GEOLOGY

Physiographic Region

The Cuivre River Basin lies in the Dissected Till Plains of the Central Lowland Physiographic Province (Fenneman 1938). This area is a part of the Glaciated Plains Natural Division (Thom and Wilson 1980) (Figure nd). It is characterized by soils and topography resulting from the influence of the Kansan stage of Pleistocene glaciation. The western and northern portion of the basin lies in the Eastern Section of the Dissected Till Plains and the southeastern and eastern edge of the basin lies in the Lincoln Hills Section.

The Eastern Section has claypan soil and the land is generally flat except for steep hills near streams. Shale underlies most of this area. Aquifers and recharge to streams during dry periods are poor. Stream substrates are dominated by sand and silt. Stream water is frequently turbid from large quantities of fine sediments in runoff water (Pflieger 1971).

Historically, prairies dominated the upland landscape. Deciduous trees grew in rugged areas and bottomland trees grew along the streams. Wet prairies and springs were uncommon.
Terrain in the Lincoln Hills Section is hillier and steeper than in the Eastern Section. Limestone replaces shale as the predominant bedrock and some karst topography is present. The streams tend to be clear and have substrates of gravel and rubble.

Presettlement vegetation was mainly deciduous forest with prairie constituting less than 5 percent of the section. There were also glade, cliff and march communities. The flora and fauna of this section are similar to that found in the Ozarks (Thom and Wilson 1980).

Geology

Pennsylvanian shales and sandstone are the principal bedrocks of the region (Figure ge). Mississippian and older rock, primarily limestone, line the surface along the Mississippi River. Lincoln and Pike counties show some karst topography.

The stratum in the region generally slants to the west. Many limestone areas have east-facing escarpments hidden by glacial drift. Some escarpments are at least 50 feet thick.

Soils developed from glacial and loess deposits. Loess deposits vary from a few feet to 90 feet in depth. The land has a submature-to-mature erosion cycle. Relief is from 100 to 300 feet.

Streams meander through broad valleys dotted by many oxbows and sloughs. The channels typically are bordered by high alluvial banks. The pools are generally long and riffle sections are sometimes lacking or are poorly defined. Silt, sand and gravel are common substrates. Water flows tend to be intermittent or have a low base.

The following list identifies the geological characteristics for the basin by county (Missouri Department of Natural Resources 1986):

Audrain - characterized by Pennsylvanian (Desmoinesian Series) rock types which consist of alternating thin limestone, shale and sandstone. Coal deposits and clay also are present.
Lincoln - primarily Mississippian formation of limestone, shale and sandstone. Near the Mississippi River flood plain quaternary alluvium predominates.
Montgomery - contains Pennsylvanian and Mississippian formations of limestone, shale and sandstone, coal and clay.
Pike - a combination of Pennsylvanian and Mississippian formations.
St. Charles - generally Mississippian formation of limestone, shale and sandstone. Near the Mississippi River flood plain quaternary alluvium predominates.
Warren - is Mississippian formation composed primarily of limestone, shale and sandstone.

Soils

The majority of the West Fork Cuivre River subbasin lies in the Central Claypan region (Figure 2, contact authors for information on Figure 2). Its soil is a poorly draining type known as a Putnam-Mexico (Soil Conservation Service 1979). The silt-loam surface overlies a silty clay subsoil. The landscape tends to be nearly level to gently sloping; slopes range from 0 to 5 percent. Stream valleys tend to be shallow and narrow. Alluvium is present in the river bottoms. This region was originally covered by prairie grasses but is now heavily cultivated. This soil is well suited for growing corn, soybeans, grain sorghum and hay crops.

The remaining areas of the West Fork subbasin and most of the North Fork Cuivre River and Cuivre River subbasin lie in the Central Mississippi Valley Wooded Slopes region (Figure 2). The soil types are Hatton-Keswick-Lindley-Goss, Menfro-Winfield-Lindley, and Hatton-Keswick-Goss-Gasconade (SCS 1979). In general, these soils formed under prairie and forest vegetation.

