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Area 317
Study 3

Minnesota Department of Natural Resources
Division of Fish and Wildlife
Section of Fisheries

Stream Survey Report

North Branch Middle Fork Zumbro River
2010

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List of Tables **Page**

Table 1. Station and reach locations and characteristics for the North Branch Middle Fork Zumbro River, 2010. 8

Table 2. Land cover composition in the North Branch Middle Fork Zumbro River determined from the 2001 National Land Cover Data Set 9

Table 3. Qualitative habitat quality ratings by sampling station determined from the Minnesota Stream Habitat Assessment protocol 10

Table 4. Fish species collected from the North Branch Middle Fork Zumbro River in 2010. 11

Table 5. Fish index of biotic integrity scores by sampling station determined from the warmwater IBI of Lyons (1992). 13

Table 6. Jacard similarity index values determined from fish species presence absence in 1983 and 2010. 14

List of Figures

Figure 1. North Branch Middle Fork Zumbro River sampling station location map 16

Figure 2. North Branch Middle Fork Zumbro River Strahler Stream Order Map. 17

Figure 3. North Branch Middle Fork Zumbro River land cover map 18

Figure 4. North Branch Middle Fork Zumbro River bedrock and karst features map 19

General Information

Stream Name:	North Branch Middle Fork Zumbro River
Tributary Number:	M-034-056-014
Counties:	Dodge, Olmsted, Goodhue, Steele, Rice
Nearest Towns:	Pine Island
Source of Flow:	Tile drainage in T109N R18W S27
Stream Length:	25.8 miles
Waterway Sequence	North Branch Middle Fork Zumbro River to Middle Fork Zumbro River to Zumbro River to Mississippi River
Ecological Classification:	Class IV-Warmwater (Coolwater?)

Watershed Name and Number

Major Watershed:	Zumbro River (M-034)
Watershed Number:	41
USGS HUC-8:	07040004
Minor Watershed:	North Branch Middle Fork Zumbro River
Watershed Number:	41070040
USGS HUC-12:	070400040306

Metric		
Basin Area	37,455 ac	58.5 mi^2
Basin Length	18.2 mi	
Basin Relief	282 ft	
Basin Relief Ratio	$2.93X10^{-3}$	
Basin Shape (Elongation Ratio)	0.47	
Basic Drainage Pattern	Dendritic	
Stream Order	5	
Main Stem Stream Length	25.8 mi	
Mean Stream Slope	0.002	9.3 ft/mi
Drainage Density	0.44 mi/mi^2	
Sinuosity	1.6	

Introduction

The North Branch Middle Fork Zumbro River is a warm/coolwater stream that originates from a confluence of drainage tiles in southwest Goodhue County. The river flows 25.8 miles and enters the Middle Fork Zumbro River at Pine Island in Olmsted County. The watershed drains 37,455 acres, 84% of which is in agricultural use.

A level I stream survey was conducted in 2010 to evaluate the fish community and qualitatively assess stream physical features (MNDNR 2006). A full stream survey was previously conducted in 1983. Stream reach designations and sampling stations followed the 1983 survey designations (Table 1; Figure 1).

Watershed

The North Branch Middle Fork Zumbro River is a Fifth order stream located in Olmsted, Dodge, and Goodhue counties in southeast Minnesota (Figure 2). The river has a drainage area of 58.5 mi^2 with land use comprised of 73% row crops, 11% pasture, 9% forest, and 9% grassland (Table 2; Figure 3). The drainage basin is 18.2 miles-long and has a stream channel length of 28.5 miles. The river drops 282 ft in elevation from the headwaters to the mouth. Watershed geology is dominated by glacial till plains in the uplands with terraces and bedrock becoming more prevalent in the lower river reach in Olmsted County (Figure 4). The change to karst formations is also noted by the appearance of sinkholes and springs in north eastern Dodge and western Olmsted County.

Hydrology

Overall stream gradient is 8.5 ft/mile but varies from 8.0 ft/mile in reach I to 9.5 ft/mile in reach III. This change in gradient corresponds to a change in underlying geology from outwash to karst formations. A total of 33 tributaries and springs contribute to the drainage network. The largest tributary is Devlin Creek (1.9 miles). All other tributaries are drainage tiles or springs. The river has been channelized at three locations for a total length of 0.3 miles. There are no dams on the river. Discharge data are unavailable for the North Branch Middle Fork Zumbro River. It should be noted that an historic flood event occurred in fall of 2010. This event resulted in extensive flooding in the Zumbro River watershed.

