing of trash and chemicals, etc.

FSU currently hosts a website for the Lee Creek Watershed where information on the watershed management plan as well as the plan itself is accessible. FSU continues to work with stakeholders to inform, educate, and involve new stakeholders and the public.

- FSU utilizes the EPA document “Getting in Step: Engaging Stakeholders in Your Watershed” as a guidance and source of information on how best to reach out to current and future stakeholders.
- The EPA Nonpoint Source program has created a nonpoint source outreach tool box that will be reviewed and used to increase awareness (http://www.epa.gov/nps/toolbox/). Relevant information and material from the Tool Box will be adapted for stakeholders in the Lee Creek Watershed.
- Annually an FSU representative discusses the importance of watersheds on a local talk-radio station.

- Printed flyers, fact sheets, booklets and educational meetings will be used to share information and educate the public on watershed management, watershed concerns, and the use of different BMPs and their maintenance.
- Ecosystem services are the benefits people obtain from nature. Examples include freshwater, timber, water purification, soil regeneration, flood control, pollination, and similar services, many of which are considered “free.” The EPA Ecosystem Services Research Program and the USDA Office of Ecosystem Services are developing approaches for quantifying the economic value of some of the non-market services (e.g., waste assimilation, water purification, soil development). Creating a better understanding among stakeholders of the monetary value of these “free” services, as well as potential markets will help inform them for better decisions.

9.0 Technical and Financial Assistance

The projected costs to accomplish a 10% reduction in sediment and phosphorus in the Lee Creek watershed is summarized in the table below. Phosphorous reduction is closely correlated to sediment reduction and is assumed to be reduced proportional to TSS reduction.

Management measure	Sediment Reduced lbs/unit area	lbs TSS Reduced	Cost ($)	Costs/lb Reduced
Stream restoration (bank stabilization)	30-320 lb/ft	6,333,526	2,988,500	$0.47
Riparian buffer restoration	3.4 lb/ft	99,603	26,880	$0.27
Unpaved road improvement	0.55 lb/ft	457,337	1,375,500	$3.01
Storm water retrofits[1]	86.1 lb/ac	29,430	1,420,000	$14.27
Agricultural BMPs (Pastures)[2]	29.9 lb/ac	231,557	1,595,676	$6.89
Education/Public Outreach	---	---	40,000	Every 3 yrs

[1] Storm water retrofits are BMPs designed to be implemented in urban, suburban and commercial/industrial areas. They include low-impact development features.
[2] These costs are for BMP implementation in either cattle pastures or hay fields.

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 land owners to implement agricultural BMPs; and grants are available to communities to install storm water treatment practices and replant riparian areas. Some grants will be more easily obtained by non-profit or community groups, such as a “Friends of Lee Creek” (possible steering committee name) discussed previously. 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 Lee Creek assessment findings and recommendations. It is anticipated that approximately 1/3 of the funding will come from a combination of these programs. The remainder of the funding will come from the City of Fort Smith, local land owners and investors.

Table 34. Private/Match Funding Entities for Watershed Management.

Entity
Adair County Government (Roads)
Arkansas Canoe Club
Arkansas Master Nationalist
City of Fort Smith
Crawford County Government (Roads)
Local Land Owners
Sequoyah County Government (Roads)

Table 35. Funding Opportunities for Watershed Management.

Grant Name	Source	Type/Purpose
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)	USDA (NRCS) EPA (ANRC or OCC)	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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Appendix A

FSU Water Quality Data

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as CaCO$_3$	Total Hardness, mg/L as CaCO$_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	OrthoP-P
02-05052	Blackburn Cr.	b	6/19/2002	> 2419.60	3.00	< 5.00		30.00	34.00	< 0.030	3.03		0.039	2.37	0.44	0.10	< 0.01	< 0.00	6.21	# 0.10	# 0.013
02-05666	Blackburn Cr.	b	7/11/2002	980.40	1.00	< 5.00		40.00	44.00	< 0.030	< 0.50		0.045	2.27	0.76	0.17	< 0.01	< 0.00	4.56	# 0.17	# 0.015
03-00486	Blackburn Cr.	b	1/15/2003	387.30	1.00	< 5.00		16.00	36.00	0.040	1.00		< 0.040	12.16	0.13	0.03	< 0.02	< 0.01	11.63	# 0.04	< 0.013
03-05261	Blackburn Cr.	b	6/30/2003	2419.60	5.20	< 5.00		40.00	44.00	< 0.030	0.64		0.064	2.14	0.16	0.04	< 0.02	< 0.01	5.23	# 0.04	# 0.021
04-01571	Blackburn Cr.	b	2/25/2004	107.60	1.00	< 5.00		24.00	30.00	0.030	1.37		< 0.050	2.81	0.42	0.10	< 0.03	< 0.01	6.33	# 0.10	< 0.016
04-06653	Blackburn Cr.	b	8/24/2004	1413.60	< 1.00	< 5.00		52.00	50.00	0.060	1.37		0.053	1.95	0.24	0.05	< 0.03	< 0.01	4.00	# 0.06	# 0.017
05-02850	Blackburn Cr.	b	5/10/2005	1732.90	9.80	< 5.00		30.00	34.00	< 0.020	1.73		< 0.060	2.00	0.20	0.04	< 0.03	< 0.01	5.01	# 0.05	< 0.020
10-07450	Blackburn Cr.	b	12/7/2010	1203.30	6.30	< 5.00	2.10	16.00	24.00	0.020	1.36	0.23	< 0.061	4.70	0.38	0.09	< 0.16	< 0.05	9.70	# 0.14	< 0.020
11-00959	Blackburn Cr.	b	2/17/2011	920.80	32.70	< 5.00	12.00	12.00	26.00	< 0.020	1.05	0.50	< 0.061	9.20	1.82	0.41	< 0.16	< 0.05	8.40	# 0.46	< 0.020
11-02814	Blackburn Cr.	b	5/19/2011	1732.90	23.80	< 5.00	8.50	16.00	20.00	0.060	2.13	0.07	< 0.061	2.70	< 0.22	< 0.05	< 0.16	< 0.05	6.00	< 0.10	< 0.020
11-07033	Blackburn Cr.	b	12/13/2011	461.10	4.10	< 5.00	3.00	12.00	20.00	< 0.020	1.00	NA	< 0.031	3.30	2.66	0.60	< 0.16	< 0.05	9.30	# 0.65	< 0.010
12-01187	Blackburn Cr.	b	2/23/2012			< 5.00	3.60	12.00	20.00	< 0.020	1.26	0.38	< 0.031				< 0.02	< 0.01			< 0.010
10-07450	Blackburn Cr.	b	12/7/2010			< 5.00				0.02	1.36		< 0.02	4.70						0.09	< 0.007
11-00959	Blackburn Cr.	b	2/17/2011			< 5.00				< 0.02	1.05		< 0.02	9.20						0.41	< 0.007
11-02814	Blackburn Cr.	b	5/19/2011			< 5.00				0.06	2.13		< 0.02	2.70						< 0.05	< 0.007
11-07033	Blackburn Cr.	b	12/13/2011			< 5.00				< 0.02	1.00		< 0.01	3.30						0.60	< 0.003
12-01187	Blackburn Cr.	b	2/23/2012			< 5.00				< 0.02	1.26		< 0.01	5.50						0.34	< 0.003
12-02508	Blackburn Cr.	b	4/26/2012			< 5.00				0.02	1.12		< 0.01	3.01						0.06	< 0.003
13-00810	Blackburn Cr.	b	2/7/2013			< 5.00				< 0.02	0.74		< 0.01	7.14						0.27	< 0.003
13-02477	Blackburn Cr.	b	4/30/2013			< 5.00				0.04	0.91		< 0.01	3.06						0.11	< 0.003

Blackburn Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as CaCO$_3$	Total Hardness, mg/L as CaCO$_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	OrthoP-P
Average	1252.65	8.08	5.00	5.84	25.00	31.83	0.030	1.30	0.29	0.035	4.43	0.67	0.15	0.07	0.02	6.94	0.20	0.01
Min	107.60	1.00	5.00	2.10	12.00	20.00	0.020	0.50	0.07	0.010	1.95	0.13	0.03	0.01	0.00	4.00	0.04	0.00
Max	2419.60	32.70	5.00	12.00	52.00	50.00	0.060	3.03	0.50	0.064	12.16	2.66	0.60	0.16	0.05	11.63	0.65	0.02
Median	1203.30	4.10	5.00	3.60	20.00	32.00	0.020	1.19	0.30	0.035	3.06	0.38	0.09	0.03	0.01	6.21	0.10	0.01
SD	780.00	10.53	0.00	4.25	13.42	10.32	0.015	0.59	0.19	0.021	2.94	0.81	0.18	0.07	0.02	2.45	0.20	0.007
75th %tile	1732.90	8.05	5.00	8.50	32.50	38.00	0.033	1.37	0.41	0.055	5.10	0.60	0.14	0.16	0.05	8.85	0.31	0.02
Count	11.00	11.00	20.00	5.00	12.00	12.00	20.000	20.00	4.00	20.000	19.00	11.00	11.00	12.00	12.00	11.00	19.00	20.00
90th %tile	2419.60	23.80	5.00	10.60	40.00	44.00	0.060	2.13	0.46	0.061	9.20	1.82	0.41	0.16	0.05	9.70	0.49	0.02
Geomean							0.027											

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
02-05050	Buckhorn Cr.	b	6/19/2002	1553.10	< 1.00	< 5.00		14.00	16.00	< 0.030	2.44		< 0.030	1.12	< 0.07	< 0.02	< 0.01	< 0.00	3.03	< 0.02	< 0.01
02-05664	Buckhorn Cr	b	7/11/2002	920.80	3.00	< 5.00		28.00	30.00	0.030	< 0.50		0.055	1.38	0.30	0.07	< 0.01	< 0.00	2.75	# 0.07	# 0.02
03-00484	Buckhorn Cr	b	1/15/2003	410.60	4.10	< 5.00		12.00	14.00	< 0.030	0.92		0.064	1.60	< 0.05	< 0.01	< 0.02	< 0.01	4.08	< 0.02	# 0.02
03-05259	Buckhorn Cr	b	6/30/2003	1203.30	38.90	< 5.00		18.00	18.00	< 0.030	1.44		< 0.040	0.93	< 0.05	< 0.01	< 0.02	< 0.01	3.16	< 0.02	< 0.01
04-01569	Buckhorn Cr	b	2/25/2004	260.20	17.10	< 5.00		12.00	12.00	0.020	0.99		< 0.050	1.57	0.09	0.02	< 0.03	< 0.01	3.63	# 0.03	< 0.02
04-06651	Buckhorn Cr	b	8/24/2004	> 2419.60	2.00	< 5.00		24.00	30.00	0.090	1.36		< 0.050	1.31	0.67	0.15	< 0.03	< 0.01	2.76	# 0.16	< 0.02
05-02848	Buckhorn Cr	b	5/10/2005	1046.20	31.30	< 5.00		10.00	14.00	< 0.020	1.88		< 0.060	1.31	0.11	0.03	< 0.03	< 0.01	3.28	# 0.03	< 0.02
06-00714	Buckhorn Grab	b	2/3/2006			< 5.00		14.00	20.00	0.039	2.31	< 1.00	< 0.060	2.08	0.06	0.01	< 0.03	< 0.01	4.61	# 0.02	< 0.02
06-01598	BHC Grab	b	3/15/2006			< 5.00		10.00	16.00	0.060	1.37	< 0.05	< 0.060	1.91	< 0.05	< 0.01	< 0.03	< 0.01	4.34	< 0.02	< 0.02
06-01771	Buckhorn Grab	b	3/22/2006			< 5.00		8.00	12.00	0.460	1.45	0.05	< 0.060	1.50	< 0.05	< 0.01	< 0.03	< 0.01	3.96	< 0.02	< 0.02
06-02772	BH GRAB	b	5/2/2006			< 5.00		12.00	14.00	0.030	1.17	0.08	< 0.060	1.44	< 0.05	< 0.01	< 0.03	< 0.01	3.72	< 0.02	< 0.02
06-03046	Buckhorn Grab	b	5/15/2006			< 5.00			12.00	< 0.020	1.12	0.09	0.070	1.54	0.07	0.02	< 0.03	< 0.01	3.36	# 0.03	# 0.02
06-03792	BHC Grab	b	6/9/2006			< 5.00		14.00	20.00	0.050	1.03	< 0.05	< 0.040	1.44	< 0.02	< 0.00	< 0.01	< 0.00	4.37	< 0.01	< 0.01
06-06198	Buckhorn Cr. Grab	b	9/28/2006			6.25		14.00	18.00	0.090	1.10	0.06	0.047	1.31	< 0.01	< 0.01	< 0.01	< 0.00	3.53	< 0.01	# 0.02
06-07760	Buckhorn Grab	b	12/6/2006			< 5.00		8.00	10.00	0.070	0.86	< 0.05	< 0.040	1.34	0.05	0.01	< 0.01	< 0.00	3.46	# 0.01	< 0.01
07-00094	Buckhorn Grab	b	1/2/2007			< 5.00		8.00	12.00	0.050	1.34	0.10	< 0.040	1.65	0.11	0.02	< 0.01	< 0.00	3.66	# 0.03	< 0.01
07-00427	Buckhorn Grab	b	1/10/2007			10.00		4.00	10.00	0.020	1.78	0.20	< 0.040	1.25	0.21	0.05	< 0.01	< 0.00	3.45	# 0.05	< 0.01
07-01038	Buckhorn Grab	b	2/15/2007			< 5.00		22.00	14.00	0.080	1.24	0.08	< 0.040	1.12	0.21	0.05	< 0.01	< 0.00	3.84	# 0.05	< 0.01
10-07333	Buckhorn Cr	b	12/2/2010	1413.60	7.50	< 5.00	14.00	12.00	12.00	0.090	1.81	0.12	< 0.061	1.60	0.58	0.13	< 0.16	< 0.05	3.80	# 0.18	< 0.02
10-07333	Buckhorn Cr.	b	12/2/2010			< 5.00				0.09	1.81		< 0.02	1.60						0.13	
11-00960	Buckhorn Cr	b	2/17/2011	355.40	7.40	< 5.00	14.00	8.00	14.00	< 0.020	1.54	0.56	< 0.061	1.80	1.68	0.38	< 0.16	< 0.05	4.62	# 0.43	< 0.02
11-00960	Buckhorn Cr.	b	2/17/2011			< 5.00				< 0.02	1.54		< 0.02	1.80						0.38	
11-02115	Grab	b	4/14/2011			< 5.00	18.00	10.00	10.00	0.100	2.02	0.24	< 0.061	1.40	0.53	0.12	< 0.16	< 0.05	3.30	# 0.17	< 0.02
11-02815	Buckhorn Cr	b	5/19/2011	920.80	4.10	< 5.00	15.00	10.00	12.00	< 0.020	2.38	0.16	< 0.061	1.40	< 0.22	< 0.05	< 0.16	< 0.05	3.40	< 0.10	< 0.02
11-02815	Buckhorn Cr.	b	5/19/2011			< 5.00				< 0.02	2.38		< 0.02	1.40						< 0.05	
11-06751	Grab	b	11/29/2011			< 5.00	9.20	8.00	10.00	0.060	0.26	0.52	< 0.031	1.40	1.73	0.39	< 0.02	< 0.01	3.20	# 0.40	< 0.01
11-07068	Buckhorn Cr	b	12/14/2011	290.90	4.10	< 5.00	6.00	8.00	10.00	0.030	1.10	NA	0.031	1.60	1.86	0.42	< 0.16	< 0.05	3.90	# 0.47	# 0.01
11-07068	Buckhorn Cr.	b	12/14/2011			< 5.00				0.03	1.10		0.01	1.60						0.42	
12-00710	Grab	b	1/31/2012			< 5.00	7.30	6.00	10.00	0.060	1.49	0.46	< 0.061	1.40	1.73	0.39	0.16	< 0.05	3.20	# 0.44	< 0.02
12-01166	Buckhorn Cr	b	2/22/2012	186.00	1.00		6.50	8.00	10.00	< 0.020	1.04	0.35	0.123				< 0.02	< 0.01		#	# 0.04
12-01166	Buckhorn Cr.	b	2/22/2012			< 5.00				< 0.02	1.04		0.04	1.70						0.32	
12-02496	Buckhorn Cr.	b	4/25/2012			< 5.00				< 0.03	1.31		< 0.01	1.46						0.06	
12-06185	Buckhorn Cr.	b	10/23/2012			< 5.00				< 0.02	1.61		< 0.01	1.50						0.10	
13-00743	Buckhorn Cr.	b	2/5/2013			< 5.00				0.03	0.57		< 0.01	1.78						0.15	
13-02504	Buckhorn Cr.	b	5/1/2013			< 5.00				0.02	0.91		< 0.01	1.60						0.01	
	Buckhorn SW Comp	s	2/2/2006			23.38		17.50	22.50	0.038	5.77	< 1.00	0.060	1.59	0.41	0.08	0.03	0.01	3.62	# 0.10	# 0.02
	Buckhorn SW Comp	s	3/14/2006			5.50		24.50	22.50	0.060	3.74	0.08	0.060	1.82	0.05	0.01	0.03	0.01	4.49	# 0.02	# 0.02
	Buckhorn SW Comp	s	3/21/2006			8.75		11.50	15.00	0.230	2.55	0.13	0.060	1.83	0.08	0.02	0.03	0.01	4.04	# 0.03	# 0.02
	Buckhorn SW Comp	s	5/1/2006			25.25		13.50	17.50	0.123	5.66	1.02	0.214	1.26	0.16	0.04	0.03	0.01	3.37	# 0.05	# 0.07
	Buckhorn SW Comp	s	5/14/2006			11.75		9.50	12.00	0.083	3.07	0.28	0.060	1.31	0.16	0.04	0.16	0.05	3.09	# 0.08	# 0.02
	Buckhorn SW Comp	s	6/8/2006			14.42		15.00	20.50	0.105	2.27	0.21	0.040	1.48	0.13	0.03	0.01	0.00	3.55	# 0.03	# 0.01
	Buckhorn SW Comp	s	9/27/2006			29.67		11.00	20.50	0.095	4.33	0.25	0.084	1.19	0.16	0.04	0.01	0.00	3.02	# 0.04	# 0.027
	Buckhorn SW Comp	s	12/5/2006			13.50		7.00	11.00	0.093	2.96	0.12	0.040	1.27	0.18	0.04	0.01	0.00	3.23	# 0.05	# 0.013
	Buckhorn SW Comp	s	1/1/2007			17.50		6.50	13.00	0.100	3.71	0.17	0.040	1.24	0.14	0.03	0.01	0.00	3.41	# 0.03	# 0.013
	Buckhorn SW Comp	s	1/15/2007			71.25		5.50	14.00	0.183	3.47	0.18	0.040	1.06	0.18	0.04	0.01	0.00	3.19	# 0.04	# 0.013
	Buckhorn SW Comp	s	2/14/2007			11.00		6.50	15.50	0.123	2.39	0.14	0.040	1.20	0.27	0.06	0.01	0.00	3.65	# 0.07	# 0.013
	Buckhorn-SW-Comp	s	4/11/2011			43.75	71.50	11.00	12.00	0.210	5.38	0.88	0.133	1.40	0.74	0.17	0.16	0.05	3.58	# 0.22	# 0.043
	Buckhorn-SW Comp	s	11/21/2011			17.00	33.25	9.50	11.00	0.120	1.48	0.59	0.031	1.25	1.33	0.30	0.02	0.01	3.00	# 0.31	# 0.010
	Buckhorn-SW comp	s	1/25/2012			34.50	41.53	7.00	9.00	0.133	2.31	0.48	0.061	1.27	1.54	0.35	0.16	0.05	2.83	# 0.40	# 0.020
	Buckhorn-SW comp	s	1/29/2013			14.75				0.0775	4.99		0.01	1.67075						0.42875	
	Buckhorn-SW comp	s	5/21/2013			54.5				0.12	2.9138		0.01	1.17275						0.17125	
	Buckhorn-SW comp	s	6/1/2013			11.75				0.08	1.81		0.01	1.21						0.13	

Buckhorn Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	915.88	10.13	5.18	11.25	12.00	14.85	0.054	1.38	0.24	0.044	1.49	0.42	0.10	0.05	0.02	3.61	0.13	0.018
Min	186.00	1.00	5.00	6.00	4.00	10.00	0.020	0.26	0.05	0.010	0.93	0.01	0.00	0.01	0.00	2.75	0.01	0.010
Max	2419.60	38.90	10.00	18.00	28.00	30.00	0.460	2.44	1.00	0.123	2.08	1.86	0.42	0.16	0.05	4.61	0.47	0.040
Median	920.80	4.10	5.00	11.60	10.00	13.00	0.030	1.34	0.11	0.040	1.48	0.11	0.02	0.03	0.01	3.53	0.05	0.019
SD	669.20	12.55	0.88	4.55	5.77	5.83	0.075	0.53	0.26	0.023	0.23	0.62	0.14	0.06	0.02	0.51	0.15	0.006
75th %tile	1255.88	9.90	5.00	14.25	14.00	16.00	0.060	1.70	0.32	0.060	1.60	0.53	0.12	0.03	0.01	3.90	0.17	0.020
Count	12.00	12.00	34.00	8.00	25.00	26.00	35.000	35.00	18.00	35.000	34.00	25.00	25.00	26.00	26.00	25.00	34.00	26.000
90th %tile	1539.15	29.88	5.00	15.90	20.40	23.00	0.090	2.20	0.54	0.061	1.79	1.71	0.39	0.16	0.05	4.36	0.41	0.020
Geomean							0.038											

Buckhorn Creek Storm water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	#DIV/0!	#DIV/0!	24.01	48.76	11.11	15.43	0.116	3.46	0.40	0.058	1.37	0.39	0.09	0.05	0.02	3.43	0.13	0.02
Min	0.00	0.00	5.50	33.25	5.50	9.00	0.038	1.48	0.08	0.010	1.06	0.05	0.01	0.01	0.00	2.83	0.02	0.01
Max	0.00	0.00	71.25	71.50	24.50	22.50	0.230	5.77	1.02	0.214	1.83	1.54	0.35	0.16	0.05	4.49	0.43	0.07
Median	#NUM!	#NUM!	17.00	41.53	10.25	14.50	0.105	3.07	0.23	0.040	1.27	0.17	0.04	0.02	0.01	3.39	0.07	0.02
SD	#DIV/0!	#DIV/0!	17.89	20.12	5.22	4.54	0.051	1.35	0.34	0.050	0.23	0.47	0.11	0.06	0.02	0.44	0.13	0.02
75th %tile	#NUM!	#NUM!	29.67	56.51	13.00	19.75	0.123	4.33	0.56	0.060	1.48	0.37	0.08	0.03	0.01	3.61	0.17	0.02
Count	0.00	0.00	17.00	3.00	14.00	14.00	17.000	17.00	14.00	17.000	17.00	14.00	14.00	14.00	14.00	14.00	17.00	14.00
90th %tile	#NUM!	#NUM!	48.05	65.51	16.75	21.90	0.194	5.49	0.96	0.104	1.73	2.15	0.26	0.16	0.05	3.93	0.34	0.04

