

FINAL REPORT

SECTION 6

ENDANGERED SPECIES ACT



FEDERAL AID PROJECT E-46  
Ouachita Rock-pocketbook Surveys in  
Major Tributaries of the Kiamichi River

JUNE 1, 1997 - MAY 31, 1998

## FINAL REPORT

STATE: Oklahoma

PROJECT NO.: E-46-1

PROJECT TITLE: Ouachita Rock-pocketbook Surveys in Major Tributaries of the Kiamichi River

SEGMENT DATES: June 1, 1997 - May 31, 1998

### I. OBJECTIVE

To determine the distribution and abundance of Ouachita rock-pocketbook mussels and associated fish species in selected major tributaries of the Kiamichi River.

### II. APPROACH

- (1) Identify accessible survey sites with potentially suitable habitat on major tributaries of the Kiamichi River.
- (2) Survey suitable sites for mussels using the standard techniques employed in previous surveys on the Kiamichi River (Vaughn *et al.* 1997). Timed searches using snorkeling will likely be the method used most frequently. All mussels will be identified and an index of relative abundance calculated for each survey site.
- (3) Assess the habitat conditions and any potential threats to mussels or their habitat.
- (4) Collect samples of stream fish by means of seining and identify all species. In addition to locating fish species associated with mussel beds, the project may also identify populations of the Kiamichi Shiner (*Notropis ortenburgeri*) and other Ouachita endemics.

### III. INTRODUCTION

The Ouachita rock-pocketbook, *Arkansia wheeleri*, is a federally endangered species. Its historical distribution includes the Ouachita, Little and Kiamichi Rivers in the Ouachita uplands subgeographic province in Southeastern Oklahoma and Southwestern Arkansas.

The present day total known population of the Ouachita rock-pocketbook is restricted to approximately 1000 individuals in the Kiamichi River, and a few individuals in the lower Little River (Vaughn and Pyron 1995; Vaughn *et al.* 1996) and one individual recently discovered in the Ouachita River, Arkansas (J. L. Harris, *personal communication*). A priority task for recovery of this species is finding new populations, including new populations or subpopulations within the Kiamichi River watershed. To date, most of the survey effort for this species has been directed toward the main stems of larger rivers. Few smaller streams have been explored to determine whether populations of the Ouachita rock-pocketbook or its suitable habitat are present, though relic shells have been found on relatively small tributaries of the Red River.

The purpose of this project is to survey selected larger tributaries of the Kiamichi River for the Ouachita rock-pocketbook. A primary reason for selecting the Kiamichi River tributaries for survey is that the Kiamichi River supports the largest numbers of *Arkansia wheeleri* remaining. If the species is capable of survival and reproduction in smaller streams, then the tributaries of the Kiamichi River appear to be the most likely streams in which the species will occur.

### IV. METHODS

During June and July 1997 we surveyed 30 sites on 23 streams, all of which are tributaries to the Kiamichi River. Sampling sites are shown in Figure 1.

We selected survey sites by looking at USGS topographical quad maps to determine the largest tributaries of the Kiamichi. Based on accessibility in the field, we also surveyed sites on smaller tributaries of the Kiamichi. At each site visited, we assessed whether or not suitable habitat for mussels was present based on substrate qualities and presence or absence of shells on the banks. If shells were present we collected representatives of each species we found.

If a site did show evidence of mussels or quality habitat, we conducted a timed mussel survey (timed to standardize sampling effort). We surveyed by hand searching and snorkeling in the following manner: (1) the entire extent of habitat was searched by one to three people for a minimum of 30 minutes; (2) all mussels encountered were removed and brought to shore; (3) all mussels were identified; (4) all mussels were then replaced as close to the point of collection as possible.

We also sampled some sites using 0.25 m<sup>2</sup> PVC pipe quadrats. Quadrat sampling was done prior to timed searches. Ten to fifteen quadrats were sampled for each area. Quadrats were searched by hand until all mussels within a quadrat had been found to a depth of 15 cm. Mussels were then identified and returned to the mussel bed.

At sites where live mussels were abundant, diverse and in good condition, we collected fish by seining. Two people seined the pool, riffle and run habitats for 45 minutes. All specimens were preserved in 10% formalin and returned to the laboratory for identification.

At sites where live mussels were abundant, we assessed habitat conditions and potential threats to mussels. This assessment included describing stream riparian, bank, flow and bottom substrate conditions. At sites where live mussels were abundant, diverse and in good condition, we also measured a suite of environmental factors including pH, conductivity, dissolved oxygen, and multiple measures of current velocity and stream depth and width. These data are given on a site-by-site basis in Appendix 1.

## V. RESULTS

Live mussels were found at only eight of the 30 sites visited. Most tributaries to the Kiamichi river are small, high gradient and intermittent. Overall, tributaries that contained mussels were permanently flowing, larger streams. The best populations occurred in Jackfork Creek, North Jackfork Creek, Big Cedar Creek, and Rock Creek. All of these streams had appropriate substrate and flow conditions for mussels and contained relatively diverse assemblages (although not as diverse or as abundant as main-stem Kiamichi River assemblages).

Twenty one species of unionid mussels and 22 species of fish occurred in the sampled Kiamichi tributaries (Appendix 1). None of these species are particularly rare or have any protected federal or state status. *Villosa arkansasensis* (the Ouachita creekshell) is a Ouachita Mountain endemic species and *Ptychobranchnus occidentalis* (the Ouachita kidneyshell) is an Interior highlands endemic. *Etheostoma radiosum* (the Orange belly darter) is a Ouachita endemic species.

No living Ouachita rock-pocketbook mussels were found in any of the 23 streams surveyed. One relic shell was found by the USFWS on Jackfork Creek (see Appendix 2), about 0.25 miles downstream from Sardis dam and directly downstream from the site we sampled at Mathies Park Recreation area (Figure 1; site 8). The Mathies Park site contained nine living species of unionids and two species of relic shells. Although mussel abundance was low compared to mainstem Kiamichi sites, the species found there co-occur with *A. wheeleri* in the Kiamichi River (Vaughn and Pyron 1995) and the site contained the kind of habitat heterogeneity typical of Ouachita rock-pocketbook sites. In addition, fish harboring *A. wheeleri* glochidia could disperse relatively easily between main-stem Kiamichi sites and lower Jackfork Creek. Thus, it is possible that living Ouachita rock-pocketbook mussels occur in lower Jackfork Creek and this area should be surveyed more extensively. Big Cedar Creek contains good mussel habitat and also warrants further survey. It is unlikely that any of the other Kiamichi tributaries surveyed contain *Arkansia wheeleri*.

## VI. ACKNOWLEDGMENTS

We thank Kirsten Work and Julian Hilliard for field assistance, and Keith Gido and Jake Schaefer for identifying fish.

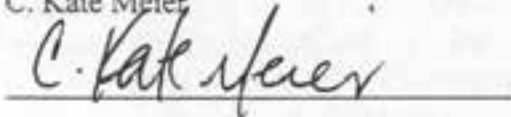
## VII. LITERATURE CITED

- Vaughn, C. C. and M. Pyron. 1995. Population ecology of the endangered Ouachita Rock-Pocketbook Mussel, *Arkansia wheeleri*, (Bivalvia: Unionidae), in the Kiamichi River, Oklahoma. *American Malacological Bulletin*, 11(2):145-151.
- Vaughn, C. C., C. M. Mather, M. Pyron, P. Melhop and E. K. Miller. 1996. The current and historical mussel fauna of the Kiamichi River, Oklahoma. *Southwestern Naturalist*, 41:325-328.
- Vaughn, C. C., C. M. Taylor and K. J. Eberhard. 1997. A comparison of the effectiveness of timed searches vs. quadrat sampling in mussel surveys. Pages 157-162, in Cummings, K. S., A. C. Buchanan, C. A. Meyer and T. J. Naimo (eds.), *Conservation and Management of Freshwater Mussels II: Initiatives for the Future*. Proceedings of a UMRCC symposium, 16-18 October 1995, St. Louis, Missouri. Upper Mississippi River Conservation Committee, Rock Island, Illinois.

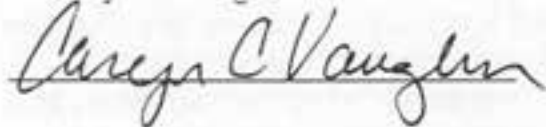
## VIII.

Prepared by:

C. Kate Meier



Dr. Caryn C. Vaughn



Date: 21 August 1998

Approved by

Dr. Harold Namminga  
Federal Aid Coordinator



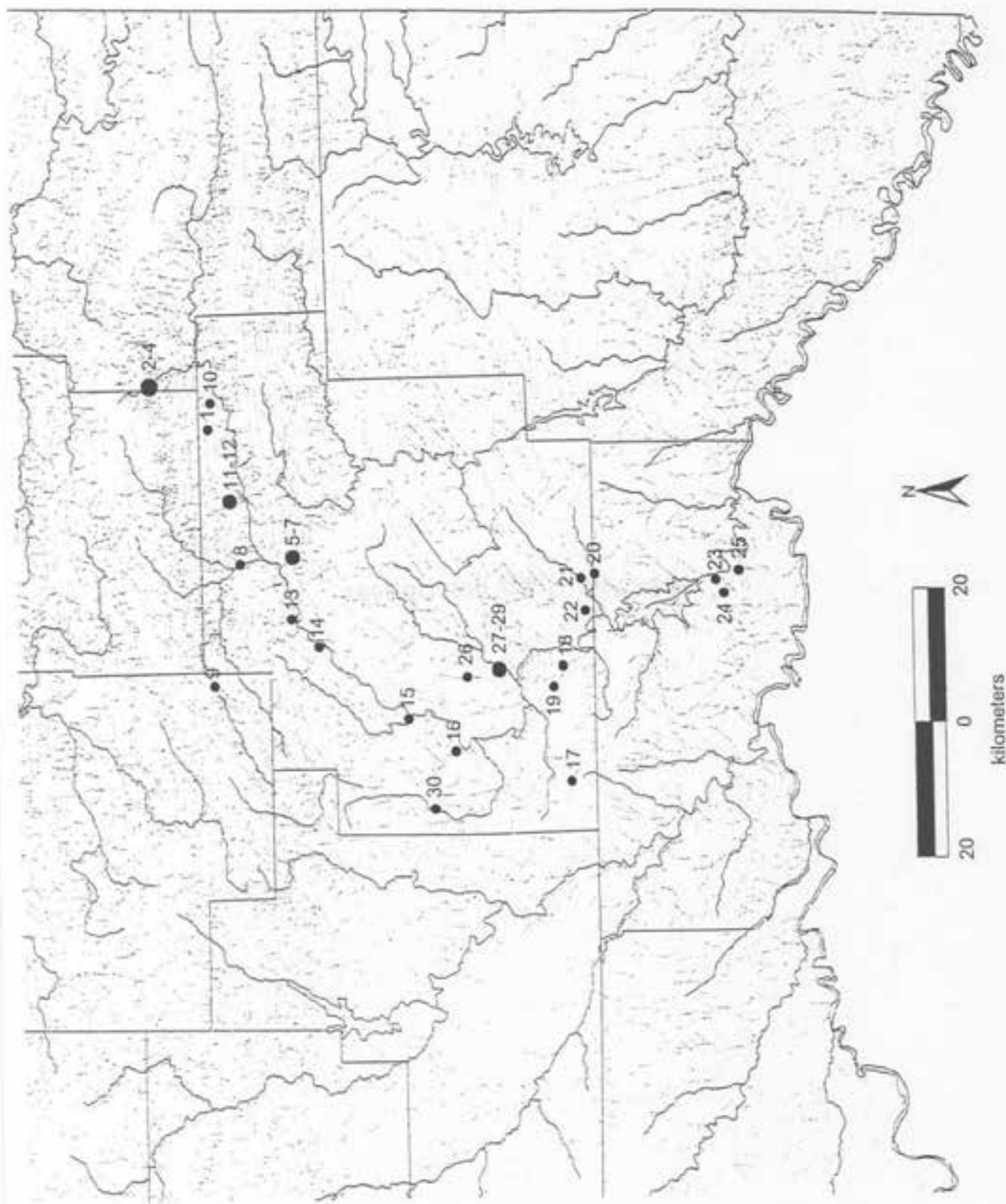


Figure 1. Map of all sites visited

## Appendix 1: Site descriptions

FIELD CODE: F97VAU02

STREAM: Walnut Creek

COUNTY: Pushmataha

QUAD: Kiamichi

NUMBER ON MAP: I

DATE: 10 June 1997

SURVEYORS: Caryn Vaughn, Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This is a braided, gravelly creek with sandstone boulders. The riparian area is relatively thick and the banks are not steep. The trees do not shade the creek. The creek is low gradient with slow flowing pools between riffles. It is shallow and narrow. A gravel pit is downstream and cattle have access to this site. Mean stream width was 8.26 m. Mean water depth was 66.55 cm. Mean flow was 0.27 m/s.

WATER QUALITY: Water Temperature 22° C                      pH: 7.8  
Conductivity 110  $\mu$ mho/cm                      DO: 9.4 mg/l

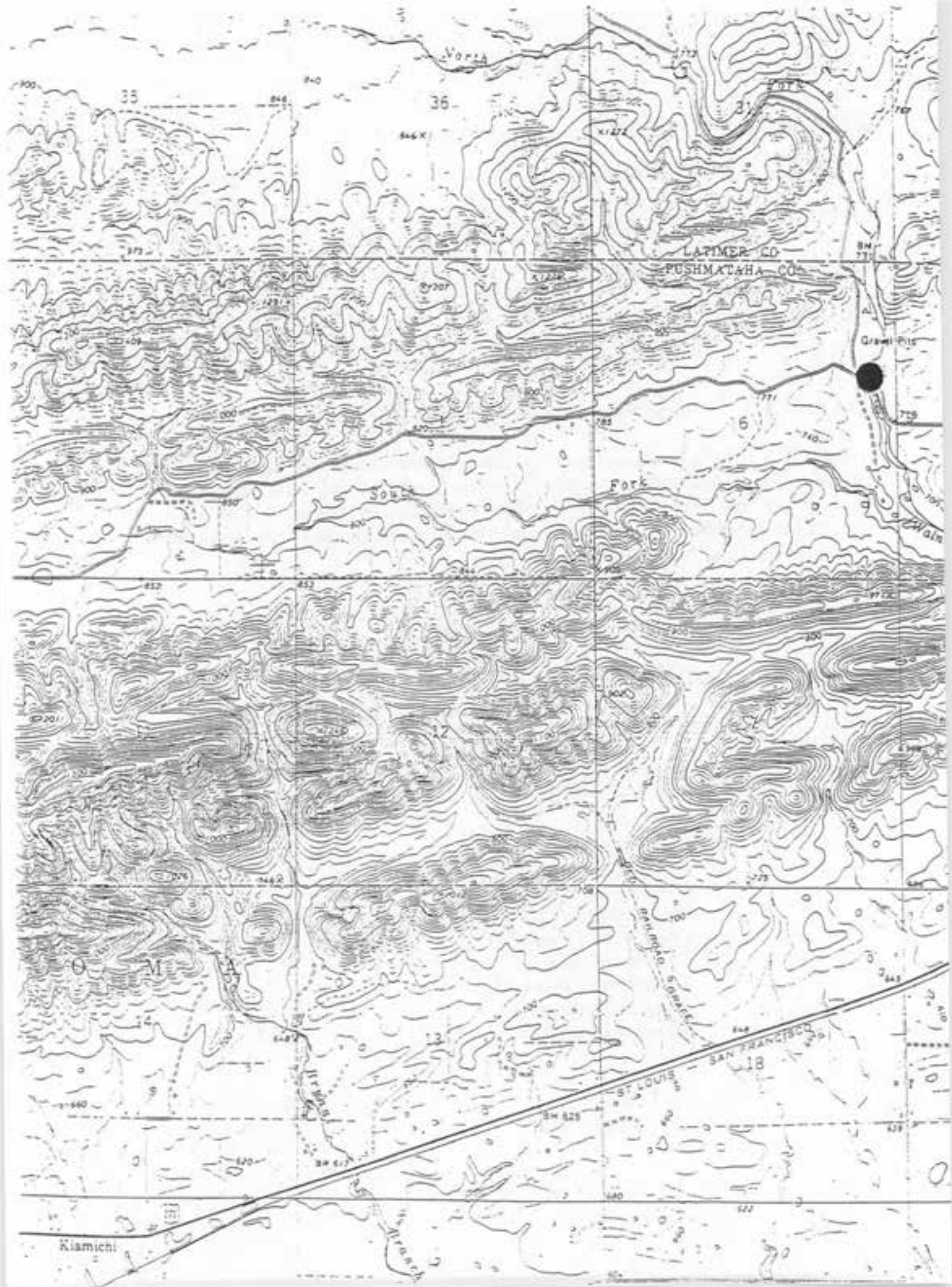
MUSSELS: No mussels were found at this site.

SHELLS: Shells were not found at this site.

FISH: Fish were seined in pools and one riffle area. The following species were collected (numbers of individuals are in parentheses):

*Lythrurus umbratilis* (5)  
*Fundulus olivaceus* (11)  
*Notropis boops* (8)  
*Lepomis megalotis* (20)  
*Campostoma anomalum* (59)  
*Gambusia affinis* (11)  
*Etheostoma radiosum* (15)  
*Pimephales notatus* (1)  
*Micropterus* sp. (1)





FIELD CODE: F97VAU03

STREAM: Rock Creek

COUNTY: Leflore

QUAD: Albion

NUMBER ON MAP: 2

DATE: 10 June 1997

SURVEYORS: Caryn Vaughn, Kirsten Work, Katie Meier, Julian Hilliard

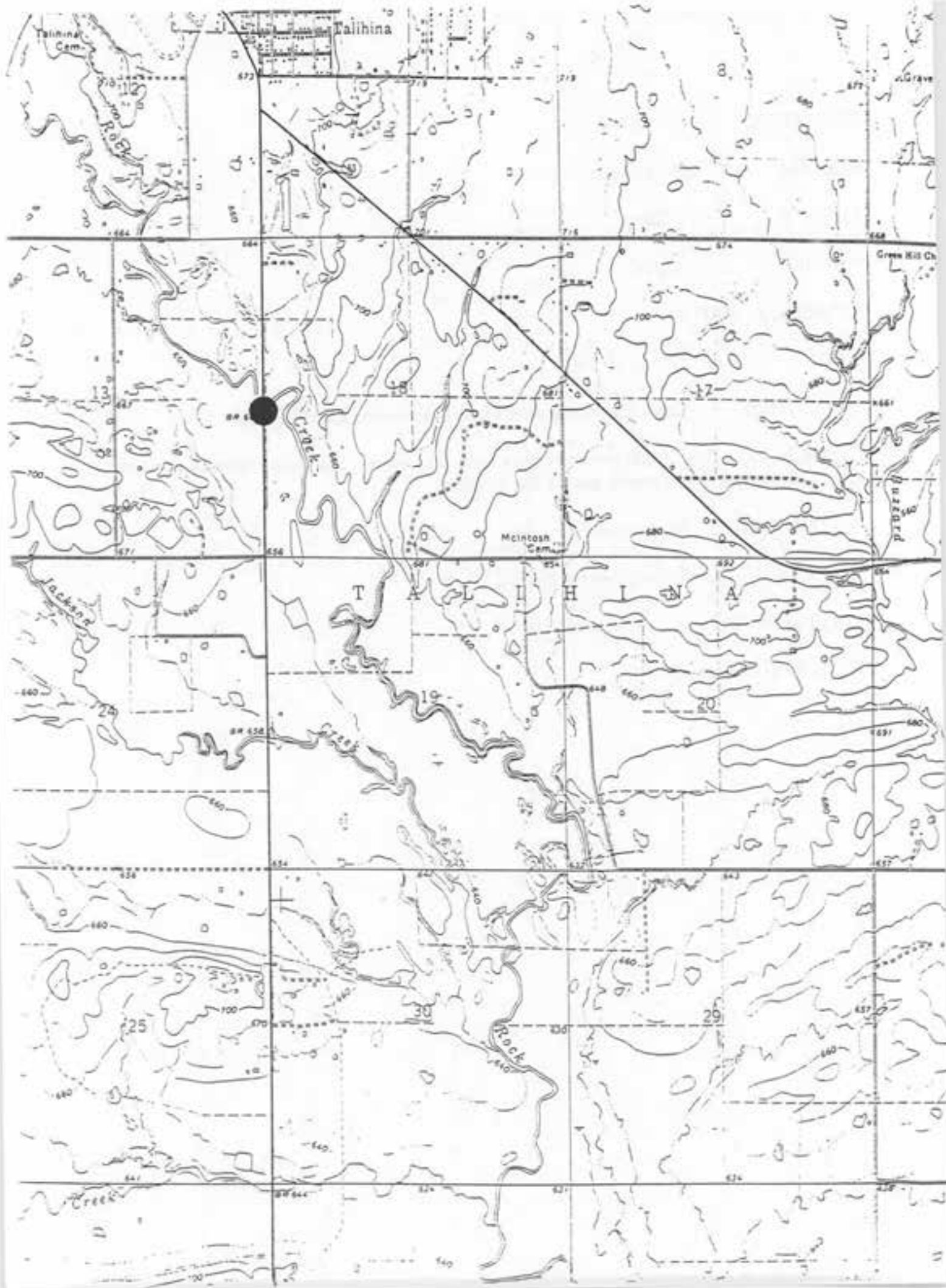
DESCRIPTION: This site has very steep banks with poor access. Substrate is bedrock with very low flow. No appropriate mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU04

