

Recreational Use Attainability Analysis for Iron Ore (0202K), Choctaw Creek (0202F), Bois D' Arc Creek (0202A), Smith Creek (0202G), and Mud Creek (0201A) in the Red River Basin

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CHAPTER 1

INTRODUCTION

Problem Statement

From west to east, Iron Ore Creek (0202K), Choctaw Creek (0202F), Bois D' Arc Creek (0202A), Smith Creek (0202G), and Mud Creek (0201A) represent five unclassified water bodies located in primarily rural watersheds within the Red River Basin (Table 1.1 and Figure 1.1). These five watersheds are on the 2012 Texas 303(d) list as impaired for primary contact recreation due to elevated bacteria concentrations (TCEQ, 2013). The assessment units (AUs) of each creek are described below as well as any other noted impairments or concerns.

- Iron Ore Creek consists of one AU, 0202K_01, which extends from the confluence with Choctaw Creek upstream to the headwaters near Farm-to-Market (FM) 120 west of Denison, Texas. Iron Ore Creek was first listed as impaired for bacteria within the 2010 Texas Integrated Report and remains on the 2012 303(d) list. No other impairments or concerns are noted for Iron Ore Creek.
- Choctaw Creek consists of two AUs, 0202F_01 and 0202F_02, both of which are listed as impaired for bacteria. Assessment unit 0202F_01 extends from the confluence with the Red River upstream to the confluence with Post Oak Creek. Assessment unit 0202F_02 extends from the confluence with Post Oak Creek upstream to the headwaters near the intersection of State Highway (SH) 56 and SH 289 in Grayson County. Choctaw Creek was first listed as impaired for bacteria within the 2010 Texas Integrated Report and remains on the 2012 303(d) list. Concerns are also noted along 0202F_01 for elevated concentrations of total phosphorus, orthophosphorus, and nitrate.
- Bois D' Arc Creek consists of two AU, 0202A_01 and 0202A_02. Only 0202A_02 is listed as impaired for bacteria. Assessment unit 0202A_01 extends from the confluence with the Red River upstream to the confluence with Sandy Creek. Assessment unit 0202A_02 extends from the confluence with Sandy Creek upstream to the confluence with Pace Creek northwest of Whitewright in Grayson County. Bois D' Arc Creek was first listed as impaired for bacteria in 2010. No other impairments or concerns are noted for Bois D' Arc Creek.
- Smith Creek consists of one AU, 0202G_01, which extends from the confluence with Pine Creek north of Paris to the upstream portion of the stream in north Paris in Lamar County. Smith Creek was first listed as impaired for bacteria within the 2006 Texas Integrated Report and remains on the 2012 303(d) list. Concerns noted for 0202G_01 include elevated concentrations of ammonia, total phosphorus, and orthophosphorus.
- Mud Creek consists of one AU, 0201A_01, which extends from the confluence of the Red River to the upstream perennial portion of the stream northwest of De Kalb in Bowie County. Mud Creek was first listed as impaired for bacteria in 2002 and remains on the 2012 303(d) list. Concerns noted for 0202A_01 include elevated concentrations of ammonia, chlorophyll-a, and depressed dissolved oxygen. Depressed dissolved oxygen is also listed as an impairment in comparison to the 24hr average.

The project's unclassified water bodies have a presumed use of primary contact recreation based on the *Texas Surface Water Quality Standards* (TSWQS) (TCEQ, 2014). Prior to June 2010, only two categories of recreation use, contact and noncontact, existed in Texas. In June 2010, the Texas Commission on Environmental Quality (TCEQ) adopted revisions to the TSWQS that expanded the designation of contact recreation into three categories (primary contact recreation, secondary contact recreation 1, and secondary contact recreation 2) based on varying degrees of interaction with the water, while maintaining a fourth category of noncontact recreation. These revisions were codified in the Texas Administrative Code (TAC), Title 30 Chapter 307 and became effective as a state rule on July 22, 2010 (TCEQ, 2010). As a result of these revisions to the TSWQS, all water bodies listed as impaired based on bacteria for contact recreation are scheduled to undergo a standards review. This standards review will be used to determine if primary contact recreation is appropriate or if a revision to the recreation use category should be considered for each water body.

Table 1.1 Water bodies targeted for RUAAs.

TCEQ ID	Water Body Name	Water Body Description	Stream Type	Listed Assessment Miles	Watershed Area (Acres)
0202K	Iron Ore Creek	From the confluence with Choctaw Creek upstream to the headwaters near FM 120 west of Denison	Intermittent	19	28,300
0202F	Choctaw Creek	From the confluence with the Red River east of Denison to the upstream perennial portion near the intersection of SH 56 and SH 289 in Grayson County	Perennial/ intermittent with pools	44	138,000
0202A	Bois D' Arc Creek	From the confluence of the Red River upstream to the headwaters northwest of Whitewright in Grayson County	Perennial	68	271,000
0202G	Smith Creek	From the confluence with Pine Creek north of Paris to the upstream portion of the stream in north Paris in Lamar County	Intermittent	6	3,800
0201A	Mud Creek	From the confluence of the Red River to the upstream perennial portion of the stream northwest of De Kalb in Bowie County	Intermittent with pools	36	54,400

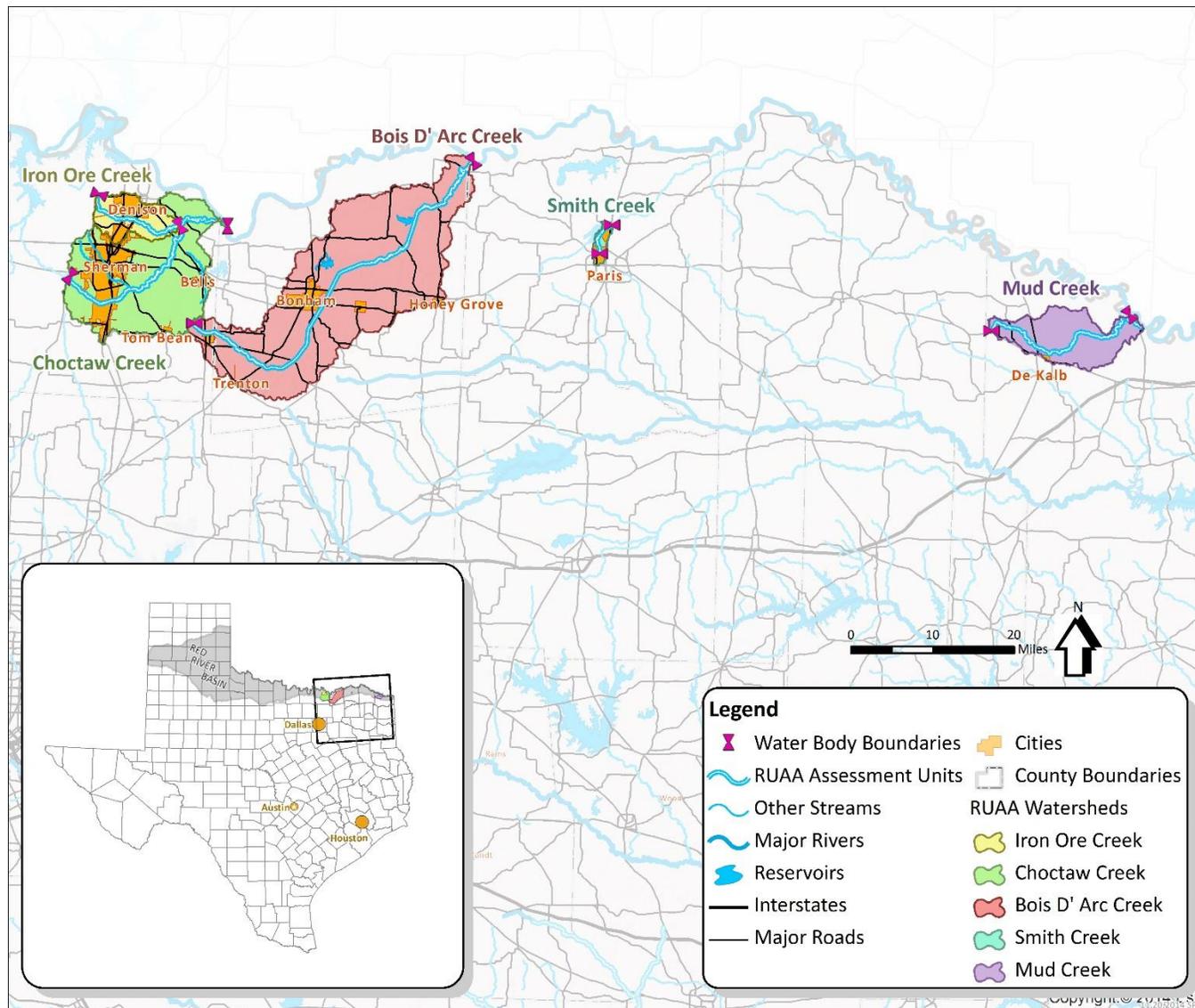


Figure 1.1 Map showing location of Iron Ore Creek, Choctaw Creek, Bois D' Arc Creek, Smith Creek, and Mud Creek watersheds.

Use attainability analyses (UAAs) are studies that evaluate the designated or presumed uses of a water body. To identify and assign attainable uses and criteria to individual water bodies, UAAs evaluate physical, chemical, biological, and economic factors affecting use attainment of a water body (40 Code of Federal Regulations §131.10(g)). A recreational use attainability analysis (RUAA) is a specific type of UAA focused on determining the appropriate recreational use category of a water body. An RUAA consists of three parts: field surveys to document water body characteristics and signs of recreation, interviews with stakeholders regarding past and current use of the water body, and a historical review regarding recreational use of the water body.

The objective of this report is to present the findings of a Comprehensive RUAA for Iron Ore Creek, Choctaw Creek, Bois D' Arc Creek, Smith Creek, and Mud Creek following the TCEQ March 2014 *Procedures for a Comprehensive RUAA and a Basic RUAA Survey* (TCEQ, 2014). All components of these RUAAs were performed by the Texas Institute for Applied Environmental Research (TIAER), which is located on the campus of Tarleton State University in Stephenville, Texas. Field surveys and interviews for these RUAAs were conducted under a Texas State Soil and Water Conservation Board (TSSWCB) approved Quality Assurance Project Plan (QAPP; TIAER, 2014).

Stakeholder and Agency Involvement

The TSSWCB and its collaborating entities maintain an inclusive public participation process. Stakeholder involvement is recognized as a key source of knowledge about each water body. Furthermore, it can facilitate the site selection process. From the inception of this project, the project team sought to ensure that stakeholders were informed and involved.

In addition to information and comments from watershed stakeholders, input was also solicited from the Red River Authority (RRA), Clean Rivers Program (CRP), Texas Parks and Wildlife Department regional staff, TCEQ regional staff, local Soil and Water Conservation Districts (SWCD), and other local agencies about the need for the RUAA. Meetings with administrative stakeholders were held to give an overview of water quality issues within each of the five watersheds (Table 1.2).

Table 1.2 RUAA introductory meeting dates and locations with administrative stakeholders.

Watershed	Local Agencies	Meeting Dates	Meeting Location
Iron Ore Creek	Grayson County SWCD	January 13, 2014	Gainesville, TX
	Sherman City Council Grayson County Commissioners	January 27, 2014	Sherman, TX
Choctaw Creek	Grayson County SWCD	January 13, 2014	Gainesville, TX
	Sherman City Council Grayson County Commissioners	January 27, 2014	Sherman, TX
Bois D' Arc Creek	Fannin County SWCD	January 21, 2014	Bonham, TX
	Dodd City, City Council Bonham City Council Fannin County Commissioners	January 28, 2014	Bonham, TX
Smith Creek	Lamar County SWCD	January 29, 2014	Paris, TX
	Paris City Council Lamar County Commissioners	January 29, 2014	Paris, TX
Mud Creek	DeKalb City Council Bowie County Commissioners	January 30, 2014	New Boston, TX
	Bowie SWCD	February 4, 2014	DeKalb, TX

Public meetings specifically targeting landowners, in each watershed, were held in an effort to inform them of the water quality impairments in the watersheds and the need for an RUAA (Table 1.3). Watershed stakeholders were invited to attend the public meetings through mailed invitations, public announcements, TSSWCB and TIAER webpages, and individual phone calls. Due to the logistics of the watershed areas, meetings pertaining to Iron Ore Creek and Choctaw Creek were combined to better accommodate time and distance to meeting locations for stakeholders. At these meetings, attendees were given an opportunity to comment on proposed study sites prior to field data collection. Landowner cooperation was also sought, as many potential RUAA survey sites for each stream were accessible only via private property. These public meetings were used to solicit input from all interested parties with the study area.

Table 1.3 RUAA introductory meetings with watershed stakeholders.

Watershed	Meeting Date	Meeting Location
Smith Creek	March 6, 2014	Paris, TX
Bois D' Arc Creek	March 4, 2014	Bonham, TX
Choctaw Creek, Iron Ore Creek	March 10, 2014	Sherman, TX
Mud Creek	March 11, 2014	DeKalb, TX

Meetings were held after the initial RUAA field survey for each creek to provide stakeholders a summary of findings and solicit interviews regarding recreational use (Table 1.4). The importance of interviews in providing feedback on past recreational use was emphasized by TIAER and TSSWCB. Interview forms were made available at these meeting to watershed stakeholders.

Table 1.4 RUAA summary meetings with watershed stakeholders.

Watershed	Meeting Date	Meeting Location
Smith Creek	July 10, 2014	Paris, TX
Choctaw Creek, Iron Ore Creek	July 14, 2014	Sherman, TX
Mud Creek	August 7, 2014	DeKalb, TX
Bois D' Arc Creek	August 12, 2014	Bonham, TX

A final stakeholder meeting will occur in each watershed, during which the findings of field surveys, the historical review, and interviews will be presented. The next steps of the RUAA will also be discussed at this meeting and feedback from stakeholders will be solicited. At the meeting, stakeholders will be informed of the availability of the draft RUAA report for public review and comment. The draft report will be made available via the project website, and TIAER will provide hard copies to individuals if desired.

Information on past meetings, including agendas, presentations, and other information can be found at the websites provided below:

[Mud Creek Project Webpage¹](#)

[Bois D' Arc Creek Project Webpage²](#)

[Choctaw Creek Project Web Page³](#)

[Smith Creek Project Webpage⁴](#)

[Iron Ore Creek Project Webpage⁵](#)

¹ <http://tiaer.tarleton.edu/ruaa/mud-creek.html>

² <http://tiaer.tarleton.edu/ruaa/bois-d-arc-creek.html>

³ <http://tiaer.tarleton.edu/ruaa/choctaw-creek.html>

⁴ <http://tiaer.tarleton.edu/ruaa/smith-creek.html>

⁵ <http://tiaer.tarleton.edu/ruaa/iron-ore-creek.html>

Chapter 2

Study Methodology

The process of developing a list of sites to be surveyed for the RUAA began with a reconnaissance of potential locations along each water body. A combination of Geographic Information System (GIS) data, review of historical information, and meetings and phone conversations with local entities and stakeholders were used to determine sites included in the RUAA field surveys.

Watershed Reconnaissance and Site Selection Strategy

Reconnaissance of each watershed was conducted to collect background information before selecting appropriate sites for each RUAA. To the degree possible, site reconnaissance was coordinated with watershed stakeholders in an effort to increase local landowner interest in water quality issues. The March 2014 RUAA procedures (TCEQ, 2014) recommends selecting three sites per every five miles of stream. Based on this recommendation, the recommended number of sites was 11 for Iron Ore Creek, 26 for Choctaw Creek, 41 for Bois D' Arc Creek, 3 for Smith Creek, and 21 for Mud Creek.

The following information was compiled using Geographic Information System (GIS) based tools prior to, during, and immediately following the watershed reconnaissance:

- The location of areas along the water body that were accessible to the public and had the highest potential for recreational use, such as road crossings and parks;
- The location of permitted wastewater outfalls and other potential point sources;
- The hydrologic characteristics, such as stream type, streamflow, and hydrologic alterations; and
- The location of city boundaries or other designated population areas.

The site selection process took into account locations that were accessible to the public, had the highest potential for recreational use, and had TCEQ monitoring stations where historical data may have been collected. The site selection process also considered parks and bridge crossings along the river, as well as access through private lands adjacent to the river.

Survey Methods

Field Survey Data Collection Activities

As specified in the procedures for a Comprehensive RUAA (TCEQ, 2014), two separate field surveys occurred at each selected survey site during the warm season (air temperature greater than or equal to 70degrees Fahrenheit or 21degrees Celsius) when human recreational activities were most likely to occur (May - September). Ideally, field surveys were to be conducted when stream flow conditions were normal. Rainfall data 30 days prior to each survey were also documented to provide antecedent conditions.

Data collection activities at each RUAA site for both field surveys included the following:

- Measurement of average depth at thalweg (deepest depth),
- Measurement of depths, lengths, and widths of substantial pools,
- Documentation of observational/anecdotal data required on the RUAA field forms,
- Photographs of any signs of recreation and
- Photographs of site conditions including upstream, downstream, left bank, and right bank photos at the 0-m, 150-m, and 300-m transects.

Average Depth at Thalweg and Substantial Pool Depths

Determination of thalweg and substantial pool depths is applicable to contact recreation use determination for intermittent and perennial freshwaters according to TCEQ (2014). The thalweg is defined as the deepest depth of a transect perpendicular to the stream channel. A substantial pool was defined as a pool greater than 1m (3.28-ft) deep and 10m (32.8-ft) long for the purposes of the RUAA survey (TCEQ, 2014).

As instructed in the RUAA procedures manual (TCEQ, 2014), a 300-m reach at each station was evaluated to determine average thalweg depth. Eleven transects at 30 m intervals were established in the 300m stream reach bracketing each station. Each reach surveyed was oriented downstream to up, the 0-m transect was always set as the most downstream and the 300-m transect as the most upstream. All transect distances including thalweg depths and pool depths and lengths are presented in units of meters per the RUAA procedures (TCEQ, 2014).

Observational /Anecdotal Data

Anecdotal information was recorded on field data sheets during all surveys using the field data sheets from the TSSWCB-approved QAPP (TIAER, 2014).

Types of observational and anecdotal records included, but were not limited to, the following:

- Channel flow status as indicated by flow severity
- Stream type (e.g., ephemeral, intermittent, etc.)
- Streamflow
- General weather conditions (cloud cover/rain)
- Substrate type
- Stream accessibility
- Anecdotal information related to observed human contact activities

Photographs

TIAER staff created photographic records of each site during the site surveys. Photographs included an upstream view, left and right bank views, downstream view (as described in the Field Data Sheets), and any evidence of observed uses or indications of human use, hydrologic modifications, etc. Photographs were intended to clearly depict the entire channel and were taken specifically at the 0-m, 150-m, and 300-m transects for the reach. Any items of interest, e.g., obstructions, were also photographed. Photographs were used to document evidence of recreational use (e.g., fishing tackle) and actual recreation. Photographs were also used to document a lack of

use (e.g., dry creek beds) or impediments to recreational use. In addition, as part of the overall project, photographs were also taken to indicate potential bacteria sources to the water body. All photographs were labeled in a manner that indicated the photo's subject, site location, date, and orientation to the stream. Selected photos representative of each RUAA field site are included with the survey results for each water body in this report

[Iron Ore Creek Project Webpage⁶](#)

[Choctaw Creek Project Webpage⁷](#)

[Bois D' Arc Project Webpage⁸](#)

[Smith Creek Project Webpage⁹](#)

[Mud Creek Project Webpage¹⁰](#)

⁶ <http://tiaer.tarleton.edu/ruaa/iron-ore-creek.html>

⁷ <http://tiaer.tarleton.edu/ruaa/choctaw-creek.html>

⁸ <http://tiaer.tarleton.edu/ruaa/bois-d-arc-creek.html>

⁹ <http://tiaer.tarleton.edu/ruaa/smith-creek.html>

¹⁰ <http://tiaer.tarleton.edu/ruaa/mud-creek.html>

Chapter 3

Iron Ore Creek

(0202K)

Watershed Characteristics

The Iron Ore Creek watershed covers 28,300 acres and encompasses portions of the cities of Denison (estimated population 22,816), Sherman (estimated population 39,296), and Knollwood (estimated population 4,258). Iron Ore Creek is a major tributary of Choctaw Creek in the Red River Basin (Figure 3.1). The watershed area traverses generally flat terrain with local shallow depressions, surfaced by clay and sandy loams that support water-tolerant hardwood trees, conifers, and various grasses. (TSHA, 2010).

The Iron Ore Creek watershed lies within the Texas Blackland Prairie (35b) ecoregion (Griffith, et al., 2007) and is primarily used for cropland. Average rainfall for Denison, Texas is 28 to 42 inches, annually (U.S. Climate Data – Denison, Texas, 2015). Mean, minimum and maximum temperatures for the Denison, Texas range from 32degrees Fahrenheit to 52 degrees Fahrenheit in January and 73degrees Fahrenheit to 93degrees Fahrenheit in July (U.S. Climate Data – Denison, Texas, 2015). The deciduous forest encompasses the majority of the watershed (34 percent) making the watershed predominately rural (Figure 3.1). The herbaceous land-use encompasses 30 percent of the watershed specifically near the upper reach of Iron Ore Creek. Roughly 22 percent of the watershed reflects developed land with most of the developed area around the City of Denison and the City of Sherman (Figure 3.2). The watershed includes Loy Park, Waterloo Park, and two unnamed parks, none of which are directly along Iron Ore Creek. All four parks are located in the City of Denison, Loy Park being located on Loy Lake and Waterloo Park being located along Waterloo Lake. Waterloo Park is the largest park within the watershed area, covering 148 total acres. Pasture and hayland along with more urban uses have altered the land within the Iron Ore Creek watershed. What was formerly tallgrass prairies, such as Indiangrass (*Sorghastrum nutans*), little bluestem (*Schizachyrium scoparium*), and big bluestem (*Andropogon gerardii*), is now primarily pasture and hay. Along the riparian areas, there are a few sections that were historically forested. Stream bottoms were often wooded with bur oak (*Quercus macrocarpa*), Shumard oak (*Q. shumardii*), sugar hackberry (*Celtis laevigata*), elm (*Ulmus spp.*), ash (*Fraxinus spp.*), eastern cottonwood (*Populus deltoids*), and pecan (*Carya illinoensis*) (Griffith, et. al. 2007).

Designated Uses, Impairments and Concerns

Iron Ore Creek consists of one assessment unit, AU 0202K_01, that is classified as intermittent and has presumed uses of primary contact recreation, general use, and fish consumption with a limited aquatic life use (TCEQ, 2013). The waterbody was first listed impaired for bacteria on the 2006 Texas 303(d) list. No other impairments or concerns are noted for Iron Ore Creek.

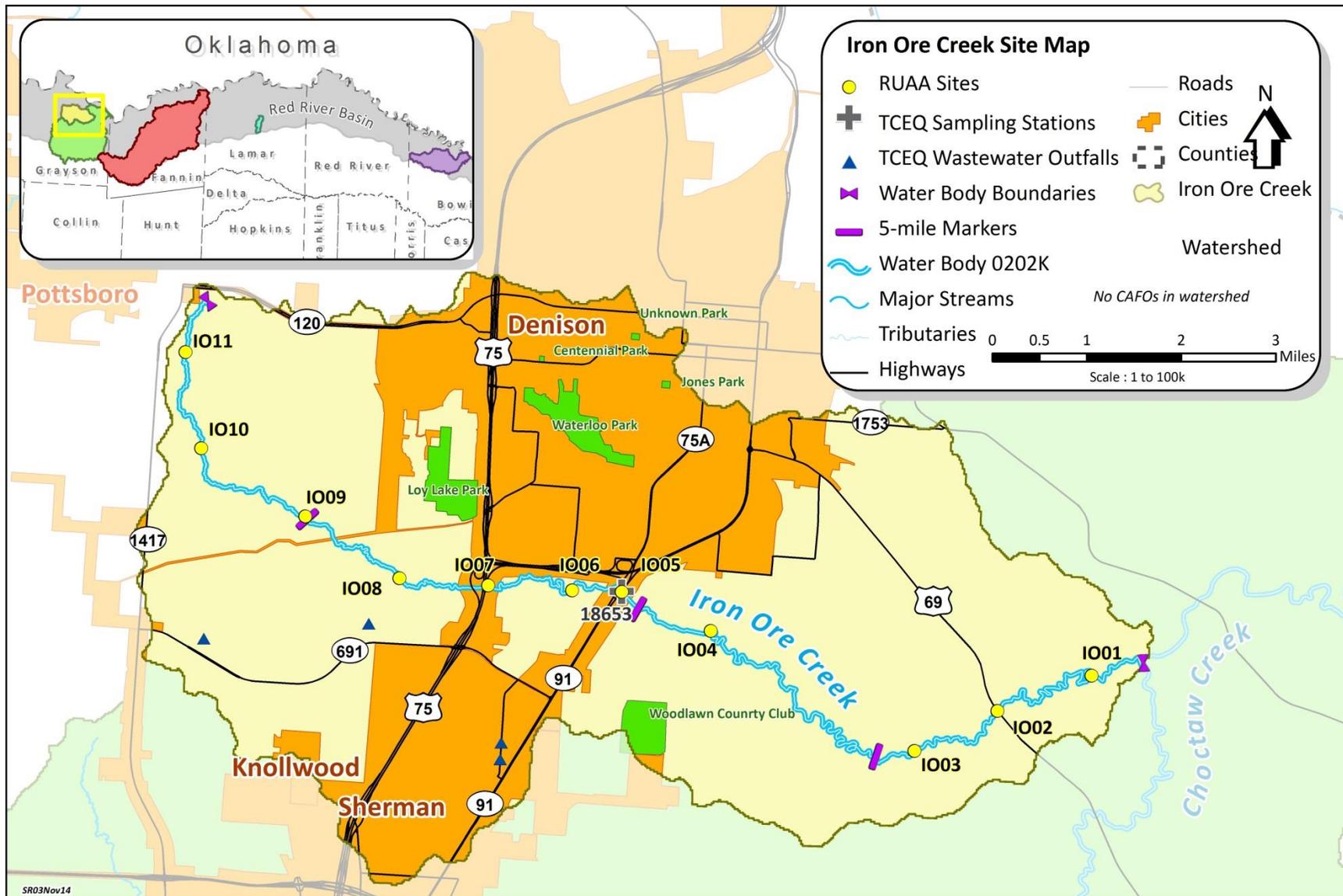


Figure 3.1 Overview of Iron Ore Creek watershed and RUAA sites.

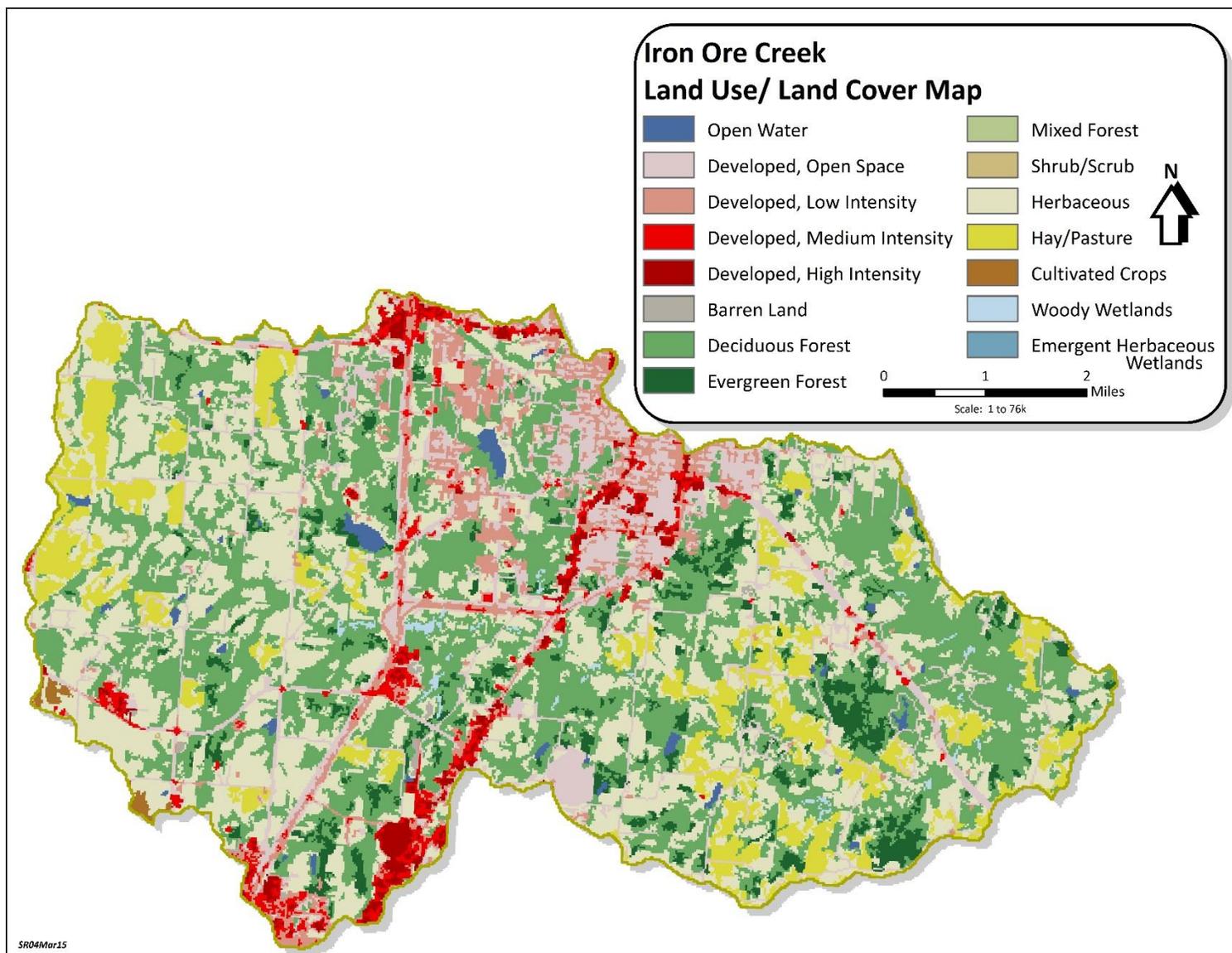


Figure 3.2 Land use/land cover for the Iron Ore Creek watershed. Source: 2006 National Land Cover Database (USGS, 2014).

Permitted Discharges

The Iron Ore Creek watershed, located in the northern portion of the Choctaw Creek watershed, has two municipalities with permitted wastewater treatment facilities (WWTFs) discharging into tributaries for Iron Ore Creek. These are the River Hills Owner Association WWTF and the Grayson County College WWTF. Additionally, there are two concrete plants, Hope Concrete and Sherman Ready Mix, in the watershed area with general permits.

The largest permitted discharge is the Grayson County College WWTF with a permitted average daily flow of 0.075 MGD. The Grayson County College WWTF (TX0056235) is located in Denison at 6101 Grayson Drive. The discharge from this WWTF flows into an unnamed tributary, which then flows to Iron Ore Creek.

The River Hills Owner Association WWTF (TX0033154) is located in Grayson County, northwest of the intersection of Farm-to-Market Road 691 and Farm-to-Market Road 131. The permitted average daily flow is 0.012 MGD and flowed into an unnamed tributary, which then flows to Iron Ore Creek.

Hope Concrete (TXG111178), located at 5815 North Travis Street in Sherman, Texas, has a general permit for minor discharge and directly discharges into Iron Ore Creek.

Sherman Ready Mix (TXG111225), located in Sherman, Texas, has a general permit for minor discharge and discharges into an unnamed tributary that then flows into Iron Ore Creek.

There are no concentrated animal feeding operations (CAFO) within the Iron Ore Creek watershed with a general permit.

Non-Permitted Agricultural Activities and Domesticated Animals

Activities such as livestock grazing close to water bodies and agricultural use of manure as fertilizer, can contribute bacteria to nearby water bodies. To provide an estimate of livestock densities in the watershed, livestock statistics were obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service website from the 2012 survey (USDA, 2012). These statistics, on a county level, indicate large numbers of beef cattle in Grayson County, and, thus, likely within the watershed area (Table 3.1).

Table 3.1 Estimated livestock numbers within the Iron Ore Creek watershed based on statistics adjusted for the percent of the county within the watershed (Source USDA, 2012).

The Iron Ore Creek watershed, in its entirety, covers less than 5% of Grayson County.

County	Year	Cattle & Calves (all beef)	All Goats	Mules, Burros, & Donkeys	Horses & Ponies	Hogs
Grayson	2012	45,912	4,679	683	5,044	745
Iron Ore Creek Watershed Average	2012	2,075	212	31	228	34

Domestic pets are another unregulated source of *E. coli* bacteria, particularly dogs, because storm runoff often carries these wastes into streams (EPA, 2009). Assuming a rough estimate of 0.584 dogs per household (AVMA, 2012) and about 8,200 households within the Iron Ore Creek watershed based on 2010 census population data, there are potentially about 4,800 dogs within the Iron Ore Creek watershed. Other domestic animals, such as outdoor cats, can also contribute to bacterial pollution; however, cat populations are difficult to estimate because in many rural areas cats are often feral.

Wildlife and Feral hogs

Other possible bacteria contributors include wildlife, such as deer, feral hogs, and birds. In 2013 statewide population estimated roughly 39 whitetail deer per 1,000 acres. This estimation suggests that the population for whitetail deer in the Post Oak Savannah region is roughly 400,000 deer, or 35 deer per 1,000 acres (Cain, 2014). Feral hogs are an invasive species commonly found throughout Texas. They have been known to travel in large groups along waterways and congregate near shallow depressions of water. Statewide feral hog densities range from an estimated average of 1.33 to 2.45 feral hogs per square mile (AgriLife, 2011).

Failing On-Site Sewage Facilities

Septic systems of on-site sewage facilities (OSSFs) are often used in rural areas that do not have the ability to connect to a central wastewater collection system. To estimate the number of potential OSSFs in the watershed, a GIS layer associated with the sewer Certificates of Convenience and Necessity (CNNs) from the Public Utility Commission of Texas was used. As not all cities with WWTFs have CNNs, the CNN layer was supplemented with a GIS layer representing municipal boundaries for those cities with WWTFs. Population data from the U.S. Census Bureau (USCB) were then overlaid masking out areas that should be serviced by WWTFs. The 2010 U.S. Census Bureau (USCB) data indicated that of the 8,200 households in Iron Ore watershed, about 1.97% are outside municipal areas and likely on septic systems.

Historical Review

A review of historical information regarding recreational use of Iron Ore Creek was conducted. The review considered the time period of November 28, 1975 to the present in accordance with 40 CFR Part 131 (EPA standards regulation). Government offices, libraries, historical societies, and newspapers were searched and contacted in addition to generic internet searches. The following is a summary of the review.

Government Sources

City of Denison

[City of Denison Homepage¹¹](#)

Nothing of significance was found pertaining to the historical use of Iron Ore Creek.

City of Sherman

[City of Sherman Homepage¹²](#)

Nothing of significance was found pertaining to the historical use of Iron Ore Creek.

Library Sources

Denison Public Library

[Denison Public Library Homepage¹³](#)

Phone: (903) 465-1797

Explored various links and online texts. Nothing pertaining to Iron Ore Creek was found

Sherman Public Library

[Sherman Public Library Homepage¹⁴](#)

Phone: (903) 892-7240

Explored various links and online texts. Nothing pertaining to Iron Ore Creek was found.

Newspaper Sources

Herold Democrat

[Herold Democate Homepage¹⁵](#)

Phone: (903) 893-8181

Explored various links and online texts. Nothing significant was found.

Van Alstyne Leader

[Van Alstyne Leader Homepage¹⁶](#)

Phone: (903) 482-5253

Explored various links and online texts. Nothing significant was found.

Internet Searches

The Handbook of Texas Online

[The Handbook of Texas Online, Iron Ore Creek Article¹⁷](#)

¹¹ <http://www.cityofdenison.com/>

¹² <http://www.ci.sherman.tx.us/>

¹³ <http://www2.youseemore.com/denison/default.asp>

¹⁴ <https://www.ci.sherman.tx.us/283/Library>

¹⁵ <http://heralddemocrat.com/>

¹⁶ <http://vanalstyneleader.com/>

¹⁷ <https://tshaonline.org/handbook/online/articles/rbi32>

Survey Site Descriptions

Iron Ore Creek (0202K) is 19 river miles long indicating a goal of 11 sites (3 per 5 miles of river) for the RUAA survey (Figure 3.1). With the help of cooperating stakeholders, TIAER was able to establish all 11 survey sites along Iron Ore Creek (Table 3.2).

All access to Iron Ore Creek is privately owned except narrow access points at public road crossings. Of the 11 survey sites, 9 were accessible from a public road that had no associated private property fencing. The remaining two sites were accessible from a public road, but had private property fences bisecting the stream. Site IO03 was not surveyed, because efforts to contact the landowner were unsuccessful and private property / no trespassing signs were located along the fence. There was also an extreme drop in height at the bridge crossing to the creek bed, so access would be very difficult and dangerous from the bridge. All road crossings were included as RUAA sites except for the crossing at Desvoignes Road, which passes about midway between Fannin Avenue and Shannon Road. In addition to unsuccessful attempts to contact the landowner for this crossing, accessing the creek directly at this road crossing was not considered safe by TIAER personnel, therefore this location was not included as an RUAA survey site.

All sites were at public road crossings where landowner permission was not required to access the stream; however, landowner permission was required and attained on sites where private property fencing impeded further travel in the streambed to conduct the entire 300 m survey. The average distance between survey sites is 1.74 river miles and ranges from 0.68 to 4.63 river miles. The largest gap between survey sites is 4.63 river miles between sites IO03 and IO04. RUAA surveys were performed May 16 - 17, 2014 and July 11, 2014 at these locations. A brief description of each site follows.

Table 3.2 Description and location of RUAA field survey sites for Iron Ore Creek, Water Body 0202K.

Site ID	TCEQ ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi) ¹	Distance from Confluence (mi) ¹	Distance from Upper Reach (mi) ¹	Access
IO01		Iron Ore Creek at Starr road	33.7069	-96.4735	NA	0.82	18.13	Public
IO02		Iron Ore Creek at Hwy 69	33.7011	-96.4905	2.22	3.04	15.91	Public
IO03		Iron Ore Creek at Shannon Rd (Tapscot in Google Earth)	33.6945	-96.5055	1.42	4.46	14.49	Public*
IO04		Iron Ore Creek at Fannin Ave	33.7119	-96.5436	4.63	9.09	9.86	Public
IO05	18653	Iron Ore Creek at North Texoma Parkway	33.7174	-96.5602	1.16	10.25	8.7	Public
IO06		Iron Ore Creek at Park Avenue	33.7173	-96.5693	0.68	10.93	8.02	Public
IO07		Iron Ore Creek at Hwy 75 Northbound Frontage Road	33.7177	-96.5848	1.39	12.32	6.63	Public
IO08		Iron Ore Creek at Loy Lake Road	33.7183	-96.6011	1.14	13.46	5.49	Public
IO09		Iron Ore Creek at Preston Rd	33.7273	-96.6188	1.57	15.03	3.92	Public
IO10		Iron Ore Creek at Davy Ln	33.7372	-96.6383	1.77	16.81	2.15	Public*
IO11		Iron Ore Creek at wells Rd/FM 996	33.7518	-96.6418	1.36	18.16	0.79	Public

* Indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property

¹Distances were digitally estimated using the measuring tool in ArcGIS 9.3 with the 2010 NAIP 1-m DOQQs and the NHD stream layer as reference guides

Site IO01 is the most downstream site located on Iron Ore Creek at Starr Road, 0.82 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO02 is located on Iron Ore Creek at Highway 69, 3.04 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO03 is located on Iron Ore Creek at Shannon Road (Tapscot in Google Earth), 4.46 miles from the confluence with Choctaw Creek. While the creek is accessible at the bridge crossing, private property fencing precludes further access upstream or downstream without landowner permission. This site was not surveyed, because efforts to contact the landowner were unsuccessful and private property / no trespassing signs were located along the fence. There was also an extreme drop in height at the bridge crossing to the creek bed, so access would be very difficult from the bridge.

Site IO04 is located on Iron Ore Creek at Fannin Avenue, 9.09 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO05 is located on Iron Ore Creek at North Texoma Parkway/State Highway 75A/91, 10.25 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO06 is located on Iron Ore Creek at Park Avenue, 10.93 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO07 is located on Iron Ore Creek at the Highway 75 Northbound frontage road, 12.32 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO08 is located on Iron Ore Creek between Loy Lake Road and FM 131, 13.46 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO09 is located on Iron Ore Creek at Preston Road, 15.03 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Site IO10 is located on Iron Ore Creek at Davy Lane, 16.81 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge but has a private property fence restricting further access. Landowner permission, allowing across-fence access, was required to complete the survey.

Site IO11 is located on Iron Ore Creek at FM 996 and Wells Road, 18.16 miles from the confluence with Choctaw Creek. This site is publically accessible at the bridge crossing.

Field Survey Results and Discussions

General Description of RUAA Survey Sites and Conditions for Iron Ore Creek (0202K)

The Iron Ore Creek RUAA surveys were conducted on May 16 and 17, 2014 and July 11, 2014. The surveys were performed on weekdays, weekends, or holidays at opportune times to observe recreational activities along Iron Ore Creek. Air temperatures prior to and during both the first

and second surveys, were above 21degrees Celsius (70degrees Fahrenheit) which is indicated by the RUAA guidelines as warm enough to promote recreational activities (Tables 3.3 and 3.4). Notably warmer temperatures occurred in July than in May. In the 30 days, prior to the May surveys, there was 2.59 inches of precipitation, while 1.89 inches fell in the 30 days prior to July surveys.

A summary of the RUAA field survey results is presented in the following tables:

- Table 3.5 describes the stream channel and corridor characteristics at each site.
- Table 3.6 notes the average thalweg depth by site during each survey and the access to the stream, whether public or private, and the ease of bank access.
- Tables 3.7 and 3.8 document the maximum, minimum, and average stream widths at each site for each survey and observed flow conditions.
- Tables 3.9 and 3.10 note stream aesthetics, wildlife observations and tracks, and the presence of garbage observed at each site during each survey.

Physical descriptions of each site follow these tables along with selected photos showing notable characteristics of each site. Overall thalweg depth averaged 0.3 m during the first survey and 0.2 m during the second survey. Access to the stream was moderately difficult in most locations due to dense vegetation and steep banks. The dominant substrate was mud/clay and the stream corridor was largely lined with trees and shrubs. The maximum stream width encountered was 10 m during the first survey in May 2014 and 5.4 m during the second survey in July 2014. Flow conditions were low to normal in May but no flow was noted at most survey sites in July. The water surface was typically clear with areas of scum and foam. The water encountered was typically clear, but sometimes red, brown and green in color. Tracks observed most often included birds, raccoon, deer, and livestock. Trash was predominantly plastics and aluminum cans and was most common at bridge crossings.

Table 3.3 Rainfall records with maximum and minimum temperature for Sherman - Denison, Texas, 30 days prior to the first RUAA survey, initiated on May 16, 2014.

Survey dates are highlighted in grey. Data obtained from Weather Underground for Sherman-Denison weather station KGYI.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
16-Apr-14	0.00	65	43
17-Apr-14	0.00	63	45
18-Apr-14	0.00	74	48
19-Apr-14	0.00	77	51
20-Apr-14	0.37	78	61
21-Apr-14	0.06	78	62
22-Apr-14	0.00	78	55
23-Apr-14	0.00	83	60
24-Apr-14	0.00	78	59
25-Apr-14	0.00	80	54
26-Apr-14	0.00	83	62
27-Apr-14	0.03	86	70
28-Apr-14	0.00	77	57
29-Apr-14	0.00	71	48
30-Apr-14	0.00	65	44
1-May-14	0.00	71	39
2-May-14	0.00	77	44
3-May-14	0.00	86	47
4-May-14	0.00	93	62
5-May-14	0.00	89	62
6-May-14	0.00	86	65
7-May-14	0.00	82	67
8-May-14	0.89	73	63
9-May-14	0.00	85	64
10-May-14	0.00	86	64
11-May-14	0.00	87	71
12-May-14	1.0	84	57
13-May-14	0.05	67	52
14-May-14	0.19	69	52
15-May-14	0.00	77	46
16-May-14	0.00	78	53
17-May-14	0.00	75	55

Table 3.4 Rainfall records with maximum and minimum temperature for Sherman - Denison, Texas, 30 days prior to the second RUAA survey, initiated on July 11, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Sherman-Denison weather station KGYI.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
11-Jun-14	0.00	92	63
12-Jun-14	0.61	82	68
13-Jun-14	0.00	86	67
14-Jun-14	0.00	90	73
15-Jun-14	0.00	91	74
16-Jun-14	0.00	93	75
17-Jun-14	0.00	93	76
18-Jun-14	0.12	93	76
19-Jun-14	0.05	89	74
20-Jun-14	0.00	92	73
21-Jun-14	0.00	89	75
22-Jun-14	0.00	83	73
23-Jun-14	0.37	87	68
24-Jun-14	0.01	90	67
25-Jun-14	0.01	85	69
26-Jun-14	0.00	89	71
27-Jun-14	0.00	90	72
28-Jun-14	0.00	89	77
29-Jun-14	0.00	94	77
30-Jun-14	0.00	96	74
1-Jul-14	0.02	96	75
2-Jul-14	0.03	85	69
3-Jul-14	0.67	85	68
4-Jul-14	0.00	89	68
5-Jul-14	0.00	90	72
6-Jul-14	0.00	94	71
7-Jul-14	0.00	97	73
8-Jul-14	0.00	97	77
9-Jul-14	0.00	92	77
10-Jul-14	0.00	97	75
11-Jul-14	0.00	96	75

Table 3.5 Stream Channel and corridor characteristics for each site along Iron Ore Creek (0202K).

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
IO01	Natural	Cobble/Sand/Silt/Mud/Clay/Gravel	Forest/Shrub/Pasture	Large	No	Native
IO02	Natural	Cobble/Sand/Silt/Mud/Clay/Gravel	Forest/Shrub/Pasture	Large	No	Native
IO03	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹
IO04	Natural	Cobble/Sand/Silt/Mud/Clay/Gravel	Forest/Shrub	Large	No	Native
IO05	Natural	Sand/Silt/Mud/Clay	Forest/Shrub/Mowed/ Maintained Corridor/Pasture	Large	No	Native
IO06	Natural	Cobble/Sand/Silt/Mud/Clay/Gravel	Forest/Shrub	Large	No	Native
IO07	Natural	Cobble/Sand/Silt/Mud/Clay	Mowed/Maintained Corridor/Pasture	Large	No	Native
IO08	Natural	Cobble/Sand/Silt/Mud/Clay/Gravel	Forest/Shrub/Pasture	Large	No	Native
IO09	Natural	Sand/Silt/Mud/Clay/Gravel	Forest/Shrub/Denuded/ Eroded Bank	Large	No	Native
IO10	Natural	Cobble/Silt/Mud/Clay	Forest/Shrub/Pasture/Denuded/ Eroded Bank	Large	No	Native
IO11	Natural	Cobble/Silt/Mud/Clay	Shrub	Large	No	Native

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 3.6 Thalweg depth, stream flow type, and site accessibility during the two surveys of Iron Ore Creek (0202K).

Stream flow type represents TCEQ descriptions (TCEQ, 2014). Under general access, * indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property. For bank access, E = Easy, ME = Moderately Easy, MD = Moderately Difficult, and D = Difficult.