They tend to be well-drained loamy and clayey upland soils with some areas of chert. Ridgetops are gently sloping but valley sides can be very steep, up to 50 percent. Small fields of grain sorghum, corn or hay are commonly found on ridgetops. Steeper valley sides are often pastured or left in forest.

Lastly, a small area near the mouth of the Cuivre River is in the Missouri and Mississippi Alluvium region (SCS 1979). This alluvial (waster-deposited) soil is quite deep and is a mixture of silt, loam and clay. The landscape tends to be moderately flat with large bottomland crop fields; slopes do not exceed 3 percent.

Stream Order

Stream order was determined using the Strahler method (Strahler 1959) from United States Geological Survey (USGS) 7.5-minute topographic maps. Within the basin are 112 third-order-and-larger streams. Of these, 84 are third order, 21 are fourth, four are fifth, two (the North Fork Cuivre River and the

West Fork Cuivre River) are sixth and one (the Cuivre River) is seventh (Table 1 , Table 2 , Table 3). Each third order-or-larger stream was assigned a code number based on a 1981 method devised by Pflieger, Haverland and Schene Jr. 91981). The North Fork and West Fork Cuivre rivers were given two code numbers because of their length. Segment 1 includes the sixth order reach and segment 2 includes the fifth-order-and-smaller segments.

Watershed Area/Stream Length

Watershed area and stream length for third-order-and-large streams were determined from USGS 7.5-minute topographic maps. Appendix A summaries the dates and names of these maps. The watershed area was digitized using PADPAC software (Taylor 1988) on a Houston Instrument True Grid Digitizing tablet, Model T.G.-1017; stream mileage was measured with calipers.

The total Cuivre River watershed is 1,235 square miles. The Cuivre River (below confluence of the North Fork Cuivre River and the West Fork Cuivre River) is 32.6 miles long and drains only 305 square miles. The North Fork and West Fork rivers are 37.9 and 76.8 miles long and drain 346 and 584 square miles, respectively. Measuring from the mouth of a stream to its headwaters, there are 420.9 miles of third order streams, 155.1 miles of fourth order streams, 93.9 miles of fifth order streams, 114.7 miles of sixth order streams and 32.6 miles of a seventh order stream (Table 1, Table 2, Table 3).

Channel Gradient

Gradient information for fourth-order-and-larger streams was obtained from USGS 7.5 minute topographic maps. Gradient plots of these streams are provided in Appendix A (Contact authors for information from Appendix A). The Cuivre River is a low-gradient stream, averaging 1.2 feet per mile. The gradient of the West Fork Cuivre River changes from 4.1 to 16.6 feet per mile along its length and the North Fork Cuivre River increases from 3.2 to 40.0 feet per mile at it's headwaters (Table 4 ; Figure 3). In general, the gradients of major tributaries are lowest in the West Fork Cuivre subbasin. This drainage encompasses the largest portion of the basin's Central Claypan Area. This soil formation is characterized by fairly low relief with slopes from 0 to 5 percent.