STREAM: Rock Creek

COUNTY: Leflore

QUAD: Talihina

NUMBER ON MAP: 3

DATE: 10 June 1997

SURVEYORS: Caryn Vaughn, Kirsten Work, Katie Meier, Julian Hilliard

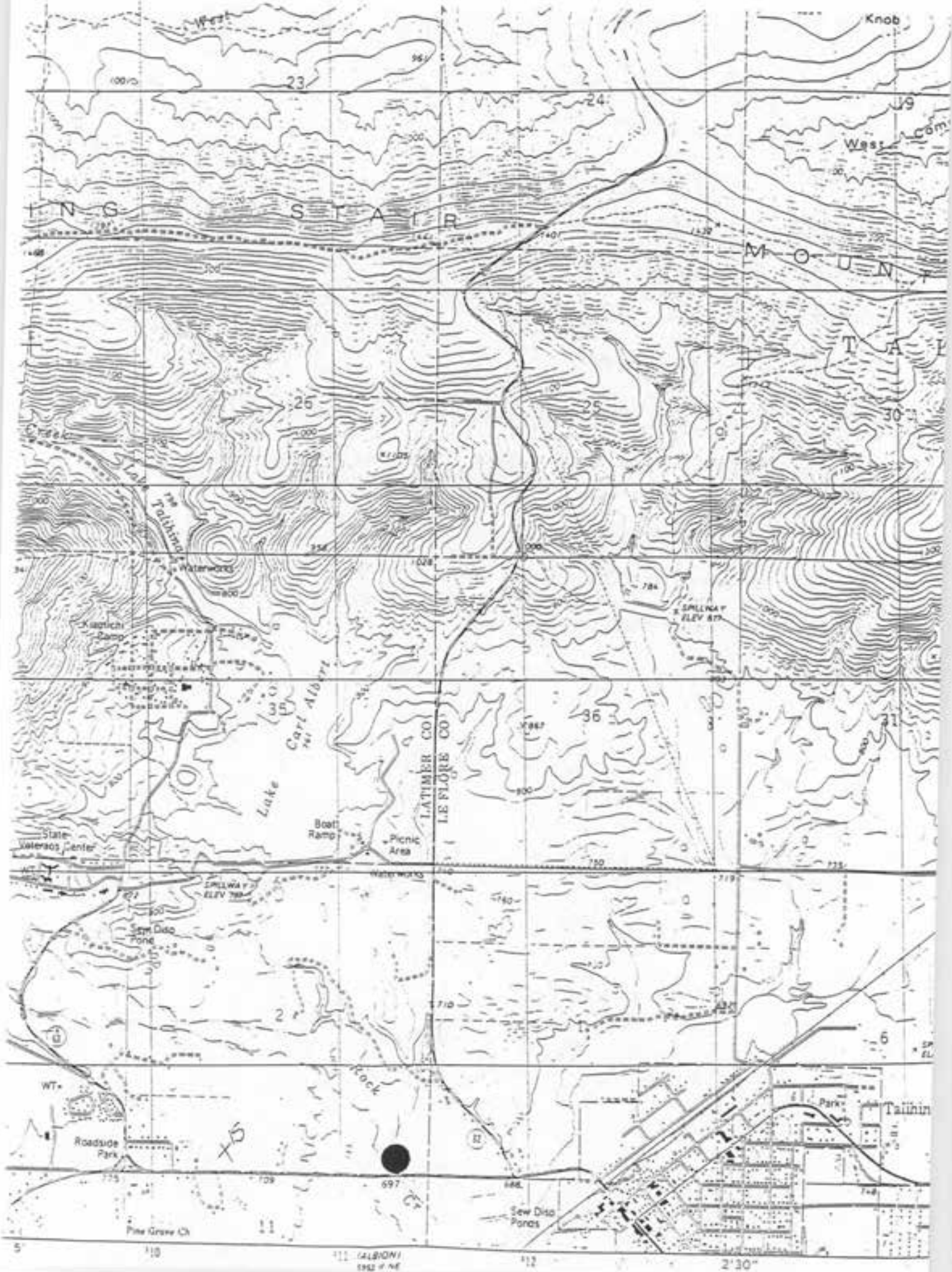
DESCRIPTION: This site is surrounded by pasture. The substrate is bedrock with some boulder and cobble. Flow was very low. No appropriate habitat for mussels was found.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU05

STREAM: Rock Creek

COUNTY: Latimer

QUAD: Talihina

NUMBER ON MAP: 4

DATE: 10 June 1997

SURVEYORS: Caryn Vaughn, Kirsten Work, Katie Meier, Julian Hilliard

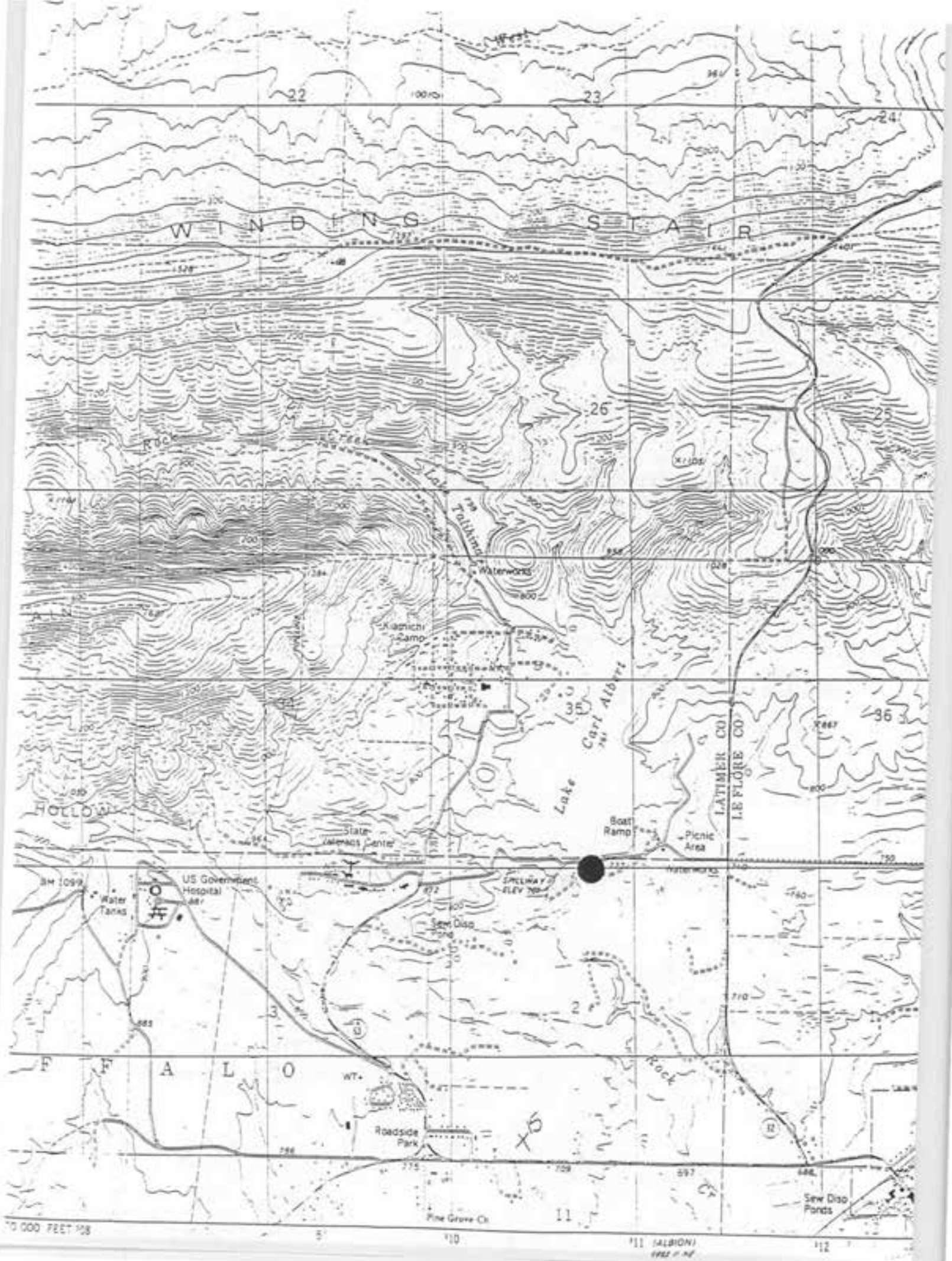
DESCRIPTION: This site was the outflow from Lake Carl Albert, an impoundment of Rock Creek. This was a pool with no flow, boulder and cobble substrate and contained trapped fish. No appropriate substrate/habitat for mussels was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



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FIELD CODE: F97VAU07

STREAM: Peal Creek

COUNTY: Pushmataha

QUAD: Clayton

NUMBER ON MAP: 5

DATE: 11 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: The stream is a medium sized creek. Only one riffle area was present downstream of a small impoundment, owned by Camp Minnetonka. The riffle area was two riffles with a short run in between. The pool areas were shallow and turbid. Bank vegetation included sycamore, maple and hackberry. The substrate was cobble and gravel with patches of silt. Mean width was 14.94 m, mean depth was 54.61 cm and mean flow was 0.173 m/s.

WATER QUALITY: Water Temperature	24° C	pH:	7.8
Conductivity	40 µmho/cm	DO:	8.1 mg/l

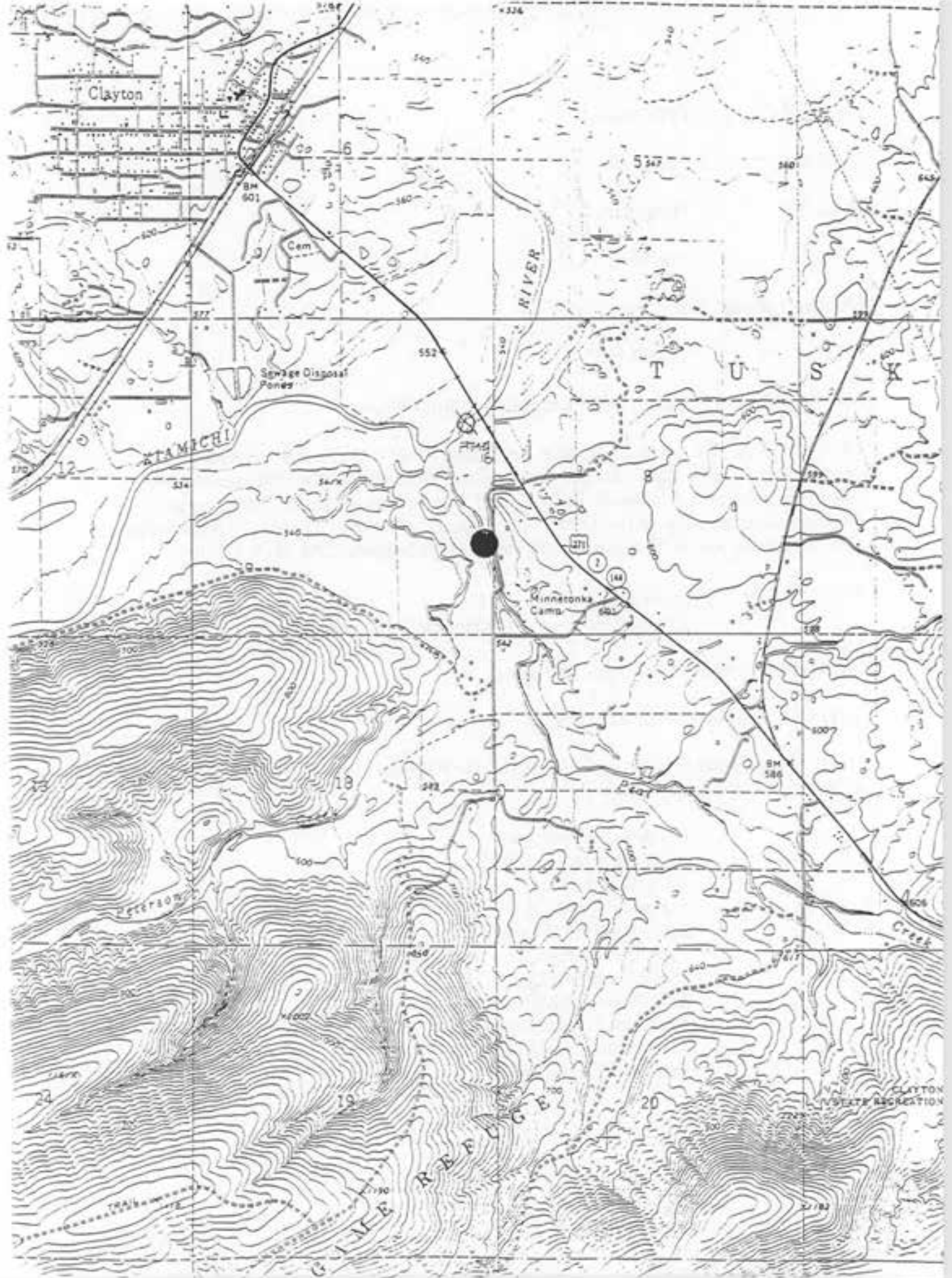
MUSSELS: No mussels were found at this site.

SHELLS: Shells were not found at this site.

FISH: Fish were seined in pool and riffle areas. The following species were collected (numbers of individuals are in parentheses):

*Lythrurus umbratilis* (2)  
*Fundulus olivaceus* (1)  
*Notropis boops* (23)  
*Lepomis megalotis* (14)  
*Lepomis macrochirus* (4)  
*Cyprinella whipplei* (6)  
*Gambusia affinis* (2)  
*Etheostoma radiosum* (1)  
*Pimephales notatus* (2)  
*Micropterus punctulatus* (2)  
*Luxilus chrysocephalus* (27)





FIELD CODE: F97VAU08

STREAM: Peterson Creek

COUNTY: Pushmataha

QUAD: Clayton

NUMBER ON MAP: 6

DATE: 11 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

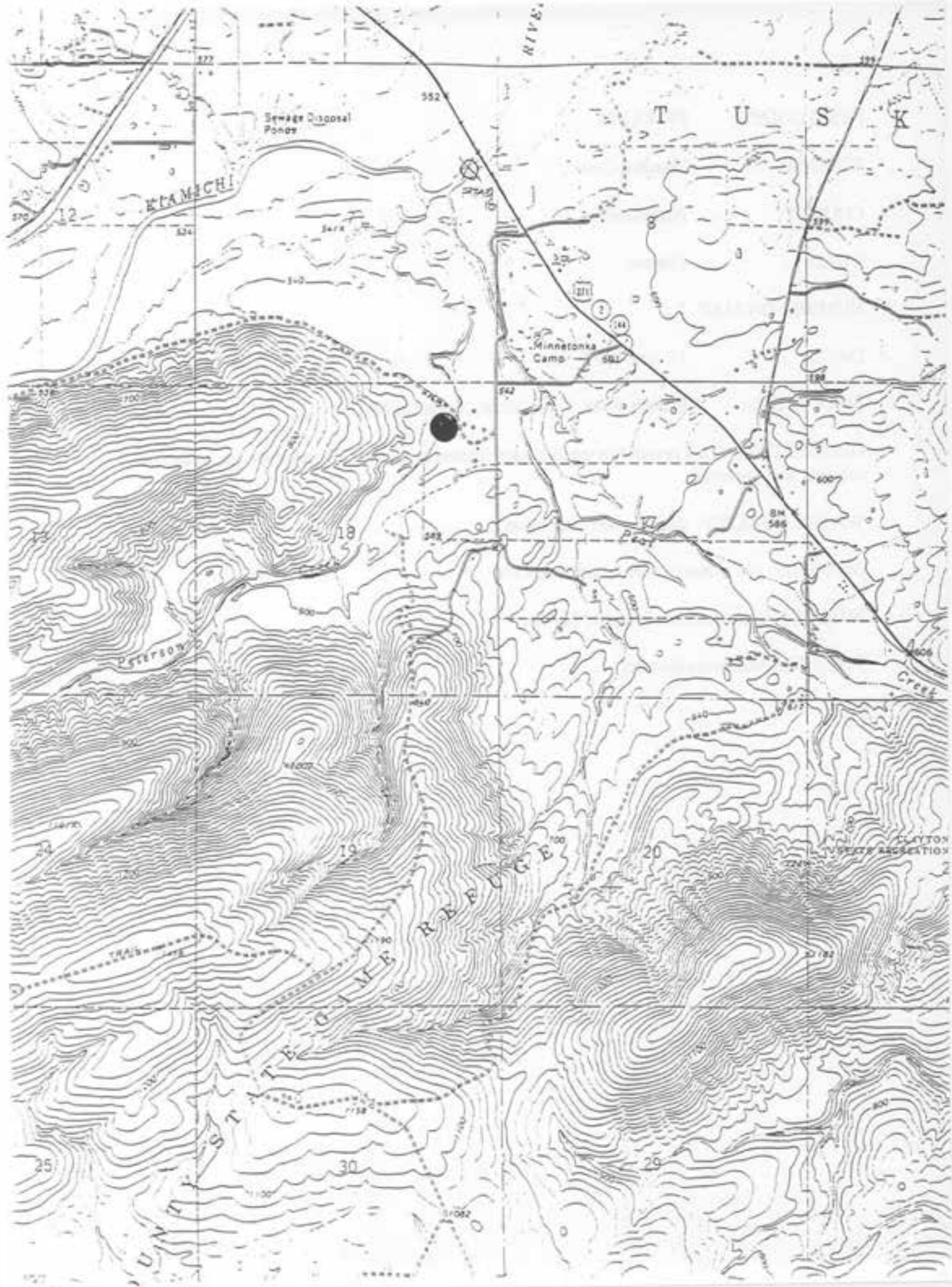
DESCRIPTION: This site was turbid, flow was low, and sediments were anoxic. The substrate is clay, gravel and silt. Land use is cattle grazing with lots of disturbance from cows evident. No suitable habitat for mussels was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU09