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
IO01	300	11	0	0.3	0.3	Intermittent with pools	Public	D
IO02	300	11	0	0.4	0.2	Intermittent with pools	Public	MD
IO03	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹
IO04	300	11	0	0.6	0.6	Intermittent with pools	Public	D
IO05	300	11	0	0.4	0.4	Intermittent	Public	MD
IO06	300	11	0	0.3	0.3	Intermittent with pools	Public	MD
IO07	300	11	0	0.3	0.2	Intermittent	Public	D
IO08	300	11	0	0.2	0.0	Intermittent	Public	MD
IO09	300	11	0	0.1	0.0	Intermittent	Public	MD
IO10	300	11	0	0.1	0.0	Ephemeral	Public*	MD
IO11	180	7	0	0.0	0.0	Ephemeral	Public	MD

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 3.7 Description of surveyed stream sites along Iron Ore Creek during first survey, performed in May 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
IO01	8.0	1.5	5.0	Normal
IO02	9.0	1.5	4.0	Normal
IO03	NA ¹	NA ¹	NA ¹	NA ¹
IO04	10	0.6	5.0	Normal
IO05	10	2.0	4.5	Normal
IO06	7.0	1.1	2.0	Normal
IO07	10	0.1	3.0	Normal
IO08	4.0	0.3	2.4	Normal
IO09	3.5	0.1	2.0	Normal
IO10	2.6	0.0	0.0	No Flow
IO11	0	0.0	0.0	Dry

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 3.8 Description of surveyed stream sites along Iron Ore Creek during second survey, performed in July 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
IO01	6.0	0.0	2.0	No Flow
IO02	6.5	0.0	4.0	No Flow
IO03	NA ¹	NA ¹	NA ¹	NA ¹
IO04	10	0.2	4.0	Normal
IO05	8.0	0.2	5.0	Normal
IO06	6.0	0.4	3.5	Normal
IO07	8.0	0.0	2.0	No Flow
IO08	0.5	0.0	0.0	No Flow
IO09	0.0	0.0	0.0	Dry
IO10	0.0	0.0	0.0	Dry
IO11	0.0	0.0	0.0	Dry

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 3.9 Stream aesthetics along Iron Ore Creek during first survey, performed in May 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F. NA indicates not accessible due to lack of access.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
IO01	R	A	N	Clear	Fine Sediment/Sludge/Solids	Clear	N	N	SP	Tracks/Fecal/Nests	Ab	R	R
IO02	R	A	R	Clear/Brown	Fine Sediment/Sludge/Solids	Clear/Scum/Debris	N	N	SP	Tracks/Fecal/Nests	Ab	R	R
IO03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IO04	C	A	R	Clear/Brown	Fine Sediment/Sludge/Solids	Clear	N	SP	SP	Tracks/Fecal/Nests	C	R	R
IO05	C	R	N	Clear	Fine Sediment/Sludge/Solids	Clear	N	SP	SP	Tracks/Fecal/Nests	R	R	R
IO06	R	A	N	Clear	Fine Sediment/Sludge	Clear	N	MP	MP	Tracks/Fecal/Nests	C	R	R
IO07	C	A	N	Clear	Fine Sediment/Sludge/Solids	Clear	N	N	N	Tracks/Fecal/Nests	R	R	C
IO08	R	R	R	Clear	Fine Sediment/Sludge/Solids	Clear/Scum	N	N	N	Tracks/Fecal/Nests	R	R	R
IO09	R	A	N	Clear	Sludge	Clear/Scum	N	N	SP	Tracks/Fecal/Nests	R	R	R

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
IO10	A	A	N	Clear	Fine Sediment/ Sludge	Clear	N	N	SP	Tracks/Fecal/ Nests	R	R	N
IO11	A	A	N	Clear	Fine Sediment/ Sludge	Clear	N	N	N	N	N	R	R

Table 3.10 Stream aesthetics and wildlife observations along Iron Ore Creek during the second survey, performed in July 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F. NA indicates not accessible due to lack of access.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
IO01	R	R	N	Clear	Fine Sediment/ Solids	Clear/ Scum/ Foam	N	N	SP	Tracks/Fecal	R	R	R
IO02	A	A	N	Clear	Fine Sediment	Clear/ Oil	N	N	N	Tracks/Fecal	R	R	R

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
IO03	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
IO04	C	A	N	Clear/ Green/ Brown	Fine Sediment	Clear	N	N	N	Tracks/Fecal	C	R	R
IO05	C	A	N	Clear	Fine Sediment	Clear/ Scum/ Foam	N	N	N	Tracks/Fecal	R	C	R
IO06	C	R	N	Clear	Fine Sediment	Clear	N	N	N	Tracks/Fecal	C	R	R
IO07	Ab	C	N	Brown	Fine Sediment/ Sludge	Clear/ Scum/ Foam	SP	N	N	Tracks/Fecal	R	R	R
IO08	R	R	R	Clear	Fine Sediment/ Solids	Clear/ Scum	N	N	SP	Tracks/Fecal	R	R	R
IO09	R	A	R	NW	Fine Sediment/ Solids	NW	N	N	N	Tracks/Fecal	R	R	R
IO10	A	A	N	NW	Fine Sediment/ Solids	NW	N	N	N	Tracks/Fecal	R	N	R
IO11	A	A	N	NW	Solids	NW	N	N	N	Fecal	N	N	R

Physical Description of IO01

Iron Ore Creek at site IO01 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge over the stream. This was on private property with no fence preventing access. However, access into the stream was difficult and dangerous due to steep banks, chain link covered rip rap, exposed metal/rebar, and dense vegetation. There was significant concrete, rip rap, and rebar at the immediate bridge with cobble, gravel, silt, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach. Figures 3.3 and 3.4 depict the appearance of the site during each survey.

The stream was wadeable with water levels averaging 0.3-m for Trip 1 and 0.29-m for Trip 2 (Table 3.6). A single substantial pool was encountered within the reach for either trip. For Trip 1, the pool measured 30 m long, 5.0 m wide, and had a maximum depth of 1.2 m. For Trip 2, the pool measured 30 m long, 3.0 m wide, and had a maximum depth of 1.1 m. Overall, the stream had an average width of 5.0 m under normal flow conditions for Trip 1 and an average width of 2.0 m under pooled or no flow conditions for Trip 2 (Tables 3.7 and 3.8).



Figure 3.3 Photograph of Iron Ore Creek at Site IO01, taken on May 17, 2014. Downstream view of the 0-m transect.



Figure 3.4 Photograph of Iron Ore Creek at Site IO01 taken July 11, 2014. Upstream view at 300-m transect.

The stream channel was naturally vegetated with grass, forbs, and trees. Banks were steep to vertical with sloughing in some places making travel up the banks difficult to impossible. There was no algae cover during the first survey but was rare during the second survey along with some surface foam and scum, and with some rare aquatic vegetation during both surveys. The color of the water body was clear throughout. Canine, feral hog, and raccoon tracks were observed as well as bird nests under the bridge, crawdad shells and live crawdads. A white bird was observed in the reach the first trip, a rabbit was observed on the second trip, and pig feces were observed both times. Garbage such as plastics, aluminum cans, glass bottles, and trash bags were present but rare. Large items, such as a single couch, fencing material, and abundant tires were throughout the reach (Tables 3.9 and 3.10). A young female on a 4 wheeler with fishing rods drove by on the road during the first trip. There was evidence of a trail visible from the bridge crossing and a set of tracks in the stream bed.

Physical Description of IO02

Iron Ore Creek at site IO02 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge over the stream. This was on private property with no fence preventing access. However, access into the stream was moderately difficult due to steep banks and dense vegetation. There was some concrete and rip rap at the immediate bridge with cobble, gravel, silt, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach. Figures 3.5 and 3.6 depict the appearance of the site during each survey.

The stream was wadeable with water levels averaging 0.38 m for Trip 1 and 0.16 m for Trip 2 (Table 3.6). Three substantial pools were encountered within the reach during both trips. For Trip 1, pool 1 measured 30 m long, 8.0 m wide, and had a maximum depth of 0.6 m. Pool 2 measured 29 m long, 8.0 m wide, and had a maximum depth of 0.5 m. Pool 3 measured greater than 80 m long, 9.0 m wide, and had a maximum depth of 0.7 m. Pool 3 continued past the 0-m transect of the survey reach. For Trip 2, Pool 1 measured 32 m long, 5.2 m wide, and had a maximum depth of 1.1 m. Pool 2 measured 27 m long, 6.5 m wide, and had a maximum depth of 1.1 m. Pool 3 measured 30 m long (it continued on past the end of the transect), 5.0 m wide, and had a maximum depth of 0.5 m. Overall, the stream had an average width of 4.0 m for both trips, under normal flow conditions for Trip 1, and under pooled/no flow conditions for Trip 2 (Tables 3.7 and 3.8).



Figure 3.5 Photograph of Site IO02, taken on May 17, 2014, downstream view at 0-m transect.



Figure 3.6 Photograph of site IO02, taken July 11, 2014. Upstream view at 150-m transect.

The stream channel was naturally vegetated with grass, forbs, and trees. Banks were steep to vertical with sloughing in some places making travel up the banks difficult to impossible. There was no algae cover during either survey. Some surface scum, leaf debris, and some rare aquatic vegetation were seen during the first survey. Some surface oil was seen during Trip 2. The color of the water body was clear throughout but significantly brown during the first survey. Canine, deer, raccoon, and turtle tracks were observed as well as bird nests under the bridge, including crawfish shells and live crawfish. Deer and feral hog feces were observed during both surveys. Ducks, geese, and feral hogs were heard, but not observed. Garbage such as plastics, aluminum cans, glass bottles, papers, and trash bags were present, but rare. Large items, such as a single couch, fencing material, metal, and abundant tires were seen throughout the reach (Tables 3.9 and 3.10). No other signs of human recreation were observed.

Physical Description of IO03

Iron Ore Creek at site IO03 was visited but no surveys were performed on May 17 or July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge over the stream; however, a private property fence prevented access beyond the bridge. There were posted signs saying “Private Property” and “No Trespassing” and attempts to contact the landowner for access were unsuccessful (Figure 3.7). In addition, access from the bridge or banks was extremely steep with significant drops and too much poison ivy to attempt entry (Figure 3.8). No human recreation was observed.



Figure 3.7 Photograph of posted no trespassing signs and fence at Site IO03, taken on May 17, 2014.



Figure 3.8 Photograph of difficult access at bridge at Site IO03, taken on May 17, 2014.

Physical Description of IO04

Iron Ore Creek at site IO04 was surveyed on May 17 and July 11, 2014. Access to this location was easy because it was without a fence preventing access, but there was not a parking area. This was on private property with no fence preventing access. However, access into the stream was moderately difficult to difficult due to steep banks and dense vegetation. There was some concrete and rip rap at the immediate bridge with cobble, gravel, silt, sand, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach and two significant log jam obstructions. Figure 3.9 and 3.10 depict the appearance of the site during each survey.

The stream was wadeable with water levels averaging 0.6 m for Trip 1 and 0.6 m for Trip 2 (Table 3.6). Three substantial pools were encountered within the reach during both trips. For Trip 1, Pool 1 measured 45 m long, 10 m wide, and had a maximum depth of 1.2 m. Pool 2 measured 30 m long, 7.0 m wide, and had a maximum depth greater than 1.5 m. Pool 3 measured greater than 120 m long, 7.0 m wide, and had a maximum depth greater than 1.5 m. Pool 3 continued past the 0 m transect of the survey reach. For Trip 2, Pool 1 measured 35 m long, 10 m wide, and had a maximum depth of 1.2 m. Pool 2 measured 30 m long, 7.0 m wide, and had a maximum depth greater than 1.5 m. Pool 3 measured 120 m long (it continued on past the end of the transect), 7.0 m wide, and had a maximum depth greater than 1.5 m. Overall, the stream had an average width of 5.0 m for Trip 1 and 4.0 m for Trip 2, both under normal flow conditions (Tables 3.7 and 3.8).



Figure 3.9 Photograph of instream obstruction encountered at Site IO04 on May 17, 2014.

The stream channel was naturally vegetated with grass, forbs, and trees. Banks were extremely steep to vertical with sloughing in some places making travel up the banks difficult to impossible. There was no algae cover during either survey, but some common aquatic vegetation was observed during both surveys. The color of the water body was clear and brown throughout both surveys but also green in parts during the second survey. Feral hog, raccoon, and bird tracks were observed as well as bird nests under the bridge, turtles, shells, and crawdads dead and alive. Feral hog feces were observed both times. Garbage such as plastics, aluminum cans, glass bottles, and trash bags were present but rare. Large items, such as plastics and tires (common) were seen throughout the reach (Tables 3.9 and 3.10). No other signs of human recreation were observed.



Figure 3.10 Photograph of Site IO04, taken on July 11, 2014. Upstream view at 150-m transect.

Physical Description of IO05

Iron Ore Creek at site IO05 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge over the stream. There were no private property fences hindering access. However, access into the stream was moderately difficult due to steep banks, dense vegetation, and slick mud. There was some concrete and rip rap at the immediate bridge with gravel, silt, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach and two significant obstructions, a log jam, and a black water pipe crossing low over the stream (Figure 3.11).

The stream was wadeable with water levels averaging 0.4 m for Trip 1 and 0.4 m for Trip 2 (Table 3.6). One substantial pool was encountered within the reach during both trips. For Trip 1 and Trip 2, Pool 1 measured 120 m long, 10 m wide, and had a maximum depth of 0.7 m. Overall, the

stream had an average width of 4.5 m for Trip 1 and 5.0 m for Trip 2, both under normal flow conditions (Tables 3.7 and 3.8) Figures 3.14 and 3.15 depict the appearance of the site during both surveys.

The stream channel was naturally vegetated with grass, forbs, and trees. Banks were moderately steep to vertical making travel up the banks difficult to impossible at points. There was some rare algae cover during the first survey but none at the second survey, and some common aquatic vegetation, including cattails and reeds, at both. The color of the water was clear throughout both surveys. Bird nests were observed under the bridge, as well as small fish, minnows, and shells throughout the reach. Feral hog feces and tracks were observed. Garbage such as plastics, aluminum cans, and glass bottles were present, but rare. Large items, such as a mattress and tires were seen throughout the reach (Tables 3.9 and 3.10). No other signs of human recreation were observed.



Figure 3.11 Photograph of pipe crossing and other instream obstructions at site IO05, taken on May 17, 2014. TIAER personnel in photograph.



Figure 3.12 Photograph of IO05, taken on May 17, 2014, the downstream view at the 0-m transect.



Figure 3.13 Photograph of Site IO05, taken on July 11, 2014. Upstream view at 300-m transect.

Physical Description of IO06

Iron Ore Creek at site IO06 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge over the stream. There were no private property fences hindering access (one side of the bridge has a barbed wire fence with a “No Trespassing” sign, but this fence was not continuous to the bridge). However, access into the stream was difficult everywhere due to steep banks, dense vegetation, and slick mud, except for moderately difficult access (steep concrete embankment) at the bridge. There was some concrete and rip rap at the immediate bridge with cobble, gravel, silt, sand, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach and one log jam obstruction at the bridge. Figure 3.14 depicts the appearance of the site.

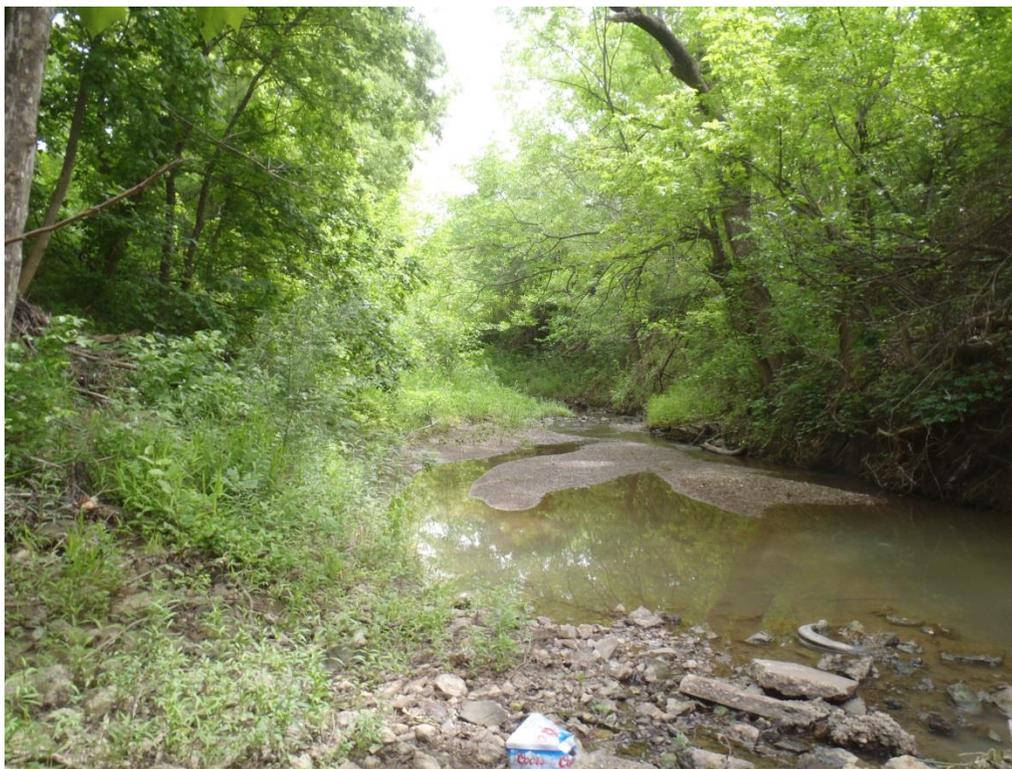


Figure 3.14 Photograph of Site IO06, taken May 17, 2014. Downstream view at 0-m transect.

The stream was wadeable with water levels averaging 0.3 m for Trip 1 and 0.3 m for Trip 2 (Table 3.6). One substantial pool was encountered within the reach during the first trip. For Trip 1, Pool 1 measured 24 m long, 7.0 m wide, and had a maximum depth greater than 1.5 m. Overall, the stream had an average width of 2.0 m for Trip 1 and 3.5 m for Trip 2, both under normal flow conditions (Tables 3.7 and 3.8).

The stream channel was naturally vegetated with grass, forbs, and trees. Banks were extremely steep to vertical making travel up the banks difficult to impossible at points. There was some (rare) algae cover during the second survey but none during the first survey, and some (rare Trip 1, common Trip 2) aquatic vegetation (cattails and reeds) at both. The color of the water body was clear throughout both surveys (Tables 3.9 and 3.10). Bird nests were observed under the bridge,

and fish carcasses were seen throughout the reach. Tracks from feral hogs and raccoons were observed, in addition to feral hog feces. Garbage such as plastics, aluminum cans, glass bottles, and papers were present, but rare. Large items, such as a TV and tires (20+) were seen throughout the reach (Figure 3.15). Although there were no other signs of human recreation, there were several fish carcasses and a single shoe (flip flop sandal) at the bridge.



Figure 3.15 Photograph of Site IO06, taken July 11, 2014. Downstream view at the 300-m transect.

Physical Description of IO07

Iron Ore Creek at site IO07 was surveyed on May 17 and July 11, 2014. Access to this location was easy because it occurred at a road crossing with several bridges over the stream on the highway right of way. There were no private property fences hindering access at this location. However, access into the stream was moderately difficult everywhere due to steep banks, dense vegetation, and slick mud. There was some rip rap at one of the bridges with cobble, silt, and deep mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks with hidden drop offs along the reach and no obstructions in the channel. Figures 3.16 and 3.17 depict the appearance of the stream during each survey.

The stream was wadeable with water levels averaging 0.3 m for Trip 1 and 0.2 m for Trip 2 (Table 3.6). No substantial pools were encountered within the reach. Overall, the stream had an average width of 3.0 m for Trip 1 under normal flow conditions and 2.0 m for Trip 2 under no flow, or pooled conditions (Tables 3.7 and 3.8). The stream channel was naturally vegetated with grass, forbs, and no trees within the reach, but was forested outside of the reach. Banks were extremely steep to vertical, with some areas sloughing off, making travel up the banks difficult to impossible

at points. Algae cover was absent during the first survey, but common during the second (Tables 3.9 and 3.20). Aquatic vegetation, primarily cattails and reeds were common to abundant. The color of the water was clear on Trip 1 and brown on Trip 2 with some foam and scum on the surface. Bird nests were observed under the bridge as well as two snakes. Tracks from felines and raccoons were observed, in addition to bird feces. Garbage such as plastics, aluminum cans, glass bottles, papers, and foam were common at the bridges, but rare along the reach. Large items, such as tires, were seen throughout the reach (Tables 3.9 and 3.10). There were no signs of human recreation.



Figure 3.16 Photograph of Site IO07, taken on May 17, 2014. Upstream view 0-m transect.



Figure 3.17 Photograph of IO07, taken on July 11, 2014. Upstream view at 150-m transect.

Physical Description of IO08

Iron Ore Creek at site IO08 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge at one point and another bridge just beyond the reach. There were no private property fences hindering access. However, access into the stream was difficult everywhere due to steep banks, dense vegetation, and slick mud, except at the immediate bridge crossing. There was some rip rap and concrete at the bridges with cobble, gravel, sand, silt, and deep mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach and no obstructions in the channel.

The stream was wadeable with water levels averaging 0.2 m for Trip 1 and 0.0 m for Trip 2 (Table 3.6). No substantial pools were encountered within the reach. Overall, the stream had an average width of 2.4 m for Trip 1 under normal flow conditions and 0.0 m for Trip 2 under no flow or pooled conditions (Tables 3.7 and 3.8). Figures 3.18 and 3.19 depict the appearance of the stream during each survey.



Figure 3.18 Photograph of IO08, taken on May 17, 2014. Upstream view at 150-m transect.



Figure 3.19 Photograph of Site IO08, taken on July 11, 2014. Downstream view at 0-m transect.

The stream channel was naturally vegetated with grass, forbs, and trees within the reach. Banks were moderately steep, with some areas sloughing off, making travel up the banks difficult. There was some rare algae cover and some rare aquatic vegetation, cattails and reeds, at both surveys. The color of the water body was clear for Trip 1 and Trip 2 with some foam and scum on the surface. No bird nests were observed under the bridge. Tracks from feral hogs and raccoons were observed, in addition to bird feces. During the second survey, two deer were observed in the stream bed. Common garbage such as plastics, aluminum cans, glass bottles, bricks, and wood debris were common at the bridge, but rare along the reach. Large items, such as tires, trash bags, a ceramic toilet, and a TV, were seen throughout the reach (Tables 3.9 and 3.10). There were no signs of human recreation.

Physical Description of IO09

Iron Ore Creek at site IO09 was surveyed on May 17 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with a bridge at one point. There was a private property fence hindering access on the downstream of the bridge but not the upstream side. However, access into the stream was difficult everywhere due to steep banks, treacherous descent, dense vegetation, with concrete, rip rap, and metal at the immediate bridge crossing. There was gravel, sand, silt, and mud/clay at varying points throughout the reach. In addition, this site had dense vegetation and steep banks along the reach, and no obstructions in the channel.

The stream was wadeable with water levels averaging 0.1 m for Trip 1 and 0.0 m for Trip 2 (Table 3.6). No substantial pools were encountered within the reach. Overall, the stream had an average width of 2.0 m for Trip 1 under normal flow conditions and 0.0 m for Trip 2 under dry conditions (Tables 3.7 and 3.8). Figures 3.20 and 3.21 depict the appearance of the stream during each survey.

The stream channel was naturally vegetated with grass, forbs, and trees within the reach. Banks were moderately steep, with some areas sloughing off, making travel up the banks difficult. There was no algae cover and some (rare) aquatic vegetation found during both surveys. The color of the water body was clear for Trip 1, while the creek was dry during Trip 2. Some bird nests were observed under the bridge. Tracks from canine, deer, feral hog, and raccoons were observed, in addition to bird feces. Typical garbage such as plastics, aluminum cans, glass bottles, bricks, and wood debris were rare at the bridge with very little bank garbage along the reach. There was a single tire throughout the reach (Tables 3.9 and 3.10). There were no signs of human recreation.



Figure 3.20 Photograph of site IO09, taken on May 17, 2014. Downstream view at 0-m transect.



Figure 3.21 Photograph of site IO09, taken on July 11, 2014. Upstream view at 150-m transect.

Physical Description of IO10

Iron Ore Creek at site IO10 was surveyed on May 16 and July 11, 2014. Access to this location was easy because it occurred at a road crossing with large pipe culverts for the stream under the road. There were private property fences hindering access at this location. One side of the road had a “No Trespassing” sign in addition to purple painted fence posts and a barbed wire fence. The side that was accessed, with landowner permission, had steep banks, rip rap, and barbed wire fence. Access into the stream was difficult everywhere due to steep banks, dense vegetation, and slick mud. There was some rip rap and concrete at the bridge with cobble, silt, and deep mud/clay at varying points throughout the reach for Trip 1. In addition, this site had dense vegetation and steep banks along the reach and no obstructions in the channel. This site could be easily overlooked because it was so heavily vegetated and hidden at the road crossing. Figures 3.22 and 3.23 depict the appearance of the site during each survey. Due to thick vegetation during the first trip, only 150 m were able to be surveyed. However, vegetation was less dense during the second survey and the full 300-m was surveyed.

The stream was wadeable with water levels averaging 0.1 m for Trip 1 and 0.0 m for Trip 2 (Table 3.6). No substantial pools were encountered within the reach. Overall, the stream had an average width of 0.0 m for Trip 1 under no flow or pooled conditions and 0.0 m for Trip 2 under dry conditions (Tables 3.7 and 3.8).



Figure 3.22 Photograph of IO10, taken on May 16, 2014. Upstream view at 150-m transect.



Figure 3.23 Photograph of IO10, taken on July 11, 2014. Upstream view at 300-m transect.

The stream channel was naturally vegetated with grass, forbs, and trees within the reach. Banks were moderately steep and heavily vegetated in parts. There was no algae cover and no aquatic vegetation noted during either survey (Tables 3.9 and 3.10). The color of the water body was clear for Trip 1, while there was no water during Trip 2. No bird nests were observed under the road/culverts but were observed throughout the reach. Tracks from cattle and raccoons were observed, in addition to bird feces. Common garbage such as plastics, aluminum cans, and glass bottles were common at the bridge, but rare along the reach. Several tires were observed throughout the reach. There were no signs of human recreation.

Physical Description of IO11

Iron Ore Creek at site IO11 was surveyed on May 16 and July 11, 2014. Access to this location was easy, because it occurred at a road crossing with pipe culverts under the road at a powerline right of way. The vegetation at this right-of-way was not maintained. There were no private property fences hindering access at the bridge. Beyond the survey reach was private property that was fenced. However, access into the stream was difficult due to dense vegetation, thick mud at points, thorny brush and trees. During the first survey, only 180 m of creek were surveyed because dense, thorny vegetation hindered further access. During the second survey only 120 m were surveyed because vegetation density had increased from the first survey. Figure 3.24 and 3.25 depict the appearance of the site during each survey.



Figure 3.24 Photograph of site IO11, taken on May 16, 2014. Downstream view at 300-m transect.



Figure 3.25 Photograph of IO11, taken on July 11, 2014. Downstream view at 180-m transect.

The stream was wadeable as there was very limited water. Dry conditions were noted during both surveys (Table 3.6). No substantial pools were encountered within the reach. Overall, the stream had an average width of 0.0 m for Trip 1 and Trip 2 under dry conditions (Tables 3.7 and 3.8).

The stream channel was naturally vegetated with grass, forbs, and thorny trees within the reach. Banks were overgrown with tall grass and thorny trees. There was no algae cover and no aquatic vegetation at either survey (Tables 3.9 and 3.10). The color of the few puddles was clear for Trip 1 and non-existent for Trip 2. No bird nests or tracks were found. There were some (rare) bird feces. Common garbage such as plastics, aluminum cans, and glass bottles were rare at the road crossing and non-existent along the reach. There were no large garbage items found in the reach. There were no signs of human recreation observed.

Observation and Interviews

Activities Observed

During each RUAA survey, field personnel visited the sites on days and during times when recreational activities were more likely to be observed. The ten sites surveyed were at road crossings that provided public access. Site IO10 was public at the bridge only and required landowner permission to cross over a private property fence that bisected the creek.

No contact (primary or secondary) or noncontact recreational activities were observed by TIAER employees at any of the sites during the field surveys.

Activities Interviewed for Iron Ore Creek (0202K)

Interviews were conducted with landowners along Iron Ore Creek as well as other persons of interest. A total of ten interviews were collected. No primary contact recreational activities were identified from these interviews (Table 3.11). One interviewee witnessed fishing at site IO06. Another interviewee mentioned hearing of people canoeing on Iron Ore creek but did not indicate on what portion of the creek.

Table 3.11 and Figure 3.26 summarize the types of recreation indicated from interviews.

Table 3.11 Summary of recreational activities noted in interviews for Iron Ore Creek.

Activities are listed as the number of times personal use, observed use, or heard of use was documented from interviews for a given location or general to the assessment unit. Blank cells indicate no interviewed feedback for that location.

Site Name	Number of Interviews	Swimming	Adult Wading	Children Wading	Hunt	Fish	Boat , Canoe, Kayak
IO01	1						
IO02	1					0,1,0	
IO03	1						
IO04							
IO05							
IO06							
IO07							
IO08	1						
IO09	1						
IO10	1						
IO11	2						
General AU	2 ^a						0,0,1
Totals	10					0,1,0	0,0,1

^a One interviewee noted use of stream for arrowhead hunting.

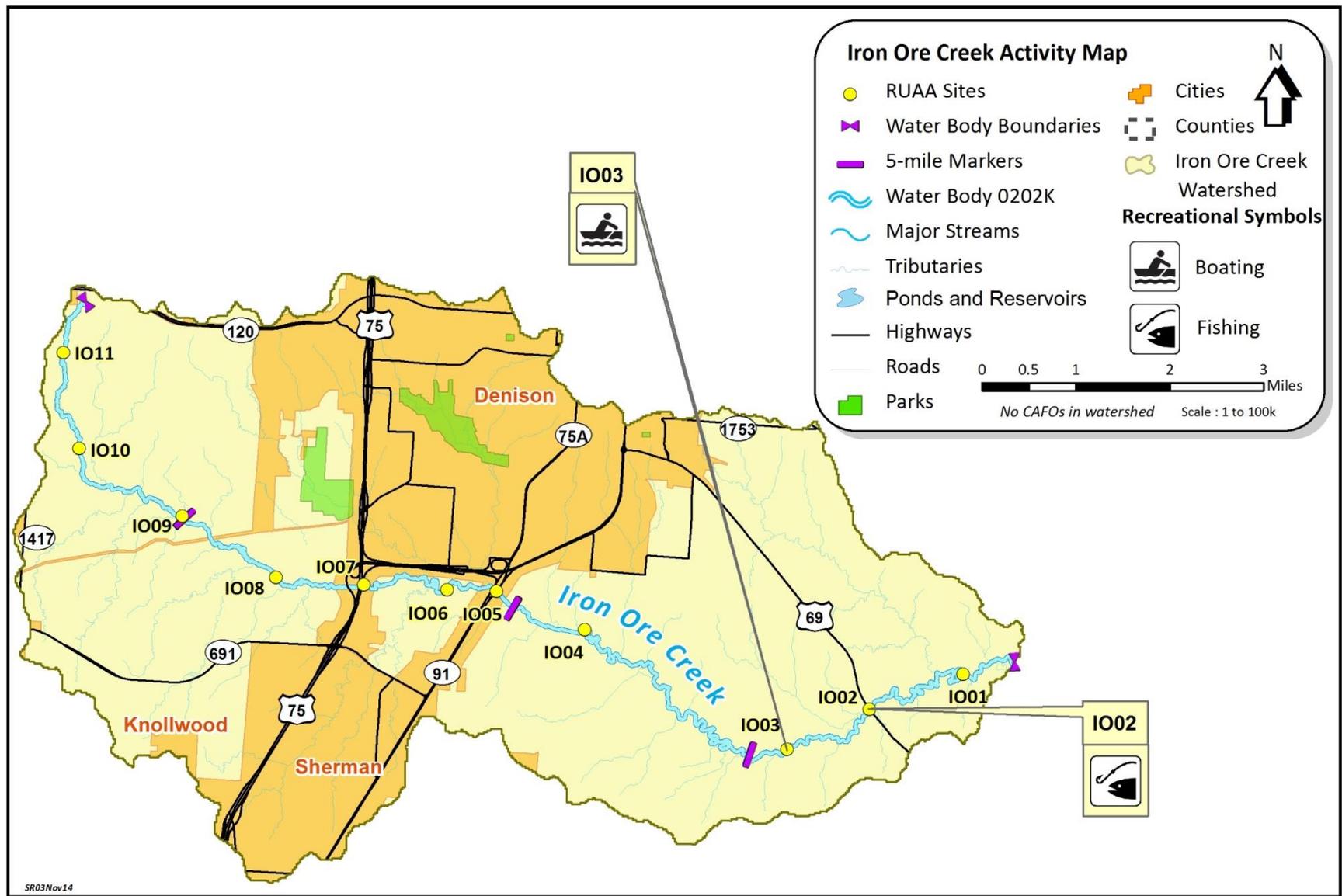


Figure 3.26 Summary of observed and interviewed human activities on Iron Ore Creek.

Summary

RUAA surveys were conducted at ten sites along Iron Ore Creek (0202K) on the days of May 16-17, 2014 and July 11, 2014. Temperatures were above 21°C (70°F) during the 30 days prior to each survey. Stream flow was considered normal at most sites during the first survey in May, but no flow to dry conditions were encountered at most sites in July during the second survey. Although normal flow conditions were found during the first survey, the Palmer Drought Severity Index (PDSI) represented moderate drought conditions in May 2014. Only mild drought conditions were noted during the second survey in July 2014 (TWDB, 2014).

Recreational activities were not observed by TIAER field staff during either of the surveys. Additionally, there were no non-contact recreational activities observed during either survey. Recreational activities reported by interviewees are summarized in Figure 3.11 and the overall RUAA findings are summarized in the form below.

While conducting the stream surveys, no characteristics, such as boat docks, parks, playgrounds, biking trails, campgrounds, or sports fields, were encountered that would promote recreation.

RUAA Summary

Name of water body: Iron Ore Creek

Segment No. of Nearest Downstream Segment No.: 0202

Classified?: No

County: Grayson

1. Observations on Use

a. Do primary contact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

b. Do secondary contact recreation 1 activities occur on the water body?

frequently seldom not observed or reported unknown

c. Do secondary contact recreation 2 activities occur on the water body?

frequently seldom not observed or reported unknown

d. Do noncontact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

2. Physical Characteristics of Water Body

a. What is the average thalweg depth? 0.23 meters

b. Are there substantial pools deeper than 1 meter? Yes No

c. What is the general level of public access?

easy very moderate very limited

3. Hydrological Conditions of site visits (Based on Palmer Drought Severity Index)

Mild-Extreme Drought

Incipient dry spell

Near Normal

Incipient wet spell

Mild-Extreme Wet

Chapter 4

Choctaw Creek

(0202F)

Watershed Characteristics

The Choctaw Creek watershed covers 138,000 acres, excluding the watershed area of Iron Ore (0202K), which covers about 28,300 acres and was previously described in Chapter 3. The Choctaw Creek watershed encompasses portions of the cities of Sherman (estimated population 39,296), Tom Bean (estimated population 1,043), Southmayd (estimated population 989), Bells (estimated population 1,400), and Howe (estimated population 2,609) (Figure 4.1). Choctaw Creek is a tributary of the Red River and flows about 44 miles from east of Sherman in Grayson County to the confluence with the Red River at the Grayson/Fannin County line. Iron Ore Creek, presented in Chapter 3 of this report, is a tributary of Choctaw Creek. The watershed area is distinguished by flat terrain with local shallow depressions, which are surfaced by clay and sandy loam soils that support water-tolerant hardwoods, conifers, and grasses (TSHA, 2013a).

The Choctaw Creek watershed lies within the Texas Blackland Prairie (35b) ecoregion (Griffith, et al., 2007). Average rainfall for the watershed is about 41 inches, annually (U.S. Climate Data – Sherman, Texas, 2015). Average minimum and maximum temperatures for the region range from 32 to 52°F in January and 73 to 94°F in July (U.S. Climate Data – Sherman, Texas, 2015). The watershed is primarily rural with 41 percent herbaceous cover (Figure 4.2). Deciduous Forest surrounds Choctaw Creek, while hay/pasture and cultivated crops cover roughly 25 percent of the watershed. The developed areas in the Choctaw Creek watershed represent the cities of Sherman, Tom Bean, Southmayd, Bells, and Howe (Figure 4.2). Three small parks are located within the City of Sherman boundaries which is located within the Choctaw Creek watershed, while a fourth park is located just outside the City of Sherman boundary but still within the watershed area (Figure 4.1). No parks are located directly along Choctaw Creek.

Designated Uses, Impairments and Concerns

Choctaw Creek has two assessment units, 0202F_01 and 0202F_02. Assessment unit 0202F_01 is classified as perennial, while assessment unit 0202F_02 is classified as intermittent with pools (TCEQ, 2013). Choctaw Creek has presumed uses of primary contact recreation, general use, and fish consumption with a limited aquatic life use (TCEQ, 2013). The water body was first listed impaired for bacteria on the 2010 Texas 303(d) list. Concerns also noted are elevated total phosphorus, orthophosphorus, and nitrate.

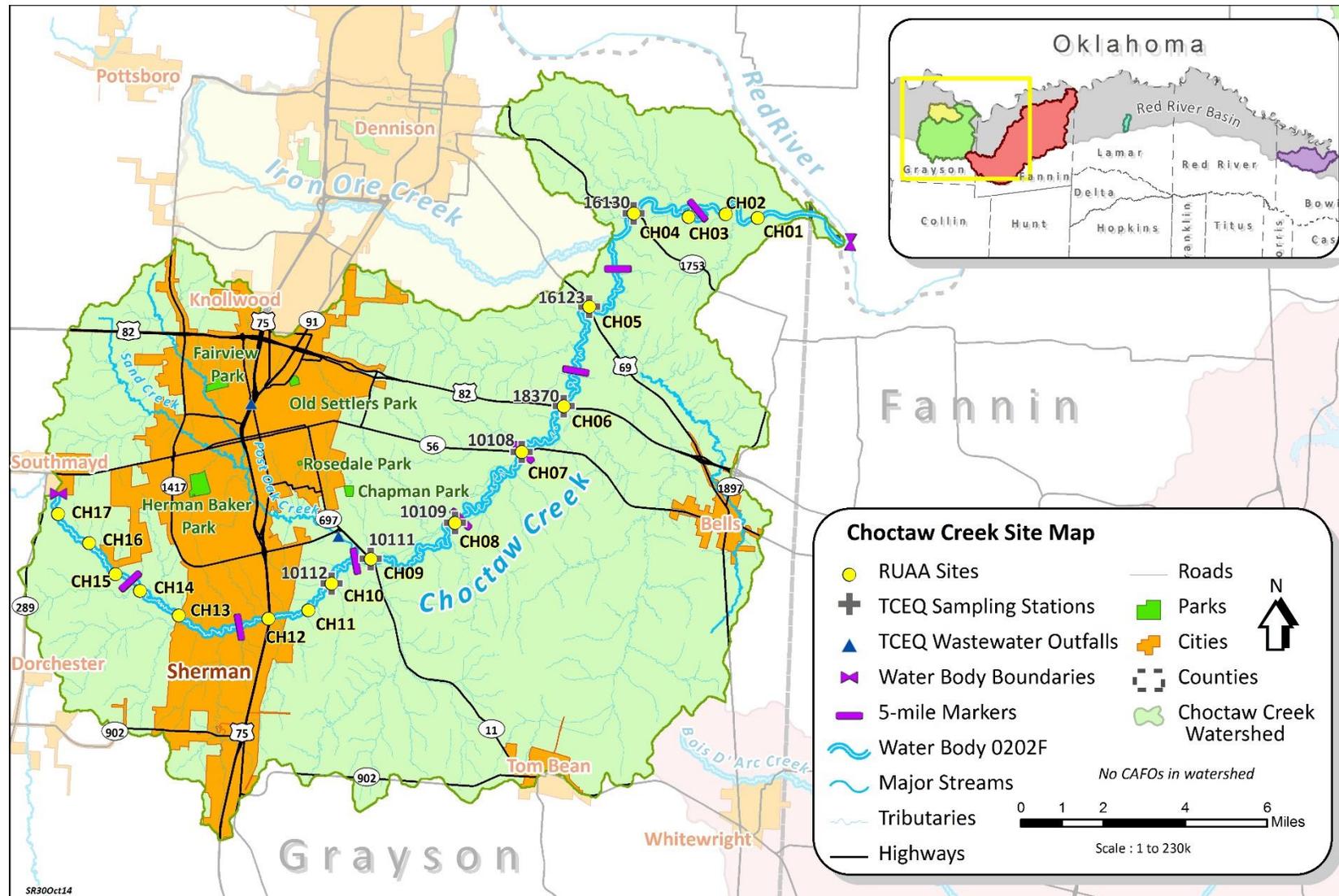


Figure 4.1 Overview of Choctaw Creek watershed and RUAAs sites.

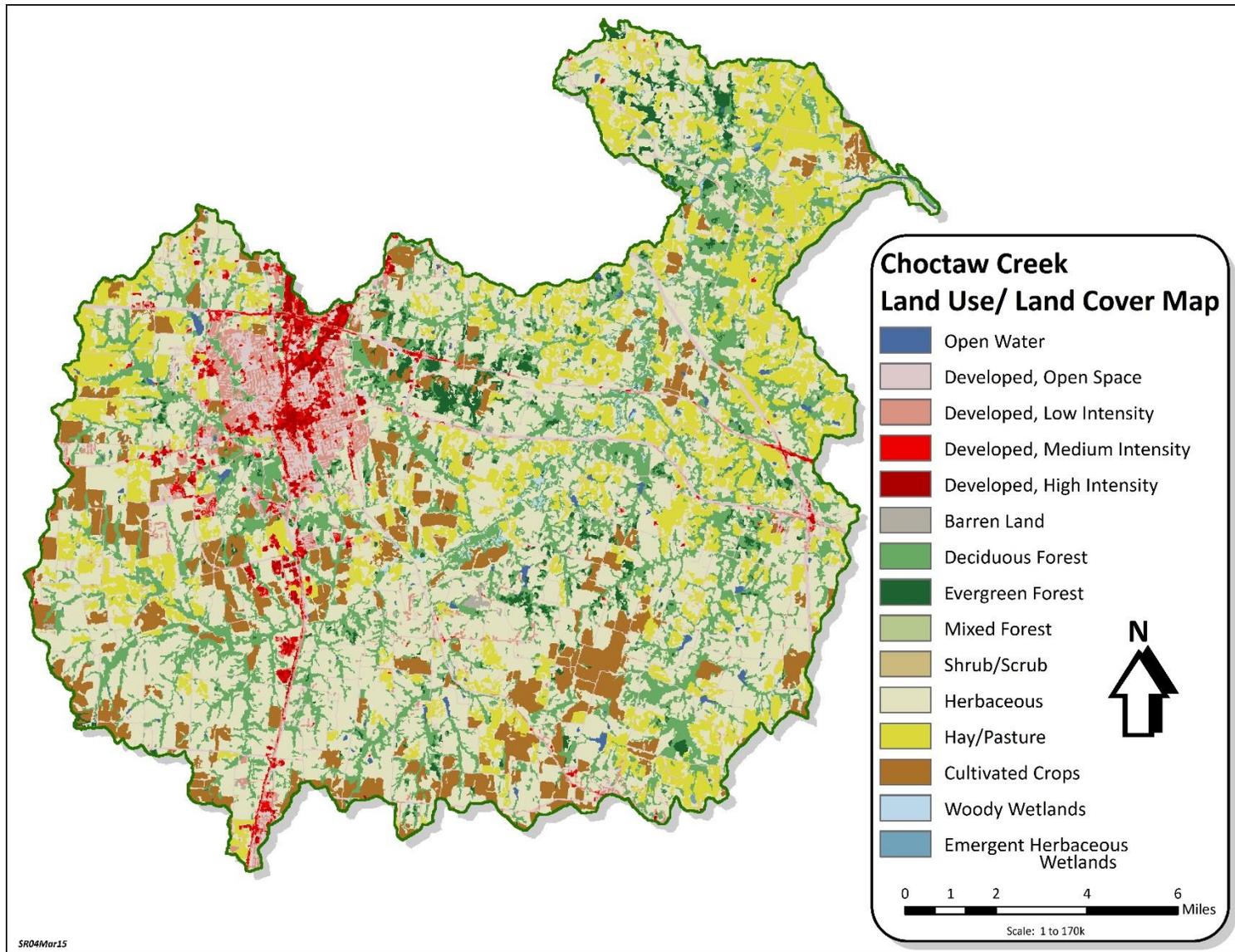


Figure 4.2 Land use/land cover for the Choctaw Creek watershed. Source: 2006 National Land Cover Database (USGS, 2014).

Permitted Discharges

Within the Choctaw Creek watershed, there are two municipal wastewater treatment facility (WWTFs) dischargers and one general permit for a concrete facility.

The largest permitted discharge is in the City of Sherman with a permitted average daily flow of 16 MGD. The City of Sherman WWTF (TX0024325) is located at 1800 E FM 1417 in Sherman, Texas and discharges into Post Oak Creek which then flows to Choctaw Creek.

The City of Bells WWTF (TX0053368) is located approximately 480 feet northwest of the intersection of U.S. Highway 69 and FM 1897, north of the City of Bells in Grayson County, Texas. The average daily flow for the City of Bells WWTF is 0.17 MGD and discharges into Corneliason Creek that flows to Mill Creek which then flows to Choctaw Creek.

Sherman Ready Mix (TXG111225), located in Sherman, Texas, has a general permit for minor discharge and discharges into an unnamed tributary which then flows into Choctaw Creek. Sherman Ready Mix also discharges into Iron Ore Creek, as seen in Chapter 3.

There are no concentrated animal feeding operations (CAFO) within the Choctaw Creek watershed.

Non-Permitted Agricultural Activities and Domesticated Animals

Activities such as livestock grazing close to water bodies and agricultural use of manure as fertilizer can contribute bacteria to nearby water bodies. In order to provide an estimate of livestock densities in the watershed, livestock statistics were obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service website from the 2012 survey (USDA, 2012). These statistics on a county level indicate large numbers of beef cattle in Fannin and Grayson Counties, and thus, likely within the watershed area (Table 4.1).

Table 4.1 Estimated livestock numbers within the Choctaw Creek watershed based on statistics adjusted for the percent of the county within the watershed (Source USDA, 2012).

Choctaw Creek watershed covers less than 1% of Fannin County and about 22% of Grayson County.

County	Year	Cattle & Calves (all beef)	All Goats	Mules, Burros, & Donkeys	Horses & ponies	Hogs
Fannin	2012	71,809	3,958	683	3,161	485
Grayson	2012	45,912	4,679	683	5,044	745
Choctaw Creek Watershed Average	2012	2,075	212	31	228	34

Domestic pets are another unregulated source of *E. coli* bacteria, particularly dogs, because storm runoff often carries these wastes into streams (EPA, 2009). Assuming a rough estimate of 0.584 dogs per household (AVMA, 2012) and about 21,500 households within the Choctaw Creek watershed based on 2010 census population data, there are potentially about 12,550 dogs within the Choctaw Creek watershed. Other domestic animals, such as outdoor cats, can also contribute to bacterial pollution; however, cat populations are difficult to estimate because in many rural areas cats are often feral.

Wildlife and Feral Hogs

Other possible bacteria contributors include wildlife, such as deer, feral hogs, and birds. In 2013, statewide population estimated roughly 39 whitetail deer per 1,000 acres. This estimation suggests that the population for whitetail deer in the Post Oak Savannah region is roughly 400,000 deer, or 35 deer per 1,000 acres (Cain, 2014). Feral hogs are an invasive species commonly found throughout Texas. They have been known to travel in large groups along waterways and congregate near shallow depressions of water. Statewide feral hog densities range from an estimated average of 1.33 to 2.45 feral hogs per square mile (AgriLife, 2011).

Failing On-Site Sewage Facilities

Septic systems or on-site sewage facilities (OSSFs) are often used in rural areas that do not have the ability to connect to a central wastewater collection system. In order to estimate the number of potential OSSFs in the watershed, a GIS layer associated with the sewer Certificates of Convenience and Necessity (CNNs) from the Public Utility Commission of Texas was used. As not all cities with WWTFs have CNNs, the CNN layer was supplemented with a GIS layer representing municipal boundaries for those cities with WWTFs. Population data from the U.S. Census Bureau (USCB) were then overlaid masking out areas that should be serviced by WWTFs. Of the (21,500) households in the Choctaw Creek watershed, 11% were indicated as outside of municipal areas serviced by WWTFs and, thus, likely on septic systems.

Historical Review

A review of historical information regarding recreational use of Choctaw Creek was conducted. The review considered the time period of November 28, 1975 to the present in accordance with 40 CFR Part 131 (EPA standards regulation). Government offices, libraries, historical societies, and newspapers were searched and contacted in addition to generic internet searches. The following is a summary of the review.

Government Sources

City of Sherman

[City of Sherman Homepage¹⁸](#)

Nothing of significance to the historical use of Choctaw Creek was found.

City of Tom Bean

[City of Tom Bean Homepage¹⁹](#)

Nothing of significance to the historical use of Choctaw Creek was found.

City of Southmayd

[City of Southmayd Homepage²⁰](#)

Nothing of significance to the historical use of Choctaw Creek was found.

City of Bells

[City of Bells Homepage²¹](#)

Nothing of significance to the historical use of Choctaw Creek was found.

City of Howe

[City of Howe Homepage²²](#)

Nothing of significance to the historical use of Choctaw Creek was found.

Library Sources

Sherman Public Library

[City of Sherman Library Homepage²³](#)

Phone: (903) 892-7240

Explored various links and online texts. Nothing pertaining to Choctaw Creek.

Howe Community Library

[Howe Community Library Homepage²⁴](#)

Phone: (903) 532-3228

Explored various links and online texts. Nothing pertaining to Choctaw Creek.

Newspaper Sources

Herold Democrat

[The Herold Democrat Homepage²⁵](#)

Phone: (903) 893-8181

Explored various links and online texts. Nothing significant was found.

Van Alstyne Leader

[The Van Alstyne Leader Homepage](#)²⁶

Phone: (903) 482-5253

Explored various links and online texts. Nothing significant was found.