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
02-05051	Cove Cr.	b	6/19/2002	> 2419.60	14.80	< 5.00		92.00	96.00		3.91		< 0.030	2.08	0.26	0.06	< 0.01	< 0.00	6.17	# 0.06	< 0.010
02-05665	Cove Cr.	b	7/11/2002	> 2419.60	19.90	< 5.00		106.00	108.00		< 0.50		< 0.030	2.19	0.33	0.07	0.01	0.00	5.03	# 0.08	< 0.010
02-09993	Cove Cr	b	12/11/2002	387.30	2.00	< 5.00		94.00	106.00		0.68		< 0.030	4.12	< 0.07	< 0.02	< 0.01	< 0.00	9.65	< 0.02	< 0.010
03-00485	Cove Cr	b	1/15/2003	> 2419.60	9.80	< 5.00		82.00	90.00		1.07		0.085	4.01	0.20	0.04	< 0.02	< 0.01	9.29	# 0.05	# 0.028
03-05260	Cove Cr	b	6/30/2003	> 2419.60	17.50	< 5.00		94.00	102.00		1.19		< 0.040	1.57	0.27	0.06	< 0.02	< 0.01	5.01	# 0.07	< 0.013
04-01570	Cove Cr.	b	2/25/2004	275.50	4.10	< 5.00		72.00	84.00		1.23		< 0.050	2.35	0.41	0.09	< 0.03	< 0.01	6.02	# 0.10	< 0.016
04-06652	Cove Cr	b	8/24/2004	> 2419.60	28.50	< 5.00		110.00	114.00		< 0.40		< 0.050	2.49	0.45	0.10	< 0.03	< 0.01	5.52	# 0.11	< 0.016
05-02849	Cove Cr.	b	5/10/2005	> 2419.60	16.00	< 5.00		82.00	94.00		1.80		< 0.050	2.23	0.30	0.07	< 0.03	< 0.01	6.60	# 0.08	< 0.016
06-00709	Grab	b	2/3/2006			< 5.00		90.00	104.00	< 0.020	5.37	< 1.00	< 0.060	3.96	0.89	0.20	< 0.03	< 0.01	15.21	# 0.21	< 0.020
06-01539	CC Grab	b	3/14/2006			< 5.00		76.00	90.00	0.110	4.70	0.52	< 0.060	4.45	< 0.05	< 0.01	< 0.03	< 0.01	12.62	< 0.02	< 0.020
06-01760	cove grab	b	3/22/2006			< 5.00		68.00	76.00	0.170	3.63	0.74	< 0.060	3.01	1.38	0.31	< 0.03	< 0.01	9.15	# 0.32	< 0.020
06-02039	Cove Grab	b	4/3/2006			< 5.00		72.00	82.00	0.030	3.22	0.11	< 0.060	3.10	0.16	0.04	< 0.03	< 0.01	10.41	# 0.05	< 0.020
06-02294	CC GRAB	b	4/12/2006			< 5.00		74.00	84.00	< 0.020	1.77	< 0.05	< 0.060	3.61	0.08	0.02	< 0.03	< 0.01	9.05	# 0.03	< 0.020
06-02767	COVE GRAB	b	5/2/2006			< 5.00		76.00	86.00	< 0.020	1.69	0.20	< 0.060	2.51	0.28	0.06	< 0.03	< 0.01	7.47	# 0.07	< 0.020
06-03041	Cove Grab	b	5/15/2006			< 5.00		62.00	72.00	0.030	2.49	0.33	< 0.060	2.55	0.89	0.20	< 0.03	< 0.01	6.10	# 0.21	< 0.020
06-07106	COVE GRAB	b	11/8/2006			< 5.00		68.00	76.00	0.070	3.09	0.49	0.048	2.75	2.00	0.45	< 0.01	< 0.00	6.65	# 0.46	# 0.016
07-00437	Cove Grab	b	1/16/2007			5.00		48.00	58.00	0.030	2.00	0.44	< 0.040	1.96	1.76	0.40	< 0.01	< 0.00	6.09	# 0.40	< 0.013
10-07332	Cove Cr.	b	12/2/2010	1119.90	17.50	< 5.00	2.40	88.00	94.00	0.040	11.44	0.19	< 0.061	2.90	0.97	0.22	< 0.16	< 0.05	8.70	# 0.27	< 0.020
10-07332	Cove Cr.	b	12/2/2010			< 5.00				0.04	11.44		< 0.02	2.90						0.22	
11-00945	Cove Cr.	b	2/16/2011	547.50	27.50	< 5.00	8.70	54.00	60.00	< 0.020	2.62	0.64	< 0.061	2.50	2.83	0.64	< 0.16	< 0.05	6.90	# 0.69	< 0.020
11-00945	Cove Cr.	b	2/16/2011			< 5.00				< 0.02	2.62		< 0.02	2.50						0.64	
11-02794	Cove Cr.	b	5/18/2011	> 2419.60	30.50	< 5.00	1.20	78.00	84.00	< 0.020	8.63	0.16	< 0.061	2.20	< 0.22	< 0.05	< 0.16	< 0.05	7.00	< 0.10	< 0.020
11-02794	Cove Cr.	b	5/18/2011			< 5.00				< 0.02	8.63		< 0.02	2.20						< 0.05	
11-07067	Cove Cr.	b	12/14/2011	547.50	15.60	< 5.00	1.10	66.00	72.00	< 0.020	1.20	NA	< 0.031	2.50	3.14	0.71	< 0.16	< 0.05	7.70	# 0.76	< 0.010
11-07067	Cove Cr.	b	12/14/2011			< 5.00				< 0.02	1.20		< 0.01	2.50						0.71	
12-00426	Cove grab	b	1/18/2012			< 5.00	0.85	66.00	72.00	< 0.020	5.23	0.47	< 0.031	2.50	1.90	0.43	< 0.02	< 0.01	7.60	# 0.44	< 0.010
12-01165	Cove Cr	b	2/22/2012	209.80	2.00		2.10	62.00	68.00	< 0.020	1.43	0.55	0.153				< 0.02	< 0.01			# 0.050
12-01165	Cove Cr.	b	2/22/2012			< 5.00				< 0.02	1.43		0.05	2.50						0.46	
12-02495	Cove Cr.	b	4/25/2012			< 5.00				0.04	2.87		< 0.01	2.14						0.04	
12-06184	Cove Cr.	b	10/23/2012			< 5.00				< 0.02	3.23		< 0.01	2.72						0.14	
13-00742	Cove Cr.	b	2/5/2013			< 5.00				< 0.02	0.03		< 0.01	3.29						0.86	
13-02505	Cove Cr.	b	5/1/2013			< 5.00				0.05	0.82		< 0.01	2.24						0.06	
	Cove-SW composite	s	2/2/2006			31.23		78.00	87.50	0.026	5.82	1.00	0.071	3.00	0.49	0.11	0.03	0.01	10.61	# 0.12	# 0.023
	Cove-SW composite	s	3/13/2006			18.75		80.00	96.00	0.155	4.25	0.13	0.060	4.41	0.10	0.02	0.03	0.01	14.51	# 0.03	# 0.020
	Cove-SW composite	s	3/21/2006			63.75		78.00	89.00	0.445	4.06	0.32	0.224	3.23	0.38	0.09	0.06	0.02	12.54	# 0.10	# 0.073
	Cove-SW composite	s	4/2/2006			9.50		69.00	78.00	0.068	3.93	0.23	0.063	3.43	0.21	0.05	0.03	0.01	9.97	# 0.06	# 0.021
	Cove-SW composite	s	4/11/2006			48.89		68.00	78.00	0.250	2.59	0.07	0.063	2.95	0.09	0.02	0.03	0.01	8.63	# 0.03	# 0.020
	Cove-SW composite	s	5/1/2006			109.33		51.33	64.67	0.540	3.34	0.43	0.060	2.25	0.83	0.19	0.17	0.05	5.69	# 0.24	# 0.020
	Cove-SW composite	s	5/14/2006			49.50		91.00	86.00	1.180	11.38	3.90	0.974	3.38	0.52	0.12	0.03	0.01	6.34	# 0.13	# 0.318
	Cove-SW composite	s	11/7/2006			87.50		55.00	66.00	0.173	5.31	0.43	0.052	2.50	1.02	0.23	0.01	0.00	5.90	# 0.23	# 0.017
	Cove-SW composite	s	1/15/2007			289.00		41.00	43.00	0.318	4.46	0.39	0.040	1.55	1.00	0.22	0.01	0.00	4.24	# 0.23	# 0.013
	Cove-SW comp	s	1/10/2012			35.50	76.15	57.00	62.00	0.155	4.27	0.56	0.154	2.03	1.75	0.40	0.02	0.01	6.40	# 0.40	# 0.050
	Cove-SW composite	s	6/4/2012			22.5				0.0825	5.15775		0.01	2.30425						0.45625	
	Cove-SW composite	s	3/22/2013			55.5				0.1425	1.354525		0.01	2.56975						0.2075	
	Cove-SW composite	s	4/27/2013			311.75				0.305	3.54725		0.01	1.9885						0.2325	
	Cove-SW composite	s	5/20/2013			127.5				0.33	2.29245		0.01	1.6545						0.2545	
	Cove-SW composite	s	5/30/2013			16				0.05	0.3974		0.01	1.678						0.126	

Cove Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	1540.36	15.82	5.00	2.73	77.39	85.74	0.037	3.17	0.42	0.045	2.73	0.86	0.19	0.05	0.01	7.91	0.25	0.02
Min	209.80	2.00	5.00	0.85	48.00	58.00	0.020	0.03	0.05	0.010	1.57	0.05	0.01	0.01	0.00	5.01	0.02	0.01
Max	2419.60	30.50	5.00	8.70	110.00	114.00	0.170	11.44	1.00	0.153	4.45	3.14	0.71	0.16	0.05	15.21	0.86	0.05
Median	2419.60	16.00	5.00	1.65	76.00	84.00	0.020	2.25	0.45	0.049	2.50	0.37	0.08	0.03	0.01	7.23	0.11	0.02
SD	1010.76	9.54	0.00	2.99	15.60	15.24	0.035	3.00	0.27	0.028	0.68	0.92	0.21	0.06	0.02	2.50	0.25	0.01
75th %tile	2419.60	19.90	5.00	2.33	89.00	95.00	0.040	3.70	0.54	0.060	2.96	1.28	0.29	0.03	0.01	9.12	0.42	0.02
Count	13.00	13.00	31.00	6.00	23.00	23.00	24.000	32.00	14.00	32.000	31.00	22.00	22.00	23.00	23.00	22.00	31.00	23.00
90th %tile	2419.60	28.30	5.00	5.55	94.00	105.60	0.064	8.30	0.71	0.061	3.96	1.99	0.45	0.16	0.05	10.33	0.69	0.02
Geomean																		

Cove Creek Storm water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	#DIV/0!	#DIV/0!	85.08	76.15	66.83	75.02	0.281	4.14	0.75	0.121	2.59	0.64	0.14	0.04	0.01	8.48	0.19	0.06
Min	0.00	0.00	9.50	76.15	41.00	43.00	0.026	0.40	0.07	0.010	1.55	0.09	0.02	0.01	0.00	4.24	0.03	0.01
Max	0.00	0.00	311.75	76.15	91.00	96.00	1.180	11.38	3.90	0.974	4.41	1.75	0.40	0.17	0.05	14.51	0.46	0.32
Median	#NUM!	#NUM!	49.50	76.15	68.50	78.00	0.173	4.06	0.41	0.060	2.50	0.51	0.11	0.03	0.01	7.52	0.21	0.02
SD	#DIV/0!	#DIV/0!	93.89	#DIV/0!	15.48	16.03	0.290	2.48	1.14	0.243	0.80	0.52	0.12	0.05	0.01	3.35	0.12	0.09
75th %tile	#NUM!	#NUM!	98.42	76.15	78.00	87.13	0.324	4.81	0.53	0.067	3.11	0.95	0.22	0.03	0.01	10.45	0.24	0.04
Count	0.00	0.00	15.00	1.00	10.00	10.00	15.000	15.00	10.00	15.000	15.00	10.00	10.00	10.00	10.00	10.00	15.00	10.00
90th %tile	#NUM!	#NUM!	224.40	76.15	81.10	89.70	0.502	5.62	1.29	0.196	3.41	1.09	0.25	0.07	0.02	12.74	0.34	0.10

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
07-06616	Jenkins Creek	b	11/7/2007	547.50	26.50	< 5.00		84.00	96.00	< 0.020	2.68		< 0.040	3.88	< 0.05	< 0.01	< 0.01	< 0.00	11.80	< 0.01	< 0.013
08-00245	Jenkins Creek	b	1/9/2008	325.50	5.20	9.00		80.00	92.00	< 0.020	1.57		< 0.040	3.66	0.09	0.02	< 0.01	< 0.00	11.17	## 0.02	< 0.013
08-02754	Jenkins Creek	b	4/21/2008	686.70	14.60	< 5.00		64.00	68.00	< 0.020	1.53		< 0.040	2.19	0.36	0.08	< 0.01	< 0.00	6.08	## 0.08	< 0.013
08-04954	Jenkins Creek	b	7/16/2008	> 2,419.60	22.80	< 5.00		100.00	110.00	< 0.020	2.66		< 0.040	2.87	0.80	0.18	< 0.01	< 0.00	7.47	## 0.18	< 0.013
08-06912	Jenkins Creek	b	10/9/2008	1,986.30	19.90	< 5.00		98.00	108.00	< 0.020	2.61		< 0.040	3.13	0.45	0.10	< 0.01	< 0.00	7.93	## 0.11	< 0.013
09-01410	Jenkins Creek	b	3/5/2009	1,299.70	63.10	< 5.00		72.00	78.00	< 0.020	2.08		< 0.040	2.56	0.13	0.03	< 0.01	< 0.00	8.48	## 0.03	< 0.013
09-03586	Jenkins Creek	b	6/3/2009	> 2,419.60	107.10	< 5.00		100.00	106.00	< 0.020	1.89		< 0.040	2.58	0.62	0.14	< 0.01	< 0.00	6.67	## 0.14	< 0.013
09-05744	Jenkins Creek	b	9/2/2009	> 2,419.60	68.30	< 5.00		94.00	116.00	< 0.020	2.19		< 0.040	4.53	1.39	0.31	< 0.01	< 0.00	20.90	## 0.32	< 0.013
09-08209	Jenkins Creek	b	12/9/2009	307.60	7.50	< 5.00		82.00	92.00	< 0.020	1.45		< 0.040	2.79	0.59	0.13	< 0.01	< 0.00	9.52	## 0.14	< 0.013
10-00785	Jenkins Creek	b	2/8/2010	248.10	22.60	< 5.00		60.00	72.00	< 0.020	1.37		< 0.040	2.32	1.07	0.24	0.02	0.01	8.79	## 0.25	< 0.013
10-02851	Jenkins Creek	b	5/6/2010	1,413.60	7.50	< 5.00		104.00	118.00	0.040	1.83		< 0.061	2.80	1.15	0.26	< 0.16	< 0.05	9.80	## 0.31	< 0.020
10-04929	Jenkins Creek	b	8/3/2010	2,419.60	36.40	< 5.00		94.00	106.00	< 0.020	4.15		< 0.061	3.70	0.71	0.16	< 0.16	< 0.05	12.00	## 0.21	< 0.020
10-06768	Jenkins Creek	b	11/4/2010	1,299.70	14.60	< 5.00		74.00	104.00	0.050	3.41		< 0.061	4.80	< 0.22	< 0.05	< 0.16	< 0.05	23.00	< 0.10	< 0.020
10-07330	Jenkins Creek	b	12/2/2010			< 5.00	2.60	64.00	76.00	0.120	5.24	0.10	< 0.061	3.20	0.37	0.08	< 0.16	< 0.05	13.00	## 0.13	< 0.020
10-07330	Jenkins Creek	b	12/2/2010			< 5.00				0.12	5.24		< 0.02	3.20						0.08	
11-00236	Jenkins Creek	b	1/12/2011	166.40	1.00	< 5.00		72.00	82.00	< 0.020	2.35		< 0.061	3.20	0.66	0.15	< 0.16	< 0.05	13.00	## 0.20	< 0.020
11-00942	Jenkins Creek	b	2/16/2011	307.60	8.40	< 5.00	5 40	52.00	62.00	< 0.020	2.45	0.35	< 0.061	3.40	1.02	0.23	< 0.16	< 0.05	12.00	## 0.28	< 0.020
11-00942	Jenkins Creek	b	2/16/2011			< 5.00				< 0.02	2.45		< 0.02	3.40						0.23	
11-02235	Jenkins Creek	b	4/20/2011	> 2,419.60	22.60	< 5.00		68.00	74.00	< 0.020	6.61		< 0.061	2.50	< 0.22	< 0.05	< 0.16	< 0.05	8.60	< 0.10	< 0.020
11-02792	Jenkins Creek	b	5/18/2011	1,413.60	34.10	< 5.00	2.70	74.00	82.00	< 0.020	6.03	0.19	< 0.061	2.70	0.44	0.10	< 0.16	< 0.05	8.90	## 0.15	< 0.020
11-02792	Jenkins Creek	b	5/18/2011			< 5.00				< 0.02	6.03		< 0.02	2.70						0.10	
11-04025	Jenkins Creek	b	7/21/2011	2,419.60	1.00	< 5.00		86.00	92.00	0.060	5.18		0.061	3.70	0.62	0.14	< 0.02	< 0.01	8.40	## 0.15	## 0.020
11-05999	Jenkins Creek	b	10/25/2011	2,621.00	1.00	< 5.00		84.00	102.00	< 0.020	4.47		< 0.031				< 0.02	< 0.01			< 0.010
11-07065	Jenkins Creek	b	12/14/2011	261.30	6.30	< 5.00	1.80	62.00	72.00	< 0.020	1.20	NA	< 0.031	3.00	1.28	0.29	< 0.16	< 0.05	12.00	## 0.34	< 0.010
11-07065	Jenkins Creek	b	12/14/2011			< 5.00				< 0.02	1.20		< 0.01	3.00						0.29	< 0.003
12-01163	Jenkins Creek	b	2/22/2012	224.70	2.00		2.00	60.00	66.00	< 0.020	0.99	0.28	0.092				< 0.02	< 0.01		## 0.01	## 0.030
12-01163	Jenkins Creek	b	2/22/2012			< 5.00				< 0.02	0.99		0.03	3.10						0.23	## 0.010
12-02493	Jenkins Creek	b	4/25/2012			< 5.00				0.02	2.92		< 0.01	3.00						0.12	< 0.003
12-06181	Jenkins Creek	b	10/23/2012			< 5.00				< 0.02	1.75		< 0.01	6.50						0.09	< 0.003
13-00739	Jenkins Creek	b	2/5/2013			< 5.00				0.02	0.39		< 0.01	6.35						0.36	< 0.003
13-02501	Jenkins Creek	b	5/1/2013			< 5.00				0.03	0.87		< 0.01	2.86						0.05	< 0.003
11-02013	Jenkins-SW-grab	s	4/11/2011			19.00	65.00	46.00	54.00	0.090	6.85	0.40	< 0.061	2.60	0.66	0.15	< 0.16	< 0.05	8.80	## 0.20	< 0.020
12-00572	Jenkins-SW-grab	s	1/25/2012			33.00	65.00	26.00	30.00	0.130	5.88	0.66	0.154	1.30	1.46	0.33	< 0.02	< 0.01	6.60	## 0.34	## 0.050
																					## 0.000

Jenkins Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	1,315.57	23.45	5.13	2.90	78.55	89.73	0.030	2.77	0.23	0.040	3.37	0.61	0.14	0.07	0.02	10.98	0.16	## 0.01
Min	166.40	1.00	5.00	1.80	52.00	62.00	0.020	0.39	0.10	0.010	2.19	0.05	0.01	0.01	0.00	6.08	0.01	0.00
Max	2,621.00	107.10	9.00	5.40	104.00	118.00	0.120	6.61	0.35	0.092	6.50	1.39	0.31	0.16	0.05	23.00	0.36	0.03
Median	1,299.70	14.60	5.00	2.60	77.00	92.00	0.020	2.35	0.24	0.040	3.10	0.61	0.14	0.02	0.01	9.66	0.14	0.01
SD	955.15	26.81	0.73	1.45	15.25	17.32	0.026	1.74	0.11	0.021	1.03	0.40	0.09	0.08	0.02	4.29	0.10	0.01
75th %tile	2,419.60	26.50	5.00	2.70	92.00	105.50	0.020	3.78	0.30	0.061	3.66	0.85	0.19	0.16	0.05	12.00	0.23	0.02
Count	21.00	21.00	30.00	5.00	22.00	22.00	31.000	31.00	4.00	31.000	29.00	20.00	20.00	22.00	22.00	20.00	30.00	28.00
90th %tile	2,419.60	63.10	5.00	4.32	99.80	109.80	0.050	5.24	0.33	0.061	4.59	1.16	0.26	0.16	0.05	13.79	0.31	0.02
Geomean	895.709	11.616	5.099	2.673	77.116	88.104	0.025	2.267	0.209	0.034	3.246	0.454	0.103	0.035	0.011	10.349	0.117	0.012

Jenkins Creek Storm water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	#DIV/0!	#DIV/0!	26.00	65.00	36.00	42.00	0.110	6.36	0.53	0.107	1.95	1.06	0.24	0.09	0.03	7.70	0.27	0.04
Min	0.00	0.00	19.00	65.00	26.00	30.00	0.090	5.88	0.40	0.061	1.30	0.66	0.15	0.02	0.01	6.60	0.20	0.02
Max	0.00	0.00	33.00	65.00	46.00	54.00	0.130	6.85	0.66	0.154	2.60	1.46	0.33	0.16	0.05	8.80	0.34	0.05
Median	#NUM!	#NUM!	26.00	65.00	36.00	42.00	0.110	6.36	0.53	0.107	1.95	1.06	0.24	0.09	0.03	7.70	0.27	0.04
SD	#DIV/0!	#DIV/0!	9.90	0.00	14.14	16.97	0.028	0.69	0.18	0.065	0.92	0.56	0.13	0.10	0.03	1.56	0.10	0.02
75th %tile	#NUM!	#NUM!	29.50	65.00	41.00	48.00	0.120	6.60	0.59	0.130	2.28	1.26	0.29	0.13	0.04	8.25	0.30	0.04
Count	0.00	0.00	2.00	2.00	2.00	2.00	2.000	2.00	2.00	2.000	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
90th %tile	#NUM!	#NUM!	31.60	65.00	44.00	51.60	0.126	6.75	0.63	0.144	2.47	1.38	0.31	0.15	0.05	8.58	0.32	0.05

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2-N mg/L	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	orthoP-P
02-05018	Little Lee Cr.	b	6/18/2002	2419.60	2.00 <	5.00		58.00	64.00 <	0.030	2.67		0.033	3.23	0.22	0.05 <	0.01 <	0.00	0.05	5.78	16.00	431.01	2.59	4.53	0.011
02-05668	Little Lee Cr.	b	7/11/2002	1986.30	1.00 <	5.00		64.00	66.00	0.050 <	0.50	<	0.030	3.45	0.25	0.06 <	0.01 <	0.00	0.06	5.10	4.80	129.30	1.29	1.54	0.010
02-09995	Little Lee Cr.	b	12/11/2002	328.20	5.20 <	5.00		44.00	54.00 <	0.030	0.53		0.038	6.23 <	0.07 <	0.02 <	0.01 <	0.00	0.02	6.93	3.30	88.90	0.53	0.34	0.012
03-00482	Little Lee Cr.	b	1/5/2003 >	2419.60	10.80 <	5.00		44.00	50.00 <	0.030	0.64	<	0.040	5.04	0.22	0.05 <	0.02 <	0.01	0.06	6.79	21.00	565.70	3.39	6.29	0.013
04-01573	Little Lee Cr.	b	2/25/2004	275.50	21.10 <	5.00		46.00	58.00	0.020	2.25	<	0.050	2.76	0.36	0.08 <	0.03 <	0.01	0.09	5.34	55.00	1481.60	5.93	26.87	0.016
04-06649	Little Lee Cr.	b	8/24/2004 >	2419.60	3.10 <	5.00		70.00	70.00	0.060	0.63	<	0.050	3.02	0.23	0.05 <	0.03 <	0.01	0.06	4.68	6.70	180.49	2.17	2.18	0.016
05-02846	Little Lee Cr.	b	5/10/2005 >	2419.60	67.00 <	5.00		60.00	66.00 <	0.020	1.16	<	0.060	2.54	0.29	0.07 <	0.03 <	0.01	0.08	5.51	53.00	1427.72	5.71	21.44	0.020
06-01544	LLC Grab	b	3/13/2006		<	5.00		56.00	68.00	0.060	2.94	0.15 <	0.060	10.08	0.17	0.04 <	0.03 <	0.01	0.05	7.98	50.00	1346.91	16.16	12.74	0.020
06-01755	little lee grab	b	3/22/2006		<	5.00		36.00	44.00	0.210	2.55	0.25	0.162	4.76	0.46	0.10 <	0.03 <	0.01	0.11	6.57	128.00	3448.09	144.82	77.64	0.053
06-02285	LLC GRAB	b	4/11/2006		<	5.00		36.00	44.00	0.060	1.63 <	0.05 <	0.060	4.44	0.08	0.02 <	0.03 <	0.01	0.03	6.00	68.00	1831.80	21.98	9.72	0.020
06-02631	Little Lee Grab	b	4/27/2006		<	5.00		42.00	52.00 <	0.020	2.05	0.15	0.137	5.77	0.18	0.04 <	0.03 <	0.01	0.05	5.71	37.00	996.71	3.99	10.06	0.045
06-02782	LLC GRAB	b	5/2/2006		<	5.00		36.00	40.00	0.140	1.56	0.28 <	0.060	3.06	0.33	0.07 <	0.03 <	0.01	0.08	5.19	156.00	4202.36	117.67	69.57	0.020
06-03796	LLC Grab	b	6/9/2006			10.00		50.00	60.00	0.040	3.44	0.28 <	0.040	3.43	3.43	0.77 <	0.05	0.02	0.79	5.34	42.00	2262.81	9.05	178.77	0.013
06-07096	LITTLE LEE GRAB	b	11/8/2006		<	5.00		38.00	46.00	0.020	2.33	0.38 <	0.040	3.73	1.07	0.24 <	0.01 <	0.00	0.24	6.14	613.00	16513.12	66.05	808.30	0.013
06-07696	LITTLE LEE GRAB	b	12/4/2006			7.00		34.00	46.00	0.090	1.63	0.39 <	0.040	2.92	1.51	0.34 <	0.01 <	0.00	0.34	5.33	201.00	7580.41	97.46	373.16	0.013
07-00109	LITTLE LEE GRAB	b	1/2/2007		<	5.00		28.00	38.00	0.140	1.80	0.28 <	0.040	5.43	1.10	0.25 <	0.01 <	0.00	0.25	5.20	231.00	6222.72	174.24	311.62	0.013
07-00422	Little Lee Grab	b	1/16/2007			10.00		30.00	34.00 <	0.020	1.88	0.41 <	0.040	2.12	1.31	0.30 <	0.01 <	0.00	0.30	4.68	627.00	33780.50	67.56	1012.94	0.013
07-01048	Little Lee Grab	b	2/15/2007		<	5.00		28.00	36.00 <	0.020	1.72	0.21 <	0.040	2.02	0.70	0.16 <	0.01 <	0.00	0.16	5.22	355.00	9563.06	38.25	309.98	0.013
10-07329	Little Lee Cr.	b	12/2/2010 >	2419.60	20.10 <	5.00	2.90	48.00	54.00	0.130	6.91	0.12 <	0.061	4.20	0.53	0.12 <	0.16 <	0.05	0.17	6.90	9.60	258.61	6.72	8.79	0.020
10-07329	Little Lee Cr.	b	12/2/2010		<	5.00				0.13	6.91	<	0.02	4.20					0.12						
11-00943	Little Lee Cr.	b	2/16/2011	1119.90	18.90 <	5.00	8.10	38.00	44.00	0.040	1.99	0.23 <	0.061	3.70	0.66	0.15 <	0.16 <	0.05	0.20	7.60	40.00	1077.53	8.62	43.10	0.020
11-00943	Little Lee Cr.	b	2/16/2011		<	5.00				0.04	1.99	<	0.02	3.70					0.15						
11-02791	Little Lee Cr.	b	5/18/2011	2419.60	44.30 <	5.00	5.10	44.00	48.00 <	0.020	5.14	0.14 <	0.061	2.30 <	0.22 <	0.05 <	0.16 <	0.05	0.10	5.60	471.00	12687.89	50.75	253.76	0.020
11-02791	Little Lee Cr.	b	5/18/2011		<	5.00			<	0.02	5.14	<	0.02	2.30				<	0.05						
11-07064	Little Lee Cr.	b	12/14/2011	517.20	28.20 <	5.00	2.60	40.00	46.00 <	0.020	1.20	NA <	0.031	3.00	1.86	0.42 <	0.16 <	0.05	0.47	7.60	134.00	3609.72	14.44	339.31	0.010
11-07064	Little Lee Cr.	b	12/14/2011		<	5.00			<	0.02	1.20	<	0.01	3.00					0.42						
12-01162	Little Lee Cr.	b	2/22/2012	193.50	4.10		2.30	40.00	44.00 <	0.020	1.53	0.24	0.123			<	0.02 <	0.01	0.01		142.00	0.00	15.30	3.83	0.040
12-01162	Little Lee Cr.	b	2/22/2012		<	5.00			<	0.02	1.53		0.04	3.10					0.17						
12-02492	Little Lee Cr.	b	4/25/2012		<	5.00				0.04	2.22	<	0.01	2.90					0.07						
12-06182	Little Lee Cr.	b	10/23/2012		<	5.00			<	0.02	2.03	<	0.01	7.14					0.14						
13-00740	Little Lee Cr.	b	2/5/2013		<	5.00			<	0.02	0.33	<	0.01	5.28					0.53						
13-02502	Little Lee Cr.	b	5/1/2013		<	5.00				0.02	0.35	<	0.01	2.75					0.05						
	LLC-SW composite	s	1/13/2006			225.25		24.00	30.00	0.230	3.41	0.27	0.043	1.50	0.76	0.17	0.01	0.00	0.18	4.00	3340.00	4053310.14	4138.79	3155.20	0.014
	LLC-SW composite	s	3/14/2006			6.25		46.00	58.00	0.085	3.43	0.05	0.060	9.54	0.05	0.01	0.03	0.01	0.02	7.84	53.00	1784.66	24.27	5.83	0.020
	LLC-SW composite	s	3/20/2006			5.00		44.00	54.00	0.215	2.54	0.15	0.093	7.79	0.15	0.03	0.03	0.01	0.04	7.09	240.00	6465.17	278.00	55.40	0.030
	LLC-SW composite	s	4/7/2006			11.67		35.00	42.50	0.128	2.77	0.11	0.060	5.45	0.11	0.02	0.03	0.01	0.03	6.61	294.00	18476.97	201.96	53.92	0.020
	LLC-SW composite	s	4/25/2006			9.25		42.50	47.50	0.078	2.13	0.17	0.060	4.82	0.12	0.03	0.03	0.01	0.04	5.52	61.00	3039.98	25.47	12.22	0.020
	LLC-SW composite	s	4/29/2006			19.50		31.00	38.00	0.130	2.60	0.14	0.060	3.88	0.13	0.03	0.03	0.01	0.04	4.92	741.00	77848.70	518.99	157.31	0.020
	LLC-SW composite	s	6/7/2006			28.00		42.00	36.00	0.213	5.03	0.50	0.040	2.87	0.87	0.20	0.11	0.03	0.23	4.83	165.00	24890.90	189.64	204.35	0.013
	LLC-SW composite	s	11/6/2006			70.50		32.00	41.50	0.193	3.62	0.22	0.040	4.17	0.43	0.10	0.01	0.00	0.10	5.75	2200.00	835622.96	2281.67	1186.03	0.013
	LLC-SW composite	s	11/30/2006			161.75		30.50	37.50	0.305	3.15	0.24	0.040	2.82	0.77	0.18	0.01	0.00	0.18	5.04	2930.00	2553350.76	4814.66	2810.67	0.013
	LLC-SW composite	s	12/30/2006			129.25		24.50	31.25	0.318	3.64	0.25	0.040	2.13	0.50	0.11	0.01	0.00	0.12	4.69	2210.00	1538938.96	3780.37	1372.97	0.013
	LLC-SW composite	s	2/13/2007			56.50		25.00	34.67	0.145	2.66	0.24	0.040	2.24	0.51	0.11	0.01	0.00	0.12	6.76	1440.00	438338.39	1124.94	915.79	0.013
	LLC-SW composite	s	1/29/2013			179.5825				0.300	2.3328		0.010	24.1745										0.24	
	LLC-SW composite	s	3/10/2013			157.875				0.235	2.447		0.010	3.24925										0.24225	
	LLC-SW composite	s	5/20/2013			106.75				0.260	1.078		0.010	2.1405										0.19425	
	LLC-SW composite	s	6/1/2013			18.5				0.100	0.55135		0.010	2.32575										0.15075	