STREAM: Peterson Creek

COUNTY: Pushmataha

QUAD: Clayton

NUMBER ON MAP: 7

DATE: 11 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

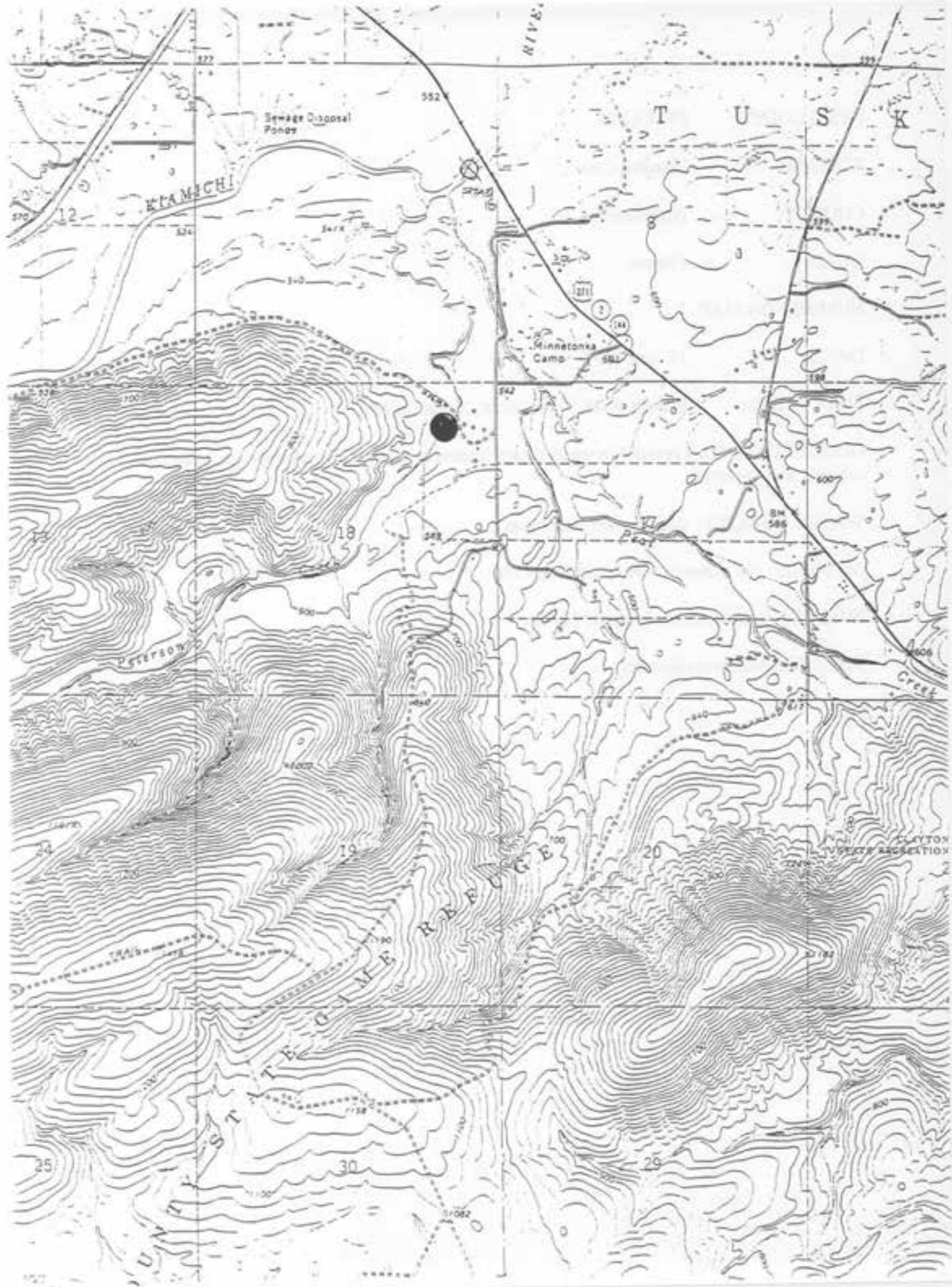
DESCRIPTION: This stream is a small, rocky, intermittent creek. No appropriate habitat for mussels was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU10

STREAM: Jackfork Creek

COUNTY: Pushmataha

QUAD: Clayton

NUMBER ON MAP: 8

DATE: 12 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This site is 0.25 mile downstream of the Sardis Lake dam release area in Mathies Park recreation area. The water ranges from clear to turbid. The substrate is cobble and gravel with some siltation. There were several water willow islands. The riparian area is second growth vegetation including willow and sycamore. Surrounding land use includes the reservoir use and several roads. Mean stream width was 16.23 m, mean depth was 54.61 cm and mean flow was 0.173 m/s.

WATER QUALITY: Water Temperature 26° C                      pH: 7.8  
Conductivity 150µmho/cm                      DO: 8.1 mg/l

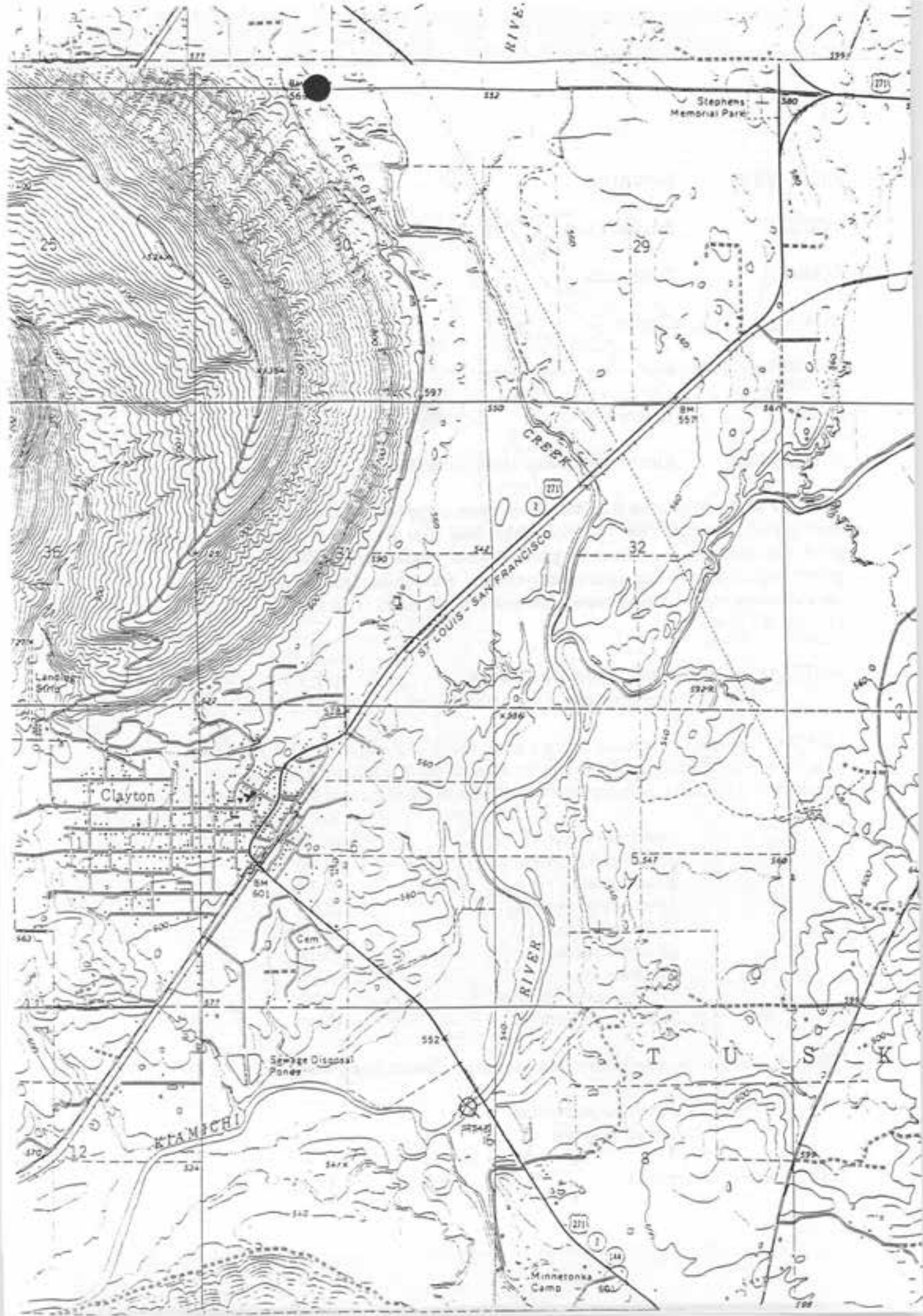
MUSSELS: Mussels were found during a timed search of 2 people for 30 minutes each. Mussels were in a bed about 37.4 m long by 5.3 m wide. The following species were found (numbers of individuals are in parentheses and relative abundances in the second column):

	Rel. abund.
<i>Ambiema plicata</i> (1)	(0.05)
<i>Actinonaias ligamentina</i> (3)	(0.15)
<i>Elliptio dilatata</i> (1)	(0.05)
<i>Megalonaias nervosa</i> (1)	(0.05)
<i>Obliquaria reflexa</i> (3)	(0.15)
<i>Quadrula pustulosa</i> (1)	(0.05)
<i>Quadrula quadrula</i> (5)	(0.25)
<i>Tritogonia verrucosa</i> (4)	(0.20)
<i>Truncilla truncata</i> (1)	(0.05)

SHELLS: Shells were collected from the bank area. Species found were:

*Potamilus purpuratus*  
*Lampsilis satura*

FISH: Fish were not sampled.



FIELD CODE: F97VAU12

STREAM: North Jackfork Creek

COUNTY: Pittsburg

QUAD: Counts

NUMBER ON MAP: 9

DATE: 12 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This is a small creek. The site is just downstream from a low water crossing. The banks are shale and limestone, with heavy vegetation including sycamore, cottonwood, hackberry and cedar. Gravel bars had lots of water willow. The substrate ranges from boulder to gravel with large patches of sand and silt in the pool areas. Land use includes cattle grazing and some trash was found in the area. Mean width was 9.36 m, mean depth was 34.54 cm and mean flow was 0.14 m/s.

WATER QUALITY: Water Temperature 27.5° C                      pH: 7.4  
 Conductivity 110 µmho/cm                      DO: 7.6 mg/l

MUSSELS: Mussels were found during a timed search of 3 people for 34 minutes each. We also sampled mussels with 10 0.25 m<sup>2</sup> quadrats. Mussels were in a bed about 73.4 m long by 6.6 m wide. The following species were found (numbers of individuals are in parentheses and relative abundances are in the second column):

	Rel. abund.
<i>Amblema plicata</i> (8)	(0.143)
<i>Actinonaias ligamentina</i> (1)	(0.018)
<i>Fusconaia flava</i> (18)	(0.321)
<i>Lampsilis teres</i> (13)	(0.232)
<i>Lampsilis cardium</i> (4)	(0.071)
<i>Lampsilis satura</i> (1)	(0.018)
<i>Leptodea fragilis</i> (2)	(0.036)
<i>Potamilus ohioensis</i> (2)	(0.036)
<i>Quadrula pustulosa</i> (3)	(0.054)
<i>Quadrula quadrula</i> (2)	(0.036)
<i>Tritogonia verrucosa</i> (1)	(0.018)
<i>Villosa lienosa</i> (1)	(0.018)

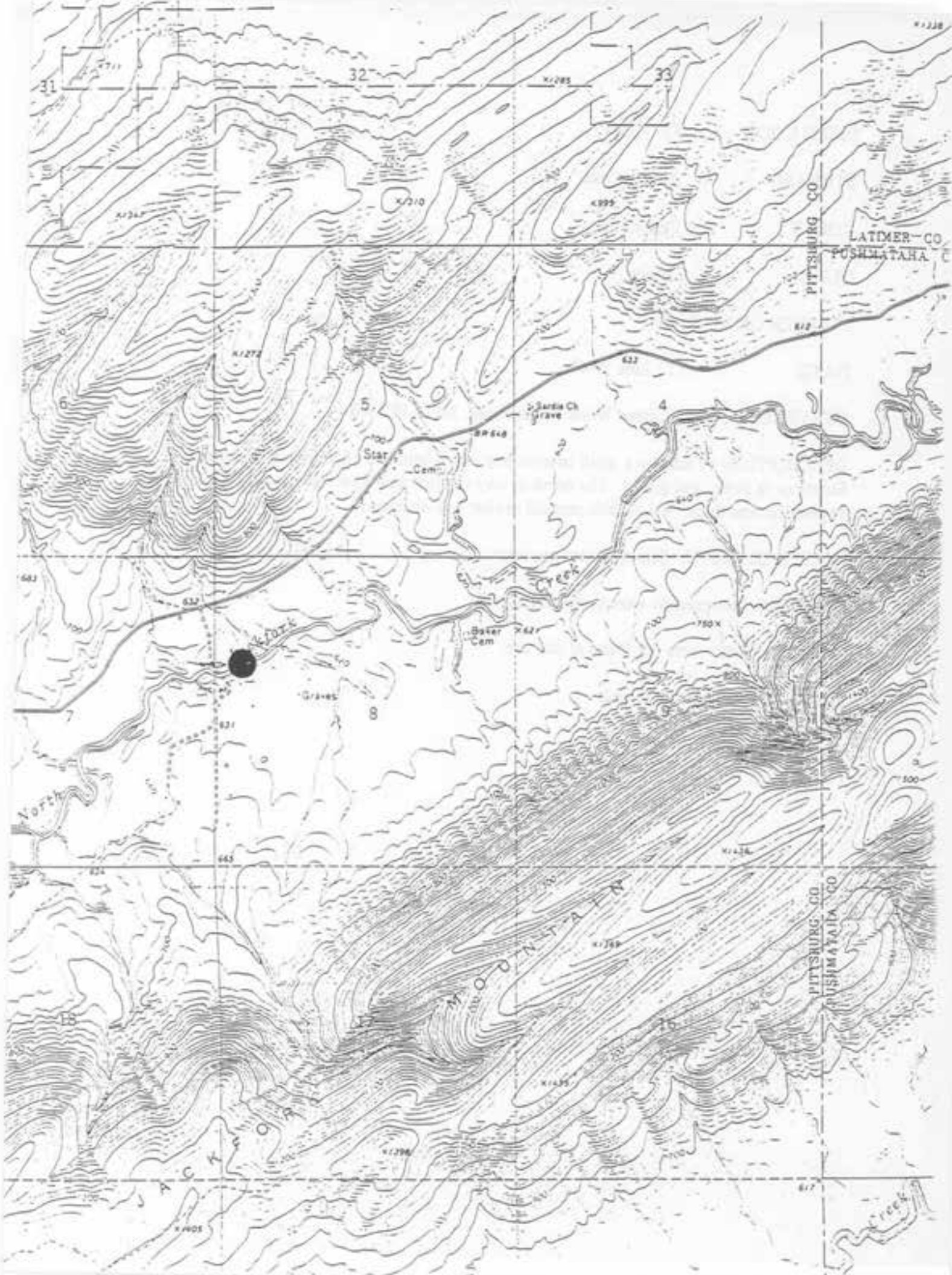


SHELLS: Shells were collected from the bank area. Species found were:

*Amblema plicata*  
*Elliptio dilatata*  
*Lampsilis cardium*  
*Lampsilis hydiana*  
*Lampsilis teres*  
*Leptodea fragilis*  
*Potamilus purpuratus*  
*Quadrula pustulosa*  
*Strophitus undulatus*

FISH: Fish were seined in riffle and pool areas for 50 minutes. Species found were (numbers of individuals are in parentheses):

*Campostoma anomalum* (17)  
*Cyprinella whipplei* (16)  
*Etheostoma nigrum* (8)  
*Etheostoma radiosum* (3)  
*Labidesthes sicculus* (3)  
*Lepomis macrochirus* (1)  
*Lepomis megalotis* (47)  
*Lythrurus umbratilis* (1)  
*Moxostoma duquesnei* (9)  
*Notropis boops* (13)  
*Percina sciera* (1)  
*Pimephales notatus* (7)



FIELD CODE: F97VAU13

STREAM: Albion Creek

COUNTY: Pushmataha

QUAD: Albion

NUMBER ON MAP: 10

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a small intermittent creek with lots of trash in the stream bed. Substrate is shale, and gravel. The creek is very shallow and flow was negligible. Riparian vegetation was thick. No suitable mussel habitat was observed.

WATER QUALITY: Samples were not taken.

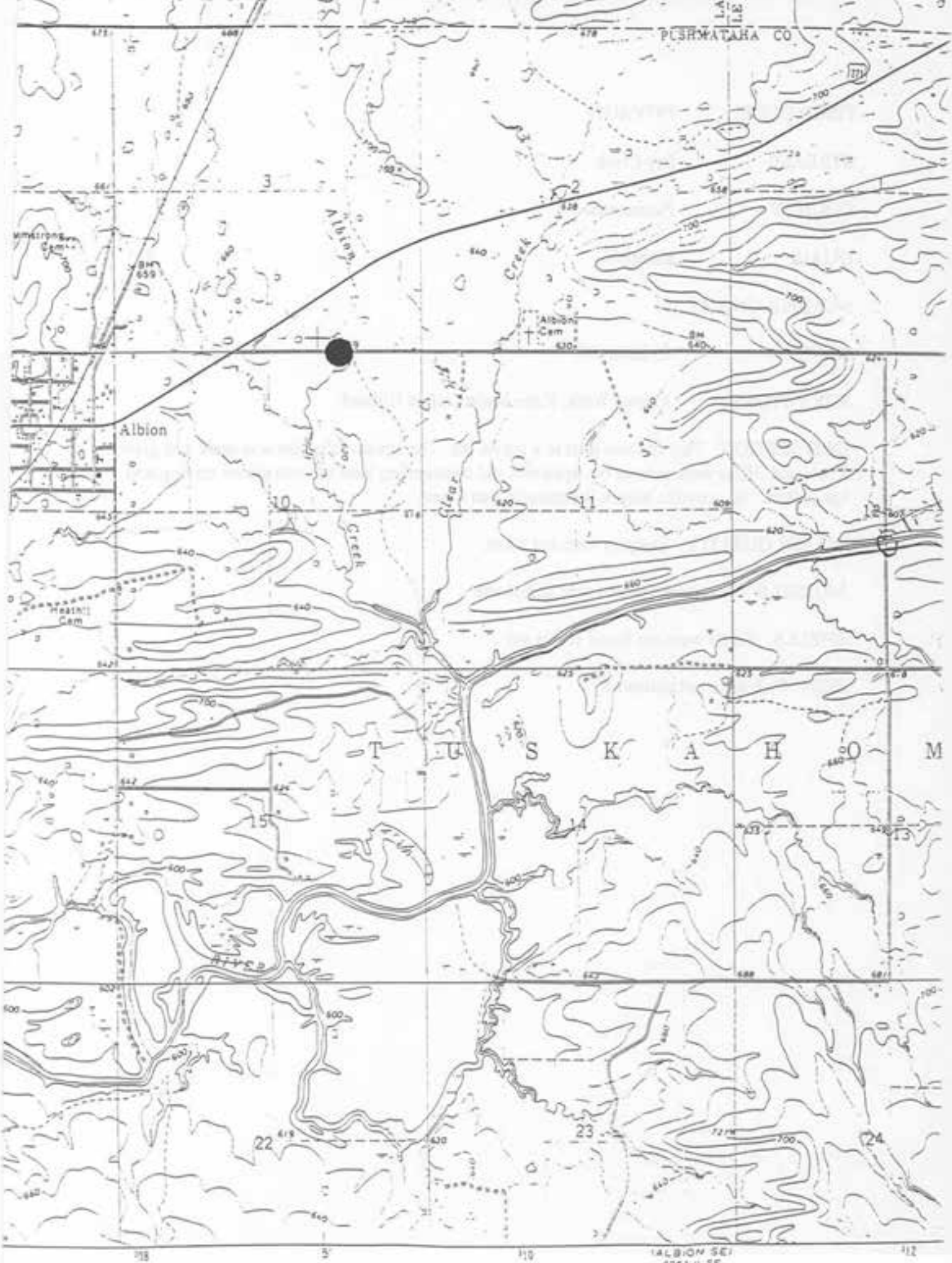
MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.

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FIELD CODE: F97VAU14

STREAM: Dry Creek

COUNTY: Pushmataha

QUAD: Kiamichi

NUMBER ON MAP: 11

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This site was next to a gravel pit. The stream substrate was shale and gravel. Pools and riffles were present but upstream and surrounding land use was gravel mining and agriculture. No suitable habitat for mussels was found.