Internet Searches

The Handbook of Texas Online

[The Handbook of Texas Online, Choctaw Creek](#)²⁷

Nothing of significance was found

¹⁸ <http://www.ci.sherman.tx.us/>

¹⁹ <http://www.tombean.net/>

²⁰ <http://southmaydtx.com/>

²¹ <http://www.cityofbells.org/>

²² <http://www.cityofhowe.org/>

²³ <https://www.ci.sherman.tx.us/283/Library>

²⁴ <http://www.howeisd.net/library>

²⁵ <http://heralddemocrat.com/>

²⁶ <http://vanalstyneleader.com/>

²⁷ <https://tshaonline.org/handbook/online/articles/rbcdx>

Survey Site Descriptions

Choctaw Creek is just over 44 river miles long, which indicates a goal of 26 sites (3 sites per 5 miles of river) for the RUAA survey. With the help of cooperating stakeholders, TIAER was able to establish 17 survey sites along Choctaw Creek (Table 4.2). Of the 17 survey sites, 15 were publically accessible via road crossings and two were accessible via private property. Of the 15 sites at public road crossings, three had private property fences across the creek for which landowner permission was obtained in order to cross. The average distance between survey sites is 2.55 river miles and ranges from 1.12 to 5.28 miles. The largest gap between survey sites is 5.28 river miles between sites CH07 and CH08. The second largest gap is 4.50 river miles between CH05 and CH06. There are no public road crossings between these two areas and attempts to secure private land access to the creek were unsuccessful in these locations. RUAA surveys were performed May 16 –18, 2014 and July 11-14, 2014.

Table 4.2 Description and location of RUAA field survey sites for Choctaw Creek, Water Body 0202F.

TCEQ ID	Site ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi)¹	Distance from Confluence (mi)¹	Distance from Upper Reach (mi)¹	Access
	CH01	Choctaw Creek at Carpenters Bluff	33.71892	-96.4019	NA	2.76	41.45	Public
	CH02	Choctaw Creek on Private Property	33.71857	-96.4243	1.39	4.15	40.06	Private
	CH03	Choctaw Creek at Choctaw Bottom Road	33.71846	-96.4311	1.59	5.74	38.46	Public
16130	CH04	Choctaw Creek at FM 1753	33.71907	-96.4543	2.39	8.13	36.08	Public
16123	CH05	Choctaw Creek at Highway 69	33.68563	-96.4718	4.13	12.26	31.94	Public
18370	CH06	Choctaw Creek at Highway 82	33.6503	-96.4811	4.50	16.76	27.45	Public
10108	CH07	Choctaw Creek at Highway 56	33.63361	-96.4982	3.20	19.96	24.24	Public
10109	CH08	Choctaw Creek at Ida Road (also shown as FM 697)	33.60786	-96.5254	5.28	25.24	18.96	Public
10111	CH09	Choctaw Creek at Highway 11	33.59416	-96.5603	4.35	29.59	14.62	Public
10112	CH10	Choctaw Creek at Luella Road	33.58499	-96.5766	1.94	31.53	12.68	Public
	CH11	Choctaw Creek on Private Property	33.57534	-96.5859	1.25	32.77	11.43	Private
	CH12	Choctaw Creek at Highway 75	33.5718	-96.6027	1.31	34.08	10.12	Public
	CH13	Choctaw Creek at Farmington Road	33.57186	-96.6405	3.41	37.50	6.71	Public
	CH14	Choctaw Creek at Old Dorchester Road	33.58004	-96.6572	1.89	39.38	4.82	Public*

TCEQ ID	Site ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi)¹	Distance from Confluence (mi)¹	Distance from Upper Reach (mi)¹	Access
	CH15	Choctaw Creek on Private Property	33.58565	-96.6678	1.12	40.51	3.70	Private
	CH16	Choctaw Creek at John Cummings Road	33.59626	-96.6794	1.48	41.99	2.21	Public*
	CH17	Choctaw Creek at Pleasant Home Road	33.60608	-96.6929	1.59	43.58	0.63	Public*

* indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property

¹Distances were digitally estimated using the measuring tool in ArcGIS 9.3 with the 2010 NAIP 1-m DOQQs and the NHD stream layer as reference guides

Site CH01 is the most downstream site located on Choctaw Creek at Carpenters Bluff crossing, 2.76 miles from the confluence with the Red River. This site is publically accessible at the bridge with a well-worn footpath leading down to the water.

Site CH02 is located on Choctaw Creek on private property, 4.15 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a gate with cattle guard, then through another gate approximately 0.5 mile into the property, before driving another 0.35 through a pecan orchard to the site.

Site CH03 is located on Choctaw Creek at Choctaw Bottom Road, 5.74 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH04 is located on Choctaw Creek at FM 1753, 8.13 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH05 is located on Choctaw Creek at Highway 69, 12.26 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH06 is located on Choctaw Creek at Highway 82, 16.76 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH07 is located on Choctaw Creek at Highway 56, 19.96 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH08 is located on Choctaw Creek at Ida Road (also shown as FM 697), 25.24 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH09 is located on Choctaw Creek at Highway 11, 29.59 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH10 is located on Choctaw Creek at Luella Road, 31.53 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH11 is located on Choctaw Creek on private property, 32.77 miles from the confluence with the Red River. Access to this site required landowner permission to enter through an electric coded gate, and drive approximately 1.25 miles on private pasture road to the site.

Site CH12 is located on Choctaw Creek at Highway 75, 34.08 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH13 is located on Choctaw Creek at Farmington Road, 37.50 miles from the confluence with the Red River. This site is publically accessible at the bridge crossing only.

Site CH14 is located on Choctaw Creek at Old Dorchester Road, 39.38 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access, away from the road crossing, was required to complete the survey.

Site CH15 is located on Choctaw Creek on private property, 40.51 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate, and drive approximately 0.33 mile on private pasture road down to the site.

Site CH16 is located on Choctaw Creek at John Cummings Road, 41.99 miles from the confluence with the Red River. This site is publically accessible at the crossing only with a private property fence restricting further access. Landowner permission allowing across-fence access, away from the road crossing, was required to complete the survey.

Site CH17 is located on Choctaw Creek at Pleasant Home Road, 43.58 miles from the confluence with the Red River. This site is publically accessible at the crossing with a private property fence restricting further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Field Survey Results and Discussions

General Description of RUAA Survey Sites and Conditions for Choctaw Creek (0202F)

The Choctaw Creek RUAA surveys were conducted on May 16 - 18, 2014 and July 11 - 13, 2014. The surveys were performed on weekdays, weekends, or holidays at opportune times to observe recreational activities along Choctaw Creek. Air temperatures prior and during both the first and second surveys were above 21°C (70°F) which is indicated by the RUAA guidelines as warm enough to promote recreational activities (Tables 4.3 and 4.4). Notably warmer temperatures occurred in July than in May. In the 30 days prior to the first survey, 2.59 inches of precipitation fell, while 1.89 inches fell in the 30 days prior to the second survey.

A summary of the RUAA field survey results is presented in the following tables:

- Table 4.5 describes the stream channel and corridor characteristics at each site.
- Table 4.6 notes the average thalweg depth by site during each survey and the access to the stream, whether public or private, and the ease of bank access.
- Tables 4.7 and 4.8 document the maximum, minimum, and average stream widths at each site for each survey and observed flow conditions.
- Tables 4.9 and 3.10 note stream aesthetics, wildlife observations and tracks, and the presence of garbage observed at each site during each survey.

Physical descriptions of each site follow these tables along with selected photos showing notable characteristics of each site. Overall thalweg depth averaged 0.8 m during the first survey and 0.5 m during the second survey. Access to the stream down the bank was moderately difficult in most locations due to dense vegetation and steep banks. The dominant substrate was mud/clay and the stream corridor was largely lined with dense forest. The maximum stream width encountered was 33 m during the first survey in June 2014 and 32 m during the second survey in July 2014. Flow conditions were high to normal in June and normal to no flow in July at most survey sites. The most upstream sites, CH16 and CH17, indicated no flow during both surveys. The water surface was typically clear with some areas of scum and brown in color. Tracks observed most often included birds, raccoon, deer, and livestock. Trash was predominantly plastics and aluminum cans, and was most common at bridge crossings.

Table 4.3 Rainfall records with maximum and minimum temperature for Sherman-Denison, Texas 30 days prior to the first RUAA survey, initiated on May 16, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Sherman-Dennison weather station KGYI.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
16-Apr-14	0.00	65	43
17-Apr-14	0.00	63	45
18-Apr-14	0.00	74	48
19-Apr-14	0.00	77	51
20-Apr-14	0.37	78	61
21-Apr-14	0.06	78	62
22-Apr-14	0.00	78	55
23-Apr-14	0.00	83	60
24-Apr-14	0.00	78	59
25-Apr-14	0.00	80	54
26-Apr-14	0.00	83	62
27-Apr-14	0.03	86	70
28-Apr-14	0.00	77	57
29-Apr-14	0.00	71	48
30-Apr-14	0.00	65	44
1-May-14	0.00	71	39
2-May-14	0.00	77	44
3-May-14	0.00	86	47
4-May-14	0.00	93	62
5-May-14	0.00	89	62
6-May-14	0.00	86	65
7-May-14	0.00	82	67
8-May-14	0.89	73	63
9-May-14	0.00	85	64
10-May-14	0.00	86	64
11-May-14	0.00	87	71
12-May-14	1	84	57
13-May-14	0.05	67	52
14-May-14	0.19	69	52

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
15-May-14	0.00	77	46
16-May-14	0.00	78	53
17-May-14	0.00	75	55
18-May-14	0.00	81	58

Table 4.4 Rainfall records with maximum and minimum temperature for Sherman-Denison, Texas 30 days prior to the second RUAA survey, initiated on July 11, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Sherman-Dennison weather station KGYI

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
11-Jun-14	0.00	92	63
12-Jun-14	0.61	82	68
13-Jun-14	0.00	86	67
14-Jun-14	0.00	90	73
15-Jun-14	0.00	91	74
16-Jun-14	0.00	93	75
17-Jun-14	0.00	93	76
18-Jun-14	0.12	93	76
19-Jun-14	0.05	89	74
20-Jun-14	0.00	92	73
21-Jun-14	0.00	89	75
22-Jun-14	0.00	83	73
23-Jun-14	0.37	87	68
24-Jun-14	0.01	90	67
25-Jun-14	0.01	85	69
26-Jun-14	0.00	89	71
27-Jun-14	0.00	90	72
28-Jun-14	0.00	89	77
29-Jun-14	0.00	94	77
30-Jun-14	0.00	96	74
1-Jul-14	0.02	96	75
2-Jul-14	0.03	85	69
3-Jul-14	0.67	85	68
4-Jul-14	0.00	89	68
5-Jul-14	0.00	90	72
6-Jul-14	0.00	94	71
7-Jul-14	0.00	97	73
8-Jul-14	0.00	97	77
9-Jul-14	0.00	92	77

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
10-Jul-14	0.00	97	75
11-Jul-14	0.00	96	75
12-Jul-14	0.00	98	73
13-Jul-14	0.00	100	74

Table 4.5 Stream Channel and corridor characteristics for each site along Choctaw Creek (0202F).

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
CH01	Natural	Mud/Clay/Bedrock	Forest/Pasture/Row Crops	Large	No	Native/Improved Pasture
CH02	Natural	Silt/Mud/Clay	Forest/Pasture/Row Crops	Large	No	Native/Improved Pasture
CH03	Natural	Sand/Silt/Mud/Clay/ Rip Rap/Concrete	Forest/Pasture	Large	No	Native/Improved Pasture
CH04	Natural	Mud/Clay/ Rip Rap/Concrete	Forest/Pasture	Large	No	Native/Improved Pasture
CH05	Natural	Mud/Clay/Gravel/ Rip Rap/Concrete	Forest/Pasture	Large	No	Native/Improved Pasture
CH06	Natural	Silt/Mud/Clay/ Rip Rap/Concrete	Forest/Shrub/Pasture/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
CH07	Natural	Silt/Mud/Clay/ Rip Rap/Concrete	Forest/Shrub/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
CH08	Natural	Sand/Silt/Mud/Clay	Forest/Shrub/Pasture	Large	No	Native/Improved Pasture
CH09	Natural	Cobble/Sand/Silt/Mud/Clay/ Gravel/Rip Rap and Concrete at Bridge	Forest/Shrub/Pasture/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
CH10	Natural	Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
CH11	Natural	Mud/Clay/Gravel	Forest/Pasture/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
CH12	Natural	Mud/Clay/Gravel	Forest/Pasture/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
CH13	Natural	Gravel	Forest	Large	No	Native/Improved Pasture
CH14	Natural	Gravel/Sand/Mud/Clay	Forest/Denuded/Eroded Bank	Large	No	Native/Improved Pasture
CH15	Natural	Mud/Clay/Gravel/Cobble	Forest/Denuded/Eroded Bank	Large	No	Native/Improved Pasture
CH16	Natural	Mud/Clay	Forest	Large	No	Native/Crop
CH17	Natural	Silt/Mud/Clay/Gravel	Shrub/Pasture	Large	No	Native/Improved Pasture

Table 4.6 Thalweg depth, stream flow type, and site accessibility during the two surveys of Choctaw Creek (0202F).

Stream flow type represents TCEQ descriptions (TCEQ, 2014). Under general access, * indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property. For bank access, E = Easy, ME = Moderately Easy, MD = Moderately Difficult, and D = Difficult.

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
CH01	300	11	0	1.4	1.3	Perennial	Public	D
CH02	300	11	0	0.9	0.9	Perennial	Private	D
CH03	300	11	0	0.6	0.5	Perennial	Public	D
CH04	180	7	0	1.5	1.3	Perennial	Public	D
CH05	300	11	0	1.2	0.8	Perennial	Public	MD
CH06	210	8	0	0.8	0.8	Perennial	Public	D
CH07	180	7	0	1.0	1.1	Perennial	Public	D
CH08	300	11	0	0.9	0.7	Perennial	Public	MD
CH09	300	11	0	0.6	0.5	Perennial	Public	MD

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
CH10	300	11	0	0.5	0.2	Intermittent with pools	Public	D
CH11	300	11	0	0.5	0.3	Intermittent	Private	D
CH12	300	11	0	0.5	0.5	Intermittent	Public	D
CH13	300	11	0	0.3	0.0	Intermittent	Public	D
CH14	300	11	0	0.3	0.0	Intermittent	Public*	D
CH15	300	11	0	0.6	0.2	Intermittent	Private	MD
CH16	300	11	0	0.3	0.0	Ephemeral	Public*	D
CH17	300	11	0	0.1	0.0	Ephemeral	Public*	ME

Table 4.7 Description of surveyed stream sites along Choctaw Creek during first survey, performed in May 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
CH01	33	30	31	High
CH02	31	3.0	12	High
CH03	17	4.4	12	High
CH04	24	17	19	High
CH05	25	3.0	15	High
CH06	11	1.5	5.0	Normal
CH07	7.0	3.0	5.0	Normal
CH08	10	4.3	8.0	Normal
CH09	9.0	3.0	5.5	Normal
CH10	7.0	0.8	2.5	High
CH11	6.4	2.3	4.0	High
CH12	12	1.7	4.0	High
CH13	10	0.6	1.0	High
CH14	9.5	0.4	2.5	Low
CH15	7.3	0.6	1.5	Low
CH16	6.0	0.7	5.0	No Flow
CH17	7.4	0.0	0.0	No Flow

Table 4.8 Description of surveyed stream sites along Choctaw Creek during second survey, performed in July 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
CH01	32	29	30	Normal
CH02	30	3.0	20	Normal
CH03	13	2.5	3.0	Normal
CH04	26	18	20	Normal
CH05	18	2.0	6.0	Normal
CH06	7.0	0.6	4.0	Normal
CH07	10	4.0	6.0	Normal
CH08	10	2.9	8.5	Normal
CH09	10	2.5	4.5	Normal
CH10	7.8	0.0	0.0	No Flow
CH11	6.5	0.0	3.5	No Flow
CH12	7.5	0.5	3.5	Low
CH13	2.5	0.0	0.0	No Flow
CH14	2.5	0.0	0.0	No Flow
CH15	7.0	0.0	3.0	No Flow
CH16	0.0	0.0	0.0	No Flow
CH17	1.0	0.0	0.0	No Flow

Table 4.9 Stream aesthetics along Choctaw Creek during first survey performed in May 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
CH01	A	A	N	Brown	Fine Sediment/Sludge	Foam/Scum	SP	SP	N	Fecal/Nests	N	N	C
CH02	C	A	N	Brown	Fine Sediment	Foam	SP	SP	SP	Tracks/Fecal	N	R	N
CH03	C	C	N	Brown	Solids	Clear/Scum/Foam	SP	SP	N	Tracks/Fecal	N	C	R
CH04	R	R	N	Brown	Fine Sediment/Sludge	Clear	LP	SP	N	Tracks/Fecal/Nests	C	R	R
CH05	C	C	N	Brown	Sludge	Clear	SP	SP	N	Tracks/Fecal	R	R	C
CH06	A	A	N	Clear	Fine Sediment/Solids/Sludge	Clear	N	N	SP	Tracks/Fecal/Nests	C	R	R
CH07	A	A	C	Clear/Brown	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal/Nests	C	R	R

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
CH08	A	A	R	Clear/Brown	Fine Sediment/Solids/Sludge	Clear	N	N	LP	Tracks/Fecal/Nests	C	R	R
CH09	C	C	N	Clear/Brown	Fine Sediment/Solids/Sludge	Clear	MP	N	MP	Tracks/Fecal/Nests	Ab	C	R
CH10	C	C	C	Brown	Fine Sediment/Sludge	Scum	MP	N	N	Tracks/Fecal	N	C	C
CH11	A	R	N	Clear	Solids	Clear	N	N	N	Tracks/Fecal	C	C	R
CH12	R	C	N	Clear/Green	Sludge	Clear	SP	N	N	Tracks/Fecal	N	R	R
CH13	C	C	N	Clear	Solids	Clear	N	N	N	Tracks/Fecal	N	R	N
CH14	C	C	N	Clear	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal	N	R	N
CH15	R	R	R	Brown	Solids	Clear	N	N	N	Tracks/Fecal	R	R	N
CH16	C	R	R	Brown	Fine Sediment	Clear	N	N	N	Tracks	N	R	N

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
CH17	A	A	N	Brown	Solids	Scum	N	N	N	Tracks	N	R	N

Table 4.10 Stream aesthetics and wildlife observations along Choctaw Creek during the second survey, performed in July 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
CH01	A	C	N	Green/Brown	Fine Sediment/Sludge	Scum	SP	SP	MP	Fecal/Nests	N	N	A
CH02	R	C	N	Brown	Fine Sediment	Scum/Foam	SP	MP	MP	Tracks/Fecal	N	R	R
CH03	C	C	R	Clear/Green	Solids	Clear/Scum	SP	SP	N	Tracks/Fecal/Nests	R	C	C

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
CH04	A	A	R	Clear/Brown	Sludge/Solids	Clear	SP	N	N	Tracks/Fecal	N	N	R
CH05	R	A	N	Clear/Brown	Solids	Clear	N	SP	N	Tracks/Fecal/Nests	N	R	C
CH06	A	A	N	Clear/Brown	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal	C	R	R
CH07	A	A	R	Brown	Fine Sediment/Solids/Sludge	Clear	M P	N	N	Tracks/Fecal	C	R	R
CH08	A	A	N	Clear/Brown	Fine Sediment	Clear/Scum/Foam/Debris	N	N	N	Tracks/Fecal	C	R	R
CH09	R	A	C	Clear	Fine Sediment/Solids	Clear	N	N	MP	Tracks/Fecal	C	R	R
CH10	C	C	N	Brown	Fine Sediment/Solids/Sludge	Clear/Scum/Foam	N	SP	N	Tracks/Fecal	C	R	R
CH11	A	R	N	Brown	Fine Sediment/Solids/Sludge	Clear/Scum/Foam	N	N	N	Tracks/Fecal	R	R	R
CH12	A	C	Ab	Green/Brown/Black	Fine Sediment/Solids/Sludge	Scum/Foam	SP	N	N	Tracks/Fecal	C	R	R

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
CH13	A	A	N	Brown	Solids	Clear/Scum	SP	N	N	Tracks/Fecal	R	R	R
CH14	A	C	R	Green	Fine Sediment/Sludge	Scum	N	N	N	Tracks/Fecal	N	R	R
CH15	A	C	R	Green	Fine Sediment	Scum/Foam	N	N	SP	Tracks/Fecal	R	R	R
CH16	A	A	R	Clear/Brown	Solids	Clear	N	SP	N	Tracks/Fecal	N	R	R
CH17	A	A	N	Brown	Solids	Clear	N	N	SP	Tracks/Fecal	N	R	N

Physical Description of CH01

Choctaw Creek, at Site CH01, was surveyed on May 18 and July 12, 2014. This site was publically accessible and moderately easy to access because it occurred at a road crossing, which had a well-worn footpath leading down to the banks and under the bridge (Figure 4.3). However, access into the stream from the streambank was difficult. A boat was required to conduct the survey, because the creek was non-wadeable at this site. Water levels were below the edge of the bank, which created an approximately 1 foot vertical drop from the already sloping bank down to the water. Banks were slick clay as were the bottom deposits in addition to mud and some bedrock associated with the upstream most transects. Carrying, launching, and retrieving the boat was very difficult. The corridor was lined with steep, forested banks on both sides with improved and native pasture beyond on the left bank and row crops beyond on the right bank (Tables 4.5). Poison ivy was abundant and especially noticeable along the footpath leading down to the creek from the bridge.

This site was non-wadeable and required the use of a boat to complete the survey with average depths ranging from 1.4 m to 1.3 m deep between surveys (Table 4.6). Flow appeared high during the first survey and normal during the second. Little change was observed in widths between surveys, ranging from 33 m to 29 m. The typical average width was approximately 31 m (Tables 4.7 and 4.8). Stream aesthetics are illustrated in Tables 4.9 and 4.10 for each survey. During the first survey algae cover, aquatic vegetation, and odor were absent. During the second survey algae cover was more common but neither aquatic vegetation nor odors were detected. The water's color was brown and the surface had foam and scum, especially from around the 150-m transect to the 300-m transect. During the second survey, the water color had more of a green coloration and the surface maintained the scum and foam.

During both surveys, snakes were observed in the creek. Additionally, during the second survey, a sounder of feral hogs (numbering at least eight) was observed wallowing and foraging along the banks at and beyond the 300-m transect. A rotting feral hog carcass was observed floating in the channel during the first survey. Other wildlife observed included turtles, fish, cliff swallows at the bridge, an egret, and a great blue heron. Raccoon tracks were also seen on the banks where the boat was put in. In general, garbage was rare to non-existent on the banks and in the channel (Tables 4.9 and 4.10). However, garbage on the banks beneath the bridge and along the footpath did exist. This garbage consisted of aluminum cans, fish bait packaging, spent shotgun shells, cigarette boxes, and a tire. The arrangement of aluminum cans into a pile, a small pile of ashes with a half burned cigarette box, and the discarded package of fish bait, particularly alludes to the recreational use of this site (Figures 4.4 and 4.5). Additionally, a trotline was observed hanging from a log out in the stream channel (Figure 4.6). These items were the only evidence of human recreation observed at this site.



Figure 4.3 Photograph of Choctaw Creek at Site CH01, taken May 18, 2014. Footpath leading down from the side of the bridge. TIAER boat in photo.



Figure 4.4 Photograph of Choctaw Creek at Site CH01, taken July 12, 2014, of beverage cans and remnants of a campfire.



Figure 4.5 Photograph of Choctaw Creek at Site CH01, taken May 18, 2014. Discarded fishing bait in photo.



Figure 4.6 Photograph of Choctaw Creek at Site CH01, taken May 18, 2014. Trotline hanging from log in stream channel.

Physical Description of CH02

Choctaw Creek at Site CH02 was surveyed on May 18 and July 12, 2014. Access to this site was difficult as it occurred approximately 0.5 mile from a public road onto private property then through two gated pastures. Access into the stream was difficult, because the entry point had nearly vertical slopes. Although water depths along the majority of this site did not necessitate a boat, one was used, because banks dropped abruptly approximately 0.5 m down to the water. Stepping off the banks into the water had unknown results and exiting the creek from a wading position would be difficult to impossible. The boat was lowered down to this site by a rope tied to a vehicle. Once in the stream, navigation was simple. The inside bends at this site had gently sloping banks, from which access to the water would be easy. Left banks were cut resulting in steep to vertical bank structure. Left and right banks were forested immediately past the waterline. A pecan orchard existed on the right bank and improved pasture on the left bank. The primary substrate at this site was silty mud-clay on the outside bends of the creek and gravel and some plate rock on the shallower inside bends (Tables 4.5). Flood debris was encountered at the 300-m transect (Figure 4.7).



Figure 4.7 Photograph of Choctaw Creek at Site CH02, taken May 18, 2014. Downstream view at the 300-m transect. Note steep forested cut banks, gravelly inside bend and flood debris. TIAER staff in photo.

The stream was wadeable with average thalweg depths of 0.9 m during both surveys (Table 4.6). Flow appeared high during the first survey but normal during the second. Non-wadeable depths were encountered between the 30-m and 60-m transects and ranged between 1.6 m and 1.8 m between both surveys combined. The typical observed width during the first survey was 12 m and 30 m during the second survey (Tables 4.7 and 4.8). Stream aesthetics are illustrated in Tables 4.9 and 4.10 respectively for each survey. Aquatic vegetation was common during the first survey but

was rarely observed during the second. Algae cover increased from absent during the first survey to common during the second. No odor was ever detected during either survey. Water coloration was brown and bottom deposits were fine sediments during both surveys. Foam was present on the water surface during both surveys as well scum during the second (Figure 4.7).



Figure 4.8 Photograph of Choctaw Creek at Site CH02, taken July 12, 2014. Downstream view at the 150-m transect. TIAER staff in photo.

Wildlife and livestock had a presence at this site. Cattle were observed in the pasture through which this portion of Choctaw Creek ran. Cattle manure and tracks were observed on a well-worn trail leading down the steep banks to the water. Two snakes were observed in the water during the first survey, and one snake was observed during the second. Water dependent birds were seen in the corridor during both surveys. Small fish, a turtle shell, clamshells, and raccoon tracks were observed at this site. Presence of garbage was minimal in general. During the first survey, there was no large or small garbage observed in the channel. Bank garbage was common. During the second survey, there was no large garbage and small and bank garbage was rare. Glass and plastic bottles, as well as some tires, were the types of garbage seen (Tables 4.9 and 4.10). No signs of human recreation were observed.

Physical Description of CH03

Choctaw Creek at Site CH03 was surveyed on May 18 and July 12, 2014. Access to this site was public from the right of way next to the bridge. Entering the creek was difficult, because it required climbing down a steep bank over large boulders (Figure 4.9). Banks were generally steep with forest/shrub vegetation including willow and sycamore trees. Outside the creek channel, the landscape opened up to improved and native pastures. Once in the creek, the observed primary substrate was a combination of sand, silt, mud, and clay where flow was slow, but the substrate was gravelly in the riffles (Table 4.5). There were some areas of swift moving water where standing in the stream was challenging.



Figure 4.9 Photograph of Choctaw Creek at Site CH03, taken July 12, 2014. Right bank view at the 300-m transect. Note tall, steep banks.

This site was wadeable with average thalweg depths of 0.6 m and 0.5 m during the first and second surveys, respectively (Table 4.6). Flow appeared high during the first survey but normal during the second. The typical width during the first survey was around 12 m and 3 m during the second (Tables 4.7 and 4.8). Stream aesthetics for this site are outlined in Tables 4.9 and 4.10. Aquatic vegetation and algae cover, particularly on submerged rocks, were common during both surveys. Odor was not detected during the first survey but was during the second. The color of the water was brown during the first survey but a clear/green color during the second. The surface was clear with some scum during both surveys, and some foam was observed during the first survey. Bottom deposits during both surveys were primarily solids including gravel and cobble. Large concrete debris was present near the bridge.



Figure 4.10 Photograph of Choctaw Creek at Site CH03, taken May 18, 2014.
Downstream view at the 150-m transect.

Wildlife observed during the surveys included frogs, water dependent birds, small fish, and a snake. Cave swallows and their nests were observed beneath the bridge. During the first survey, numerous spotted gar were seen swimming upstream in the riffles. Gar were also observed during the second survey but not in the riffles. Clamshells and crawfish exoskeletons were also encountered. Tracks of raccoon, beaver, feral hog and cattle were seen in the channel. Garbage was encountered during both surveys. During the first survey, small garbage in the channel was common and bank garbage was rare. Aluminum cans, scrap metal, plastic and glass bottles as well as bags of household garbage were observed (Figure 4.11) During the second survey small garbage in channel and bank garbage appeared more common (Tables 4.9 and 4.10). The same household garbage bags were observed in addition to tires. No signs of human recreation were observed at this site.



Figure 4.11 Photograph of Choctaw Creek at Site CH03, taken May 18, 2014. Photo of trash bags containing household garbage.

Physical Description of CH04

Choctaw Creek at Site CH04 was surveyed on May 18 and July 12, 2014. Access to this site was easy at the bridge right-of-way, although dense woody vegetation and slick banks made entering the channel moderately difficult. Depths at this site became non-wadeable approximately 150 m downstream from the bridge, and a utility pipe obstructed travel further than 30 m upstream from the bridge. Deployment of a boat was not possible on the left bank, because the density of woody vegetation prohibited transport of the boat through it. The right bank was not conducive to deploying a boat, because the right-of-way was overgrown with tall vegetation so that the ground conditions were unknown. Where visible, the ground appeared deeply rutted from runoff, which would make carrying a heavy object through it hazardous. There were safety and feasibility concerns regarding use of these entry points for a boat; therefore, one was not used and only 180 m of the 300 m survey was attainable.

Banks were steep at this site and the corridor was densely vegetated with large trees, regrowth, shrubs, and herbaceous vegetation. Beyond the riparian corridor on the left bank was improved pasture. Beyond the riparian corridor on the right bank, forested tracts of land existed. As mentioned before, an obstruction formed by a utility pipe crossing the creek encountered approximately 30 m upstream of the bridge that had caught flood debris on its upstream side (Figure 4.13). The primary substrate was mud/clay, which caused considerable sinking when walking in the stream (Table 4.5). Submerged rip rap was encountered in the water below the bridge also making wading difficult.



Figure 4.12 Photograph of Choctaw Creek at Site CH04, taken May 18, 2014. Left bank view at the 150-m transect, also the access site. Note dense woody bank vegetation.



Figure 4.13 Photograph of Choctaw Creek at Site CH04, taken July 12, 2014. Photo of upstream view at utility pipe obstruction with associated debris.

Site CH04 was wadeable from approximately 30 m upstream from the bridge to approximately 150 m downstream from the bridge. The creek at this site became non-wadeable beyond these distances from the bridge. Creek banks beyond the wadeable portions were too steep and vegetation too thick for personnel to climb out to access the other transects. During the first survey, 180 m was surveyed with average thalweg depths of approximately 1.5 m, approaching non-wadeable (<1.5 m). During the second survey, 150 m of the creek was surveyed. Thalweg depths averaged approximately 1.3 m (Table 4.6). Widths were about the same between surveys at about 20 m. Flow during the first survey appeared high but normal during the first survey (Tables 4.7 and 4.8). Aesthetics of the stream are outlined in Tables 4.9 and 4.10. During the first survey, aquatic vegetation and algae cover were rare and absent during the second. No odor was detected during the first survey but did occur rarely during the second. Water coloration was brown and the surface was clear during both surveys. Bottom deposits were soft fine sediment with occasional submerged solid objects encountered.

Evidence of wildlife presence included six individual snakes of the genus *Nerodia* observed at the bridge during the first survey, and two snakes observed during the second survey. Spotted gar and other smaller fish were seen swimming in the channel. Frogs, turtles, pigeon, and cave swallows were also encountered. Cave swallow nests existed beneath the bridge, and tracks of raccoon, canine, bobcat, beaver, and squirrel were seen. Birds were observed dropping feces into the creek below the bridge. Garbage in general was rare at this site (Tables 4.9 and 4.10). During the first survey, some large scrap metal was observed near the bridge. Small garbage in the channel appeared rare during the first survey but none was seen during the second survey. Bank garbage remained rare during both surveys. Types of garbage encountered included primarily glass bottles and aluminum cans. No evidence of human recreation was observed at this site.



Figure 4.14 Photograph of Choctaw Creek at Site CH04, taken May 18, 2014. Downstream view at 150-m transect.

Physical Description of CH05

Choctaw Creek at Site CH05 was surveyed on May 18 and July 13, 2014. Access to this site was public and easy by driving down the right of way and parking under the bridge. A footpath under the bridge led down to the water. Beneath the bridge were large amounts of various types of concrete debris with rusty re-bar and steel protruding out (Figure 4.15). This made accessing the creek under the bridge hazardous as a trip or fall could easily result in severe abrasions or impalement. Additionally, remnants of I-beam supports from the old bridge were still in place and cut off approximately 1 m above ground surface. The primary substrate was a hard packed mud/clay that was slick and perforated with deep holes into which one could easily step and stumble (Table 4.5). Thick woody and herbaceous bank vegetation existed throughout the survey reach including poison ivy. Some non-wadeable places along the survey made use of a boat a requirement. Deploying the boat required lowering it down through tall Johnsongrass down a steep bank into flowing water using a rope tied to the field vehicle, which also served to retrieve the boat from the channel.

This site was wadeable in some locations and non-wadeable in others. Non-wadeable depths were measured at the 90, 180 and 240-m transects. Although depths would suggest the presence of pools, due to the visible movement of the water, these areas were designated glides. The flow at this site appeared high during the first survey but normal during the second. Thalweg depth averages were 1.2 m at the first survey and 0.8 m at the second survey (Table 4.6). Widths reflected the water level difference between surveys with averages of 15 m during the first survey and 6 m during the second. Maximum widths during the two surveys were 25 m and 18 m, respectively (Tables 4.7 and 4.8). Stream aesthetics are outlined in Tables 4.9 and 4.10. During the first survey, aquatic vegetation and algae cover were common but became rare and absent during the second survey. The color of the water during the first survey appeared brown with a clear surface. During the second survey, the color of the water had become clearer. Bottom deposits were composed of sludge in some areas of the reach and solids in the more shallow areas, especially near the bridge.



Figure 4.15 Photograph of Choctaw Creek at Site CH05, taken May 18, 2014. Rebar and concrete obstructions at bridge.



Figure 4.16 Photograph of Choctaw Creek at Site CH05, taken July 13, 2014. Upstream view at the 0-m transect.

Indications of wildlife presence were observed at this site. Clamshells, a snake, turtles, a terrestrial snail and a great blue heron were seen while surveying this site. Other evidence of wildlife included tracks of raccoon, beaver and feral hog. Cave swallow nests were built under the bridge beneath which feathers and droppings were seen on the ground. Additionally, the sound of bats could be heard when in the vicinity of the bridge. Wildlife trails were seen entering the channel from the surrounding riparian corridor and bird feces were observed on the banks. Garbage in general was rare at this site; however, a pile of vehicle tires was encountered on the bank under the bridge (Figure 4.17). Bank garbage was common and included typical garbage found on roadsides such as glass bottles, aluminum cans and plastic wrappers. Evidence of human activity included graffiti on the bridge support columns and beams, dumped tires and a foot-path leading down to the water. The only observed evidence of recreation was a fishing bobber hung up in flood debris. No other evidence of human recreation was observed at this site.



Figure 4.17 Photograph of Choctaw Creek at Site CH05, taken May 18, 2014. Tires and graffiti under bridge.

Physical Description of CH06

Choctaw Creek at Site CH06 was surveyed on May 18, 2014 and July 13, 2014. Access to this site was public at the highway right-of-way. Getting into the water was difficult. Submerged riprap, concrete, garbage and other unknown objects created a walking/wading hazard at the bridge. Banks were steep and densely vegetated with tall grasses and weeds. Some banks were denuded and eroding. Native and improved grass pastures existed beyond the forested riparian area. Remains of a cable and wood bridge suspended across the creek at approximately the 150-m transect were encountered (Figure 4.18). Boards from the old bridge hung, swinging over the channel creating a potential hazard of falling debris.

The dominant substrate was clay/mud overlain by up to 0.5 m of silt, which caused considerable, unpredictable sinking (Table 4.5). Additionally, field personnel encountered deep holes created by swirling water in the firmly packed clay. These holes were approximately the size of post-holes and were scattered throughout the reach. Some of these holes were not visible to the wader through the murky water and created very hazardous navigation by foot. At approximately 180 m during the first survey, depths exceeding chest height were encountered. The same conditions were met during the second survey but at approximately 30 m further downstream. The clay content in the soil made the banks slick and climbing up the bank was impossible. Swift water and narrowing of the channel in places made for conditions not conducive to surveying by boat because the motor on the boat was not large enough to overcome the creek's flow rate. The full 300 m survey could not be completed at this site.



Figure 4.18 Photograph of Choctaw Creek at Site CH06, taken July 13, 2014. Downstream view near the 150-m transect. Note old suspension bridge remains, steep vegetated banks.

Site CH06 was wadeable up to the 180-m transect during the first survey and to the 210-m transect during the second, beyond which the creek became non-wadeable and there was no access to the banks to collect widths for the remaining transects. Flow appeared normal during both surveys. Although thalweg averages remained about the same during both surveys at 0.8 m (Table 4.6), maximum widths decreased from the first survey to the second with measurements of 11 m and 7 m, respectively. Typical widths were 5 m during the first survey and 4 m during the second (Tables 4.7 and 4.8). A pool did exist, beginning at the 300-m transect, but extended beyond the reach of the survey so a full measurement was not taken. A laser range finder was used to measure the pool up to where the creek curved out of sight. This partial measurement indicated that the pool was at least 50 m in length. Stream aesthetics remained generally the same from the first survey to the second (Tables 4.9 and 4.10). Aquatic vegetation and algae cover were absent, no

odor was detected, and the water's surface was clear. Water color was clear during the first survey and brown during the second.

Some indications of wildlife presence were seen in the stream including a turtle, clamshells, and a dead crawfish (Tables 4.9 and 4.10). The sound of a feral hog in the brush was detected. Tracks of feral hog and deer were seen along with a trail/slide in the bank mud leading into the stream. Large garbage in the channel was common, but all other garbage was rare (Tables 4.9 and 4.10). Large garbage included tires and scrap metal. Other garbage was characterized as typical garbage found on roadsides. No evidence of human recreation was observed at this site.

Physical Description of CH07

Choctaw Creek at Site CH07 was surveyed on May 18 and July 13, 2014. Access to this site was public at the bridge. The bridge was approximately a quarter mile long, and parking, where the terrain was reliably solid, was difficult to find. There was an abundance of large flood debris accumulated under the bridge and partially submerged riprap, concrete, and rebar (Figure 4.19). These hindrances along with steep banks at the bridge made access difficult. The corridor was a combination of forest and shrub vegetation with native and improved grass pastures beyond the riparian area. Some of the banks were eroded and free of established vegetation. The dominant substrate was a soft combination of silt, mud and clay, which caused significant sinking when walking through the channel in addition to deep holes the size of post holes (Table 4.5). Two obstructions of log debris were encountered throughout the surveyed stretch (Figure 4.20).



Figure 4.19 Photograph of Choctaw Creek at Site CH07, taken July 13, 2014. Flood debris beneath bridge.

Approximately 180 m of site CH07 was wadeable. Non-wadeable depths were encountered upstream and downstream from the bridge. Steep banks and thick vegetation restricted bank access that was required to access the creek further, therefore the full 300 m survey was unattainable. Average thalweg depth was approximately 1.6 m during the two surveys (Table 4.6). Observed flow was normal during both surveys. Typical widths for this site were 5.5 m with a maximum of 10 m and a minimum of 3 m over the course of both surveys. Stream aesthetics remained largely the same between surveys. Aquatic vegetation and algae cover were absent, the water's color was a clear brown, and its surface was clear. Only the detection of odor changed from common to rare between the first and second surveys. Bottom deposits were fine sediment sludge with encounters with occasional solids (Tables 4.9 and 4.10).



Figure 4.20 Photograph of Choctaw Creek at Site CH07, taken July 13, 2014. Log obstruction. TIAER staff in photo.

Little was observed regarding wildlife at this site. However, evidence of feral hog rooting in the right-of-way next to the creek was observed as well as feral hog tracks. Bird droppings and two snakes were also seen. Observed garbage did not change between surveys. Large garbage was common and included tires, scrap steel, other metals, and concrete. Small garbage in the channel and bank garbage were rare but did include plastic, glass jars, bottles, and various plastics (Tables 4.9 and 4.10). No evidence of human recreation was observed at this site.

Physical Description of CH08

Choctaw Creek at Site CH08 was surveyed on May 18 and July 12, 2014. Access to the site was simple as it occurred at a road crossing. However, entering the channel to complete the survey was moderately difficult because banks were steep and densely vegetated. An extremely large amount of flood debris had accumulated under the bridge creating a massive log obstruction (Figure 4.21).

The 0-m transect for this site was established at the road crossing. Due to the increase in debris density at this transect during the second survey, a depth measurement was not attainable. The primary substrate was a mix of sand, silt, mud, and clay (Table 4.5). Sinking in the mud up to mid-thigh was common at this site. A barbed wire private property fence bisected the creek keeping livestock in adjacent pastures. The corridor had some large trees and shrubby vegetation, but opened up into improved pastures beyond the riparian corridor.



Figure 4.21 Photograph of Choctaw Creek at Site CH08, taken May 18, 2014. Left bank view at the 0-m transect. Note large accumulation of debris under bridge.

This site was wadeable during the two surveys with average depths of 0.9 m during the first survey and 0.8 m during the second (Table 4.6). Observed flow was normal during both surveys (Tables 4.7 and 4.8). The typical observed width varied little between surveys and was approximately 8.3 m. The entire 300 m stretch was designated as one large pool with a length extending beyond the last transect during both surveys. During the first survey, the width at the widest point was 8 m and maximum depth was >1.5 m. During the second survey, maximum width was 10 m and maximum depth was 1 m. Stream aesthetics were similar between surveys (Tables 4.9 and 4.10). Aquatic vegetation and algae cover were absent and the water's color was a clear brown during both surveys. Odor was rarely encountered during the first survey and absent during the second. Bottom deposits at this site were fine sediment during both surveys with a sludge component present during the first survey only. During the first survey, the water surface was clear but developed scum with foam and other debris by the second survey.



Figure 4.22 Photograph of Choctaw Creek at Site CH08, taken July 12, 2014. Upstream view at the 30-m transect.

Evidence of wildlife was observed primarily during the second survey. Frogs, turtles, crawfish burrows, and livestock were encountered (Tables 4.9 and 4.10). Tracks of turtle, canine, raccoon, and cattle were seen in addition to a livestock path in the bank leading from pasture to the water. Large garbage in the channel was common and included a 55-gallon plastic barrel, a telephone pole and tires (Tables 4.9 and 4.10). Small garbage in the channel and on the banks was rare in general, but excessive at the bridge where the large debris pile had accumulated (Figure 4.23). This garbage was characterized by typical road trash: plastic wrappers, bottles, aluminum cans, other plastics, and glass. No evidence of human recreation was observed at this site.



Figure 4.23 Photograph of Choctaw Creek at Site CH08 taken May 18, 2014. Upstream view at the 0-m transect. Note large accumulation of debris and garbage.

Physical Description of CH09

Choctaw Creek at Site CH09 was surveyed on May 18, 2014 and on July 12, 2014. Access to this site was public at the bridge crossing. However, getting into the creek from the right-of-way was moderately difficult, because banks were steep with thick vegetation, including poison ivy, and woody flood debris. Private property fence existed parallel with the creek but did not cross the stream or prohibit access into or through it. Banks along the stretch were primarily forest and shrub dominated but opened up to improved pastures beyond the immediate riparian area. Some sections of banks were denuded and eroded. The primary substrate was a combination of sand, silt, clay, cobble, and gravel (Table 4.5). Concrete and riprap were encountered in the water at the bridge only. One obstruction in the form of a downed tree in the stream was encountered (Figure 4.24).



Figure 4.24 Photograph of Choctaw Creek at Site CH09, taken July 12, 2014. Downstream view at the 0-m transect. Note obstruction in stream.

Site CH09 was wadeable with an average thalweg depth measuring approximately 0.8 m (Table 4.6). One pool was encountered, which persisted from one survey to the next. During the first survey, it measured 60 m long, 8 m wide and 1.2 m deep. During the second survey, the same pool measured 44 m long, 10 m wide and >1.5 m deep. Flow appeared normal during both surveys (Tables 4.7 and 4.8). Typical average widths ranged from 5.5 m to 4.5 m from the first survey to the second. Stream aesthetics changed between surveys (Tables 4.9 and 4.10). Aquatic vegetation was common during the first survey but was rarely encountered during the second. Algae cover was also common during the first survey but was absent during the second. Odor was not detected during the first survey but was commonly detected during the second survey. The color of the water remained clear from one survey to the next but had a brownish tinge during the first. Fine sediment with some solids characterized the bottom deposits at this site and the surface of the water was clear.

Indications of wildlife were observed during both surveys. Minnows, spotted gar, birds, clamshells, a snake, and cattle were encountered at this site. Tracks of feral hogs, cattle, and canine were observed as well as cow manure, bird nests, and droppings (Tables 4.9 and 4.10). Garbage was observed at this site. Large garbage in the channel, including tires and a plastic chair, was abundant during the first survey and was only common during the second (Figure 4.25). Small garbage in the channel was common during the first survey but rare during the second and included glass bottles, aluminum cans, plastics, and other typical road trash. Bank garbage was rare during both surveys. No evidence of human recreation was observed at this site.



Figure 4.25 Photograph of Choctaw Creek at Site CH09, taken May 18, 2014. Large garbage in stream.

Physical Description of CH10

Choctaw Creek at Site CH10 was surveyed on May 17 and July 12, 2014. Access to this site was public at the bridge crossing. Access into the stream was difficult due to steep, densely vegetated banks. The corridor was a mix of forest, shrub, and herbaceous vegetation, including poison ivy, but opened up to cultivated/improved pastures beyond the riparian area (Table 4.5). Multiple log jams and a beaver dam were encountered. A particularly extensive field of flood debris at the 0-m transect was encountered that blocked all further access in the stream (Figure 4.26). Additionally, during the first survey, a loud humming sound was detected at the 0-m transect and was identified as a bee hive approximately 20 m up in a tree on the right bank. Other hazards encountered at this site included unpredictable changes in water depth and mud that caused sinking up to the mid-shin to knee.



Figure 4.26 Photograph of Choctaw Creek at Site CH10, taken May 17, 2014. Extensive debris field. Note, a bee hive occupied the two large trees on the right side of photo.

This site was wadeable with average thalweg depths measuring approximately 0.5 m during the first survey and 0.2 m during the second (Table 4.6). Observed flow appeared high during the first survey and did not flow during the second (Tables 4.7 and 4.8). A pool was encountered during the second survey that measured 41 m long, 2.5 m wide, and 0.7 m deep. Typical observed widths ranged from 2.5 m to 0 m between the first and second surveys, respectively. Maximum width was 7.8 m and minimum was 0.8 m. Stream aesthetics changed little between surveys (Tables 4.9 and 4.10). Aquatic vegetation and algae cover were common during both surveys. Odor was commonly detected during the first survey but was absent during the second. Water was brown and bottom deposits were fine sediment/sludge during both surveys. Scum was detected all along the stretch during the first survey but included foam and some clear spots during the second survey.



Figure 4.27 Photograph of Choctaw Creek at Site CH10 taken July 12, 2014. Downstream view at the 150-m transect.

Wildlife and their signs were encountered at this site (Tables 4.9 and 4.10). Minnows, frogs, crawfish, bees, and snakes were encountered. Tracks of raccoon, deer, beaver, and feral hog were observed in addition to a dam and gnaw marks left by a beaver. A turtle shell, crawfish burrows, and bird droppings were also seen in the channel. Garbage on the banks and channel was common, especially concentrated at the bridge. A bag of household garbage was found at the bridge during the first survey as well as the slide portion of a child's play set. Large garbage observed during the second survey included discarded carpet, plywood, and tires. Other garbage found at this site included Styrofoam, aluminum cans, glass bottles, jars, plastic jugs, and plastic bottles among other general trash. No evidence of human recreation was observed at this site.



Figure 4.28 Photograph of Choctaw Creek at Site CH10 taken May 17, 2014.
Bank/household garbage.

Physical Description of CH11

Choctaw Creek at Site CH11 was surveyed on May 17 and July 12, 2014. Access to this site was difficult. This site existed on private property and was only accessible by entering the property through a coded electric gate and driving approximately 1.25 miles on pasture roads. Once near the site, personnel climbed over a barbed wire fence and hiked approximately 30 m through dense brush to get into the creek bed. Once in the creek bed, walking was easy. The dominant substrate was mud/clay with a significant gravel component (Table 4.5). Banks were denuded and eroding, but the riparian corridor was forested (Figure 4.29). Native pasture and improved pastures existed beyond the riparian corridor.



Figure 4.29 Photograph of Choctaw Creek at Site CH11, taken May 17, 2014. Downstream view at the 0-m transect. Note tires in the stream.