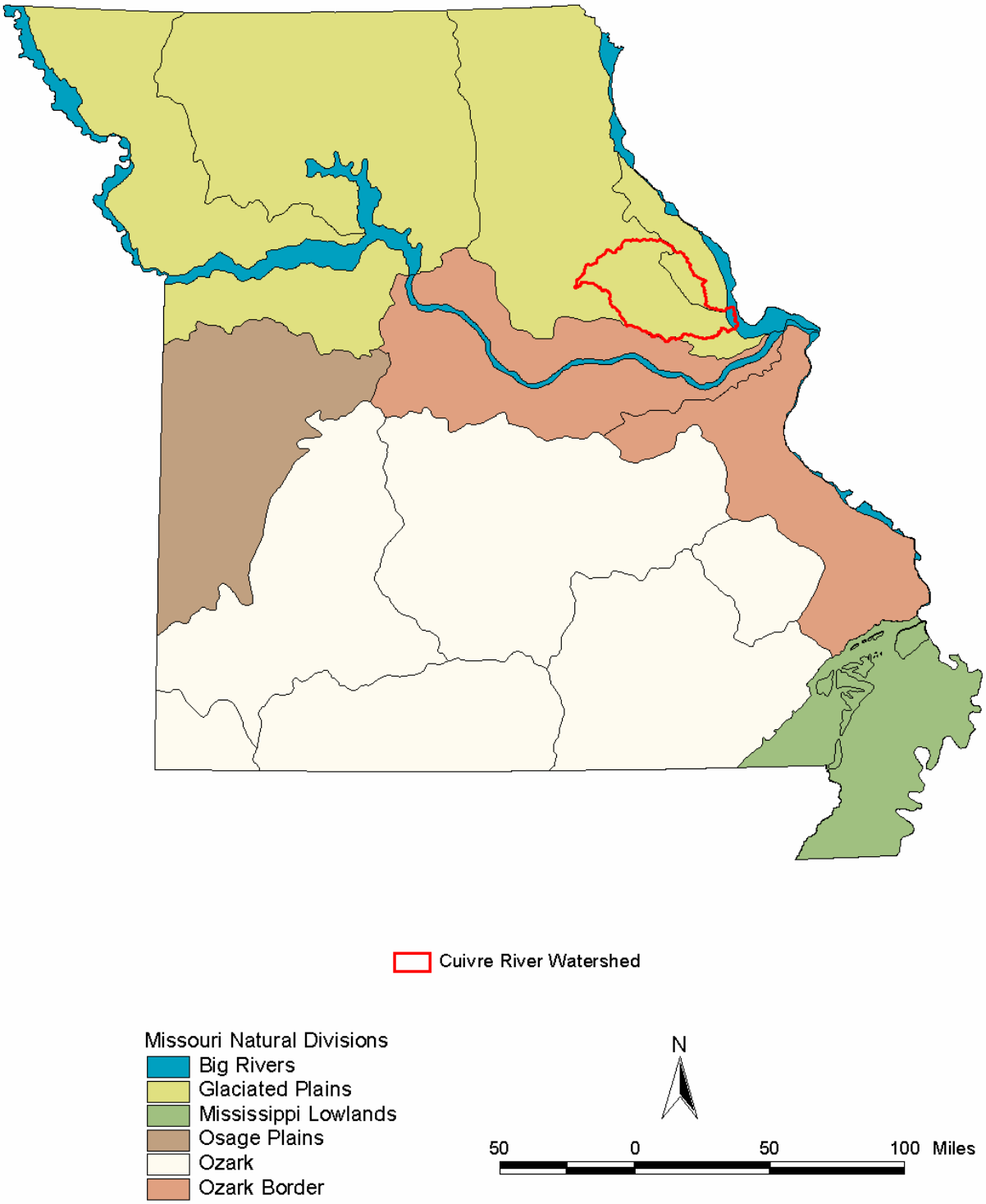

Figure nd. Location of the Cuivre River watershed within the natural divisions of Missouri.