Water Quality

Water quality sampling was not conducted in this survey, although the MPCA and Dodge County Soil and Water Conservation District (SWCD) have conducted extensive water quality monitoring throughout the Middle Fork Zumbro River watershed. Based upon turbidity measurements obtained through the Citizens Stream Monitoring Program, the North Branch Middle Fork Zumbro River was listed as impaired for turbidity in 2010 (MNPCA 2010). The Minnesota Pollution Control Agency and Barr Engineering are currently developing a total maximum daily load (TMDL) to address this impairment in the Zumbro River watershed. A

listing of probable sources of suspended solids in this TMDL includes bank erosion, algae growth and death, ditching and stream channelization, row crops, inadequate buffer strips, and livestock in the riparian zone. Water quality data is available from MPCA, Dodge County SWCD, and in the United States Environmental Protection Agency STORET database (USEPA 2011).

Water temperature data was unavailable for this survey. However, examination of temperature data from the South Branch Middle Fork Zumbro River resulted in a change in the classification from a warmwater river to a coolwater river (Lyons et al. 2009). It is likely that the North Branch Middle Fork Zumbro River is also a coolwater stream, possibly due to the contribution of cool water from the numerous drain tiles.

Habitat

Physical habitat was qualitatively evaluated in each stream reach using the Minnesota Stream Habitat Assessment protocol (MNDNR 2006). Habitat quality scores ranged from a low of 50 (fair) in stream reach III to 66 (good) in stream reach II (Table 3). Habitat quality was poorest in the upper stream reach where agricultural land use was highest and habitat diversity (riffle:pool sequence) was poorly developed. Habitat quality was good in reach II due to good riffle:pool sequencing, increased coarse substrate, and increased cover. Instream cover was provided by deep pools (>3 ft), boulders, and abundant instream vegetation. Habitat quality declined to fair in reach I due to poorly developed riffle:pool sequencing, lower substrate diversity, and a lack of cover. Depths were wadeable in all stream reaches and rarely exceeded 4 ft. The underlying geology does not foster down cutting and the development of deep pools. Woody cover is present but is often ephemeral in nature due to the frequency of high water events in southeastern Minnesota rivers and streams.

Fish Community

Fish were sampled in stations 11.5 and 18.4 with a tote barge using a DC generator while station 23.2 was sampled with a single backpack electrofishing unit. Electrofishing was conducted by a single upstream pass. All fish > 1 inch TL were collected, sorted by species, bulk weighed, and a length range was attained following the Index of Biotic Integrity sampling protocol (MNDNR 2006). Since a coolwater Index of Biotic Integrity (IBI) for fish has not been developed for southeast Minnesota rivers, fish populations were evaluated using the Wisconsin warmwater IBI for central and southern Wisconsin streams (Lyons 1992).

A total of 31 fish species from seven families were collected, including redside dace (*Clinostomus elongates*) , redfin shiner (*Lythrurus umbratilis*) , and Ozark minnow (*Notropis nubilus*) which are considered species of greatest conservation need in Minnesota (Berendzen etal. 2008; MNDNR 2010) (Table 4). Overall there are 11 fish species of greatest conservation need listed from the Rochester Plateau Habitat Subsection for small streams and rivers (MNDNR

2006b). Southern redbelly dace (*Phoxinus erythrogaster*) and common shiner (*Luxilus cornutus*) were the most abundant species comprising 42% of the total catch combined (Table 4). White sucker (*Catostomus commersoni*) (12%), fathead minnow (*Pimephales promelas*) (11%), creek chub (*Semotilus atromaculatus*) (5%), bluntnose minnow (*Pimephales notatus*) (5%), and largescale stoneroller (*Campostoma oligolepis*) (5%) were common. Common shiner, creek chub, southern redbelly dace, bluntnose minnow, fathead minnow, Johnny darter (*Etheostoma nigrum*), and white sucker were collected in all sampling stations. No gamefish species were collected even though habitat in reach two appeared suitable for smallmouth bass (*Micropterus dolomieu*).