This site was wadeable during both surveys with average thalweg depths of 0.5 m during the first survey and 0.3 m during the second (Table 4.6). Observed flow appeared high during the first survey and was not flowing during the second survey. Two pools were encountered during the second survey. The first pool was 25 m long, 6.5 m wide, and 0.8 m deep. The second pool was 50 m long, 6 m wide, and 0.8 m deep. The typical width during the first survey was 4 m and 3.5 m during the second (Tables 4.7 and 4.8). Stream aesthetics remained similar between surveys (Tables 4.9 and 4.10). Aquatic vegetation was absent, algae was rare and no odor was detected. The color of the water changed from clear to brown between the first and second surveys, respectively. The bottom deposit was primarily solids in the form of gravel. The water surface was clear during the first survey but developed a scum/foam layer at the second survey.

Evidence of wildlife was seen during the two surveys (Tables 4.9 and 4.10). Tadpoles and clams were encountered. Tracks of feral hog, deer, canine, and raccoon were observed as well as feral hog wallows and a wildlife trail leading from the banks into the creek (Figure 4.30). Bird droppings were also seen in the stream. Garbage in the stream appeared more abundant during the first survey than the second. During the first survey, many tires were seen in the creek. Other garbage was rare but included broken glass, glass bottles, jars, tire tubes, plastic pipes, and plastic buckets.



Figure 4.30 Photograph of Choctaw Creek at Site CH11, taken July 12, 2014. Feral hog wallow.

A deer blind and a deer feeder were set up approximately 100 m from the entry point of the riparian area that let down to the creek. During the first survey, two people were encountered near the stand and feeder who said they were about to hunt feral hogs. An interview was conducted. No evidence of any other human recreation was observed at this site.

Physical Description of CH12

Choctaw Creek at Site CH12 was surveyed May 17 and July 12, 2014. Access to this site was public at the highway bridge crossing; however, safe parking was not available on the shoulder or highway right of way. TIAER personnel were required to request permission from the business whose property bordered the creek on one side to park on their premises. The closest available parking was approximately 100 m away. Furthermore, access down into the creek at the bridge was difficult due to steep, densely vegetated banks and large flood debris accumulated at the bridge (Figure 4.31 and Table 4.5). Travel in the creek was moderately easy once upstream from the bridge. Dominant substrate was mud/clay and gravel (Table 4.5). The banks were steep and densely forested, included poison ivy in the understory, but opened up to improved pasture beyond the riparian area. Two more log obstructions were encountered in addition to the debris at the bridge.

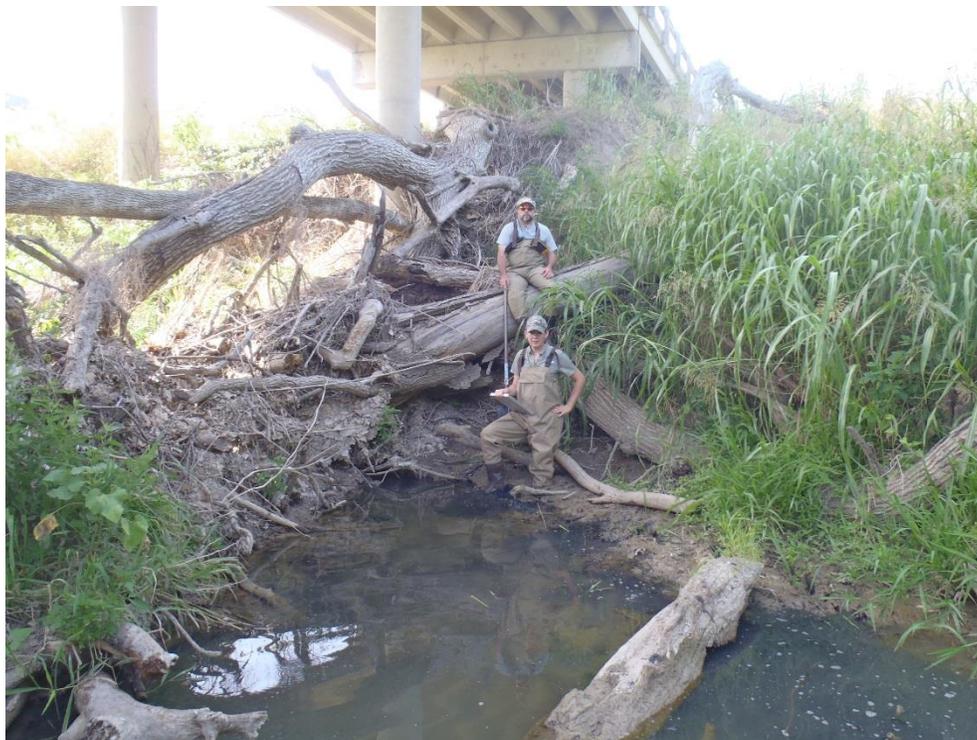


Figure 4.31 Photograph of Choctaw Creek at Site CH012, taken July 12, 2014. Right bank view at the 0-m transect. TIAER personnel in photo.

Choctaw Creek at this site was wadeable during both surveys with an average thalweg of 0.5 m (Table 4.6). Observed flow during the first survey appeared high but appeared low during the second. Maximum width was measured at the first survey and was 12 m with a typical width of 4 m (Tables 4.7 and 4.8). Maximum width during the second survey was 7.5 m with a typical width of 3.5 m (Table 4.8). Aesthetics of the stream during the two surveys is outlined in Tables 4.9 and 4.10. During the first survey, aquatic vegetation was rare, algae cover was commonly observed, and an odor was commonly detected. The water's color was clear with a green tinge and the surface was clear. During the second survey, aquatic vegetation was absent, algae cover was still common, and the odor had become abundant. The color of the water had become greenish brown and black in some places. The surface of the water had also developed foam and scum. The bottom deposits were fine sediment and sludgy during both surveys.



Figure 4.32 Photograph of Choctaw Creek at Site CH12, taken May 17, 2014. Upstream view at the 300-m transect.

Indications of wildlife presence were observed at this site. Small fish, frogs, turtles, crawfish, vultures roosting in the trees, and snakes were encountered. Tracks of raccoon, feral hog, and canine were seen in addition to crawfish burrows, beaver dams, slides, and gnawed trees. Garbage in general was rare at this site; however, large garbage appeared common during the second survey and included primarily tires and scrap metal (Tables 4.9 and 4.10). Smaller garbage was seen in the channel and the banks, which included glass bottles, aluminum cans, Styrofoam, and other plastics. No evidence of human recreation was observed at this site.

Physical Description of CH13

Choctaw Creek at Site CH13 was surveyed on May 17 and July 12, 2014. Access to this site was public at the road crossing and adequate parking existed near the site. However, entering the creek was difficult due to almost vertical banks at the bridge and private property fencing disallowing along-bank access (Table 4.5). Once in the stream bed, the observed dominant substrate was gravel, making travel down the creek easy. Both banks were forested and, on the right bank, opened up to improved pastures beyond. A railroad bridge crossed the creek at approximately the 150-m transect.



Figure 4.33 Photograph of Choctaw Creek at Site CH13, taken July 12, 2014. Upstream view at the 150-m transect.

This site was wadeable during both surveys. Average thalweg depths were 0.3 m during the first survey and 0.0 m during the second. Only one transect had a measureable amount of water during the second survey (Table 4.6). Observed flow during the first survey appeared high and did not flow during the second. Widths at this site were as wide as 10 m during the first survey with a typical width of 1 m. During the second survey, the widest width was 2.5 m but the typical width was 0 m (Tables 4.7 and 4.8). Stream aesthetics appeared different from one survey to the next (Tables 4.9 and 4.10). During the first survey, aquatic vegetation and algae cover were common but were absent during the second survey. The water's color changed from clear to brown between the first survey and the second. Bottom deposits remained predominantly gravel with some fine sediment during both surveys as well. Clear water surfaces present during the first survey had developed a scum in places by the second.

Wildlife and wildlife signs were observed at this site (Tables 4.9 and 4.10). Frogs, minnows, tadpoles, snake, crawfish, and a dead vulture were encountered in the stream. Tracks of raccoon, deer, canine, bird, and heron were seen. Fecal material of cattle and bird were observed in the stream as well as crawfish burrows. Garbage in general was rare at this site. Most garbage was found near the bridge crossing (Tables 4.9 and 4.10). Glass bottles, aluminum cans, paper, and Styrofoam were some of the small garbage observed in the stream. A disintegrating bag of household garbage was observed near the bridge. Larger garbage included some tires and scrap metal. No evidence of human recreation was observed at this site.

Physical Description of CH14

Choctaw Creek at Site CH14 was surveyed on May 17 and July 12, 2014. This site was on private property and access was difficult because private property fencing was built up to meet the sides of the bridge creating a barrier to public access from the roadside. Safe, nearby parking was not available and parking on the road was the only option. Additionally, the banks at the bridge were almost vertical with poison ivy growing on them, contributing to the difficulty of entering the streambed. Once in the creek walking was easy (Figure 4.34). The primary substrate was gravel and the forested corridor was wide enough so that it did not interfere with travel through the channel (Table 4.5). Water was scarce during both surveys and large fallen trees created obstructions across the creek (Figure 4.35).



Figure 4.34 Photograph of Choctaw Creek at Site CH14, taken May 17, 2014. Upstream view at the 0-m transect.

This site was wadeable with average thalweg depths of 0.3 m during the first survey and 0.0 m during the second (Table 4.6). Observed flow appeared low during the first survey and had a designation of “no flow” during the second survey. Typical width during the first survey was 2.5 m and 0 m during the second (Tables 4.7 and 4.8). Stream aesthetics are outlined in Tables 4.9 and 4.10. During the first survey, aquatic vegetation and algae cover appeared common and the color of the water was clear. During the second survey, aquatic vegetation was absent, algae remained common, a rarely detected odor had developed and the color of the water had become green. The creek bottom was a fine sediment sludge mixed in with gravel. While the water’s surface was clear during the first survey, a scum had developed at the time of the second survey.



Figure 4.35 Photograph of Choctaw Creek at Site CH14, taken May 17, 2014. Log obstruction.

Wildlife presence was detected at this site and included tadpoles, clams and crawfish. Raccoon, canine, cattle, and feral hog tracks were encountered. Fecal material of cattle, raccoon, and bird were also seen. Other evidence of wildlife included a trail leading down the bank in the creek at the 30-m transect. Garbage in general was rare at this site. Some scattered smaller garbage such as aluminum cans, and plastic and glass bottles were found in the stream. Other garbage encountered included tires, bricks, scrap metal, and a can of paint (Tables 4.9 and 4.10). No evidence of human recreation was observed at this site.

Physical Description of CH15

Choctaw Creek at Site CH15 was surveyed on May 17 and July 12, 2014. This site existed on private property and required landowner permission to access the site. Driving through the property down to the site was easy, however getting down into the stream was moderately difficult as the banks were slick and densely vegetated. Some sections of the creek at this site had steep, denuded banks as well. The primary substrate of the stream bottom was muddy clay with some gravel. Banks were forested and shrub dominated on both sides but opened up to pasture on the right bank (Table 4.5). A species of locust tree dominated the banks and upper pasture areas. This tree has large thorns, which makes walking through dense stands of them hazardous. A water gap at the landowner's eastern fence line existed across the creek (Figure 4.36). This water gap was constructed of a cable spanning the creek with sheets of corrugated metal fixed to it, hindering downstream access.



Figure 4.36 Photograph of Choctaw Creek at Site CH15, taken May 17, 2014. Downstream view at 0-m transect. Note water gap.

This site was wadeable during both surveys with average thalweg depths of 0.6 m during the first survey and 0.2 m during the second survey (Table 4.6). Low flow was observed during the first survey and no flow was observed at the second (Tables 4.7 and 4.8). The typical width during the first survey was approximately 1.5 m. During the second survey, five of the eleven transects had no water. Transects that did have water had typical widths of approximately 3 m. One pool was observed between the 120-m and 150-m transects during the second survey. This pool measured 20 m long, 7 m wide and 0.6 m deep. The aesthetics of the stream differed from the first survey to the second (Tables 4.9 and 4.10). Aquatic vegetation, algae cover and odor were rare during the first survey. However, during the second survey, aquatic vegetation was absent and algae cover had become more common. The water turned from brown during the first survey to green during the second. Bottom deposits detected during the first survey were solids, but a fine sediment was more detectable during the second survey. Moreover, while the surface of the water was clear during the first survey, it had developed a scum and foam during the second survey.



Figure 4.37 Photograph of Choctaw Creek at Site CH15 taken July 12, 2014. Downstream view at 300-m transect.

Wildlife evidence was observed during both surveys. Crawfish and clams were encountered in the creek as well as tracks of raccoon, cattle, canine, turtle, and bird. A livestock trail was also observed bisecting the creek. Garbage in general was rare at this site. Garbage observed included aluminum cans, glass bottles, foam, plastic, and some large scraps of metal. No evidence of human recreation was observed at this site.

Physical Description of CH16

Choctaw Creek at Site CH16 was surveyed on May 16 and July 11, 2014. Access off the road crossing was public and parking was adequate a few meters from the crossing. However, a private property fence connected to a water gap spanning the channel existed, requiring landowner permission to cross in order to complete the surveys. This made accessing the creek difficult in addition to thick vegetation encroaching on the channel (Tables 4.5 and 4.6). Banks were densely forested with some steeply sloping on the cut bank side. Vegetation along the corridor was dense and non-aquatic plants, such as grasses, saplings, small shrubs and poison ivy, grew in the streambed. The dominant substrate was mud/clay and rock with some large chunks of concrete near the road crossing. One logjam in the form of a fallen tree was encountered during the first survey at about the 120-m transect.



Figure 4.38 Photograph of Choctaw Creek at Site CH16, taken June 12, 2014. Downstream view at 150-m transect.

This site was wadeable during both surveys with an average thalweg depth of 0.3 m during the first survey and 0 m during the second (Table 4.6). No flow was observed during both surveys. The typical width during the first survey was approximately 5 m where water was encountered. Some water was encountered in small puddles during the second survey, but water was absent at all transects. Therefore, a typical width of 0 m was designated for this survey. Stream aesthetics changed little between surveys (Tables 4.9 and 4.10). During the first survey, aquatic vegetation appeared common while algae cover and odor were rare. During the second survey, aquatic vegetation and algae were absent while odor remained rare. The color of the water remained brown during both surveys and the surface was clear. The bottom deposits seemed to be a fine sediment during the first survey when more water was present, but appeared to be more solid during the second survey when water was scarce.

Evidence of wildlife was observed during both surveys (Tables 4.9 and 4.10). Frogs, tadpoles, and water dependent birds were encountered. Fish carcasses that appeared to have been cleaned then dumped were observed at the crossing (Figure 4.39). Tracks of raccoon, armadillo, feline, and canine were observed in the mud, while fecal materials from birds, feline, and canine were also seen in the creek. Garbage in general was rare at this site, although some was seen, primarily near the road crossing. Aluminum cans, plastics and glass bottles were among the smaller garbage. A bag of household garbage was also seen near the bridge in addition to a plastic candy cane Christmas decoration. A 6-foot locker partially buried in the creek's mud was the only large garbage encountered in the stream at this site. No evidence of human recreation was observed at this site.



Figure 4.39 Photograph of Choctaw Creek at Site CH16, taken July 11, 2014. Fish carcasses at road crossing.

Physical Description of CH17

Choctaw Creek at Site CH17 was surveyed on May 16 and July 11, 2014. Access to this site was public only at the bridge. Private property fences existed on both sides of the road crossing requiring landowner permission to cross over onto private property to complete the surveys. The barbed wire fencing was loose so crossing between strands of wire was possible making access moderately easy. Once in the stream, walking through it was easy. This upstream-most portion of the creek is ephemeral as it primarily looks like a dry gully cutting through the edge of a pasture. Banks were cut and eroding in places but gently sloping in others. Some large elm and hackberry trees lined this part of Choctaw Creek, but improved pastures existed almost right up to the creek's edge. No well-defined riparian area existed at this site and some of the pasture grasses grew down into the channel. A few logjams were encountered along the narrow channel (Figure 4.40).



Figure 4.40 Photograph of Choctaw Creek at Site CH17, taken May 16, 2014. Upstream view at the 0-m transect.

This site was wadeable. Average thalweg depth during the first survey was 0.1 m and 0 m during the second (Table 4.6). No flow was detected during either survey (Tables 4.7 and 4.8). The widest width at the first survey was 7.4 m where water existed, but typical width was 0 m. The widest width at the second survey was 1 m where water was encountered, but typical width was 0 m. Aquatic vegetation and algae cover were absent at both surveys. Where water was encountered, an odor was rarely detected only during the second survey. The water's color was brown during both surveys and the bottom deposits were solids. A scum was detected on the water's surface during the first survey but was clear during the second.

Evidence of wildlife was encountered at this site including frogs and tracks of canine and raccoon. A livestock crossing was observed along with cow tracks and manure. Bird droppings were also seen in the creek in addition to some pieces of clamshells. Garbage in general was rare at this site (Tables 4.9 and 4.10). Aluminum cans, Styrofoam cups, paper cups, plastics, and glass was occasionally found at this site. No evidence of human recreation was observed at this site.

Observation and Interviews

Activities Observed

During each RUAA survey, field personnel visited the sites on days and during times when recreational activities were more likely to be observed. Fourteen of the seventeen selected sites were at road crossings that provided public access, although only at the bridge that crosses the

stream. The remaining three sites were located on private property and TIAER personnel were granted permission from the landowners to conduct the RUAA at these locations.

No contact (primary or secondary) or noncontact recreational activities were observed by TIAER employees at any of the sites during the field surveys. Signs of recreation were observed at Site CH01. A well-defined footpath led from the road at the bridge down to the water. TIAER personnel found fish bait packaging on the banks as well as piles of beer cans next to a small pile of ashes that appeared to have been a campfire. Trotlines were also seen tied to tree limbs and log debris in the stream. No evidence of recreation was found at any of the other sites.

Activities Interviewed

Interviews were conducted with landowners along Choctaw Creek as well as other persons of interest. A total of ten interviews were collected. According to interviews conducted, there were no accounts of swimming, adults wading or children wading (Table 4.11). Albeit prior to 1970, an interview for site CH02 did indicate having heard of these three activities in addition to hunting, fishing and boating. Since they occurred prior to 1975, these activities were not reported in the interview table below and not considered viable for the RUAA.

One interview indicated having perceived hunting along the creek in general. An interview for CH11 also indicated perceived hunting and that they had hunted at this site. Two counts of fishing were indicated by two interviews describing the creek in general and one interview referencing CH01 indicated having seen and heard of boating taking place. Two landowners indicated that during times of higher water levels, such as after a rain or when the Red River was elevated, boaters were seen near Sites CH01 and CH02. They indicated that these boaters would deploy their boats on the Red River then move upstream into Choctaw Creek. Hunting the creek bed for prehistoric shark's teeth was referenced multiple times in conversations with locals and in interviews. One interview referencing CH01 indicated having participated in hunting shark's teeth in the creek and hearing of this activity occurring. Another interview, referencing the creek in general, also indicated seeing and hearing of hunting for shark's teeth in the creek.

Table 4.11 and Figure 4.41 summarize the types of recreation indicated from interviews.

Table 4.11 Summary of interviews from Choctaw Creek.

Activities are listed as the number of times personal use, observed use, or heard of use was documented from interviews for a given location or general to the assessment unit. Blank cells indicate no interviewed feedback for that location.

Site Name	Number of Interviews	Swimming	Adult Wading	Children Wading	Hunt	Fish	Boat , Canoe, Kayak	Hunting Shark Teeth ^a
CH01	2						0,1,1	1,0,1
CH02	1							
CH03								
CH04								
CH05								
CH06								
CH07								
CH08								
CH09	1							
CH10								
CH11	1				1,0,1			
CH12								
CH13								
CH14								
CH15								
CH16	1							
CH17	2							
General AU	2				0,0,1	2,0,0		0,1,1
Totals	10				1,0,2	2,0,0	0,1,1	1,1,2

^aThis column was added because this activity was reported numerous times among interviews and appears to be unique to Choctaw Creek

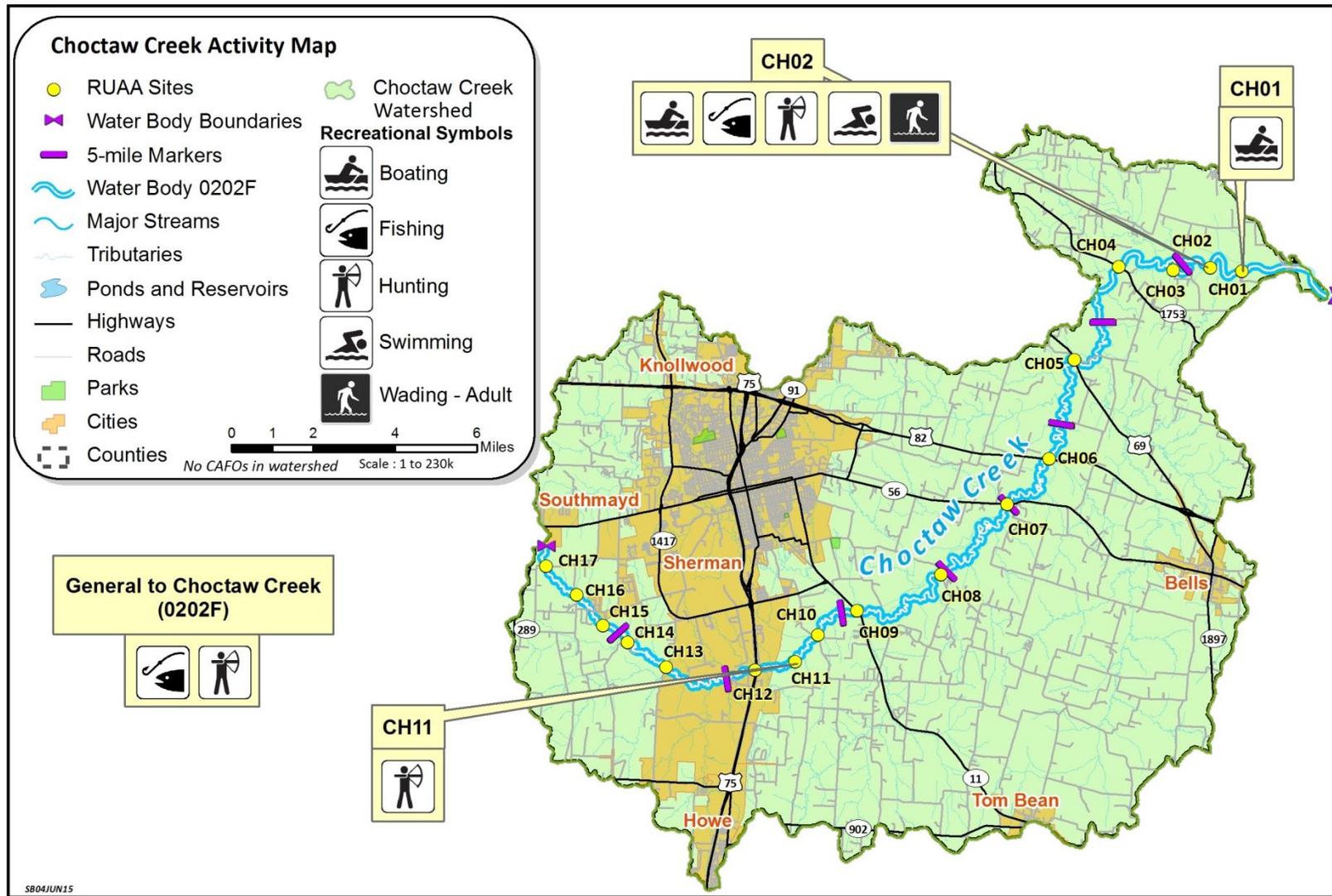


Figure 4.41 Summary of observed and interviewed human activities on Choctaw Creek.

Summary

RUAA surveys were conducted at seventeen sites along Choctaw Creek (0202F) on the days of May 16 -18, 2014 and July 11 -13, 2014. Temperatures were above 21°C (70°F) during the 30 days prior to each survey. During the two surveys, there were no recreational activities observed by TIAER field staff. The Palmer Drought Severity Index (PDSI) represented moderate drought conditions during the first survey in May 2014 and mild drought conditions during the second survey in July 2014 (TWDB, 2014).

Recreational activities were not observed by TIAER field staff during either of the surveys. Additionally, there were no non-contact recreational activities observed during either survey. Recreational activities reported by interviewees are summarized in Figure 4.33 and the overall RUAA findings are summarized in the form below.

While conducting the stream surveys, no characteristics, such as boat docks, parks, playgrounds, biking trails, campgrounds, or sports fields, were encountered that would promote recreation.

RUAA Summary

Name of water body: Choctaw Creek

Segment No. of Nearest Downstream Segment No.: 0202

Classified?: No

County: Grayson

1. Observations on Use

a. Do primary contact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

b. Do secondary contact recreation 1 activities occur on the water body?

frequently seldom not observed or reported unknown

c. Do secondary contact recreation 2 activities occur on the water body?

frequently seldom not observed or reported unknown

d. Do noncontact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

2. Physical Characteristics of Water Body

a. What is the average thalweg depth? 0.643 meters

b. Are there substantial pools deeper than 1 meter? Yes No

c. What is the general level of public access?

easy moderate very limited

3. Hydrological Conditions of site visits (Based on Palmer Drought Severity Index)

Mild-Extreme Drought

Incipient dry spell

Near Normal

Incipient wet spell

Mild-Extreme Wet

Chapter 5

Bois D' Arc Creek (0202A)

Watershed Characteristics

The Bois D' Arc Creek watershed covers 272,000 acres and encompasses the cities of Bonham (estimated population 10,005), Whitewright (estimated population 1,612), and Dodd City (estimated population 368), and portions of the cities of Windom (estimated population 198), Honey Grove (estimated population 1,674), and Trenton (estimated population 635) (Figure 5.1). Bois D' Arc Creek is a tributary of the Red River and flows about 68 miles from Whitewright, in Grayson County, to the confluence with the Red River at the Fannin/Lamar County line. The soils directly surrounding Bois D' Arc Creek are clayey and loamy, with moderately alkaline soils on flood plains (Source USDA, 2001).

The Bois D' Arc Creek watershed lies within the Texas Blackland Prairie (35b) ecoregion (Griffith, et al., 2007). Average rainfall for the region is 44 inches, annually (U.S. Climate Data – Bonham, Texas 2015). Mean, minimum, and maximum temperatures for the region range from 31 to 52degrees Fahrenheit in January and 72 to 94degrees Fahrenheit in July (U.S. Climate Data - Bonham, Texas, 2015). The Bois D' Arc Creek watershed is primarily rural with 36 percent herbaceous cover and roughly 20 percent deciduous forest (Figure 5.2). About 12 percent of the watershed is comprised of cultivated cropland, most of which is found in the western portion of the watershed. Developed land occurs primarily around the City of Bonham and comprises about 6 percent of the total watershed area (Figure 5.2). There are three lakes within the Bois' D Arc Creek watershed none of which are directly on water body 0202A (Figure 5.1). The watershed includes Bonham State Park and a small park within the City of Bonham neither of which is directly along Bois D' Arc Creek. A major feature along the creek is the Caddo National Grasslands. The Caddo National Grasslands are located in Fannin County and comprise two units, the 13,360 acre Bois D' Arc Creek Unit, which contains both Coffee Mill Lake and Lake Crockett, and the 2,780 acre Ladonia Unit to the northeast. Both units are largely located within the watershed, although a small portion of the Bois D' Arc Creek Unit is located outside the watershed to the north. The Bois D' Arc Creek Unit has a more diversified habitat with the two lakes and supports camping, hiking, hunting, and boating. The Ladonia Unit is used mainly for hunting of white-tailed deer, squirrels, and waterfowl.

Designated Uses, Impairments and Concerns

Bois D' Arc Creek has two assessment units, 0202A_01 and 0202A_02. Both assessment units are classified as perennial (TCEQ, 2013). Bois D' Arc Creek has presumed uses of primary contact recreation, general use, and fish consumption with a limited aquatic life use (TCEQ 2013). The water body was first listed impaired for bacteria on the 2010 Texas 303(d) list. No other impairments or concerns are noted for Bois D' Arc Creek.

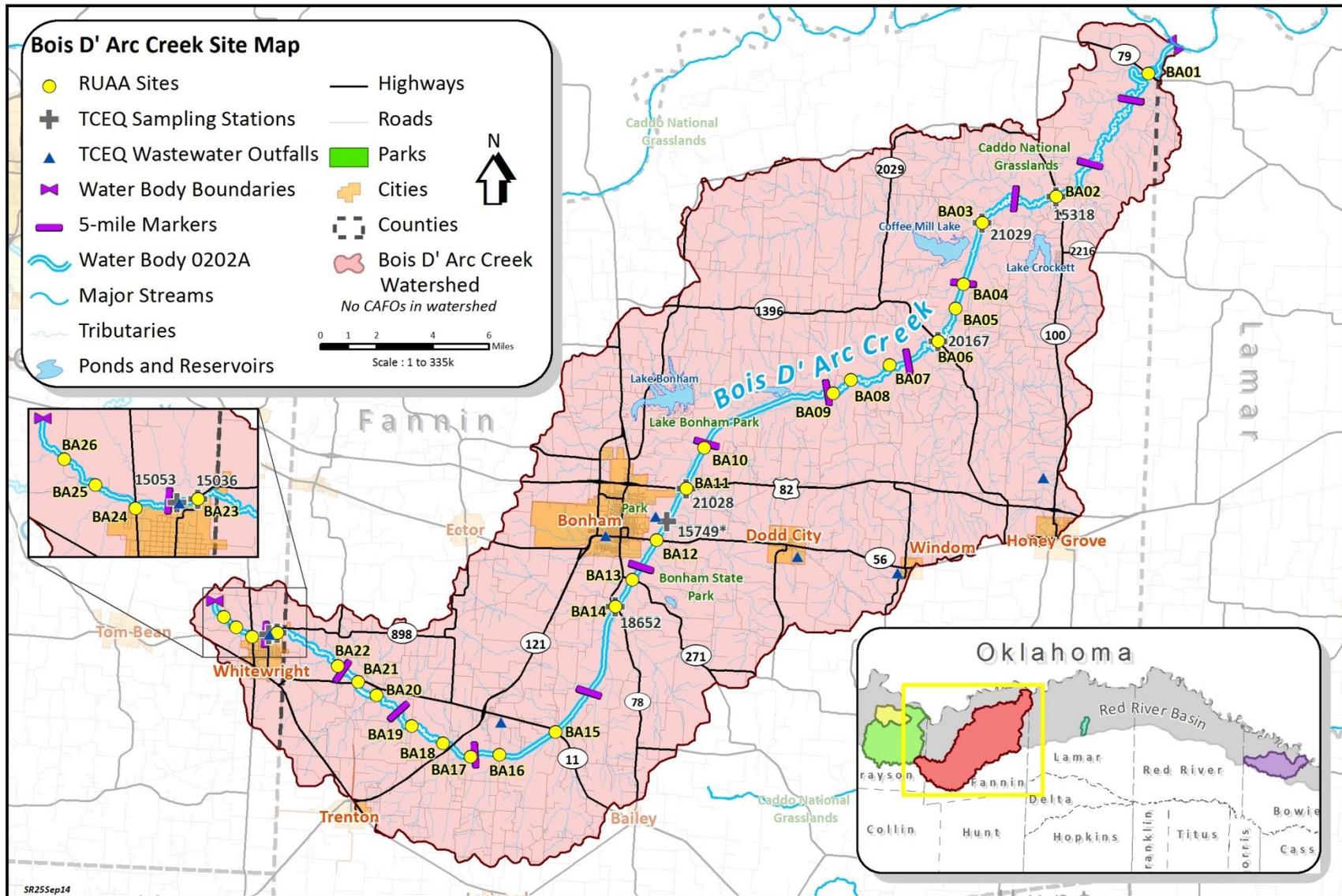


Figure 5.1 Overview of Bois D' Arc Creek watershed and RUAA sites.

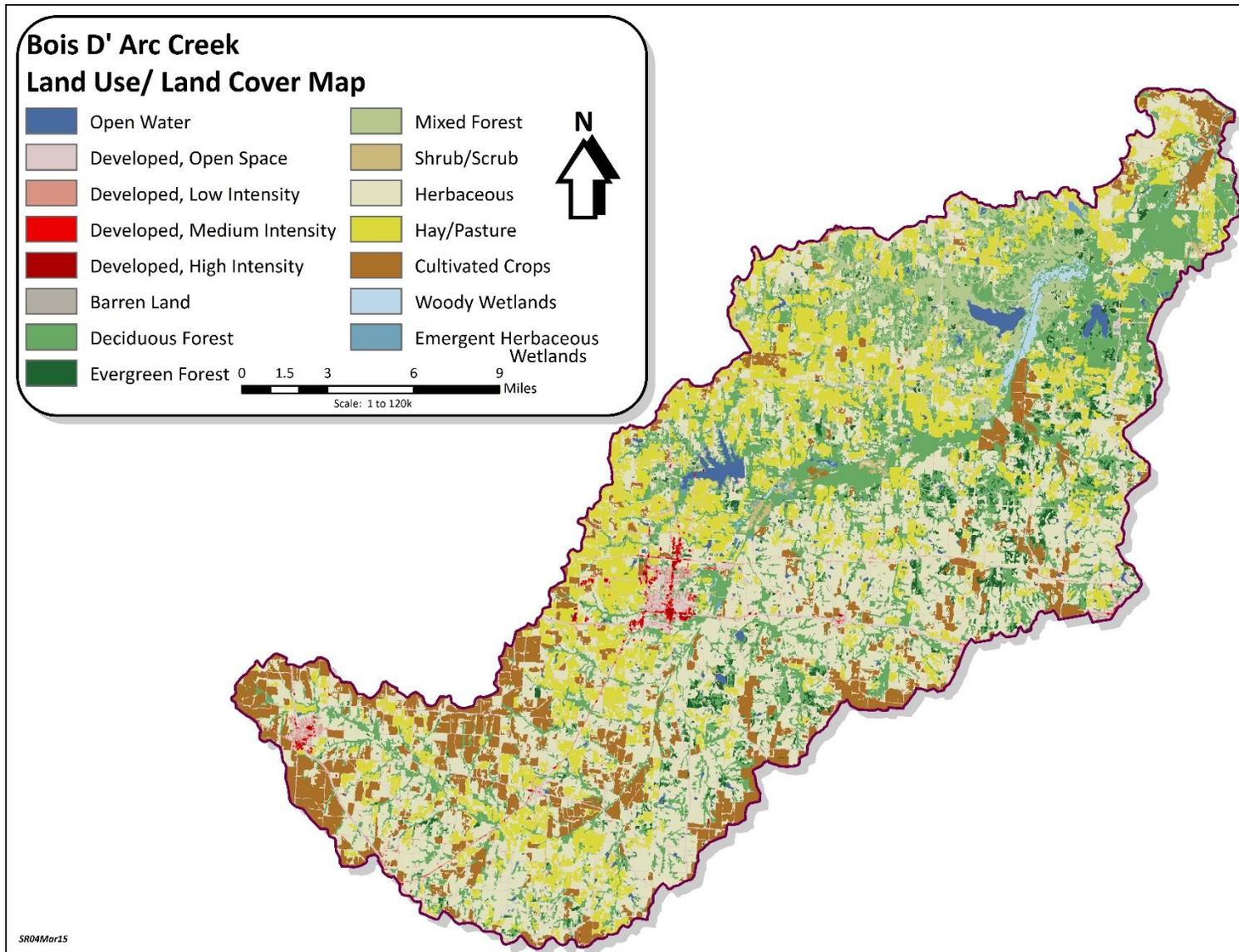


Figure 5.2 Land use/land cover for the Bois D' Arc Creek watershed. Source: 2006 National Land Cover Database (USGS, 2014).

Permitted Discharges

There are six municipal, permitted wastewater treatment facilities (WWTFs) within the Bois D' Arc Creek watershed. The City of Whitewright WWTF and the Randolph Water Supply Corporation WWTF discharge directly into Bois D' Arc Creek, while the other four discharge into creeks or tributaries that then flow into Bois D' Arc Creek.

The City of Whitewright WWTF (TX0033294) has a permitted average daily flow of 0.627 MGD. The Whitewright WWTF is located at 810 ½ North Bond Street, approximately one block west of the intersection of Farm-to-Market Road 898 and MK&T Railroad, north of the City of Whitewright in Grayson County, Texas. The Randolph Water Supply Corporation WWTF (TX0027928) is located on Farm-to-Market Road 896, 0.5 mile south of State Highway Business 121 in Fannin County, Texas and has a permitted average daily flow of 0.0218 MGD. Both of these wastewater treatment facilities discharge directly into Bois D' Arc Creek.

The largest permitted discharge is the City of Bonham WWTF with a permitted average daily flow of 2.5 MGD. The City of Bonham WWTF (TX0021814) is located approximately 0.5 mile east of the City of Bonham on Seven Oaks Road in Fannin County, Texas. The discharge from this WWTF flows into Pig Branch of Bois D' Arc Creek.

The City of Dodd WWTF (TX0057169) is located 2,200 feet southwest of the intersection of State Highway 897 and U.S. Highway 82, and approximately 2,500 feet southeast of the intersection of U.S. Highway 82 and Farm-to-Market Road 2077, Southeast of Dodd City in Fannin County, Texas. The City of Dodd WWTF has a permitted average daily flow of 0.048 MGD and discharges into an unnamed tributary that flows into Bullard Creek and then into Bois D' Arc Creek.

The Town of Windom WWTF (TX0072711) is located east of Burnett Creek about 1,000 feet west of Wall Street and approximately 0.25 mile southwest of the intersection of Texas State Highway 56 and Farm-to-Market Road 1743 in Fannin County, Texas. The Town of Windom WWTF has a permitted average daily flow of 0.032 MGD and discharges into an unnamed tributary that flows into Burnett Creek and then into Bois D' Arc Creek.

The City of Honey Grove WWTF (TX0117951) is located approximately 2,000 feet west from Farm-to-Market Road 100 and approximately 3,000 feet north of U.S. Highway 82 in Fannin County, Texas. The City of Honey Grove WWTF has a permitted average daily flow of 0.5 MDG and discharges into Honey Grove Creek, which then flows into Bois D' Arc Creek.

Bonham Concrete (TXG111177), located at 835 W Sam Rayburn Drive in Bonham, Texas has a general permit for minor discharge. It does not directly discharge into Bois D' Arc Creek and discharges into Powder Creek, which then flows into Bois D' Arc Creek.

There are no concentrated animal feeding operation (CAFO) within the Bois D' Arc Creek watershed, although a cattle feedlot, which now has a cancelled permit, was located in the northeastern part of the watershed.

Non-Permitted Agricultural Activities and Domesticated Animals

Activities such as livestock grazing close to water bodies and agricultural use of manure as fertilizer can contribute bacteria to nearby water bodies. To provide an estimate of livestock densities in the watershed, livestock statistics were obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service website from the 2012 survey (USDA, 2012). These statistics, on a county level, indicate large numbers of beef cattle in Fannin, Grayson, and Lamar Counties, and, thus, likely within the watershed area.

Table 5.1 Estimated livestock numbers within the Bois D' Arc Creek watershed based on statistics for adjusted for the percent of the county within the watershed (Source USDA, 2012).

Bois D' Arc Creek watershed, in its entirety, covers less than 1% of Grayson and Lamar Counties and about 46% of Fannin County.

County	Year	Cattle & Calves (all beef)	All Goats	Mules, Burros, & Donkeys	Horses & Ponies	Hogs
Fannin	2012	71,809	3,958	683	3,161	485
Grayson	2012	45,912	4,679	683	5,044	745
Lamar	2012	77,045	1,548	293	2,609	197
Bois D' Arc Creek Watershed Average	2012	33,610	1,871	322	1,513	231

Domestic pets are another unregulated source of *E. coli* bacteria, particularly dogs, because storm runoff often carries these wastes into streams (EPA, 2009). Assuming a rough estimate of 0.584 dogs per household (AVMA, 2012) and about 9,000 households within the Bois D' Arc Creek watershed based on 2010 census population data, there are potentially about 5,260 dogs within the Bois D' Arc Creek watershed. Other domestic animals, such as outdoor cats, can also contribute to bacterial pollution; however, cat populations are difficult to estimate because in many rural areas cats are often feral.

Wildlife and Feral Hogs

Other possible bacteria contributors include wildlife, such as deer, feral hogs, and birds. In 2013 statewide population estimated roughly 39 whitetail deer per 1,000 acres. This estimation suggests that the population for whitetail deer in the Post Oak Savannah region is roughly 400,000 deer, or 35 deer per 1,000 acres (Cain, 2014). Feral hogs are an invasive species commonly found throughout Texas. They have been known to travel in large groups along waterways and congregate near shallow depressions of water. Statewide feral hog densities range from an estimated average of 1.33 to 2.45 feral hogs per square mile (AgriLife, 2011).

Failing On-Site Sewage Facilities

Septic systems or on-site sewage facilities (OSSFs) are often used in rural areas that do not have the ability to connect to a central wastewater collection system. To estimate the number of potential OSSFs in the watershed, a GIS layer associated with the sewer Certificates of Convenience and Necessity (CNNs) from the Public Utility Commission of Texas was used. As not all cities with WWTFs have CNNs, the CNN layer was supplemented with a GIS layer representing municipal boundaries for those cities with WWTFs. Population data from the U.S. Census Bureau (USCB) were then overlaid masking out areas that should be serviced by WWTFs. Of the 9,000 households in the Bois D' Arc Creek watershed, 58% were indicated as outside of municipal areas serviced by WWTFs and, thus, likely on septic systems.

Historical Review

A review of historical information regarding recreational use of Bois D' Arc Creek was conducted. The review considered the time period of November 28, 1975 to the present in accordance with 40 CFR Part 131 (EPA standards regulation). Government offices, libraries, historical societies, and newspapers were searched and contacted in addition to generic internet searches. The following is a summary of the review.

Government Sources

City of Bonham

[City of Bonham Homepage²⁸](#)

Nothing of significance was found pertaining to the historical use of Bois D' Arc Creek.

City of Whitewright

[City of Whitewright Homepage²⁹](#)

Nothing of significance was found pertaining to the historical use of Bois D' Arc Creek.

City of Honey Grove

[City of Honey Grove Homepage³⁰](#)

Nothing of significance was found pertaining to the historical use of Bois D' Arc Creek.

City of Windom

[City of Windom Homepage³¹](#)

Nothing of significance was found pertaining to the historical use of Bois D' Arc Creek.

Library Sources

Bonham Public Library

[City of Bonham Public Library Homepage³²](#)

Phone: (903) 583-3128

Explored various links and online texts. Nothing pertaining to Bois D' Arc Creek was found.

Whitewright Public Library

[City of Whitewright Public Library Homepage³³](#)

Phone: (903) 364-2955

Explored various links and online texts. Nothing pertaining to Bois D' Arc Creek was found.

Bertha Coyer Memorial Library

[Bertha Coyer Memorial Library Homepage³⁴](#)

Phone: (903) 378-2206

Windom Public Library

[City of Windom Public Library Homepage³⁵](#)

Phone: (507) 831-6131

Explored various links and online texts. Nothing pertaining to Bois D' Arc Creek was found.

Newspaper Sources

Herold Democrat

[Herald Democrat Homepage³⁶](#)

Phone: (903) 893-8181

Explored various links and online texts. Nothing significant was found.

Van Alstyne Leader

[Van Alstyne Leader Homepage³⁷](#)

Phone: (903) 482-5253

Explored various links and online texts. Nothing significant was found.

The Fannin County Leader

[The Fannin County Leader Homepage³⁸](#)

Phone: (903) 583-3280

Explored various links and online texts. Nothing significant was found.

The Paris News

[The Paris News Homepage³⁹](#)

Phone: (903) 785-8744

Explored various links and online texts. Nothing significant was found.

Internet Searches

The Handbook of Texas Online

[The Handbook of Texas Online, Bois D' Arc Creek Article⁴⁰](#)

No significant information pertaining to the historical use of Bois D' Arc Creek was found.

Texas Parks and Wildlife

[Texas Parks and Wildlife, Caddo National Grasslands WMA Article](#)⁴¹

Information on the Caddo National Grasslands was found at this link.

²⁸ <http://cityofbonham.org/>

²⁹ <https://www.whitewright.com/>

³⁰ <http://www.cityofhoneygrove.org/>

³¹ <http://www.windom-mn.com/>

³² <http://www.bonhamlibrary.net/>

³³ <http://www.whitewright.lib.tx.us/>

³⁴ <http://www.honeygrovelibrary.org/>

³⁵ <http://www.windom-mn.com/city-facilities/windom-public-library/>

³⁶ <http://heralddemocrat.com/>

³⁷ <http://vanalstynelider.com/>

³⁸ <http://fannincountyleader.info/>

³⁹ <http://theparisnews.com/>

⁴⁰ <https://tshaonline.org/handbook/online/articles/rhb25>

⁴¹ https://tpwd.texas.gov/huntwild/hunt/wma/find_a_wma/list/?id=4

Survey Site Descriptions

Bois D' Arc Creek is just under 70 river miles long, indicating a goal of 41 sites (3 sites per 5 miles of river) for the RUAA survey (Figure 5.1). With the help of cooperating stakeholders, TIAER was able to establish 26 survey sites along Bois D' Arc Creek (Table 5.2). Of the 26 survey sites, 18 were publically accessible and did not require landowner permission to access the creek. Eight of the public survey sites were at road crossings where access to the creek was limited by private property fencing. At these eight sites, landowner permission was attained to conduct the entire 300 m survey. The remaining eight survey sites were located on private property where access was restricted by fences, locked gates, long distances from public roads, or required a landowner escort. The average distance between survey sites was 2.61 river miles and ranges from 10.34 to 0.77 miles. The largest gap between survey sites is 10.34 river miles between BA01 and BA02. RUAA surveys were performed June 16 -18, 2014 and August 8 - 10, 2014.

Table 5.2 Description and location of RUAA field survey sites for Bois D' Arc Creek (0202A).

TCEQ ID	Site ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi) ¹	Distance from Confluence (mi) ¹	Distance from Upper Reach (mi) ¹	Access
	BA01	Bois D' Arc at Highway 79	33.8236	-95.8611	NA	2.08	65.97	Public
15318	BA02	Bois D' Arc at FM 100	33.7588	-95.9159	10.34	12.42	55.63	Public*
21029	BA03	Bois D' Arc at FM 409	33.7442	-95.9609	5.27	17.69	50.36	Public
	BA04	Bois D' Arc on private property	33.7123	-95.9712	2.34	20.03	48.02	Private
	BA05	Bois D' Arc on private property	33.6997	-95.9759	0.91	20.94	47.11	Private
20167	BA06	Bois D' Arc at FM 1396	33.6825	-95.9861	1.97	22.92	45.14	Public
	BA07	Bois D' Arc on private property	33.6696	-96.0156	3.07	25.99	42.07	Private
	BA08	Bois D' Arc on private property	33.6614	-96.0391	2.6	28.59	39.46	Private
	BA09	Bois D' Arc at CR 2645	33.6541	-96.0499	1.17	29.76	38.29	Public*
	BA10	Bois D' Arc on private property	33.6241	-96.1281	5.41	35.17	32.88	Private
21028	BA11	Bois D' Arc at Highway 82	33.6028	-96.1383	1.6	36.78	31.28	Public
	BA12	Bois D' Arc at Highway 56	33.5758	-96.1558	2.12	38.89	29.16	Public
	BA13	Bois D' Arc at FM 271	33.5550	-96.1700	1.66	40.55	27.50	Public

TCEQ ID	Site ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi) ¹	Distance from Confluence (mi) ¹	Distance from Upper Reach (mi) ¹	Access
18652	BA14	Bois D' Arc at Highway 78	33.5409	-96.1799	1.14	41.70	26.36	Public
	BA15	Bois D' Arc at State Highway 11	33.4755	-96.2145	5.15	46.84	21.21	Public
	BA16	Bois D' Arc at CR 896	33.4626	-96.2485	2.27	49.11	18.94	Public
	BA17	Bois D' Arc on private property	33.4613	-96.2661	1.06	50.17	17.89	Private
	BA18	Bois D' Arc on private property	33.4678	-96.2833	1.26	51.43	16.63	Private
	BA19	Bois D' Arc at CR 4525	33.4761	-96.3029	2.35	53.78	14.28	Public*
	BA20	Bois D' Arc at CR 4510	33.4914	-96.3252	2.86	56.63	11.42	Public*
	BA21	Bois D' Arc at State Highway 11	33.4978	-96.3366	1.79	58.43	9.63	Public*
	BA22	Bois D' Arc at CR 4300	33.5057	-96.3494	2.01	60.44	7.61	Public
15036	BA23	Bois D' Arc at FM 898	33.5218	-96.3874	3.97	64.41	3.65	Public*
	BA24	Bois D' Arc at State Highway 69	33.5194	-96.4027	1.28	65.69	2.36	Public*
	BA25	Bois D' Arc on private property	33.5239	-96.4127	0.81	66.5	1.56	Private
	BA26	Bois D' Arc at FM 697	33.5290	96.42046	0.77	67.27	0.79	Public*

* indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property

¹ Distances were digitally estimated using the measuring tool in ArcGIS 9.3 with the 2010 NAIP 1-m DOQQs and the NHD stream layer as reference guides

Site BA01 is the most downstream site located on Bois D' Arc Creek at the Highway 79 Crossing, 2.08 miles from the confluence with the Red River. This site is publically accessible at the bridge with an earthen boat ramp leading down to the water.