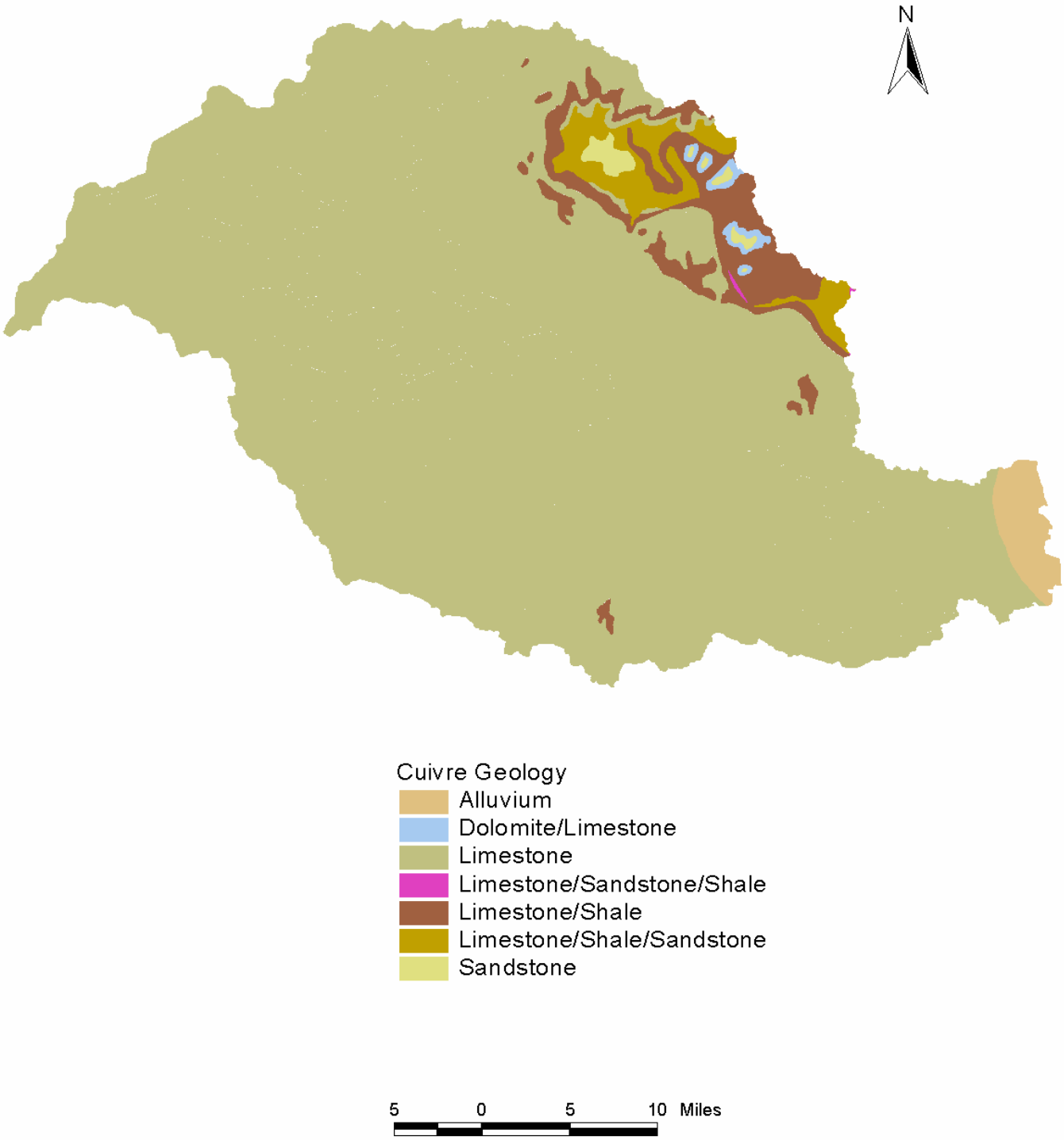

Figure ge. Geology within the Cuivre River watershed in Missouri.

Table 1. Length and watershed area of third-order-and larger streams in the Cuivre River subbasin.

Stream Code	Stream Name	Maximum Stream Order	Length of Stream to Headwaters (miles)	Watershed Size (square miles)
32100000	Cuivre River	7	32.6	305.0
32113000	Whites Branch	3	5.4	7.2
32116000	Groshing Branch	3	3.9	2.8
32117000	Keelstone Branch	3	3.2	4.7
32121000	Crooked Creek	4	13.4	19.6
32121200	Unnamed #1 (Trib. to Crooked Cr. RM 4.2)	3	2.0	2.4
32126000	Unnamed #2 (Trib. to Cuivre R. RM 22.3)	3	2.0	3.4
32123000	Buchanan Creek	3	5.0	5.8
32121100	Butcher Creek	3	3.0	3.4
32125000	Spring Creek	3	7.1	8.2
32114000	Big Creek	5	30.5	174.4
32114100	McCoy Creek	4	11.5	32.6
32114110	Enon Branch	3	3.6	5.7
32114120	Dry Branch	3	5.4	10.8
32114300	Sand Run	3	3.0	2.9
32114200	Indian Camp Creek	4	16.8	31.3
32114210	Unnamed #3 (Trib. To Indian Camp Cr. RM 6.5)	3	2.9	3.7
32114600	Hickory Lick Creek	3	8.8	10.5
32114500	Dry Creek	3	6.4	10.2
32114400	Coon Creek	4	13.1	24.9
32114410	Casmer Branch	3	3.4	4.3
32114700	Yeater Branch	3	8.9	10.8
32114800	Schlanker Branch	3	5.6	8.2