Little Lee Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2-N mg/L	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	orthoP-P
Average	1578.18	18.82	5.39	4.20	43.91	50.96	0.051	2.20	0.24	0.047	3.92	0.69	0.16	0.05	0.01	0.17	5.96	150.63	4769.00	38.03	168.98	0.02
Min	193.50	1.00	5.00	2.30	28.00	34.00	0.020	0.33	0.05	0.010	2.02	0.07	0.02	0.01	0.00	0.01	4.68	3.30	0.00	0.53	0.34	0.01
Max	2419.60	67.00	10.00	8.10	70.00	70.00	0.210	6.91	0.41	0.162	10.08	3.43	0.77	0.16	0.05	0.79	7.98	627.00	33780.50	174.24	1012.94	0.05
Median	2202.95	14.85	5.00	2.90	42.00	48.00	0.030	1.84	0.24	0.040	3.43	0.34	0.08	0.03	0.01	0.11	5.66	55.00	1481.60	14.44	26.87	0.02
SD	996.67	19.95	1.28	2.44	11.35	10.67	0.048	1.68	0.10	0.035	1.71	0.79	0.18	0.06	0.02	0.18	0.97	189.03	7684.74	50.40	268.08	0.01
75th %tile	2419.60	22.88	5.00	5.10	49.00	59.00	0.060	2.39	0.28	0.060	4.60	0.98	0.22	0.03	0.01	0.21	6.73	178.50	5212.54	58.40	281.87	0.02
Count	12.00	12.00	31.00	5.00	23.00	23.00	32.000	32.00	15.00	32.000	31.00	22.00	22.00	23.00	23.00	32.00	22.00	23.00	23.00	23.00	23.00	23.00
90th %tile	2419.60	42.69	5.00	6.90	59.60	66.00	0.130	4.97	0.38	0.061	5.77	1.49	0.34	0.16	0.05	0.41	7.53	447.80	12062.93	113.63	366.39	0.04
Geomean							0.037															

Little Lee Creek Storm Water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2-N mg/L	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	orthoP-P
Average	#DIV/0!	#DIV/0!	79.04	#DIV/0!	34.23	40.99	0.196	2.76	0.21	0.041	5.27	0.40	0.09	0.03	0.01	0.10	5.73	1243.09	868369.78	1579.89	662.03	0.02
Min	0.00	0.00	5.00	0.00	24.00	30.00	0.078	0.55	0.05	0.010	1.50	0.05	0.01	0.01	0.00	0.02	4.00	53.00	1784.66	24.27	0.15	0.01
Max	0.00	0.00	225.25	0.00	46.00	58.00	0.318	5.03	0.50	0.093	24.17	0.87	0.20	0.11	0.03	0.23	7.84	3340.00	4053310.14	4814.66	3155.20	0.03
Median	#NUM!	#NUM!	56.50	#NUM!	32.00	38.00	0.213	2.66	0.22	0.040	3.25	0.43	0.10	0.03	0.01	0.10	5.52	741.00	77848.70	518.99	55.40	0.01
SD	#DIV/0!	#DIV/0!	74.84	#DIV/0!	8.23	8.97	0.081	1.08	0.12	0.024	5.69	0.30	0.07	0.03	0.01	0.07	1.19	1235.60	1338656.47	1845.03	1051.66	0.01
75th %tile	#NUM!	#NUM!	143.56	#NUM!	42.25	45.00	0.248	3.42	0.24	0.060	5.13	0.64	0.14	0.03	0.01	0.15	6.69	2205.00	1187280.96	3031.02	1050.91	0.02
Count	0.00	0.00	15.00	0.00	11.00	11.00	15.000	15.00	11.00	15.000	15.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00	15.00	11.00
90th %tile	#NUM!	#NUM!	172.45	#NUM!	44.00	54.00	0.303	3.63	0.27	0.060	8.84	0.77	0.18	0.03	0.01	0.18	7.09	2930.00	2553350.76	4138.79	2235.59	0.02

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
02-05019	Mt.Fork Cr.	b	6/18/2002	> 2419.60	1.00	< 5.00		68.00	82.00	< 0.030	3.05		0.033	2.65	0.27	0.06	< 0.01	< 0.00	5.51	# 0.06	# 0.011
02-05669	Mt.Fork Cr.	b	7/11/2002	> 2419.60	6.30	< 5.00		76.00	80.00	< 0.030	0.70		0.051	2.89	0.38	0.08	0.01	0.00	4.84	# 0.09	# 0.017
03-00483	Mt.Fork Cr.	b	1/5/2003	> 2419.60	14.30	< 5.00		50.00	58.00	0.030	1.04		< 0.040	4.62	0.48	0.11	< 0.02	< 0.01	7.05	# 0.11	< 0.013
03-05258	Mt.Fork Cr.	b	6/30/2003	> 2419.60	16.90	< 5.00		66.00	74.00	< 0.030	< 0.50		< 0.040	2.21	0.30	0.07	< 0.02	< 0.01	4.45	# 0.07	< 0.013
04-01574	Mt.Fork Cr.	b	2/25/2004	387.30	3.10	< 5.00		54.00	58.00	< 0.020	1.37		< 0.050	2.93	0.35	0.08	< 0.03	< 0.01	5.11	# 0.09	< 0.016
04-06650	Mt.Fork Cr.	b	8/24/2004	> 2419.60	33.10	< 5.00		60.00	60.00	0.110	< 0.40		< 0.050	3.18	0.45	0.10	< 0.03	< 0.01	6.49	# 0.11	< 0.016
05-02847	Mt.Fork Cr.	b	5/10/2005	> 2419.60	101.40	< 5.00		58.00	64.00	< 0.020	1.36		< 0.060	2.55	0.21	0.05	< 0.03	< 0.01	4.89	# 0.06	< 0.020
06-01534	MF Grab	b	3/14/2006			5.00		60.00	74.00	< 0.020	2.70	< 0.05	< 0.060	10.11	0.08	0.02	< 0.03	< 0.01	12.30	# 0.03	< 0.020
06-01776	Mt. Fork Grab	b	3/22/2006			< 5.00		54.00	58.00	< 0.020	2.71	0.32	< 0.060	4.52	0.64	0.14	< 0.03	< 0.01	7.15	# 0.15	< 0.020
06-02299	MFC GRAB	b	4/12/2006			< 5.00		48.00	52.00	< 0.020	2.14	< 0.05	< 0.060	8.97	0.23	0.05	< 0.03	< 0.01	6.28	# 0.06	< 0.020
06-02777	MF GRAB	b	5/2/2006			< 5.00		44.00	48.00	0.100	1.30	0.14	< 0.060	2.98	0.32	0.07	< 0.03	< 0.01	5.64	# 0.08	< 0.020
06-03799	Mt Fork Grab	b	6/9/2006			6.00		56.00	66.00	0.030	3.31	0.18	< 0.040	3.51	0.29	0.07	< 0.01	< 0.00	5.70	# 0.07	< 0.013
06-06188	Mt. Fork Grab	b	9/26/2006			8.00		64.00	60.00	0.020	2.71	0.34	< 0.040	3.76	0.84	0.19	< 0.01	< 0.00	6.20	# 0.19	< 0.013
06-07111	MT FORK GRAB	b	11/8/2006			p< 5.00		44.00	50.00	0.030	2.30	0.18	< 0.040	2.93	0.56	0.13	< 0.01	< 0.00	5.04	# 0.13	< 0.013
06-07691	MT FORK GRAB	b	12/4/2006			< 5.00		36.00	44.00	0.080	1.63	0.13	< 0.040	2.20	0.49	0.11	< 0.01	< 0.00	4.75	# 0.11	< 0.013
07-00104	MT FORK GRAB	b	1/2/2007			10.00		36.00	40.00	0.090	1.89	0.15	< 0.040	12.75	0.37	0.08	< 0.01	< 0.00	4.63	# 0.09	< 0.013
07-00432	Mt. Fork Grab	b	1/16/2007			< 5.00		32.00	40.00	0.080	1.80	0.18	< 0.040	1.60	0.49	0.11	< 0.01	< 0.00	4.32	# 0.11	< 0.013
07-01053	Mt. Fork Grab	b	2/15/2007			< 5.00		28.00	40.00	0.020	1.48	0.11	< 0.040	1.76	0.37	0.08	< 0.01	< 0.00	4.88	# 0.09	< 0.013
10-07331	Mt.Fork Cr.	b	12/2/2010	980.40	37.30	< 5.00	3.10	50.00	54.00	0.060	5.70	0.08	< 0.061	2.90	0.39	0.09	< 0.16	< 0.05	5.80	# 0.14	< 0.020
10-07331	Mt.Fork Cr.	b	12/2/2010			< 5.00				0.06	5.70		< 0.02	2.90						0.09	< 0.007
11-00944	Mt.Fork Cr.	b	2/16/2011	307.60	33.10	< 5.00	9.00	40.00	46.00	0.040	1.95	0.28	< 0.061	2.80	0.93	0.21	< 0.16	< 0.05	6.20	# 0.26	< 0.020
11-00944	Mt.Fork Cr.	b	2/16/2011			< 5.00				0.04	1.95		< 0.02	2.80						0.21	< 0.007
11-02793	Mt.Fork Cr.	b	5/18/2011	2419.60	13.50	< 5.00	3.10	46.00	52.00	< 0.020	5.66	0.12	< 0.061	2.00	< 0.22	< 0.05	< 0.16	< 0.05	5.20	< 0.10	< 0.020
11-02793	Mt.Fork Cr.	b	5/18/2011			< 5.00				< 0.02	5.66		< 0.02	2.00						< 0.05	< 0.007
11-07066	Mt.Fork Cr.	b	12/14/2011	648.80	12.10	< 5.00	1.90	42.00	46.00	< 0.020	1.20	NA	< 0.031	2.60	1.99	0.45	< 0.16	< 0.05	5.90	# 0.50	< 0.010
11-07066	Mt.Fork Cr.	b	12/14/2011			< 5.00				< 0.02	1.20		< 0.01	2.60						0.45	< 0.003
12-01164	Mt.Fork Cr.	b	2/22/2012	172.20	1.00		1.90	44.00	46.00	0.020	1.72	0.35	0.031				< 0.02	< 0.01			# 0.010
12-01164	Mt.Fork Cr.	b	2/22/2012			< 5.00				0.02	1.72		0.01	2.50						0.30	# 0.003
12-02494	Mt.Fork Cr.	b	4/25/2012			< 5.00				< 0.02	2.28		< 0.01	2.73						0.07	< 0.003
12-06183	Mt.Fork Cr.	b	10/23/2012			< 5.00				0.02	2.24		< 0.01	5.67						0.31	< 0.003
13-00741	Mt.Fork Cr.	b	2/5/2013			< 5.00				< 0.02	1.04		< 0.01	3.94						0.97	< 0.003
13-02503	Mt.Fork Cr.	b	5/1/2013			< 5.00				0.04	0.71		< 0.01	2.23						0.03	< 0.003
	Mtn Fk-SW composite	s	3/13/2006			5.00		45.00	77.00	0.023	3.42	0.09	0.060	21.67	0.24	0.05	0.03	0.01	9.57	# 0.06	# 0.020
	Mtn Fk-SW composite	s	3/21/2006			14.75		50.00	64.50	0.210	3.18	0.19	0.060	7.79	0.24	0.06	0.03	0.01	9.23	# 0.06	# 0.020
	Mtn Fk-SW composite	s	4/11/2006			12.58		46.67	52.50	0.093	3.05	0.15	0.095	4.95	0.15	0.03	0.03	0.01	6.58	# 0.04	# 0.031
	Mtn Fk-SW composite	s	5/1/2006			31.75		43.50	51.00	0.160	2.81	0.20	0.061	4.10	0.29	0.06	0.03	0.01	5.72	# 0.07	# 0.020
	Mtn Fk-SW composite	s	6/8/2006			18.00		49.00	61.00	0.020	4.49	0.24	0.040	4.20	0.44	0.10	0.01	0.00	5.36	# 0.10	# 0.013
	Mtn Fk-SW composite	s	9/25/2006			102.92		49.50	64.50	0.303	3.10	0.31	0.040	4.02	0.60	0.14	0.01	0.00	4.67	# 0.14	# 0.013
	Mtn Fk-SW composite	s	11/7/2006			98.50		47.50	55.50	0.213	4.21	0.44	0.046	3.46	0.37	0.09	0.07	0.02	5.60	# 0.11	# 0.015
	Mtn Fk-SW composite	s	12/3/2006			111.00		35.00	44.50	0.198	3.48	0.19	0.040	2.75	0.43	0.10	0.01	0.00	4.43	# 0.10	# 0.013
	Mtn Fk-SW composite	s	1/1/2007			58.00		34.50	42.00	0.245	3.19	0.16	0.040	2.31	0.26	0.06	0.01	0.00	4.62	# 0.06	# 0.013
	Mtn Fk-SW composite	s	1/15/2007			95.25		24.50	31.00	0.273	3.40	0.24	0.040	1.49	0.37	0.08	0.01	0.00	3.75	# 0.09	# 0.013
	Mtn Fk-SW composite	s	2/14/2007			53.50		32.00	41.50	0.150	3.00	0.24	0.066	2.08	0.37	0.08	0.01	0.00	4.98	# 0.09	# 0.022

Mountain Fork Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	1,619.46	22.76	5.29	3.80	50.26	56.17	0.038	2.22	0.18	0.038	3.67	0.48	0.11	0.04	0.01	5.83	0.17	0.01
Min	172.20	1.00	5.00	1.90	28.00	40.00	0.020	0.40	0.05	0.010	1.60	0.08	0.02	0.01	0.00	4.32	0.03	0.00
Max	2,419.60	101.40	10.00	9.00	76.00	82.00	0.110	5.70	0.35	0.061	12.75	1.99	0.45	0.16	0.05	12.30	0.97	0.02
Median	2,419.60	13.90	5.00	3.10	50.00	54.00	0.025	1.85	0.15	0.040	2.89	0.37	0.08	0.02	0.01	5.58	0.10	0.01
SD	1,007.51	27.83	1.04	2.97	12.20	12.53	0.027	1.51	0.10	0.018	2.51	0.39	0.09	0.06	0.02	1.65	0.19	0.01
75th %tile	2,419.60	33.10	5.00	3.10	59.00	62.00	0.040	2.70	0.23	0.053	3.64	0.49	0.11	0.03	0.01	6.20	0.17	0.02
Count	12.00	12.00	31.00	5.00	23.00	23.00	32.000	32.00	15.00	32.000	31.00	22.00	22.00	23.00	23.00	22.00	31.00	32.00
90th %tile	2,419.60	36.88	5.00	6.64	65.60	74.00	0.080	5.43	0.33	0.060	5.67	0.82	0.19	0.16	0.05	6.99	0.31	0.02
Geomean							0.031											

Mountain Fork Storm water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	#DIV/0!	#DIV/0!	54.66	#DIV/0!	41.56	53.18	0.171	3.39	0.22	0.053	5.35	0.34	0.08	0.02	0.01	5.87	0.08	0.02
Min	0.00	0.00	5.00	0.00	24.50	31.00	0.020	2.81	0.09	0.040	1.49	0.15	0.03	0.01	0.00	3.75	0.04	0.01
Max	0.00	0.00	111.00	0.00	50.00	77.00	0.303	4.49	0.44	0.095	21.67	0.60	0.14	0.07	0.02	9.57	0.14	0.03
Median	#NUM!	#NUM!	53.50	#NUM!	45.00	52.50	0.198	3.19	0.20	0.046	4.02	0.37	0.08	0.01	0.00	5.36	0.09	0.02
SD	#DIV/0!	#DIV/0!	40.97	#DIV/0!	8.61	13.13	0.094	0.52	0.09	0.017	5.68	0.12	0.03	0.02	0.01	1.90	0.03	0.01
75th %tile	#NUM!	#NUM!	96.88	#NUM!	48.25	62.75	0.229	3.45	0.24	0.061	4.57	0.40	0.09	0.03	0.01	6.15	0.10	0.02
Count	0.00	0.00	11.00	0.00	11.00	11.00	11.000	11.00	11.00	11.000	11.00	11.00	11.00	11.00	11.00	11.00	11.00	11.00
90th %tile	#NUM!	#NUM!	102.92	#NUM!	49.50	64.50	0.273	4.21	0.31	0.07	7.79	0.44	0.10	0.03	0.01	9.23	0.11	0.02

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2 N (mg/L)	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	OrthoP-P
06-00719	Upper Lee Creek Grab	b	2/3/2006			< 5.00		40.00	46.00	< 0.020	2.71	< 1.00	< 0.060	4.74	0.32	0.07	< 0.03	< 0.01	0.08	6.47	2.10	86.92	0.23	0.92	0.020
06-01603	ULC Grab	b	3/15/2006			6.00		38.00	46.00	0.350	2.51	0.32	< 0.060	2.98	0.79	0.18	< 0.03	< 0.01	0.19	7.93	78.00	3902.47	147.08	78.64	0.020
06-01766	Upper Lee Grab	b	3/22/2006			< 5.00		32.00	40.00	0.350	2.18	0.45	< 0.060	2.41	0.79	0.18	< 0.03	< 0.01	0.19	6.21	275.00	11466.85	518.56	278.93	0.020
06-02290	GRAB ULC	b	4/12/2006			< 5.00		36.00	40.00	0.030	1.49	< 0.05	< 0.060	3.27	< 0.05	< 0.01	< 0.03	< 0.01	0.02	5.96	89.00	3710.65	14.38	9.80	0.020
06-03591	Upper Lee Creek Grab	b	6/6/2006			< 5.00			46.00	< 0.020	1.62	0.10	< 0.040	2.04	0.23	0.05	< 0.01	< 0.00	0.06	5.11	491.00	20474.05	52.91	147.88	0.013
06-06029	Upper Lee Creek Grab	b	9/22/2006			< 5.00		58.00	54.00	0.020	1.98	0.17	< 0.040	1.88	0.51	0.12	0.01	0.00	0.12	6.60	71.00	2960.05	7.65	45.58	0.013
06-06193	Upper Lee Creek Grab	b	9/28/2006			11.43		48.00	56.00	< 0.020	1.87	0.10	< 0.040	2.17	0.20	0.05	< 0.01	< 0.00	0.05	5.98	109.00	10389.91	11.75	28.32	0.013
06-07101	UPPER LEE GRAB	b	11/8/2006			< 5.00		32.00	40.00	0.040	2.11	0.21	< 0.040	2.16	< 0.59	0.13	< 0.01	< 0.00	0.14	4.94	777.00	32400.25	167.45	572.55	0.013
06-07765	Upper Lee Cr Grab	b	12/7/2006			< 5.00		26.00	26.00	0.040	1.77	0.23	< 0.040	2.16	0.53	0.12	< 0.01	< 0.00	0.12	4.53	441.00	18389.05	95.04	291.15	0.013
07-00099	Upper Lee Cr Grab	b	1/2/2007			< 5.00		22.00	26.00	0.030	1.21	0.13	< 0.040	1.99	0.50	0.11	< 0.01	< 0.00	0.12	4.53	925.00	38571.85	149.51	575.78	0.013
07-00450	ULC Grab	b	1/18/2007			9.00		20.00	24.00	0.030	2.08	0.25	< 0.040	1.67	0.79	0.18	< 0.01	< 0.00	0.18	4.28	992.00	74458.87	160.34	974.84	0.013
07-01043	Upper Lee Creek Grab	b	2/15/2007			< 5.00				0.020	1.31	0.20	< 0.040	1.65	0.84	0.19	< 0.01	< 0.00	0.19	4.48	1140.00	47537.35	122.84	1181.32	0.013
10-07451	Upper Lee Cr.	b	12/7/2010	1553.10	43.20	< 5.00	1.50	26.00	32.00	< 0.020	1.56	0.27	< 0.061	8.20	0.84	0.19	< 0.16	< 0.05	0.24	7.70	58.00	2417.95	6.25	75.00	0.020
10-07451	Upper Lee Cr.	b	12/7/2010			< 5.00				< 0.02	1.56		< 0.02	8.20					0.19						
11-00961	Upper Lee Cr.	b	2/17/2011	> 2419.60	21.30	< 5.00	12.00	20.00	28.00	< 0.020	1.99	0.76	< 0.061	7.00	2.66	0.60	< 0.16	< 0.05	0.65	6.90	428.00	17846.95	46.12	1498.84	0.020
11-00961	Upper Lee Cr.	b	2/17/2011			< 5.00				< 0.02	1.99		< 0.02	7.00					0.60						
11-02795	Upper Lee Cr.	b	5/18/2011	1986.30	13.20	< 5.00	6.60	22.00	36.00	0.040	3.01	0.10	< 0.061	3.20	< 0.22	< 0.05	< 0.16	< 0.05	0.10	4.90	220.00	9173.35	47.41	118.53	0.020
11-02795	Upper Lee Cr.	b	5/18/2011			< 5.00				0.04	3.01		< 0.02	3.20					< 0.05						
11-07034	Upper Lee Cr.	b	12/13/2011	461.10	9.70	< 5.00	2.70	20.00	24.00	< 0.020	1.20	NA	0.061	3.80	3.32	0.75	< 0.16	< 0.05	0.80	6.90	506.00	21099.55	54.52	2180.92	0.020
11-07034	Upper Lee Cr.	b	12/13/2011			< 5.00				< 0.02	1.20		0.02	3.80					0.75						
12-01167	Upper Lee Cr.	b	2/22/2012	686.70	1.00		5.80	16.00	22.00	< 0.020	0.99	0.51	0.123				< 0.02	< 0.01	0.01		293.00	-0.65	31.57	7.89	0.040
12-01167	Upper Lee Cr.	b	2/22/2012			< 5.00				< 0.02	0.99		0.04	4.20					0.45						
12-02509	Upper Lee Cr.	b	4/26/2012			< 5.00				0.03	1.58		< 0.01	2.43					0.06						
12-06186	Upper Lee Cr.	b	10/23/2012			< 5.00				< 0.02	2.85		< 0.01	36.76					0.99						
13-00744	Upper Lee Cr.	b	2/5/2013			< 5				< 0.02	1.18		< 0.01	11.51					0.59						
13-02478	Upper Lee Cr.	b	4/30/2013			< 5				< 0.02	0.76		< 0.01	3.57					0.114						
	Upper LC-SW comp	s	2/2/2006			14.99		48.00	42.00	0.021	4.28	1.00	0.060	3.94	0.55	0.12	0.03	0.01	0.13	5.33	1.80	224.31	0.20	1.28	0.020
	Upper LC-SW comp	s	3/14/2006			16.36		57.50	62.00	0.053	3.43	0.19	0.060	4.83	0.25	0.06	0.03	0.01	0.07	12.53	148.00	20186.66	41.86	52.94	0.020
	Upper LC-SW comp	s	3/21/2006			7.75		38.00	43.50	0.405	2.57	0.24	0.060	2.63	0.37	0.08	0.03	0.01	0.09	7.27	414.00	26758.24	903.35	205.28	0.020
	Upper LC-SW comp	s	4/8/2006			10.05		32.50	37.50	0.113	1.95	0.05	0.060	3.80	0.06	0.01	0.03	0.01	0.02	5.88	369.00	30920.13	223.65	43.76	0.020
	Upper LC-SW comp	s	6/4/2006			34.07		45.50	47.50	0.140	3.38	0.39	0.153	2.36	0.65	0.15	0.32	0.10	0.24	5.05	45.00	12784.89	33.94	58.90	0.050
	Upper LC-SW comp	s	9/18/2006			284.50		44.50	49.00	0.558	3.49	0.29	0.054	2.45	0.73	0.17	0.01	0.00	0.17	5.56	963.00	2284938.34	2892.48	881.84	0.018
	Upper LC-SW comp	s	9/23/2006			138.12		36.50	49.00	0.363	3.70	0.31	0.040	1.75	0.61	0.14	0.01	0.00	0.14	5.05	1280.00	1474484.67	2499.86	964.61	0.013
	Upper LC-SW comp	s	11/6/2006			69.50		31.00	34.50	0.153	3.94	0.25	0.070	2.40	0.51	0.12	0.01	0.00	0.12	4.83	4110.00	2382278.65	3376.84	2643.72	0.023
	Upper LC-SW comp	s	11/30/2006			143.25		20.50	26.50	0.353	3.84	0.23	0.050	1.68	0.30	0.07	0.01	0.00	0.07	3.88	8730.00	10429774.00	16579.52	3322.57	0.016
	Upper LC-SW comp	s	12/30/2006			32.92		19.00	28.50	0.048	3.02	0.18	0.040	1.73	0.25	0.06	0.01	0.00	0.06	4.33	3590.00	985569.05	918.73	1153.33	0.013
	Upper LC-SW comp	s	1/13/2007			162.25		17.50	24.50	0.278	2.83	0.25	0.040	1.44	0.64	0.14	0.01	0.00	0.15	3.66	9150.00	12381459.10	13679.89	7232.30	0.013
	Upper LC-SW comp	s	2/13/2007			38.00		14.00	25.50	0.125	2.25	0.21	0.040	1.78	0.55	0.12	0.01	0.00	0.13	11.15	3570.00	1131403.75	2404.23	2435.11	0.013