Site BA02 is located on Bois D' Arc Creek, 12.42 miles from the confluence with the Red River, where FM 100 crosses the creek and is also a TCEQ sampling station (ID 15318). This site is publically accessible at the bridge only with a private property fence restricting further access.

Site BA03 is located on Bois D' Arc Creek, 17.69 miles from the confluence with the Red River, at where FM 409 crosses the creek and is also a TCEQ sampling station (ID 21029). The creek is publically accessible at the bridge. This portion of the creek runs through a public park, The Caddo National Grasslands. Besides the FM crossing, there are no other trails or roads leading down to the creek within the property boundaries.

Site BA04 is located on Bois D' Arc Creek on private property, 20.03 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate, and drive approximately 3.5 miles on private pasture road down to the site.

Site BA05 is located on Bois D' Arc Creek on private property, 20.94 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate, and drive approximately 3 miles on private pasture road down to the site.

Site BA06 is located on Bois D' Arc Creek, 22.92 miles from the confluence with the Red River, where FM 1396 crosses the creek and is also a TCEQ sampling station (ID 20167). Access to this site is public at the bridge crossing.

Site BA07 is located on Bois D' Arc Creek on private property, 25.99 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate and 2 interior pasture gates, approximately 1.5 miles to the site.

Site BA08 is located on Bois D' Arc Creek on private property, 28.59 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate, and drive approximately 2 miles on private pasture road down to the site.

Site BA09 is located on Bois D' Arc Creek where County Road 2645 crosses the creek, 29.76 miles from the confluence with the Red River. This site is publically accessible at the bridge only with a private property fence restricting further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site BA10 is located on Bois D' Arc Creek on private property, 35.17 miles from the confluence with the Red River. Access to this site require landowner permission, passage through a locked gate, down pasture roads into dense forest regrowth, approximately 1 mile to site.

Site BA11 is located on Bois D' Arc Creek, 36.78 miles from the confluence with the Red River, at the Highway 82 crossing, also a TCEQ sampling station (ID 21028). Access to this site is public at the bridge crossing.

Site BA12 is located on Bois D' Arc Creek at the Highway 56 crossing, 38.89 miles from the confluence with the Red River. Access to this site is public at the bridge crossing.

Site BA13 is located on Bois D' Arc Creek at the FM 271 crossing, 40.55 miles from the confluence with the Red River. Access to this site is public at the bridge crossing.

Site BA14 is located on Bois D' Arc Creek, 41.70 miles from the confluence with the Red River, at the Highway 78 crossing, also a TCEQ sampling station (ID 18652). Access to this site is public at the bridge crossing.

Site BA15 is located on Bois D' Arc Creek at the western crossing of State Highway 11, 46.84 miles from the confluence with the Red River. Access to this site is public at the bridge crossing.

Site BA16 is located on Bois D' Arc Creek at the County Road 896 crossing, 49.11 miles from the confluence with the Red River. Access to this site is public at the bridge crossing.

Site BA17 is located on Bois D' Arc Creek on private property, 50.17 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a locked gate and drive approximately 1 mile down a pasture road.

Site BA18 is located on Bois D' Arc Creek on private property, 51.43 miles from the confluence with the Red River. Access to this site required landowner permission to enter through a closed gate and drive approximately 0.5 mile down a pasture road.

Site BA19 is located on Bois D' Arc Creek at the County Road 4525/4515 crossing, 53.78 miles from the confluence with the Red River. This site is publically accessible at the bridge but private property fence restricts further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site BA20 is located on Bois D' Arc Creek at the County Road 4510 crossing, 56.63 miles from the confluence with the Red River. This site is publically accessible at the bridge but a private property fence restricts further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site BA21 is located on Bois D' Arc Creek at the eastern crossing with State Highway 11, 58.43 miles from the confluence with the Red River. This site is publically accessible at the bridge but a private property fence restricts further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site BA22 is located on Bois D' Arc Creek at the County Road 4300 crossing, 60.44 miles from the confluence with the Red River. Access to this site is public at the bridge crossing.

Site BA23 is located on Bois D' Arc Creek, 64.41 miles from the confluence with the Red River, at the FM 898 crossing, which is also a TCEQ sampling station (ID 15036). This site is publically accessible at the bridge crossing but with private property fence restricting further access.

Site BA24 is located on Bois D' Arc Creek at the State Highway 69 crossing, 65.69 miles from the confluence with the Red River. This site is publically accessible at the bridge but a private

property fence restricts further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site BA25 is located on Bois D' Arc Creek on private property, 66.5 miles from the confluence with the Red River. The private driveway crossed over the creek approximately 20 feet from the county road. Access to this site required landowner permission to enter property through a private entrance.

Site BA26 is located on Bois D' Arc Creek at the FM 697 crossing, 67.27 miles from the confluence with the Red River. This site is publically accessible at the bridge but a private property fence restricts further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Field Survey Results and Discussions

General Description of RUAA Survey Sites and Conditions for Bois D' Arc Creek (0202A)

The Bois D' Arc Creek RUAA surveys were conducted on June 16 - 18 and August 8 – 10 and 13, 2014. Surveys were not conducted at sites BA05 and BA25. Vegetation at Site BA05 during the dormant season reconnaissance visit allowed access down to the creek. However, upon onset of the growing season, the vegetation became too dense and completely obstructed access to the survey site. Therefore, no data were collected nor photos taken at Site BA05. Permission to access Site BA25 was initially granted by the landowner during a reconnaissance trip to the watershed. However, permission to access was rescinded during a courtesy phone call to the landowner before the first survey was conducted. Therefore, no data were collected nor photos taken at Site BA25. At sites BA10 and BA11, recent localized rainfall caused access points to become impassable during the second survey trip. A third visit to these sites was attempted on August 13, 2014 but conditions had not improved. During the August 13th visit to Site BA10 the field crew encountered thick vegetation after driving about a half mile into the property towards the creek. Since the first survey, giant ragweed and annual sunflower had become well established in a dense stand nearly 3 m high in an area of recently cleared forest. The previously used trail was not visible. There were concerns of possibly becoming stuck in the muddy holes, present from previous forest clearing, or driving off into dump sites because of the severely impaired ability to see the driving surface. Walking was considered potentially hazardous because a sounder of feral hogs was encountered during the reconnaissance visit and, according to local residents, regularly inhabit the Bois D' Arc Creek riparian corridor. Height measurements of the vegetation were taken in addition to photographs. A second survey of BA10 was not conducted. Observations and photos from the bridge crossing at BA11 were documented on August 10th and 13th. A second survey of BA11 was not conducted. The surveys conducted were performed on weekdays, weekends, or holidays at opportune times to observe recreational activities along Bois D' Arc Creek. Air temperatures prior to and during both the first and second surveys, were above 21degrees Celsius degrees Celsius (70degrees Fahrenheit degrees Fahrenheit) which is indicated by the RUAA guidelines as warm enough to promote recreational activities (Tables 5.3 and 5.4).

Due to the large size of this watershed (1,100 sq km, 426 sq mi, 272,000 sq acres) and a water body length of 68 miles, rainfall and temperature were highly variable. To address this, three weather stations were selected to represent rainfall and temperature data for the northern, central,

and southwest regions of the watershed. The Caddo weather station is located at the downstream-most region of Bois D' Arc Creek. The Bonham weather station represents the mid-section of the creek, and the Whitewright weather station represents weather conditions in the headwater region of the creek. Total precipitation for the 30 days prior to the first survey was 2.84 inches in Whitewright, 2.91 inches in Bonham, and 8.81 inches in Caddo. Rainfall totals for the 30 days prior to the second survey were 4.18 inches in Whitewright, 3.23 inches in Bonham, and 8.32 inches at the Caddo station. Temperature readings also varied some among weather stations with maximum temperatures ranging from 91degrees Fahrenheit to 94degrees Fahrenheit during the first survey in June and from 87degrees Fahrenheit to 104degrees Fahrenheit during the second survey in August (Tables 5.3 and 5.4).

A summary of the RUAA field survey results is presented in the following tables:

- Table 5.13 describes the stream channel and corridor characteristics at each site.
- Table 5.14 notes the average thalweg depth by site during each survey and the access to the stream, whether public or private, and the ease of bank access.
- Tables 5.7 and 5.8 document the maximum, minimum, and average stream widths at each site for each survey and observed flow conditions.
- Tables 5.9 and 5.10 note stream aesthetics, wildlife observations and tracks, and the presence of garbage observed at each site during each survey.

Physical descriptions of each site follow these tables along with selected photos showing notable characteristics of each site. Overall thalweg depth averaged 0.54 m during the first survey and 0.42 m during the second survey. Access to the stream was moderately difficult in most locations due to dense vegetation and steep banks. The dominant substrate was mud/clay, or had a mud/clay component, and the stream corridor was largely lined with trees and shrubs. The maximum stream width encountered was 20 m during the first survey in June 2014 and 18 m during the second survey in August 2014. Flow conditions were largely normal in June as noted at about 83% of sites visited. In August, only 59% of sites visited had normal flow conditions, and 41% of sites had low or no-flow conditions. The water surface was typically clear with some instances of foam, scum, or oil sheen. The water encountered was typically clear but occasionally appeared red, brown, or green. Tracks observed most often were birds, raccoon, deer, and livestock. Trash was predominantly plastics and aluminum cans and was most common at bridge crossings. Trash on private lands was rare and appeared to have washed in during high flow periods.

Table 5.3 Rainfall records with maximum and minimum temperature for the Bois D' Arc Creek watershed, 30 days prior to the first RUAA survey initiated on June 16, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Caddo, TX weather station ID MCDDT2, Bonham, TX weather station ID KTXBONHA1, and Whitewright, TX weather station ID KTXWHITE16.

Date	Caddo Daily Precip (in)	Bonham Daily Precip (in)	Whitewright Daily Precip (in)	Caddo Max Daily Temp (°F)	Bonham Max Daily Temp (°F)	Whitewright Max Daily Temp (°F)	Caddo Min. Daily Temp (°F)	Bonham Min. Daily Temp (°F)	Whitewright Min. Daily Temp (°F)
17-May-14	0.00	0.00	0.00	76	84	76	53	55	53
18-May-14	0.00	0.00	0.00	81	84	79	56	60	58
19-May-14	0.00	0.00	0.00	83	84	81	63	65	64
20-May-14	0.00	0.00	0.00	84	87	83	68	68	68
21-May-14	0.00	0.00	0.00	84	86	83	67	67	67
22-May-14	0.00	0.00	0.00	85	88	83	66	68	67
23-May-14	0.00	0.00	0.00	84	85	79	67	68	69
24-May-14	0.13	0.13	0.07	81	86	81	66	67	68
25-May-14	0.03	0.03	0.15	86	86	84	67	68	67
26-May-14	0.00	0.00	0.03	80	84	78	67	67	67
27-May-14	0.84	0.84	0.74	82	88	80	63	65	62
28-May-14	0.74	0.74	0.01	85	86	80	60	66	59
29-May-14	0.01	0.01	0.00	85	91	84	62	69	64
30-May-14	1.04	1.04	0.03	83	83	81	67	72	66
31-May-14	0.17	0.17	0.05	81	90	83	68	72	68
1-Jun-14	0.06	0.06	0.00	86	90	85	70	75	69
2-Jun-14	0.00	0.00	0.00	88	75	88	77	74	72
3-Jun-14	0.00	0.00	0.00	90	92	88	72	73	72
4-Jun-14	0.00	0.00	0.00	89	91	88	73	73	72
5-Jun-14	0.00	0.00	0.00	88	84	87	72	74	73

Date	Caddo Daily Precip (in)	Bonham Daily Precip (in)	Whitewright Daily Precip (in)	Caddo Max Daily Temp (°F)	Bonham Max Daily Temp (°F)	Whitewright Max Daily Temp (°F)	Caddo Min. Daily Temp (°F)	Bonham Min. Daily Temp (°F)	Whitewright Min. Daily Temp (°F)
6-Jun-14	0.02	0.02	0.00	87	84	87	72	74	73
7-Jun-14	0.01	0.01	0.00	93	76	95	73	76	75
8-Jun-14	0.32	0.32	0.13	85	90	88	65	75	66
9-Jun-14	1.47	1.47	1.31	79	84	82	64	67	63
10-Jun-14	0.03	0.03	0	83	87	82	64	62	63
11-Jun-14	0.00	0.00	0.00	90	95	88	61	65	62
12-Jun-14	0.8	0.8	0.23	84	85	82	68	69	68
13-Jun-14	0.06	0.06	0.00	87	95	86	64	68	66
14-Jun-14	0.00	0.00	0.00	88	91	87	71	71	71
15-Jun-14	0.00	0.00	0.00	89	92	88	74	75	74
16-Jun-14	0.00	0.00	0.00	91	93	91	74	77	74
17-Jun-14	0.00	0.00	0.00	91	94	90	75	76	75
18-Jun-14	0.08	0.00	0.09	90	94	91	75	75	74

Table 5.4 Rainfall records with maximum and minimum temperature for the Bois D' Arc Creek watershed 30 days prior to the first RUAA survey initiated on July 8, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Caddo, TX; weather station ID MCDDT2, Bonham, TX; weather station ID KTXBONHA1, and Whitewright, TX; weather station ID KTXWHITE16.

Date	Caddo Daily Precip (in)	Bonham Daily Precip (in)	Whitewright Daily Precip (in)	Caddo Max Daily Temp (°F)	Bonham Max Daily Temp (°F)	Whitewright Max Daily Temp (°F)	Caddo Min. Daily Temp (°F)	Bonham Min. Daily Temp (°F)	Whitewright Min. Daily Temp (°F)
9-Jul-14	0.01	0.00	0.00	92	99	93	76	75	75
10-Jul-14	0.01	0.00	0.00	95	100	94	74	73	73
11-Jul-14	0.00	0.04	0.00	96	99	94	77	74	74
12-Jul-14	0.00	0.00	0.00	98	102	97	72	71	71
13-Jul-14	0.00	0.00	0.00	101	105	100	73	72	74
14-Jul-14	0.00	0.00	0.00	96	100	98	79	77	77
15-Jul-14	0.00	0.00	0.00	89	92	87	66	68	70
16-Jul-14	0.00	0.00	0.00	87	93	87	56	59	60
17-Jul-14	3.38	1.53	1.86	72	93	75	63	72	63
18-Jul-14	0.04	0.00	0.01	69	90	70	62	69	61
19-Jul-14	0.04	0.00	0.00	76	78	75	66	71	65
20-Jul-14	0.02	0.00	0.01	86	88	85	65	70	64
21-Jul-14	0.00	0.00	0.00	91	97	91	68	72	69
22-Jul-14	0.00	0.00	0.00	92	98	92	72	73	72
23-Jul-14	0.84	0.00	0.00	95	99	92	69	72	71
24-Jul-14	0.84	0.00	0.00	91	96	90	68	72	69
25-Jul-14	0.00	0.00	0.00	95	100	95	71	73	70
26-Jul-14	0.00	0.00	0.00	96	101	96	76	74	75
27-Jul-14	0.00	0.00	0.00	99	106	101	78	76	76
28-Jul-14	0.00	0.00	0.00	91	95	88	71	75	76

Date	Caddo Daily Precip (in)	Bonham Daily Precip (in)	Whitewright Daily Precip (in)	Caddo Max Daily Temp (°F)	Bonham Max Daily Temp (°F)	Whitewright Max Daily Temp (°F)	Caddo Min. Daily Temp (°F)	Bonham Min. Daily Temp (°F)	Whitewright Min. Daily Temp (°F)
29-Jul-14	0.00	0.00	0.00	92	96	93	65	68	70
30-Jul-14	0.6	0.54	0.27	78	77	77	71	71	70
31-Jul-14	1.63	1.16	1.95	70	74	74	67	70	67
1-Aug-14	0.08	0.04	0.01	77	82	74	67	69	67
2-Aug-14	0.01	0.00	0.02	87	92	84	65	67	64
3-Aug-14	0.01	0.00	0.00	90	95	87	66	69	68
4-Aug-14	0.00	0.00	0.00	90	95	88	66	69	68
5-Aug-14	0.00	0.00	0.00	92	100	92	66	68	69
6-Aug-14	0.00	0.00	0.00	94	100	94	75	76	76
7-Aug-14	0.00	0.00	0.00	92	98	94	83	76	76
8-Aug-14	0.00	0.00	0.00	98	104	100	76	77	78
9-Aug-14	0.39	1.45	0.03	97	103	98	71	72	72
10-Aug-14	0.42	0.00	0.02	94	103	100	72	75	73
11-Aug-14	0.02	0.00	0.00	92	94	90	74	74	74
12-Aug-14	0.00	0.00	0.00	88	91	85	68	66	69
13-Aug-14	0.00	0.00	0.00	89	94	87	60	63	64

Table 5.5 Stream Channel and corridor characteristics for each site along Bois D' Arc Creek (0202A).

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
BA01	Natural	Silt/Mud/Clay/Bedrock	Forest/Pasture	Large	No	Native/Improved Pasture
BA02	Natural	Sand/Silt/Mud/Clay/Gravel	Forest/Shrub/Pasture	Large	Yes	Native/Improved Pasture
BA03	Natural	Mud/Clay/Gravel	Forest	Large	No	Native
BA04	Natural	Sand/Silt/Mud/Clay/Gravel	Forest	Large	No	Native
BA05	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹
BA06	Natural	Silt/Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture
BA07	Natural	Mud/Clay	Forest	Large	No	Native/Improved Pasture
BA08	Natural	Mud/Clay	Forest/Pasture	Large	No	Native
BA09	Natural	Silt/Mud/Clay	Forest/Pasture	Large	No	Native
BA10	Natural	Mud/Clay	Forest	Large	No	Native
BA11	Natural	Mud/Clay	Forest	Large	No	Native/Improved Pasture

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
BA12	Natural	Sand/Silt/Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture
BA13	Natural	Silt/Mud/Clay/Gravel	Forest/Pasture	Large	No	Native/Improved Pasture
BA14	Natural	Silt/Mud/Clay	Forest/Pasture	Large	No	Native/Crop/Improved Pasture
BA15	Natural	Cobble/Silt/Gravel	Forest/Pasture/Row Crops	Large	No	Native/Crop/Improved Pasture
BA16	Natural	Cobble/Silt/Gravel	Forest/Pasture	Large	No	Native/Crop/Improved Pasture
BA17	Natural	Mud/Clay/Bedrock	Shrub/Pasture	Large	No	Native/Improved Pasture
BA18	Natural	Cobble/Mud/Clay	Forest/Shrub/Pasture/ Row Crops	Large	No	Native/Improved Pasture
BA19	Natural	Silt/Mud/Clay/Bedrock	Forest/Pasture	Large	No	Native/Improved Pasture
BA20	Natural	Silt/Mud/Clay	Forest/Denuded/ Eroded Bank	Large	No	Native/Improved Pasture
BA21	Natural	Sand/Silt/Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture
BA22	Natural	Sand/Silt/Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
BA23	Natural	Sand/Silt/Mud/Clay/Gravel/Bedrock	Forest/Pasture/Denuded/Eroded Bank	Large	No	Native/Improved Pasture
BA24	Natural	Silt/Mud/Clay/Gravel	Pasture	Large	No	Native/Improved Pasture
BA25	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹	NA ¹
BA26	Natural	Silt/Mud/Clay/Gravel/Bedrock	Forest/Shrub/Pasture	Large	No	Native/Crop/Improved Pasture

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 5.6 Thalweg depth, stream flow type, and site accessibility during the two surveys of Bois D' Arc Creek (0202A).

Stream flow type represents conditions at the time of the survey. Stream flow type for Bois D' Arc Creek is classified as perennial based on TCEQ descriptions (TCEQ, 2014). Under general access, * indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property. For bank access, E = Easy, ME = Moderately Easy, MD = Moderately Difficult, and D = Difficult. NA indicates not applicable as the site was not surveyed due to lack of accessibility.

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
BA01	300	11	0	1.1	1.1	Perennial	Public	ME
BA02	300	11	0	1.0	0.4	Perennial	Public*	D
BA03	300	11	0	1.4	0.8	Perennial	Public	MD
BA04	300	11	0	0.5	0.4	Perennial	Private	MD
BA05	NA	NA	NA	NA	NA	NA	Private	NA
BA06	300	11	0	0.4	0.3	Perennial	Public	MD
BA07	300	11	0	0.4	0.4	Perennial	Private	D
BA08	300	11	0	0.5	0.4	Intermittent with pools	Private	MD
BA09	300	11	0	0.3	0.3	Perennial	Public*	D
BA10	150	6	0	0.8	NA	Intermittent with pools	Private	D
BA11	240	9	0	1.5	NA	Intermittent with pools	Private	MD
BA12	300	11	0	0.6	0.7	Perennial	Public	MD
BA13	300	11	0	0.3	0.3	Perennial	Public	MD
BA14	300	11	0	0.3	0.2	Perennial	Public	D

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
BA15	300	11	0	0.4	0.2	Intermittent with pools	Public	MD
BA16	300	11	0	0.5	0.5	Intermittent with pools	Public	MD
BA17	300	11	0	0.4	0.6	Intermittent with pools	Private	MD
BA18	300	11	0	0.3	0.5	Intermittent with pools	Private	MD
BA19	300	11	0	0.5	0.4	Intermittent with pools	Public*	MD
BA20	300	11	0	0.3	0.4	Intermittent with pools	Public*	D
BA21	300	11	0	0.4	0.4	Intermittent with pools	Public*	MD
BA22	300	11	0	0.4	0.4	Intermittent with pools	Public	MD
BA23	300	11	0	0.3	0.3	Intermittent	Public*	MD
BA24	300	11	0	0.2	0.3	Intermittent	Public*	MD
BA25	NA	NA	NA	NA	NA	NA	Private	NA
BA26	300	11	0	0.2	0.1	Intermittent	Public*	ME

Table 5.7 Description of surveyed stream sites along Bois D' Arc Creek during first survey performed in June 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
BA01	50	13	19	Normal
BA02	17	5.5	8.5	Normal
BA03	18	2.0	13	Normal
BA04	12	2.2	10	High
BA05	NA ¹	NA ¹	NA ¹	NA ¹
BA06	8.2	4.0	4.5	Normal
BA07	8.0	3.0	6.0	Normal
BA08	7.0	0.5	3.0	Normal
BA09	8.5	2.5	5.0	Normal
BA10	11	9.0	10	Normal
BA11	25	15	19	Normal
BA12	14	0.5	4.0	Normal
BA13	13	0.8	4.0	Normal
BA14	13	0.5	3.0	Normal
BA15	12	0.5	3.0	Normal
BA16	11	0.0	8.0	No Flow
BA17	20	0.0	18	No Flow
BA18	13	0.0	1.0	Normal
BA19	8.5	0.4	4.0	Low
BA20	6.5	0.0	4.0	No Flow
BA21	8.5	0.4	4.0	Normal
BA22	8.5	0.8	3.1	Normal
BA23	7.2	1.2	4.0	Normal
BA24	5.0	0.0	2.5	No Flow
BA25	NA ¹	NA ¹	NA ¹	NA ¹
BA26	4.5	0.1	1.5	Normal

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 5.8 Description of surveyed stream sites along Bois D' Arc Creek during second survey performed in August 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
BA01	40	12	18	Normal
BA02	6.5	3.0	5.0	Normal
BA03	15	1.5	15	Normal
BA04	8.5	2.0	6.5	Low
BA05	NA ¹	NA ¹	NA ¹	NA ¹
BA06	8.0	3.0	6.0	Normal
BA07	13	1.5	5.0	Normal
BA08	10	2.0	6.0	Normal
BA09	6.0	3.0	4.0	Normal
BA10	NA ¹	NA ¹	NA ¹	NA ¹
BA11	NA ¹	NA ¹	NA ¹	NA ¹
BA12	11	0.0	8.0	No Flow
BA13	8.5	0.4	5.0	Normal
BA14	15	1.0	5.0	Normal
BA15	8.0	0.0	5.0	No Flow
BA16	12	0.0	8.0	No Flow
BA17	18	0.0	13	No Flow
BA18	13	0.0	1.0	No Flow
BA19	9.0	0.5	3.0	Normal
BA20	6.0	0.0	3.0	No Flow
BA21	6.0	0.7	3.0	Normal
BA22	10	0.7	3.0	Normal
BA23	6.5	0.5	3.0	Normal
BA24	7.5	0.3	2.0	Normal
BA25	NA ¹	NA ¹	NA ¹	NA ¹
BA26	1.5	0.0	0.0	No Flow

¹NA indicates not applicable as field surveys were not conducted due to lack of access

Table 5.9 Stream aesthetics along Bois D' Arc Creek during first survey performed in June 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F. NA indicates not accessible due to lack of access.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
BA01	A	A	N	Brown	Fine Sediment	Clear	N	MP	N	Tracks/Fecal/ Nests	N	R	R
BA02	A	A	R	Brown	Fine Sediment/ Sludge	Clear	SP	SP	N	Tracks/Fecal/ Nests	R	C	R
BA03	A	A	N	Clear/Brown	Fine Sediment/ Solids	Clear/Foam	N	N	N	Tracks/Fecal/ Nests	R	N	R
BA04	A	A	N	Clear/Brown	Fine Sediment/ Solids	Clear	SP	N	N	Tracks/Fecal	N	R	N
BA05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA06	A	R	N	Brown	Sludge	Clear	N	N	N	Tracks/Fecal/ Nests	R	R	R
BA07	A	C	N	Clear	Fine Sediment	Clear/Foam	SP	LP	N	Tracks/Fecal/ Nests	R	R	N

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
BA08	A	A	N	Clear/Brown	Fine Sediment	Clear	SP	SP	N	Tracks/Fecal	N	R	N
BA09	A	A	N	Brown	Solids	Clear	N	N	N	Tracks/Fecal/ Nests	Ab	C	R
BA10	A	A	N	Brown	Fine Sediment	Clear	SP	N	N	Tracks/Fecal	R	R	N
BA11	A	C	N	Clear/Brown	Fine Sediment	Clear/Foam	N	SP	N	Fecal	N	R	R
BA12	A	A	N	Brown	Fine Sediment	Clear/Scum/ Foam	SP	N	SP	Tracks/Fecal	R	R	N
BA13	A	A	N	Clear/Brown	Fine Sediment	Clear/Scum/ Foam	SP	N	N	Tracks/Fecal/ Nests	R	C	N
BA14	C	R	N	Clear/Brown	Fine Sediment	Clear/Scum/ Foam	N	N	N	Tracks/Fecal	C	C	N
BA15	C	C	N	Clear	Fine Sediment/ Solids	Clear/Oil	SP	SP	N	Tracks/Fecal/ Nests	C	R	R
BA16	C	A	N	Clear/Brown	Fine Sediment/ Solids	Clear	LP	N	N	Tracks/Fecal/ Nests	C	R	A

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
BA17	C	C	N	Clear/Brown	Solids	Clear	SP	N	N	Tracks/Fecal	R	N	N
BA18	C	A	C	Clear/Brown	Fine Sediment	Clear/Scum/Oil	SP	N	N	Tracks/Fecal	N	R	N
BA19	A	A	R	Brown	Fine Sediment/Sludge/Bedrock	Scum/Oil	SP	N	N	Tracks/Fecal/Nests	C	C	R
BA20	A	A	R	Brown	Fine Sediment/Sludge	Scum/Oil	N	N	N	Tracks/Fecal/Nests	C	C	R
BA21	A	A	R	Brown	Fine Sediment/Sludge	Scum/Oil	N	N	N	Tracks/Fecal/Nests	Ab	R	R
BA22	A	A	R	Clear/Brown	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Fecal/Nests	Ab	C	R
BA23	A	A	N	Clear	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Nests	R	R	R

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
BA24	A	A	N	Clear	Fine Sediment/ Solids	Clear	MP	SP	N	Tracks/Fecal/ Nests	A	R	R
BA25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA26	A	C	N	Clear	Fine Sediment/ Sludge	Clear/Scum	N	N	N	Tracks/Fecal/ Nests	R	C	R

Table 5.10 Stream aesthetics and wildlife observations along Bois D' Arc Creek during the second survey performed in August 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F. NA indicates not accessible due to lack of access.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
BA01	A	A	N	Clear/Brown	Sludge/Solids	Clear	N	N	N	Tracks/Fecal Droppings	N	N	R
BA02	R	A	N	Clear	Fine Sediment	Clear	N	N	N	Tracks/Fecal	R	C	R
BA03	A	A	N	Brown	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Nests	N	N	N
BA04	A	R	N	Clear	Fine Sediment	Clear	N	N	N	Tracks	N	N	N
BA05	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA06	R	R	N	Clear/Brown	Fine Sediment	Clear	N	N	N	Tracks/Fecal	N	R	N
BA07	A	A	N	Clear	Fine Sediment	Clear	N	SP	N	Tracks/Fecal	N	N	N
BA08	A	A	N	Clear	Fine Sediment/Solids	Scum	SP	N	N	Tracks/Fecal	N	R	N

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
BA09	R	A	C	Brown	Fine Sediment/Sludge	Clear	SP	N	N	Tracks/Fecal	R	C	R
BA10	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA11	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA12	R	R	C	Brown	Fine Sediment	Clear/Oil	SP	N	N	Tracks/Fecal	R	R	C
BA13	R	R	R	Brown	Fine Sediment	Clear	SP	N	N	Tracks/Fecal	R	C	C
BA14	R	R	R	Brown	Fine Sediment/Sludge	Clear/Scum	N	N	N	Tracks/Fecal	R	R	R
BA15	R	R	N	Brown	Fine Sediment/Solids	Clear/Scum/Oil	N	N	N	Tracks/Fecal	R	R	R
BA16	R	R	N	Clear/Brown	Fine Sediment/Solids	Clear/Scum	N	MP	SP	Tracks/Fecal	N	R	R
BA17	A	R	N	Brown	Fine Sediment	Clear	N	N	N	Tracks/Fecal	N	R	N

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
BA18	R	A	N	Brown	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal	N	N	R
BA19	A	C	N	Clear/Green	Fine Sediment	Clear	N	N	N	Tracks/Fecal	R	R	R
BA20	A	A	N	Clear/Brown	Fine Sediment	Clear/Scum	N	N	N	Tracks/Fecal	N	R	R
BA21	A	A	N	Clear/Brown	Fine Sediment/Sludge	Clear/Scum/Debris	N	N	N	Tracks/Fecal	R	C	C
BA22	A	A	N	Clear	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal	C	C	C
BA23	A	A	N	Clear	Fine Sediment/Solids	Clear	N	N	N	Tracks/Fecal	R	C	C
BA24	A	A	N	Clear	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Fecal	C	R	R
BA25	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
BA26	A	C	N	Green	Fine Sediment/Sludge	Clear/Scum	N	N	N	Tracks/Fecal	R	C	C

Physical Description of BA01

Bois D' Arc Creek at Site BA01 was surveyed on June 17 and August 9, 2014. Access to this site was easy because it occurred at a road crossing and a well-defined public vehicle trail led to the water. Access into the water was also easy because a rudimentary boat ramp existed on the bank (Table 5.6). Banks were lined with trees but the landscape opened up to native and improved pasture just beyond the vicinity of the creek (Tables 5.5).

Flow appeared normal during both surveys (Tables 5.7 and 5.8). Portions of this site were wadeable; however, average thalweg depths of about 1 m and creek widths around 18 m allowed TIAER to use boats to complete the 300-m transect. Approximately a third of transects had depths greater than 1.5 m resulting in a 'non-wadeable' designation for these portions of the surveyed stretch. One substantial pool was encountered during the first survey that measured 75 m long, 50 m wide and 3.5 m deep. The same pool during the second survey measured 70 m long, 40 m wide and 3 m deep.

Banks were steep and muddy making walking up and down the banks moderately difficult. The dominant substrate was fine sediment and in some places bedrock was exposed. The water was brown and lacked aquatic vegetation, algae cover, and odor during both surveys. The water's surface was clear as well. Tracks of feral hog, canine, raccoon, and water birds were seen on the banks. Garbage was very minimal at this site; however, typical plastics, glass bottles, and aluminum cans were observed at the bridge access point and old dumped trash was observed during the second survey (Tables 5.9 and 5.10). A fire ring with charcoal was observed during the first survey. Two individuals were encountered at the bridge crossing during the second survey, and an interview revealed that they used the site to fish and camp on weekends. Figure 5.3 is of the boat they used to travel in the creek. Figure 5.4 provides a general depiction of Bois D' Arc Creek at Site BA01.



Figure 5.3 Photograph of Bois D' Arc Creek at Site BA01, taken August 9, 2014 of access point, rudimentary boat ramp and boat.



Figure 5.4 Photograph of Bois D' Arc Creek at Site BA01, taken August 9, 2014. Downstream view at 300-m transect. TIAER staff in photo.

Physical Description of BA02

Bois D' Arc Creek at Site BA02 was surveyed on June 17 and August 9, 2014. Access to this site was at a road crossing. A private property fence existed along the highway right-of-way perpendicular to the stream, but did not meet the bridge and ended at the creek banks. Therefore, it did not pose a hindrance to in-creek navigation. Access into the stream from the banks was difficult because of concrete and rip-rap at the bridge, dense vegetation, and steep, slippery banks (Tables 5.5 and 5.6).

A discrepancy occurred between surveys of this site regarding the direction from the bridge for survey transects. The first survey began at 210 m west or upstream of the bridge crossing and was completed 90 m east or downstream of the bridge crossing. The second survey began at the bridge crossing and was completed 300 m east or downstream of the bridge. The two surveys overlapped in the first 90 m east or downstream from the bridge (Figure 5.5). There was not a significant change in riparian zone appearance from one survey to the next, both being primarily forest/shrub with pasture beyond. The image below illustrates this, in addition to, the cultivated hay pastures east of the highway (Figure 5.5). Conversely, water depths did differ slightly between surveys. During the first survey, depths greater than 1.5 m were encountered from about the 90-m transect, which was at the bridge, to the 210-m transect, which was 120 m upstream of the bridge to the west. These were the only portions of the surveyed reach that were non-wadeable. The second survey had an average thalweg depth of 0.4 m and never exceeded 0.8 m (Table 5.6).

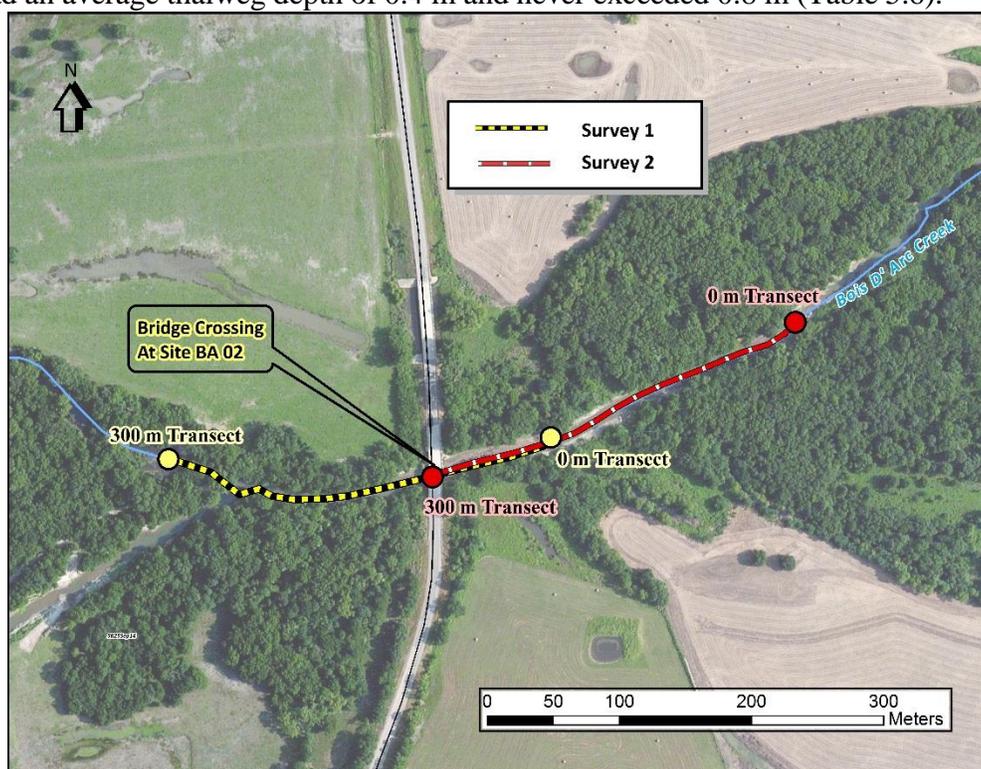


Figure 5.5 Image of Site BA02, illustrating locations of the two surveys and surrounding landscape. Note overlap of the two surveys in the first 90 m east of the bridge.

In general, stream flow appeared normal during both surveys (Tables 5.7 and 5.8). Travel through the stream corridor was difficult due to some log obstructions in the channel, depths greater than 1.5 m, and soft clay bottom that caused considerable sinking when walking. The stream channel was naturally vegetated with a variety of shrubs and herbaceous vines at the banks (Figure 5.6).

The water surface was predominantly clear with a brown coloration and an occasional foul odor (Tables 5.9 and 5.10). Aquatic vegetation was absent at the first survey and rare at the second. No algae cover was observed during either survey. Small fish, clams and a great blue heron were observed at this site. Tracks of canine, raccoon, beaver, and feral hog were seen along the mud banks. Feral hog wallows were also present in places. Garbage in the channel was common and included plastic bags, cans, glass bottles, scrap metal, discarded sections of carpet, tires, mattress springs, and a bicycle. Larger items were rare and more prevalent at the bridge crossing (Tables 5.9 and 5.10). During the first survey, a fish trap was observed half buried in the muddy creek bottom and did not appear to be anchored in place (Figure 5.7). No other signs of human recreation were observed.



Figure 5.6 Photograph of Site BA02, taken August 9, 2014. Downstream view at 300-m transect. Note log obstructions and bank vegetation.



Figure 5.7 Photograph of Site BA02, taken June 17, 2014 of fish trap.

Physical Description of BA03

Bois D' Arc Creek at Site BA03 was surveyed on June 18 and August 9, 2014. The creek is publically accessible at the bridge at this location. This portion of the creek runs through the Caddo National Grasslands. Banks were densely vegetated by large trees and an understory of shrubs and herbaceous vegetation (Tables 5.5 and 5.6). A boat was used to conduct the surveys at this site, because depths were commonly at least 1 m, making use of a boat more practical than wading.

The majority of the stream was wadeable with an average width of 13 m during both surveys and an average thalweg depth of approximately 1 m. The stream appeared to have normal flow during both surveys (Tables 5.7 and 5.8).

The stream channel was naturally vegetated with a variety of shrubs at the banks including poison ivy (Figure 5.8). Water conditions were the same from one survey to the next. Surface was clear, color was brown and the bottom was predominantly fine sediment. Aquatic vegetation and algae cover were absent and no odor was detected (Tables 5.9 and 5.10). Wildlife observed included spotted gar, other small fish, and turtles. Tracks of canine, raccoon, deer, beaver, and large water bird were seen. Feral hog wallows and tracks were observed on the banks in addition to bird droppings in the bank vegetation. Cliff swallow nests existed under the bridge. Garbage was minimal at the bridge and included a broken folding chair and a television set. Stream banks and channel were free of garbage beyond the bridge crossing. No signs of human recreation were observed.



Figure 5.8 Photograph of BA03, taken on June 18, 2014. Downstream view at 0-m transect.

Physical Description of BA04

Bois D' Arc Creek at Site BA04 was surveyed on June 18 and August 9, 2014. No public access to this site was available and access was only possible with landowner permission and a key to the gate. The site was approximately 3.5 miles from a public road through pastures, cultivated fields, and down a path cleared through the forest. Once at the site, access into the stream was very difficult as it required repelling down steep banks using a rope (Table 5.6). In-stream navigation was moderately difficult as well due to large debris piles of trees and limbs, slick bottom, deep mud in places, and some sections of deep water (Figure 5.9).



Figure 5.9 Photograph of Site BA04, taken June 18, 2014. Upstream view at 0-m transect. Note steep, vegetated banks and debris accumulation.

This stream was wadeable with flow appearing high during the first survey and low during the second. During the first survey, landowners familiar with BA04 said that typical flow at this site was lower than what was being experienced at the time of the survey. Therefore, TIAER field personnel denoted observed flow as ‘high’ (Table 5.7). Typical widths on the first survey were 10 m and 6.5 m during the second survey (Tables 5.7 and 5.8). Average thalweg depths were approximately 0.4 m.

This site was bordered by dense forest on both sides. The channel was deep creating steep banks that were difficult to impossible to climb should one wish to exit the creek (Table 5.6 and Figure 5.10). Conditions for this section of Bois D’ Arc Creek were very similar between the two surveys. Water surface was clear, color was clear to brown, aquatic cover and algae were primarily absent, and no odor was detected (Tables 5.9 and 5.10). Wildlife observed included small fish, clams, crawfish, turtles, and snakes. Raccoon (Figure 5.11), feral hog, beaver, and waterbird tracks were observed on the banks in addition to bird feces and feral hog wallows. Garbage was minimal and only included a couple glass bottles. No evidence of human recreation was observed.



Figure 5.10 Photograph of Site BA04, taken August 9, 2014. Left bank view at 150-m transect. Note steep, muddy banks.



Figure 5.11 Photograph of BA04, taken on August 9, 2014, of a beaver track.

Physical Description of BA05

Site BA05 was visited on June 18, 2014, but not surveyed. Access to BA05 required landowner permission to enter through a locked gate and drive approximately 3 miles on private pasture road down to the site. Establishment of this location for an RUAA site occurred approximately three months prior to the surveys, when vegetation was significantly less dense and travel to the edge of the creek was relatively easy. By June, spring rains had promoted the growth of an abundance of new vegetation along this section of the creek. Extremely dense vegetation included regrowth of Cedar elm and hackberry with limbs too close together to easily walk through (Figures 5.12 and 5.13). Access to the creek from this location was limited, and, therefore, this site was not surveyed in June, nor was it revisited during the second round of surveys in August.



Figure 5.12 Photograph of BA05, taken on June 18, 2014, at access point.



Figure 5.13 Photograph of BA05, taken on June 18, 2014, access point. Note dense vegetation with heights greater than 3 m tall. TIAER personnel in photograph.

Physical Description of BA06

Bois D' Arc Creek at Site BA06 was surveyed on June 17 and August 9, 2014. Access to this site was public at the bridge and right-of-way, and was moderately difficult because banks at the bridge were steep and slick (Figure 5.14). Access to the stream was also moderately difficult due to deep mud, slick banks, and slick creek bottom (Table 5.6). Some log obstructions were present along the stretch (Figure 5.15). The riparian area was dense forest but the landscape beyond it was native and improved pastures.

This stretch of Bois D' Arc Creek was wadeable and flow appeared normal during both surveys (Tables 5.7 and 5.8). Typical average widths ranged from 4.5 m during the first survey to 6 m during the second. The widest width encountered was 8.5 m. Average thalweg depths measured 0.4 m during the first survey and 0.3 m during the second survey (Table 5.6).



Figure 5.14 Photograph of BA06, taken on June 17, 2014. Right bank view at the 300-m transect. Note steep bank access.



Figure 5.15 Photograph of Site BA06, taken on August 9, 2014. Downstream view at 0-m transect. Note - log jams. TIAER staff in photo.

Water characteristics changed little from one survey to the next (Tables 5.9 and 5.10). The water surface was clear and the color was brown and some foam was encountered in places where water was moving during the first survey. Some aquatic vegetation was observed at the first survey but was rare by the second. Algae cover was rare and no odor was detected. Wildlife encountered included small fish, frogs, crawfish, and clams. Tracks observed along this stretch included those of canine, raccoon, bird, deer, feral hog, crane, and feline. Bird droppings were also seen during the surveys. Garbage was rare during both surveys and included plastics, aluminum cans, and glass bottles. During the second survey, bridge work had taken place, which appeared to include some excavation of the creek bottom and banks in the immediate vicinity of the bridge (Figure 5.16). No evidence of human recreational activity was observed.



Figure 5.16 Photograph of BA06, taken on August 9, 2014. Right bank view at the 300-m transect. Note bridge work.

Physical Description of BA07

Bois D' Arc Creek at Site BA07 was surveyed on June 18 and August 19, 2014. No public access to this site was available. Access was only possible with landowner permission through a locked gate and two interior pasture gates, approximately 1.5 miles from the entrance. Once at the site, entering the stream was moderately difficult due to steep slopes with slick, muddy banks (Table 5.6). Traversing the stream bed was difficult in some locations where mud became hip-deep; otherwise, the surveyed stretch was free of much debris. The riparian area was well forested but opened to low herbaceous vegetation within the banks. Improved pasture existed beyond the riparian corridor (Figure 5.17).



Figure 5.17 Photograph of Site BA07, taken June 18, 2014. Downstream view at 0-m transect.

This portion of Bois D' Arc Creek was wadeable and water existed throughout the 300-m stretch during the first survey. Flow appeared normal during both surveys. Average thalweg depth was approximately 0.41 m and changed very little between surveys (Table 5.6). The typical stream width ranged from 5 to 6 m (Tables 5.7 and 5.8).

The creek bottom was composed of a clay mud that was firm in some places but soft and unstable in others (Table 5.5). The water surface was generally clear with foam in places where water movement was swifter. No aquatic vegetation or odor was observed during either survey; however, algae cover was common during the first survey (Tables 5.9 and 5.10). There was evidence of a wide variety of wildlife in the creek. Tracks of skunk, deer, raccoon, bobcat, possum, feral hog, beaver, bird, and coyote were recorded (e.g., Figure 5.18). Animals observed included frogs, turtles, clams, small fish, snakes, and crawfish.



Figure 5.18 Photograph of BA07, taken on July 18, 2014. Wildlife tracks in mud.

Of special interest was a great blue heron rookery at the 30-m transect (Figure 5.19). There were approximately 3 to 4 nests observed in the canopy of a sycamore tree (*Platanus occidentalis*) on the right bank. Young birds were observed in the nests during the first survey. Figure 5.20 shows one of the nests. The survey team was unable to capture clear images of the birds in the nests, but in Figure 5.20 there are two young herons shown, one in the nest and one on a limb to the right of the nest. Bird droppings were profuse on bank vegetation below the nests as was the smell when walking in the immediate vicinity (Figure 5.21).



Figure 5.19 Photograph of Site BA07, taken on June 18, 2014. Great blue heron rookery at 30-m transect.



Figure 5.20 Photograph of Site BA07, taken June 18, 2014. Great blue heron rookery and young in nest.



Figure 5.21 Photograph of BA07, taken on June 18, 2014. Bird droppings in vegetation below heron rookery.

Garbage at this site was very minimal. During the first survey, a tire, plastic bottles, and cans were observed but were rare. No garbage was detected during the second survey. Aside from a human foot print alongside large canine tracks, presumed from a domestic dog, no evidence of human recreation was observed.

Physical Description of BA08

Bois D' Arc Creek at Site BA08 was surveyed on June 17 and August 9, 2014. Access to this site was moderately difficult, because it required landowner permission to enter through a locked gate and drive approximately 2 miles through pastures down to the site. Travel through one pasture was particularly challenging, because it had been recently cleared of forest vegetation, leaving the ground uneven and rough. Entering the stream was moderately difficult as well, because the creek was fenced off from the pasture, and banks were steep and densely vegetated along the entire 300 m stretch (Figure 5.22). Once in the channel, travel through the corridor was moderately easy with the exception of some areas of deep mud that made wading challenging. The riparian area was primarily forest, but opened up to cleared pastures and native grasses (Table 5.5). No major obstructions were encountered except for where a tree had fallen across the creek (Figure 5.23) and some flood debris had accumulated just downstream beyond the 0-m transect.



Figure 5.23 Photograph of Site BA08, taken on June 18, 2014. Downstream at the 300-m transect. Note steep banks and dense vegetation.



Figure 5.23 Photograph of BA08, taken on August 9, 2014, log obstruction.

The stream at this site was wadeable. Flow appeared normal during both surveys, although slightly higher during the first. Average thalweg depths for the first and second surveys were 0.5 m and 0.4 m, respectively (Table 5.6). Typical widths of the stream were approximately 4.5 m (Tables 5.7 and 5.8).

The creek bottom was primarily fine sediment/mud/clay (Table 5.5). Water characteristics did not differ between surveys with the exception of the presence of scum on the water surface during the second survey (Tables 5.9 and 5.10). Overall, the water was clear to brown in color and aquatic vegetation, algae cover, and odor were all absent. Evidence of wildlife included tracks of raccoon, beaver, and feral hog in addition to bird and crawfish feces. Domestic dog tracks were also seen. Frogs, small fish, clams, and crawfish burrows were observed in the stream. Vultures were observed in the trees adjacent to the creek, hawks were heard nearby but not directly observed, and a ratsnake was encountered by the stream (Figure 5.24). Garbage was minimal at this site but did include some glass and plastic bottles, tires and bricks (Tables 5.9 and 5.10). No evidence of human recreation was observed.