Fish IBI scores ranged from a low of 25 (poor) in station 23.2 to a high of 50 (good) in station 11.5 (Table 5). Since fish abundance was qualitatively rated in the 1983 survey, an IBI could not be calculated for direct comparison. The Jacard Similarity Index (Ludwig and Reynolds 1988) which uses species presence/absence was used for comparing fish species composition between the 1983 and 2010 surveys. The index is calculated as:

JI=

Where: a=total number of species which occurred in each sample year;
b=number of species present in 1983 and not 2010
c=number of species present in 2010 and not 1983

Similarity values ranged from 47% to 62% in the five stations evaluated. The overall similarity score between survey years was 56%. This indicates a 44% change in fish species composition overall. Fish community changes within sampling stations varied among surveys (Table 6). The lowest similarity score occurred in station 11.5 where 11 species collected in 2010 were absent in 1983. New species collected included four darter species along with Ozark minnow and redside dace. Six species considered to be intolerant to environmental disturbance were collected overall (Ozark minnow, redside dace, northern hogsucker, Carmine shiner, rainbow darter, and American brook lamprey), five of which were not collected in 1983. This may indicate that water quality and physical habitat have improved since the previous survey.

The Minnesota Pollution Control Agency conducted fish and invertebrate sampling in 2004 on a single station near the boundary between reaches I and II. A total of 21 fish species were collected including redside dace. The fish IBI score was 73 (excellent) which was considerably higher than the scores in this survey. The invertebrate community included species from 16 different taxonomic families and had an IBI score of 44.

Summary

The North Branch Middle Fork Zumbro River supports a diverse fish community and has adequate habitat even though the stream is listed as impaired water. Physical habitat and the fish community varied by stream reach but ratings were mostly consistent within reaches, with fish IBI scores corroborating habitat quality scores. Of particular note are the changes which have occurred in the fish community over the 27 year period between surveys. The increase in the occurrence of intolerant species is encouraging. Reduced sedimentation may have lead to an improved aquatic insect community and spawning habitat for lithophils. The entire aquatic community likely greatly benefitted from improvements in waste water treatment by communities that discharge into the North Branch Middle Fork Zumbro River. Many treatment plants in southern Minnesota were constructed or renovated during the late 1970's and early 1980's. Prior to this time, fish kills were a common occurrence and fish communities were often unstable and limited to species tolerant of degraded water quality.

Of particular note is the presence of three species considered species of greatest conservation need in Minnesota. All three species were collected in station 18.4. This reach of the North Branch Middle Fork Zumbro River has a diverse aquatic community which also includes several live freshwater mussel species. This river segment should be targeted for habitat and species conservation through the State Wildlife Grants Program and possibly include acquisition of an aquatic management area.

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Table 1. Station, reach locations and characteristics for the North Branch Middle Fork Zumbro River, 2010.

	Station		
	11.5	18.4	23.2
Length (ft)	735	700	650
Width (ft)	21	19	10
utm_x	527740	510307	505770
utm_y	4894832	4893777	4894832

	Reach		
	I	II	III
Mile to Mile	0-15.0	15.0-21.6	21.6-25.8
Gradient (ft/mi)	8.0	9.1	9.5
Sinuosity	1.6	1.8	1.3

Table 2. Land cover composition in the North Branch Middle Fork Zumbro River determined from the 2001 National Land Cover Data Set.

Cover Type	**Acres**	**Percent**
Developed Open Space	1,865	5.5
Developed Low Intensity	535	1.6
Developed Medium Intensity	44	0.1
Developed High Intensity	32	0.1
Deciduous Forest	3,037	9.0
Grassland/Herbaceous	3,111	9.2
Pasture/Hay	3,799	11.2
Cultivated Crops	24,641	72.8
Woody Wetlands	331	1.0
Emergent Herbaceous Wetlands	42	0.1

Table 3. Qualitative habitat quality ratings by sampling station determined from the Minnesota Stream Habitat Assessment Protocol.

	Station		
Metric	**11.5**	**18.4**	**23.2**
Land use	2	0	0
Max=5			
Riparian zone	11	8	7
Max=15			
Substrate	13	19	13
Max=27			
Cover	6	11	9
Max=17			
Channel Morph.	23	28	21
Max=36			
QHEI Score	55	66	50
Max=100			
Habitat Rating	**Fair**	**Good**	**Fair**

Table 4. Fish species collected from three stations in the North Branch Middle Fork Zumbro River, 2010.