Upper Lee Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2 N (mg/L)	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	OrthoP-P
Average	1421.36	17.68	5.46	5.72	30.40	36.63	0.050	1.80	0.30	0.042	5.28	0.82	0.19	0.05	0.02	0.27	5.84	405.59	18522.68	96.09	474.52	0.02
Min	461.10	1.00	5.00	1.50	16.00	22.00	0.020	0.76	0.05	0.010	1.65	0.05	0.01	0.01	0.00	0.01	4.28	2.10	-0.65	0.23	0.92	0.01
Max	2419.60	43.20	11.43	12.00	58.00	56.00	0.350	3.01	1.00	0.123	36.76	3.32	0.75	0.16	0.05	0.99	7.93	1140.00	74458.87	518.56	2180.92	0.04
Median	1553.10	13.20	5.00	5.80	26.00	38.00	0.020	1.69	0.22	0.040	3.20	0.56	0.13	0.02	0.01	0.16	5.97	293.00	11466.85	52.91	147.88	0.02
SD	835.89	16.02	1.49	4.10	11.86	11.04	0.089	0.64	0.26	0.025	7.02	0.89	0.20	0.07	0.02	0.28	1.19	359.28	19995.65	123.84	632.13	0.01
75th %tile	1986.30	21.30	5.00	6.60	37.00	46.00	0.030	2.10	0.35	0.060	4.74	0.81	0.18	0.03	0.01	0.40	6.68	506.00	21099.55	147.08	575.78	0.02
Count	5.00	5.00	25.00	5.00	15.00	16.00	26.000	26.00	16.00	26.000	25.00	16.00	16.00	17.00	17.00	26.00	16.00	17.00	17.00	17.00	17.00	17.00
90th %tile	2246.28	34.44	5.60	9.84	44.80	50.00	0.040	2.78	0.63	0.061	8.20	1.75	0.40	0.16	0.05	0.70	7.30	951.80	42158.05	163.18	1308.33	0.02
Geomean							0.030															

Upper Lee Creek Strom Water summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as $CaCO_3$	Total Hardness, mg/L as $CaCO_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	NO3-NO2 N (mg/L)	Sulfate, mg/L	USGS daily discharge (cfs)	TSS lb/day	Total Phosphorus lb/day	NO3-NO2-N lb/day	OrthoP-P
Average	#DIV/0!	#DIV/0!	79.31	#DIV/0!	33.71	39.17	0.217	3.22	0.30	0.060	2.57	0.45	0.10	0.04	0.01	0.12	6.21	2697.57	2596731.82	3629.55	1582.97	0.02
Min	0.00	0.00	7.75	0.00	14.00	24.50	0.021	1.95	0.05	0.040	1.44	0.06	0.01	0.01	0.00	0.02	3.66	1.80	224.31	0.20	1.28	0.01
Max	0.00	0.00	284.50	0.00	57.50	62.00	0.558	4.28	1.00	0.153	4.83	0.73	0.17	0.32	0.10	0.24	12.53	9150.00	12381459.10	16579.52	7232.30	0.05
Median	#NUM!	#NUM!	36.03	#NUM!	34.50	39.75	0.146	3.41	0.24	0.057	2.38	0.53	0.12	0.01	0.00	0.12	5.19	1121.50	1058486.40	1661.48	923.23	0.02
SD	#DIV/0!	#DIV/0!	85.57	#DIV/0!	13.83	11.72	0.170	0.71	0.24	0.031	1.07	0.21	0.05	0.09	0.03	0.06	2.81	3275.74	4226415.69	5538.70	2116.68	0.01
75th %tile	#NUM!	#NUM!	139.40	#NUM!	44.75	47.88	0.355	3.74	0.29	0.060	2.92	0.61	0.14	0.03	0.01	0.14	6.22	3720.00	2309273.42	3013.57	2487.26	0.02
Count	0.00	0.00	12.00	0.00	12.00	12.00	12.000	12.00	12.00	12.000	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00	12.00
90th %tile	#NUM!	#NUM!	160.35	#NUM!	47.75	49.00	0.401	3.93	0.38	0.069	3.92	0.65	0.15	0.03	0.01	0.17	10.76	8268.00	9625024.47	12649.59	3254.68	0.02

Control Number	Sample Number	Type	Date Collected	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as CaCO$_3$	Total Hardness, mg/L as CaCO$_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
02-05017	Weber Cr.	b	6/18/2002	> 2419.60	8.60	< 5.00		40.00	44.00	< 0.030	3.30		< 0.030	3.06	0.08	0.02	< 0.01	< 0.00	4.72	# 0.02	< 0.010
02-05667	Weber Cr.	b	7/11/2002	> 2419.60	< 1.00	< 5.00		48.00	52.00	0.050	1.80		0.039	3.64	0.11	0.03	< 0.01	< 0.00	4.19	# 0.03	# 0.013
02-09994	Weber Cr.	b	12/11/2002	> 2419.60	3.10	< 5.00		40.00	44.00	0.100	2.35		< 0.030	5.09	< 0.07	< 0.02	< 0.01	< 0.00	4.55	< 0.02	< 0.010
03-00481	Weber Cr.	b	1/5/2003	1203.30	19.70	< 5.00		12.00	20.00	< 0.030	0.97		0.065	6.87	1.81	0.41	< 0.02	< 0.01	5.40	# 0.41	# 0.021
03-05257	Weber Cr.	b	6/30/2003	> 2419.60	8.60	< 5.00		42.00	48.00	< 0.030	1.37		< 0.040	2.85	0.13	0.03	< 0.02	< 0.01	4.26	# 0.04	< 0.013
04-01572	Weber Cr.	b	2/25/2004	307.60	9.70	< 5.00		32.00	48.00	< 0.020	1.30		< 0.050	3.62	0.64	0.14	< 0.03	< 0.01	5.11	# 0.15	< 0.016
04-06648	Weber Cr.	b	8/24/2004	> 2419.60	5.20	< 5.00		46.00	48.00	0.040	1.62		< 0.050	3.35	0.19	0.04	< 0.03	< 0.01	4.02	# 0.05	< 0.016
05-02845	Weber Cr.	b	5/10/2005	> 2419.60	14.40	< 5.00		38.00	48.00	< 0.020	2.10		< 0.060	2.96	0.34	0.08	< 0.03	< 0.01	4.63	# 0.09	< 0.020
10-07328	Weber Cr.	b	12/2/2010	1553.10	37.30	< 5.00	4.90	14.00	18.00	0.060	1.43	0.28	< 0.061	5.30	0.84	0.19	< 0.16	< 0.05	6.40	# 0.24	< 0.020
11-00941	Weber Cr.	b	2/16/2011	648.80	49.60	< 5.00	7.40	10.00	16.00	0.050	1.50	0.42	< 0.061	5.90	1.59	0.36	< 0.16	< 0.05	7.40	# 0.41	< 0.020
11-02790	Weber Cr.	b	5/18/2011	2419.60	51.20	< 5.00	8.30	14.00	16.00	< 0.020	3.04	0.14	< 0.061	2.60	< 0.22	< 0.05	< 0.16	< 0.05	5.30	< 0.10	< 0.020
11-07063	Weber Cr.	b	12/14/2011	461.10	17.30	< 5.00	2.40	10.00	16.00	< 0.020	1.50	NA	< 0.031	4.00	6.64	1.50	< 0.16	< 0.05	6.60	# 1.55	< 0.010
12-01161	Weber Cr.	b	2/22/2012	195.60	8.50		2.40	10.00	12.00	< 0.020	1.70	0.59	< 0.031				< 0.02	< 0.01			< 0.010
10-07328	Weber Cr.	b	12/2/2010			< 5.00				0.060	1.43		< 0.02	5.30						0.19	
11-00941	Weber Cr.	b	2/16/2011			< 5.00				0.050	1.50		< 0.02	5.90						0.36	
11-02790	Weber Cr.	b	5/18/2011			< 5.00				< 0.020	3.04		< 0.02	2.60						< 0.05	
11-07063	Weber Cr.	b	12/14/2011			< 5.00				< 0.020	1.50		< 0.01	4.00						1.50	
12-01161	Weber Cr.	b	2/22/2012			< 5.00				< 0.020	1.70		< 0.01	4.00						0.52	
12-02491	Weber Cr.	b	4/25/2012			< 5.00				0.030	1.56		< 0.01	2.94						0.08	
12-06180	Weber Cr.	b	10/23/2012			< 5.00				< 0.020	1.85		< 0.01	3.62						0.58	
13-00738	Weber Cr.	b	2/5/2013			< 5.00				< 0.020	1.32		< 0.01	5.41						0.77	
13-02500	Weber Cr.	b	5/1/2013			< 5.00				0.040	0.77		< 0.01	3.67						0.118	

Weber Creek Baseline summary statistics	Total Coliform, Colony/100 mL	E. coli, Colony/100 mL	TSS, mg/L	Turbidity, NTU	Total Alkalinity, mg/L as CaCO$_3$	Total Hardness, mg/L as CaCO$_3$	Total Phosphorous, mg/L	TOC, mg/L	Total Nitrogen, mg/L	Orthophosphate, mg/L	Chloride, mg/L	Nitrate, mg/L	Nitrate as N, mg/L	Nitrite, mg/L	Nitrite as N, mg/L	Sulfate, mg/L	NO3-NO2-N	Ortho-P-P
Average	1638.98	18.02	5.00	5.08	27.38	33.08	0.035	1.76	0.36	0.033	4.13	1.06	0.24	0.06	0.02	5.21	0.35	0.02
Min	195.60	1.00	5.00	2.40	10.00	12.00	0.020	0.77	0.14	0.010	2.60	0.07	0.02	0.01	0.00	4.02	0.02	0.01
Max	2419.60	51.20	5.00	8.30	48.00	52.00	0.100	3.30	0.59	0.065	6.87	6.64	1.50	0.16	0.05	7.40	1.55	0.02
Median	2419.60	9.70	5.00	4.90	32.00	44.00	0.030	1.53	0.35	0.030	3.67	0.28	0.06	0.03	0.01	4.91	0.15	0.02
SD	943.69	17.08	0.00	2.75	15.65	16.34	0.020	0.65	0.20	0.020	1.24	1.86	0.42	0.07	0.02	1.07	0.44	0.00
75th %tile	2419.60	19.70	5.00	7.40	40.00	48.00	0.048	1.84	0.46	0.050	5.30	1.03	0.23	0.16	0.05	5.65	0.41	0.02
Count	13.00	13.00	21.00	5.00	13.00	13.00	22.000	22.00	4.00	22.000	21.00	12.00	12.00	13.00	13.00	12.00	21.00	13.00
90th %tile	2419.60	47.14	5.00	7.94	45.20	48.00	0.059	2.97	0.54	0.061	5.90	1.79	0.40	0.16	0.05	6.58	0.77	0.02
Geomean							0.031											

Appendix B

GBMc Water Quality Data

Upper Little Lee Ck (LLC-1)

Sample Type	Sample ID	Sample Date	Flow (cfs)	BOD, mg/L	TSS, mg/L	PO_4 as P, mg/L	NH_3 as N, mg/L	NO_3+NO_2 as N, mg/L	Chloride, mg/L	Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	LLC-1	1/17/2012	29.9	< 2.00	< 5.00	< 0.02	< 0.05	< 0.5	NA	< 0.020	1.77	3.2	805.5	8.1	80.5	3.2	322.2	284.5	36.2	23168	0.034766	0.003477	0.000139
Baseline Dup	LLC-1-D	1/17/2012	29.9	< 2.00	< 5.00	< 0.02	0.08	< 0.5	NA	< 0.020	1.32	3.2	805.5	12.9	80.5	3.2	322.2	213.0	36.2	23168	0.034766	0.003477	0.000139
Storm Event	LLC-1	1/25/2012	228.0	I 6.74	36.00	< 0.02	< 0.05	< 0.5	NA	0.400	3.47	24.6	44221.7	61.4	614.2	491.4	8279.3	4264.9	36.2	23168	1.908743	0.02651	0.021208
Baseline	LLC-1	3/28/2012	58.0	< 2.00	< 5.00	< 0.02	< 0.05	0.46	2.1	0.040	0.21	6.2	1562.4	15.6	143.7	12.5	625.0	66.3	36.2	23168	0.067439	0.006204	0.00054
Storm Event	LLC-1	4/15/2012	23.1	< 2.00	< 5.00	< 0.02	< 0.05	0.17	3.3	< 0.020	2.67	2.5	622.3	6.2	21.2	2.5	248.9	332.8	36.2	23168	0.026859	0.000913	0.000107
Storm Event	LLC-1	3/16/2014	54.7		9.00	< 0.02	< 0.05	0.16	3.12	< 0.02		5.9	2652.3	14.7	47.7	5.9			36.2	23168	0.114483	0.002061	0.000254
Storm Event	LLC-1	4/4/2014	136.0		13.00	< 0.02	< 0.05	0.29	2.53	0.02		14.7	9525.3	36.6	212.5	14.7			36.2	23168	0.411142	0.009172	0.000633
Storm Event-Dı	LLC-1D	4/4/2014	136.0		13.00	< 0.02	< 0.05	0.29	2.55	0.02		14.7	9525.3	36.6	211.0	14.7			36.2	23168	0.411142	0.009108	0.000633
Storm Event	LLC-1	5/8/2014	12.1		< 5.00	< 0.02	< 0.05	0.14	3.38	0.02		1.3	326.0	3.3	9.1	1.3			36.2	23168	0.014069	0.000391	5.63E-05
Baseflow summary																							
Average				2.00	5.00	0.020	0.05	0.48	2.10	0.030	0.99	4.7	1183.9	11.8	112.1	7.9	473.6	175.4			0.0511	0.0048	0.0003
Min				2.00	5.00	0.020	0.05	0.46	2.10	0.020	0.21	3.2	805.5	8.1	80.5	3.2	322.2	66.3			0.0348	0.0035	0.0001
Max				2.00	5.00	0.020	0.05	0.50	2.10	0.040	1.77	6.2	1562.4	15.6	143.7	12.5	625.0	284.5			0.0674	0.0062	0.0005
Stdev				0	0	0.000	0	0.028284	#DIV/0!	0.014	1.098632	2.1	535.3	5.4	44.7	6.6	214.1	154.3			0.0231	0.0019	0.0003
Median				2.00	5.00	0.020	0.05	0.48	2.10	0.030	0.99	4.7	1183.9	11.8	112.1	7.9	473.6	175.4			0.0511	0.0048	0.0003
n				2	2	2.000	2	2	1	2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
										0.028													
Storm flow summary																							
Average				4.37	13.60	0.02	0.05	0.25	3.08	0.10	3.07	9.78	11469.53	24.45	180.93	103.14	4264.10	2298.87			0.4951	0.0078	0.0045
Min				2.00	5.00	0.02	0.05	0.14	2.53	0.02	2.67	1.30	325.95	3.26	9.06	1.30	248.91	332.79			0.0141	0.0004	0.0001
Max				6.74	36.00	0.02	0.05	0.50	3.38	0.40	3.47	24.57	44221.75	61.42	614.19	491.35	8279.29	4264.94			1.9087	0.0265	0.0212
Stdev				3.351686	12.95376	0	0	0.15045	0.385127	0.169941166	0.564271	9.779282	18682.03	24.4482	255.6933	217.0811	5678.34	2780.45			0.8064	0.0110	0.0094
Median				4.37	9.00	0.02	0.05	0.17	3.21	0.02	3.07	5.89	2652.34	14.74	47.74	5.89	4264.10	2298.87			0.1145	0.0021	0.0003
n				2	5	5	5	5	4	5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

Notations: <:
I:

Upper Little Lee Ck (LLC-1)

Sample Type	Sample ID	Sample Date	Flow (cfs)	BOD, mg/L	TSS, mg/L	PO_4 as P, mg/L	NH_3 as N, mg/L	NO_3+NO_2 as N, mg/L	Chloride, mg/L	Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	LLC-1	1/17/2012	29.9	< 2.00	< 5.00	< 0.02	< 0.05	< 0.5	NA	< 0.020	1.77	3.2	805.5	8.1	80.5	3.2	322.2	284.5	36.2	23168	0.034766	0.003477	0.000139
Baseline Dup	LLC-1-D	1/17/2012	29.9	< 2.00	< 5.00	< 0.02	0.08	< 0.5	NA	< 0.020	1.32	3.2	805.5	12.9	80.5	3.2	322.2	213.0	36.2	23168	0.034766	0.003477	0.000139
Storm Event	LLC-1	1/25/2012	228.0	i 6.74	36.00	< 0.02	< 0.05	< 0.5	NA	0.400	3.47	24.6	44221.7	61.4	614.2	491.4	8279.3	4264.9	36.2	23168	1.908743	0.02651	0.021208
Baseline	LLC-1	3/28/2012	58.0	< 2.00	< 5.00	< 0.02	< 0.05	0.46	2.1	0.040	0.21	6.2	1562.4	15.6	143.7	12.5	625.0	66.3	36.2	23168	0.067439	0.006204	0.00054
Storm Event	LLC-1	4/15/2012	23.1	< 2.00	< 5.00	< 0.02	< 0.05	0.17	3.3	< 0.020	2.67	2.5	622.3	6.2	21.2	2.5	248.9	332.8	36.2	23168	0.026859	0.000913	0.000107
Storm Event	LLC-1	3/16/2014	54.7		9.00	< 0.02	< 0.05	0.16	3.12	< 0.02		5.9	2652.3	14.7	47.7	5.9			36.2	23168	0.114483	0.002061	0.000254
Storm Event	LLC-1	4/4/2014	136.0		13.00	< 0.02	< 0.05	0.29	2.53	0.02		14.7	9525.3	36.6	212.5	14.7			36.2	23168	0.411142	0.009172	0.000633
Storm Event-Du	LLC-1D	4/4/2014	136.0		13.00	< 0.02	< 0.05	0.29	2.55	0.02		14.7	9525.3	36.6	211.0	14.7			36.2	23168	0.411142	0.009108	0.000633
Storm Event	LLC-1	5/8/2014	12.1		< 5.00	< 0.02	< 0.05	0.14	3.38	0.02		1.3	326.0	3.3	9.1	1.3			36.2	23168	0.014069	0.000391	5.63E-05
Baseflow summary																							
Average				2.00	5.00	0.020	0.05	0.48	2.10	0.030	0.99	4.7	1183.9	11.8	112.1	7.9	473.6	175.4			0.0511	0.0048	0.0003
Min				2.00	5.00	0.020	0.05	0.46	2.10	0.020	0.21	3.2	805.5	8.1	80.5	3.2	322.2	66.3			0.0348	0.0035	0.0001
Max				2.00	5.00	0.020	0.05	0.50	2.10	0.040	1.77	6.2	1562.4	15.6	143.7	12.5	625.0	284.5			0.0674	0.0062	0.0005
Stdev				0	0	0.000	0	0.028284	#DIV/0!	0.014	1.098632	2.1	535.3	5.4	44.7	6.6	214.1	154.3			0.0231	0.0019	0.0003
Median				2.00	5.00	0.020	0.05	0.48	2.10	0.030	0.99	4.7	1183.9	11.8	112.1	7.9	473.6	175.4			0.0511	0.0048	0.0003
n				2	2	2.000	2	2	1	2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
										0.028													
Storm flow summary																							
Average				4.37	13.60	0.02	0.05	0.25	3.08	0.10	3.07	9.78	11469.53	24.45	180.93	103.14	4264.10	2298.87			0.4951	0.0078	0.0045
Min				2.00	5.00	0.02	0.05	0.14	2.53	0.02	2.67	1.30	325.95	3.26	9.06	1.30	248.91	332.79			0.0141	0.0004	0.0001
Max				6.74	36.00	0.02	0.05	0.50	3.38	0.40	3.47	24.57	44221.75	61.42	614.19	491.35	8279.29	4264.94			1.9087	0.0265	0.0212
Stdev				3.351686	12.95376	0	0	0.15045	0.385127	0.169941166	0.564271	9.779282	18682.03	24.4482	255.6933	217.0811	5678.34	2780.45			0.8064	0.0110	0.0094
Median				4.37	9.00	0.02	0.05	0.17	3.21	0.02	3.07	5.89	2652.34	14.74	47.74	5.89	4264.10	2298.87			0.1145	0.0021	0.0003
n				2	5	5	5	5	4	5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

Notations: <:
i:

LLC-2

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)		BOD, mg/L		TSS, mg/L		PO_4 as P, mg/L		NH_3 as N, mg/L		NO_3+NO_2 as N, mg/L	Chloride, mg/L		Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS- lb/acre	NO3-NO2- lb/acre	TP- lb/acre
Baseline	LLC-2	12-00357	1/17/2012	17:50	86.0	<	2.00	<	5.00	<	0.02	<	0.05	<	0.5	NA	<	0.02	1.00	9.3	2316.7	23.2	231.7	9.3	926.7	462.9	119.4	76416	0.030317	0.003032	0.000121
Storm Event	LLC-2	12-00571	1/25/2012	11:10	2210.0	i	3.39		244.00		0.12	<	0.05	<	0.5	NA		0.36	4.41	1428.8	2905231.0	595.3	5953.3	4286.4	40363.7	52544.2	119.4	76416	38.01862	0.077907	0.056093
Baseline	LLC-2	12-01913	3/28/2012	13:10	207.0	<	2.00	<	5.00	<	0.02	<	0.05		0.29	1.8		0.04	1.58	22.3	5576.2	55.8	323.4	44.6	2230.5	1756.5	119.4	76416	0.072972	0.004232	0.000584
Storm Event	LLC-2	12-02283	4/15/2012	21:20	48.0	<	2.00	<	5.00	<	0.02	<	0.05		0.12	2.5		0.02	1.86	5.2	1293.0	12.9	31.0	5.2	517.2	480.2	119.4	76416	0.016921	0.000406	6.77E-05
Storm Event D	LLC-2-D	12-02284	4/15/2012	21:21	48.0	<	2.00	<	5.00	<	0.02	<	0.05		0.12	2.6		0.02	2.20	5.2	1293.0	12.9	31.0	5.2	517.2	569.7	119.4	76416	0.016921	0.000406	6.77E-05
Storm Event	LLC-2	14-01464	3/16/2014	9:20	425.0				57.00	<	0.02	<	0.05		0.15	2.46		0.14		45.8	130515.6	114.5	341.2	320.6			119.4	76416	1.707961	0.004465	0.004195
Storm Event	LLC-2	14-01909	4/4/2014	9:25	333.0			<	5.00	<	0.02	<	0.05		0.13	2.38	<	0.02		35.9	8970.4	89.7	231.4	35.9			119.4	76416	0.117389	0.003029	0.00047
Storm Event	LLC-2	14-02620	5/8/2014	17:20	38.0			<	5.00	<	0.02	<	0.05		0.16	2.58		0.04		4.1	1023.7	10.2	32.1	8.2			119.4	76416	0.013396	0.000421	0.000107
Baseflow summary																															
Average							2.00		5.00		0.020		0.05		0.40	1.80		0.030	1.29	15.8	3946.4	39.5	277.5	26.9	1578.6	1109.7			0.0516	0.0036	0.0004
Min							2.00		5.00		0.020		0.05		0.29	1.80		0.020	1.00	9.3	2316.7	23.2	231.7	9.3	926.7	462.9			0.0303	0.0030	0.0001
Max							2.00		5.00		0.020		0.05		0.50	1.80		0.040	1.58	22.3	5576.2	55.8	323.4	44.6	2230.5	1756.5			0.0730	0.0042	0.0006
Stdev							0		0		0.000		0		0.148492	#DIV/0!		0.014	0.407294	9.2	2304.8	23.0	64.9	25.0	921.9	914.7			0.0302	0.0008	0.0003
Median							2.00		5.00		0.020		0.05		0.40	1.80		0.030	1.29	15.8	3946.4	39.5	277.5	26.9	1578.6	1109.7			0.0516	0.0036	0.0004
n							2		2		2.000		2		2	1		2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																															
Average							2.70		63.20		0.04		0.05		0.21	2.48		0.12	3.14	303.95	609406.74	164.54	1317.83	931.24	20440.44	26512.22			7.9749	0.0172	0.0122
Min							2.00		5.00		0.02		0.05		0.12	2.38		0.02	1.86	4.09	1023.65	10.24	31.03	5.17	517.21	480.23			0.0134	0.0004	0.0001
Max							3.39		244.00		0.12		0.05		0.50	2.58		0.36	4.41	1428.80	2905230.99	595.33	5953.34	4286.41	40363.66	52544.20			38.0186	0.0779	0.0561
Stdev							0.982878		103.5481		0.044721		0		0.162239	0.080914		0.145189531	1.807365	629.0824	1284581.8	245.196	2594.751	1880.25	28175.69	36814.78			16.8104	0.0340	0.0246
Median							2.70		5.00		0.02		0.05		0.15	2.48		0.04	3.14	35.88	8970.42	89.70	231.44	35.88	20440.44	26512.22			0.1174	0.0030	0.0005
n							2		5		5		5		5	4		5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

		Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)
LLC-2		2905231	595.3342	5953.342	4286.406
LLC-1		44221.75	61.4191	614.191	491.3528
JC-1		107408	47.95	479.5	47.95
diff		2753601	485.9651	4859.651	3747.104
WS area	68.3	62.99417	0.011117	0.111174	0.085723
		lb/acre	lb/acre	lb/acre	lb/acre

Jenkins Creek (JC-1)