Table 1 continued

32124000	**Sugar Creek**	**4**	**13.8**	**35.6**
32124100	**Little Sugar Creek**	**3**	**8.0**	**8.9**
32124200	**Unnamed #4 (Trib. to Sugar Cr. RM 7.4)**	**3**	**2.9**	**3.3**
32124300	**Unnamed #5 (Trib. to Sugar Cr. RM 9.9)**	**3**	**3.9**	**5.6**
TOTAL		**3**	**94.4**	**122.8**
TOTAL		**4**	**68.6**	**144.0**
TOTAL		**5**	**30.5**	**174.4**
TOTAL		**6**	**0**	**0**
TOTAL		**7**	**32.6**	**305.0**

Table 2. Length and watershed area of third-order-and larger streams located in the West Fork Cuivre River subbasin.

Stream Code	Stream Name	Maximum Stream Order	Length of Stream to Headwaters (miles)	Watershed Size (square miles)
32210000	West Fork Cuivre River (Segment 1)	6	76.8	584.1
32220000	West Fork Cuivre River (Segment 2)	5		
32210000-A	Unnamed #6 (Trib. to West Fork Cuivre River RM 1.1)	3	4.4	3.5
32213000	Cottonwood Branch	3	3.4	4.0
32214000	Turkey Creek	3	4.6	8.0
32210000-B	Unnamed #7 (Trib. to West Fork Cuivre River RM 13.6)	3	2.6	2.1
32211000	Lead Creek	4	8.0	53.2
32211200	Little Lead Creek	4	13.2	20.1
32211210	Lost Branch	3	5.0	6.4
32211100	Big Lead Creek	3	20.5	25.2
32215000	Camp Creek	4	19.0	56.9
32215100	Baily Branch	3	3.4	4.3
32215110	Unnamed #8 (Trib. to Bailey Branch RM 2.1)	3	1.8	1.6
32215200	Rock Branch	3	6.1	6.1
32215300	Unnamed #9 (Trib. to Camp Cr. RM 7.9)	3	3.3	3.3
32215400	Camp Branch	3	10.3	17.3
32216000	Bear Creek	4	22.1	58.3
32216100	Unnamed #10 (Trib. to Bear Cr. RM 5.8)	3	4.1	3.9
32216200	Little Bear Creek	3	11.8	16.9

Table 2 continued

32216200	Prices Branch	3	8.0	10.4
32216300	Brush Creek	3	14.4	30.1
32210000-C	Unnamed #11 (Trib. to West Fork Cuivre River RM29.4)	3	2.4	3.4
32222000	Elkhorn Creek	5	27.3	98.2
32222100	Long Branch	3	6.0	6.9
32222299	Wolf Creek	4	12.5	13.4
32222210 32222300	Little Wolf Creek White Oak Creek	4 4	5.9 9.2	5.2 16.5
32222310	Unnamed #12 (Trib. to White Oak Cr. RM 2.5)	3	1.9	2.0
32222310	Little Elkhorn Creek	4	6.8	12.9
32222410	Unnamed #13 (Trib. to Elkhorn Cr. RM 2.7)	3	2.4	2.6
32223000	Coon Creek	4	18.8	47.8
32223100	Crooked Creek	3	5.8	7.7
32223200	Unnamed #14 (Trib. to Coon Cr. RM 5.0)	3	4.4	4.0
32223300	Unnamed #15 (Trib. to Coon Cr. RM 10.3)	3	1.2	1.2
32223400	Little Coon Creek	4	5.8	7.6
32223410	Unnamed #16 (Trib. to L. Elkhorn Cr. RM 1.9)	3	1.6	1.6
32224000	Sandy Creek	4	12.1	29.6
32224200	Unnamed #17 (Trib. to Sandy Cr. RM 4.8)	3	3.3	3.6
32224300	Unnamed #18 (Trib. to Sandy Cr. RM 9.3)	3	2.7	4.8
32224100	Johns Branch	3	4.0	5.0
32225000	Lost Creek	3	5.9	7.6