Family		Station			Species
Common Name	*Genus species*	11.5	18.4	23.2	Total
Cyprinidae					
Creek chub	*Semotilus atromaculatus*	83	46	15	144
Redfin shiner	*Lythrurus umbratilis*	0	26	2	28
Carmine shiner	*Notropis percobromus*	1	0	0	1
Bigmouth shiner	*Notropis dorsalis*	6	6	0	12
Mimic shiner	*Notropis volucellus*	1	0	0	1
Ozark minnow	*Notropis nubilus*	4	72	0	76
Common shiner	*Luxilus cornutus*	147	441	6	594
Redside dace	*Clinostomus elongatus*	0	3	11	14
Southern redbelly dace	*Phoxinus erythrogaster*	11	137	453	601
Hornyhead chub	*Nocomis biguttatus*	4	26	0	30
Blacknose dace	*Rhinichthys atratulus*	39	16	6	61
Longnose dace	*Rhinichthys cataractae*	16	0	0	16
Bluntnose minnow	*Pimephales notatus*	33	101	4	138
Fathead minnow	*Pimephales promelas*	14	62	245	321
Central stoneroller	*Campostoma anomalum*	99	0	0	99
Largescale stoneroller	*Campostoma oligolepis*	0	130	3	133
Catostomidae					
Golden redhorse	*Moxostoma erythrurum*	1	0	0	1
Northern hogsucker	*Hypentelium nigricans*	6	2	0	8
White sucker	*Catostomus commersoni*	160	131	56	347
Ictaluridae					
Tadpole madtom	*Noturus gyrinus*	0	33	0	33
Stonecat	*Noturus flavus*	0	1	0	1
Centrarchidae					
Green sunfish	*Lepomis cyanellus*	0	36	0	36
Orangespot sunfish	*Lepomis humilis*	0	1	0	1
Percidae					
Johnny darter	*Etheostoma nigrum*	4	22	4	30
Fantail darter	*Etheostoma flabellare*	3	5	0	8
Banded darter	*Etheostoma zonale*	2	0	0	2
Rainbow darter	*Etheostoma caeruleum*	1	0	0	1
Logperch	*Percina caprodes*	6	0	0	6
Blackside darter	*Percina maculata*	5	0	0	5
Gasterosteidae					
Brook stickleback	*Culaea inconstans*	0	4	51	55
Petromyzontidae					
American brook lamprey	*Lampetra appendix*	2	0	0	2
	Total Number per Station	648	1301	856	2805
	Number of Species	22	21	12	31

Table 5. Fish index of biotic integrity scores by sampling station determined from the warmwater IBI of Lyons (1992). Station numbers indicate the downstream boundary for each sampling station.

	Station		
	11.5	**18.4**	**23.2**
Gear	Barge	Barge	Backpack
Length (ft)	735	700	650
Width (ft)	21	19	10
Metric			
Native spp.	22	21	12
Darter spp.	6	2	1
Sucker spp.	3	2	1
Sunfish spp.	0	2	0
Intolerant spp.	5	3	1
% Tolerant	51%	30%	38%
% Omnivores	32%	23%	36%
% Insectivores	32%	47%	1%
% Carnivores	0%	0%	0%
% Lithophils	63%	62%	61%
IBI Score	**50**	**47**	**25**
IBI Rating	**Good**	**Fair**	**Poor**

From Lyons (1992) "A good rating indicates that species richness is somewhat below expectation, especially due to the loss of the most intolerant forms; some species, especially top carnivores, are present with less than optimal abundances or size/age distributions; trophic structure shows some signs of imbalance".

Table 6. Jacard similarity index values determined from fish species presence/absence in 1983 and 2010. Index values are represented by: a=species present in both yearsp; b=species present in 1983 only; c=species present in 2010 only.