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)		BOD, mg/L		TSS, mg/L		PO$_4$ as P, mg/L		NH$_3$ as N, mg/L		NO$_3$+NO$_2$ as N, mg/L	Chloride, mg/L		Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	JC-1	12-00352	1/17/2012	11:40	12.6	<	2.00	<	5.00	<	0.02		0.07	<	0.5	NA	<	0.02	0.97	1.4	339.4	4.8	33.9	1.4	135.8	65.6	14.9	9536	0.035594	0.003559	0.000142
Storm Event	JC-1	12-00564	1/25/2012	6:30	178.0	i	2.71		112.00		0.04	<	0.05	<	0.5	NA		0.05	4.09	38.4	107408.0	47.9	479.5	47.9	2598.9	3917.5	14.9	9536	11.26342	0.050283	0.005028
Baseline	JC-1	12-01911	3/28/2012	12:35	27.5	<	2.00	<	5.00	<	0.02	<	0.05		0.32	2.0	<	0.02	1.70	3.0	740.8	7.4	47.4	3.0	296.3	252.0	14.9	9536	0.077685	0.004972	0.000311
Storm Event	JC-1	12-02276	4/15/2012	16:45	64.7	<	2.00		9.00		0.04	<	0.05		0.35	2.6		0.05	3.18	13.9	3137.2	17.4	122.0	17.4	697.2	1108.8	14.9	9536	0.328987	0.012794	0.001828
Storm Event	JC-1	14-01462	3/16/2014	8:15	173.0				80.00	<	0.02	<	0.05		0.22	2.64		0.13		18.6	74564.9	46.6	204.1	121.2			14.9	9536	7.81931	0.021405	0.012706
Storm Event	JC-1	14-01906	4/4/2014	8:25	47.4			<	5.00	<	0.02	<	0.05		0.19	2.65	<	0.02		5.1	1276.9	12.8	48.5	5.1			14.9	9536	0.1339	0.005088	0.000536
Storm Event	JC-1	14-02618	5/8/2014	16:30	6.4			<	5.00	<	0.02	<	0.05		0.24	2.69		0.06		0.7	172.4	1.7	8.3	2.1			14.9	9536	0.018079	0.000868	0.000217
Baseflow summary																															
Average							2.00		5.00		0.020		0.06		0.41	2.00		0.020	1.33	2.2	540.1	6.1	40.7	2.2	216.0	158.8			0.0566	0.0043	0.0002
Min							2.00		5.00		0.020		0.05		0.32	2.00		0.020	0.97	1.4	339.4	4.8	33.9	1.4	135.8	65.6			0.0356	0.0036	0.0001
Max							2.00		5.00		0.020		0.07		0.50	2.00		0.020	1.70	3.0	740.8	7.4	47.4	3.0	296.3	252.0			0.0777	0.0050	0.0003
Stdev							0		0		0.000		0.014142		0.127279	#DIV/0!		0.000	0.519016	1.1	283.8	1.9	9.5	1.1	113.5	131.8			0.0298	0.0010	0.0001
Median							2.00		5.00		0.020		0.06		0.41	2.00		0.020	1.33	2.2	540.1	6.1	40.7	2.2	216.0	158.8			0.0566	0.0043	0.0002
n							2		2		2.000		2		2	1		2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																															
Average							2.36		42.20		0.03		0.05		0.30	2.65		0.06	3.63	15.35	37311.89	25.29	172.48	38.74	1648.03	2513.17			3.9127	0.0181	0.0041
Min							2.00		5.00		0.02		0.05		0.19	2.60		0.02	3.18	0.69	172.40	1.72	8.28	2.07	697.16	1108.83			0.0181	0.0009	0.0002
Max							2.71		112.00		0.04		0.05		0.50	2.69		0.13	4.09	38.36	107407.99	47.95	479.50	121.17	2598.89	3917.51			11.2634	0.0503	0.0127
Stdev							0.502046		50.42519		0.010954		0		0.127241	0.038638		0.040865633	0.639225	14.68083	50366.221	20.86657	187.1759	49.52091	1344.726	1986.037			5.2817	0.0196	0.0052
Median							2.36		9.00		0.02		0.05		0.24	2.65		0.05	3.63	13.94	3137.22	17.43	122.00	17.43	1648.03	2513.17			0.3290	0.0128	0.0018
n							2		5		5		5		5	4		5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

CC-1

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)	BOD, mg/L	TSS, mg/L	PO_4 as P, mg/L	NH_3 as N, mg/L	NO_3+NO_2 as N, mg/L	Chloride, mg/L	Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	CC-1	12-00354	1/17/2012	13:30	53.0	< 2.00	< 5.00	< 0.02	0.07	< 0.5	NA	< 0.02	1.42	5.7	1427.7	20.0	142.8	5.7	571.1	405.5	53.7	34368	0.041542	0.004154	0.000166
Storm Event	CC-1	12-00566	1/25/2012	8:20	870.0	i 2.00	53.00	0.02	< 0.05	< 0.5	NA	0.29	4.24	93.7	248424.1	234.4	2343.6	1359.3	9374.5	19878.6	53.7	34368	7.228354	0.068192	0.039551
Baseline	CC-1	12-01909	3/28/2012	10:45	121.0	< 2.00	< 5.00	< 0.02	< 0.05	0.22	1.3	0.05	1.54	13.0	3259.5	32.6	143.4	32.6	1303.8	1003.9	53.7	34368	0.094842	0.004173	0.000948
Storm Event	CC-1	12-02278	4/15/2012	18:15	21.8	< 2.00	< 5.00	< 0.02	< 0.05	0.07	1.9	0.03	1.57	2.3	587.3	5.9	7.8	3.5	234.9	183.9	53.7	34368	0.017087	0.000226	0.000103
Storm Event	CC-1	14-01468	3/16/2014	12:35	202.0		122.00	< 0.02	< 0.05	0.43	1.82	0.27		21.8	132773.0	54.4	464.7	293.8			53.7	34368	3.863274	0.013521	0.00855
Storm Event	CC-1	14-01913	4/4/2014	12:15	41.9		< 5.00	< 0.02	< 0.05	0.16	1.85	< 0.02		4.5	1128.7	11.3	35.2	4.5			53.7	34368	0.032842	0.001025	0.000131
Storm Event	CC-1	14-02624	5/8/2014	19:20	13.4		< 5.00	< 0.02	< 0.05	0.14	2.06	< 0.02		1.4	361.0	3.6	10.1	1.4			53.7	34368	0.010503	0.000294	4.2E-05
Baseflow summary																									
Average						2.00	5.00	0.020	0.06	0.36	1.30	0.035	1.48	9.4	2343.6	26.3	143.1	19.2	937.4	704.7			0.0682	0.0042	0.0006
Min						2.00	5.00	0.020	0.05	0.22	1.30	0.020	1.42	5.7	1427.7	20.0	142.8	5.7	571.1	405.5			0.0415	0.0042	0.0002
Max						2.00	5.00	0.020	0.07	0.50	1.30	0.050	1.54	13.0	3259.5	32.6	143.4	32.6	1303.8	1003.9			0.0948	0.0042	0.0009
Stdev						0	0	0.000	0.014142	0.19799	#DIV/0!	0.021	0.084853	5.2	1295.3	8.9	0.5	19.0	518.1	423.2			0.0377	0.0000	0.0006
Median						2.00	5.00	0.020	0.06	0.36	1.30	0.035	1.48	9.4	2343.6	26.3	143.1	19.2	937.4	704.7			0.0682	0.0042	0.0006
n						2	2	2.000	2	2	1	2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																									
Average						2.00	38.00	0.02	0.05	0.26	1.91	0.13	2.90	24.76	76654.80	61.91	572.28	332.53	4804.70	10031.27			2.2304	0.0167	0.0097
Min						2.00	5.00	0.02	0.05	0.07	1.82	0.02	1.57	1.44	360.97	3.61	7.75	1.44	234.90	183.93			0.0105	0.0002	0.0000
Max						2.00	122.00	0.02	0.05	0.50	2.06	0.29	4.24	93.74	#########	234.36	2343.62	1359.30	9374.49	19878.61			7.2284	0.0682	0.0396
Stdev						0	51.35173	0	0	0.19256	0.107367	0.140819033	1.891511	39.44504	111764.4	98.6126	1009.009	587.6253	6462.668	13926.25			3.2520	0.0294	0.0171
Median						2.00	5.00	0.02	0.05	0.16	1.88	0.03	2.90	4.51	1128.71	11.29	35.22	4.51	4804.70	10031.27			0.0328	0.0010	0.0001
n						2	5	5	5	5	4	5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)		BOD, mg/L		TSS, mg/L		PO$_4$ as P, mg/L		NH$_3$ as N, mg/L		NO$_3$+NO$_2$ as N, mg/L	Chloride, mg/L		Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	MFC-1	12-00356	1/17/2012	17:05	41.6	<	2.00	<	5.00	<	0.02	<	0.05	<	0.5	NA	<	0.02	0.98	4.5	1120.6	11.2	112.1	4.5	448.3	219.0	39.6	25344	0.044217	0.004422	0.000177
Storm Event	MFC-1	12-00567	1/25/2012	8:50	1556.0	i	2.68		163.00		0.09	<	0.05	<	0.5	NA		0.39	4.81	754.5	1366456.4	419.2	4191.6	3269.4	22466.9	40281.1	39.6	25344	53.91637	0.165388	0.129002
Baseline	MFC-1	12-01908	3/28/2012	10:20	63.5	<	2.00	<	5.00	<	0.02	<	0.05		0.26	1.5		0.05	1.26	6.8	1710.6	17.1	88.9	17.1	684.2	430.4	39.6	25344	0.067494	0.00351	0.000675
Storm Event	MFC-1	12-02280	4/15/2012	19:20	17.6	<	2.00	<	5.00	<	0.02	<	0.05		0.15	2.3	<	0.02	1.86	1.9	474.1	4.7	14.2	1.9	189.6	175.9	39.6	25344	0.018707	0.000561	7.48E-05
Storm Event	MFC-1	14-01467	3/16/2014	11:30	218.0				9.00	<	0.02	<	0.05		0.13	2.65		0.03		23.5	10570.5	58.7	148.0	35.2			39.6	25344	0.417083	0.005839	0.00139
Storm Event	MFC-1	14-01912	4/4/2014	11:35	168.0			<	5.00	<	0.02	<	0.05		0.12	1.97	<	0.02		18.1	4525.6	45.3	107.7	18.1			39.6	25344	0.178568	0.00425	0.000714
Storm Event	MFC-1	14-02613	5/8/2014	16:30	13.5			<	5.00	<	0.02		0.10		0.17	2.40		0.04		1.5	363.7	7.3	12.6	2.9			39.6	25344	0.014349	0.000496	0.000115
Baseflow summary																															
Average							2.00		5.00		0.020		0.05		0.38	1.50		0.035	1.12	5.7	1415.6	14.2	100.5	10.8	566.2	324.7			0.0559	0.0040	0.0004
Min							2.00		5.00		0.020		0.05		0.26	1.50		0.020	0.98	4.5	1120.6	11.2	88.9	4.5	448.3	219.0			0.0442	0.0035	0.0002
Max							2.00		5.00		0.020		0.05		0.50	1.50		0.050	1.26	6.8	1710.6	17.1	112.1	17.1	684.2	430.4			0.0675	0.0044	0.0007
Stdev							0		0		0.000		0		0.169706	#DIV/0!		0.021	0.198697	1.7	417.2	4.2	16.3	8.9	166.9	149.5			0.0165	0.0006	0.0004
Median							2.00		5.00		0.020		0.05		0.38	1.50		0.035	1.12	5.7	1415.6	14.2	100.5	10.8	566.2	324.7			0.0559	0.0040	0.0004
n							2		2		2.000		2		2	1		2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																															
Average							2.34		37.40		0.03		0.06		0.21	2.33		0.10	3.33	159.89	276478.06	107.03	894.82	665.52	11328.27	20228.51			10.9090	0.0353	0.0263
Min							2.00		5.00		0.02		0.05		0.12	1.97		0.02	1.86	1.45	363.67	4.74	12.58	1.90	189.64	175.90			0.0143	0.0005	0.0001
Max							2.68		163.00		0.09		0.10		0.50	2.65		0.39	4.81	754.49	1366456.36	419.16	4191.58	3269.44	22466.89	40281.12			53.9164	0.1654	0.1290
Stdev							0.480833		70.23389		0.031305		0.022361		0.161509	0.280521		0.162326831	2.085965	332.5341	609330.5677	176.0596	1843.892	1455.699	15752.39	28358.68			24.0424	0.0728	0.0574
Median							2.34		5.00		0.02		0.05		0.15	2.35		0.03	3.33	18.10	4525.62	45.26	107.71	18.10	11328.27	20228.51			0.1786	0.0042	0.0007
n							2		5		5		5		5	4		5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

WC-1

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)		BOD, mg/L		TSS, mg/L		PO$_4$ as P, mg/L		NH$_3$ as N, mg/L		NO$_3$+NO$_2$ as N, mg/L	Chloride, mg/L		Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	WC-1	12-00402	1/18/2012	15:50	30.8	<	2.00	<	5.00	<	0.02	<	0.05	<	0.5	NA	<	0.02	0.99	3 3	829 7	8.3	83.0	3.3	331 9	164 9	37 9	24256	0 034206	0 003421	0 000137
Baseline Dup	WC-1-D	12-00403	1/18/2012	15:50	30.8	<	2.00	<	5.00	<	0.02	<	0.05	<	0.5	NA	<	0.02	0.99	3 3	829 7	8.3	83.0	3.3	331 9	164 9	37 9	24256	0 034206	0.003421	0 000137
Storm Event	WC-1	12-00562	1/25/2012	11:25	500.0		2.24		54.00		0.05	<	0.05	<	0.5	NA		0.16	5.58	134 7	145466 3	134.7	1346.9	431.0	6034.2	15039.6	37 9	24256	5 997126	0.055529	0.017769
Baseline	WC-1	12-01907	3/28/2012	9:10	56.6	<	2.00	<	5.00	<	0.02	<	0.05		0.27	2.0		0.04	1.51	6.1	1524.7	15.2	82.3	12.2	609 9	461 1	37 9	24256	0 062859	0.003394	0 000503
Storm Event	WC-1	12-02281	4/15/2012	20:25	28.0	<	2.00	<	5.00	<	0.02	<	0.05		0.14	2.5		0.04	1.37	3.0	754 3	7.5	21.1	6.0	301.7	206 4	37 9	24256	0 031096	0.000871	0 000249
Storm Event	WC-1	14-01466	3/16/2014	10:25	89.0				13.00	<	0.02	<	0.05		0.25	5.57		0.02		9.6	6233 5	24.0	117.5	9.6			37 9	24256	0 256988	0 004843	0 000395
Storm Event Du	WC-10	14-01473	3/16/2014	10:25	89.0				13.00	<	0.02	<	0.05		0.24	5.49		0.02		9.6	6233 5	24.0	117.0	9.6			37 9	24256	0 256988	0 004823	0 000395
Storm Event	WC-1	14-01911	4/4/2014	10:25	180.0				5.00	<	0.02	<	0.05		0.37	4.46	<	0.02		19.4	4848 9	48.5	355.9	19.4			37 9	24256	0 199904	0 014673	0 0008
Storm Event	WC-1	14-02623	5/8/2014	18:15	16.5				6.00	<	0.02		0.05		0.19	4.06		0.02		1.8	533.4	4.4	16.7	1.8			37 9	24256	0 021989	0.000689	7 33E-05
Baseflow summary																															
Average							2 00		5.00		0 020		0.05		0 39	2 00		0 030	1 25	4.7	1177.2	11.8	82.7	7.8	470.9	313.0			0 0485	0.0034	0 0003
Min							2 00		5 00		0 020		0 05		0 27	2 00		0 020	0 99	3.3	829.7	8.3	82.3	3.3	331.9	164.9			0.0342	0 0034	0 0001
Max							2.00		5 00		0 020		0 05		0 50	2.00		0 040	1 51	6.1	1524.7	15.2	83.0	12.2	609.9	461.1			0 0629	0 0034	0.0005
Stdev							0		0		0 000		0		0.162635	#DIV/0!		0.014	0 366281	2.0	491.4	4.9	0.4	6.3	196.6	209.4			0 0203	0 0000	0 0003
Median							2 00		5 00		0.020		0 05		0 39	2 00		0.030	1 25	4.7	1177.2	11.8	82.7	7.8	470.9	313.0			0.0485	0 0034	0 0003
n							2		2		2.000		2		2	1		2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																															
Average							2 12		16.60		0.03		0 05		0 29	4.15		0 05	3.48	33.69	31567 26	43.83	371 63	93 56	3167 93	7622 98			1.3014	0.0153	0.0039
Min							2 00		5 00		0.02		0.05		0 14	2 50		0.02	1.37	1 78	533 38	4 44	16 71	1 78	301 71	206.37			0.0220	0 0007	0.0001
Max							2 24		54 00		0 05		0 05		0 50	5.57		0 16	5.58	134 69	145466.28	134 69	1346 91	431 01	6034 16	15039 60			5 9971	0 0555	0 0178
Stdev							0 169706		21 1731		0 013416		0		0 145721	1 269105		0 060991803	2.980455	56 88926	63720 484	53.71129	562.3246	188.7521	4053.454	10488 68			2 6270	0 0232	0 0078
Median							2.12		6 00		0 02		0 05		0 25	4.26		0 02	3.48	9 59	4848 88	23 97	117.48	9.59	3167 93	7622 98			0 1999	0 0048	0.0004
n							2		5		5		5		5	4		5	2	5	5	5	5	5	2	2			5 0000	5 0000	5 0000

LC-1 (upper Lee Ck)

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)		BOD, mg/L		TSS, mg/L		PO$_4$ as P, mg/L		NH$_3$ as N, mg/L		NO$_3$+NO$_2$ as N, mg/L	Chloride, mg/L		Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	LC-1	12-00355	1/17/2012	15:30	78.6	<	2.00	<	5.00	<	0.02	<	0.05	<	0.5	NA	<	0.02	0.77	8.5	2117.3	21.2	211.7	8.5	846.9	324.4	97.2	62208	0.034036	0.003404	0.000136
Storm Event	LC-1	12-00568	1/25/2012	9:45	687.0	i	2.41		115.00		0.06	<	0.05	<	0.5	NA		0.32	2.83	222.1	425650.5	185.1	1850.7	1184.4	8920.2	10471.0	97.2	62208	6.842376	0.029749	0.01904
Storm Event Dup	LC-1-D	12-00569	1/25/2012	9:45	687.0	i	2.35		116.00	<	0.02	<	0.05	<	0.5	NA		0.56	2.76	74.0	429351.8	185.1	1850.7	2072.7	8698.1	10219.3	97.2	62208	6.901874	0.029749	0.033319
Baseline	LC-1	12-01910	3/28/2012	11:15	199.0	<	2.00	<	5.00	<	0.02	<	0.05		0.36	2.2		0.05	0.96	21.4	5360.7	53.6	386.0	53.6	2144.3	1026.9	97.2	62208	0.086174	0.006205	0.000862
Baseline Dup	LC-1-D	12-01915	3/28/2012	11:20	199.0	<	2.00	<	5.00	<	0.02	<	0.05		0.37	2.3	<	0.02	0.97	21.4	5360.7	53.6	396.7	21.4	2144.3	1041.2	97.2	62208	0.086174	0.006377	0.000345
Storm Event	LC-1	12-02279	4/15/2012	18:41	19.8	<	2.00	<	5.00		0.02	<	0.05		0.10	4.7		0.03	1.21	2.1	533.4	5.3	10.7	3.2	213.4	128.9	97.2	62208	0.008574	0.000171	5.14E-05
Storm Event	LC-1	14-01470	3/16/2014	15:00	1580.0				143.00	<	0.02	<	0.05		0.40	3.95		0.31		170.2	1217283.4	425.6	3396.5	2638.9			97.2	62208	19.56796	0.054599	0.04242
Storm Event	LC-1	14-01915	4/4/2014	14:40	284.0			<	5.00	<	0.02	<	0.05		0.20	3.66	<	0.02		30.6	7650.4	76.5	303.0	30.6			97.2	62208	0.122982	0.00487	0.000492
Storm Event	LC-1	14-02615	5/8/2014	19:30	30.6			<	5.00	<	0.02		0.05		0.15	6.37	<	0.02		3.3	824.3	8.2	25.4	3.3			97.2	62208	0.013251	0.000408	5.3E-05
Baseflow summary																															
Average							2.00		5.00		0.020		0.05		0.43	2.20		0.035	0.86	15.0	3739.0	37.4	298.9	31.0	1495.6	675.6			0.0601	0.0048	0.0005
Min							2.00		5.00		0.020		0.05		0.36	2.20		0.020	0.77	8.5	2117.3	21.2	211.7	8.5	846.9	324.4			0.0340	0.0034	0.0001
Max							2.00		5.00		0.020		0.05		0.50	2.20		0.050	0.96	21.4	5360.7	53.6	386.0	53.6	2144.3	1026.9			0.0862	0.0062	0.0009
Stdev							0		0		0.000		0		0.098995	#DIV/0!		0.021	0.135623	9.2	2293.4	22.9	123.2	31.9	917.4	496.8			0.0369	0.0020	0.0005
Median							2.00		5.00		0.020		0.05		0.43	2.20		0.035	0.86	15.0	3739.0	37.4	298.9	31.0	1495.6	675.6			0.0601	0.0048	0.0005
n							2		2		2.000		2		2	1		2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																															
Average							2.21		54.60		0.03		0.05		0.27	4.67		0.14	2.02	85.67	330388.40	140.15	1117.23	772.08	4566.75	5299.93			5.3110	0.0180	0.0124
Min							2.00		5.00		0.02		0.05		0.10	3.66		0.02	1.21	2.13	533.38	5.33	10.67	3.20	213.35	128.86			0.0086	0.0002	0.0001
Max							2.41		143.00		0.06		0.05		0.50	6.37		0.32	2.83	222.08	1217283.38	425.62	3396.48	2638.87	8920.15	10471.00			19.5680	0.0546	0.0424
Stdev							0.289914		68.63527		0.017889		0		0.171085	1.218406		0.159843674	1.14622	103.1468	528496.497	175.4552	1484.294	1160.486	6156.64	7312.996			8.4956	0.0239	0.0187
Median							2.21		5.00		0.02		0.05		0.20	4.32		0.03	2.02	30.60	7650.45	76.50	302.96	30.60	4566.75	5299.93			0.1230	0.0049	0.0005
n							2		5		5		5		5	4		5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

LC-2

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)	BOD, mg/L	TSS, mg/L	PO_4 as P, mg/L	NH_3 as N, mg/L	NO_3+NO_2 as N, mg/L	Chloride, mg/L	Phosphorous as P, mg/L	TOC, mg/L	Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	Load-BOD	Load-TOC	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Baseline	LC-2	12-00405	1/18/2012	17:00	49.0	< 2.00	< 5.00	< 0.02	< 0.05	< 0.5	NA	< 0.02	0.92	5.3	1320.0	13.2	132.0	5.3	528.0	242.1	241.9	154816	0.008526	0.000853	3.41E-05
~~Storm Event~~	~~LC-2~~	~~12-00570~~	~~1/25/2012~~	~~10:45~~	~~3350.0~~	<, ~~2.00~~	~~65.00~~	~~0.07~~	< ~~0.05~~	< ~~0.5~~	~~NA~~	~~0.18~~	~~2.93~~	1263.4	1173158.6	902.4	9024.3	3248.7	36097.2	52954.6	241.9	154816	7.577761	0.05829	0.020985
Baseline	LC-2	12-01914	3/28/2012	13:30	392.0	< 2.00	< 5.00	< 0.02	< 0.05	0.44	1.9	0.05	1.33	42.2	10559.8	105.6	929.3	105.6	4223.9	2806.8	241.9	154816	0.068209	0.006002	0.000682
Storm Event	LC-2	12-02282	4/15/2012	21:05	118.0	< 2.00	< 5.00	< 0.02	< 0.05	0.17	2.8	0.02	1.46	12.7	3178.7	31.8	108.1	12.7	1271.5	930.1	241.9	154816	0.020532	0.000698	8.21E-05
Storm Event	LC-2	14-01465	3/16/2014	9:35	313.0		< 5.00	< 0.02	< 0.05	0.14	5.37	< 0.02		33.7	8431.7	84.3	237.8	33.7			241.9	154816	0.054462	0.001536	0.000218
Storm Event	LC-2	14-01910	4/4/2014	9:40	619.0		5.00	< 0.02	< 0.05	0.19	3.13	< 0.02		66.7	16674.7	166.7	643.6	66.7			241.9	154816	0.107707	0.004157	0.000431
Storm Event	LC-2	14-02621	5/8/2014	17:35	137.0		< 5.00	< 0.02	0.06	0.18	3.64	< 0.02		14.8	3690.5	44.3	135.1	14.8			241.9	154816	0.023838	0.000872	9.54E-05
Storm Event D	LC-2D	14-02622	5/8/2014	17:35	137.0		< 5.00	< 0.02	< 0.05	0.18	3.61	< 0.02		14.8	3690.5	36.9	132.1	14.8			241.9	154816	0.023838	0.000853	9.54E-05
Baseflow summary																									
Average						2.00	5.00	0.020	0.05	0.47	1.90	0.035	1.12	23.8	5939.9	59.4	530.6	55.4	2375.9	1524.4			0.0384	0.0034	0.0004
Min						2.00	5.00	0.020	0.05	0.44	1.90	0.020	0.92	5.3	1320.0	13.2	132.0	5.3	528.0	242.1			0.0085	0.0009	0.0000
Max						2.00	5.00	0.020	0.05	0.50	1.90	0.050	1.33	42.2	10559.8	105.6	929.3	105.6	4223.9	2806.8			0.0682	0.0060	0.0007
Stdev						0	0	0.000	0	0.042426	#DIV/0!	0.021	0.291328	26.1	6533.5	65.3	563.8	70.9	2613.4	1813.5			0.0422	0.0036	0.0005
Median						2.00	5.00	0.020	0.05	0.47	1.90	0.035	1.12	23.8	5939.9	59.4	530.6	55.4	2375.9	1524.4			0.0384	0.0034	0.0004
n						2	2	2.000	2	2	1	2.000	2	2.0	2.0	2.0	2.0	2.0	2.0	2.0			2.0000	2.0000	2.0000
Storm flow summary																									
Average						2.00	17.00	0.03	0.05	0.24	3.73	0.05	2.20	278.26	241026.85	245.91	2029.77	675.33	18684.34	26942.33			1.5569	0.0131	0.0044
Min						2.00	5.00	0.02	0.05	0.14	2.80	0.02	1.46	12.71	3178.71	31.79	108.08	12.71	1271.48	930.09			0.0205	0.0007	0.0001
Max						2.00	65.00	0.07	0.06	0.50	5.37	0.18	2.93	1263.40	1173158.61	902.43	9024.30	3248.75	36097.19	52954.57			7.5778	0.0583	0.0210
Stdev						0	26.83282	0.022361	0.004472	0.148092	1.143336	0.071554175	1.040154	551.1361	521105.62	370.7755	3915.954	1438.747	24625.49	36786.87			3.3660	0.0253	0.0093
Median						2.00	5.00	0.02	0.05	0.18	3.38	0.02	2.20	33.73	8431.66	84.32	237.77	33.73	18684.34	26942.33			0.0545	0.0015	0.0002
n						2	5	5	5	5	4	5	2	5	5	5	5	5	2	2			5.0000	5.0000	5.0000