Table 2 continued

32226000	**Hickory Creek**	**4**	**14.4**	**36.8**
32226100	**Bear Slough**	**3**	**3.1**	**9.8**
32226110	**Unnamed #19 (Trib. to Bear Slough RM 0.8)**	**3**	**3.9**	**4.8**
32226200	**Unnamed #20 (Trib. to Hickory Cr. RM 11.0)**	**3**	**2.6**	**3.3**
32210000-D	**Unnamed #21 (Trib. to West Fork Cuivre River RM 54.6)**	**3**	**3.5**	**4.8**
32227000	**Johns Branch**	**3**	**6.9**	**9.2**
32228000	**Mams Slough**	**3**	**6.3**	**7.9**
32210000-E	**Unnamed #22 (Trib. To West Fork Cuivre River RM 65.5)**	**3**	**1.5**	**2.2**
TOTAL		**3**	**179.0**	**240.7**
TOTAL		**4**	**141.9**	**353.1**
TOTAL		**5**	**27.3**	**98.2**
TOTAL		**6**	**76.8**	**584.1**
TOTAL		**7**	**0**	**0**

Table 3. Length and watershed area of third-order-and-larger streams located in the North Fork Cuivre River subbasin.

Stream Code	Stream Name	Maximum Stream Order	Length of Stream to Headwaters (miles)	Watershed Size (square miles)
32310000	North Fork Cuivre River (Segment 1)	6	37.9	345.9
32320000	North Fork Cuivre River (Segment 2; to mouth of Irvine Branch)	5		
32311000	Paris Branch	3	4.8	4.7
32312000	Hupp Branch	3	2.8	3.0
32313000	Nulls Creek	3	8.3	8.8
32314000	Fort Branch	3	4.0	7.2
32314100	Draper Branch	3	2.2	3.3
32316000	Mill Creek	4	7.5	17.4
32316100	Unnamd #23 (Trib. to Mill Cr. RM 2.3)	3	2.8	1.9
32316200	Unnamed #24 (Trib. to Mill Cr. RM 3.7)	3	2.9	2.4
32319000	Sitton Branch	3	4.5	4.9
32317000	Unnamed #25 (Trib. to North Fork Cuivre River RM 14.8)	3	3.7	3.9
32321000	Sulphur Creek (to mouth of Middle Sulphur Cr.)	5	10.6	81.3
32321100	Sandy Creek	4	11.3	51.5
32321110	Little Sandy Creek	3	9.2	11.4
32321120	Brushy Creek	4	6.6	15.0
32321122	Unnamed #26 (Trib. to Brushy Cr. RM 2.9)	3	2.9	2.6
32321121	Reid Creek	3	7.2	8.4
32321200	Unnamed #27 (Trib. to Sulphur Cr. RM 4.6)	3	4.3	3.7

Table 3 continued

32321300	West Sulphur Creek	3	9.5	10.7
32321500	East Sulphur Creek	3	5.7	6.1
32323000	Indian Creek	5	35.5	107.1
32323700	Sandy Creek	3	4.1	4.2
32323200	Lewellen Branch	3	4.8	4.9
32323100	Moore Branch	3	4.9	5.9
32323000-A	Roundtop Branch	3	4.8	7.3
32323600	Shady Creek	4	12.4	27.3
32323800	Brush Branch	3	8.1	10.9
32323000-B	Unnamed #28 (Trib. to Indian Cr. RM 19.7)	3	5.1	5.3
32323620	Haw Creek	3	4.9	5.5
32323610	Unnamed #29 (Trib. to Shady Cr. RM 2.1)	3	3.7	5.8
32322000	Unnamed #30 (Trib. to NFCR RM 23.2)	3	2.2	2.0
32327000	Jones Branch	3	2.3	2.0
32328000	Unnamed #31 (Trib. to NFCR RM 33.2)	3	2.7	2.8
32324000	Lick Creek	3	10.9	14.5
32329000	Cuivre Creek	3	6.4	10.3
32325000	Irvine Branch	4	6.8	13.8
32325100	Jasper Spring Branch	3	4.2	5.7
32329100	Dry Straw Branch	3	3.6	2.9
TOTAL		3	147.5	173.0
TOTAL		4	44.6	125.0
TOTAL		5	36.1	188.4
TOTAL		6	37.9	345.9
TOTAL		7	0	0