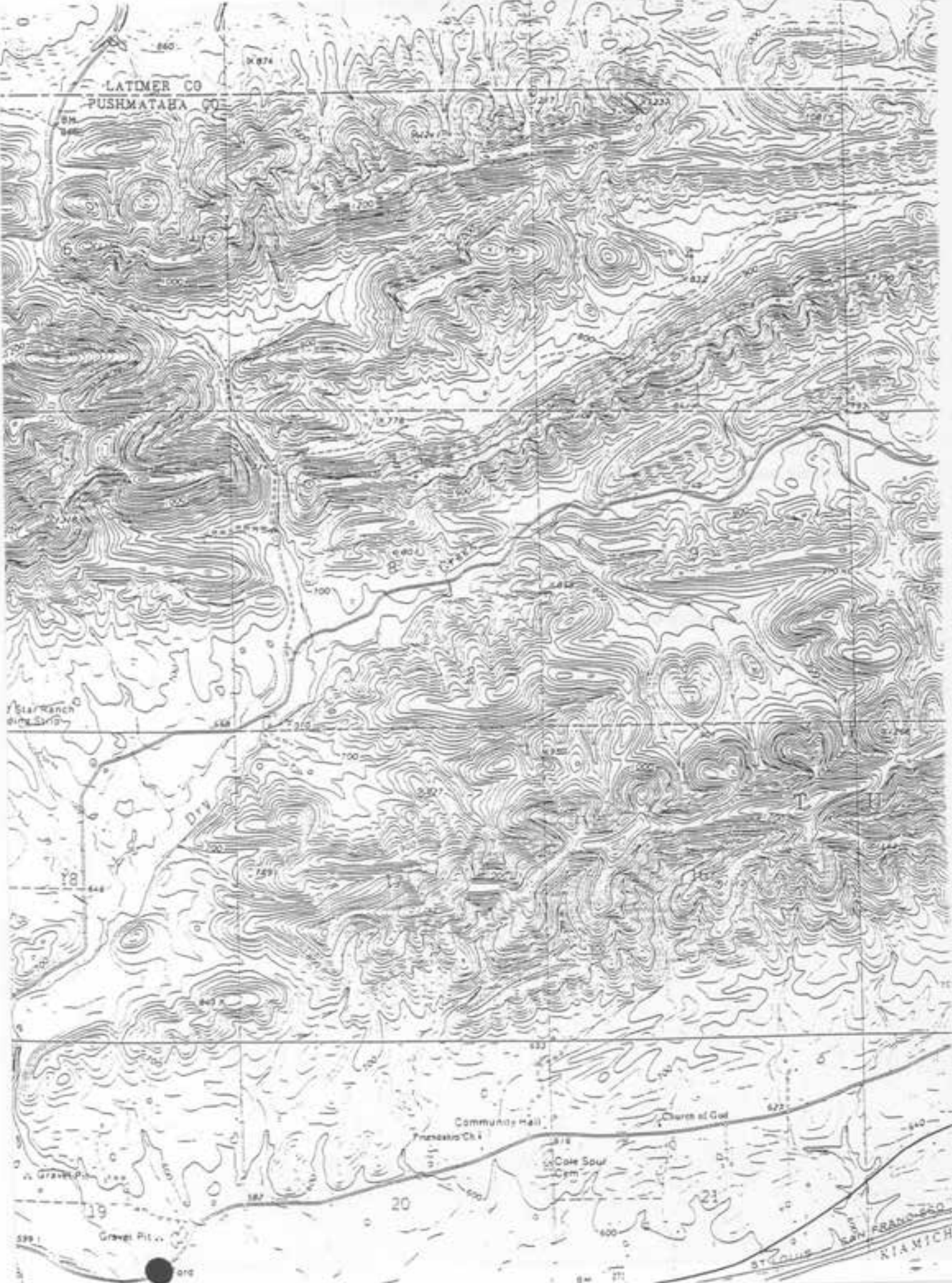
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.

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Coke Sou  
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Gravel Pit

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SAN FRANCISCO  
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FIELD CODE: F97VAU15

STREAM: Dry Creek

COUNTY: Pushmataha

QUAD: Kiamichi

NUMBER ON MAP: 12

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This site was near a gravel pit. The substrate was gravel and boulder. No suitable mussel habitat was found.

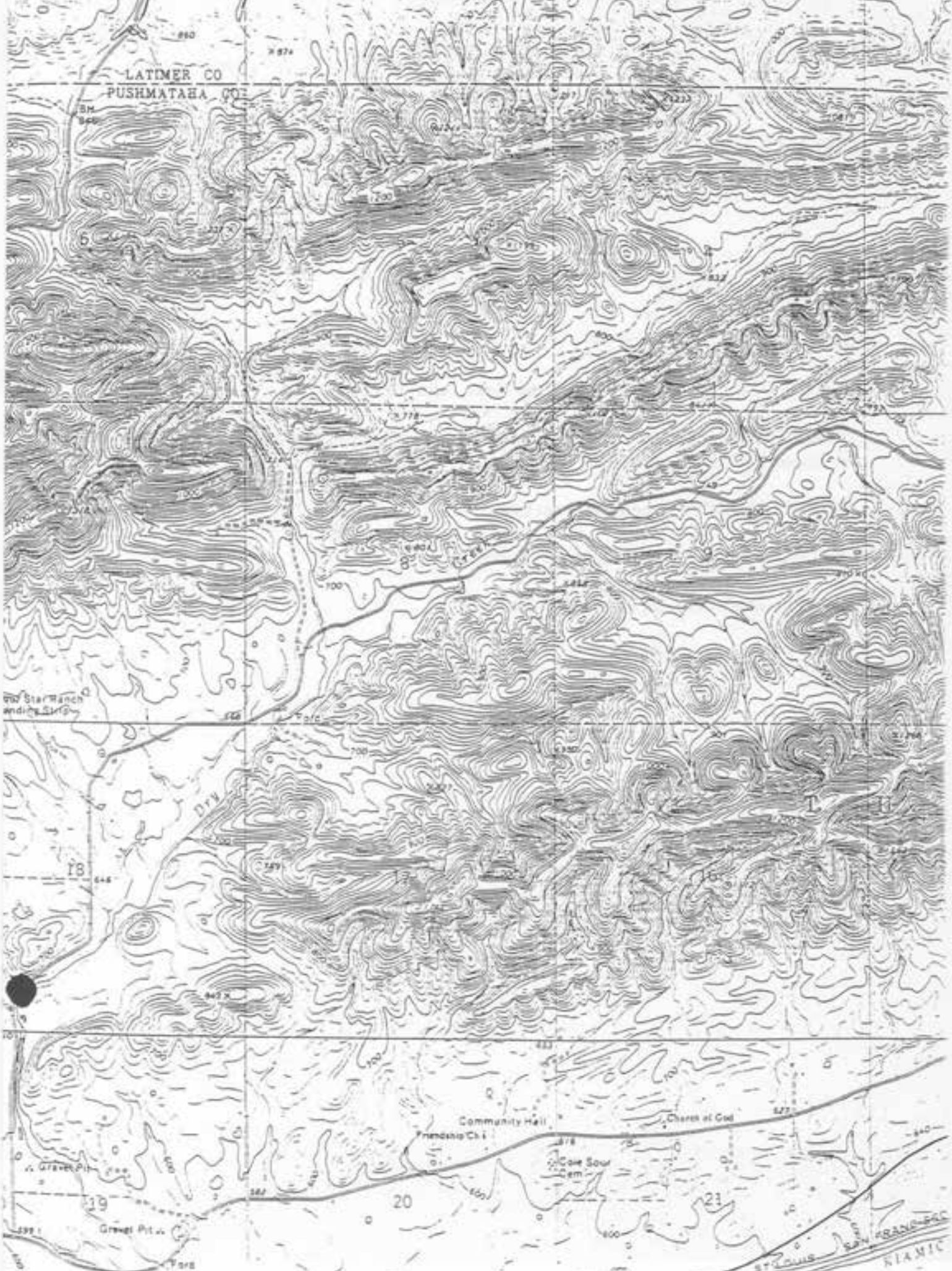
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.

LATIMER CO  
PUSHMATAHA COE



Old Starman's  
and his wife

Gravel Pit

Gravel Pit

Community Hall  
Friendship Ch.

Church of God

Coke Soud  
Cem

ST. LOUIS SAN FRANCISCO  
RAILROAD



FIELD CODE: F97VAU16  
STREAM: Little Cedar Creek  
COUNTY: Pushmataha  
QUAD: Stanley

NUMBER ON MAP: 13

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

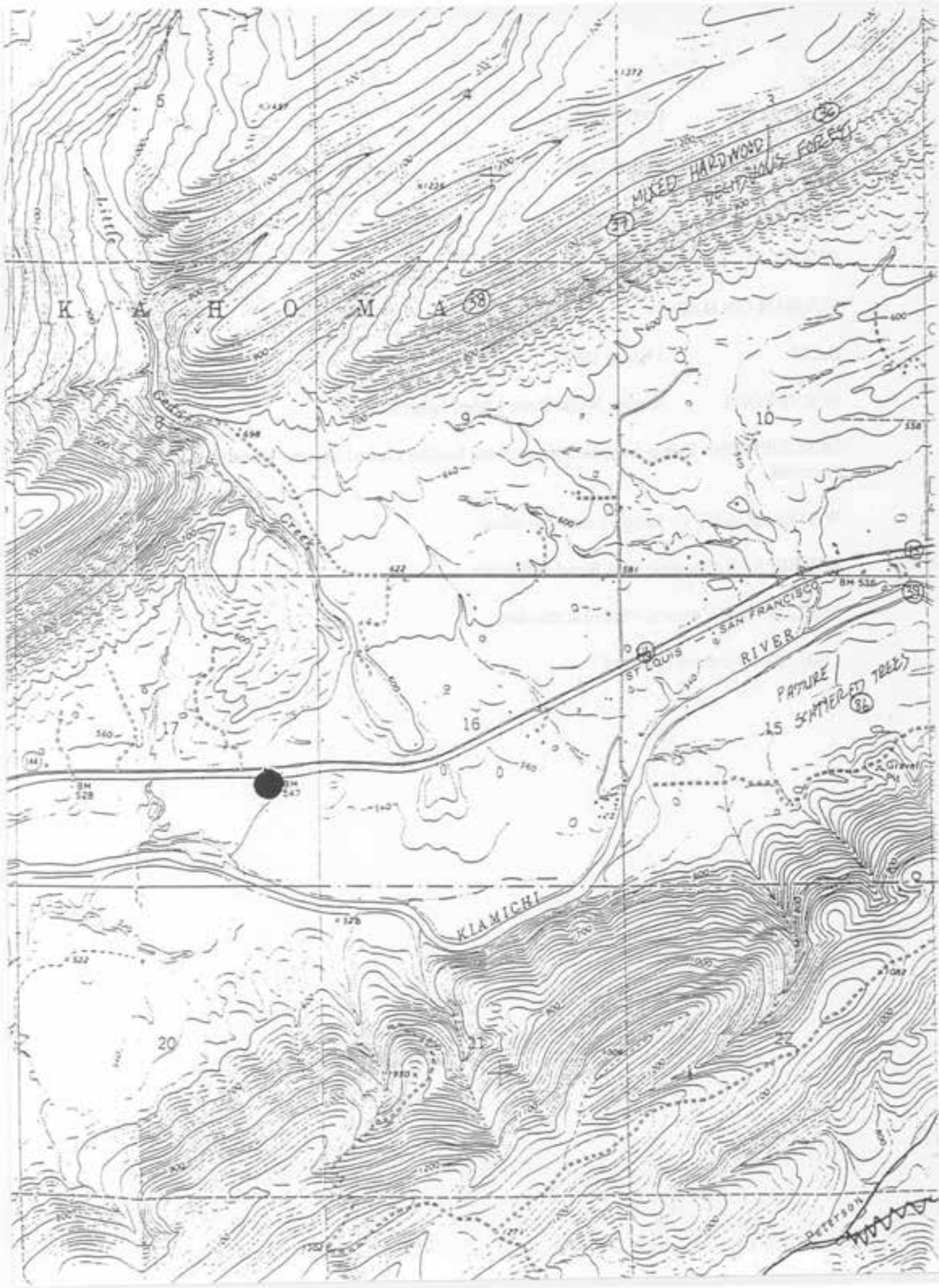
DESCRIPTION: This was a small, shallow silty creek with gravel substrate and water willows. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU17

STREAM: Crumb Creek

COUNTY: Pushmataha

QUAD: Stanley

NUMBER ON MAP: 14

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

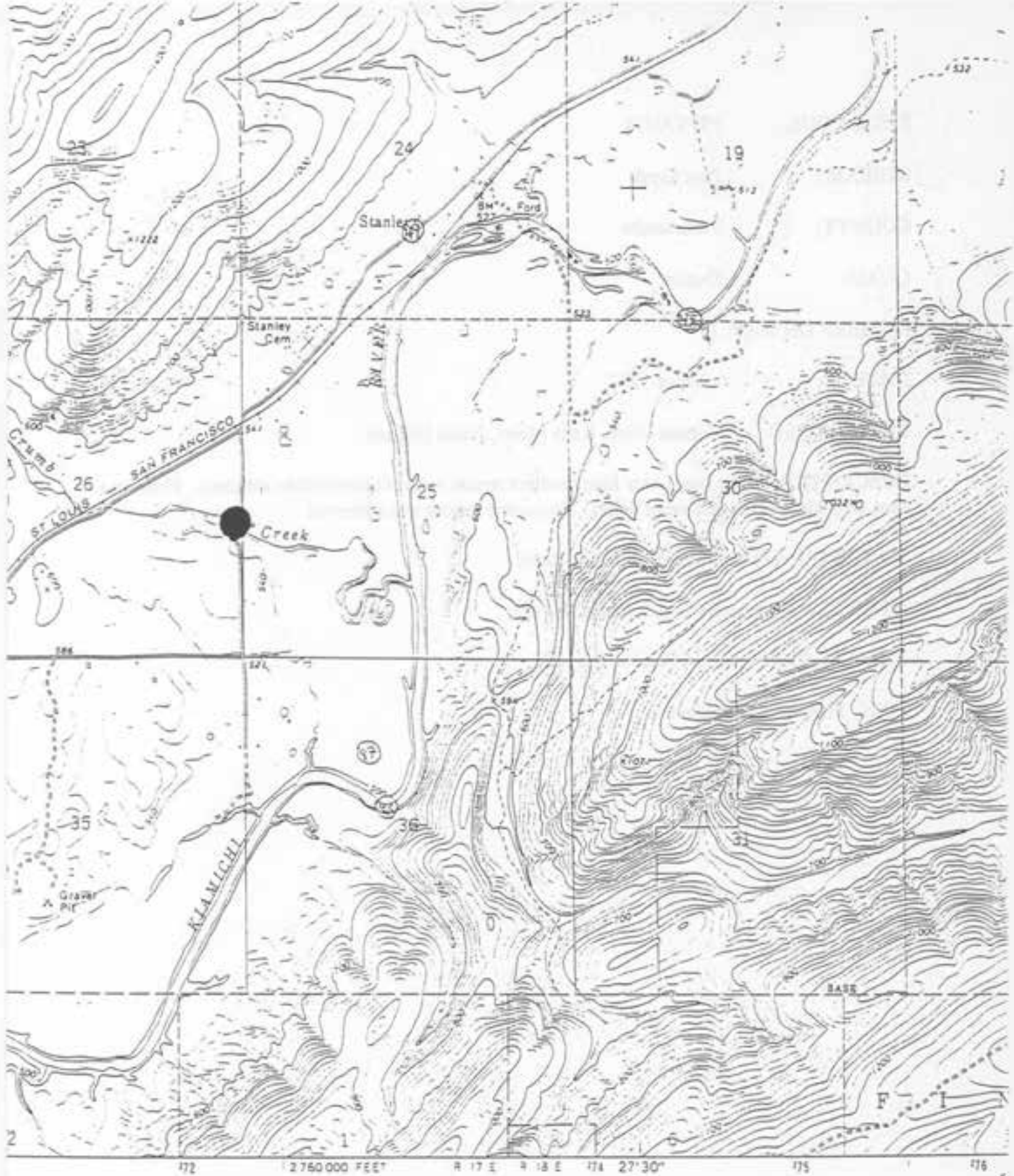
DESCRIPTION: This is a small, high gradient, boulder choked stream. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

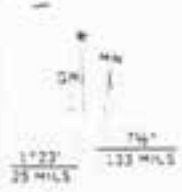
MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



Published by the Geological Survey  
 &GS and Oklahoma Highway Department  
 Symmetric methods from aerial  
 0-71. Field checked 1971  
 1927 North American datum  
 on Oklahoma coordinate system, south zone  
 transverse Mercator grid ticks.



CONTOUR  
 DATUM IS

Indicate selected fence and field lines where

FIELD CODE: F97VAU18

STREAM: Pine Creek

COUNTY: Pushmataha

QUAD: Dunbar

NUMBER ON MAP: 15

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

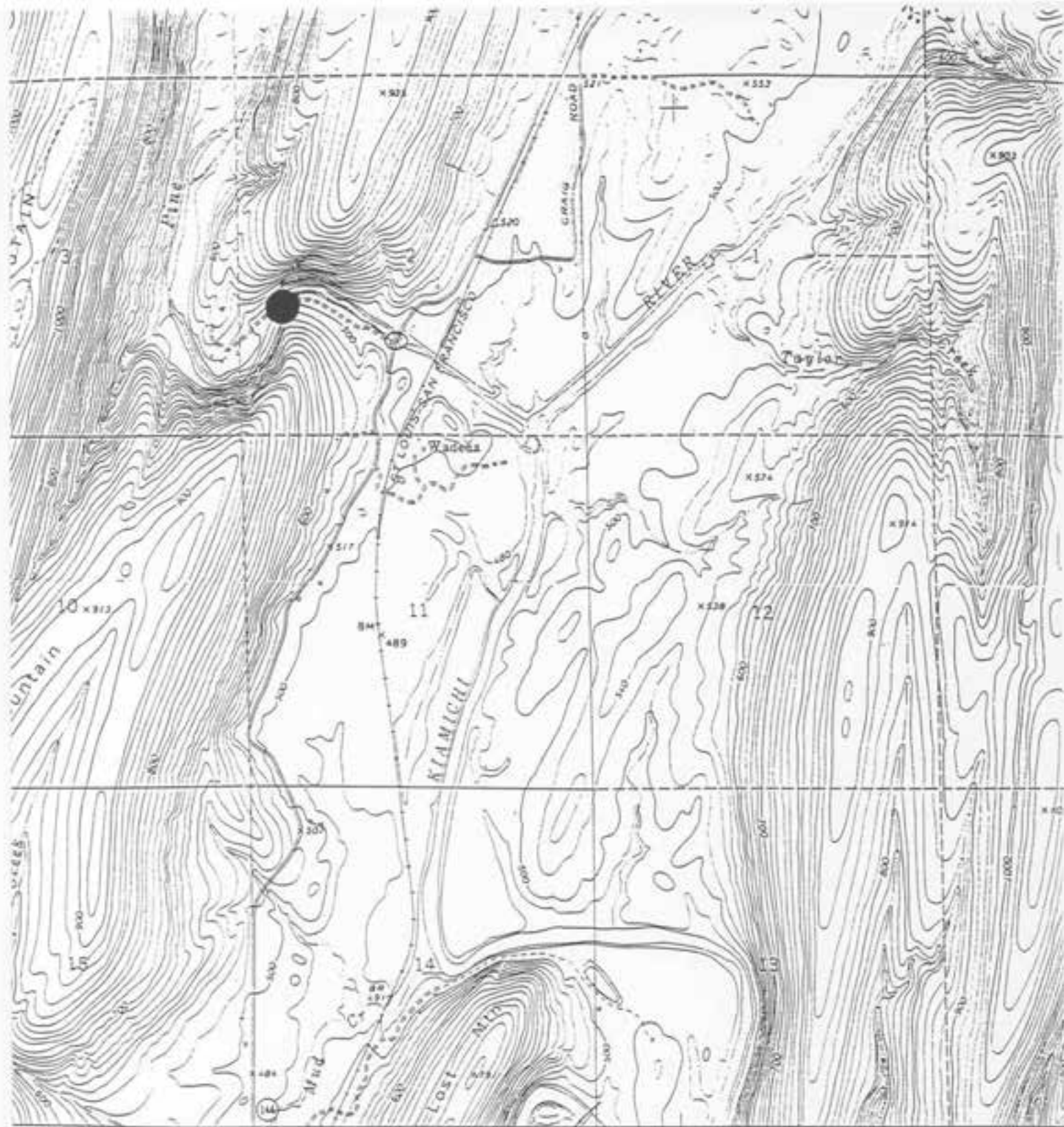
DESCRIPTION: This was a very high gradient stream with boulder/cobble substrate. Flow was low, with large pools and small riffles. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.