Figure 5.24 Photograph of BA08 taken on June 17, 2014. Ratsnake on banks.

Physical Description of BA09

Bois D' Arc Creek at Site BA09 was surveyed on June 17 and August 9, 2014. Access to this site was possible from a dirt road that was alongside a one-lane bridge crossing, leading down to the creek. Private property fencing existed perpendicular to the creek but did not cross it nor did it meet the bridge. Access was difficult getting down to the creek at the bridge because the banks were steep and lined with loose, muddy rip rap that shifted considerably when walked upon (Table 5.6). Once in the channel, travel through the creek was moderately easy with the exception of

some places where the bottom was mucky due to the silty/mud/clay bottom or had log debris (Figure 5.25). The riparian corridor along the 300 m stretch was densely forested immediately at the banks but opened up to pasture beyond (Table 5.5). The banks were also steep and frequently lined with herbaceous cover, including poison ivy (Figure 5.26).



Figure 5.25 Photograph of Site BA09, taken on August 9, 2014. Downstream view at 300-m transect from bridge access. Note the steep banks, forested corridor and downed trees in channel.

This site was wadeable and flow appeared normal during both surveys. Typical widths ranged from 4 m to 5 m between surveys (Tables 5.7 and 5.8). Thalweg depths did not differ significantly between surveys, averaging 0.3 m for both (Table 5.6). The water surface was clear of any scum or foam and was brown in color during both surveys. During the first survey no odor, algae, or aquatic vegetation were detected. During the second survey, an odor was common and aquatic vegetation was observed (Tables 5.9 and 5.10).



Figure 5.26 Photograph of Site BA09, taken on August 9, 2014. Upstream view at the 0-m transect. Note steep banks and thick vegetation on the left. TIAER personnel in photo.

There was evidence of various species of wildlife in the creek bottom. Tracks of feral hog, raccoon, and deer were seen. Frogs, crawfish, snakes, and clams were seen in the creek or on the banks. Feces of cattle, deer, and birds were also observed. Some large garbage was seen in the creek at the bridge such as tires and a discarded recliner chair. Some tires were also observed further downstream from the bridge as well. Small garbage in the channel was common and included plastic bottles, glass bottles, plastic bags, and various scrap metal and glass. During the first survey a fishing reel was found in the creek but without a rod, suggesting it was only flood debris. No other evidence of potential human recreation at this site was observed.



Figure 5.27 Photograph of Site BA09, taken on June 17, 2014. Fishing reel.

Physical Description of BA10

Bois D' Arc Creek at Site BA10 was surveyed on June 18, 2014 and attempts were made to survey it on August 10 and 13, 2014. Access to the site was difficult, because it required landowner permission and a key to enter through a locked gate (Table 5.6). There were three private property signs mounted on a gate, the fence, and a tree near the entrance to the property (Figure 5.28). Once on the property, access to the site was also difficult as it required driving approximately a mile down a pasture road, then through a recently cleared forested area with no well-established road. Obstacles to avoid when driving to the site included frequent holes where trees were pushed over or uprooted from the forest clearing, in addition to two large dumping pits established by the previous landowner. Although vegetation was more prolific during the first survey than it was during the reconnaissance visit, these obstacles were not a hindrance to accessing the site because they were more visible and could be avoided (Figure 5.29).

The second survey was scheduled for August 10th; however, a significant rain event around 5:30 pm August 9th dropped 1.45 inches at the site making access impossible due to muddy road and pasture conditions. Another effort at the second survey was attempted on August 13th, during which the field crew was able to drive about a half mile in on the property until they reached a stand of thick vegetation. Since the first survey, giant ragweed and annual sunflower had become well established in a dense stand about 3m high in the area of recently cleared forest (Figure 5.30).



Figure 5.28 Photograph of BA10 taken, on August 13, 2014 at locked gate with private property sign.



Figure 5.29 Photograph of BA10, taken on June 18, 2014. Access trail through recently cleared forest. Note bumper-high vegetation.



Figure 5.30 Photograph of BA10, taken on August 13, 2014. Dense vegetation where forest clearing had taken place. Photo taken from a standing position on bumper of field truck.

The previously used trail was no longer visible, and there were concerns of possibly becoming stuck in the muddy holes or driving off into the dump sites, because of the severely impaired visibility of the driving surface. Walking was considered too hazardous because a sounder of feral hogs was encountered during the reconnaissance visit, and according to local residents, regularly inhabited the Bois D' Arc Creek riparian corridor. Height measurements of the vegetation were taken in addition to photographs. A second RUAA of BA10 was not conducted.

The steep, muddy, densely vegetated banks at this site were forested on both sides (Table 5.5). This portion of the creek had been channelized as well. Large tree debris in the water was common throughout the surveyed stretch. Because of hazards associated with submerged log debris and unknown water depths, a boat was used to survey this site. Deployment of the boat was extremely difficult, because access with the field vehicle was only possible to within approximately 30 m of the creek in addition to steep, slick banks.

Only 150 m of this site was surveyed rather than the recommended 300m reach. In the upstream direction, depths greater than 1.5 m did not allow for further wading and abundant submerged log debris impeded further travel in the boat (Figure 5.31). In the downstream direction, 1 m depths with submerged woody debris were considered too hazardous for wading or boat travel. Flow appeared normal during the survey (Table 5.7). The average thalweg depth for this site was 0.8 m and typical average width was 10 m (Tables 5.6 and 5.7).



Figure 5.31 Photograph of Site BA10, taken June 18, 2014. Upstream view at 300-m transect. Note abundant submerged log debris, steep banks, and dense bank vegetation.



Figure 5.32 Photograph of Site BA10, taken June 18, 2014. Downstream view at 150-m transect.

The water surface was clear and brown in color. The bottom was a fine sediment mud. Aquatic vegetation, algae cover, and odor were not present during this survey (Table 5.9). Wildlife observed included fish, snakes, crawfish, and turtles. A wildlife trail was seen on the banks leading down to the creek with unknown animal tracks. Garbage in the stream and banks was rare, but did include a tire, plastic bottle, and aluminum can (Table 5.9). No evidence of human recreation was observed at this site.

Physical Description of BA11

Bois D' Arc Creek at Site BA11 was surveyed on June 17 and attempted August 10 and 13, 2014. Access to this site was at a public highway crossing; however, access to the creek was still moderately difficult (Table 5.6). The highway right of way was wide and grassy, but one could still get stuck even with a small amount of rain as the soils easily became very soft. Additionally, the right of way had one terrace to negotiate leading down to the water's edge, which involved driving down a steep concrete embankment. The ground was soft during the first survey and required four wheel drive to get to and from the creek bank. The banks at this site were steep, muddy, and shrub dominated with the exception of an approximately 20m width at the bridge where vegetation was primarily Johnson grass (Figure 5.33). Many log obstructions and submerged log debris were encountered (Figure 5.34).



Figure 5.33 Photograph of Site BA11, taken June 17, 2014. Left bank at the 300-m transect. Note steep, muddy banks. Rope line used to deploy and retrieve boat. TIAER personnel in photo.



Figure 5.34 Photograph of Site BA11, taken June 17, 2014. Downstream at 60-m transect. Note significant amount of submerged debris and large log jam.

The second survey was attempted on August 10th and again on August 13th; however, like BA10, a rain event around 5:30 pm August 9th dropped 1.45 inches of rain making access down to the site impassable. Photographs were taken from the bridge on both the August 10th and the 13th to document conditions (e.g., Figure 5.35). A second RUAA survey was not conducted at BA11.

In June, the site was non-wadeable with water depths consistently greater than 1.5 m, thus, a boat was used to conduct the survey. The average thalweg depth was 1.5 m, widths ranged from 25 m to 15 m, and the typical width was 19 m (Tables 5.6 and 5.7). Flow appeared normal during the survey. As mentioned previously, large wood debris was encountered at this site. Figure 5.34 was taken at the 60-m transect and depicts a large log jam approximately 270 m downstream from the bridge, which obstructed the ability to further navigate by boat. Of note, the 300-m transect was at the bridge. With depths greater than 1.5 m, wading the remainder of the survey was not possible therefore only 9 of the 11 transects were conducted. During the scouting visit to this site, a large log jam of similar magnitude existed on the upstream side of the highway bridge and was stacked up against the bridge supports. That log jam was gone by the first survey, presumed to have washed downstream and re-accumulated where the photo was taken.

The water surface was clear with some foam and was brown in color (Table 5.9). The creek bottom deposit was a fine sediment. No aquatic vegetation or odor was observed, and algal cover was common, specifically at the 60-m transect. The banks were primarily wooded immediately at the creek, but opened up to native and improved pastures beyond. At approximately 240 m, a private property fence existed perpendicular to the creek, but did not extend across the water.



Figure 5.35 Photograph of Site BA11, taken August 10, 2014, the morning following the 1.45 inch rain. Note concrete embankment and running water from highway right of way.



Figure 5.36 Photograph of site BA11, taken June 17, 2014. Upstream view at 150-m transect.

Wildlife encountered included small minnows, spotted gar, crawfish and water birds. Bird droppings were also observed in addition to cliff swallow nests under the bridge. Garbage in general was rare but included a life jacket, glass bottles, aluminum cans, and polystyrene cups. A tire was seen in the channel near the large log jam. No human recreation was encountered during the first survey or during the visits to the bridge crossing on August 10 and 13th.

Physical Description of BA12

Bois D' Arc Creek at Site BA12 was surveyed on June 15 and August 9, 2014. Access to this site was public only at the bridge. Getting to the site was moderately easy and required walking down a foot path down the bank from the highway right of way. Banks were forested, opening up to pasture beyond (Table 5.5). The channel was deep with steep sides and densely vegetated banks with poison ivy, Johnson grass and trees making access to the channel moderately difficult (Table 5.6). Log obstructions were observed at the 300-m transect, which also hindered travel within the stream channel (Figure 5.37).



Figure 5.37 Photograph of BA12, taken on June 15, 2014. Downstream view at 300-m transect.

The creek at this site was wadeable. Flow during the first survey appeared normal and was dry at the second survey (Tables 5.7 and 5.8). The average thalweg depth during the first survey was 0.6 m (Table 5.6). During the first survey, widths ranged from 13 m to 0.5 m with a typical width of 4 m (Table 5.7). During the second survey, the average thalweg was 0.7 m (Table 5.6). Widths ranged from 11 m to 0 m with a typical width of 8 m (Table 5.8).

The water surface during the first survey was clear in some areas with scum and foam present in others. The coloration was brown and the bottom deposit was a fine sediment. During the first

survey, algae and aquatic vegetation were absent and there was no odor (Table 5.9). However, during the second survey, aquatic vegetation and algae were rare and there was a common odor (Table 5.10).

Wildlife observed at this site included crawfish, perch, catfish, other small fish, clams, beaver, a speckled kingsnake (Figure 5.38), and a skunk. Tracks of raccoon, feline, canine, feral hog, great blue heron, possum, deer, and beaver were noted. A turtle egg shell was also found. Cliff swallow nests were present under the bridge and bird droppings were also observed in the channel. Garbage was generally rare during both surveys, but bank garbage was noticeably more common during the second survey. Garbage observed included glass bottles, aluminum cans, polystyrene cups, tires, plastic sheeting, and a 55 gallon drum. Additionally, a solitary fishing reel was found in the creek but was in poor condition and appeared to be part of flood debris (Figure 5.39). No evidence of human recreation was observed.



Figure 5.38 Photograph of Site BA12, taken on June 15, 2014, of a speckled kingsnake.



Figure 5.39 Photograph of Site BA12, taken on June 15, 2014, of a fishing reel.

Physical Description of BA13

Bois D' Arc Creek at Site BA13 was surveyed June 16 and August 9, 2014. Access to this site was public at the bridge and right-of-way and was moderately difficult because banks at the bridge were steep with thick vegetation (Table 5.6). A rope secured to the field vehicle was used to facilitate stream access. Banks were densely vegetated up to the stream and included noticeable amounts of poison ivy (Figure 5.40). The riparian area was primarily forest that opened up to improved pastures beyond (Figure 5.41). Walking in the stream was moderately easy. This site was wadeable for the entire stretch and flow appeared normal during both surveys. Average thalweg depths were 0.3 m. Typical average widths were 4 m and 5 m, respectively (Tables 5.7 and 5.8).

The creek bottom at this site was a fine sediment, the water was brown in color, and the surface was primarily clear (Tables 5.9 and 5.10). However, during the first survey there was some surface scum and foam observed. During the first survey, algae, aquatic vegetation, and odor were all absent. During the second survey, these were detected although instances were rare. Evidence of wildlife included tracks of raccoon, possum, heron, beaver, turtles, and canine. Small fish, bass, clams, crawfish, and a snake were encountered. Feces of feral hog, bird, and raccoon were also seen in addition to a beaver dam. A rotting feral hog carcass was encountered floating in the stream during the second survey. Large garbage in the channel was rare and small garbage was common during both surveys. Bank garbage was commonly observed during the second survey. Broken glass, plastic bags, aluminum cans, glass bottles, cups, baling twine, and cardboard were among the smaller garbage in the stream and on the banks. Larger items consisted of a couch, tires and old electronics (Figure 5.42). No evidence of human recreation was observed at this site.



Figure 5.40 Photograph of Site BA13, taken August 9, 2014 of access point at bridge.



Figure 5.41 Photograph of Site BA13, taken August 9, 2014. Downstream view at 0-m transect.



Figure 5.42 Photograph of Site BA13, taken August 9, 2014. Downstream view at 150-m transect. Note large garbage on right bank.

Physical Description of BA14

Bois D' Arc Creek at Site BA14 was surveyed June 17 and August 9, 2014. Access to this site was public at the bridge and right-of-way. Additionally, walking down to the creek was difficult, because banks at the bridge were steep and had thick vegetation (Table 5.6). As with Site BA13, a rope secured to the field vehicle and bridge was used to facilitate stream access. Banks were steep and densely vegetated down to the stream bed (Figure 5.43). The riparian area was primarily forest that opened up to improved pastures beyond. Walking in the stream was moderately easy (Figure 5.44). This site was wadeable for the entire stretch, and flow appeared normal during both surveys (Tables 5.7 and 5.8). Average thalweg depths were not significantly different between surveys, averaging 0.3 m. Typical average widths were 3 m and 5 m during the first and second surveys, respectively.

The creek bottom at this site was fine sediment. The water was brown in color, and the surface primarily clear with occasional scum (Tables 5.9 and 5.10). In general, aquatic vegetation, algae, and odor were rare to absent. Some aquatic vegetation was encountered during the first survey. Evidence of wildlife included tracks of raccoon, turtles, birds, deer, feral hogs, feline, and canine. Small fish, bass, clams, crawfish, and frogs were encountered. Bird droppings were observed in the stream corridor. A tree branch, cut by a beaver, was seen floating in the stream as well. Large garbage was rare and concentrated near the bridge crossing (e.g., riding lawnmower parts and large scrap metal). Small garbage was commonly observed and included glass bottles, aluminum cans, scrap metal, some household trash, and bottle caps. Bank garbage was rare to non-existent. No evidence of human recreation was observed at this site.



Figure 5.43 Photograph of Site BA14, taken June 17, 2014 of access point at right bank, next to bridge. TIAER personnel in photo.



Figure 5.44 Photograph of Site BA14, taken August 9, 2014. Downstream view at 150-m transect.

Physical Description of BA15

Bois D' Arc Creek at Site BA15 was surveyed on June 17 and August 9, 2014. Access to this site was public only at the bridge and no fence existed through the channel. Access to the site was moderately easy and required walking down the bank from the highway right of way. Banks were steep and densely forested, opening up to pasture beyond (Tables 5.5 and 5.6). Excessive rip rap was observed at this site and a rock obstruction was encountered at 180 m (Figure 5.45).



Figure 5.45 Photograph of Site BA15, taken June 17, 2014. Obstruction at 180-m transect.

The creek at this site was wadeable. Flow during the first survey appeared normal and dry during the second survey. The average thalweg depth was 0.3 m (Table 5.6). During the first survey widths ranged from 12 m to 0.5 m, and from 8 m to 0 m during the second survey (Tables 5.7 and 5.8). The water surface during the first survey was clear with some oil in areas (Table 5.9). The coloration was also clear and the bottom deposit was a fine sediment. During the first survey, algae and aquatic vegetation was common with no odor. The second survey differed from the first in that the water surface developed a scum in some places, the color of the water was brown, and aquatic vegetation and algae were rare (Table 5.10).

Wildlife observed at this site included crawfish, turtles, frogs, a snake, clams, a heron, and small fish. Egg pieces from a turtle nest were seen scattered near a hole in the stream bank. Tracks of raccoon, feral hog, bird, deer, and beaver were noted. Cliff swallow nests were present under the bridge, and bird droppings were also observed in the channel. Deer feces were observed in the channel. Additionally, a beaver slide was observed leading into the channel. Large garbage was common only during the first survey and included a couch in the stream below the bridge (Figure 5.46). Garbage was rare in general during both surveys but did include cans, bottles, various plastics, and some scrap metal. No evidence of human recreation was observed.



Figure 5.46 Photograph of Site BA15, taken June 17, 2014. Large garbage at 300-m transect. Note densely vegetated banks.

Physical Description of BA16

Bois D' Arc Creek at Site BA16 was surveyed June 17 and August 9, 2014. This site was publically accessible at the bridge crossing. Access down into the stream was moderately difficult as the banks were steep and slick (Table 5.6). A water hose tied to a tree was observed at the site, which field crews used to repel into the creek (Figure 5.47). Banks were densely forested but opened up to pastures beyond (Table 5.5). Submerged rebar and rip rap were encountered, which made walking the stream dangerous. The stream was considered wadeable with average width of 8 m during both surveys and an average thalweg depth of 0.5 m. The stream was not flowing at this location during the surveys (Tables 5.7 and 5.8).

The stream channel was naturally vegetated with a variety of shrubs at the banks including poison ivy (Figure 5.48). There were only minor changes in water conditions from one survey to the next (Tables 5.9 and 5.10). Surface was clear, color was clear/brown, and the bottom was predominantly fine sediment. Aquatic vegetation and algae cover were common to abundant during the first survey and rare at the second. No odor was detected. Wildlife observed included small fish, crawfish, a snake, water birds, and cliff swallows under the bridge. Canine and raccoon tracks, crawfish burrows, and beaver slides were also seen. Garbage was present during both surveys. Large garbage was detected at the bridge only in the form of the large pieces of rip-rap with rebar. Bank trash was abundant during the first survey in the form of recently dumped household trash (Figure 5.49). The most commonly observed trash was glass bottles, aluminum cans, and scrap metal. No signs of human recreation were observed.



Figure 5.47 Photograph of Site BA16, taken June 17, 2014. Access point at bridge.



Figure 5.48 Photograph of Site BA16, taken June 17, 2014. Downstream view at 150-m transect.



Figure 5.49 Photograph of Site BA16, taken June 17, 2014. Household garbage dumped at site.

Physical Description of BA17

Bois D' Arc Creek at Site BA17 was surveyed on June 16 and August 9, 2014. Access to this site was considered moderately difficult because it required landowner permission to enter through a locked gate and drive approximately 1 mile down a pasture road (Table 5.6). Once at the site, access to the creek was easy. The banks were lightly wooded and improved pastures were visible beyond the trees (Table 5.5). Banks were steep with livestock trails frequently entering the creek (Figure 5.50). Additionally, this site began at a fence that bisected the channel and served as the landowner's property line. The stream was wadeable with typical average width of 18 m during the first survey and 13 m during the second survey (Tables 5.7 and 5.8). Average thalweg depth for both surveys was 0.5 m (Table 5.6). The stream was not flowing during either survey (Tables 5.7 and 5.8). The dominate substrate for most of the reach was a mud/clay bedrock.

Water conditions changed minimally from one survey to the next (Tables 5.9 and 5.10). The water surface was clear and the color was brown (Figure 5.51). The bottom was half fine sediment and half solid rock (Figure 5.50). Aquatic vegetation and algae cover were common and no odor was detected during the first survey. During the second survey, aquatic vegetation increased to abundant, algae became more rare, and odor remained absent. Wildlife observed included small fish, frogs, and turtles. Tracks observed included raccoon, cattle, and water bird. A snakeskin, bird feathers, bird droppings, and cow manure were also seen in the stream. Garbage was rare overall; however, some items were seen including a glass bottle and an old appliance. Some ATV tracks were observed that crossed the creek, but no other signs of human recreation were observed at this location.



Figure 5.50 Photograph of Site BA17, taken June 16, 2014. Upstream view at 0-m transect.



Figure 5.51 Photograph of Site BA17, taken June 16, 2014. Upstream view at 300-m transect.

Physical Description of BA18

Bois D' Arc Creek at Site BA18 was surveyed on June 16 and August 9, 2014. Access to this site required landowner permission to enter through a closed gate and drive approximately 0.5 miles down a pasture road. Once at the site, access into the channel was moderately difficult because banks were steep and eroding. The left bank was densely forested and the right bank was vegetated with improved pasture (Table 5.5). One log obstruction was observed at the 210-m transect (Figure 5.52).



Figure 5.52 Photograph of Site BA18, taken August 9, 2014. Log obstruction at 210-m transect.

The majority of this site was wadeable; however, the depth at the 300-m transect was greater than 1.5 m, which is considered non-wadeable. Flow appeared normal during the first survey, while no flow conditions were encountered during the second survey (Tables 5.7 and 5.8). Only minor width changes occurred between surveys with a maximum width of 13, and a typical average width of 1 m (Tables 5.7 and 5.8). The typical average thalweg depth was 0.4 m (Tables 5.6).

Stream aesthetics for both surveys are summarized in Tables 5.9 and 5.10. During the first survey aquatic vegetation and odor were common, while algae cover was abundant. However, during the second survey, while algae cover remained the same, aquatic vegetation was rare and the odor was absent (Figure 5.53). The water surface was clear with a brown coloration during both surveys. The primary substrate was a cobble/mud/clay with bottom deposits of fine sediment and rocks.



Figure 5.53 Photograph of Site BA18, taken August 9, 2014. Downstream view at 300-m transect.

Wildlife observed included fish, turtles, crawfish, snakes, kingfisher, heron, and clams. Tracks of raccoon, armadillo, beaver, canine, and feral hog were seen in the stream. A dead raccoon and an unhatched turtle egg were found in the channel as well. Garbage was almost absent from the channel and banks. A glass bottle, plastic sack, other general plastics, and a tire were the only garbage encountered in the stream. No evidence of human recreation was observed at this site.

Physical Description of BA19

Bois D' Arc Creek at Site BA19 was surveyed on June 17 and August 8, 2014. Access to this site was restricted to the county road crossing and was moderately difficult due to very steep banks and private property fencing built up to the bridge. There were several obstacles that made walking in the channel moderately difficult: water depth of approximately 0.5 m, a muddy bottom, and a log obstruction at approximately 270 m (Figure 5.54). Stream banks were forested immediately at the edge but opened up to improved pasture beyond (Table 5.5). Additionally, poison ivy was observed growing on the banks.

This portion of the creek was wadeable. Average thalweg depths ranged from 0.5 m to 0.4 m between the first and second survey (Table 5.6). It was characterized by low flow during the first survey and widths ranged from 8.5 m to 0.4 m with a typical width of approximately 4 m (Table 5.7). Flow during the second survey appeared normal and widths ranged from 9 m to 0.5 m (Table 5.8).



Figure 5.54 Photograph of Site BA19, taken June 17, 2014. Log obstruction at 270-m transect.

Stream aesthetics are described for both surveys in Tables 5.9 and 5.10. A pool was encountered during the first survey from the 0-m transect to the 190-m transect. The widest point of the pool was 8.5 m. The pool depth was 1 m. During the first survey aquatic vegetation and algae cover were absent; however, algae appeared common during the second survey. An odor was rarely encountered during the first survey; however, was non-existent during the second. The color of the water during the first survey was brown with scum on the surface. During the second survey though, the color appeared green and the surface was clear (Figure 5.55). The bottom deposit was a fine sediment.

Evidence of wildlife presence was observed during both surveys. Small fish, clam, turtle, and a snake were observed in the stream. Raccoon, feral hog, canine, and armadillo tracks were also seen. Fecal material from birds and feral hogs were noted as well as a snake skin and crawfish burrows. Large and small garbage were commonly seen during the first survey but were rare during the second. No bank garbage was observed (Tables 5.9 and 5.10). Among the garbage seen were plastic bags, glass, scrap metal, a 55 gallon plastic barrel, a television set, tires, a trap and a grill. ATV tracks were observed in the stream during the first survey (Figure 5.56). No other evidence of human recreation was observed at this site.



Figure 5.55 Photograph of Site BA19, taken August 8, 2014. Upstream view at 0-m transect.



Figure 5.56 Photograph of Site BA19, taken June 17, 2014. ATV tracks.

Physical Description of BA20

Bois D' Arc Creek at Site BA 20 was surveyed on June 17 and August 8, 2014. Access to this site was difficult as it was public at the bridge only with a private property fence restricting further access (Table 5.6). Landowner permission was required to complete the survey. Banks were steep, eroding, and slick (Figure 5.57). Debris in the channel, deep mud, and poison ivy also contributed to difficult access. During the second survey water levels were slightly lower, which made navigating the creek less difficult once in the stream. Stream banks were vegetated with large trees and some understory with improved pasture visible beyond the trees (Tables 5.5).



Figure 5.57 Photograph of Site BA20 taken August 8, 2014. Access at bridge crossing. Note steep, muddy, slick banks. TIAER staff in photo.

Bois D' Arc Creek at this site was wadeable. Average thalweg depth was approximately 0.4 m. Maximum width was 6.5 m and typical widths throughout the reach were 4 m during the first survey and 3 m during the second (Tables 5.7 and 5.8). Stream aesthetics are described for both surveys in Tables 5.9 and 5.10. During both surveys aquatic vegetation and algae cover were absent. An odor was rarely encountered during the first survey, but was non-existent during the second. The color of the water during both surveys was brown with scum/oil mix on the surface. The bottom deposit was a fine sediment.

Evidence of wildlife presence was observed during both surveys. Crawfish, frogs, and clams were species observed in the stream. Tracks of raccoon, feral hog, canine, possum, and bird were also seen. A turkey feather, a beaver gnawed limb, a feral hog skull, and bird droppings were also among the evidence of wildlife (Figure 5.58). Large and small garbage were common in the stream during the first survey but were non-existent and rare during the second. Bank garbage was rarely seen during both surveys (Tables 5.9 and 5.10). Large garbage included carpet and tires.

Other trash included scrap metal, glass bottles and other broken glass, aluminum cans, and a discarded car radio. No evidence of human recreation was observed at this site.



Figure 5.58 Photograph of Site BA20, taken June 17, 2014. Downstream view at the 150-m transect. Note steep banks, feral hog skull and bank/corridor conditions.

Physical Description of BA21

Bois D' Arc Creek at Site BA21 was surveyed June 16 and August 8, 2014. Access to this site was public at the bridge only and moderately difficult (Table 5.6). A private property fence restricted access to the channel and required landowner permission to conduct the survey (Figure 5.59). Steep banks, poison ivy, log jams and additional debris in the channel also contributed to difficulty in navigating the streambed (Figure 5.60). The vegetation immediately at the edge of the creek was forest but opened up to improved pasture beyond. The primary substrate was a mix of sand, silt, mud, and clay which made walking in the stream challenging (Tables 5.5 and 5.6).

This site was wadeable and observed flow appeared normal during both surveys (Tables 5.7 and 5.8). Widths were greater during the first survey, with a maximum width of 8.5 m and typical width of about 4 m. During the second survey, the maximum width was down to 6 m and the typical width was approximately 3 m (Tables 5.7 and 5.8). One pool was encountered during the first survey, which measured 18 m long, 8.5 m wide, and 1 m deep.



Figure 5.59 Photograph of Site BA21, taken June 16, 2014. Right bank view at the 300-m transect. Note access at bridge and private property fence.



Figure 5.60 Photograph of Site BA21, taken August 8, 2014. Large log jam obstructing access through creek. TIAER staff in photo.

Stream aesthetics are described for both surveys in Tables 5.9 and 5.10. During both surveys aquatic vegetation and algae cover were absent. An odor was rarely encountered during the first survey but was non-existent during the second. The color of the water during both surveys was brown with scum/oil mix on the surface (Figure 5.61), but more surface debris existed during the second survey. The bottom deposit was a fine sediment/sludge.



Figure 5.61 Photograph of Site BA21, taken August 8, 2014. Downstream view at the 0-m transect. TIAER staff in photo.

Wildlife and livestock were encountered during the surveys. Crawfish, small fish, turtles, and a cow were seen in the creek. Tracks of cattle, canine, bird, raccoon, and some unidentifiable were also observed. Fecal material reported included that of feral hog, bird, and livestock. A feral hog skull was also found as well as a branch fragment gnawed by a beaver. Garbage was observed during the surveys. Large garbage was rare but included some tires and remains of a chair. Plastic bags, glass bottles and jars, aluminum cans, cups, scrap metal, and a water hose were also observed in the channel (Tables 5.9 and 5.10). No evidence of human recreation was observed at this site.

Physical Description of BA22

Bois D' Arc Creek, at Site BA22, was surveyed on June 16 and August 8, 2014. This site was publically accessible at the bridge. Entering the creek was moderately difficult due to steep banks (Table 5.6). A silt and mud/clay substrate and various submerged objects caused some sinking and stumbling while walking in the stream (Table 5.5). Rip rap and concrete were also encountered at the 270-m transect as well as occasional debris piles along the stretch. One significant log jam was encountered at the 150-m transect, which impeded access through the stream channel (Figure 5.62). Forest vegetation existed immediately at the edge of the banks but opened up to pasture beyond. Poison ivy grew along the banks, as well.



Figure 5.62 Photograph of Site BA22, taken June 16, 2014. Downstream view at the 150-m transect. Note obstruction, garbage and bank vegetation.

Site BA22 was wadeable and flow appeared normal during both surveys (Tables 5.7 and 5.8). Two pools were encountered and were present during both surveys. One measured 30 m long, 6.2 m wide, and 0.9 m deep. The other measured 38 m long, 8.5 m wide, 1.2 m deep and was located near the 300-m transect. The typical width of the creek remained about 3 m during both surveys with maximum width of 10 m and minimum width of 0.7 m (Tables 5.7 and 5.8). The average thalweg depth for the first and second surveys were 0.4 m.

Stream aesthetics are described for both surveys in Tables 5.9 and 5.10. During both surveys, aquatic vegetation and algae cover were absent. An odor was rarely encountered during the first survey, but was non-existent during the second. The color of the water during both surveys was clear/brown and the surface was clear. The bottom deposit was a fine sediment/sludge. Wildlife was observed during the surveys and included turtles, clams, and crawfish. A cow observed on the bank was the only indication of livestock. Tracks of raccoon, bird, turtle, snake, and canine were seen in the channel. Other evidence of wildlife included bird droppings, clamshells, and crawfish burrows in the mud. Garbage was common at this site (Figure 5.63). Large numbers of tires were reported in the creek, as well as a mattress, springs, and a sink. Other small garbage included PVC pipe, a section of hose, various metal, cans, glass bottles, and other broken glass (Tables 5.9 and 5.10). No evidence of human recreation was observed at this site.



Figure 5.63 Photograph of Site BA22 taken June 16, 2014. Downstream view at the 0-m transect. Note garbage under bridge. TIAER staff in photo.

Physical Description of BA23

Bois D' Arc Creek, at Site BA23, was surveyed June 16 and August 8, 2014. Access to this site was public at the bridge crossing. A fence was observed on the right bank but did not affect access into or through the creek. The dominant substrate was a combination of sand, silt, mud, clay gravel and bedrock (Figure 5.64). The corridor was densely wooded and opened up to pasture beyond the riparian area. Banks were steep and, along some stretches, were denuded and eroding (Table 5.5). Rip rap, concrete, and areas of soft mud created unstable and varying terrain, which made navigation difficult overall. This site was wadeable and flow appeared normal during both surveys (Tables 5.7 and 5.8). Average thalweg depths were 0.3 m. Widths remained within about 1 m from one survey to the next and the typical width was 3.5 m.

Stream aesthetics are detailed in Tables 5.9 and 5.10 and did not change from one survey to the next, with the exception of garbage. Aquatic vegetation and algae cover were absent and no odor was detected. The water surface and coloration were clear and the bottom deposit was fine sediment with some solids (Figure 5.65). One pool was encountered during the second survey and measured 60 m long, 32 m wide and 0.4 m deep. Evidence of wildlife was minimal and included only raccoon tracks. Garbage was rare at this site but did include some broken glass, aluminum cans, a water hose, tires, plastic bags, scrap metal, some car parts, and a fragment of carpet. A plastic bucket was observed on the bank. Fish carcasses concentrated around a black garbage bag were encountered at the bridge (Figure 5.66). Larger garbage and debris included tires, scrap metal, and plastic in the stream (Tables 5.9 and 5.10). No evidence of human recreation was observed at this site.



Figure 5.64 Photograph of Site BA23, taken June 16, 2014. Downstream view at the 0-m transect. Note garbage under bridge and combination substrate. TIAER staff in photo.



Figure 5.65 Photograph of Site BA23, taken June 16, 2014. Downstream view at the 300-m transect. Note clarity of water surface, steep eroding banks and bank vegetation.



Figure 5.66 Photograph of Site BA23, taken June 16, 2014. Note fish carcasses.

Physical Description of BA24

Bois D' Arc Creek at Site BA24 was surveyed on June 16 and August 8, 2014. This site was publically accessible at the bridge only. Accessing the creek was moderately difficult as parking in the ditch beside the road was required and climbing through thick, thorny vegetation was necessary to reach the creek bottom (Figure 5.67). Once in the creek bottom the substrate consisted of sand, silt, mud, clay, gravel, and bedrock, which made navigating on foot challenging. Rip rap and concrete at the bridge also contributed to uneven terrain through which to walk. A fence was encountered bisecting the creek approximately 30 m from the bridge and a log/debris obstruction existed in the creek bed as well. Some forest vegetation grew immediately on both sides of the creek, including poison ivy, but quickly opened up to pasture beyond the riparian area (Tables 5.5).

This site was wadeable throughout the entire stretch. Flow appeared normal during the first survey, but did not appear to flow during the second survey (Tables 5.7 and 5.8). Average thalweg depths for the first and second survey were 0.3 m and 0.2 m, respectively. The maximum widths changed from 7.5 m during the first survey to 5 m during the second with the minimum widths being 0.3 m and 0 m. Typical average widths of this stream were about 2.3 m (Tables 5.7 and 5.8).

Stream aesthetics are outlined in Tables 5.9 and 5.10 for both surveys. Aquatic vegetation, algae cover, and odors were absent during both surveys. Water color and surface were both clear during both surveys, and the bottom deposit was a fine sediment/sludge during both surveys as well.



Figure 5.67 Photograph of Site BA24, taken August 8, 2014. Access point at bridge. TIAER personnel in photo.



Figure 5.68 Photograph of Site BA24, taken June 16, 2014. Upstream view at the 300-m transect.

Wildlife encountered during the surveys included a snake and a water dependent bird (Tables 5.9 and 5.10). Livestock/wildlife trails entered the channel at numerous locations along the survey stretch. Tracks of raccoon and cattle were seen in the mud as well as cattle manure and bird droppings. Large garbage was common to abundant during the two surveys and took the form of an entire vehicle frame and a water heater (Figure 5.69). Other garbage was rarely encountered but included tires, a television set, glass bottles, aluminum cans, general plastics, and other typical road garbage. No evidence of human recreation was observed at this site.



Figure 5.69 Photograph of Site BA24 taken August 8, 2014. Note large garbage in form of vehicle frame.

Physical Description of BA25

Bois D' Arc Creek at Site BA25 was established as a site located on private property and only accessible with permission from the landowner by entering through a private gate. Permission to access this site was initially granted by the landowner during a reconnaissance trip to the watershed. However, permission to access was rescinded during a courtesy phone call to the landowner before the first survey was conducted. Therefore, no data were collected nor photos taken at this site.

Physical Description of BA26

Bois D' Arc Creek at Site BA26 was surveyed June 16 and August 8, 2014. This site was publically accessible at the road crossing only. Access at the banks was moderately easy as banks were not very steep (Table 5.6). However, once in the channel, a private property fence bisected the creek so landowner permission was required to cross. Bank vegetation was thick throughout the reach and included poison ivy. The corridor was forest/shrub dominated but opened up to

cultivated pastures beyond the riparian area (Table 5.5). Debris in the channel was abundant. Four significant log jams that hindered travel through the creek were encountered during both surveys (Figure 5.70).



Figure 5.70 Photograph of Site BA26, taken June 16, 2014. Large log obstruction.

This site was wadeable during both surveys with flow appearing normal during the first survey and no flow during the second (Tables 5.7 and 5.8). Maximum widths varied between 4.5 m and 1.5 m during the first and second surveys, respectively. Typical widths were 1.5 m during the first survey and 0 m during the second survey. Thalweg depths averaged 0.2 m and 0.1 m from the first survey to the second survey, respectively.

Streams were very similar between surveys and are outlined in Tables 5.9 and 5.10. Aquatic vegetation was absent, algae was common, and there was no odor detected. The water surface was clear with some scum during both surveys, but the color of the water changed from clear to green between the first and second surveys. Creek bottom deposits were a fine sediment/sludge, which caused considerable sinking when walking through it.

Evidence of wildlife was observed during both surveys and included raccoon, feral hog, and canine tracks as well as raccoon feces. Crawfish burrows were seen in the mud. Large garbage in the channel was rare. Small garbage and bank garbage included a glass jar, trash bags, a few plastic pieces, a plastic 5 gallon bucket, tires, pieces of lumber, and a discarded tent (Figure 5.71). No evidence of human recreation was observed at this site.



Figure 5.71 Photograph of Site BA26, taken June 16, 2014. Upstream view at the 150-m transect. Note yellow 5 gallon bucket in stream.

Observation and Interviews

Activities Observed

During each RUAA survey, field personnel visited the sites on days and during times when recreational activities were more likely to be observed. Eighteen of the twenty-six selected sites were at road crossings that provided public access, although at eight of these properties fencing across the creek hindered further access and required landowner permission to continue with the surveys. The remaining eight selected sites were on private property but surveys were conducted at only six of these locations. At Site BA05, dense vegetative growth that occurred between the reconnaissance trip in the early spring and the first RUAA survey in June made this site inaccessible. While TIAER personnel were initially granted permission from the landowner to conduct the RUAA at Site BA25, this permission was rescinded prior to the time of the surveys.

No primary contact recreational activities were observed by TIAER employees at any of the sites during the field surveys. Secondary contact recreation in the form of fishing was observed by TIAER personnel at Site BA01. Tire tracks from an all-terrain vehicle were observed in the stream at Sites BA17 and BA19. Discarded fishing reels were observed at Sites BA09 and BA12; however, they did not appear to be in working order and were considered garbage or flood debris.

Activities Interviewed

Interviews were conducted with landowners along Bois D' Arc Creek as well as other persons of interest. A total of ten interviews were collected. No primary contact recreational activities, such as swimming, were identified from these interviews (Table 5.11).

During the second survey, TIAER personnel observed individuals fishing at BA01. One person interviewed at that time indicated having fished and observed fishing from that site, downstream to the Red River. Canoeing was also indicated as having been seen for the specified area as well. Perceived fishing on Bois D' Arc Creek in general was also indicated by this interviewee. A second interviewee also mentioned having hunted and heard of people hunting at Site BA01 and included that they had seen hunting from BA01 through BA11 in association with road crossings. Additionally, the individual had fished at this site and had heard of fishing from BA01 to BA03 as well.

A property owner in the vicinity of BA08 mentioned personally hunting at and near this site over the past 50+ years. Another property owner at sites BA17 and BA18 reported having fished and seen fishing at these sites. An interviewee familiar with Site BA22 for 60 years reported having squirrel and feral hog hunted near this site but did not have any other knowledge of anyone using the creek. Another property owner in the vicinity of BA23 reported having hunted near this site and also reported having heard of hunting and fishing occurring throughout Bois D' Arc Creek and the Red River in general. A second interviewee also referred to having personally hunted at BA23, but also mentioned that there are no other recreational uses at this site.

Two interviews were given that referenced the creek in general. Observed and perceived hunting, fishing and boating/canoeing were reported to occur primarily between Bonham and the Red River. This interviewee also mentioned hunting from a boat in the creek. An owner of property on an undisclosed part of the creek for 50 years indicated having hunted and fished the creek in the 1960s, but this activity is not included in the table because it is beyond the historical scope of this project.

Table 5.11 and Figure 5.72 summarize the types of recreation indicated from interviews.

Table 5.11 Summary of interviews from Bois D' Arc Creek.

Activities are listed as the number of times personal use, observed use, or heard of use was documented from interviews for a given location or general to the assessment unit. Blank cells indicate no interviewed feedback for that location. An * indicates recreation at multiple sites from one interview forms.

Site Name	Number of Interviews	Swimming	Adult Wading	Children Wading	Hunt	Fish	Boat , Canoe, Kayak
BA01	2 ^a				1,1,1	2,1,2	1,1,0
BA02					*,*,*	*	
BA03					*,*,*	*	
BA04							
BA05							
BA06					*,*,*		
BA07					*		
BA08	1				1,0,0		
BA09							
BA10							
BA11					*,*,*		
BA12							
BA13							
BA14							
BA15							
BA16							
BA17	1 ^b					1,1,0	
BA18						*,*,0	
BA19							
BA20							
BA21							
BA22	1				1,0,0		
BA23	2				2,0,1	0,0,1	
BA24							
BA25							
BA26	1						
General AU	2				0,2,1	1,3,2	0,3,1
Totals	10				5,3,3	3,4,4	0,3,1

^a One interviewee also provided information pertaining to Site BA02, BA03, BA06, BA11, BA12, BA14 and BA15

^b One interviewee also provided information pertaining to Site BA18

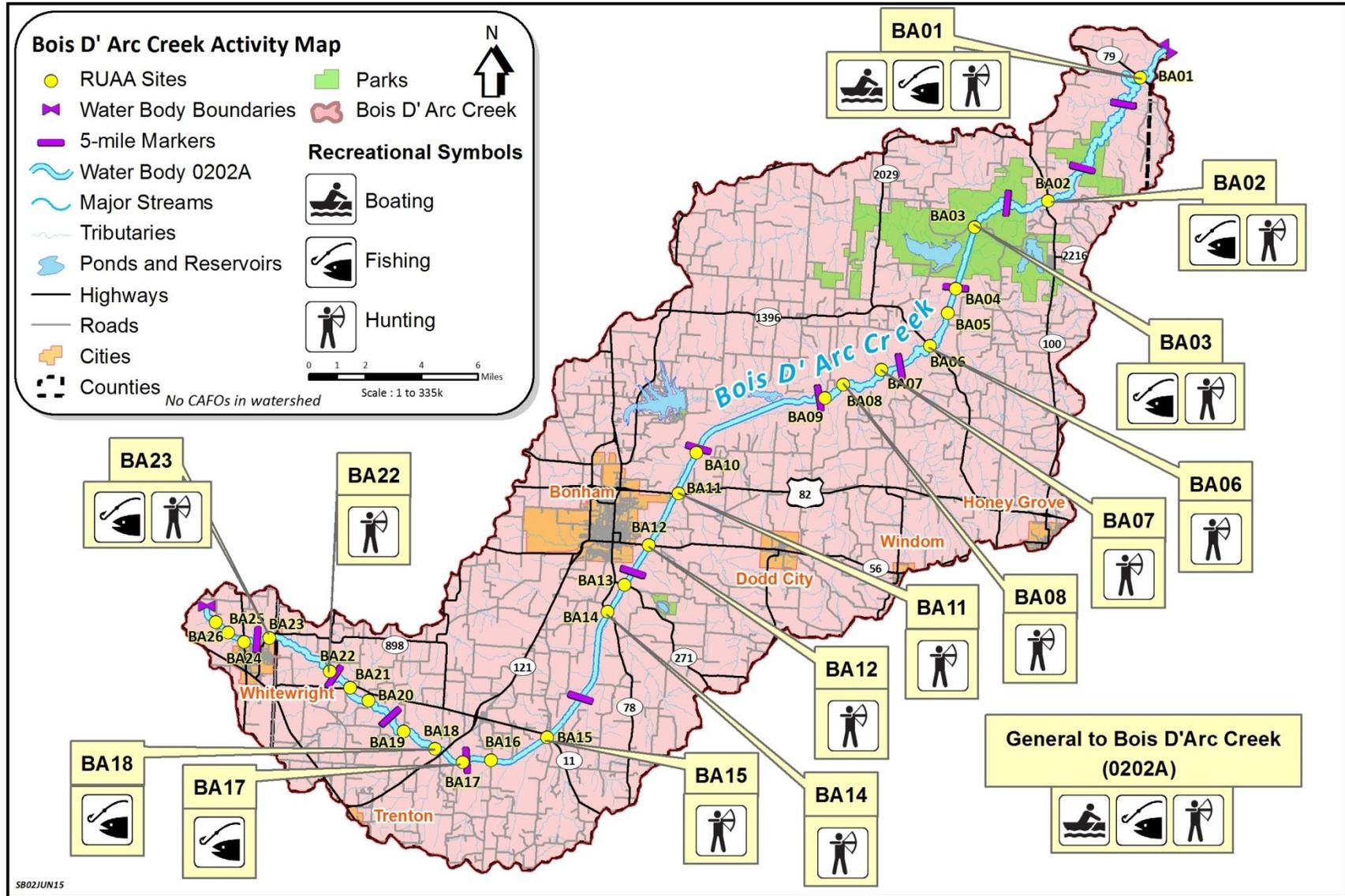


Figure 5.72 Summary of observed and interviewed human activities on Bois D' Arc Creek.

Summary

RUAA surveys were conducted at twenty-four sites along Bois D' Arc Creek (0202A) on June 16-18, 2014 and August 8-10 and 13, 2014. Temperatures were above 21°C (70°F) during the 30 days prior to each survey. For about 83 percent of sites visited in June, flow conditions were normal. In August, only 59 percent of sites visited had normal flow conditions, with approximately 41 percent of the sites having low to no-flow. The Palmer Drought Severity Index (PDSI) represented near normal conditions during the first survey in June 2014 and mild drought during the second survey in August 2014 (TWDB, 2014).

During the two surveys, TIAER employees did not observe any primary contact recreational activities at any of the sites. Secondary contact recreation in the form of fishing was observed by TIAER personnel at Site BA01. Recreational activities reported by interviewees are summarized in Figure 5.33 and the overall RUAA findings are summarized in the form below.

While conducting the stream surveys, no parks, playgrounds, biking trails, or campgrounds were encountered that would promote recreation. However, a rudimentary boat ramp did exist at Site BA01 and a golf course existed on the west bank of Bois D' Arc Creek, on the upstream side of the Highway 82 bridge just east of Bonham, Texas. Site BA03 was located within the Caddo National Grasslands, which Bois D' Arc Creek flows through. While recreational activities such as hunting, camping, and fishing are promoted within the Caddo National Grasslands, there are no features promoting these activities in association with Bois D' Arc Creek.

RUAA Summary

Name of water body: Bois D' Arc Creek

Segment No. of Nearest Downstream Segment No.: 0202

Classified?: No

County: Grayson, Fannin, and Lamar

1. Observations on Use

a. Do primary contact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

b. Do secondary contact recreation 1 activities occur on the water body?

frequently seldom not observed or reported unknown

c. Do secondary contact recreation 2 activities occur on the water body?

frequently seldom not observed or reported unknown

d. Do noncontact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

2. Physical Characteristics of Water Body

a. What is the average thalweg depth? 0.48 meters

b. Are there substantial pools deeper than 1 meter? Yes No

c. What is the general level of public access?

easy moderate very limited

3. Hydrological Conditions of site visits (Based on Palmer Drought Severity Index)

Mild-Extreme Drought

Incipient dry spell

Near Normal

Incipient wet spell

Mild-Extreme Wet

Chapter 6

Smith Creek

(0202G)

Watershed Characteristics

The Smith Creek watershed covers 4,800 acres and encompasses the city of Paris (estimated population 24,912) (Figure 6.1). Smith Creek is a tributary of Pine Creek in the Red River Basin. The watershed area is distinguished by fine-textured, clayey soils. (Griffith, et. al., 2007). Using US Highway 82, which runs east and west through the county, as a dividing line, soils in the North half of the county are primarily sandy or clay loams while those in the South half are clays (River Valley Properties, 2001). The soil directly surrounding Smith Creek is comprised of slowly, permeable loamy soils on uplands (Source USDA, 1979).