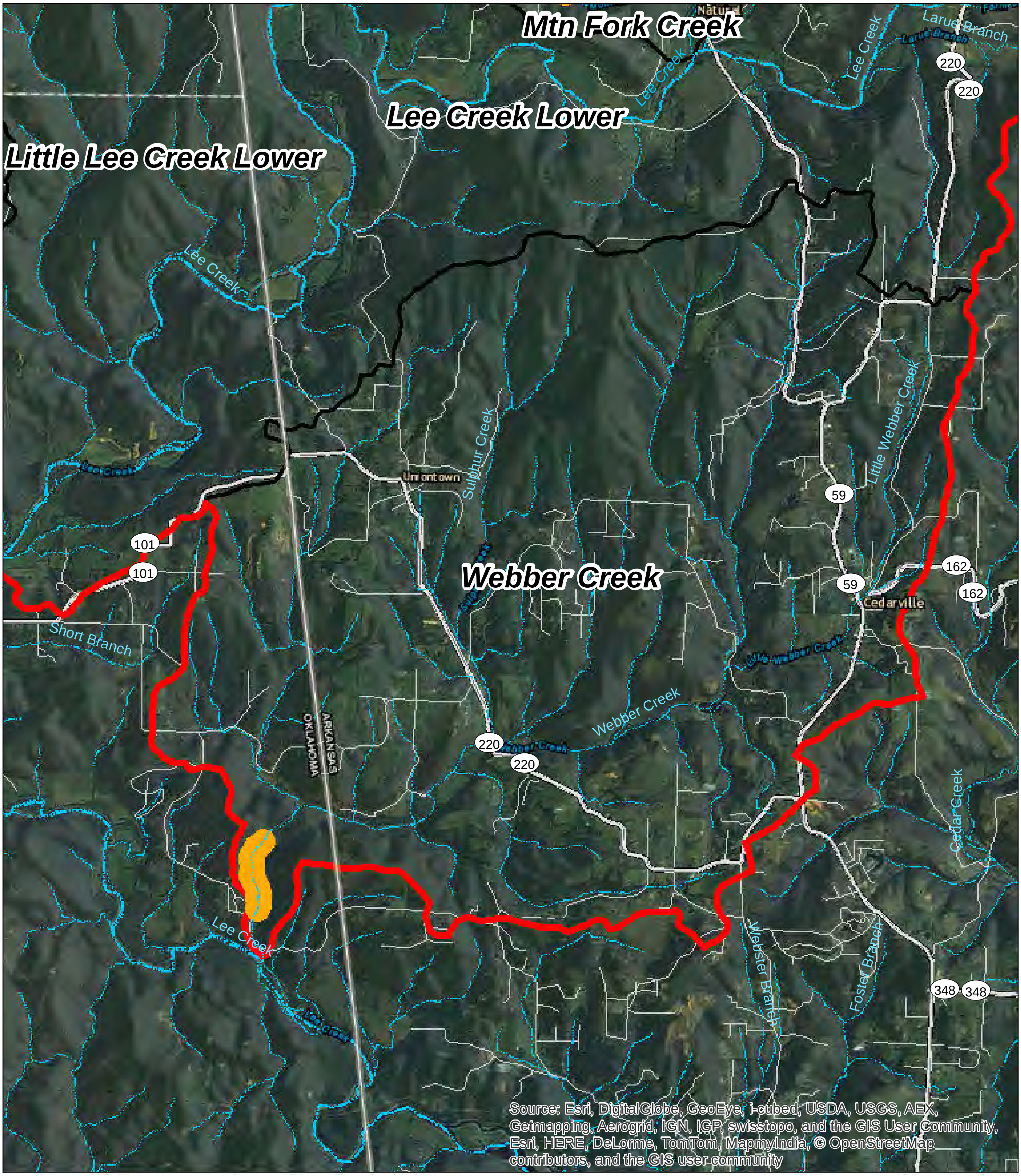
	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)
LC-2	1173159	902.4297	9024.297	3248.747
LC-1	425650.5	185.0654	1850.654	1184.419
CC-1	248424.1	234.3623	2343.623	1359.302
MFC-1	1366456	419.1584	4191.584	3269.435
	-867372	63.84353	638.4353	-2564.41

Buckhorn Ck (BH-1)

Sample Type	Sample ID	Lab Control Number	Sample Date	Sample Time	Flow (cfs)	TSS,	mg/L	PO_4 as P,	mg/L	NH_3 as N,	mg/L	NO_3+NO_2 as N, mg/L	Chloride,	mg/L	Phosphorous as P, mg/L		Load-OrhtoP (lb/d)	Load-TSS (lb/d)	Load-NH3 (lb/d)	Load-NO3-NO2-N (lb/d)	Load-TP (lb/d)	WS-area (mi2)	WS-area (Acres)	TSS-lb/acre	NO3-NO2-lb/acre	TP-lb/acre
Storm Evei	BH-1	14-01469	3/16/2014	13:55	56.4	<	5.00	<	0.02	<	0.05	0.38		1.36		0.03	6 1	1519 3	15 2	114.3	9 1	5.8	3712	0.409298	0 030779	0.002456
Storm Evei	BH-1	14-01914	4/4/2014	13:25	20.9	<	5.00	<	0.02	<	0.05	0.16		1.35	<	0.02	2.3	563.0	5 6	18 2	2 3	5.8	3712	0.151673	0 004914	0.000607
Storm Evei	BC-1	14-02614	5/8/2014	18:00	1.3	<	5.00	<	0.02		0.05	0.12		1.37	<	0.02	0.1	35.0	0.4	0 8	0.1	5.8	3712	0 009434	0 000221	3 77E-05
Storm flow summary																										
Average					26.20		5 00		0.020		0.05	0.22		1.36		0.023	2.823	705.781	7 058	44.438	3 836			0.190	0.012	0.001
Min					1 30		5.00		0 020		0.05	0.12		1.35		0.020	0.140	35.020	0.350	0.819	0 140			0 009	0.000	0.000
Max					56 40		5.00		0 020		0.05	0.38		1.37		0.030	6.077	1519 314	15.193	114.252	9 116			0.409	0 031	0.002
Stdev					27.92973		0		0 000		0.00	0.14		0.01		0 006	3 010	752.377	7.524	61.086	4.693			0 203	0.016	0.001
Median					20.90		5 00		0.020		0.05	0.16		1.36		0.020	2 252	563.008	5 630	18 241	2.252			0.152	0.005	0.001
n					3		3		3.000		3.00	3.00		3.00		3.000	3.000	3 000	3 000	3.000	3 000			3 000	3.000	3 000

Appendix C

USA Field Data Forms



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

N
W E
S

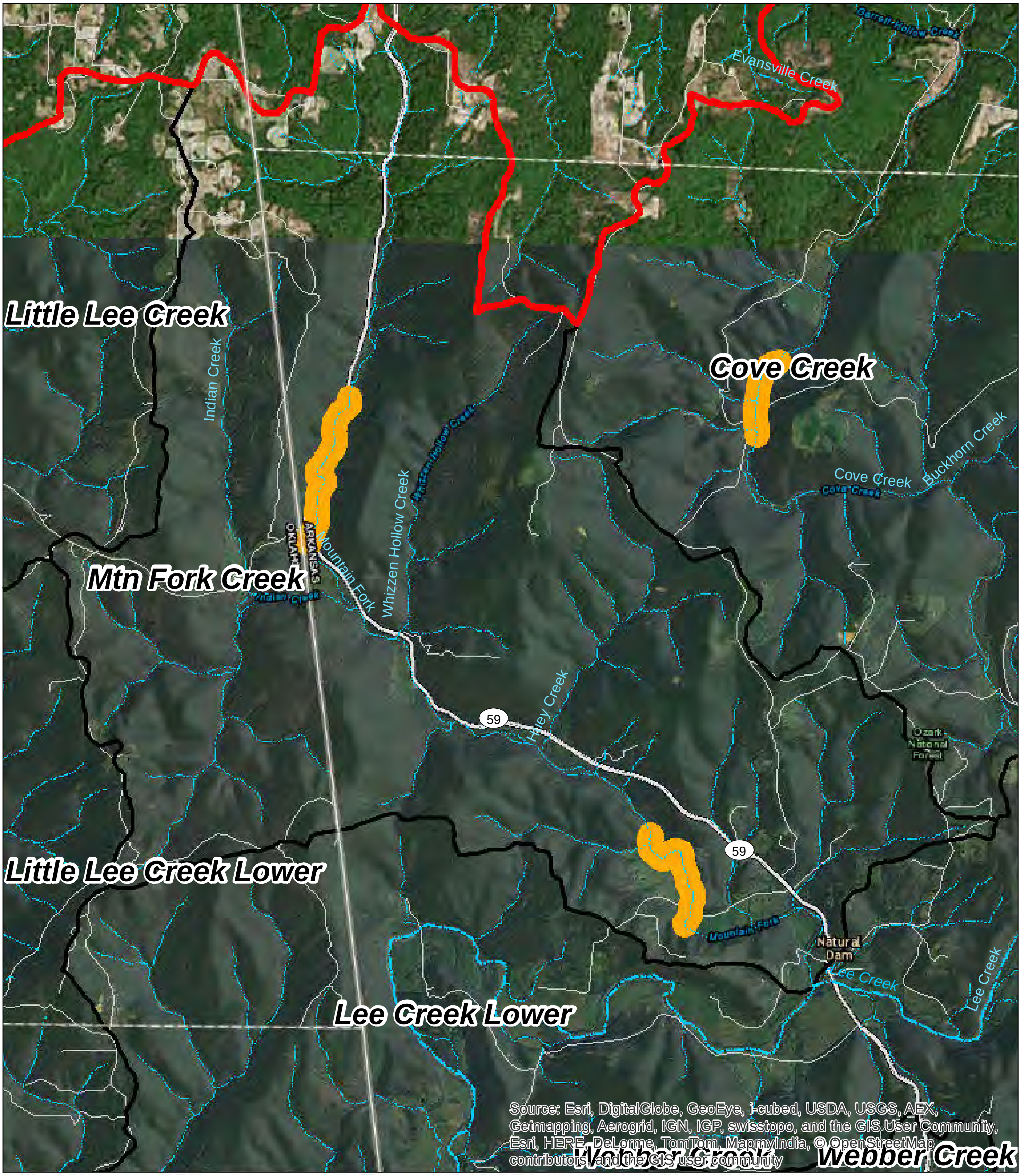
1.5
Miles

🟧 USA Reach

4095.000.G4

LEE CREEK WATERSHED
WEBBER CREEK

Approved by:	GLP	GBMC STRATEGIC ENVIRONMENTAL SERVICES 219 Brown Lane Bryant, Arkansas 72022	Project No.:	4095-13-800
Checked by:	GLP		Date:	09/19/2014
Drawn by:	ACT		Scale:	SHOWN



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

N
W E
S

1.5
Miles

🟧 USA Reach

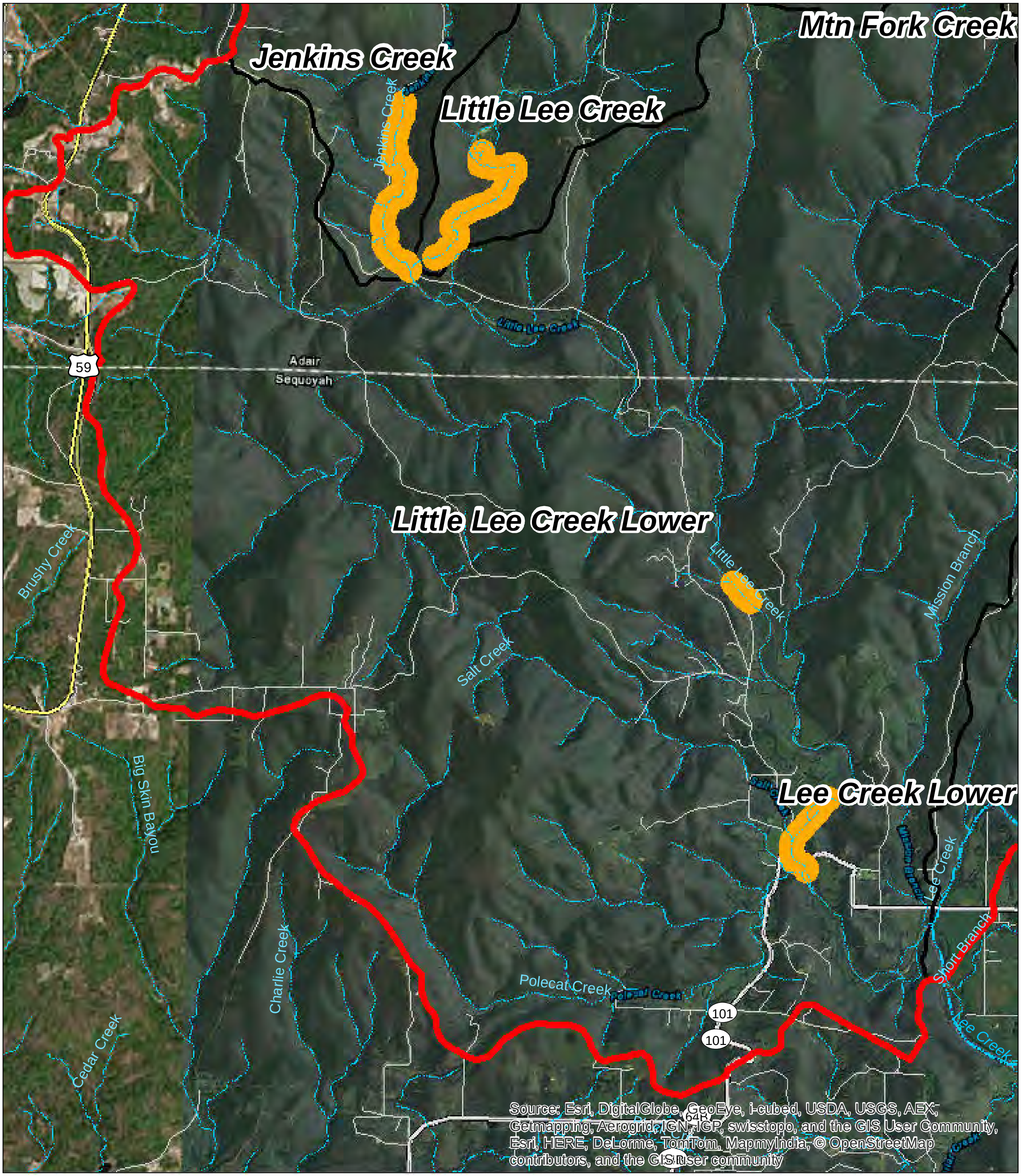
4095.000.G5

LEE CREEK WATERSHED
MTN FORK CREEK

Approved by: GLP
Checked by: GLP
Drawn by: ACT

GBMc
STRATEGIC ENVIRONMENTAL SERVICES
219 Brown Lane
Bryant, Arkansas 72022

Project No.: 4095-13-800
Date: 09/19/2014
Scale: SHOWN



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community

N
W E
S

1.5
Miles

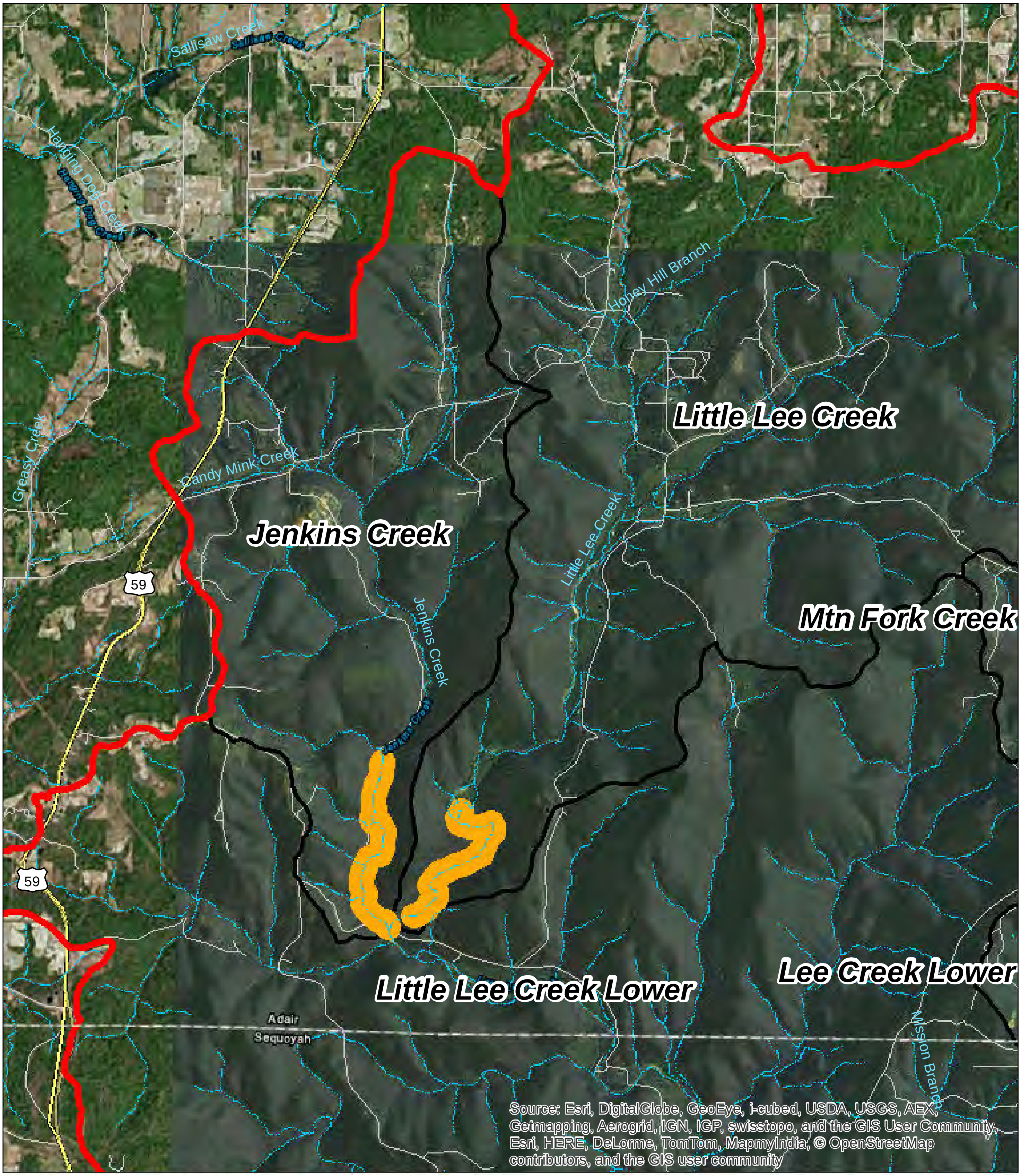
🟧 USA Reach

4095.000.G3

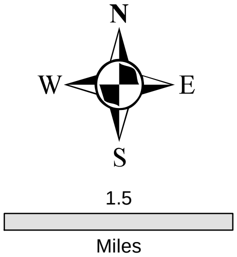
LEE CREEK WATERSHED

LOWER LITTLE LEE CREEK

Approved by:	GLP	GBMC STRATEGIC ENVIRONMENTAL SERVICES 219 Brown Lane Bryant, Arkansas 72022	Project No.:	4095-13-800
Checked by:	GLP		Date:	09/19/2014
Drawn by:	ACT		Scale:	SHOWN



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community



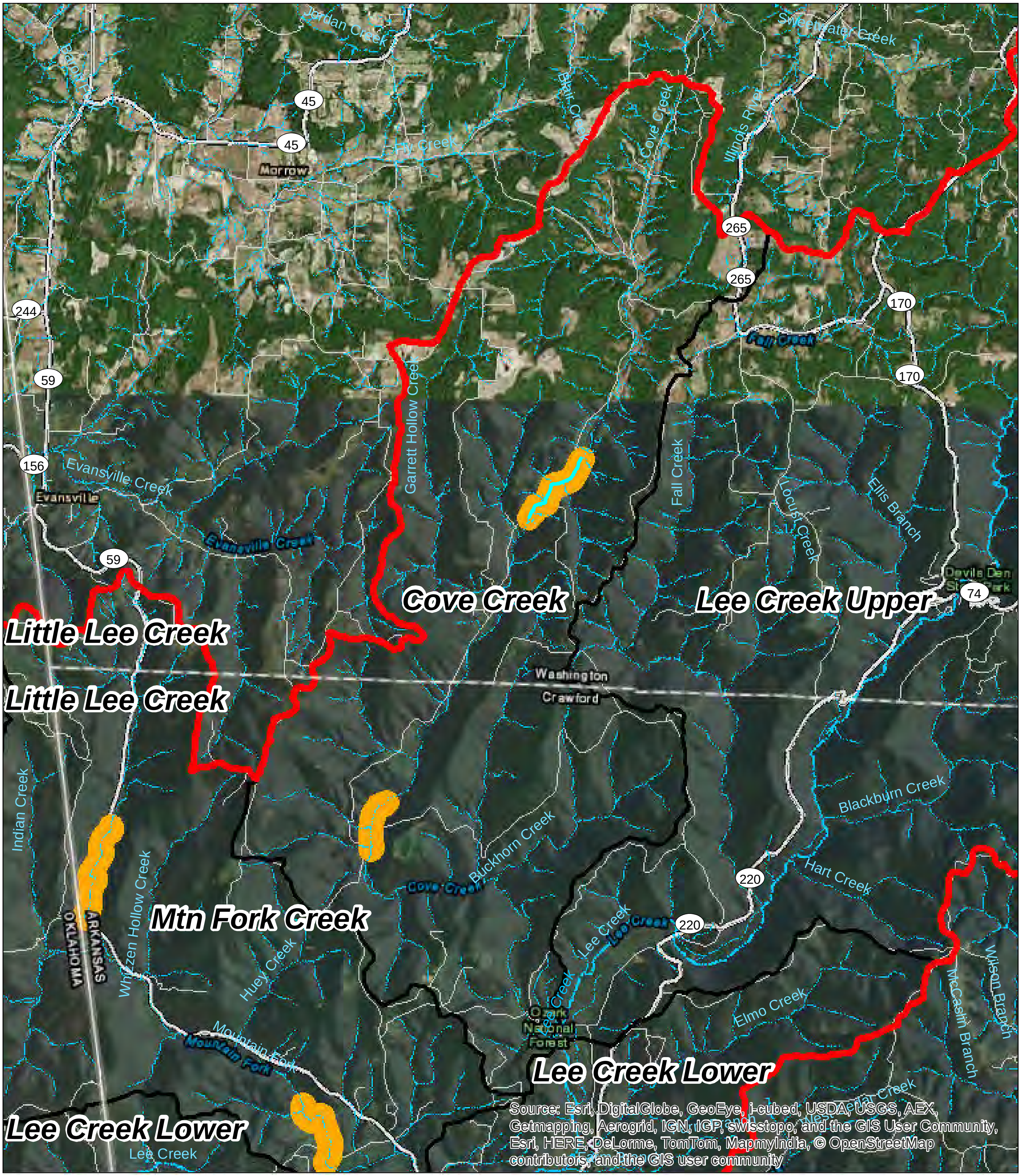
🟧 USA Reach

4095.000.G6

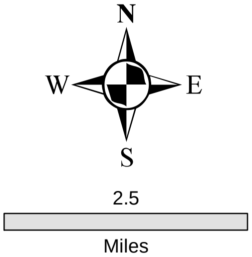
LEE CREEK WATERSHED

JENKINS CREEK & LITTLE LEE CREEK

Approved by:	GLP	GBMc STRATEGIC ENVIRONMENTAL SERVICES 219 Brown Lane Bryant, Arkansas 72022	Project No.:	4095-13-800
Checked by:	GLP		Date:	09/19/2014
Drawn by:	ACT		Scale:	SHOWN



Source: Esri, DigitalGlobe, GeoEye, i-cubed, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community, Esri, HERE, DeLorme, TomTom, MapmyIndia, © OpenStreetMap contributors, and the GIS user community



🟧 USA Reach

4095.000.G2

LEE CREEK WATERSHED

COVE CREEK

Approved by:	GLP	GBMc STRATEGIC ENVIRONMENTAL SERVICES 219 Brown Lane Bryant, Arkansas 72022	Project No.:	4095-13-800
Checked by:	GLP		Date:	09/19/2014
Drawn by:	ACT		Scale:	SHOWN

Unified Stream Assessment (USA)

REACH ID: LLC-2	**STREAM:** Little Lee Ck	**DATE/TIME:** 6/5/14 1100	**INITIALS:** ENS/CLP
REACH START wpt ~~235~~ 238		**REACH END** 291 + 100'	
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 pt sunny

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% 50-25 ☐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 25 % ☒ Run 15' % ☒ Pool 60 % ☐ Steps ______%

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

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

Land use
☒ Forest 60 % ☒ Pasture 40 % ☐ 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 75 % ☒ Shrub/Sapling 15 % ☒ 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

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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: LLC-2	**Date:**	**Initials:**

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
IB	239			Pasture Buffer <25' wide
UT	294	1	1	T-line
SC	244	1	1	all around area can see where trail is
UT	297	1	1	T-line/cable ?

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	290 RB	L M H VH EX (circle one)	400' +	2	Bank: Height 7 ft, Angle 80 Deg Protection: Roots 90 %, Root Depth 4 ft Vegetation 85 % gravelly silt loam [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 60
ER	242-293 LB	L M H VH EX (circle one)	~300'	1	Bank: Height 12 + ft, Angle 75 Deg Protection: Roots 20 %, Root Depth 3 ft Vegetation 40 % Slate [4]Material: Silt/Clay Sand / [✓ Gravel] [✓ Cobble] - % 85
ER	244 RB - ~ 100' ~~LB 244~~	L M H VH EX (circle one)	100	2	Bank: Height 10 ft, Angle 80 Deg Protection: Roots 40 %, Root Depth 3 ft Vegetation 70 % [4]Material: Silt/Clay Sand / [✓ Gravel] Cobble - % 40
ER	244-248 LB	L M H VH EX (circle one)		1	Bank: Height 13 ft, Angle 80 Deg Protection: Roots 30 %, Root Depth 3 ft Vegetation 50 % slate/shale [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % 80
ER	248-249 RB	L M H VH EX (circle one)		1.5	Bank: Height 10 ft, Angle 80 Deg Protection: Roots 50 %, Root Depth 5 ft Vegetation 60 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel] Cobble - % 50

near Bridge

[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:	STREAM:	DATE/TIME:	INITIALS:
Little Lee Creek	LLC-2	6/5/14 1100	GLP/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)

☒ 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: ________(ft)

Rt bank Ht: ________(ft)

Bankfull Depth .4 (ft)

Bankfull Width ~~40yd~~ 50yd (ft)

Wetted Width: 40yd. (ft)

TOB Width: ~~48yd~~ 54yd. (ft)

Riffle/Run Depth 1.2 (ft)

Pool Depth ________(ft)

Channel Stability:

Lt Bank: Angle ________ degrees

LtBank Vegetation protection: ________% cover

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

Length Lt Bank Affected: ________

Wpt(s): ________

Rt Bank: Angle ________ degrees

RtBank Vegetation protection ________% 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

☐ Stormwater retrofit

☐ Channel modification

☐ Culvert rehab.