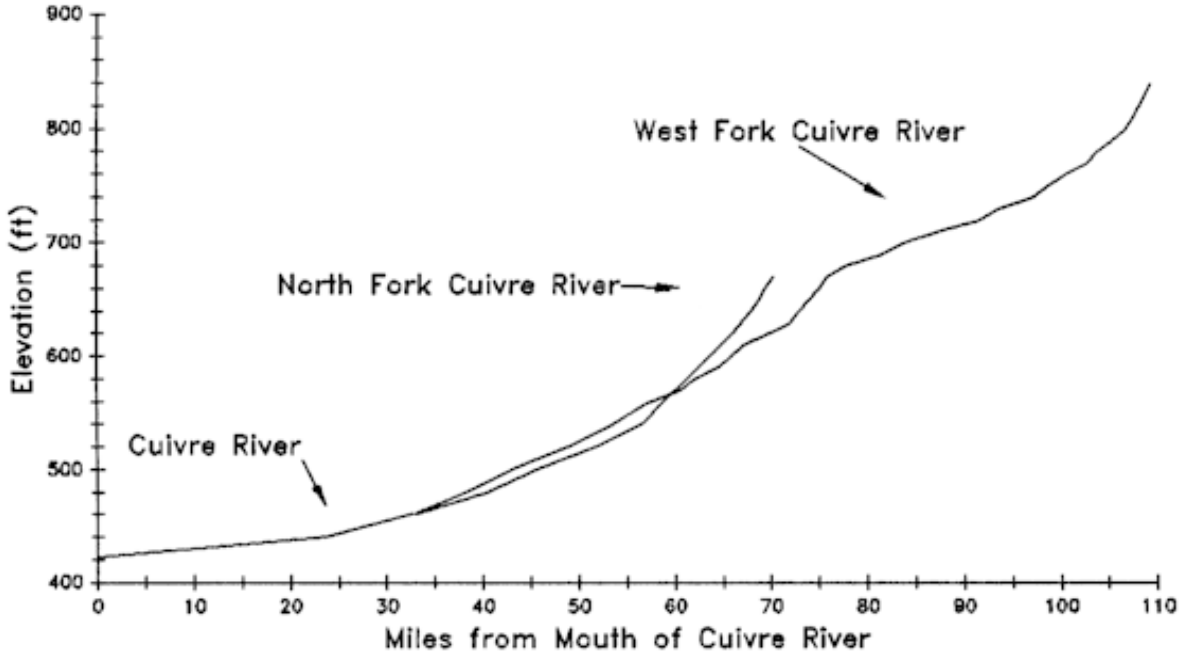

Figure 3. Gradient plot of Cuivre River, West Fork Cuivre River, and North Fork Cuivre River.

Table 4. Average gradient, by stream order, of the Cuivre River, the West Fork Cuivre River and the North Fork Cuivre River.

Stream	Stream Code	Order	Segment Length (miles)	Average Gradient (ft/mile)
Cuivre River	32100000	7	32.6	1.2
West Fork Cuivre River	32210000	6	31.9	4.1
	32220000	5	18.0	5.8
		4	15.6	3.4
		3	8.9	6.4
		2	0.8	13.2
		1	1.6	16.6
North Fork Cuivre River	32310000 32320000	6 5	19.6 4.5	3.2 4.3
		4	13.9	10.9
Irvine Branch*	32325000	4	2.2	30.8
		3	2.3	30.0
		2	1.4	30.0
		1	0.8	40.0

*** Irvine Branch forms the headwaters of the North Fork Cuivre River.**