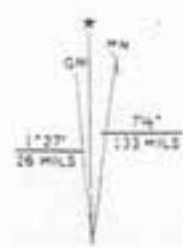


12720000 FEET      162      35'      163      R. 16 E. R. 17 E. 164

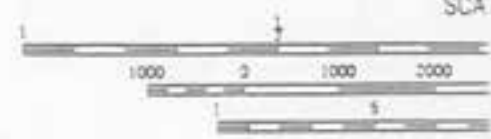
Published by the Geological Survey  
 the Oklahoma Highway Department,  
 sources Board, and Oklahoma State Soil

SC&GS  
 Simmetric methods from aerial  
 Q. Field checked 1972  
 1927 North American datum  
 on Oklahoma coordinate system, south zone  
 transverse Mercator grid ticks.

Indicate selected fence and field lines where  
 on photographs. This information is unchecked

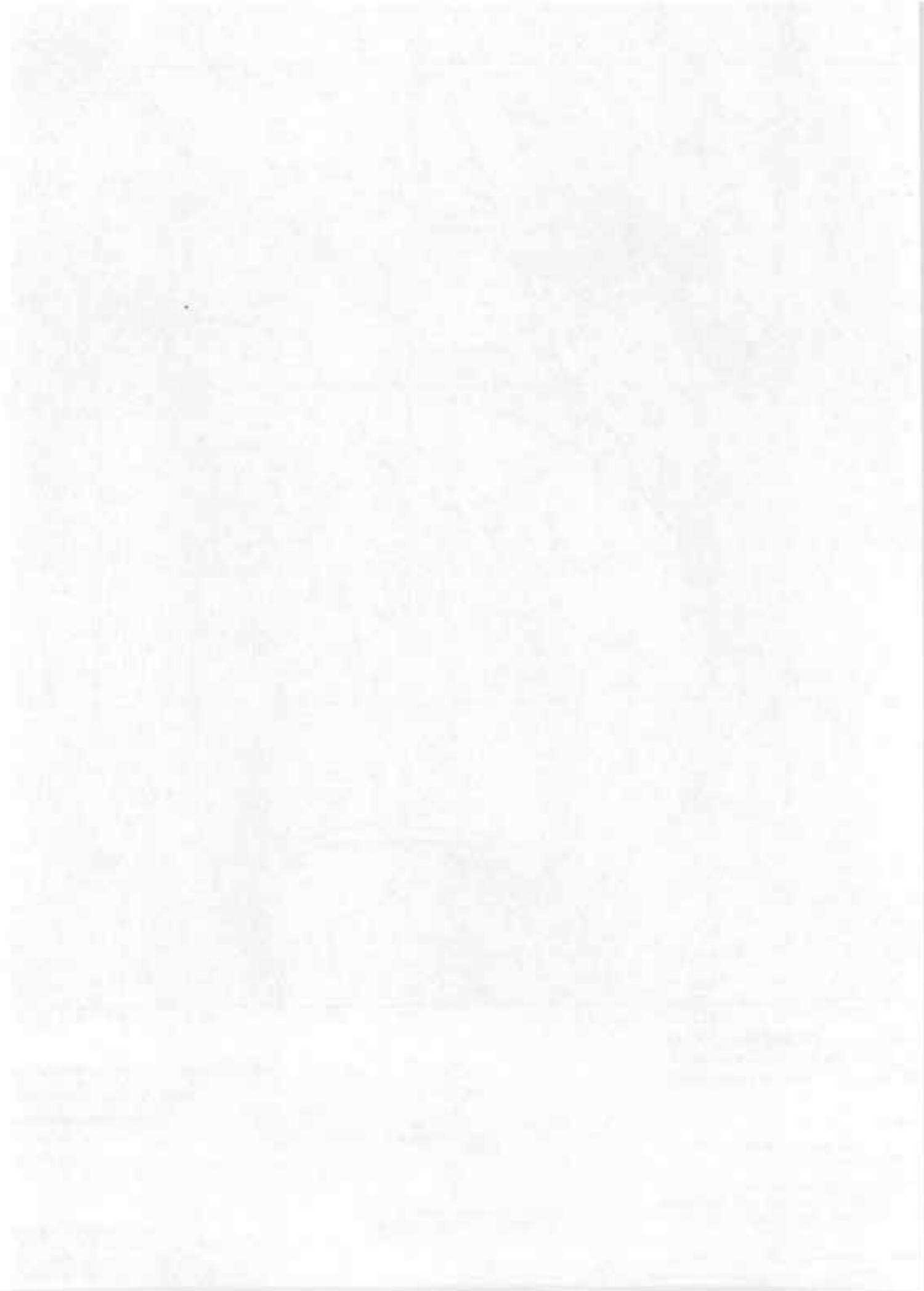


UTM GRID AND 1972 MAGNETIC NORTH  
 DECLINATION AT CENTER OF SHEET



CONTOUR  
 DATUM IS

THIS MAP COMPLIES WITH N.  
 FOR SALE BY U. S. GEOLOGICAL SURVEY, DEN  
 AND BY THE OKLAHOMA GEOLOG  
 A FOLDER DESCRIBING TOPOGRAPHIC



FIELD CODE: F97VAU19

STREAM: Buck Creek

COUNTY: Pushmataha

QUAD: Moyers

NUMBER ON MAP: 16

DATE: 13 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a high gradient, high flow stream. It had large pools and long fast water riffles. The substrate was cobble and boulders. No suitable mussel habitat was observed.

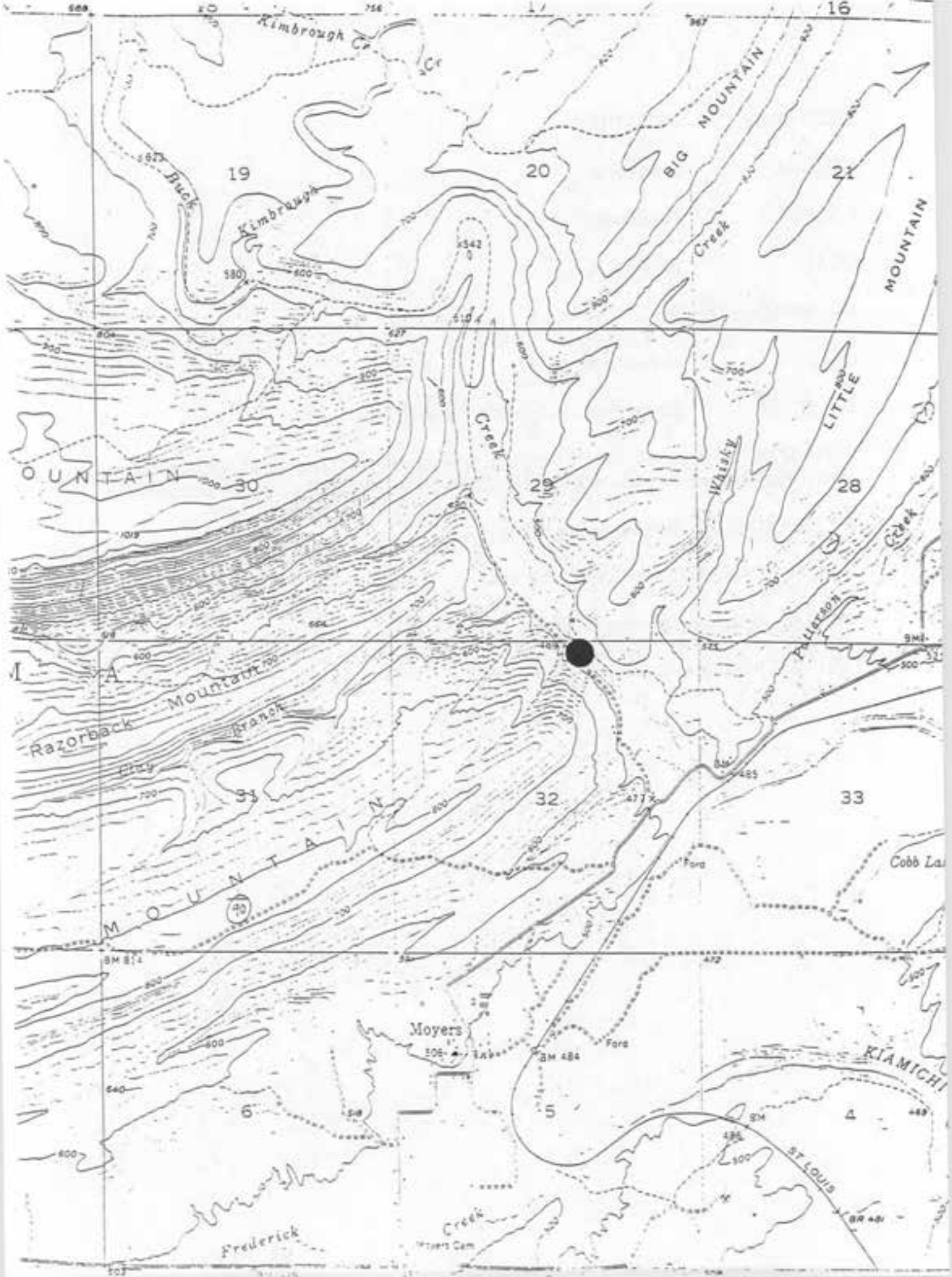
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.





FIELD CODE: F97VAU20

STREAM: Dumpling Creek

COUNTY: Pushmataha

QUAD: Antlers West

NUMBER ON MAP: 17

DATE: 14 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

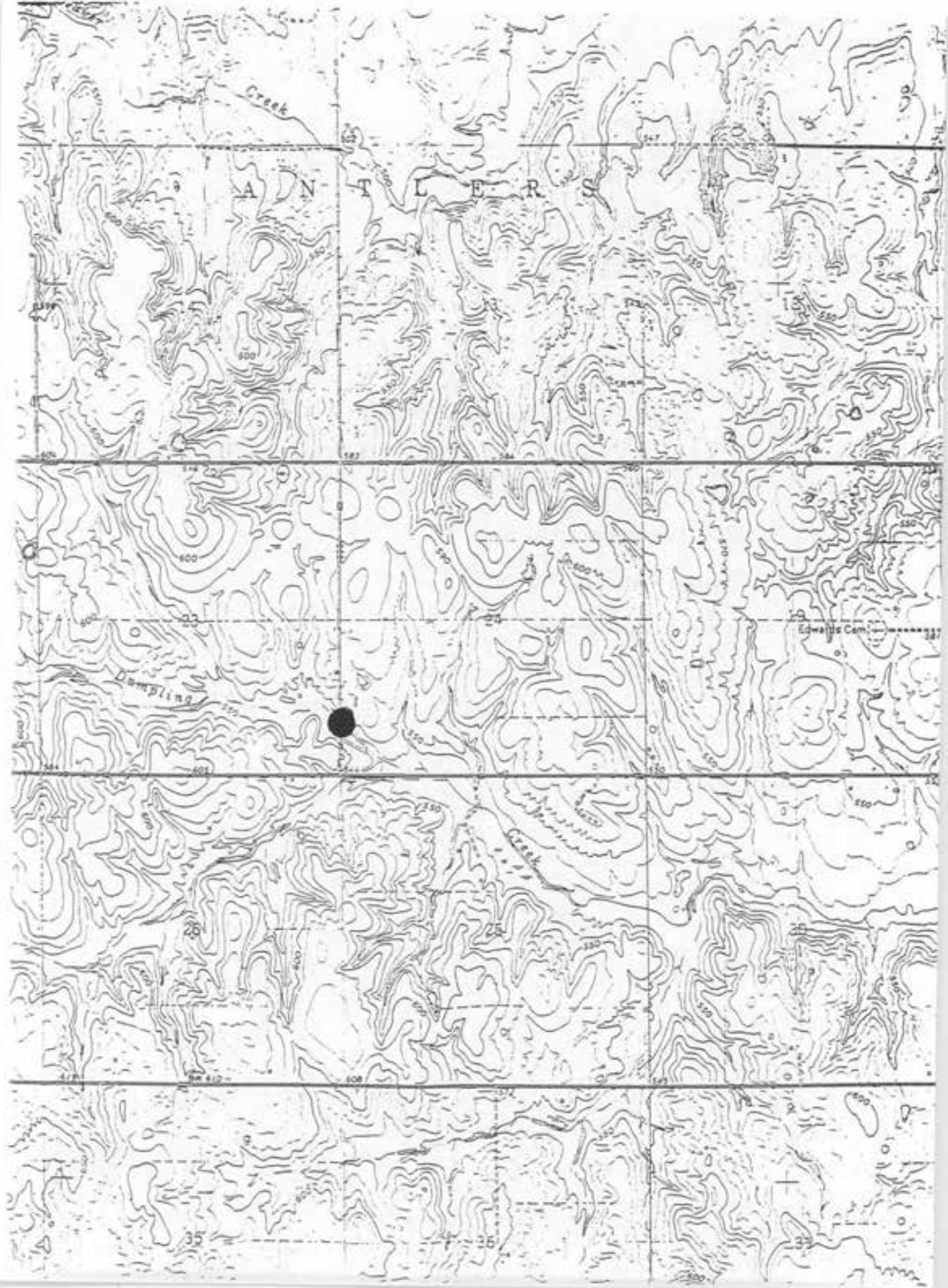
DESCRIPTION: This was a low gradient, low flow, muddy creek. Surrounding land use was all agriculture. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU21  
STREAM: Haggerman Creek  
COUNTY: Pushmataha  
QUAD: Antlers East  
NUMBER ON MAP: 18  
DATE: 14 June 1997  
SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

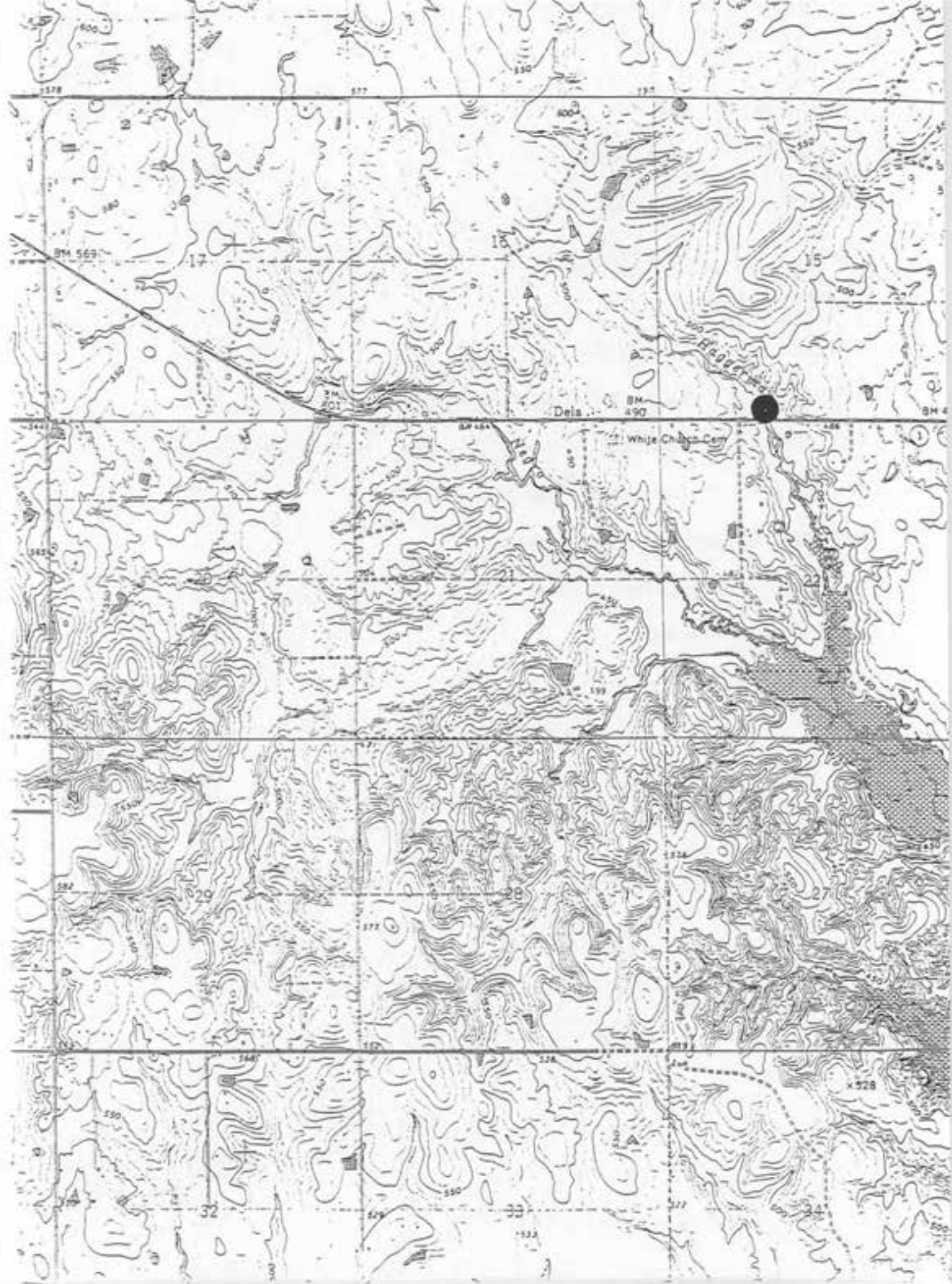
DESCRIPTION: This was a small, shallow, low flow creek. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU22

STREAM: Negro Creek

COUNTY: Pushmataha

QUAD: Antlers East

NUMBER ON MAP: 19

DATE: 14 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

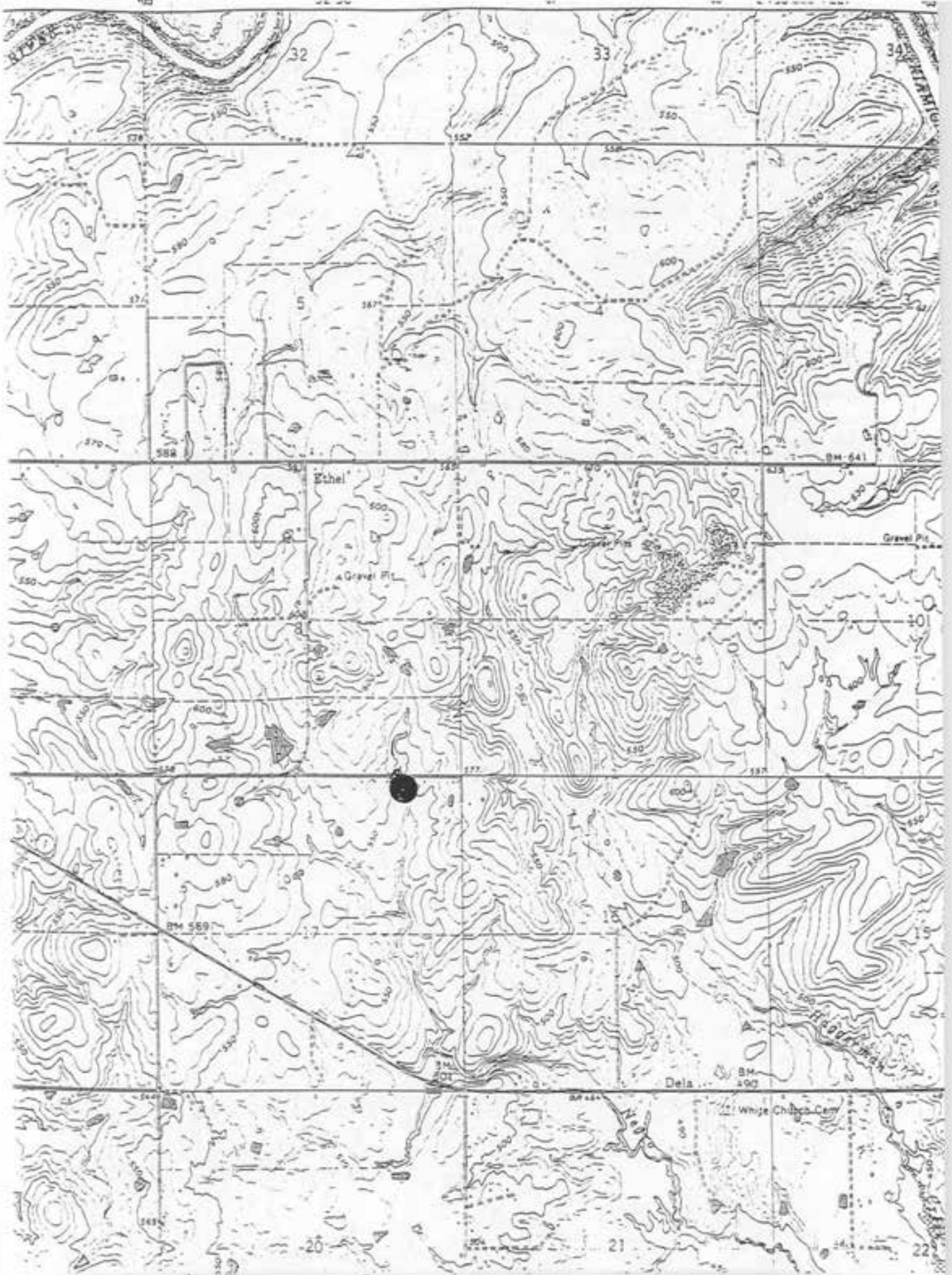
DESCRIPTION: This creek was dammed for irrigation. No mussel habitat was observed.

WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU24

STREAM: Spencer Creek

COUNTY: Pushmataha

QUAD: Spencerville

NUMBER ON MAP: 20

DATE: 14 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a large, low flow creek with bedrock substrate. There were deep pools and heavy riparian vegetation. No appropriate mussel habitat was found.

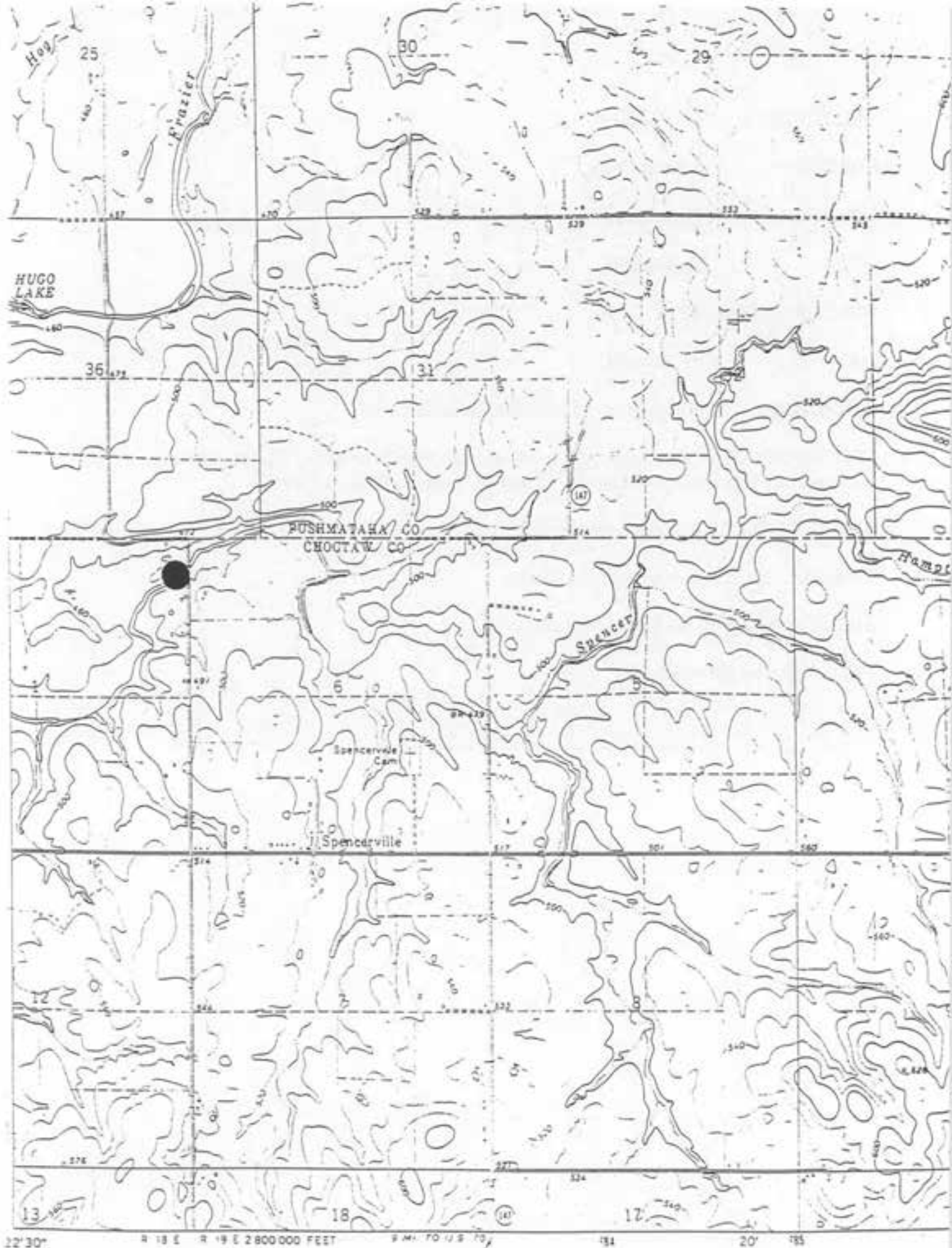
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.





Mapped, edited, and published by the Geological Survey  
 in cooperation with the Oklahoma Highway Department.

FIELD CODE: F97VAU25  
STREAM: Frazier Creek  
COUNTY: Pushmataha  
QUAD: Spencerville

NUMBER ON MAP: 21

DATE: 14 June 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was medium sized creek with cobble and boulder riffles separated by big bedrock and sand pools. The riparian vegetation was in tact. Flow was low.

WATER QUALITY: Samples were not taken.

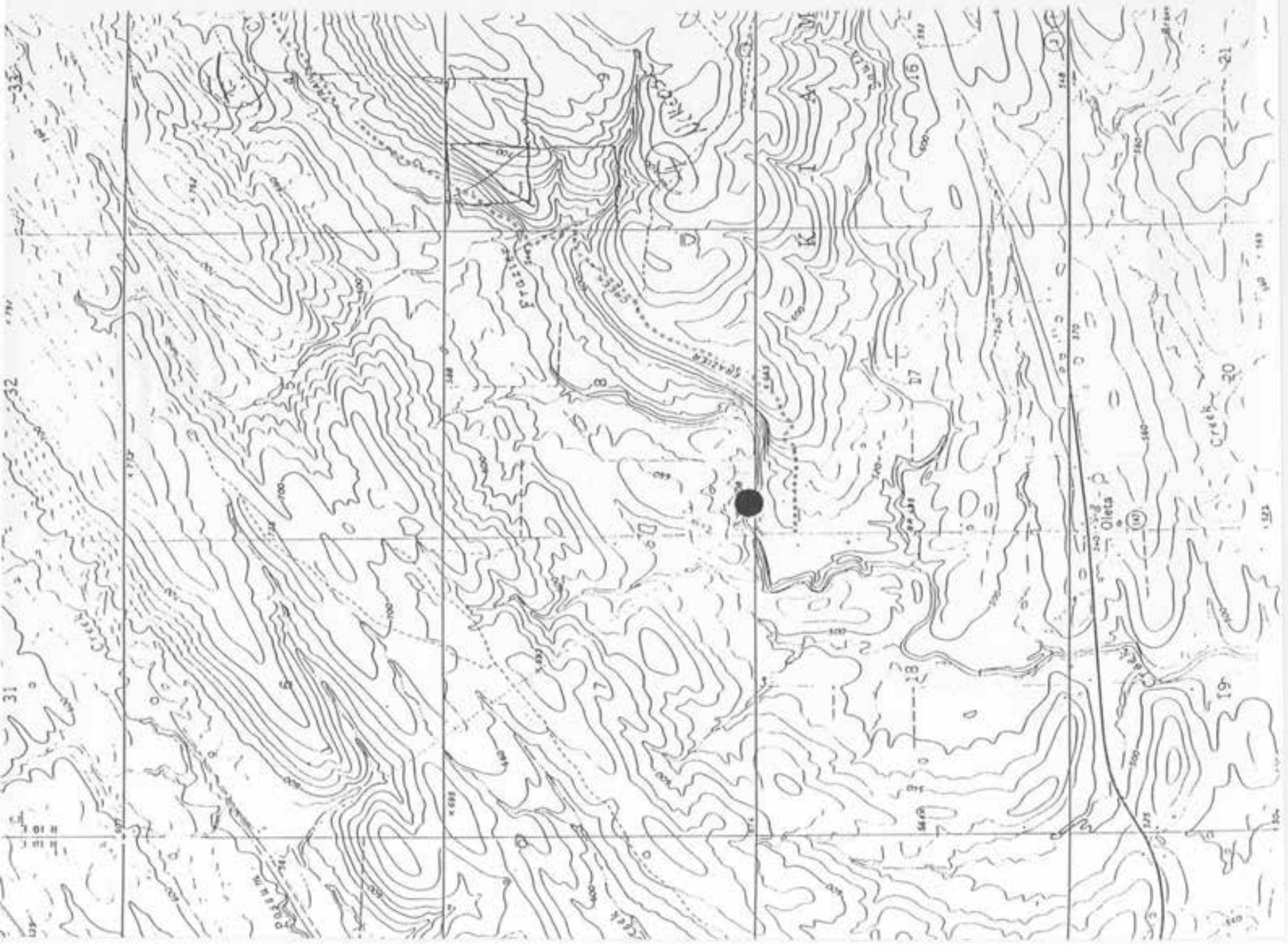
MUSSELS: No mussels were found at this site

SHELLS: The following species were found:

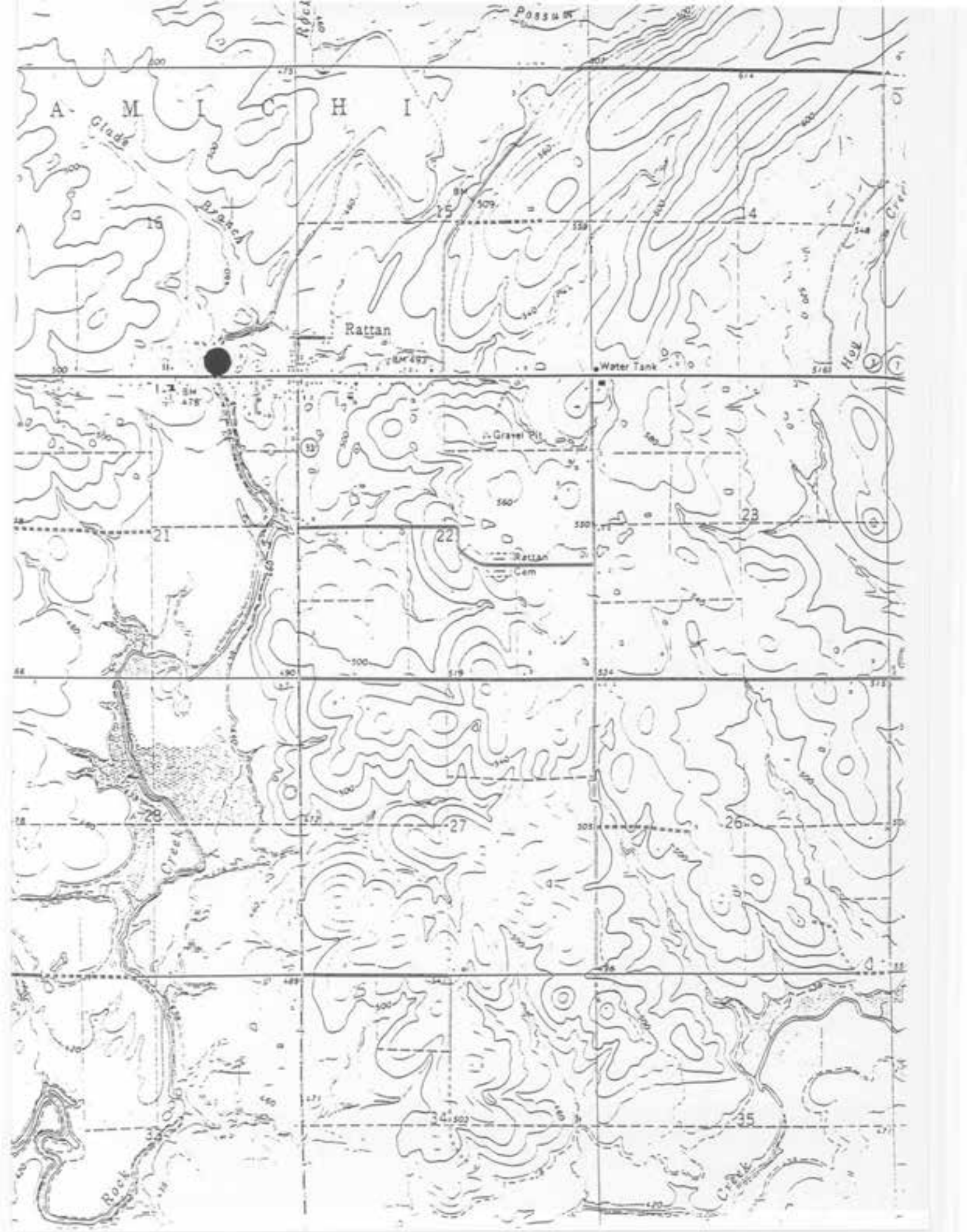
*Pyganodon grandis*  
*Villosa* sp.

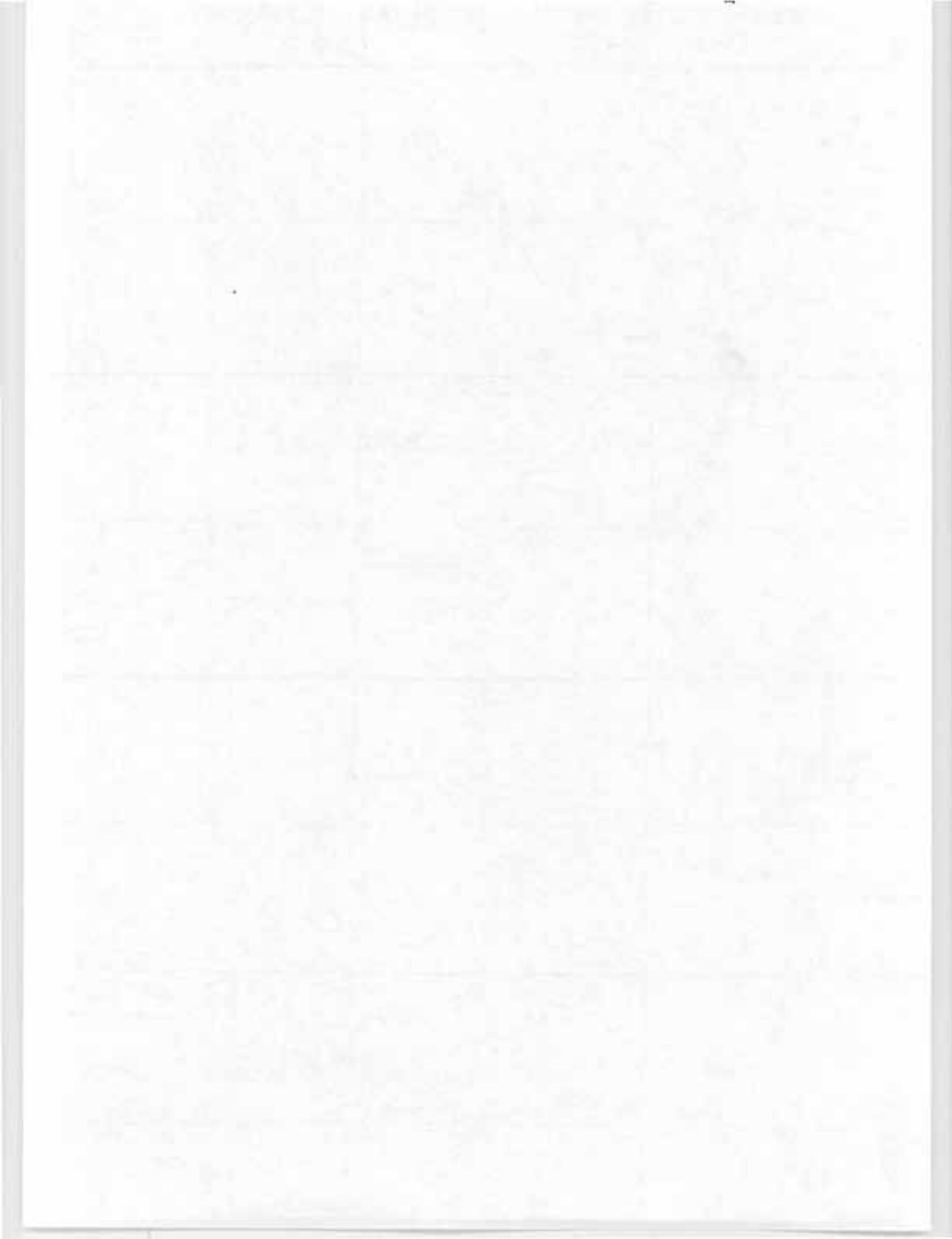
FISH: Fish were not collected.

*Lepomis megalotis* (13)  
*Lythrurus umbratilis* (13)  
*Notropis boops* (2)  
*Percina caprodes* (1)  
*Pimephales notatus* (1)



*Lepomis megalotis* (13)  
*Lythrurus umbratilis* (13)  
*Notropis boops* (2)  
*Percina caprodes* (1)  
*Pimephales notatus* (1)





FIELD CODE: F97VAU37

STREAM: Rock Creek

COUNTY: Choctaw

QUAD: Shoals

NUMBER ON MAP: 23

DATE: 16 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a shallow, low flow stream with lots of disturbance. Bridge pilings, fencing and trash were observed. The flow was negligible.

WATER QUALITY: Samples were not taken.

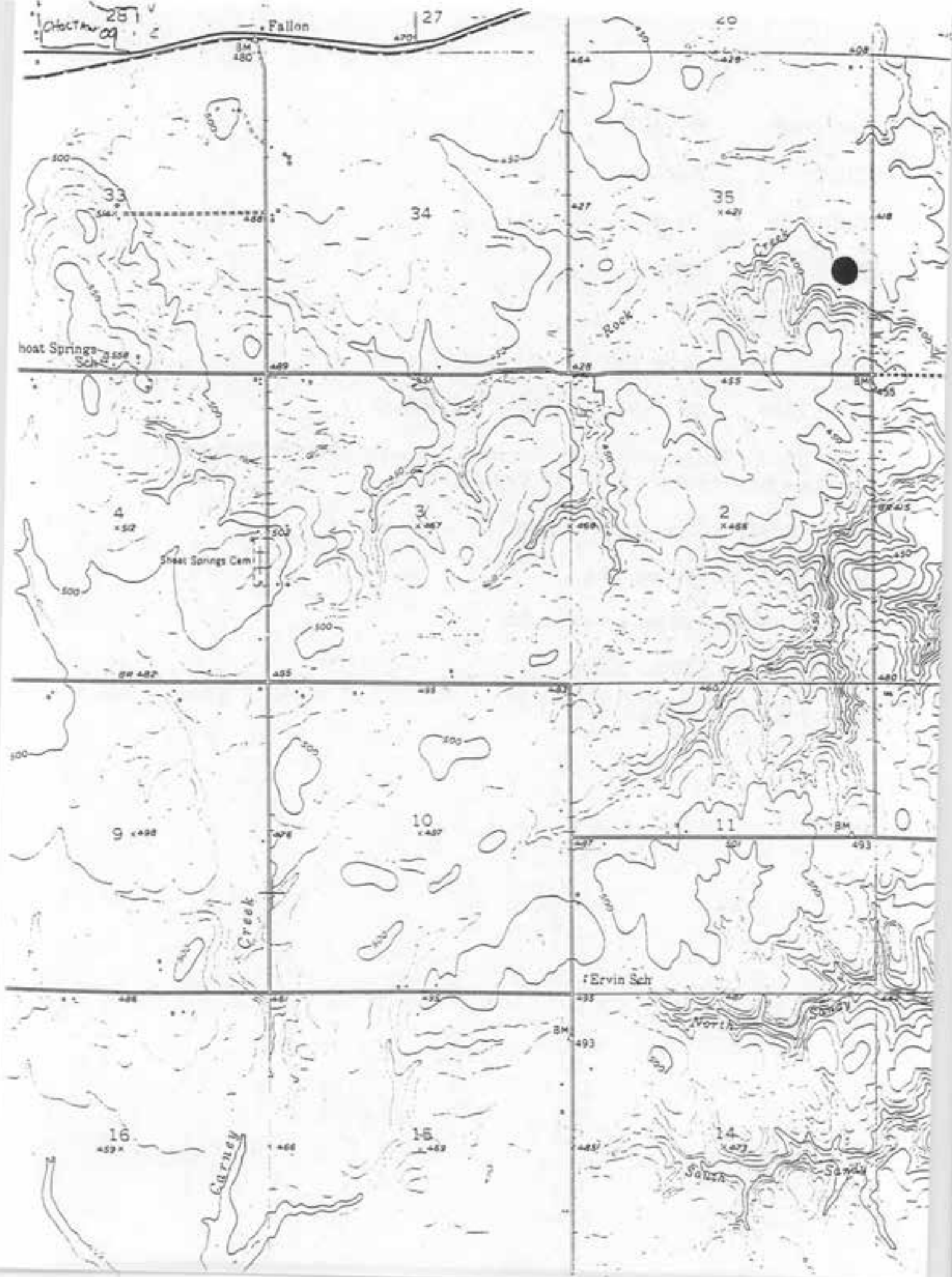
MUSSELS: No mussels were found.