☒ Bank stabilization

☐ Outfall stabilization

☐ PS investigation

☐ Other ________

---

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

Unified Stream Assessment (USA)

REACH ID: JC-1	**STREAM:** Jenkins Cr. ~~Jones~~	**DATE/TIME:** 6/9/14 1100	**INITIALS:** GLP/NEJ
REACH START wpt. 218		**REACH END** wpt. 228	
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/mostly sunny

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

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 45 % ☒ Run 20 % ☒ Pool 35 % ☐ Steps _____%

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

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

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

Local Watershed NPS Pollution
☐ Industrial Storm Water
☐ Urban/Sub-Urban Storm Water ☐ Row crops
☐ Cattle ☒ Other 5% gravel Rd ☐ 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)
☒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: SC-1	**Date:** 6/4/14	**Initials:** GLB / NEJ

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
SL	220			Old SC or side relict channel lots of erosion on LB there In floodway
other	225	1.5	1.5	Possible head cut In riffle

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	wpt 219 LB	L M H VH EX (circle one)	65yd 3	1	Bank: Height 5 ft, Angle 85 Deg Protection: Roots 35 %, Root Depth 3 ft Vegetation 40 % Sandy loam [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 60
ER	wpt 220 RB	L M H VH EX (circle one)	40yd 3	2	Bank: Height 8 ft, Angle 90 Deg Protection: Roots 35 %, Root Depth 7 ft Vegetation 15 % loam [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel] [✓ Cobble] - % 30
ER	222	L M H VH EX (circle one)	83y 3	1	Bank: Height 6 ft, Angle 90 Deg Protection: Roots 60 %, Root Depth 2.5 ft Vegetation 25 % [4]Material: Silt/Clay Sand / [✓ Gravel Cobble] - % ~~35~~ 40 20 P
ER	223-224 LB	L M H VH EX (circle one)	~300'	1	Bank: Height 6 ft, Angle 90 Deg Protection: Roots 30 %, Root Depth .5 ft Vegetation 20 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel] Cobble - % 35
ER	226-227 RB	L M H VH EX (circle one)	~300'	1	Bank: Height 6.5 ft, Angle 90 Deg Protection: Roots 30 %, Root Depth 3 ft Vegetation 20 % loam [4]Material: Silt/Clay [✓ Sand] / Gravel [✓ Cobble] - % 45

[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: Jenkins Ck	DATE/TIME:	INITIALS:
OTHER INFO:			

Average Conditions (check applicable)

Flood Plain Dynamics

Connection: ☐ Poor ☐ Fair ☒ Good Vegetation: ☒ Forest ☐ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops
Habitat: ☐ Poor ☐ Fair ☒ Good 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 Snake

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 sk.
☐ 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 one spot
☐ 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 (ft) Bankfull Depth 1.4/1.4 (ft) Wetted Width: 28/45 (ft) Riffle/Run Depth 0.5 (ft)
Rt bank Ht: 5 (ft) Bankfull Width 56/58 (ft)) TOB Width: 90/85 (ft) Pool Depth 1.8 (ft)

Channel Stability:

Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________

Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 ☐ 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: LLC-1	**STREAM:** Little Lee	**DATE/TIME:** 6/9/14 / 1345	**INITIALS:** GW / NEJ

REACH START wpt 229

LAT:

LONG:

REACH END wpt 234 + 50' u/s

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 partly sunny

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

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 15 % ☒ Pool 45 % ☐ Steps _____%

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

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

Land use
☒Forest _____% ☐ Pasture _____% ☐ 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)
☒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: LLC-1	**Date:**	**Initials:**

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
SL	231	1	1	UTV trail crossing
SL	233	1	1	UTV trail

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	230-231 RB	L M H VH EX (circle one)	7300	1	Bank: Height 9 ft, Angle 80 Deg Protection: Roots 20 %, Root Depth 4 ft Vegetation 15 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel Cobble] - % 25 loam
ER	232 LB	L M H VH EX (circle one)	~250	1	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 20 %, Root Depth 2 ft Vegetation 40 % ← loam w/sandy [4]Material: [✓ Silt/Clay] Sand / Gravel Cobble - % 0
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: LLC-1
STREAM: Little Lee Ck
DATE/TIME: 6/4/14
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:
☒ 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: 5 (ft)
Rt bank Ht: 6 (ft)
Bankfull Depth 1.3/1.5 (ft)
Bankfull Width 88/92 (ft))
Wetted Width: 57/31 (ft)
TOB Width: 105/80 (ft)
Riffle/Run Depth 0.5 (ft)
Pool Depth 2.5 (ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________
Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ________

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

Unified Stream Assessment (USA)

REACH ID: WC-1 | **STREAM:** Weber Ck. | **DATE/TIME:** 6/5/14/1330 | **INITIALS:** GLP/NEJ

REACH START wpt. 250/251 | **REACH END**

LAT: | **LAT:**

LONG: Logger- Time 1334 if it is correct 1-67ft. | **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 / part sunny

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

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% 50-75 ☐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 5 % ☒Pool 55 % ☐ 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 ☒ Cobble/boulders
☒Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☐Poor ☐Fair ☒Good ☐ Optimal

Land use
☒ Forest 90 % ☒ Pasture 10 % ☐ 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 70 % ☒ Shrub/Sapling 25 % ☒ Herbs/Grasses 5 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☒ 26-50 ft LB ☒ > 50 ft RB

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: WC-1	**Date:**	**Initials:**

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
UT	254 (also)	1	1	D-line Crossing

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI 1.8
ER	252 LB	L M H VH EX (circle one)	100	2	Bank: Height 5.5 ft, Angle 85 Deg Protection: Roots 40 %, Root Depth 2.5 ft Vegetation 70 % 1mm [4]Material: Silt/Clay [✓ Sand] / Gravel [✓ Cobble] - % 70
ER	253-254 RB	L M H VH EX (circle one)	~	1	Bank: Height 5 ft, Angle 80 Deg Protection: Roots ~~40~~ 60 %, Root Depth ~~2.5~~ ft Vegetation ~~70~~ 25 % 1mm [4]Material: Silt/Clay Sand / [✓ Gravel] [✓ Cobble] - % 60
ER	255	L M H VH EX (circle one)	100	1	Bank: Height 5 ft, Angle 80 Deg Protection: Roots 20 %, Root Depth 2.5 ft Vegetation 30 % 10mm [4]Material: Silt/Clay [✓ Sand] / Gravel [✓ Cobble] - % ~~60~~ 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 - % ___
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: WC-1 **STREAM:** webber ck. **DATE/TIME:** 6/5/19 **INITIALS:** GLP | NEJ

OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics
Connection: ☐ Poor ☐ Fair ☒ Good Vegetation: ☒ Forest ☒ Shrub/Sapling ☒ Tall grasses ☐ Turf/crops
Habitat: ☐ Poor ☐ Fair ☒ Good 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 along Rd. / pasture
☐ 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: 4 (ft) Bankfull Depth 1,4/23 (ft) Wetted Width: 43/20 (ft) Riffle/Run Depth 0,5 (ft)
Rt bank Ht: 5 (ft) Bankfull Width 62/98 (ft)) TOB Width: 55/120 (ft) Pool Depth 3.5 (ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________

Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ________

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

Unified Stream Assessment (USA)

REACH ID: CC-1 (4/5)
STREAM: Cove Ck
DATE/TIME: 5/22/14 (130)
INITIALS: GW/NEJ

REACH START wpt-207
REACH END wpt ~~215~~ 217 (4/5)
LAT: NEJ pic 787
LAT:
LONG: GW pic 1376
LONG:

Average Conditions (check applicable)

Weather – Antecedent (24-h) Rain in past 72-hr 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 warm

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 45 % ☒ Run 35 % ☒ Pool 15 % ☒ Steps 5 %

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 ☒ Boulders
☒ Aquatic Plants ☐ Overhanging Vegetation
Habitat Quality: ☐ Poor ☐ Fair ☒ Good ☐ Optimal

Land use
☒ Forest 30 % ☒ Pasture _____% ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☒ Hay 70 % ☐ Industrial_____% ☐ Sub-Urban____%

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

Riparian Buffer
Vegetation Type: ☒ Forest 50 % ☒ Shrub/Sapling 25 % ☒ Herbs/Grasses (9H) ~~20~~ 25 % ☐ 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: CC-1 u/s	**Date:**	**Initials:**

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
UT	208	1	~~2~~ 1	single phase d-line crossing
IB CB	209	1	2	Thinned out for home/barn
IB RB	~210-211	1.5	2	Buffer only ~ 10' wide Then pasture/hay
IB	211-212-213 LB	3	3	No trees on bank only hay grass eros at 212 but 10' buffer extends to 213
IB RB	214 ~~[illegible]~~ - ~~216~~ 217	2	2	Cleared for pasture - barn within 150' of bank.

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	209 LB	L M H VH EX (circle one)	~100	2	Bank: Height 5.5 ft, Angle 70 Deg Protection: Roots 25 %, Root Depth 2.5 ft Vegetation 75 % fine ~~[illegible]~~ [4]Material: Silt/Clay [✓ Sand] / Gravel [✓ Cobble] - % 45 55
ER	wet. 211- 212 LB	L M H VH [✓ EX] (circle one)	~200	3	Bank: Height 8.5 ft, Angle 80 Deg Protection: Roots 5 %, Root Depth 1.0 ft Vegetation 10 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 30
ER	216 RB	L M H [✓ VH] EX (circle one)	~100	1	Bank: Height 6 ft, Angle 85 Deg Protection: Roots 25 %, Root Depth 2.0 ft Vegetation 35 % [4]Material: Silt/Clay Sand / [✓ 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 - % ____
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: CC-1 4/5
STREAM: Cove Ck.
DATE/TIME: 5/22/14
INITIALS: GLP/NEJ
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) some in pools
☐ 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________
☒ Impacted Buffers(IB): 1 [✓ 2] [✓ 3] Wpt________
☐ Stream Crossing(SC): 1 2 3 Wpt________
☐ Trash(TR): 1 2 3 Wpt________
☒ Bank Erosion(ER): [✓ 1] [✓ 2] 3 Wpt________
☒ Utilities(UT): [✓ 1] 2 3 Wpt________
☐ Channel Modification(CM): 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: 5 (ft) Bankfull Depth 1.7/2.9 (ft) Wetted Width 37/28 (ft) Riffle/Run Depth 0.5/0.5 (ft)
Rt bank Ht: 4 (ft) Bankfull Width 78/40 (ft)) TOB Width: 95/65 (ft) Pool Depth 2/1.5 (ft)

Channel Stability:
Lt Bank: Angle ________ degrees
Rt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
RtBank Vegetation protection ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
RtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Length Rt Bank Affected:________
Wpt(s):________
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)
lots private property

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)

PTC 530 Starts upper MF

REACH ID: MF-1 u/s	**STREAM:** Mtn. Fk.	**DATE/TIME:**	**INITIALS:** GLP / MEJ

REACH START	**REACH END** wpt.
LAT: wpt. 184	**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 50 % ☒ Run 35 % ☒ Pool 15 % ☐ Steps _____%

Dominant Substrate

☐Silt/clay (fine or slick) ☒Cobble (2.5-10") 50%.
☐Sand (gritty) ☐Boulder (>10")
☐Gravel (0.1-2.5") ☒Bed Rock 50

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

DrP
☒ Forest 65 % ☒ ~~Pasture 25~~ % ☐ Urban _____%
☐ Commercial_____% ☐ Row Crops _____%
☒ Hay 25 % ☐ Industrial_____% ☒ Sub-Urban Rock 10 %

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) ☐Unshaded (<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: MFC-1 u/s	**Date:**	**Initials:**

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
IB	192-193	3	3	Stretch with no Riparian
ER LB	194-195			Roots 4' - 35% veg - 10% cob/grav - 30 Ht - 10' 85°ang. silt/loam At wpt 195 an odd drain comes in from RB
ER RB	196-197 ~300'	3	2	Roots 1.5' - 10% veg - 5% - 8' ht 86 deg. cobble - 70% silt loam Drain at end of bank wpt 197
ER	198-199 LB	2	1	6.5' ht 75 deg Roots - 2' - 25% veg - 10% cobble - 75% silt/loam

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 RB	185	L M H VH [✓ EX] (circle one)	125	1	Bank: Height 5 ft, Angle 95 Deg Protection: Roots 40 %, Root Depth 2 ft Vegetation 30 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 60
ER RB	186	L M H [✓ VH] EX (circle one)	125	1	Bank: Height 6.5 ft, Angle 90 Deg Protection: Roots 50 %, Root Depth 4 ft Vegetation 25 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 30
ER RB	188-189	L M H VH [✓ EX] (circle one)	~400 see wpts	1	Bank: Height 6.5 ft, Angle 90 Deg Protection: Roots 50 %, Root Depth 2.5 ft Vegetation 50 % [4]Material: Silt/Clay Sand / [✓ Gravel Cobble] - % 20
ER LB	190-191	L M H VH [✓ EX] (circle one)	~	2	Bank: Height 15 ft, Angle 80 Deg Protection: Roots 30 %, Root Depth 3.5 ft Vegetation 30 % [4]Material: [✓ Silt/Clay] Sand / [✓ Gravel Cobble] - % 20
ER RB	192-193	L M H VH [✓ EX] (circle one)	~	2	Bank: Height 9 ft, Angle 80 Deg Protection: Roots 10 %, Root Depth 1.5 ft Vegetation 20 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 30

[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:	STREAM:	DATE/TIME:	INITIALS:
MF-1 4/5	MTN FK	5/21/14	GLP/NEJ

OTHER INFO:

Average Conditions (check applicable)

Flood Plain Dynamics

Connection: ☐ Poor ☐ Fair ☒ Good   Vegetation: ☒ Forest ☒ Shrub/Sapling ☐ Tall grasses ☐ Turf/crops
Habitat: ☐ Poor ☐ Fair ☒ Good   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________ Roadcross HW459
☐ 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: 6.5/5 (ft) Bankfull Depth 2.5/2.5 (ft) Wetted Width: 15/12 (ft) Riffle/Run Depth 0.5/0.5 (ft)
Rt bank Ht: 4/4 (ft) Bankfull Width 72/60 (ft)) TOB Width: 85/80 (ft) Pool Depth 2.5/2.0 (ft)

Channel Stability:

Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________

Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ________

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

Unified Stream Assessment (USA)

REACH ID: CC-2 (A/S)	**STREAM:** Cove Ck.	**DATE/TIME:** 5/22/14	**INITIALS:** GLP/NEJ

REACH START Wpt. 201	**REACH END**
LAT: NEJ pics Start @ 693	**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 warm

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 45 % ☐ Pool 10 % ☐ Steps 5 %

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 ☒Cobble
☒Aquatic Plants ☒Overhanging Vegetation
Habitat Quality: ☐Poor ☐Fair ☐Good ☐ Optimal

Land use
☒ Forest 100 % ☐ Pasture _____% ☐ 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 20 % ☐ Herbs/Grasses ____% ☐ 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) (50%) ☐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: CC-2 D/S	**Date:**	**Initials:**

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

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	202 (mid) RB	L M [✓ H] VH EX (circle one)	~125	2	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 35 %, Root Depth 3.5 ft Vegetation 40 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 40
ER	203 (mid) RB	L M H VH EX (circle one)	~100	1	Bank: Height 5 ft, Angle 80 Deg Protection: Roots 35 %, Root Depth 2.5 ft Vegetation 45 % loam [4]Material: Silt/Clay [✓ Sand] / Gravel [✓ Cobble] - % 50
ER	204 (mid) LB	L M H VH EX (circle one)	~250	1	Bank: Height 5 ft, Angle 80 Deg Protection: Roots 45 %, Root Depth 3 ft Vegetation 20 % loam [4]Material: Silt/Clay [✓ Sand] / Gravel Cobble - % 65
ER	205 mid RB	L M H VH EX (circle one)	100	1	Bank: Height 6 ft, Angle 80 Deg Protection: Roots 20 %, Root Depth 2 ft Vegetation 20 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 60
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: CC-2
STREAM: Cove Ck.
DATE/TIME: 5/22/14
INITIALS: GLP/NEJ
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 Main Rd.
☒ 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 - minor ☐ Aggrading ☐ Bank Failure ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☐ Bank scour ☐ Slope failure ☒ None (natural stabile channel) mostly stable

Channel Dimensions (facing downstream):
Lt bank Ht: 5 (ft) Bankfull Depth 2.1/2.6 (ft) Wetted Width: 41/38 (ft) Riffle/Run Depth 0.6/ (ft)
Rt bank Ht: 5 (ft) Bankfull Width 55/52 (ft)) TOB Width: 70/80 (ft) Pool Depth 2/1.8 (ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:____________
Wpt(s):____________
Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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)
Wpt. 204 is a high bluff line on RB

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 ____________

None really needed.

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

Unified Stream Assessment (USA)

REACH ID: MFK-2(d/s)
STREAM: Mtn. Fork
DATE/TIME: 5/21/14 (1100)
INITIALS: GLP

REACH START wpt. 176
LAT:
LONG:

REACH END wpt. 183
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 warm

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 15 % ☒ Steps 5 %

Dominant Substrate
☐Silt/clay (fine or slick) ☒Cobble (2.5-10") 60
☐Sand (gritty) ☐Boulder (>10") – some
☐Gravel (0.1-2.5") ☒Bed Rock 40

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 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 75 % ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 25 % ☐ 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: MFR-2 2/5	**Date:**	**Initials:**

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
IB	176 to 177	2		
SC/CM	179	2.5		Complete gravel crossing Cattle inf. Obvious truck use. Appears gravel is removed here.

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Bank Erosion Hazard	Bank Lth. (ft)	Rest. Opp. (1-3)[3]	Bank information for BEHI BFAD 1.5'
ER	177	L [✓ M] H VH EX (circle one)	150	2	Bank: Height 8 ft, Angle 75 Deg Protection: Roots 15 %, Root Depth 2 ft Vegetation 75 % [4]Material: [✓ Silt/Clay] [✓ Sand] little / Gravel [✓ Cobble] - % 60
ER	178	L M [✓ H] VH EX (circle one)	175	2	Bank: Height 4 ft, Angle 95 Deg Protection: Roots 40 %, Root Depth 1.5 ft Vegetation 60 % [4]Material: [✓ Silt/Clay] [✓ Sand] little / Gravel [✓ Cobble] - % 40
ER	180 - 181	L M H VH [✓ EX] (circle one)	~300 see Lat longs	3	Bank: Height 11 ft, Angle 75 Deg Protection: Roots 10 %, Root Depth 1.0 ft Vegetation 15 % [4]Material: Silt/Clay [✓ Sand] / [✓ Gravel Cobble] - % 50
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: MFK-2 (d/s)
STREAM: Mtn. Fork
DATE/TIME: 5/21/12
INITIALS: BH
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 (old) ☐ 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: ________(ft) | Bankfull Depth 1.3/1.6 ________(ft) Wetted Width: 20/25 ________(ft) Riffle/Run Depth________(ft)
Rt bank Ht: ________(ft) | Bankfull Width 60 78 ________(ft)) TOB Width: 90 95 ________(ft) Pool Depth ________(ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________
Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ________

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

Unified Stream Assessment (USA)

REACH ID: Jones-1	**STREAM:** Jones Ck - upper	**DATE/TIME:** 9/4/12	**INITIALS:** JJLP

REACH START winfrey Rd - upstream (& downstream to near conf. w/ FRoy Bayou)
LAT:
LONG:
Started @ 1115

REACH END conf. of main tribs
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: 4/3 [✓ Yes] / 9/4 [✓ 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 50 % ☒ Run 35 % ☒ Pool 15 % ☐ 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 75 % ☒ Pasture _____% Remnant ☐ 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 75 % ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 25 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☒ 26-50 ft ☐ > 50 ft RB - >50 LB - variable

Stream Shading (water surface)
☐Mostly shaded (≥75% coverage) ☒Partially shaded (≥25% coverage) high end
☐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

Trail along bank at wpt 160w/4w crossing
wp7 (bl camping access (lwdc)

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

75'
~12.3
6.5
1.3

BF

25 yd w
0.55 D

41 yd-w
0.6' D (2/3 (width in bar)
6.5' w - 0.1' D

May 22-25

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: Jones - 1 (1.3 mi)	Date: 4/4/12	Initials:

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
~~ER~~ RB	165	H-VH	300' / (2)	Ht - 4-5' Angle 85° Roots - 40% Root depth - 2' Veg - 20% Cobble 50%
~~ER~~ LB	166	H	200' / (2)	4' H 80° angle 75% Roots 3' rt. depth 10% Veg. Cobble 80%
IB	162	3	225'	Pasture no trees to edge bank all sides
✩ SC	160	1	1	Access to stream in 2-3 spots here. ATV mostly. new ✩

Much of LB below Road is Eroding (M-H) ~ 100 yds.

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 RB	158 (rank) GIP-603	L M H [✓ VH] [✓ EX] (circle one)	200'	~~3 (both)~~ 2.5	Bank: Height 4 ft, Angle 85 Deg Protection: Roots 70 %, Root Depth 4 ft Vegetation 15 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 70
ER RB	159 high bank 10'+	L M H [✓ VH] [✓ EX] (circle one)	100'	1	Bank: Height 8-10 ft, Angle 85 Deg Protection: Roots 10 %, Root Depth 3 ft Vegetation 10 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 20
ER LB	162 LB	L M H VH [✓ EX] (circle one)	225'	3	Bank: Height 10 ft, Angle 90 Deg Protection: Roots 5 %, Root Depth 1 ft Vegetation 65 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - %
ER	163 LB	L M [✓ H] VH EX (circle one)	150	2	Bank: Height 7 ft, Angle 80 Deg Protection: Roots 50 %, Root Depth 50 ft Vegetation 20 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - %
ER RB	164	L M [✓ H] VH EX (circle one)	175	3	Bank: Height 4 ft, Angle 85 Deg Protection: Roots 65 %, Root Depth 4 ft Vegetation 10 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 65

[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 %.

Total - 1350' bank
6864
= 19.7%

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

USA, Cont.

REACH ID: Jones-1	**STREAM:** Jones Ck.	**DATE/TIME:** 4/4/12	**INITIALS:** DSP
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 minor ☒ Deer minor ☐ 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 minor

☒ 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 minimal ☐ Aggrading ☐ Bank Failure ☐ Culvert Scour (upstream / downstream / top)

☐ Headcutting ☒ Bank scour in areas ☐ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream):

Lt bank Ht: 5 (ft) Bankfull Depth [illegible].0 (ft) 20+ Wetted Width: 55 (ft) Riffle/Run Depth 0.6 (ft)

Rt bank Ht: 6 (ft) Bankfull Width 90 (ft)) TOB Width: 100 (ft) Pool Depth 1-2' (ft)

Channel Stability:

Lt Bank: Angle _______ degrees

LtBank Vegetation protection: _______% cover

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

Length Lt Bank Affected:_______

Wpt(s):_______

Rt Bank: Angle _______ degrees

RtBank Vegetation protection _______% 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 ☐ PS investigation

☐ Culvert rehab. ☐ Other _______

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

Unified Stream Assessment (USA)

REACH ID: FB-1	**STREAM:** Frog Bayou	**DATE/TIME:** 4/4/12	**INITIALS:** JWP

REACH START	**REACH END** Bridge over Frog on Bienville
LAT:	**LAT:**
LONG:	**LONG:**

wd. 168 middle

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: 4/3 [✓ Yes] / 4/4 [✓ 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 45 % ☒Run 35 % ☒Pool 20 % ☐ 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 Snags ☒Root Wads ☐Leaf Packs
☐Deposition ☒Undercut Bank
☐Aquatic Plants ☐Overhanging Vegetation
Habitat Quality: ☐Poor ☐Fair ☒Good ☐ Optimal

Land use BH
☑ Forest ~~55~~ 60 % ☒ Pasture ~~45~~ 40 % ☐ 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 70 % ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 30 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☒26-50 ft ☐ > 50 ft LB – mostly >50' RB – less

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)

35 wd x 0.8' D 4.5' bkfd
27 wd x 0.8' D 40' bkfd

USA Reach Impact Data Detail Sheet (optional)

Reach ID/Stream: FB-1 (1.5 mi)	**Date:** 4/4/12	**Initials:**

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
IB	169	3	3	500' Pasture – no trees Just grasses to edge.
IB	near 172	2	~~100~~ 3	160' – Pasture/no trees

Ne
*
*

[illegible]

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 RB	162	L M [✓ H] VH EX (circle one)	150	1	Bank: Height 7 ft, Angle 80 Deg Protection: Roots 50 %, Root Depth 3 ft Vegetation 20 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 70
ER RB	169	L M H [✓ VH] EX (circle one)	250	3	Bank: Height 9 ft, Angle 90 Deg Protection: Roots 5 %, Root Depth 1 ft Vegetation 5 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 60
ER LB	170	L M [✓ H] [✓ VH] EX (circle one) [illegible]	100	3	Bank: Height 13 ft, Angle 90 Deg Protection: Roots 5 %, Root Depth 1.5 ft Vegetation 5 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 50
ER LB	171	L M [✓ H] VH EX (circle one)	225	1	Bank: Height 7 ft, Angle 85 Deg Protection: Roots 70 %, Root Depth 5.5 ft Vegetation 10 % [4]Material: Silt/Clay Sand / Gravel [✓ Cobble] - % 55
ER LB	172 erosn upstream edge	L M H VH EX (circle one)	+ 600'		Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___

1325' ER
[illegible]
= 16.7%

---

[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: FB-1
STREAM: Frog Bayou
DATE/TIME: 9/9/12
INITIALS: JJHP
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 minor
☐ Headcutting
☐ Channelized
☐ Aggrading
☒ Bank scour minor
☐ Bed Scour
☐ Bank Failure
☐ Slope failure
☐ Sediment Deposition
☐ Culvert Scour (upstream / downstream / top)
☐ None (natural stabile channel)

Channel Dimensions (facing downstream):
Lt bank Ht: 5.5 (ft) Bankfull Depth 4.5 (ft) Wetted Width: 70 (ft) Riffle/Run Depth 0.8 (ft)
Rt bank Ht: 4.5 (ft) Bankfull Width 108 (ft)) TOB Width: 120 (ft) Pool Depth 2.5 (ft)

Channel Stability:
Lt Bank: Angle __________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________________
Wpt(s):________________
Rt Bank: Angle __________ degrees
RtBank Vegetation protection ________% 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ____________

---

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

Unified Stream Assessment (USA)

REACH ID: FB-2	**STREAM:** Ash Rd to 282	**DATE/TIME:** 4/5/12	**INITIALS:** JLP

REACH START Γ	**REACH END** wpt 185
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 40 % ☒ Run 30 % ☒ Pool 25 % ☒Steps 5 %

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 60 % ☒ Pasture 35 % ☐ Urban _____%
☐ Commercial_____% ☒ Row Crops 5 %
☐ Hay_____% ☐ Industrial_____% ☐ Sub-Urban____%

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

Riparian Buffer
Vegetation Type: ☒ Forest 80 % ☐ Shrub/Sapling ____% ☒ Herbs/Grasses 20 % ☐ Turf/Crops ____%
Riparian Width: ☐<10 ft ☐11-25 ft ☒ 26-50 ft [✓ ☐ > 50 ft] — on RB

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: FB-2 (3.3mi)

Date: 4/5/12

Initials:

Impact I.D.[1]	**Coordinates (Lat / Long) or Waypoint**	**Severity (1-3)**[2]	**Restoration Opportunity (1-3)**[3]	**Description**
OT	175	1	n/a	Farm field drain??
SC	178	1	n/a	Small Bridge in Pasture
SC	181, 182, 183	1.5	1	2 Bridges (1 RR 1 old Rd. Abandoned?)
~~RR~~	~~185~~	~~1.5~~	~~?~~	~~[illegible] bar since [illegible] pasture & Riparian [illegible]~~
~~SC~~	~~188~~	~~1~~	~~1~~	~~RB Road access~~

~~RB 184 [illegible] pasture [illegible] plans [illegible] Riparian [illegible]~~

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 RB	173 – (~75) 174	L M H [✓ VH] EX (circle one)	1200	1.5	Bank: Height 12 ft, Angle 85 Deg Protection: Roots 15 %, Root Depth 3 ft Vegetation 105 % [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % 20
ER LB	175-176	L M H [✓ VH] EX (circle one)	300	2	Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER LB	176-178 (178)	L M [✓ H] VH EX (circle one)	? 375	1	Bank: Height ___ ft, Angle ___ Deg Protection: Roots ___ %, Root Depth ___ ft Vegetation ___ % [4]Material: Silt/Clay Sand / Gravel Cobble - % ___
ER RB	179 – 180 (~75')	L M H [✓ VH] EX (circle one)	1458	1	Bank: Height 15 ft, Angle 85 Deg Protection: Roots 20 %, Root Depth 3.5 ft Vegetation 10 % [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % 20
ER ~~RB~~	~~180 – 184~~	L M H VH EX (circle one)	~~2000~~	~~2~~	Bank: Height 9 ft, Angle 85 Deg Protection: Roots 10 %, ~~Root Depth~~ 1 ft Vegetation 25 % [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % 30

[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 %.