	Station								
	11.2			18.4			23.2		
Species	1983	2010	j	1983	2010	j	1983	2010	j
Creek chub	1	1	a	1	1	a	1	1	a
Redfin shiner	0	0		0	1	c	0	1	c
Emerald shiner	1	0	b	0	0		0	0	
Carmine shiner	0	1	c	0	0		0	0	
Common shiner	1	1	a	1	1	a	1	1	a
Spottail shiner	0	0		1	0	b	0	0	
Bigmouth shiner	0	1	c	1	1	a	1	0	b
Mimic shiner	0	1	c	0	0		0	0	
Sand shiner	1	0	b	0	0		0	0	
Ozark minnow	0	1	c	1	1	a	0	0	
Redside dace	0	1	c	1	1	a	0	1	c
Southern redbelly dace	1	1	a	1	1	a	1	1	a
Hornyhead chub	1	1	a	0	1	c	0	0	
Blacknose dace	1	1	a	1	1	a	1	1	a
Longnose dace	1	1	a	1	0	b	0	0	
Brassy minnow	1	0	b	0	0		0	0	
Bluntnose minnow	1	1	a	1	1	a	1	1	a
Fathead minnow	1	1	a	1	1	a	1	1	a
Central stoneroller	1	1	a	1	0	b	1	0	b
Largescale stoneroller	0	0		0	1	c	0	1	c
Golden redhorse	1	1	a	1	0	b	0	0	
Northern hogsucker	1	1	a	1	1	a	0	0	
White sucker	1	1	a	1	1	a	1	1	a
Black bullhead	0	0		1	0	b	1	0	b
Tadpole madtom	0	0		0	1	c	0	0	
Stonecat	1	0	b	1	1	a	0	0	
Green sunfish	1	0	b	1	1	a	1	0	b
Orangespot sunfish	0	0		0	1	c	0	0	
Johnny darter	1	1	a	1	1	a	1	1	a
Fantail darter	1	1	a	1	1	a	0	0	
Logperch	0	1	c	0	0		0	0	
Blackside darter	0	1	c	0	0		0	0	
Banded darter	0	1	c	0	0		0	0	
Rainbow darter	0	1	c	0	0		0	0	
Brook stickleback	0	1	c	1	1	a	1	1	a
American brook lamprey	0	1	c	0	0		0	0	
Jacard Similarity (j)		**0.47**			**0.61**			**0.56**	

Figure 1. Sampling station locations.