SHELLS: The following species was collected:

*Elliptio dilatata*

FISH: Fish were not collected.





FIELD CODE: F97VAU38

STREAM: Rock Creek

COUNTY: Choctaw

QUAD: Shoals

NUMBER ON MAP: 24

DATE: 16 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a shallow, low flow stream with lots of disturbance. Agriculture is the predominant surrounding land use. Substrate was gravel and sand. The flow was negligible.

WATER QUALITY: Samples were not taken.

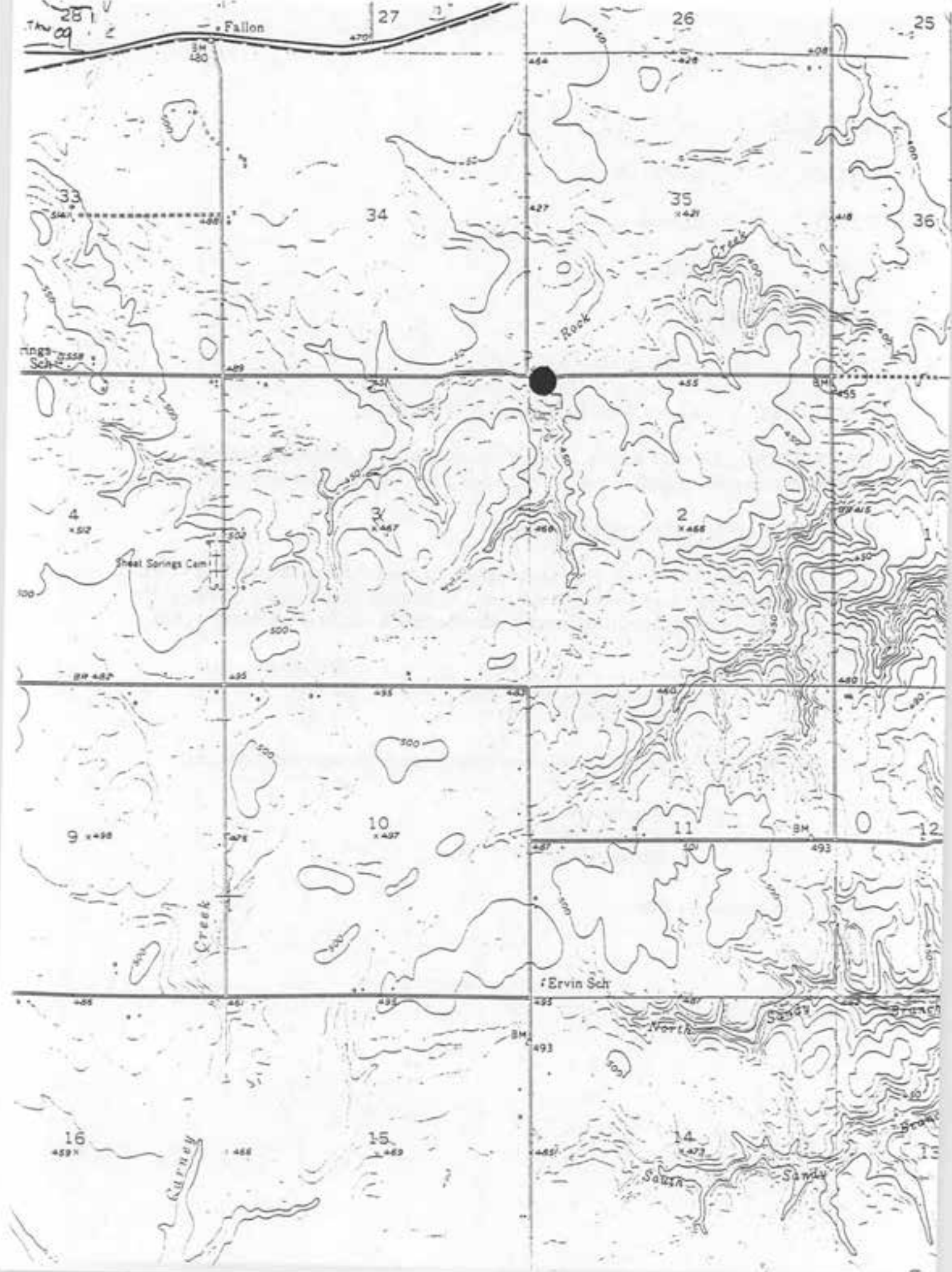
MUSSELS: Mussels were found scattered throughout the reach of stream searched and were not in a bed configuration. The following species were found during a timed search of 3 people for 30 minutes each (numbers of individuals are in parentheses and relative abundances are in the second column):

	Rel. abund.
<i>Unio merus tetralasmus</i> (18)	(0.947)
<i>Ligumia subrostrata</i> (1)	(0.053)

SHELLS: The following species of shells were collected from the banks and streambed:

*Unio merus tetralasmus*  
*Ligumia subrostrata*  
*Toxolasma parvus*

FISH: Fish were not collected.



FIELD CODE: F97VAU39

STREAM: Sandy Branch Creek

COUNTY: Choctaw

QUAD: Frogville

NUMBER ON MAP: 25

DATE: 16 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a shallow, low flow stream with lots of disturbance. The creek is dammed. The banks are steep with surrounding agricultural land use. The substrate was sand and flow was negligible.

WATER QUALITY: Samples were not taken.

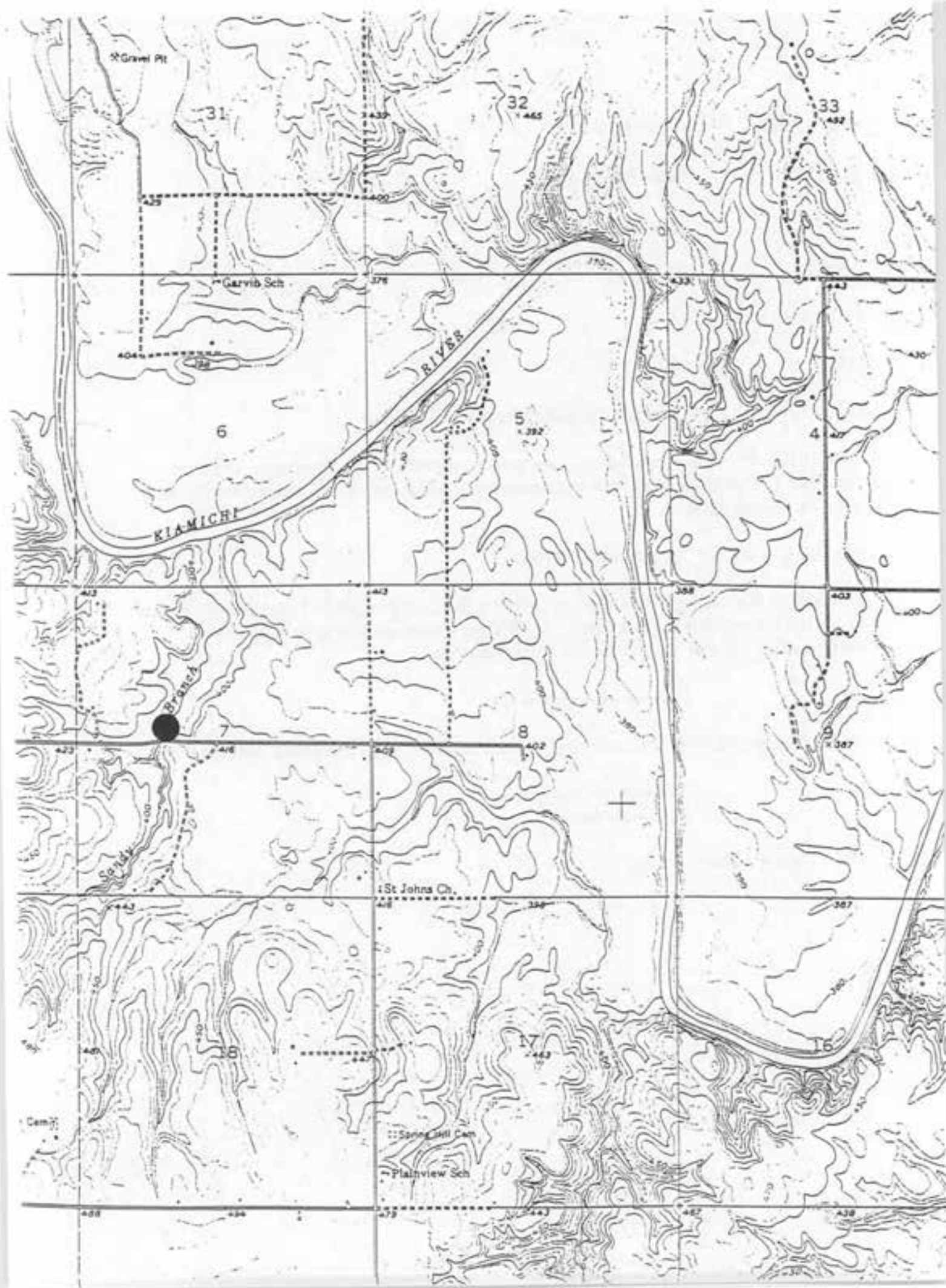
MUSSELS: We searched visually for mussels during a timed search of 3 people for 20 minutes each. The following species was found. Individuals were spaced far apart, not in a bed configuration (Number of individuals is in parentheses):

*Unio merus tetralasmus* (4)

SHELLS: The following species of shells were collected from the banks and streambed:

*Unio merus tetralasmus*  
*Elliptio dilatata*

FISH: Fish were not collected.



FIELD CODE: F97VAU40

STREAM: Chickasaw Creek

COUNTY: Pushmataha

QUAD: Kosoma

NUMBER ON MAP: 26

DATE: 16 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a shallow, no flow stream. The substrate was shale. A greasy film covered the water surface. No mussel habitat was observed.

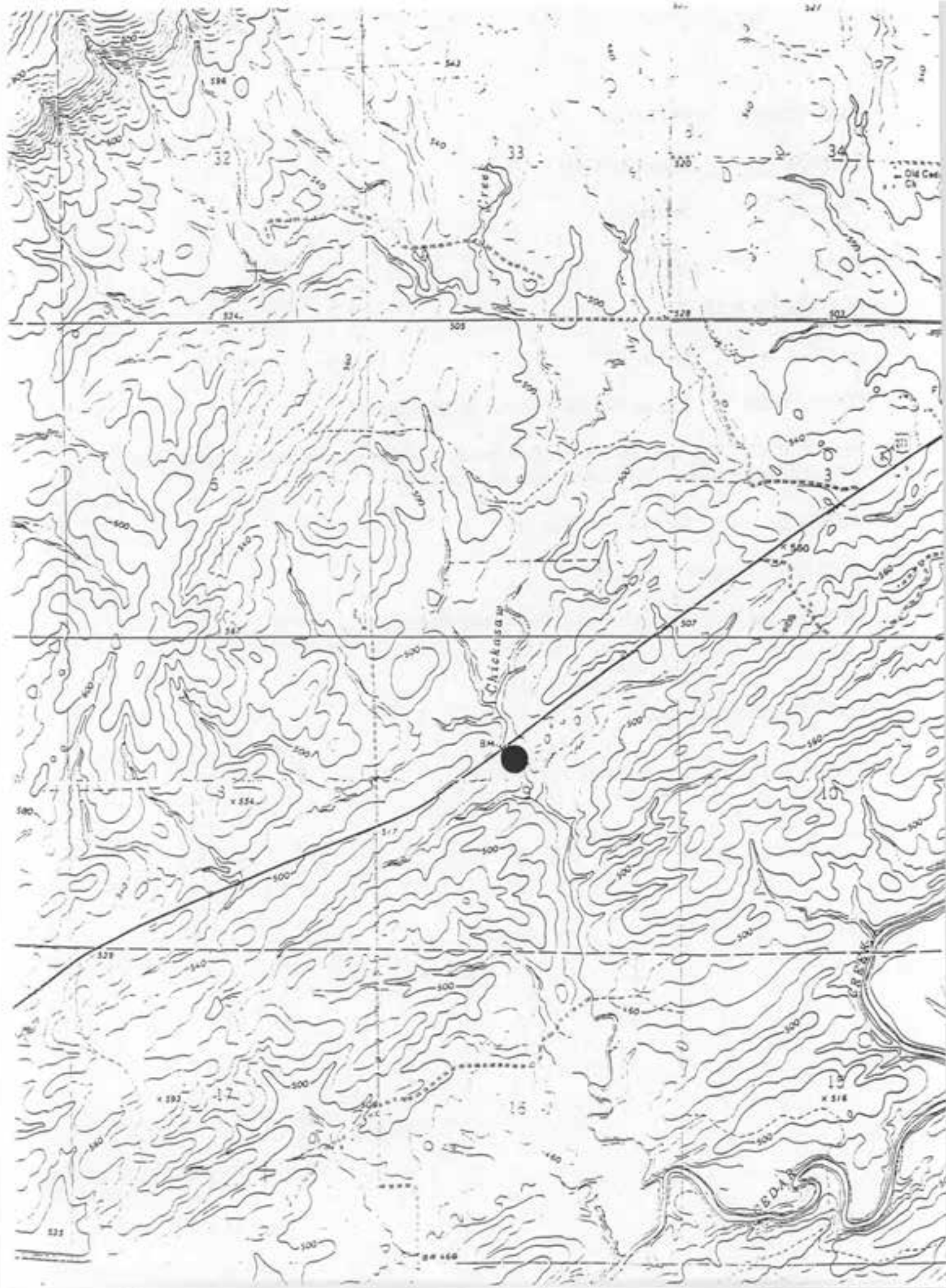
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found.

SHELLS: The following species was collected from the bank:

*Villosa lienosa*

FISH: Fish were not collected.



FIELD CODE: F97VAU42

STREAM: Big Cedar Creek

COUNTY: Pushmataha

QUAD: Kosoma

NUMBER ON MAP: 27

DATE: 16 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a low flow stream. The substrate was cobble, gravel and sand. The water was turbid and muddy with a greasy film on the surface. The banks were steep with heavy riparian vegetation.

WATER QUALITY: Samples were not taken.

MUSSELS: Mussels were sampled during a 3 person 30 minute each timed search. Many of the mussels found were in bad condition with thin, degraded shells. The following species were found (numbers of individuals are in parentheses and relative abundances in the second column):

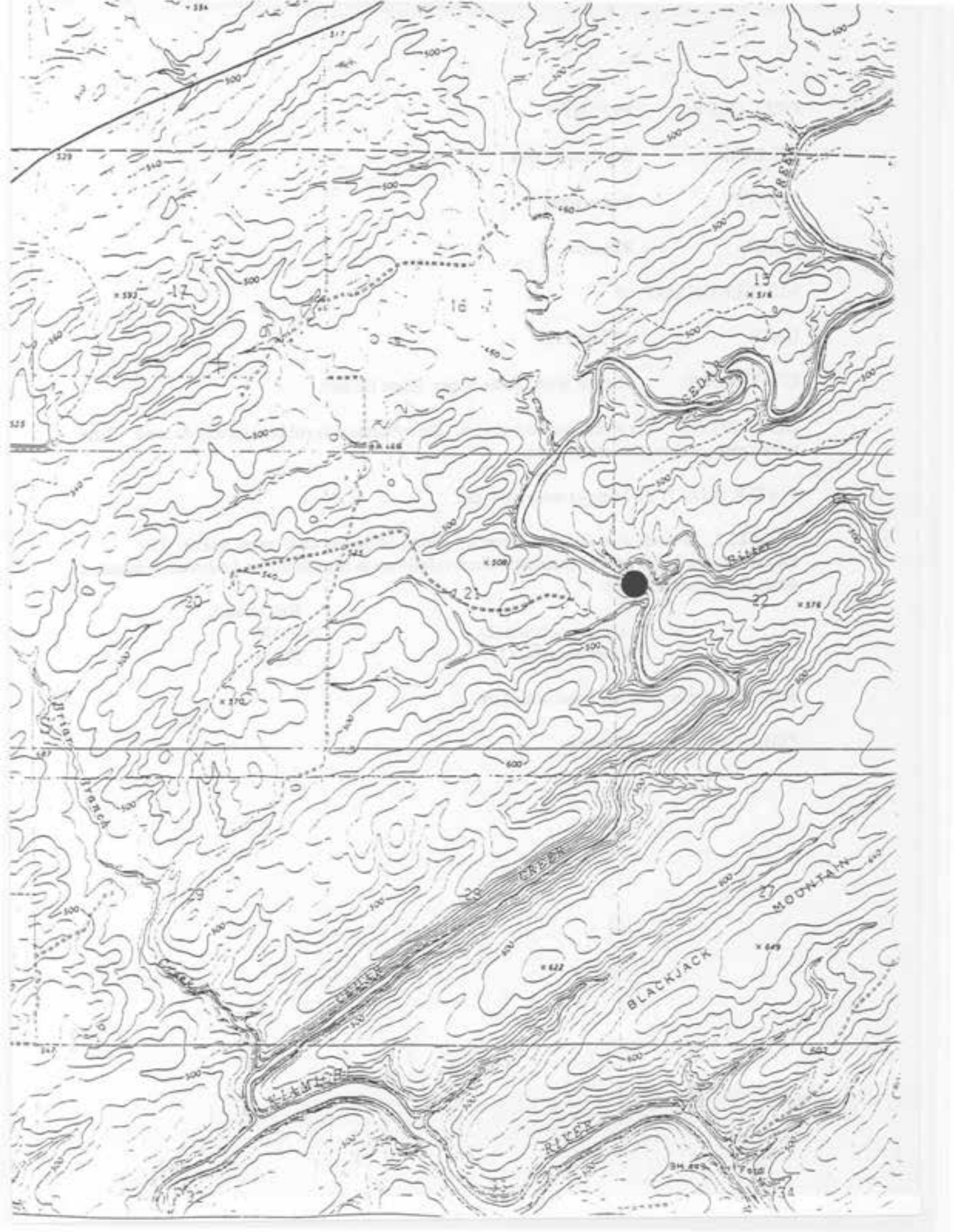
	Rel. abund.
<i>Actinonaias ligamentina</i> (1)	(0.04)
<i>Potamilus purpuratus</i> (1)	(0.04)
<i>Lampsilis cardium</i> (3)	(0.12)
<i>Tritogonia verrucosa</i> (1)	(0.04)
<i>Quadrula quadrula</i> (2)	(0.08)
<i>Amblyma plicata</i> (16)	(0.64)
<i>Villosa arkansasensis</i> (1)	(0.04)

SHELLS: The following species were found:

*Actinonaias ligamentina*  
*Amblyma plicata*  
*Fusconata flava*  
*Lampsilis cardium*  
*Lampsilis teres*  
*Quadrula pustulosa*  
*Toxolasma parvus*  
*Tritogonia verrucosa*  
*Truncilla truncata*  
*Villosa lienosa*  
*Corbicula fluminea*



FISH: Fish were not collected.