~~190-191 – RR 189~~ Waterfall (LB)

3325' ER
17424'
= 19.1%

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

USA, Cont.

REACH ID: FB-2	**STREAM:** Frog Bayou	**DATE/TIME:** 9/5/12	**INITIALS:** JP
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 vultures/geese

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: 5 (ft) Bankfull Depth 4.5 (ft) Wetted Width: ~~48~~ 90 (BHP) (ft) Riffle/Run Depth 1.0 (ft)
Rt bank Ht: 5 (ft) Bankfull Width 130 (ft)) TOB Width: 150 (ft) Pool Depth 4.5 (ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________________
Wpt(s):________________
Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 [✓ 3.5] 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 ☐ PS investigation
☐ Culvert rehab. ☐ Other ____________

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

Unified Stream Assessment (USA)

REACH ID: FB-2.5
STREAM:
DATE/TIME: 4/5/12
INITIALS: JJHP
REACH START wpt 185 (edge lg. Pastur.)
LAT:
LONG:
REACH END WPT 282 @ RR track
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 10 % ☒ Run 25 % ☒ Pool 35 % ☐ 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 60 % ☒ Pasture 40 % ☐ 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 ____% ☒ Herbs/Grasses 40 % ☐ Turf/Crops ____%
Riparian Width: ☐ <10 ft ☒ 11-25 ft RB ~~☒ 26-50 ft RB~~ Sp ☒ > 50 ft LB

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: LB-2.5 (3.1 mi)	Date: 4/5/12	Initials:

Impact I.D.[1]	Coordinates (Lat / Long) or Waypoint	Severity (1-3)[2]	Restoration Opportunity (1-3)[3]	Description
SC + TR	193	1.5	1.5	Some Trash in area Access from RB
IB	185-190	2.5	3	along Big pasture some areas no trees, erosion ~~minor~~ mod here (3900')
SC	188	1	1	RB - Road Access
ER	RB 189	1	1	healing over areas over ER

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 RB	185 – ~~193~~ 190	L M [✓ H] VH EX (circle one)	3900 ~~Variable~~ ~~4-8~~	2	Bank: Height 4-8 ft, Angle 45-90 Deg Protection: Roots Var %, Root Depth Var ft Vegetation 50 % avg. [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % ~90
ER RB	186-187	L M [✓ H] VH EX (circle one)	~400'	2	Bank: Height 9 ft, Angle 85 Deg Protection: Roots ~~20~~ 10 %, Root Depth 1 ft Vegetation 25 % [4]Material: [✓ Silt/Clay] Sand / Gravel [✓ Cobble] - % 30
ER LB	190-191	L M [✓ H] VH EX (circle one)	575 Variable		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 - % ___

$\frac{4375}{16368} = 26.7\%$

[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: FB-2.5
STREAM: Frog Bayou
DATE/TIME: 4/5/12
INITIALS: BA
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 turtles

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 minor ☐ Aggrading ☐ Bank Failure ☐ Culvert Scour (upstream / downstream / top)
☐ Headcutting ☒ Bank scour minor ☐ Slope failure ☐ None (natural stabile channel)

Channel Dimensions (facing downstream): See FB-2
Lt bank Ht: ________(ft) Bankfull Depth ________(ft) Wetted Width:________(ft) Riffle/Run Depth________(ft)
Rt bank Ht:________(ft) Bankfull Width ________(ft)) TOB Width:________(ft) Pool Depth ________(ft)

Channel Stability:
Lt Bank: Angle ________ degrees
LtBank Vegetation protection: ________% cover
LtBank Erosion Hazard: L M H VH EX (circle one)
Length Lt Bank Affected:________
Wpt(s):________
Rt Bank: Angle ________ degrees
RtBank Vegetation protection ________% 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 Buffer absence on RB
- Some bank erosion

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.

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

Appendix D

Non-Point Source Matrix

Ranking of sub-watersheds based on NPS issue (Combined Phases)

Rank #	TSS Loading	Nutrient Loading	%pasture	Imapcted riparian	Bank erosion	Cattle	Poultry	Unpaved Roads	total possible
1	**MFC-1**	**MFC-1**	**WC-1**	**LC-2**	**LLC-2**	**LC-1**	--	**LC-2**	21
2	**LLC-2**	**LC-1**	**LLC-1**	**WC-1**	**JC-1**	**WC-1**	--	**LLC-2**	14
3	**LC-1**	**LLC-2**	**LC-2**	**MFC-1**	**MFC-1**	**CC-1**	--	**WC-1**	7
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	
6									42
7									
8									

Matrix Scoring from rankings (3 = rank1, 2 = rank2, 1 = rank3)

	1	**2**	**3**	**Total**
WC-1	3	4	1	8
LLC-1	0	2	0	2
LLC-2	3	4	1	8
CC-1	0	0	1	1
LC-2	6	0	1	7
LC-1	3	2	1	6
MFC-1	6	0	2	8
JC-1	0	2	0	2
			Total:	42

Appendix E

WTM Modeling

Final w/ banks & unpaved roads 9/19/14

This table summarizes the pollutant loads and runoff volumes from ***Uncontrolled*** pollutant sources, including both the Primary Sources and Secondary Sources included in the **"Sources"** tab. The purple cells summarize loads from each broad category of sources. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the difference between loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load).

Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	1,631	241	38,050	70,782	286
MDR (1-4 du/acre)	35	5	813	1,513	6
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	24	12	79,910	0	67
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	18,587	1,487	743,470	89,216	980
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	8,165	1,243	177,500	69,225	234
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	51	2	620	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**28,493**	**2,989**	**1,040,363**	**230,736**	**1,573**
Primary Source Storm Load	**15,117**	**2,170**	**948,266**	**230,736**	**1,573**
Primary Source Non-Stormwater Load	**13,376**	**819**	**92,097**	**0**	**0**

Secondary Sources

Secondary Load to Surface Waters					
OSDSs - Surface	34	6	229	369	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	2,520	1,260	1,800,000	0	0
Hobby Farms/Livestock	0	0	0	0	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**2,554**	**1,266**	**1,800,229**	**369**	**0**
Secondary Source Storm Load	**2,520**	**1,260**	**1,800,000**	**0**	**0**
Secondary Source Non-Stormwater Load	**34**	**6**	**229**	**369**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	382	8	0	0	0
Total Groundwater Load	**382**	**8**	**0**	**0**	**0**

This table summarizes the pollutant loads and runoff volumes from ***Uncontrolled*** pollutant sources, including both the Primary Sources and Secondary Sources included in the "**Sources**" tab. The purple cells summarize loads from each broad category of sources. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the difference between loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load).

Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	4,288	633	100,051	186,115	753
MDR (1-4 du/acre)	147	22	3,429	6,378	26
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	58	29	194,115	0	162
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	42,221	3,378	1,688,840	202,661	2,280
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	24,950	3,797	542,400	211,536	732
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	115	5	1,395	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**71,780**	**7,863**	**2,530,230**	**606,691**	**3,953**
Primary Source Storm Load	**38,194**	**5,710**	**2,307,106**	**606,691**	**3,953**
Primary Source Non-Stormwater Load	**33,586**	**2,152**	**223,124**	**0**	**0**

Secondary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
Secondary Load to Surface Waters					
OSDSs - Surface	81	14	543	874	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	4,057	2,029	2,898,000	0	0
Hobby Farms/Livestock	0	0	0	0	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**4,139**	**2,042**	**2,898,543**	**874**	**0**
Secondary Source Storm Load	**4,057**	**2,029**	**2,898,000**	**0**	**0**
Secondary Source Non-Stormwater Load	**81**	**14**	**543**	**874**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	905	20	0	0	0
Total Groundwater Load	**905**	**20**	**0**	**0**	**0**

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Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	10,534	1,555	245,800	457,241	1,850
MDR (1-4 du/acre)	335	49	7,815	14,538	59
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	192	96	639,963	0	537
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	153,186	12,255	6,127,440	735,293	9,926
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	58,912	8,965	1,280,700	499,473	2,075
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	4,019	157	48,670	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**227,179**	**23,077**	**8,350,389**	**1,706,544**	**14,447**
Primary Source Storm Load	**121,129**	**16,711**	**7,609,575**	**1,706,544**	**14,447**
Primary Source Non-Stormwater Load	**106,049**	**6,366**	**740,814**	**0**	**0**
Secondary Sources					
Secondary Load to Surface Waters					
OSDSs - Surface	367	61	2,449	3,945	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	5,048	2,524	3,606,000	0	0
Hobby Farms/Livestock	0	0	0	0	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**5,416**	**2,585**	**3,608,449**	**3,945**	**0**
Secondary Source Storm Load	**5,048**	**2,524**	**3,606,000**	**0**	**0**
Secondary Source Non-Stormwater Load	**367**	**61**	**2,449**	**3,945**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	4,081	90	0	0	0
Total Groundwater Load	**4,081**	**90**	**0**	**0**	**0**

This table summarizes the pollutant loads and runoff volumes from *Uncontrolled* pollutant sources, including both the Primary Sources and Secondary Sources included in the "**Sources**" tab. The purple cells summarize loads from each broad category of sources. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the difference between loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load).

Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	9,373	1,384	218,706	406,839	1,646
MDR (1-4 du/acre)	314	46	7,326	13,627	55
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	245	123	617,617	0	685
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	131,254	10,500	5,250,160	630,019	7,560
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	34,882	5,308	758,300	295,737	1,092
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	2,624	103	31,775	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**178,692**	**17,464**	**7,083,883**	**1,346,223**	**11,038**
Primary Source Storm Load	**95,624**	**12,721**	**6,483,037**	**1,346,223**	**11,038**
Primary Source Non-Stormwater Load	**83,068**	**4,743**	**600,846**	**0**	**0**
Secondary Sources					
Secondary Load to Surface Waters					
OSDSs - Surface	811	135	5,405	8,705	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	7,748	3,874	5,534,000	0	0
Hobby Farms/Livestock	864	144	0	31,680	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**9,422**	**4,153**	**5,539,405**	**40,385**	**0**
Secondary Source Storm Load	**8,612**	**4,018**	**5,534,000**	**31,680**	**0**
Secondary Source Non-Stormwater Load	**811**	**135**	**5,405**	**8,705**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	9,007	199	0	0	0
Total Groundwater Load	**9,007**	**199**	**0**	**0**	**0**

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Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	18,085	2,670	421,978	784,969	3,175
MDR (1-4 du/acre)	325	48	7,575	14,091	57
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	90	45	298,718	0	250
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	300,125	24,010	12,004,990	1,440,599	16,423
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	131,891	20,070	2,867,200	1,118,208	3,922
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	35,277	1,378	427,180	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**485,792**	**48,221**	**16,027,641**	**3,357,868**	**23,827**
Primary Source Storm Load	**269,784**	**34,997**	**14,540,422**	**3,357,868**	**23,827**
Primary Source Non-Stormwater Load	**216,008**	**13,224**	**1,487,219**	**0**	**0**

Secondary Sources

Secondary Load to Surface Waters					
OSDSs - Surface	338	56	2,256	3,634	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	9,794	4,897	6,996,000	0	0
Hobby Farms/Livestock	0	0	0	0	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**10,133**	**4,954**	**6,998,256**	**3,634**	**0**
Secondary Source Storm Load	**9,794**	**4,897**	**6,996,000**	**0**	**0**
Secondary Source Non-Stormwater Load	**338**	**56**	**2,256**	**3,634**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	3,760	83	0	0	0
Total Groundwater Load	**3,760**	**83**	**0**	**0**	**0**

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Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	4,289	633	100,083	186,177	753
MDR (1-4 du/acre)	49	7	1,142	2,125	9
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	45	22	148,845	0	124
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	72,082	5,767	2,883,260	345,991	3,737
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	21,546	3,279	468,400	182,676	607
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	397	16	4,805	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**98,408**	**9,724**	**3,606,535**	**716,968**	**5,230**
Primary Source Storm Load	**51,594**	**7,010**	**3,271,369**	**716,968**	**5,230**
Primary Source Non-Stormwater Load	**46,814**	**2,714**	**335,166**	**0**	**0**

Secondary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
Secondary Load to Surface Waters					
OSDSs - Surface	331	55	2,208	3,556	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	2,500	1,250	1,786,000	0	0
Hobby Farms/Livestock	5,184	864	0	190,080	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**8,016**	**2,169**	**1,788,208**	**193,636**	**0**
Secondary Source Storm Load	**7,684**	**2,114**	**1,786,000**	**190,080**	**0**
Secondary Source Non-Stormwater Load	**331**	**55**	**2,208**	**3,556**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	3,679	81	0	0	0
Total Groundwater Load	**3,679**	**81**	**0**	**0**	**0**

This table summarizes the pollutant loads and runoff volumes from ***Uncontrolled*** pollutant sources, including both the Primary Sources and Secondary Sources included in the "**Sources**" tab. The purple cells summarize loads from each broad category of sources. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the difference between loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load).

Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	3,619	534	84,452	157,098	636
MDR (1-4 du/acre)	70	10	1,629	3,031	12
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	55	28	183,827	0	154
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	53,341	4,267	2,133,640	256,037	2,842
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	14,982	2,280	325,700	127,023	434
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	461	18	5,580	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**72,528**	**7,137**	**2,734,828**	**543,189**	**4,077**
Primary Source Storm Load	**38,367**	**5,173**	**2,488,894**	**543,189**	**4,077**
Primary Source Non-Stormwater Load	**34,162**	**1,964**	**246,934**	**0**	**0**

Secondary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
Secondary Load to Surface Waters					
OSDSs - Surface	217	36	1,448	2,332	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	5,186	2,593	3,704,000	0	0
Hobby Farms/Livestock	0	0	0	0	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**5,403**	**2,629**	**3,705,448**	**2,332**	**0**
Secondary Source Storm Load	**5,186**	**2,593**	**3,704,000**	**0**	**0**
Secondary Source Non-Stormwater Load	**217**	**36**	**1,448**	**2,332**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	2,413	53	0	0	0
Total Groundwater Load	**2,413**	**53**	**0**	**0**	**0**

This table summarizes the pollutant loads and runoff volumes from ***Uncontrolled*** pollutant sources, including both the Primary Sources and Secondary Sources included in the "**Sources**" tab. The purple cells summarize loads from each broad category of sources. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the difference between loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load).

Source Loads (Without Practices)

Primary Sources

	TN (lb/year)	TP (lb/year)	TSS (lb/year)	Fecal Coliform (billion/year)	Runoff Volume (acre-feet/year)
LDR (<1du/acre)	5,731	846	133,719	248,747	1,006
MDR (1-4 du/acre)	779	115	18,175	33,808	137
HDR (>4 du/acre)	0	0	0	0	0
Multifamily	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Commercial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Roadway	112	56	371,769	0	312
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Industrial	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Forest	39,617	3,169	1,584,660	190,159	2,539
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Rural	33,069	5,032	718,900	280,371	1,152
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
	0	0	0	0	0
Open Water	410	16	4,960	0	0
Active Construction	0	0	0	0	0
Total Surface Water Primary Source Load	**79,717**	**9,234**	**2,832,183**	**753,085**	**5.145**
Primary Source Storm Load	**43,374**	**6,774**	**2,601,827**	**753,085**	**5,145**
Primary Source Non-Stormwater Load	**36,343**	**2,460**	**230,356**	**0**	**0**

Secondary Sources

Secondary Load to Surface Waters					
OSDSs - Surface	1,118	186	7,457	12,008	0
SSOs	0	0	0	0	0
CSOs	0	0	0	0	0
Illicit Connections	0	0	0	0	0
Channel Erosion	1,140	570	814,000	0	0
Hobby Farms/Livestock	2,160	360	0	79,200	0
Marinas	0	0	0	0	0
Road Sanding	0	0	0	0	0
Point Source Discharges	0	0	0	0	0
Total Surface Water Secondary Source Surface Load	**4,418**	**1,116**	**821,457**	**91,208**	**0**
Secondary Source Storm Load	**3,300**	**930**	**814,000**	**79,200**	**0**
Secondary Source Non-Stormwater Load	**1,118**	**186**	**7,457**	**12,008**	**0**
Secondary Load to Groundwater					
OSDSs- Subsurface	12,425	275	0	0	0
Total Groundwater Load	**12,425**	**275**	**0**	**0**	**0**

Future Practices

This table summarizes the ***Net pollutant load and runoff reductions*** achieved by practices included in the **"Future Practices"** tab. The reductions presented in this table include only the benefits beyond the practices already in place in the Existing Conditions. So, for example, an improvement to an existing education program would include only the ***additional load reduction*** achieved by improving the program.The purple cells summarize the total load reduction from all practices, while the grey cells report the benefits of individual practices. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the reductions from loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load). In some cases, a *negative load reduction* may be reported. This represents an *increase* in load, which would occur if a program or practice was made *less* effective in the future condition.

Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	48	13	2,779	1,692	8
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	0	0	0	0	0
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	5	1	35	56	0
Channel Protection	317	158	452,424	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	**370**	**172**	**455,238**	**1,748**	**8**
Storm Load Reduction	**364**	**172**	**455,203**	**1,692**	**8**
Non-Storm Load Reduction	**5**	**1**	**35**	**56**	**0**
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-6	0	0	0	0
Total Groundwater Load Reduction	**-57**	**-1**	**0**	**0**	**0**

Future Practices

This table summarizes the ***Net pollutant load and runoff reductions*** achieved by practices included in the **"Future Practices"** tab. The reductions presented in this table include only the benefits beyond the practices already in place in the Existing Conditions. So, for example, an improvement to an existing education program would include only the ***additional load reduction*** achieved by improving the program The purple cells summarize the total load reduction from all practices, while the grey cells report the benefits of individual practices. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the reductions from loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load). In some cases, a *negative load reduction* may be reported. This represents an *increase* in load, which would occur if a program or practice was made *less* effective in the future condition.

Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	291	81	26,091	10,512	60
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	0	0	0	0	0
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	124	21	823	1,326	0
Channel Protection	1,546	773	2,207,862	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	1,960	875	2,234,777	11,838	60
Storm Load Reduction	1,836	855	2,233,953	10,512	60
Non-Storm Load Reduction	124	21	823	1,326	0
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-152	-3	0	0	0
Total Groundwater Load Reduction	-441	-8	0	0	0

Future Practices

This table summarizes the ***Net pollutant load and runoff reductions*** achieved by practices included in the **"Future Practices"** tab. The reductions presented in this table include only the benefits beyond the practices already in place in the Existing Conditions. So, for example, an improvement to an existing education program would include only the ***additional load reduction*** achieved by improving the program. The purple cells summarize the total load reduction from all practices, while the grey cells report the benefits of individual practices. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the reductions from loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load). In some cases, a *negative load reduction* may be reported. This represents an *increase* in load, which would occur if a program or practice was made *less* effective in the future condition.

Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	561	153	18,571	20,376	89
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	292	94	10,768	10,170	35
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	52	9	344	554	0
Channel Protection	1,225	612	1,749,739	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	**2,129**	**868**	**1,779,420**	**31,100**	**124**
Storm Load Reduction	**2,078**	**859**	**1,779,076**	**30,546**	**124**
Non-Storm Load Reduction	**52**	**9**	**344**	**554**	**0**
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-64	-1	0	0	0
Total Groundwater Load Reduction	**-640**	**-10**	**0**	**0**	**0**

Future Practices

This table summarizes the ***Net pollutant load and runoff reductions*** achieved by practices included in the **"Future Practices"** tab. The reductions presented in this table include only the benefits beyond the practices already in place in the Existing Conditions. So, for example, an improvement to an existing education program would include only the ***additional load reduction*** achieved by improving the program The purple cells summarize the total load reduction from all practices, while the grey cells report the benefits of individual practices. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the reductions from loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load). In some cases, a *negative load reduction* may be reported. This represents an *increase* in load, which would occur if a program or practice was made *less* effective in the future condition.

Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	122	33	6,696	4,331	21
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	0	0	0	0	0
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	12	2	83	133	0
Channel Protection	508	254	726,400	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	642	290	733,179	4,464	21
Storm Load Reduction	630	288	733,096	4,331	21
Non-Storm Load Reduction	12	2	83	133	0
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-15	0	0	0	0
Total Groundwater Load Reduction	-149	-3	0	0	0

Future Practices

This table summarizes the ***Net pollutant load and runoff reductions*** achieved by practices included in the **"Future Practices"** tab. The reductions presented in this table include only the benefits beyond the practices already in place in the Existing Conditions. So, for example, an improvement to an existing education program would include only the ***additional load reduction*** achieved by improving the program.The purple cells summarize the total load reduction from all practices, while the grey cells report the benefits of individual practices. Note that, while the summary table presents only the Total Surface Water loads, this table also breaks out the reductions from loads during storm events (i.e., the Storm Load) and the loads occuring during dry weather conditions (i.e., the Non-Stormwater Load). In some cases, a *negative load reduction* may be reported. This represents an *increase* in load, which would occur if a program or practice was made *less* effective in the future condition.

Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	253	70	17,872	9,436	49
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	0	0	0	0	0
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	56	9	373	601	0
Channel Protection	631	316	901,815	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	940	395	920,060	10,036	49
Storm Load Reduction	884	386	919,687	9,436	49
Non-Storm Load Reduction	56	9	373	601	0
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-69	-2	0	0	0
Total Groundwater Load Reduction	-382	-7	0	0	0

Future Practices

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Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	214	59	10,128	7,626	36
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	0	0	0	0	0
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	50	8	336	542	0
Channel Protection	316	158	451,500	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	**580**	**225**	**461,964**	**8,168**	**36**
Storm Load Reduction	**530**	**217**	**461,628**	**7,626**	**36**
Non-Storm Load Reduction	**50**	**8**	**336**	**542**	**0**
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-62	-1	0	0	0
Total Groundwater Load Reduction	**-258**	**-5**	**0**	**0**	**0**

Future Practices

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Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	104	29	6,208	3,683	18
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	104	34	7,164	3,377	11
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	33	6	221	355	0
Channel Protection	1,032	516	1,474,110	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	1,273	584	1,487,702	7,415	30
Storm Load Reduction	1,239	578	1,487,482	7,060	30
Non-Storm Load Reduction	33	6	221	355	0
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-41	-1	0	0	0
Total Groundwater Load Reduction	-162	-3	0	0	0

Future Practices

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Net Benefit (Load Reductions) of Future Practices

	TN (lbs/year)	TP (lbs/year)	TSS (lbs/year)	Bacteria (billion/year)	Runoff Reduction (acre-ft/yr)
Reductions to Surface Water Loads					
Lawn Care Education Surface	0	0	0	0	0
Pet Waste Education	0	0	0	0	0
Erosion and Sediment Control	0	0	0	0	0
Street Sweeping	0	0	0	0	0
Street Sweeping - Sanding	0	0	0	0	0
Structural Stormwater Management Practices	#REF!	#REF!	#REF!	#REF!	#REF!
Riparian Buffers	162	44	11,259	6,075	31
Catch Basin Cleanouts	0	0	0	0	0
Marina Pumpouts	0	0	0	0	0
Urban Downsizing	0	0	0	0	0
Redevelopment With Improvements	0	0	0	0	0
Stormwater Retrofits	144	48	11,500	4,930	17
Illicit Connection Removal	0	0	0	0	0
CSO Repair/ Abatement	0	0	0	0	0
SSO Repair/ Abatement	0	0	0	0	0
OSDS Programs - Surface	170	28	1,136	1,829	0
Channel Protection	143	71	204,036	0	0
Point Source Reduction	0	0	0	0	0
Total Surface Water Reduction	**619**	**192**	**227,931**	**12,834**	**48**
Storm Load Reduction	**449**	**164**	**226,795**	**11,005**	**48**
Non-Storm Load Reduction	**170**	**28**	**1,136**	**1,829**	**0**
Reductions to Groundwater Loads					
Urban Land	0	0	0	0	0
OSDSs	-210	-5	0	0	0
Total Groundwater Load Reduction	**-409**	**-8**	**0**	**0**	**0**

TSS reduction (lbs annually)

Reuction source	Sub-watershed (TP lb/year)								
	JC-1	LLC-1	LLC-2	LC-1	LC-2	CC-1	MFC-1	WC-1	Total
Riparian buffer restoration	2,779	6,696	17,872	26,091	18,571	10,128	6,208	11,259	99,603
SW retrofits					10,766		7,164	11,500	29,430
Septic programs	35	83	373	823	344	336	221	1,136	3,351
Stream restoration	452,424	726,400	901,815	1,388,142	1,749,739	451,500	919,906	204,036	6,793,962
Unpaved road improvement			159,991	204,404				92,942	457,337
Ag BMPs			24,974		156,979			49,604	231,557
Total	455,238	733,179	1,105,025	1,619,460	1,936,399	461,964	933,499	370,477	7,615,240

Costs sheet

Reduction Action	Unit area (ft)	Unit area (acres)	Reduction (lbs)/UA	Cost/UA	Total cost	lbs reduced	Cost/lb reduced	Notes
Stream Restoration	29885		30-320 lb/ft	75	$2,241,360.00	6,333,526	$0.35	
Riparian restoration	29321	33.61	3.4 lb/ft	800/ac	$26,880.00	99,603	$0.27	This is 50% buffered. More buffer will likely not get much more reduction
Unpaved road improvement	830016	266.8	0.55 lb/ft	1.66/ft	$1,375,500.00	457,337	$3.01	
SW retrofits		342	86.06 lb/ac	1228/ac	$420,000.00	29,430	$14.27	
Agri BMPs		7746	29.89 lb/ac	206/ac	$1,595,676.00	231,557	$6.89	
Total					$5,659,416.00	$7,151,453.00		