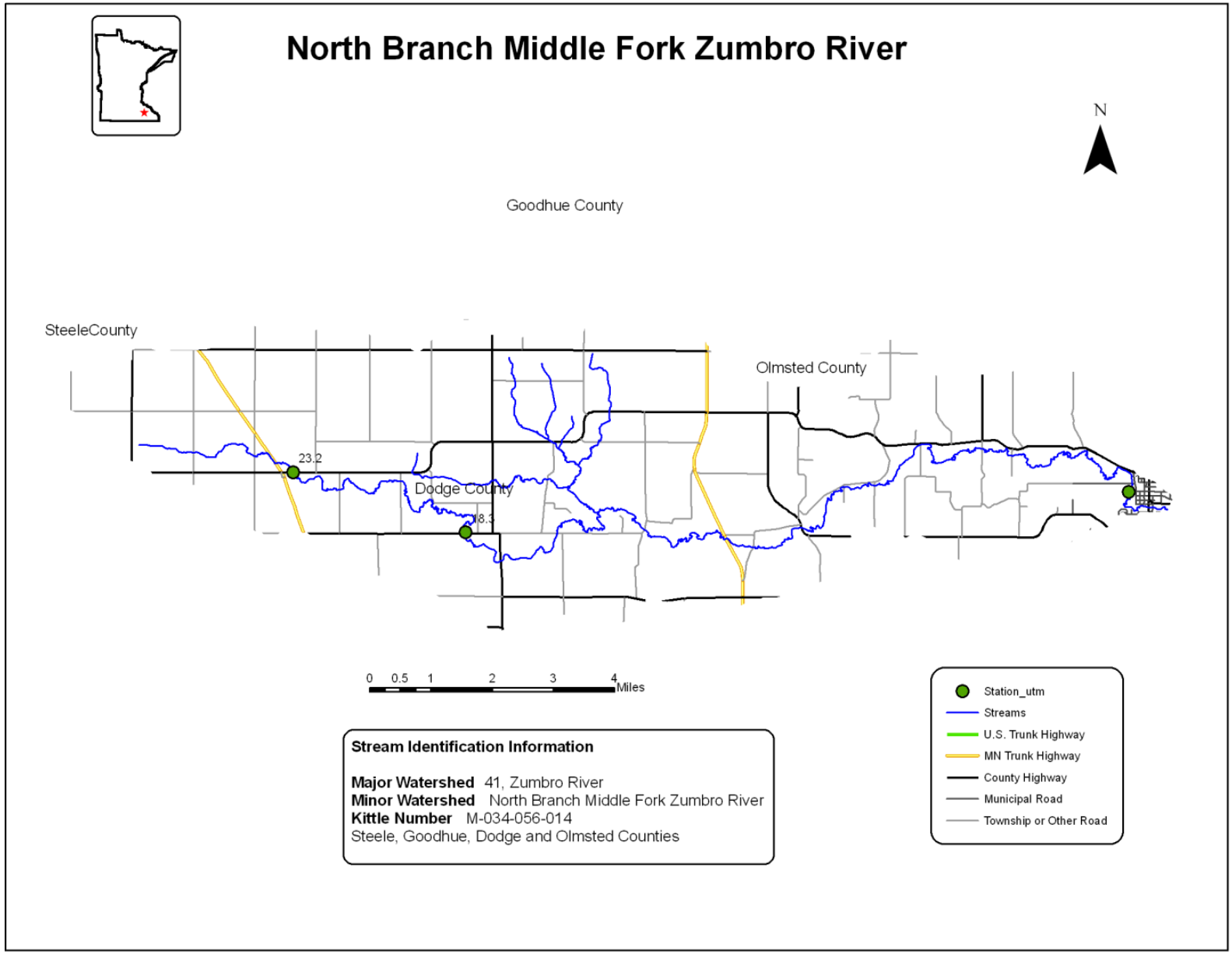

Figure 2. Strahler stream order and basin relief.