The Smith Creek watershed lies within the Texas Blackland Prairie (35b) ecoregion (Griffith, et al., 2007) and much of the watershed is used as an industrial overland flow land (OFL) treatment system. Average rainfall for the region is 47 inches, annually (U.S. Climate Data- Paris, Texas, 2015). Mean, minimum and maximum temperatures for the region range from 32 to 54degrees Fahrenheit in the southern region in January and 73 to 96degrees Fahrenheit in July (U.S. Climate Data- Paris, Texas, 2015). The Smith Creek watershed has an equal distribution of deciduous forest (27 percent) and herbaceous (27 percent) land cover (Figure 6.2). The City of Paris is responsible for the 27 percent of developed land within the watershed. While neither are directly on the Smith Creek water body, there are two parks located in the watershed within the City of Paris boundaries. The Campbell Soup Supply LLC is a large landholder within the Smith Creek watershed. The Campbell Soup property comprises approximately 1,271 acres.

Designated Uses, Impairments and Concerns

Smith Creek consists of one assessment unit, AU 0202G_01, that is classified as intermittent and has presumed uses of primary contact recreation, general use, and fish consumption with limited aquatic life use (TCEQ, 2013). The water body was first listed impaired for bacteria on the 2006 Texas 303(d) list. Concerns also noted for AU 0202G_01 include elevated ammonia, total phosphorus, and orthophosphorus.

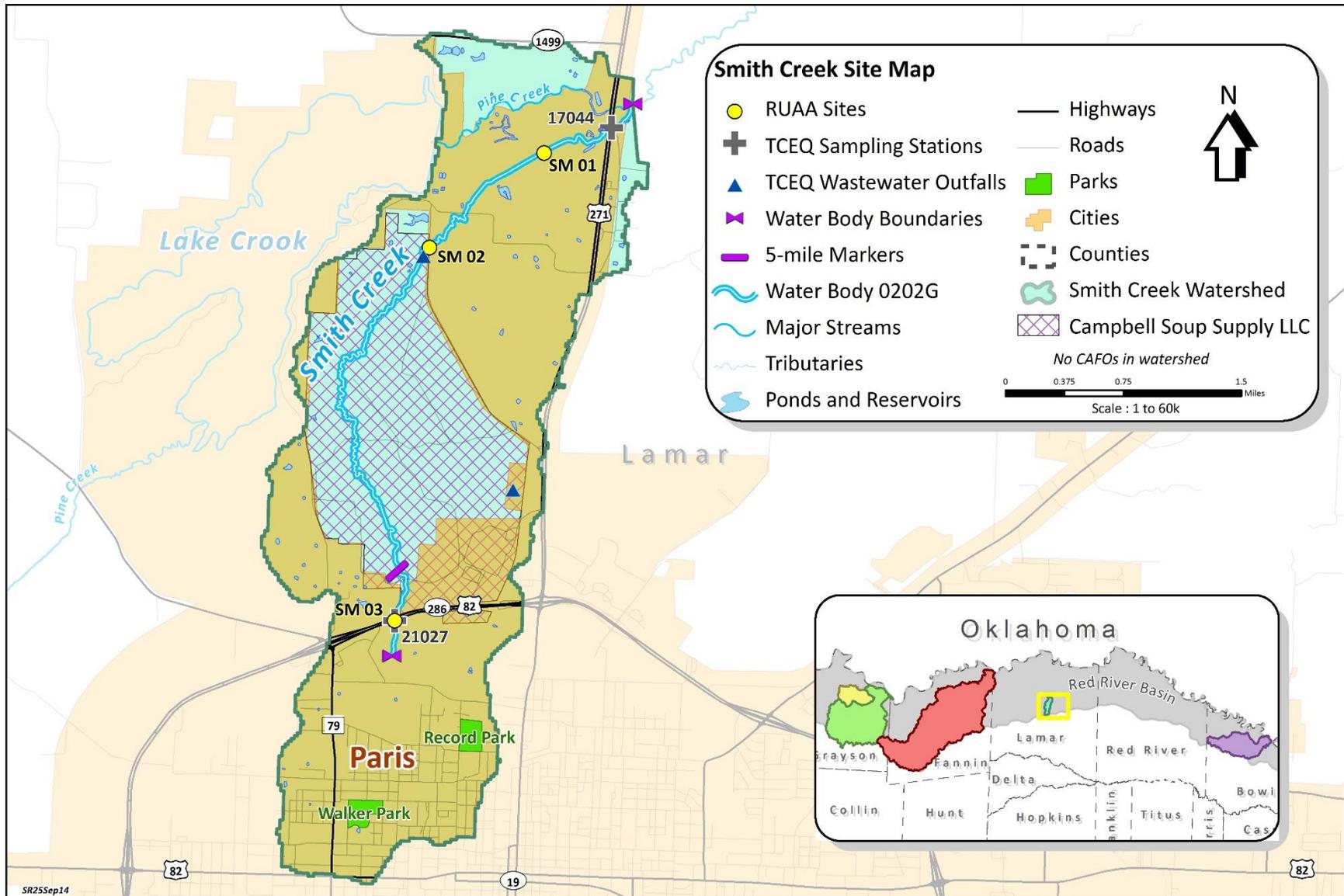


Figure 6.1 Overview of Smith Creek watershed and RUAA sites.

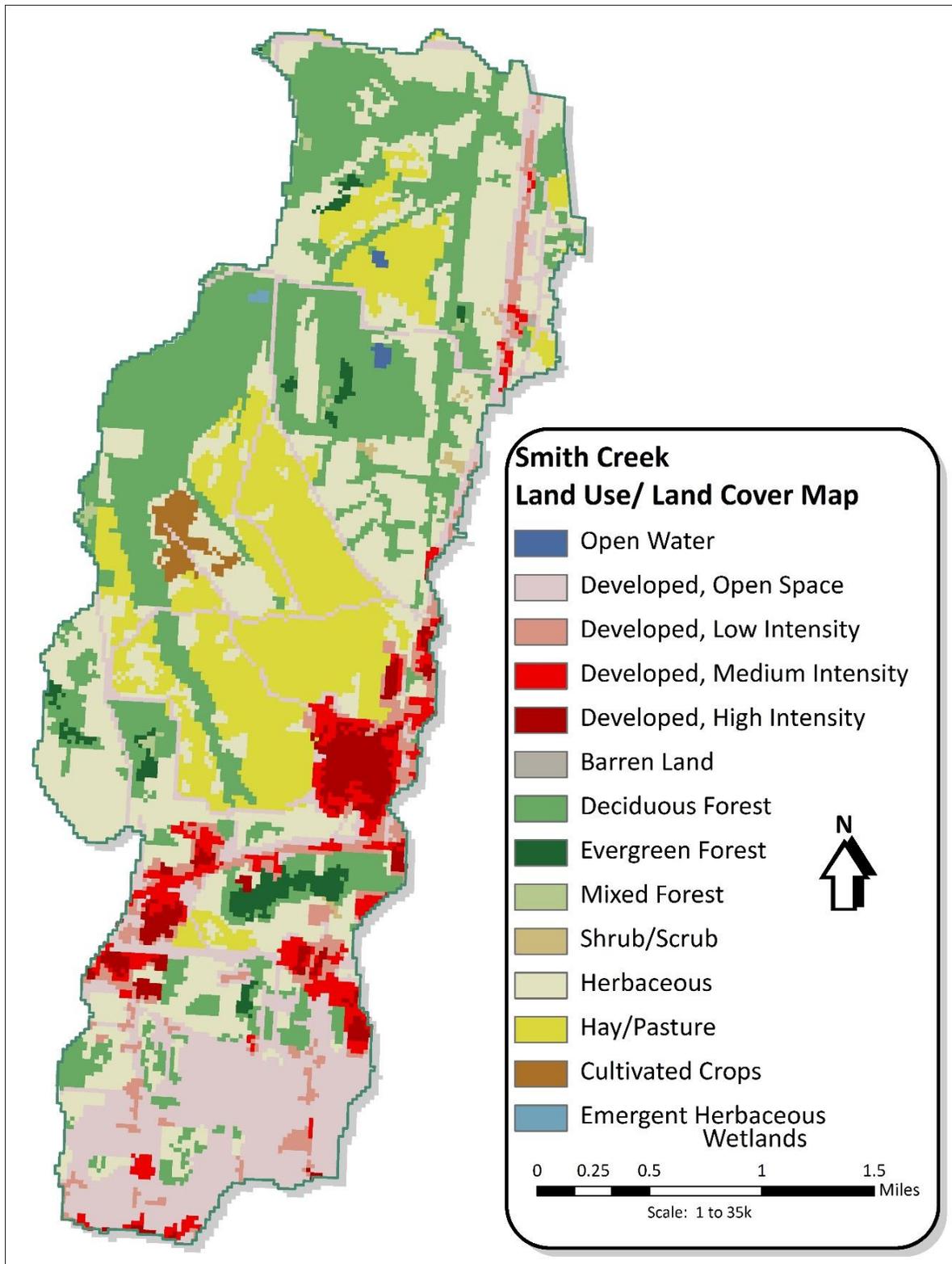


Figure 6.2 Land use/land cover for the Smith Creek watershed. Source: 2006 National Land Cover Database (USGS, 2013).

Permitted Discharges

There are two permitted facilities within the Smith Creek watershed that discharge directly or indirectly to Smith Creek, The Campbell Soup Paris Plant and the Paris Energy Generation Plant.

The Campbell Soup Paris Plant (TX0008982) is the largest discharger in the watershed area and has a permitted average daily discharge of 10 MGD. The plant is located at 500 Route 286, Paris, Texas 75460 and discharges directly into Smith Creek.

The Paris Energy Generation Plant (TX0103586), located in Paris, Texas, is permitted to discharge a low amount of industrial stormwater. The plant discharges into an unnamed tributary that then flows into Smith Creek.

There are no concentrated animal feeding operations (CAFO) within the Smith Creek watershed with a general permit.

Non-Permitted Agricultural Activities and Domesticated Animals

Activities such as livestock grazing close to waterbodies and agricultural use of manure as fertilizer, can contribute to the bacteria levels in nearby waterbodies. To provide an estimate of livestock densities in the watershed, livestock statistics were obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service website from the 2012 survey (USDA, 2012). These statistics, on a county level, indicate large numbers of beef cattle in Lamar County, and, thus, likely within the watershed area.

Table 6.1 Estimated livestock numbers within the Smith Creek watershed based on statistics adjusted for the percent of the county within the watershed. (Source USDA, 2012).

The Smith Creek watershed, in its entirety, covers about 1% of Lamar County.

County	Year	Cattle & Calves (all beef)	All Goats	Mules, Burros, & Donkeys	Horses & Ponies	Feral hogs
Lamar	201	77,045	1,548	293	2,609	197
Smith Creek Watershed Average	2012	3,483	70	13	118	9

Domestic pets are another unregulated source of *E. coli* bacteria, particularly dogs, because storm runoff often carries these wastes into streams (EPA, 2009). Assuming a rough estimate of 0.584 dogs per household (AVMA, 2012) and about 1,065 households within the Smith Creek watershed based on 2010 census population data, there are potentially about 622 dogs within the Smith Creek watershed. Other domestic animals, such as outdoor cats, can also contribute to bacterial pollution; however, cat populations are difficult to estimate because in many rural areas cats are often feral.

Wildlife and Feral Hogs

Other possible bacteria contributors include wildlife, such as deer, feral hogs, and birds. In 2013 statewide population estimated roughly 39 whitetail deer per 1,000 acres. This estimation suggests that the population for whitetail deer in the Post Oak Savannah region is roughly 400,000 deer, or 35 deer per 1,000 acres (Cain, 2014). Feral hogs are an invasive species commonly found throughout Texas. They have been known to travel in large groups along waterways and congregate near shallow depressions of water. Statewide feral hog densities range from an estimated average of 1.33 to 2.45 feral hogs per square mile (AgriLife, 2011).

Failing On-Site Sewage Facilities

Septic systems or on-site sewage facilities (OSSFs) are often used in rural areas that do not have the ability to connect to a central wastewater collection system. To estimate the number of potential OSSFs in the watershed, a GIS layer associated with the sewer Certificates of Convenience and Necessity (CNNs) from the Public Utility Commission of Texas was used. As not all cities with WWTFs have CNNs, the CNN layer was supplemented with a GIS layer representing municipal boundaries for those cities with WWTFs. Population data from the U.S. Census Bureau (USCB) were then overlaid masking out areas that should be serviced by WWTFs. Of the (1,000) households in the Smith Creek watershed, 1.7% were indicated as outside of the municipal areas serviced by WWTFs and, thus, likely on septic systems.

Historical Review

A review of historical information regarding recreational use of Smith Creek was conducted. The review considered the time period of November 28, 1975 to the present in accordance with 40 CFR Part 131 (EPA standards regulation). Government offices, libraries, historical societies, and newspapers were searched and contacted in addition to generic internet searches. The following is a summary of the review.

Government Sources

City of Paris

City of Paris Homepage

[City of Paris Homepage](#)⁴²

Nothing of significance was found pertaining to the historical use of Smith Creek.

Library Sources

Paris Public Library

[City of Paris Library Homepage](#)⁴³

Phone: (903) 785-8531

Explored various links and online texts. Nothing significant was found.

Newspaper Sources

The Paris News

[The Paris News Homepage](#)⁴⁴

Phone: (903) 785-8744

Explored various links and online texts. Nothing significant was found.

Internet Searches

The Handbook of Texas Online

[The Handbook of Texas Online, Smith Creek Search](#)⁴⁵

Nothing was found.

⁴² <http://www.paristexas.gov/>

⁴³ <http://www.paristexas.gov/index.aspx?NID=89>

⁴⁴ <http://theparisnews.com/>

⁴⁵ [https://tshaonline.org/handbook-search-results?arfarf=Smith%20Creek%20\(bowie%20County\)](https://tshaonline.org/handbook-search-results?arfarf=Smith%20Creek%20(bowie%20County))

Survey Site Descriptions

Smith Creek (0202G) is just under 6 river miles long, which indicates a goal of 3 sites (3 sites per 5 miles of river) for the RUAA survey (Figure 6.1). With the help of cooperating stakeholders, TIAER was able to establish a total of 3 sampling stations along Smith Creek (Table 6.2).

Of the 3 sites used for RUAA field surveys, 2 were located at public road crossings. One of these sites required landowner permission to access the entire 300 m stretch of the survey, while the other site was at a public road crossing but private property fencing prevented legal access to the creek from the bridge and, therefore, required landowner permission to gain access. The third site is located approximately 0.6 miles from the public road, on private property where access is restricted by fences, and a locked gate that required landowner assistance to unlock. The average distance between survey sites was 2.23 river miles and ranged from 1.16 to 3.47 miles. The largest gap between survey sites of 3.47 river miles was between SM02 and SM03, the majority of which is owned by Campbell Soup Supply LLC, which denied TIAER access. RUAA surveys were performed May 16, 2014 and July 11, 2014 at these locations. A brief description of each site follows.

Table 6.2 Description and location of RUAA field survey sites for Smith Creek, Water Body 0202G.

Site ID	TCEQ ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi)¹	Distance from Confluence (mi)¹	Distance from Upper Reach (mi)¹	Access
SM01		Smith Creek on private property	33.72604	-95.5555	N/A	0.76	4.86	Private
SM02		Smith Creek at Lake Crook Road	33.71886	-95.5676	1.16	1.91	3.7	Public*
SM03	21027	Smith Creek at Loop 286/Hwy 82	33.68445	-95.5704	3.47	5.38	0.23	Public*

* indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property.

¹Distances were digitally estimated using the measuring tool in ArcGIS 9.3 with the 2010 NAIP 1-m DOQQs and the NHD stream layer as reference guides.

Site SM01 is the most downstream site located on Smith Creek, 0.76 miles from the confluence with Pine Creek. This site is on private property, approximately 0.6 mile off Old Lake Crook Road (County Road 2900), where access is restricted by fences and a locked gate.

Site SM02 is located on Smith Creek at Lake Crook Road, 1.91 miles from the confluence with Pine Creek. This site is publically accessible at the bridge only with a private property fence restricting further access. Landowner permission allowing across-fence access away from the road crossing was required to complete the survey.

Site SM03 is located on Smith Creek at Loop 286/Hwy 82, 5.38 miles from the confluence with Pine Creek. This site is publically accessible at the bridge; however, landowner permission to access was still attained to complete the survey.

Field Survey Results and Discussions

General Description of RUAA Survey Sites and Conditions for Water Body 0202G

The Smith Creek RUAA surveys were conducted on May 16, 2014 and July 11, 2014. The surveys were performed on weekdays, weekends, or holidays at opportune times to observe recreational activities along Smith Creek. Air temperatures prior to and during both first and second surveys, were above 21° C (70° F) which is indicated by the RUAA guidelines as warm enough to promote recreational activities (Tables 6.3 and 6.4). Notably warmer temperatures occurred in July than in May. In the 30 days prior to the May surveys there was 6.10 inches of precipitation, while 1.51 inches fell in the 30 days prior to July surveys.

A summary of the RUAA field survey results is presented in the following tables:

- Table 6.5 describes the stream channel and corridor characteristics at each site.
- Table 6.6 notes the average thalweg depth by site during each survey and the access to the stream, whether public or private, and the ease of bank access.
- Tables 6.7 and 6.8 document the maximum, minimum, and average stream widths at each site for each survey and observed flow conditions.
- Tables 6.9 and 6.10 note stream aesthetics, wildlife observations and tracks, and the presence of garbage observed at each site during each survey.

Physical descriptions of each site follow these tables along with selected photos showing notable characteristics of each site. Overall thalweg depth averaged 0.58 m during the first survey and 0.51 m during the second survey. Access to the stream was difficult in most locations due to dense vegetation and steep banks. The dominant substrate was mud/clay and the stream corridor was largely lined with trees and shrubs. The maximum stream width encountered was 28 m during the first survey in May 2014 and 20 m during the second survey in July. Flow conditions were normal during both surveys. The water surface was typically clear with an occasional oily sheen. The water encountered was typically clear, but sometimes brown in color. Tracks observed most often included birds, raccoon, deer and feral hogs. Trash was rarely observed at most survey sites and when observed was predominantly typical plastics, aluminum cans, and bottles. Trash on private lands was rare and appeared to have washed up during high flow periods.

Table 6.3 Rainfall records with maximum and minimum temperature for Paris, Texas 30 days prior to the first RUAA survey initiated on May 11, 2014.

Survey dates are highlighted in grey. Data obtained from Weather Underground for Paris weather station KPRX.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
16-Apr-14	0.00	64	39
17-Apr-14	0.00	66	42
18-Apr-14	0.00	73	48
19-Apr-14	0.00	77	50
20-Apr-14	0.36	78	55
21-Apr-14	0.93	75	60
22-Apr-14	0.00	78	57
23-Apr-14	0.00	82	55
24-Apr-14	0.04	80	59
25-Apr-14	0.00	78	48
26-Apr-14	0.00	84	53
27-Apr-14	0.01	82	68
28-Apr-14	0.00	75	59
29-Apr-14	0.00	71	51
30-Apr-14	0.00	64	46
1-May-14	0.00	69	42
2-May-14	0.00	75	46
3-May-14	0.00	82	48
4-May-14	0.00	87	55
5-May-14	0.00	84	57
6-May-14	0.00	84	60
7-May-14	0.00	80	66
8-May-14	3.52	73	62
9-May-14	0.14	82	62
10-May-14	0.00	84	64
11-May-14	0.00	84	69
12-May-14	0.81	84	57
13-May-14	0.01	62	53
14-May-14	0.28	64	48
15-May-14	0.00	75	44
16-May-14	0.00	75	51

Table 6.4 Rainfall records with maximum and minimum temperature for Paris, Texas 30 days prior to the first RUAA survey initiated on July 11, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for Paris weather station KPRX.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
11-Jun-14	0.00	87	60
12-Jun-14	0.00	82	69
13-Jun-14	0.00	87	66
14-Jun-14	0.00	87	69
15-Jun-14	0.29	89	73
16-Jun-14	0.00	91	73
17-Jun-14	1.22	91	73
18-Jun-14	0.00	91	71
19-Jun-14	0.00	89	71
20-Jun-14	0.00	91	71
21-Jun-14	0.00	89	73
22-Jun-14	0.00	82	73
23-Jun-14	0.00	87	73
24-Jun-14	0.00	91	66
25-Jun-14	0.00	84	71
26-Jun-14	0.00	89	69
27-Jun-14	0.00	86	69
28-Jun-14	0.00	91	73
29-Jun-14	0.00	91	77
30-Jun-14	0.00	93	75
1-Jul-14	0.00	93	71
2-Jul-14	0.00	87	71
3-Jul-14	0.00	86	71
4-Jul-14	0.00	87	66
5-Jul-14	0.00	87	66
6-Jul-14	0.00	93	69
7-Jul-14	0.00	95	71
8-Jul-14	0.00	95	75
9-Jul-14	0.00	91	73
10-Jul-14	0.00	95	71
11-Jul-14	0.00	95	73

Table 6.5 Stream Channel and corridor characteristics for each site along Smith Creek (0202G).

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
SM01	Natural	Mud/Clay	Pasture/Shrub	Large	No	Native/Improved Pasture
SM02	Natural	Silt/Mud/Clay	Forest/Shrub/Pasture	Large	No	Native
SM03	Natural	Mud/Clay	Forest/Shrub/Pasture	Large	No	Native

Table 6.6 Thalweg depth, stream flow type, and site accessibility during the two surveys of Smith Creek (0202G).

Stream flow type represents TCEQ descriptions (TCEQ, 2014). Under general access, * indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property. For bank access, E = Easy, ME = Moderately Easy, MD = Moderately Difficult, and D = Difficult.

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
SM01	300	11	0	0.43	0.40	Perennial	Private	D
SM02	300	11	0	0.49	0.45	Perennial	Public*	D
SM03	300	11	0	0.82	0.68	Perennial	Public*	MD

Table 6.7 Description of surveyed stream sites along Smith Creek during first survey, performed in May 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
SM01	7	0.5	3	Normal
SM02	9	2	6	Normal
SM03	28	0.2	5	Normal

Table 6.8 Description of surveyed stream sites along Smith Creek during second survey, performed in July 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
SM01	4.5	3.5	4	Normal
SM02	9	2	4	Normal
SM03	20	0.2	4.5	Normal

Table 6.9 Stream aesthetics along Smith Creek during first survey, performed in May 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
SM01	A	A	C	Clear	Fine Sediment	Clear	SP	N	SP	Tracks	N	R	N
SM02	A	A	N	Clear/ Brown	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Fecal/Nests	R	R	R
SM03	R	R	N	Brown	Fine Sediment/Sludge	Clear	SP	N	N	Tracks/Fecal	R	C	A

Table 6.10 Stream aesthetics and wildlife observations along Smith Creek during the second survey, performed in July 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
SM01	A	A	C	Brown	Solids	Clear	N	N	N	Tracks/Fecal	R	R	R
SM02	C	C	R	Clear/ Brown	Solids/Sludge	Clear	N	N	N	Tracks/Fecal	R	R	R
SM03	Ab	R	R	Clear	Solids/Sludge	Clear/ Oil	N	SP	SP	Tracks/Fecal	R	C	R

Physical Description of SM01

Smith Creek at site SM01 was surveyed on May 16 and July 11, 2014. Access to this site was difficult because stream banks were high, nearly vertical, and required assistance from roots or ropes to climb into and out of the creek. Additionally, landowner permission was required to access the creek through a locked gate.

Slick mud/clay in the creek bottom caused considerable loss of traction when walking the creek (Tables 6.5 and 6.6). In addition, this site had dense vegetation and steep banks. Forested banks were characterized by Bois D' Arc trees and elm trees. Log jams were obstacles to be avoided when walking this stretch of the stream.

The stream was wadeable with water levels averaging 0.4 m during the first and second survey (Table 6.6). The stream had an average width of 3 m during the first survey, and 4 m during the second survey (Tables 6.7 and 6.8). Stream flow appeared normal during both surveys (Tables 6.7 and 6.8).

The stream channel was naturally vegetated, primarily with Bois D' Arc, elm trees and herbaceous vegetation. Banks were steep and slick in some places making travel up the banks difficult to impossible. Algae cover was absent. The color of the water body was clear and a foul odor was common throughout the stretch. Raccoon tracks and gnaw marks on trees from beavers were observed as well as snakes, crawfish, turtles, frogs, and clams. Various types of wildlife feces were observed as well. Garbage such as tires, glass bottles, cans, and general plastics in the stream were present but rare (Table 6.9 and 6.10). No evidence of human recreation was observed.



Figure 6.3 Photograph of Site SM01, taken May 16, 2014. Upstream view of the 150-m transect.



Figure 6.4 Photograph of Site SM01, taken May 16, 2014. Downstream view at 180-m transect. Note log obstruction, dense vegetation and steep banks.

Physical Description of SM02

Smith Creek at site SM02 was surveyed on May 16 and July 11, 2014. Access to this site occurred at a public road crossing. However, access into the stream was moderately difficult because it required landowner permission to cross a fence that bisected the creek, in addition to dense vegetation, steep banks, and poison ivy (Tables 6.5 and 6.6). Forested banks were characterized by elm, oak and Bois D' Arc trees in addition to thick regrowth and herbaceous vegetation making bank access to the 300 m stretch difficult. Travel through the stream corridor was difficult due to the slick clay bottom, deep mud in places, large obstacles of downed trees, and bisecting utility pipe.

The stream was wadeable with water levels averaging 0.49 m for the first survey and 0.45 m for the second survey (Table 6.6). The stream had an average width of 6 m during the first survey, and 4 m during the second survey. Stream flow appeared normal during both surveys (Tables 6.7 and 6.8).

The stream channel was naturally vegetated with a variety of shrubs and trees at the banks, clearing out to pasture beyond the right bank (Table 6.5). The water surface was clear with a brown coloration and during the second survey a foul odor was detected at times (Table 6.9 and 6.10). No wildlife was observed; however, feral hog tracks and bird feces were seen. Although garbage was rare, a tire, small metal, and some bottles were noted (Tables 6.9 and 6.10). Notable obstructions encountered that bisected the creek were two large utility pipes and fallen trees (Figures 6.6 and 6.7). No signs of human recreation were observed.



Figure 6.5 Photograph of Site SM02, taken on July 11, 2014. Upstream view at 150-m transect.



Figure 6.6 Photograph of Site SM02, taken May 16, 2014. Large utility pipe obstruction and TIAER personnel.



Figure 6.7 Photograph of Site SM02, taken July 11, 2014, of large utility pipe.

Physical Description of SM03

Smith Creek at site SM03 was surveyed on May 16 and July 11, 2014. Access to this site was easy as it was located at a public road crossing. However, access into the stream was moderately difficult due to dense vegetation and deep mud (Table 6.5 and Figure 6.8). Travel down the stream was difficult because water depths approached 1 m deep in places, the bottom was muddy and banks were densely vegetated (Figure 6.9).

The stream was wadeable with average width of approximately 4.75 m during both surveys and an average thalweg depth of approximately 0.75 m. Flow appeared normal during both surveys (Tables 6.6, 6.7 and 6.8).

The stream was wadeable with water levels averaging 0.82 m during the first survey and 0.68 m for the second survey (Table 6.6). The stream had an average width of 5 m during the first survey, and 4.5 m during the second survey (Tables 6.7 and 6.8). Stream flow appeared normal during both surveys (Tables 6.7 and 6.8).



Figure 6.8 Photograph of Site SM03, taken on July 11, 2014. Downstream view at 150-m transect and TIAER personnel.



Figure 6.9 Photograph of SM03, taken on July 11, 2014. Downstream view at 300-m transect. Note significant corridor vegetation.

The stream channel was naturally vegetated with a variety of shrubs at the banks, clearing out to pasture beyond the left bank (Table 6.5). Some aquatic vegetation including cattails was common during the first survey and abundant during the second. The water surface was predominantly clear with a brownish coloration and an occasional foul odor (Tables 6.9 and 6.10). Birds, snakes, frogs, and crawfish were observed in the stream corridor. Tracks of raccoon, beaver, and water birds were observed, in addition to, some dead crawfish and clam shells. Feces of birds were seen as well. A beaver dam was also encountered at approximately 150 m which successfully caused water to be impounded behind it (Figure 6.10). Large garbage was observed at the bridge where it appears to have been discarded along with carcasses of various other animals including deer. Garbage consisted of tires, Styrofoam, aluminum cans, glass, and plastic bottles. No signs of human recreation were observed.



Figure 6.10 Photograph of Site SM03 of a beaver dam near the 150-m transect. Note water impounding on the left.

Observation and Interviews

Activities Observed

During each RUAA survey, field personnel visited the sites on days and during times when recreational activities were more likely to be observed. Two of the three selected sites were at road crossings that provided public access (although only at the bridge that crosses the stream). The remaining site was located on private property and TIAER personnel were granted permission from the landowner to conduct the RUAA at these locations.

No contact (primary or secondary) or noncontact recreational activities were observed by TIAER employees at any of the sites during the field surveys. No evidence of recreation was found at any of the sites.

Activities Interviewed

Interviews were conducted with landowners along Smith Creek as well as other persons of interest. A total of ten interviews were collected. No primary contact recreational activities were identified from these interviews (Table 6.11). One interview, conducted at a public meeting, indicated having seen adults wading at site SM02 during the warmer months of the year. This was the only recreational activity indicated through surveys and interviews.

Table 6.11 and Figure 6.11 summarize the types of recreation indicated from interviews.

Table 6.11 Summary of recreational activities noted in interviews for Smith Creek.

Activities are listed as the number of times for personal use, observed use, or heard of use was documented from interviews for a given location or the whole assessment unit. Blank cells indicate no interviewed feedback for that location. An * indicates and numbers indicate recreation reported from an interview for another site.

Site Name	Number of Interviews	Swimming	Adult Wading	Children Wading	Hunt	Fish	Boat , Canoe, Kayak
SM01	4 ^{ab}						
SM02	1		0,1,0				
SM03	1						
General AU	4						
Totals	10		0,1,0				

^aTwo interviewees also provided information pertaining to site SM02

^bTwo interviewees also provided information pertaining to site SM03

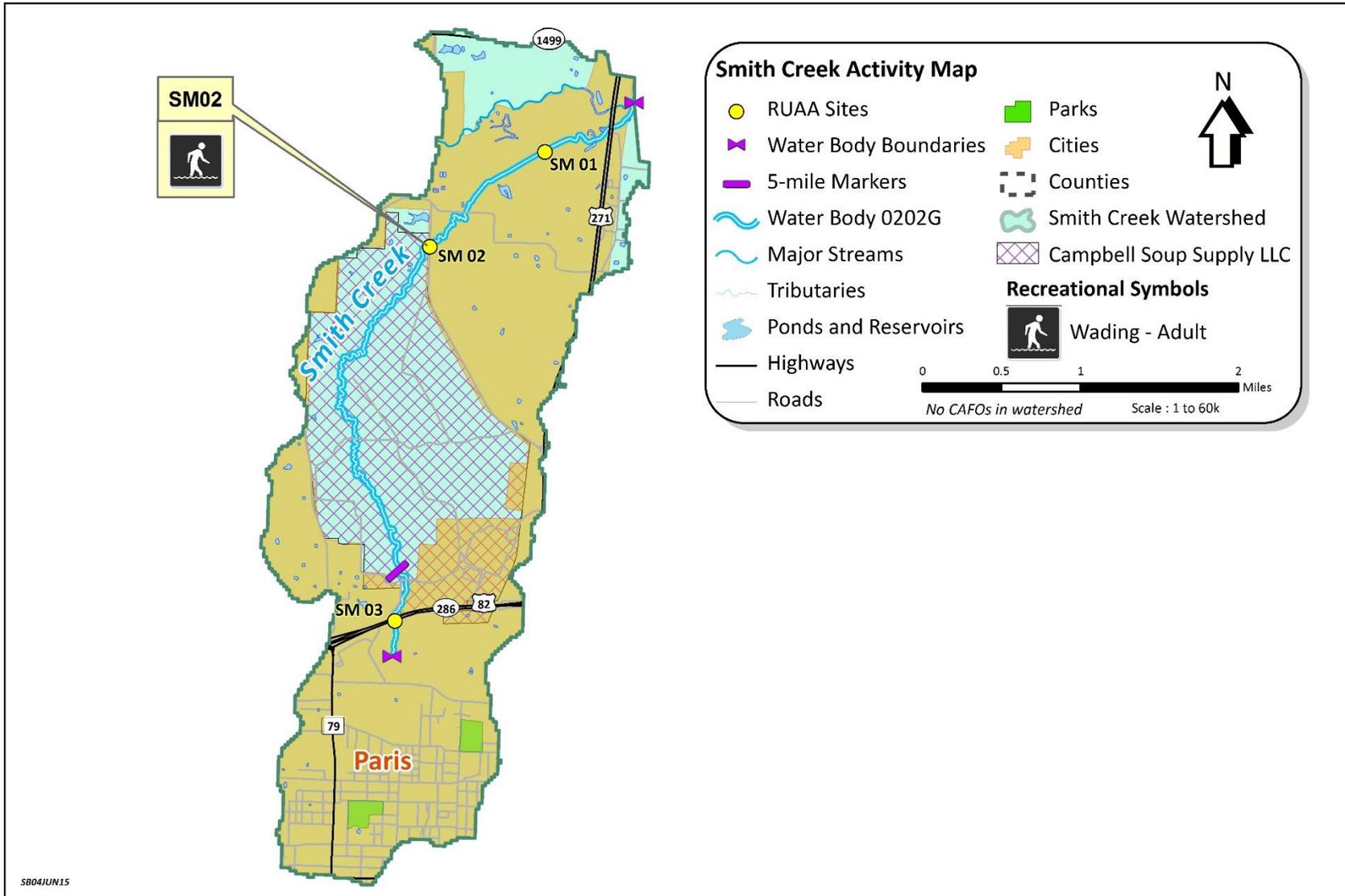


Figure 6.11 Summary of observed and interviewed human activities on Smith Creek.

Summary

RUAAs were conducted at three sites along Smith Creek (0202G) on the days of May 16, 2014 and July 11, 2014. Temperatures were above 21°C (70°F) during the 30 days prior to each survey. Stream flow was considered normal at all sites for both surveys. The Palmer Drought Severity Index (PDSI) represented moderate drought conditions during the first survey in May 2014 and mild drought conditions during the second survey in July 2014 (TWDB, 2014).

Recreational activities were not observed by TIAER field staff during either of the surveys. Additionally, there were no non-contact recreational activities observed during either survey. Recreational activities reported by interviewees are summarized in Figure 6.11 and the overall RUAAs findings are summarized in the form below.

No recreation-promoting characteristics such as boat docks, parks, playgrounds, biking trails, campgrounds, or sport fields were observed while conducting stream surveys.

RUAAs Summary

Name of water body: Smith Creek

Segment No. of Nearest Downstream Segment No.: 0202

Classified?: No

County: Lamar

1. Observations on Use

a. Do primary contact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

b. Do secondary contact recreation 1 activities occur on the water body?

frequently seldom not observed or reported unknown

c. Do secondary contact recreation 2 activities occur on the water body?

frequently seldom not observed or reported unknown

d. Do noncontact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

2. Physical Characteristics of Water Body

a. What is the average thalweg depth? 0.545 meters

b. Are there substantial pools deeper than 1 meter? Yes No

c. What is the general level of public access?

easy moderate very limited

3. Hydrological Conditions of site visits (Based on Palmer Drought Severity Index)

Mild-Extreme Drought

Incipient dry spell

Near Normal

- Incipient wet spell
- Mild-Extreme Wet

Chapter 7

Mud Creek

(0201A)

Watershed Characteristics

The Mud Creek watershed covers about 54,000 acres and encompasses the City of De Kalb (estimated population 1,658) (Figure 7.1). Mud Creek is a tributary of the Red River and flows 35.5 miles east to the confluence with the Red River, from two miles east of the community of Avery to three miles southeast of the Arkansas/Oklahoma border. The soils directly north of Mud Creek are slowly permeable, loamy soils and permeable clayey soils, while the soils south of the creek are predominantly slowly permeable, loamy soils (Source USDA, 1980). There are no parks located within the Mud Creek watershed.

The Mud Creek watershed lies within the Tertiary Uplands (35a) ecoregion (Griffith, et al., 2007). Average annual rainfall for the watershed is approximately 54 inches (U.S. Climate Data – De Kalb, Texas, 2015). Mean minimum and maximum temperatures range from 31 - 55 degrees Fahrenheit in January and 70 - 93 degrees Fahrenheit in July (U.S. Climate Data – De Kalb, Texas, 2015). The watershed is mostly rural with a land-use/land-cover that consists prominently of hay/pasture (32 percent) and forest (35 percent) (Figure 7.2). Woody wetlands are evident along the riparian areas of water body. Additionally, there is some developed landuse (< 5 percent), largely associated with the City of De Kalb (Figure 7.2).

Designated Uses, Impairments and Concerns

Mud Creek consists of one assessment unit, AU 0201A_01, that is classified as intermittent with pools and has presumed uses of primary contact recreation, general use, and fish consumption with a limited aquatic life use (TCEQ 2013). Mud Creek was first listed impaired for bacteria on the 2002 Texas 303(d) list. Other impairments for the water body include depressed dissolved oxygen with concerns for elevated chlorophyll-a and ammonia.

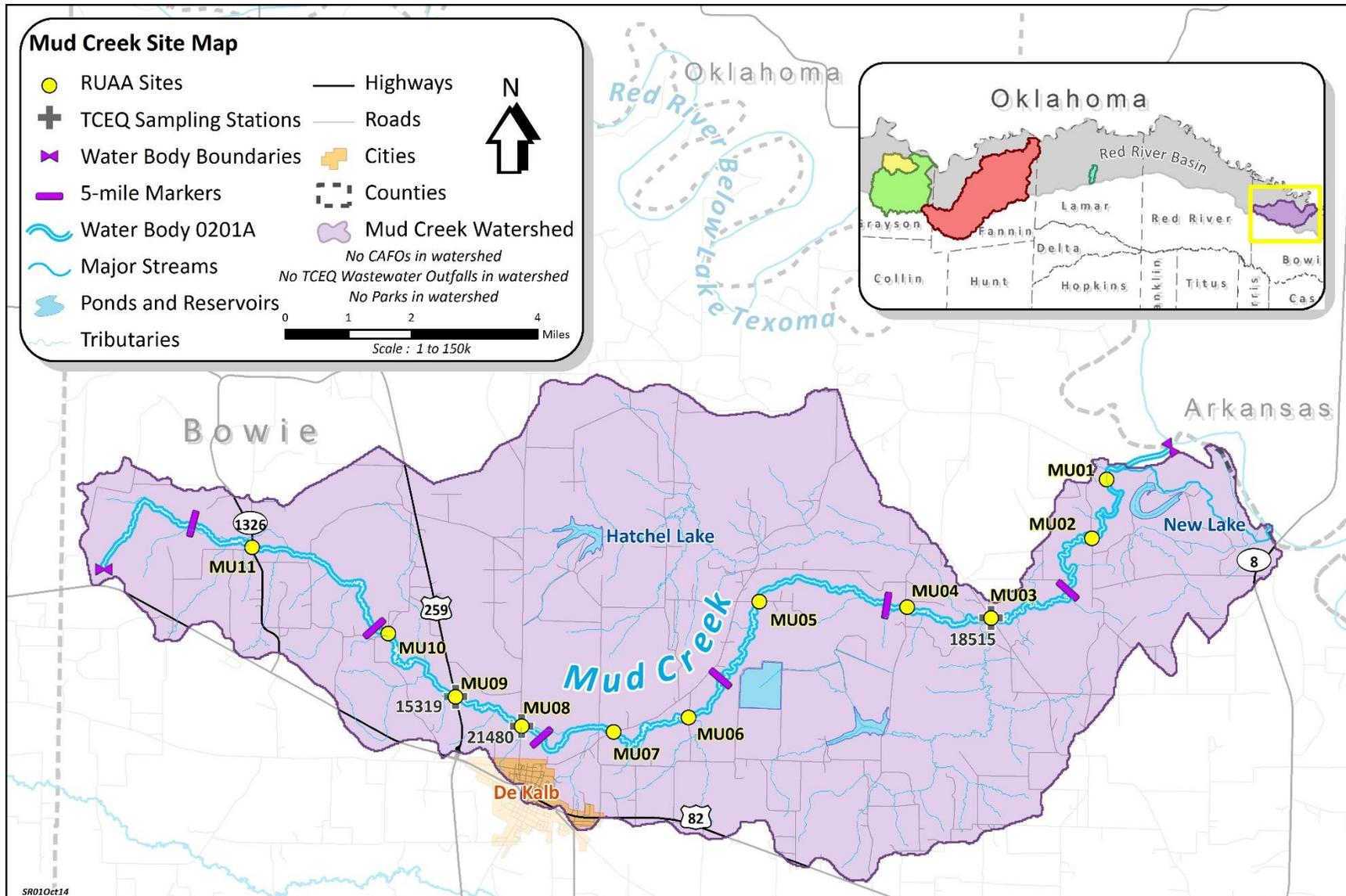


Figure 7.1 Overview of Mud Creek watershed and RUAA sites.

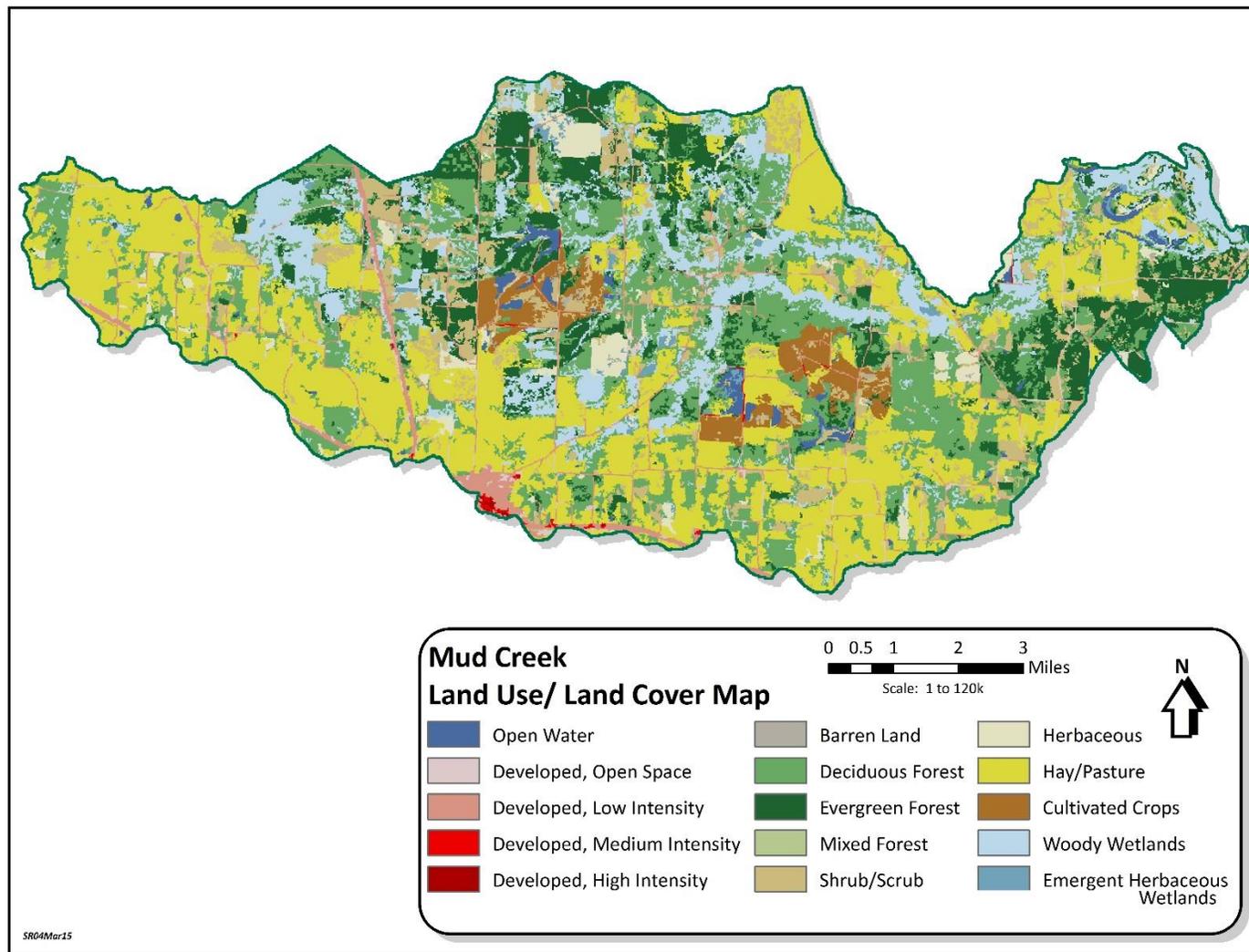


Figure 7.2 Land use/land cover for the Mud Creek watershed. Source: 2006 National Land Cover Database (USGS, 2014).

Permitted Discharges

There are no permitted discharges or concentrated animal feeding operations (CAFOs) within the Mud Creek watershed. The City of DeKalb is the only municipality within the watershed and its wastewater treatment facility (WWTF) discharges outside the watershed into Anderson Creek south of Mud Creek.

Non-Permitted Agricultural Activities and Domesticated Animals

Activities such as livestock grazing close to water bodies and agricultural use of manure as fertilizer can contribute bacteria to nearby water bodies. To provide an estimate of livestock densities in the watershed, livestock statistics were obtained from the United States Department of Agriculture (USDA) National Agricultural Statistics Service website from the 2012 survey (USDA, 2012). These statistics, on a county level, indicate large numbers of beef cattle in Bowie County, and, thus, likely within the watershed area.

Table 7.1 Estimated livestock numbers within the Mud Creek watershed based on statistics adjusted for the percent of the county within the watershed. (Source USDA, 2012)

The Mud Creek watershed, in its entirety, covers about 9% of Bowie County.

County	Year	Cattle & Calves (all beef)	All Goats	Mules, Burros, & Donkeys	Horses & Ponies	Hogs
Bowie	2012	57,018	1,404	561	2,917	269
Mud Creek Watershed Average	2012	5,189	128	51	265	24

Domestic pets are another unregulated source of *E. coli* bacteria, particularly dogs, because storm runoff often carries these wastes into streams (EPA, 2009). Assuming a rough estimate of 0.584 dogs per household (AVMA, 2012) and about 965 households within the Mud Creek watershed based on 2010 census population data, there are potentially about 560 dogs within the Mud Creek watershed. Other domestic animals, such as outdoor cats, can also contribute to bacterial pollution; however, cat populations are difficult to estimate because in many rural areas cats are often feral.

Wildlife and Feral Hogs

Other possible bacteria contributors include wildlife, such as deer, feral hogs, and birds. In 2013 statewide population estimated roughly 39 whitetail deer per 1,000 acres. This estimation suggests that the population for whitetail deer in the Post Oak Savannah region is roughly 400,000 deer, or 35 deer per 1,000 acres (Cain, 2014). Feral hogs are an invasive species commonly found throughout Texas. They have been known to travel in large groups along waterways and congregate near shallow depressions of water. Statewide feral hog densities range from an estimated average of 1.33 to 2.45 feral hogs per square mile (AgriLife, 2011).

Failing On-Site Sewage Facilities

Septic systems or on-site sewage facilities (OSSFs) are often used in rural areas that do not have the ability to connect to a central wastewater collection system. To estimate the number of potential OSSFs in the watershed, a GIS layer associated with the sewer Certificates of Convenience and Necessity (CNNs) from the Public Utility Commission of Texas was used. As not all cities with WWTFs have CNNs, the CNN layer was supplemented with a GIS layer representing municipal boundaries for those cities with WWTFs. Population data from the U.S. Census Bureau (USCB) were then overlaid masking out areas that should be serviced by WWTFs. Of the 965 households in the Mud Creek watershed, 38% were indicated as outside of the municipal area of the City of De Kalb and, thus, likely on septic systems.

Historical Review

A review of historical information regarding recreational use of Mud Creek was conducted. The review considered the time period of November 28, 1975 to the present in accordance with 40 CFR Part 131 (EPA standards regulation). Government offices, libraries, historical societies, and newspapers were searched and contacted in addition to generic internet searches. The following is a summary of the review.

Government Sources

De Kalb Texas - Chamber of Commerce Official Site
[De Kalb Texas Chamber of Commerce Official Site](#)⁴⁶

Nothing of significance was found pertaining to the historical use of Mud Creek.

Library Sources

New Boston Public Library
[New Boston Public Library Homepage](#)⁴⁷

Phone: (9063) 628-5414

Explored various links and online texts. Nothing pertaining to Mud Creek was found.

Newspaper Sources

Texarkana Gazette
[Texarkana Gazette Homepage](#)⁴⁸

Phone: (903) 794-3311

Explored various links and online texts. Nothing significant was found.

Bowie County Citizens Tribune
[Bowie County Citizens Tribune Homepage](#)⁴⁹

Phone: (903) 628-5801

Explored various links and online texts. Nothing significant was found.

Internet Searches

The Handbook of Texas Online

[Texas State Historical Association Online Handbook, Mud Creek](#)⁵⁰

Nothing of significance was found pertaining to the historical use of Mud Creek.