FIELD CODE: F97VAU43

STREAM: Big Cedar Creek

COUNTY: Pushmataha

QUAD: Kosoma

NUMBER ON MAP: 28

DATE: 17 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was a low flow stream. The substrate was cobble, gravel and sand. There were dense patches of water willows.

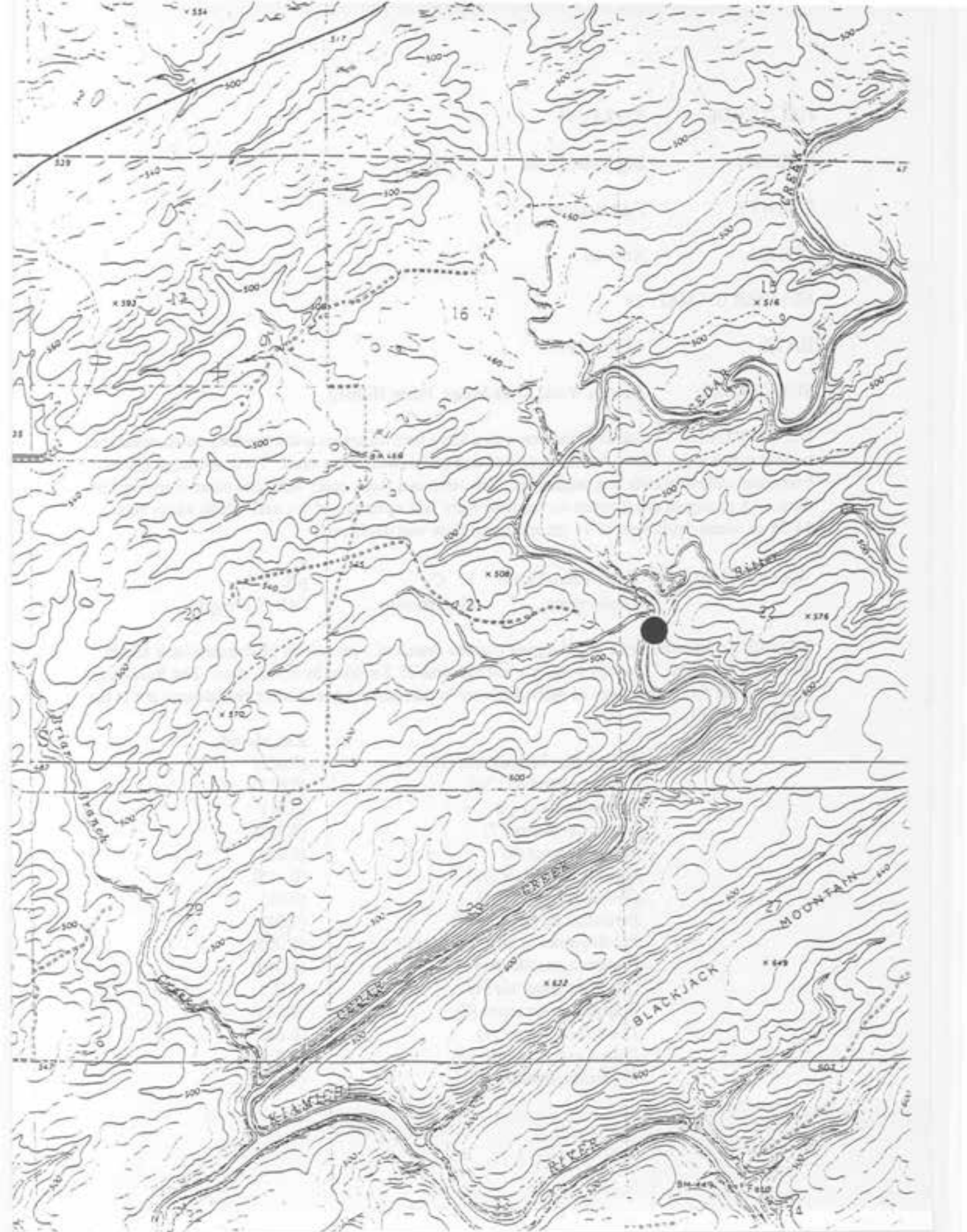
WATER QUALITY: Samples were not taken.

MUSSELS: Mussels were sampled during a 3 person 10 minute each visual search. The following species were found (numbers of individuals are in parentheses and relative abundances are in the second column):

	<b>Rel. abund.</b>
<i>Amblema plicata</i> (2)	(0.67)
<i>Lampsilis teres</i> (1)	(0.33)

SHELLS: Shells were not found at this site.

FISH: Fish were not collected.



FIELD CODE: F97VAU44  
STREAM: Big Cedar Creek  
COUNTY: Pushmataha  
QUAD: Kosoma

NUMBER ON MAP: 29

DATE: 17 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: The site is in an area with a large pool upstream and a run area downstream but no real riffles exist. The substrate is cobble and gravel with some sand. There are large gravel bar/water willow islands and peninsulas. One bank is a rocky bluff while the other is covered in trees. An unnamed creek enters on the river right side upstream of the site. Mean width was 13.85 m, mean depth was 15.24 cm and mean flow was 0.093 m/s.

WATER QUALITY: Water Temperature 37° C pH: 8.0  
Conductivity 69 µmho/cm DO: 7.1 mg/l

MUSSELS: Mussels were found during a timed search of 3 people for 30 minutes each and in 15 0.25m<sup>2</sup> quadrats. Mussels were in a bed that was 25.2 m long by 6.9 m wide. The following species were found (numbers of individuals are in parentheses and relative abundances are in the second column):

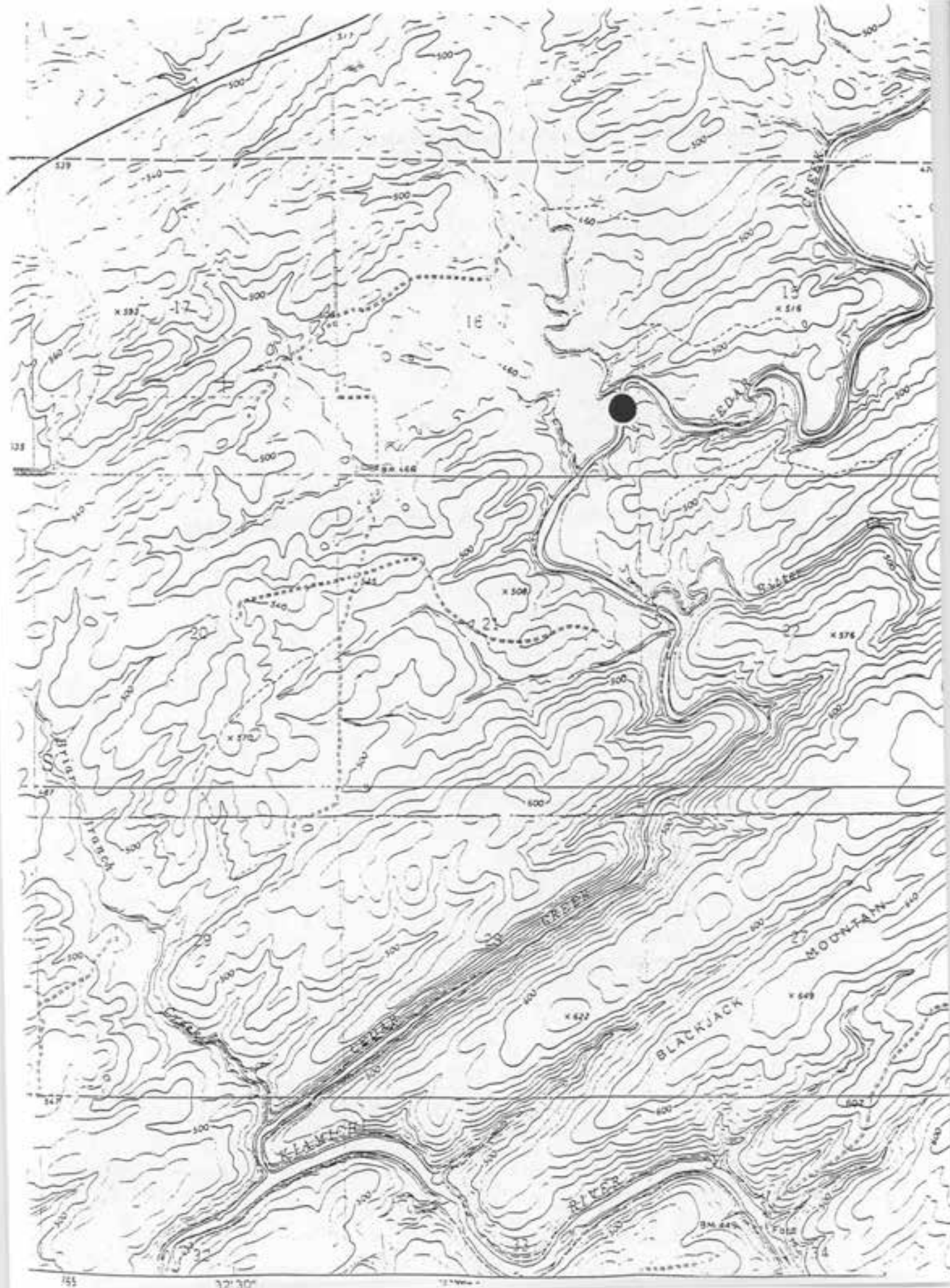
	Rel. abund.
<i>Actinonaias ligamentina</i> (13)	(0.065)
<i>Amblema plicata</i> (124)	(0.617)
<i>Fusconaia flava</i> (2)	(0.01)
<i>Lampsilis hydiana</i> (7)	(0.035)
<i>Lampsilis teres</i> (4)	(0.02)
<i>Lampsilis cardium</i> (3)	(0.015)
<i>Obliquaria reflexa</i> (2)	(0.01)
<i>Potamilus purpuratus</i> (8)	(0.04)
<i>Ptychobranthus occidentalis</i> (1)	(0.005)
<i>Quadrula pustulosa</i> (11)	(0.055)
<i>Quadrula quadrula</i> (4)	(0.02)
<i>Tritogonia verrucosa</i> (9)	(0.045)
<i>Truncilla truncata</i> (4)	(0.02)
<i>Villosa arkansasensis</i> (3)	(0.015)
<i>Corbicula fluminea</i> (6)	(0.03)

SHELLS: Species found on the banks and in the streambed at this site include:

*Amblyema plicata*  
*Tritogonia verrucosa*  
*Potamilus purpuratus*  
*Quadrula pustulosa*  
*Actinonaias ligamentina*  
*Leptodea fragilis*  
*Lampsilis cardium*  
*Fusconaias flava*  
*Truncilla truncata*  
*Villosa lienosa*  
*Toxolasma parvus*  
*Lampsilis teres*  
*Corbicula fluminea*

FISH: Fish were seined in pool areas for 45 minutes. Species found were (numbers of individuals are in parentheses):

*Campostoma anomalum* (57)  
*Cyprinella whipplei* (7)  
*Etheostoma radiosum* (1)  
*Fundulus olivaceus* (7)  
*Gambusia affinis* (42)  
*Labidesthes sicculus* (7)  
*Lepomis megalotis* (11)  
*Lepomis cyanellus* (4)  
*Luxilus chrysocephalus* (34)  
*Lythrurus umbratilis* (3)  
*Micropterus punctulatus* (12)  
*Moxostoma duquesnei* (13)  
*Notropis atherinoides* (17)  
*Notropis boops* (138)  
*Notropis volucellus* (5)  
*Percina sciera* (2)  
*Pimephales notatus* (1)  
*Pimephales vigilax* (1)



FIELD CODE: F97VAU45

STREAM: Tenmile Creek

COUNTY: Pushmataha

QUAD: Moyers

NUMBER ON MAP: 30

DATE: 17 July 1997

SURVEYORS: Kirsten Work, Katie Meier, Julian Hilliard

DESCRIPTION: This was an intermittent stream. The substrate was cobble. The water had a greasy film on the surface.

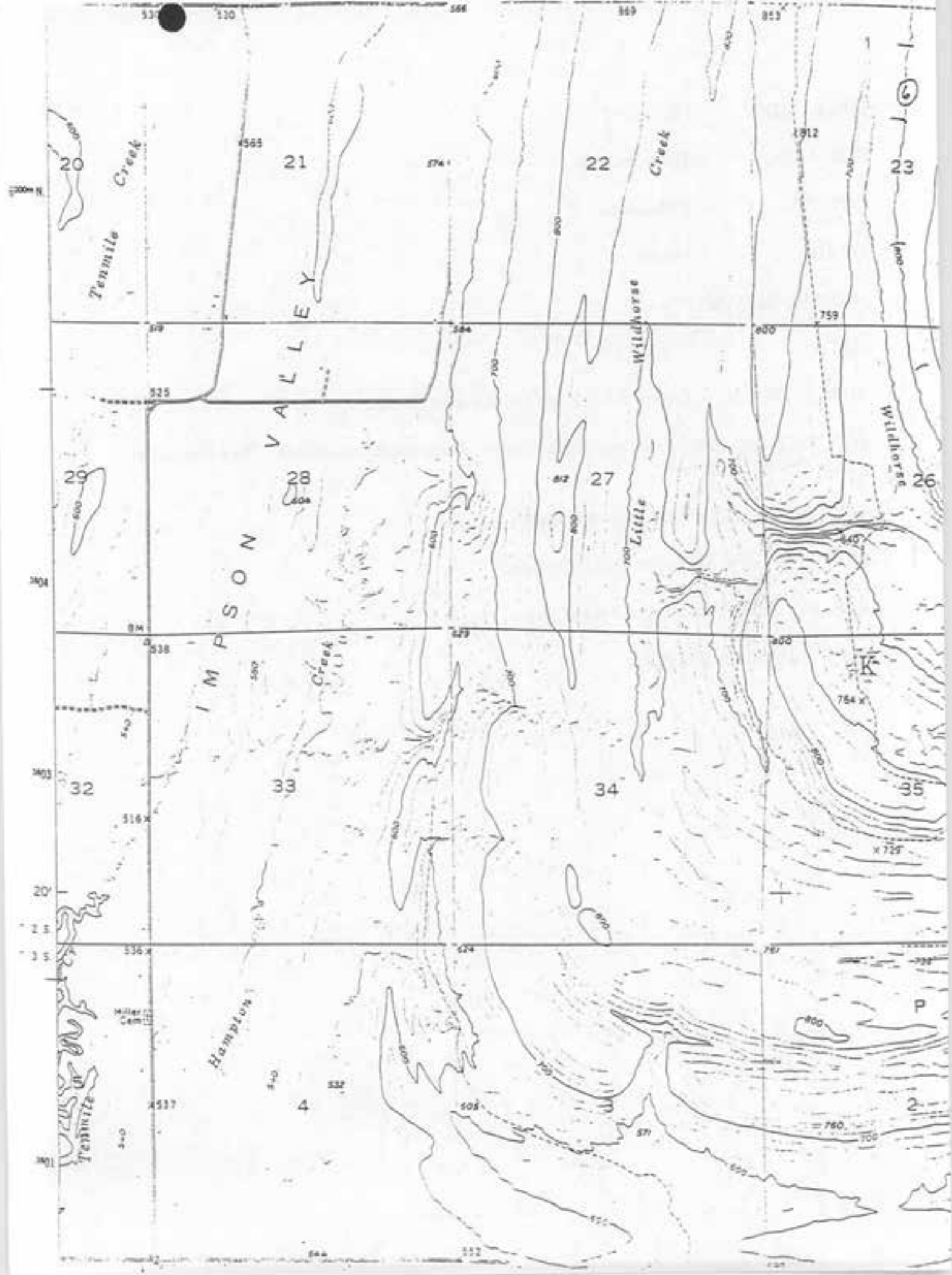
WATER QUALITY: Samples were not taken.

MUSSELS: No mussels were found at this site.

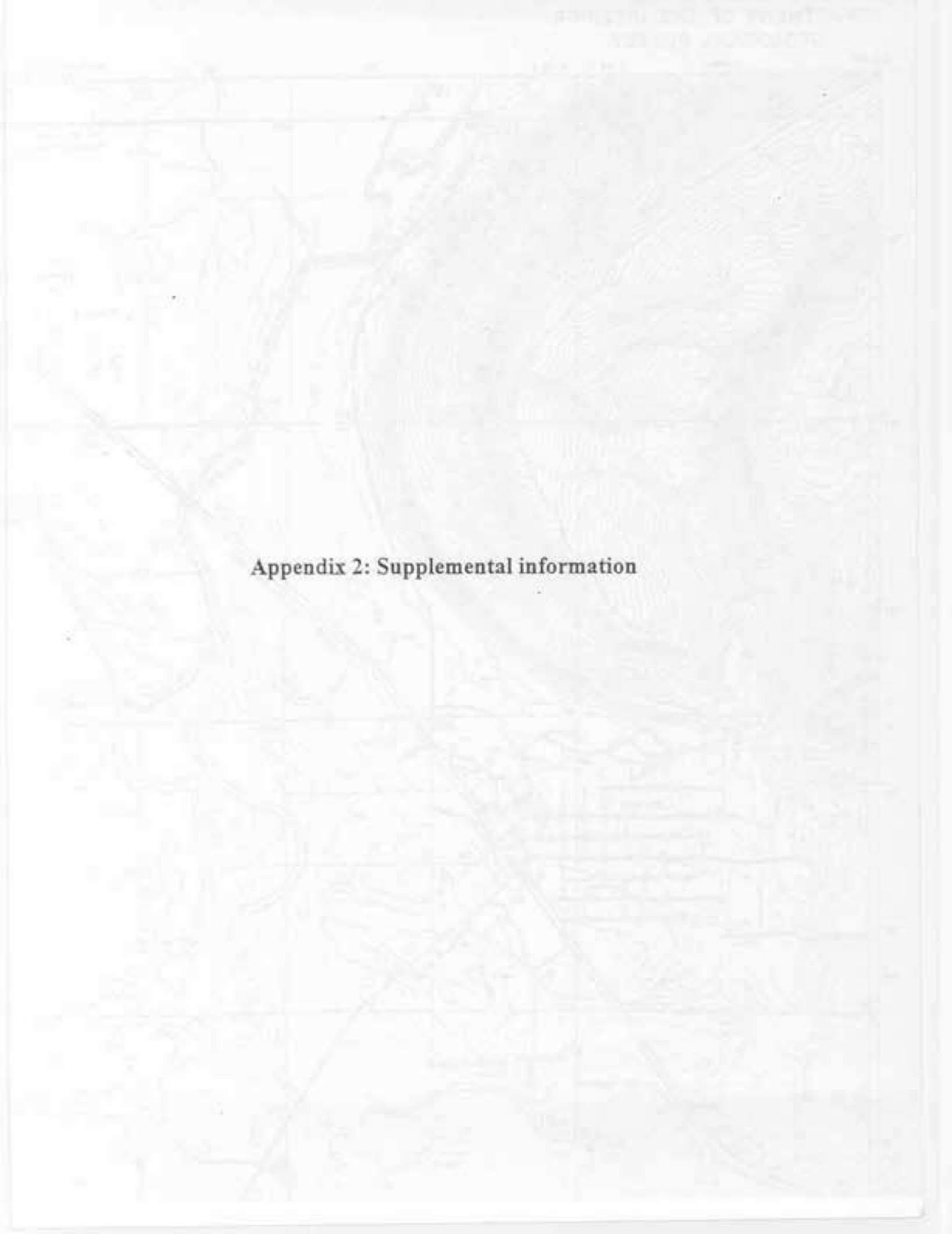
SHELLS: Shells were not found at this site.

FISH: Fish were not collected.





**Appendix 2: Supplemental information**



DEPARTMENT OF THE INTERIOR  
GEOLOGICAL SURVEY