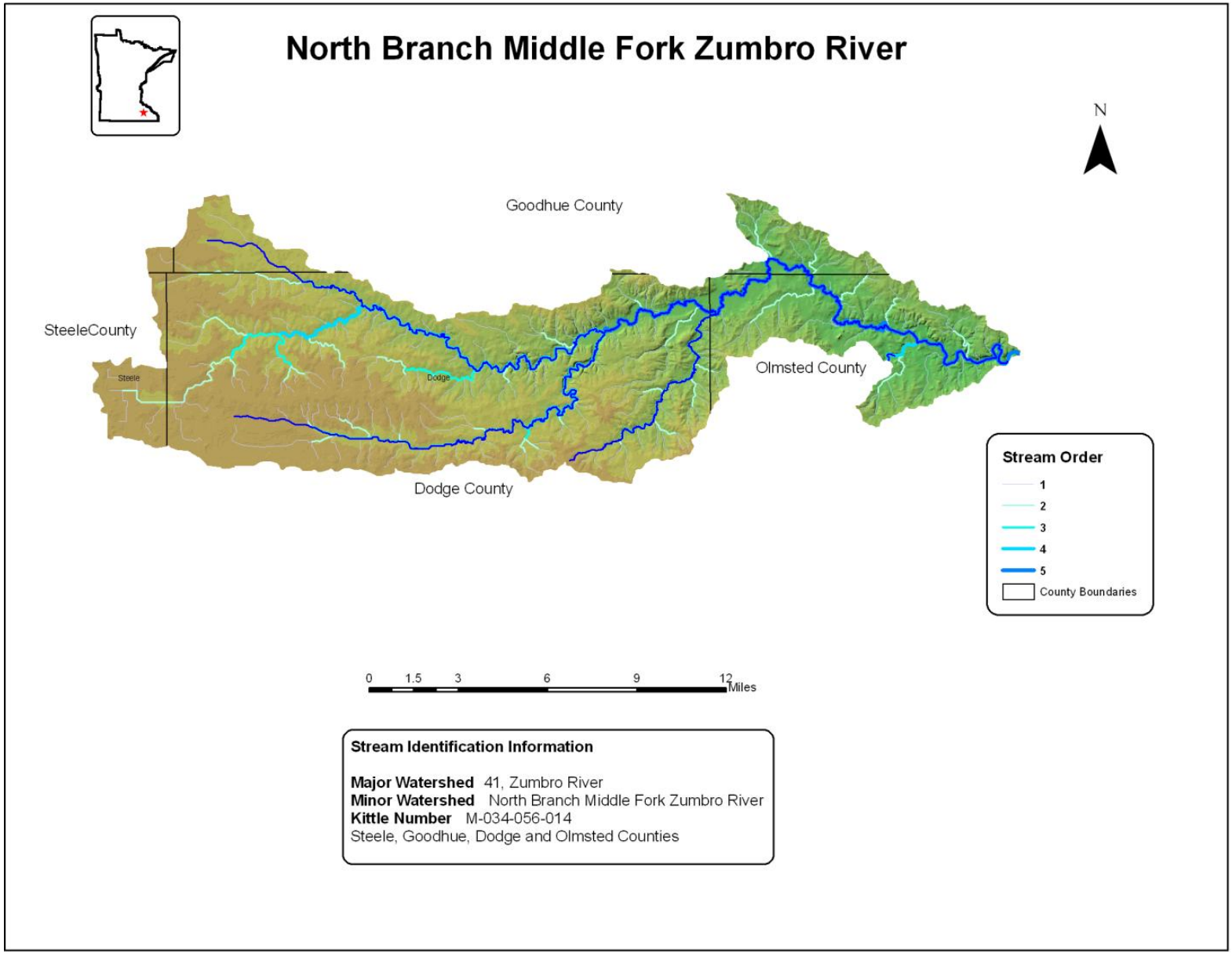

Figure 3. Land cover from the National Land Cover Dataset, 2001.