⁴⁶ <http://dekalbtexas.org/>

⁴⁷ <http://newbostonlibrary.org/>

⁴⁸ <http://texarkanagazette.com/>

⁴⁹ <http://bowiecountynow.com/>

⁵⁰ <https://tshaonline.org/handbook/online/articles/rbmce>

Survey Site Descriptions

Mud Creek (0201A) is just under 36 river miles long, which indicates a goal of 21 sites (3 sites per 5 miles of river) for the RUAA survey (Figure 7.1). With the help of cooperating stakeholders, TIAER was able to establish 11 survey sites along Mud Creek (Table 7.2). Nine of the eleven sites are publically accessible via road crossings and two were accessible via private property (Table 7.2). The average distance between survey sites was 2.73 river miles and ranged from 1.62 to 4.41 miles. The largest gap between survey sites was 4.41 river miles between Sites MU02 and MU03. The second largest gap was 4.29 river miles from MU11 to the upper end of the segment. There was no suitable public access to Mud Creek along these two stretches without accessing private property, which landowner access was not granted. RUAA surveys were performed June 18 - 19, 2104 and August 7 - 8, 2014. A brief description of each site follows.

Table 7.2 Description and location of RUAA field survey sites for Mud Creek (0201A).

TCEQ ID	Site ID	Site Description	Latitude	Longitude	Distance from Previous Site (mi)¹	Distance from Confluence (mi)¹	Distance from Upper Reach (mi)¹	Access
	MU01	Mud Creek on private property	33.5833	-94.4593	Not applicable	1.24	31.54	Private
	MU02	Mud Creek on private property	33.5698	-94.4631	1.71	2.95	29.83	Private
18515	MU03	Mud Creek at FM 992	33.5511	-94.4905	4.41	7.36	25.42	Public*
	MU04	Mud Creek at CR 3109	33.5533	-94.5136	2.20	9.56	23.22	Public
	MU05	Mud Creek at CR 3220	33.5541	-94.5543	3.15	12.71	20.08	Public
	MU06	Mud Creek at CR 3202	33.5272	-94.5732	3.40	16.11	16.68	Public*
	MU07	Mud Creek at FM 992	33.5236	-94.5937	2.27	18.37	14.41	Public*
21480	MU08	Mud Creek at FM 2735	33.5246	-94.6190	1.99	20.37	12.42	Public*
15319	MU09	Mud Creek at Highway 259	33.5312	-94.6373	1.62	21.98	10.80	Public*
	MU10	Mud Creek at CR 3216	33.5455	-94.6560	2.58	24.57	8.22	Public*
	MU11	Mud Creek at FM 1326	33.5670	-94.6948	3.93	28.50	4.29	Public*

* indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property.

¹Distances were digitally estimated using the measuring tool in ArcGIS 9.3 with the 2010 NAIP 1-m DOQQs and the NHD stream layer as reference guides.

Site MU01 is the most downstream site located on Mud Creek on private property, 1.24 miles from the confluence with the Red River. Access to this site required landowner escort through private property gate approximately 2.5 miles on dirt road from Woodstock Road, and an additional 1 mile drive via ATV.

Site MU02 is located on Mud Creek on private property, 2.95 miles from the confluence with the Red River. This site is located at the end on an old county road right-of-way that is no longer maintained by the county since a bridge failed, and has reverted back to private control. Access to this site required landowner permission allowing travel through a private property gate, on a grass/mud trail, approximately 0.25 miles from Woodstock Road.

Site MU03 is located on Mud Creek at Farm-to-Market Road 992, 7.36 miles from the confluence with the Red River. This site is publically accessible at the bridge only with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU04 is located on Mud Creek at County Road 3109, 9.56 miles from the confluence with the Red River. This site is publically accessible at the road with no encounters with private property fence.

Site MU05 is located on Mud Creek at County Road 3220, 12.71 miles from the confluence with the Red River. This site is publically accessible at the road with no encounters with private property fence.

Site MU06 is located on Mud Creek at County Road 3202, 16.11 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU07 is located on Mud Creek at Farm-to-Market Road 992, 18.37 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU08 is located on Mud Creek at Farm-to-Market 2735, 20.37 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU09 is located on Mud Creek at State Highway 259, 21.98 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU10 is located on Mud Creek at County Road 3216, 24.57 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence

restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Site MU11 is located on Mud Creek at Farm-to-Market Road 1326, 28.5 miles from the confluence with the Red River. This site is publically accessible at the bridge with a private property fence restricting further access. Landowner permission allowing across-fence access was required to complete the survey.

Field Survey Results and Discussions

General Description of RUAA Survey Sites and Conditions for Mud Creek (0201A)

The Mud Creek RUAA surveys were conducted on June 18 and 19, 2014 and August 8, 2014. The surveys were performed on weekdays, weekends, or holidays at opportune times to observe recreational activities along Mud Creek. Air temperatures prior and during both the first and second surveys were above 21degrees Celsius (70degrees Fahrenheit) which is indicated by the RUAA guidelines as warm enough to promote recreational activities (Tables 7.3 and 7.4), although notably warmer temperatures occurred in August than in June. In the 30 days prior to the first survey, 1.89 inches of precipitation fell, while 5.39 inches fell in the 30 days prior to the second survey.

A summary of the RUAA field survey results is presented in the following tables:

- Table 7.5 describes the stream channel and corridor characteristics at each site.
- Table 7.6 notes the average thalweg depth by site during each survey and the access to the stream, whether public or private, and the ease of bank access.
- Tables 7.7 and 7.8 document the maximum, minimum, and average stream widths at each site for each survey and observed flow conditions.
- Tables 7.9 and 7.10 note stream aesthetics, wildlife observations and tracks, and the presence of garbage observed at each site during each survey.

Physical descriptions of each site follow these tables along with selected photos showing notable characteristics of each site. Overall thalweg depth averaged 0.7 m during the first survey and 0.6 m during the second survey. Access to the stream down the bank was difficult to moderately difficult in most locations due to dense vegetation and steep banks and fences. The dominant substrate was mud/clay and the stream corridor was largely lined with trees, shrubs, and thick herbaceous cover. The maximum stream width encountered was 28 m during the first survey in June 2014 and 20 m during the second survey in August 2014. Flow conditions appeared normal during both surveys. The water surface was generally clear occasionally with scum. Water coloration was primarily brown. In general, the majority of observed tracks and fecal droppings reported in the tables are from wildlife. Tracks observed primarily included birds, raccoon, deer, and occasionally, livestock. Rarely observed garbage was made up predominantly of plastics, glass bottles, aluminum cans, scrap metals, and tires. Observations of such were more common at bridge crossings.

Table 7.3 Rainfall records with maximum and minimum temperature for De Kalb, Texas, 30 days prior to the first RUAA survey, initiated on June 18, 2014.

Survey dates are shaded in grey. Data obtained from Weather Underground for De Kalb weather station KTXDEKAL1.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
19-May-14	0.00	83	62
20-May-14	0.00	86	65
21-May-14	0.00	86	64
22-May-14	0.00	87	65
23-May-14	0.00	86	66
24-May-14	0.02	81	67
25-May-14	0.00	86	65
26-May-14	0.00	84	69
27-May-14	0.53	79	67
28-May-14	0.00	84	62
29-May-14	0.00	86	65
30-May-14	0.04	83	70
31-May-14	0.00	86	70
1-Jun-14	0.00	87	71
2-Jun-14	0.00	88	72
3-Jun-14	0.00	90	71
4-Jun-14	0.00	91	70
5-Jun-14	0.00	88	71
6-Jun-14	0.00	87	75
7-Jun-14	0.00	94	72
8-Jun-14	0.14	83	72
9-Jun-14	0.72	76	66
10-Jun-14	0.20	83	64
11-Jun-14	0.05	89	61
12-Jun-14	0.02	83	69
13-Jun-14	0.01	88	66
14-Jun-14	0.00	88	69
15-Jun-14	0.00	91	71
16-Jun-14	0.00	92	73
17-Jun-14	0.16	91	73
18-Jun-14	0.00	91	72

19-Jun-14	0.00	91	72
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Table 7.4 Rainfall records with maximum and minimum temperature for De Kalb, Texas, 30 days prior to the second RUAA survey, initiated on August 8, 2014.

The survey date is shaded in grey. Data obtained from the Weather Underground for De Kalb weather station KTXDEKAL1.

Date	Daily Precipitation (in)	Maximum Daily Temperature (°F)	Minimum Daily Temperature (°F)
8-Jul-14	0	95	75
9-Jul-14	0.01	90	73
10-Jul-14	0	94	72
11-Jul-14	0	95	73
12-Jul-14	0	96	72
13-Jul-14	0	97	72
14-Jul-14	0	98	74
15-Jul-14	0	90	69
16-Jul-14	0	85	62
17-Jul-14	2.43	74	63
18-Jul-14	0.06	69	61
19-Jul-14	0	77	64
20-Jul-14	0.01	84	63
21-Jul-14	0	89	65
22-Jul-14	0	89	68
23-Jul-14	0.68	92	68
24-Jul-14	0.01	85	66
25-Jul-14	0	91	70
26-Jul-14	0	95	72
27-Jul-14	0	96	75
28-Jul-14	0	91	73
29-Jul-14	0	91	67
30-Jul-14	0.15	77	69
31-Jul-14	1.65	69	68
1-Aug-14	0.02	75	66
2-Aug-14	0	85	67
3-Aug-14	0.01	89	69
4-Aug-14	0	90	68
5-Aug-14	0	92	69
6-Aug-14	0	93	73

7-Aug-14	0	92	76
8-Aug-14	0.36	95	73

Table 7.5 Stream Channel and corridor characteristics for each site along Mud Creek (0201A).

Site Number	Stream Channel Appearance	Dominant Substrate	Corridor Appearance	Riparian Size	Park	Landscape Surroundings
MU01	Natural	Mud/Clay	Forest	Large	No	Native
MU02	Natural	Mud/Clay	Forest/Pasture	Large	No	Native/Improved Pasture
MU03	Natural	Silt/Mud/Clay	Shrub/Pasture	Large	No	Native/Improved Pasture
MU04	Natural	Silt/Mud/Clay	Forest	Large	No	Native/Improved Pasture
MU05	Natural	Silt/Mud/Clay	Forest	Large	No	Native
MU06	Natural	Silt/Mud/Clay/ Rip Rap/Concrete	Forest/Pasture	Large	No	Native
MU07	Natural	Sand/Silt/Mud/Clay	Forest/Shrub/Pasture	Large	No	Native/Improved Pasture
MU08	Natural	Silt/Mud/Clay	Shrub/Pasture	Large	No	Native/Improved Pasture
MU09	Natural	Sand/Silt/Mud/Clay	Shrub/Pasture	Large	No	Native/Improved Pasture
MU10	Natural	Silt/Mud/Clay	Forest/Marsh/Pasture	Large	No	Native/Improved Pasture
MU11	Natural	Mud/Clay/Gravel	Shrub/Pasture	Large	No	Native/Improved Pasture

Table 7.6 Thalweg depth, stream flow type, and site accessibility during the two surveys of Mud Creek (0201A).

Stream flow type represents TCEQ descriptions (TCEQ, 2014). Under general access, * indicates that the site was publically accessible at a road crossing but that further access was limited by fencing of private property. For bank access, E = Easy, ME = Moderately Easy, MD = Moderately Difficult, and D = Difficult.

Site	Transect length (m)	# of Transects	# of Recreational Areas at Site	Avg. Site Thalweg Depth (m) for Trip 1	Avg. Site Thalweg Depth (m) for Trip 2	Stream Flow Type	General Access	Bank Access
MU01	90	4	0	1.5	1.5	Perennial	Private	D
MU02	300	11	0	1.0	0.8	Intermittent with pools	Private	D
MU03	300	11	0	0.7	0.4	Intermittent with pools	Public*	ME
MU04	240	9	0	0.6	0.8	Intermittent with pools	Public	D
MU05	210	8	0	1.2	1.2	Intermittent with pools	Public	D
MU06	300	11	0	0.5	0.4	Intermittent with pools	Public*	MD
MU07	300	11	0	0.4	0.3	Intermittent with pools	Public*	MD
MU08	300	11	0	0.4	0.4	Intermittent with pools	Public*	ME
MU09	300	11	0	0.8	0.7	Intermittent with pools	Public*	MD
MU10	300	11	0	0.3	0.1	Intermittent with pools	Public*	MD
MU11	300	11	0	0.3	0.4	Intermittent with pools	Public*	MD

Table 7.7 Description of surveyed stream sites along Mud Creek during first survey, performed in June 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
MU01	31	18	20	High
MU02	12	4.3	10	Normal
MU03	16	3.0	6.5	Normal
MU04	10	0.0	5.0	No Flow
MU05	14	5.0	8.0	Low
MU06	15	4.5	8.0	Low
MU07	7.7	1.0	5.5	Low
MU08	8.5	1.0	5.0	Normal
MU09	10	4.5	5.5	Normal
MU10	9.0	0.8	2.5	Low
MU11	9.0	0.3	3.0	Low

Table 7.8 Description of surveyed stream sites along Mud Creek during second survey, performed in August 2014.

Site Number	Maximum Width (m)	Minimum Width (m)	Typical Average Width (m)	Observed Flow
MU01	18	16	16	Normal
MU02	11	1.4	5.0	Normal
MU03	15	3.4	6.5	Normal
MU04	10	0.0	5.5	No Flow
MU05	17	4.5	7.5	Normal
MU06	12	3.0	6.0	Low
MU07	10	0.3	5.0	Normal
MU08	10	0.3	7.0	Normal
MU09	10	5.0	6.0	Low
MU10	4.5	0.0	2.5	No Flow
MU11	14	0.0	1.5	No Flow

Table 7.9 Stream aesthetics along Mud Creek during first survey performed in June 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of Wildlife	Large Garbage in Channel	Small Garbage in Channel	Bank Garbage
MU01	R	A	N	Brown	Fine Sediment	Clear/Oil	N	SP	N	Tracks/Fecal	N	N	N
MU02	R	R	R	Clear	Sludge/Solids	Clear/Scum/Oil	SP	SP	N	Tracks/Fecal/Nests	R	R	R
MU03	A	R	N	Clear	Sludge/Solids	Clear	SP	N	N	Tracks/Fecal/Nests	R	R	R
MU04	R	R	C	Brown	Sludge	Scum/Foam/Oil	MP	N	N	Tracks/Fecal	R	R	R
MU05	A	A	C	Brown	Fine Sediment/Sludge	Scum/Foam/Oil	MP	N	N	Tracks/Fecal	N	R	R
MU06	A	A	C	Brown	Sludge	Scum/Foam/Debris/Oil	N	N	N	Tracks/Fecal/Nests	C	C	R
MU07	A	A	R	Clear/Brown	Sludge/Solids	Clear/Scum/Oil	N	SP	N	Tracks/Fecal/Nests	R	R	R
MU08	A	A	C	Brown	Sludge	Clear	MP	N	N	Tracks/Fecal/Nests	R	R	R
MU09	A	A	N	Brown	Sludge	Clear/Oil	SP	SP	N	Tracks/Fecal	R	R	R
MU10	A	A	C	Brown	Sludge	Clear	N	N	N	Tracks/Fecal	R	R	R
MU11	R	R	N	Clear	Solids	Clear	N	N	N	Tracks/Fecal	N	R	R

Table 7.10 Stream aesthetics and wildlife observations along Mud Creek during the second survey performed in August 2014.

A = absent, R = rare, C = common, Ab = abundant, N = none, NW = no water, SP = slight presence, MP = moderate presence, LP = large presence from Field Data Sheet – Sect. F.

Site	Aquatic Vegetation	Algae Cover	Odor	Color	Bottom Deposit	Water Surface	Reptiles	Water Dependent Birds	Mammals	Evidence of wildlife	Large garbage in Channel	Small garbage in Channel	Bank garbage
MU01	C	R	R	Brown	Fine Sediment	Clear	N	N	N	N	N	N	N
MU02	C	R	N	Brown	Fine Sediment/Sludge	Clear	SP	SP	N	Tracks/Fecal	N	R	N
MU03	C	A	R	Clear	Fine Sediment/Sludge	Clear	N	N	N	Tracks/Fecal	N	R	N
MU04	C	C	C	Brown	Fine Sediment/Sludge	Scum/Oil	SP	N	N	N	R	N	C
MU05	C	C	R	Brown	Fine Sediment/Sludge	Scum	N	N	N	N	N	R	R
MU06	C	A	C	Brown	Sludge	Scum/Oil	N	N	N	Tracks/Fecal	R	Ab	Ab
MU07	A	R	N	Brown	Fine Sediment/Sludge	Scum/Foam/	N	N	N	Tracks	R	C	R
MU08	R	A	N	Brown	Fine Sediment/Sludge	Clear	N	N	MP	Tracks/Fecal	R	C	R
MU09	R	A	N	Brown	Fine Sediment	Scum	N	N	LP	Fecal	R	N	N
MU10	A	A	R	Brown	Fine Sediment	Clear	MP	N	N	Tracks/Fecal	N	C	N
MU11	R	A	N	Clear	Solids	Clear	N	N	N	Tracks	N	N	N

Physical Description of MU01

Mud Creek at Site MU01 was surveyed on June 19 and August 8, 2014. Access to this site was difficult because it was located approximately 3.5 miles from a public road on private property. Access into the stream was also difficult due to thick vegetation and long distance from the public road. Although there was an all-terrain-vehicle trail that was used to access the site, recent rains caused the ATV trails to hold water resulting in more difficult travel to this site. Site MU01 was originally selected because it exists on a cooperatively owned recreational property where recreation in the creek was likely to occur. The landowner indicated water levels at this stretch of the creek were typically wadeable during the time summer surveys would be conducted. Additionally, when reconnaissance was conducted in the spring, the trails leading to the site were dry and the density of vegetation at the time of site selection was minimal. During the surveys, the banks were overgrown by dense herbaceous cover, which was too thick to navigate on foot, therefore, only 90 m (4 transects) were surveyed (Figure 7.5).

During the surveys the creek banks consisted of fine sediment and were relatively firm (Tables 7.5 and 7.6). Depths at this site were all greater than 1.5 m, rendering it non-wadeable (Table 7.6). The stream had an average width of approximately 20 m during the first survey and flow appeared high with a high-water line approximately 0.5 m up into the bank vegetation (Figure 7.3). Flow appeared normal during the second survey with an approximate width of 16 m (Tables 7.7 and 7.8). Although widths were smaller during the second survey, vegetation had increased in density and spread quickly down the banks and past the waterline into the channel. Therefore, collecting a precise width measurement during the second survey was difficult.

The stream channel was naturally vegetated, primarily with hardwood forest and herbaceous growth of buttonbush (*Cephalanthus occidentalis*), cocklebur (*Xanthium strumarium*), and Johnsongrass (*Sorghum halepense* sp.) (Figure 7.4). Banks were densely vegetated, gently sloping, muddy, and slick. No algae cover was observed during the first survey and was rare during the second survey. The color of the water was brown. Hog tracks and a snake skin were observed on the banks as well as a great blue heron and bird droppings. Garbage was not observed (Table 7.9 and 7.10). An all-terrain-vehicle trail passed by this site. No evidence of human recreation was observed.



Figure 7.3 Photograph of Mud Creek Site MU01, taken on June 19, 2014. Downstream view at the 300-m transect. Note high-water mark.



Figure 7.4 Photograph of Mud Creek Site MU01, taken on August 8, 2014. Downstream view at the 300-m transect. Note increased vegetation down into the water.



Figure 7.5 Photograph of Mud Creek Site MU01, taken on August 8, 2014. Right bank view at the 300-m transect. Note tall vegetation growing into water and access point behind TIAER staff.

Physical Description of MU02

Mud Creek at Site MU02 was surveyed on June 18 and August 7, 2014. Access to this site occurred on private property down an abandoned county road right-of-way that led to an old bridge crossing site. Access into the stream was difficult because it required landowner permission to enter property through a gate, go down an overgrown path, and climb through dense vegetation and down steep banks (Tables 7.5 and 7.6). Banks were characterized by hardwood forest, with shrubs and herbaceous vegetation, including poison ivy, growing down the sloping banks. Travel through the stream corridor was moderately difficult due to the deep muddy clay bottom and slick banks.

The stream was wadeable with an average width of 10 m during the first survey and 5 m during the second (Tables 7.7 and 7.8). Average thalweg depth was 1.0 m during the first survey and 0.8 m during the second (Table 7.6). Stream flow appeared normal during both surveys (Tables 7.7 and 7.8).

The stream channel was naturally vegetated with a variety of shrubs at the banks, clearing out to pasture beyond the banks (Table 7.5). During the first survey the water surface was clear with an occasional oily scum but was predominantly clear during the second survey. Aquatic vegetation and algae cover were rare with an occasional odor during the first survey (Table 7.9 and 7.10). The second survey revealed common aquatic vegetation, rare algae, and no detectable odor. Water coloration was brown during both surveys. Wildlife observed included snakes, frogs, clams, and a great blue heron. The tracks of raccoon, feral hog, canine, bird, and deer were also seen. Feral hog

wallows were observed along with bird droppings. Garbage was rare but did include glass bottles, cans, various metals, a boot, and other small trash (Tables 7.9 and 7.10). Remnants of the old county bridge were observed (Figure 7.6). An aluminum boat tied to a cross-tie that spanned the creek was present during both surveys (Figures 7.7 and 7.8). No other signs of human recreation were observed.



Figure 7.6 Photograph of Site MU02, taken on August 7, 2014. Downstream view at old bridge crossing and TIAER staff.



Figure 7.7 Photograph of Site MU02, taken August 7, 2014. Downstream view at the 150-m transect. Note the white cross tie spanning the creek.



Figure 7.8 Photograph of site MU02, taken June 18, 2014. Right bank view at 150-m transect. Note overgrown banks and aluminum boat.

Physical Description of MU03

Mud Creek at Site MU03 was surveyed on June 18 and August 7, 2014. Access to this site was easy because it occurred at a road crossing. However, access into the stream was moderately difficult because it required landowner permission to cross a fence that bisected the creek (Table 7.5 and Figure 7.8). Travel down the stream was difficult due to sucking mud/clay bottom, some deep spots, dense bank vegetation, and large obstructions (Figure 7.9).

The stream channel was naturally vegetated with hardwood forest and shrubs at the banks, clearing out to pasture beyond the banks (Table 7.5). Aquatic vegetation was absent during the first survey; however, cattails were common during the second survey. The water surface and color was predominantly clear during both surveys with a rare occurrence of odor during the second survey (Tables 7.9 and 7.10). No wildlife was observed; however, tracks of cattle, raccoon, and squirrel, in addition to dead crawfish were seen. Bird and cow feces were seen as well. Garbage was rare but did include some household glass (Table 7.10). No signs of human recreation were observed.

The stream was wadeable with a typical average width of approximately 6.5 m during both surveys, and thalweg depths of 0.7 m during the first survey and 0.4 m during the second survey. The stream appeared to have normal flow during both surveys (Tables 7.6, 7.7 and 7.8). A substantial pool was encountered at approximately 200 m that measured 70 m long, 16 m wide and was greater than 1.5 m deep during the first survey. During the second survey the pool had reduced to 13 m long, 11 m wide but was still greater than 1.5 m deep. A low water crossing with culverts was encountered just beyond the 300-m transect on private property that caused some water to be impounded (Figure 7.11).



Figure 7.9 Photograph of Site MU03, taken on August 7, 2014. Upstream view at 150-m transect.



Figure 7.10 Photograph of MU03, taken on August 7, 2014, of large log obstruction.



Figure 7.11 Photograph of Site MU03, taken June 18, 2014. Upstream view at 300-m transect and low water crossing with culverts on private property.

Physical Description of MU04

Mud Creek at Site MU04 was surveyed on June 18 and August 8, 2014. This site is publically accessible at the bridge crossing but access down to the water required landowner permission to cross over a private property fence line (Table 7.5). Travel through the channel was difficult as well because of steep slopes and dense forest vegetation and the deep, muddy bottom. Submerged trees and debris contributed to difficult travel in the stream (Figure 7.13).

This stream was wadeable from the bridge crossing up to the 240-m transect where depths were greater than 1.5 m and therefore non-wadeable. Dense bank vegetation inhibited walking along banks to the next transects. Average thalweg depth was approximately 0.81 m (Table 7.6). The water was not flowing during either survey. Typical average width during both surveys was approximately 5 m (Tables 7.7 and 7.8) with one pool measuring approximately 50 m long, 10 m wide, and 1.3 m deep (Figure 7.12).

The riparian corridor at this site included dense forest on both sides and herbaceous vegetation growing directly on the banks, including poison ivy (Table 7.5 and Figure 7.13). The creek bottom was a combination of silt, mud, and clay and caused significant sinking when walking through it. The water surface had scum covering it with an oily sheen in places. Algae cover, aquatic vegetation, and odor were rare during the first survey and had increased by the second survey. Snakes, fish, and frogs were observed at this site. Wildlife tracks encountered included those of feral hogs and raccoons. Crawfish burrows were seen as well. Minimal garbage was seen in the stream including glass bottles, aluminum cans, and scrap metal (Tables 7.9 and 7.10). No evidence of human recreation was observed.



Figure 7.12 Photograph of Site MU04, taken August 8, 2014. Upstream view at 0-m

transect. Note dense vegetation on left and right banks.



Figure 7.13 Photograph of MU04, taken on June 18, 2014. Downstream view of the 150-m transect. Note dense bank vegetation and debris in stream.

Physical Description of MU05

MU05 was surveyed on June 18 and August 8, 2014. Access to this site was easy because it occurred at a public road crossing and there was no fencing, although the landowner did have “No Trespassing” signs visible along the property line. Permission was sought and granted to travel further in the creek at this point. Access into the stream was moderately difficult because of the presence of dense vegetation and steep banks from the road. Once in the creek, travel through the corridor was difficult due to the densely forested banks, deep water, and mud. The riparian area of the creek was comprised of natural forest community (Table 7.5 and Figure 7.14).

This site was wadeable for the first 210 m, at which point depths became too great to wade. The riparian area and creek aesthetics beyond the wadeable stretch appeared to be consistent with the previously observed section of creek. Flow appeared low to normal during both surveys. Average thalweg depth for this site was approximately 1.2 m and the typical average width was approximately 7.8 m (Tables 7.6, 7.7, and 7.8).

The water surface had scum, foam, and oil sheen, in addition to algae. Coloration was brown and had a foul odor. Aquatic vegetation, including duckweed, was common during both surveys. The creek bottom was a fine sediment sludge which made walking difficult. Wildlife encountered included a water moccasin (*Agkistrodon picivorous*) (Figure 7.15), small fish, and frogs. Tracks observed included canine, raccoon, and feral hog. Evidence of crawfish was also found. Garbage

in the channel was rare but did include some glass bottles, general plastics, and a tire on the bank. No evidence of human recreation was observed.



Figure 7.14 Photograph of MU05, taken on June 18, 2014. Downstream view at 90-m transect. Note brown water with foam and dense bank vegetation.



Figure 7.15 Photograph of MU05, taken on June 18, 2014, of a water moccasin on the banks.

Physical Description of MU06

Mud Creek at site MU06 was surveyed on June 18 and August 8, 2014. This site was publically accessible at the bridge only where approximately 30 m is public (Table 7.6). A private property fence bisected the creek on both sides of the bridge which required landowner permission to cross. Access into the stream at the bridge was moderately difficult due to unstable rip rap and steep slopes (Figure 7.16). Additionally, the mud/clay substrate and submerged trees and branches made walking in the creek channel difficult.



Figure 7.16 Photograph of MU06, taken on June 18, 2014. Left bank view of 300-m transect. Note public access at bridge and large rip-rap.

Flow during the two surveys was low with typical average widths of approximately 7 m and an average thalweg depth of approximately 0.45 m (Tables 7.6, 7.7, and 7.8). A water modification structure appearing to be a continuation of the rip rap at the bridge was encountered just downstream from the bridge crossing (Figure 7.17).

A large riparian corridor bordered this stretch of Mud Creek with open pasture beyond (Table 7.5). Dense herbaceous cover, including poison ivy, was encountered on the banks throughout the surveyed stretch. The creek bottom was a fine sediment mud. The water surface had scum, foam, and oil sheen, in addition to common algae cover. Water coloration was brown during both surveys and there was an odor detected when the bottom was disturbed (Tables 7.9 and 7.10). Small fish and crawfish were encountered in the creek as were tracks of raccoon, feral hogs, and deer. Clam shells were seen in the creek and on the banks and aquatic vegetation was common-

abundant during both surveys. Bird droppings were also observed. Garbage was encountered on the banks and in the stream during both surveys; some was directly at the bridge crossing and in the downstream stretch. Larger garbage included a couch, tires, and a television. Glass bottles, aluminum cans, and scraps of metal were among the small garbage encountered (Figure 7.18). No evidence of human recreation was observed.



Figure 7.17 Photograph of MU06, taken on August 8, 2014. Water modification structure near bridge. Note oily scum on water surface and tire garbage.

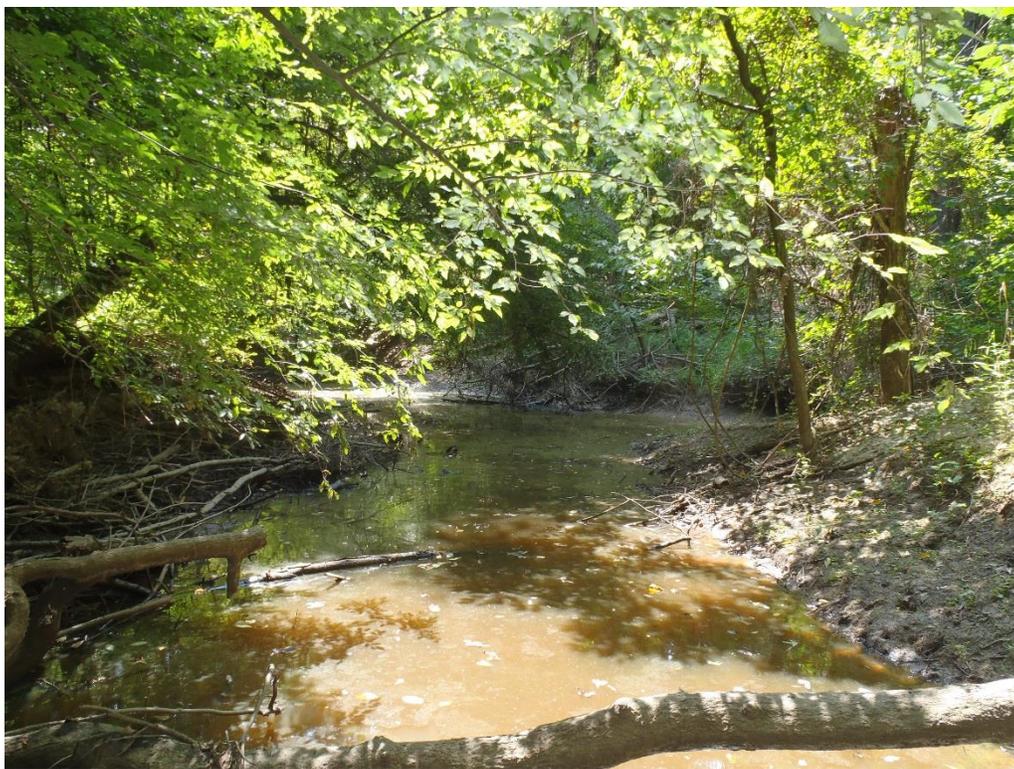


Figure 7.18 Photograph of Site MU06, taken August 8, 2014. Downstream view at 0-m. Note forested banks and debris in channel.

Physical Description of MU07

MU07 was surveyed on June 18 and August 8, 2014. Access to this site was available at the highway bridge only. Entering the creek was moderately difficult due to dense herbaceous vegetation at the bridge crossing. A private property fence bisecting the creek hindered further travel down the stream (Table 7.5). In addition to multiple log obstructions, deep submerged leaf and twig litter combined with water depths averaging 0.42 m to 0.34 m made traveling through the creek difficult (Table 7.6 and Figure 7.21).

This portion of Mud Creek was wadeable with flow appearing low during the first survey and normal during the second. The typical stream width was approximately 5.0 m – 5.5 m (Tables 7.7 and 7.8). There was a pool at this site with depths greater than 0.7 m and that stretched for more than 270 m.

The creek bottom was characterized by mud/clay which caused some sinking when wading through it (Table 7.5). The water surface during the first survey appeared clear with some scum and oil in places and the color was brown (Table 7.9). During the second survey water levels were lower, the water was brown, and the surface had leaf debris, foam, and some form of scum (Table 7.10).



Figure 7.19 Photograph of Site MU07, taken on August 8, 2014. Upstream view at 300-m transect.



Figure 7.20 Photograph of MU07, taken on August 8, 2014. Upstream view at 150-m transect. Note steep vegetated banks and log obstruction. TIAER staff in photo.

The banks at this site were steep, dominated by forest and herbaceous undergrowth on both sides, and opened up to improved pasture beyond (Table 7.5 and Figure 7.20). Aquatic vegetation was present during both surveys; however, an odor was only detected during the first survey. Various animal tracks were observed including raccoon, water bird, feral hog, deer, and cow. Fish and frogs were seen in the stream as well as bird droppings. Some garbage was observed in the creek such as tires, a plastic bucket, aluminum cans and scrap metal, glass bottles, and plastics (Tables 7.9 and 7.10). No other evidence of human recreation was observed.



Figure 7.21 Photograph of MU07, taken on August 8, 2014. Log obstruction.

Physical Description of MU08

MU08 was surveyed on June 18 and August 8, 2014. This site was publically accessible but only at the bridge crossing. Private property fences hindered further access both upstream and downstream and required landowner permission to cross (Figure 7.22). Once in the channel travel through the corridor was moderately easy with some deep mud and steep slopes making climbing out of the channel more difficult (Figure 7.23).



Figure 7.22 Photograph of MU08, taken on August 8, 2014. Upstream view at 300-m transect. Note private barbed wire fence line and algae on water surface.

This site was wadeable for the entire stretch. Flow appeared normal during both surveys. Average thalweg depths for the first and second surveys were 0.44 m and 0.47 m, respectively (Table 7.6). Typical width of the stream during the first survey was approximately 5 m and approximately 7 m during the second survey (Tables 7.7 and 7.8).

The creek bottom was primarily fine sediment sludge (Table 7.5). The water surface during both surveys was clear and algae cover remained abundant for both surveys. Aquatic vegetation appeared abundant during the first survey but rare during the second. An odor was detected during the first survey but was absent during the second (Tables 7.9 and 7.10). The banks were lined with trees and small shrubs opening up to improved pastureland visible through the trees. Cattle were present in the pastures in addition to being observed crossing the creek. Stream banks were steep except where a low water/livestock crossing existed (Figure 7.24). Turtles, snakes, crawfish, frogs, and small fish were observed in the stream. Raccoon tracks and cow manure were also seen. Garbage was rare in this stretch of creek but did include tires, small plastics, glass bottles, scrap metal, aluminum cans, and Styrofoam. Bagged household garbage and large metal scrap were observed at the bridge only. No evidence of human recreation was observed.



Figure 7.23 Photograph of Site MU08, taken on June 18, 2014. Downstream view at the 0-m transect.



Figure 7.24 Photograph of MU08, taken on August 8, 2014, of livestock crossing leading across creek.

Physical Description of MU09

MU09 was surveyed on June 18 and August 8, 2014. Access to the stream at this point was public only at the public road crossing and only if one jumped off the bridge into the channel. Private property fencing connected up to the bridge to allow livestock to travel beneath the bridge alongside the creek which made entering the channel by TIAER staff moderately difficult (Figure 7.25). Traveling in the creek itself was moderately difficult as well, with depths often greater than 0.5 m, a muddy clay bottom, and steep banks that made exiting the channel challenging.



Figure 7.25 Photograph of site MU09, taken on August 8, 2014, of private property fence preventing foot traffic from roadside. This existed at all four points around bridge.

This stretch of the creek was wadeable throughout the 300 m reach that was surveyed. During the first survey, the flow rate appeared normal and dropped to a low flow designation during the second survey. The water surface appeared clear with some oil sheen and a brown coloration during the first survey (Figure 7.26). During the second survey aquatic vegetation such as duck weed was present but rare and the surface developed a layer of scum (Figure 7.27). Typical average widths were approximately 5.8 m during both surveys (Table 7.7), and the widest transect point measured was 10 m (Table 7.8). The average thalweg depth was 0.8 m and 0.73 m during the first and second surveys, respectively (Table 7.6). A pool beginning at approximately 30 m had depths consistently meeting or exceeding 0.5 m and extended beyond the last transect.



Figure 7.26 Photograph of site MU09, taken on August 8, 2014. Downstream view at 0-m transect. Note the steep banks, water levels and debris. TIAER staff in photo.



Figure 7.27 Photograph of site MU09, taken on June 18, 2014. Pipeline obstruction bisecting the creek. TIAER personnel in photograph.

The bottom was fine sediment/sludge which made wading through it moderately challenging. Depths were greater than 1.5 m at the 240-m transect and a width of 8 m was measured. Personnel were required to climb out of the channel and walk the banks to the next transect. This was challenging because the banks were steep and dominated by shrubs immediately at the edge (Figure 7.26). A steel pipe was the only obstruction that bisected the creek (Figure 7.27). Open pastureland with dense grasses and low brush existed beyond the immediate vicinity of the bank (Table 7.5). During the second survey, two wild turkeys were flushed from the dense grass at the banks and their droppings were observed. Other evidence of wildlife included frogs and raccoon tracks. Cattle tracks were also observed in the creek. Garbage was rarely encountered; tires, plastics, glass bottles, and aluminum cans were the only garbage observed during both surveys (Tables 7.9 and 7.10). No evidence of human recreation was observed.

Physical Description of MU10

MU10 was surveyed on June 18 and August 8, 2014. Access to this site was at a public road crossing with only a culvert pipe passing beneath the gravel road. The upstream stretch of the creek was not fenced from the road but the downstream stretch was fenced. The landowner granted permission to survey the downstream portion at this crossing. Accessing this stretch of the creek was moderately difficult due to the soft muddy bottom, two bisecting fence lines, multiple log jams, and thick marshy vegetation (Table 7.5).

This site was wadeable (Figures 7.28 and 7.29). Average thalweg depths for the two surveys were 0.3 m and 0.11 m, respectively (Table 7.6). Flow appeared low during the first survey and no flow was observed during the second. Typical average widths for the two surveys were both 2.5 m; however, a maximum width of 9 m was recorded during the first survey and only 4.5 m maximum during the second (Tables 7.7 and 7.8). Two pools were recorded as well. One measured 30 m long, 9 m wide and 0.6 m deep and the other measured 50 m long, 5 m wide and 0.6 m deep.

The stream corridor was densely vegetated with trees, vines, and poison ivy with improved pastures beyond the creek corridor. Aquatic vegetation and algae cover were absent but an odor was present during the first survey only. The water color was brown and the surface was clear during both surveys (Tables 7.9 and 7.10). The bottom deposit was a fine sediment sludge. Various animal tracks were observed including raccoon, feral hog, bobcat, canine, and cattle. Wildlife encountered included a water moccasin, frogs, and crawfish burrows. The fecal material of cattle and birds were also observed. Overall, garbage in the channel and on the banks was rare; however, glass, plastic bottles, aluminum cans, and an occasional tire were observed. No evidence of human recreation was observed at this site.



Figure 7.28 Photograph of MU10, taken on June 18, 2014. Upstream view at the 150-m transect from road crossing.



Figure 7.29 Photograph of MU10, taken on August 8, 2014. Downstream view at 300-m transect. Note lack of water, muddy substrate, dense vegetation, and debris.

Physical Description of MU11

MU11 was surveyed on June 18 and August 8, 2014. Access to this site was easy because it occurred at a road crossing and the stream ran parallel to the road for approximately 75 m (Figure 7.30). However, the channel was fenced both upstream and downstream from the bridge. Access down the stream was moderately easy after acquiring landowner permission to cross a fence that bisected the creek. The dominant substrate was gravel with some mud/clay deposited in places which made wading a challenge at times. There was some rip rap and concrete at the bridge that was difficult to navigate through. A few log jams existed along the surveyed stretch as well. Streambanks were steep and densely vegetated with native shrubs and herbaceous plants, including poison ivy, with some scattered trees. Beyond both right and left banks exists improved pastureland.



Figure 7.30 Photograph of site MU11, taken June 18, 2014. Downstream view at 300-m transect. Note public access availability from road.

This site was wadeable throughout the 300 m stretch. Average thalweg depths were approximately 0.34 m during both surveys. Typical average widths ranged from 3 m during the first survey to 1.5 m during the second survey. Flow appeared low during the first survey and no flow was detected during the second (Tables 7.7 and 7.8). Water was present during both surveys.

Aquatic vegetation and algae cover were detected during both surveys but were more prevalent during the first survey. Foam and scum were reported during the first survey, as was an odor. The color of the water and the surface was primarily clear during both surveys.

Wildlife encountered during the surveys included frogs, small fish, and clam shells. Raccoon tracks and cattle manure were also observed on the banks of the stream. Garbage was very rare and only included the occasional glass bottle and aluminum cans (Tables 7.9 and 7.10). No indications of human recreation were observed.



Figure 7.31 Photograph of MU11, taken on August 8, 2014. Downstream view at 0-m transect. Note steep vegetated banks and obstruction.

Observation and Interviews

Activities Observed

During each RUAA survey, field personnel visited the sites on days and during times when recreational activities were more likely to be observed. Nine of the eleven selected sites were at road crossings that provided public access, although only at the bridge that crosses the stream. The remaining two sites were located on private property and TIAER personnel were granted permission from the landowners to conduct the RUAA at these locations.

No contact (primary or secondary) or noncontact recreational activities were observed by TIAER employees at any of the sites during the field surveys. No evidence of recreation was found at any of the other sites.

Activities Interviewed

Interviews were conducted with landowners along Mud Creek as well as other persons of interest. A total of ten were collected. No primary contact recreational activities were identified from these interviews (Table 7.11). Hunting and fishing were the main forms of recreation noted in the

interviews. The majority of these activities occurred at site MU01. Site MU01 is on a privately owned hunting club where deer and duck hunting as well as fishing were reported to have been participated in, seen, and heard of. Two property owners were interviewed regarding the area around MU03. It was mentioned that pre-1972 a flood came and some boaters were observed on the creeks elevated waters. One interview reflects fishing having been participated in, seen and heard of at site MU06. The interviewee for this site commented that people dump animal carcasses and garbage at the bridge here and that fish are not very much larger than a perch. An interviewee commented that the area of Mud Creek from MU04 to MU11 did not have much water in it. This same interviewee did not report any forms of recreation along this stretch of Mud Creek. An interview referencing MU09 reported that Mud creek is not appropriate for recreation and did not report any recreational activities. A property owner near MU07 commented that the creek was weedy, forested, had low water, and was swampy. This person did not report any recreation. No other sites were reported to have had any types of recreation.

Table 7.11 and Figure 7.32 summarize the types of recreation indicated from interviews.

Table 7.11 Summary of interviews from Mud Creek.

Activities are listed as the number of times personal use, observed use, or heard of use was documented from interviews for a given location or general to the assessment unit. Blank cells indicate no interviewed feedback for that location. An * indicates recreation at multiple sites from one interview form.

Site Name	Number of Interviews	Swimming	Adult Wading	Children Wading	Hunt	Fish	Boat , Canoe, Kayak
MU01	3 ^a				2,2,2	1,1,2	
MU02	1					1*,1*,1*	0,0,1
MU03	1				1,1,1	1,1,1	1,1,1
MU04	1 ^b						
MU05							
MU06	2					1,1,1	
MU07	1						
MU08							
MU09	1						
MU10							
MU11							
General AU						1,1,0	
Totals	10				3,3,3	5,5,5	1,1,2

^a One interviewee also provided information pertaining to site MU02

^b Interviewee also provided information pertaining to sites MU05, MU06, MU07, MU08, MU09, MU10, and MU11

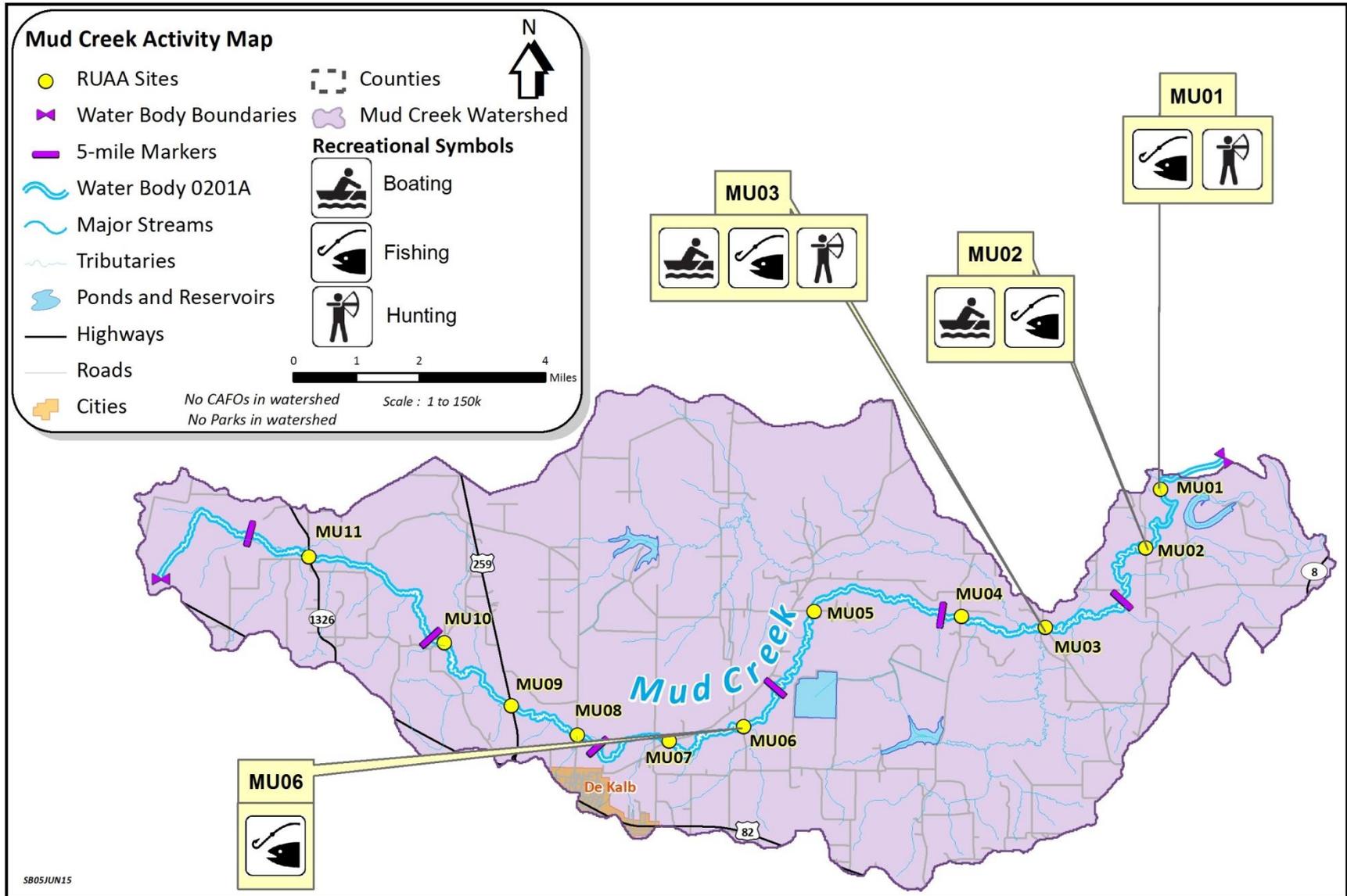


Figure 7.32 Summary of observed and interviewed human activities on Mud Creek.

Summary

RUAA surveys were conducted at eleven sites along Mud Creek (0201A) on June 18 and 19, 2014 and August 8, 2014. Temperatures were above 21°C (70°F) during the 30 days prior to each survey. During the two surveys, there were no recreational activities observed by TIAER field staff. The Palmer Drought Severity Index (PDSI) represented an incipient wet spell during the first survey in June 2014 and slightly wet conditions during the second survey in August 2014 (TWDB, 2014).

Additionally, there were no non-contact recreational activities observed during either survey. Recreational activities reported by interviewees are summarized in Figure 7.33 and the overall RUAA findings are summarized in the form below.

While conducting the stream surveys, no features, such as boat docks, parks, playgrounds, biking trails, campgrounds, or sports fields, were encountered that would promote recreation.

RUAA Summary

Name of water body: Mud Creek

Segment No. of Nearest Downstream Segment No.: 0202

Classified?: No

County: Bowie

1. Observations on Use

a. Do primary contact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

b. Do secondary contact recreation 1 activities occur on the water body?

frequently seldom not observed or reported unknown

c. Do secondary contact recreation 2 activities occur on the water body?

frequently seldom not observed or reported unknown

d. Do noncontact recreation activities occur on the water body?

frequently seldom not observed or reported unknown

2. Physical Characteristics of Water Body

a. What is the average thalweg depth? 0.68 meters

b. Are there substantial pools deeper than 1 meter? Yes No

c. What is the general level of public access?

easy moderate very limited

3. Hydrological Conditions of site visits (Based on Palmer Drought Severity Index)

Mild-Extreme Drought

Incipient dry spell

Near Normal

Incipient wet spell

Mild-Extreme Wet

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