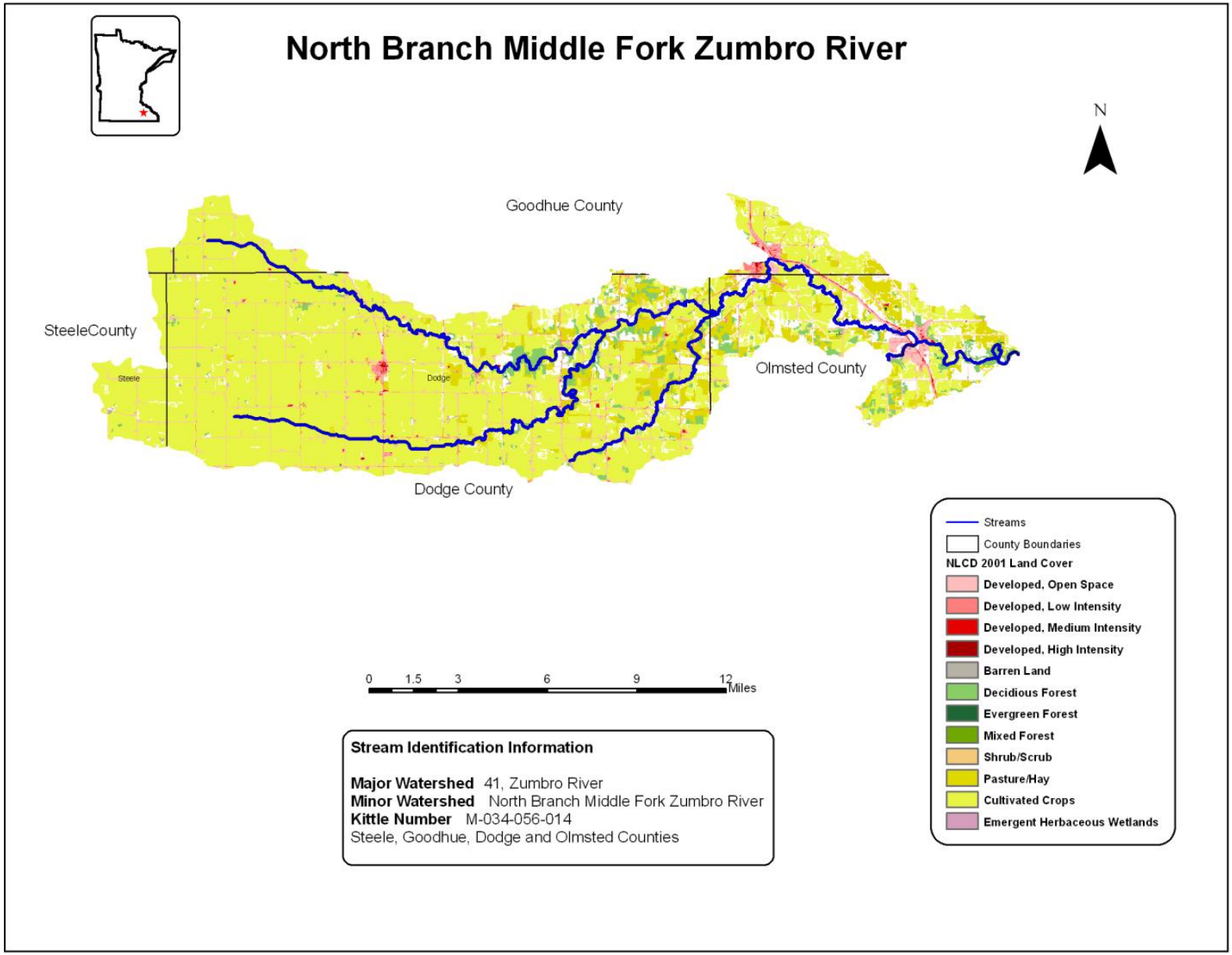
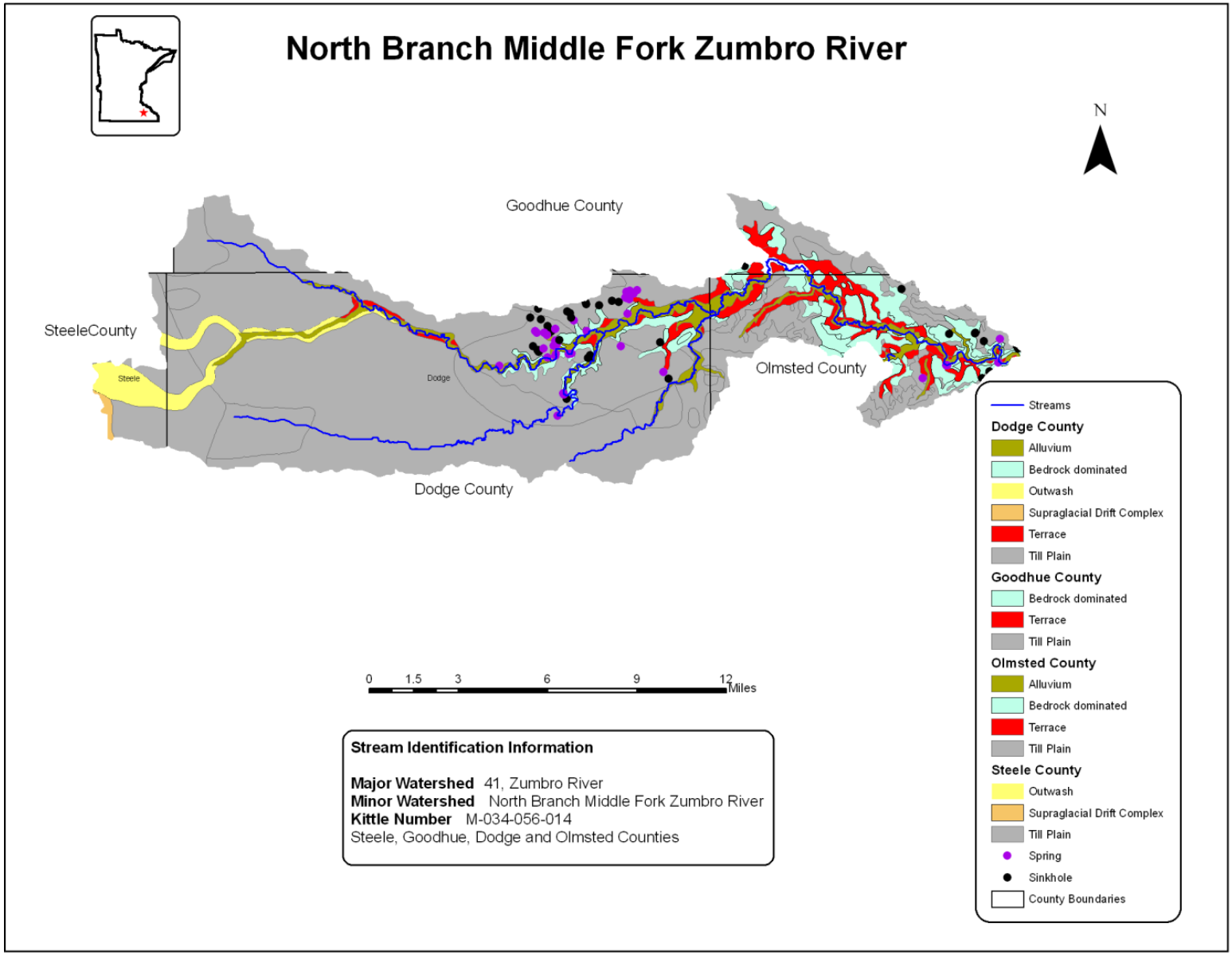
Figure 4. Bedrock geology and karst features.