Chapter 2 Project Area Description

General Summary

Entire Watershed

Most of the upper portion of the watershed is completely level (0-2% slopes). As Seven Mile Creek descends into the Minnesota River valley (210 feet drop), land slope changes to a steep dendritic drainage (40-60% slopes near the channel). Row cropping (corn/soybean rotation) is the dominant agricultural use. Many wetlands and drained lakes lie within the 23,551-acre watershed. Soils consist mostly of poorly drained clay loams and silty loams on level land. The watershed is nearly all privately owned except for a 626-acre county owned park at the mouth of the watershed.

Land Adjacent to the Creek

Soils are mainly well-drained loams to poorly drained clay loams. The lower reach has a high gradient and is densely wooded. The mid and upper reaches are privately owned wooded areas and eventually open up to cultivated farmland. Seven Mile Creek Park is located from 0-1.6 river miles. The park includes 320 acres of wooded property. A public access to the Minnesota River is located near the mouth of the creek on the East side of the County Park near Highway 169.

The Study Watershed

Seven Mile Creek Watershed was chosen for a Water Quality Resource Investigation Grant following the 1996 Middle Lower Assessment Project funded through the Minnesota Pollution Control Agency. The two-year study was postponed following the 1998 tornado; monitoring resumed in earnest in 1999 and 2000. Watershed assessments and monitoring continued in 2001 and is currently temporarily funded through the DNR Environmental Partnerships Program. Map 4 shows the location of the watershed and relation of the watershed with respect to St. Peter, Seven Mile Creek County Park, Research Fields, Minnesota River, water ways, transportation networks and St. Peter Wellhead Protection Area.

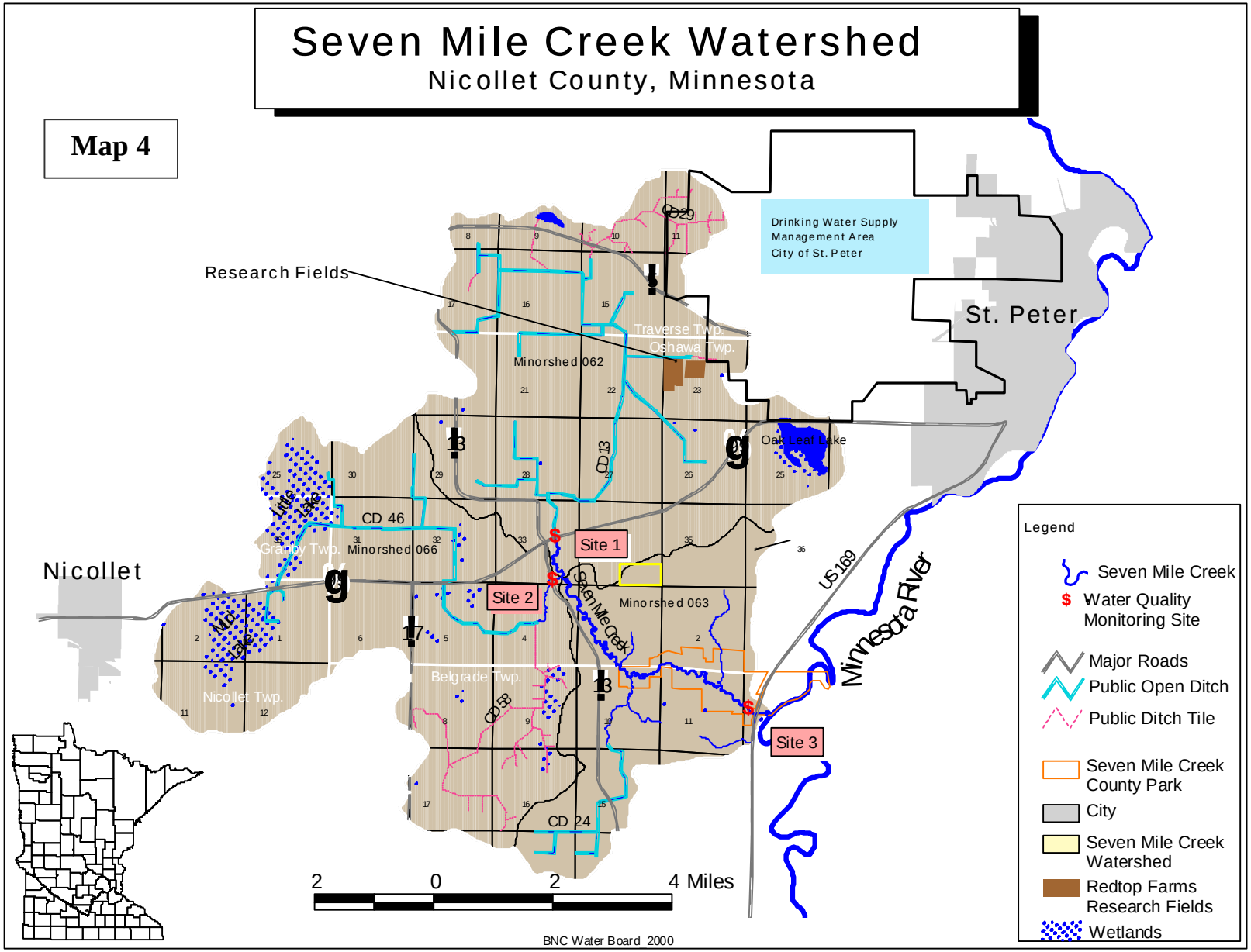
Seven Mile Creek is 6.1 miles long and receives most of the drainage from three constructed ditches, CD 46, CD 13, and CD 24. The creek itself does not start until after Highway 99. There are also two major public ditch tile systems. Those include County Ditch 29 and County Ditch 58. The public open drainage ditches are generally intermittent in nature in that they dry up completely and do not provide substantial flows to Seven Mile Creek after the month of July in a typical year. The creek itself maintains a minimum of 1-3 cubic feet per second of flow as a result of ground water upwelling near the upper portion of the County Park. These flows are consistent throughout the year and presumed to be from the Jordan Sandstone Aquifer. At certain times of the year, water from the upper ditches infiltrates into the alluvial material found in watershed 3. This groundwater and surface water interaction is of great interest to the watershed staff since surface water quality might be affecting groundwater quality. More studies need to be completed to further the understanding of groundwater and surface water interactions within Seven Mile

Creek. The watershed contains three minor watersheds. Hydrologic units include: minorshed 28062 (9956 acres), minorshed 28066 (9120 acres) and minorshed 28063 (4475 acres). For simplistic purposes, this report describes the minorsheds as watershed 1, watershed 2, and watershed 3 respectively. Soil type, soil internal drainage, and landscape slope steepness distributions are very similar in watershed 1 and watershed 2. Watershed 3 contains much steeper slopes, and transitions from a cultivated land use to mature deciduous forest. Three monitoring stations were installed in 2000 to monitor CD 46, CD 13, and the mouth of the watershed. Through subtraction, the influence of watershed 3 is determined.

The majority of the watershed land use is under row crop corn/soybean rotation agriculture. 86% of the land is under cultivation; 6% is deciduous forest, with the remaining nearly equally divided between wetlands, grassland, and farmsteads. Residential development is growing in the watershed, and current recreational use is medium to high, mainly because of the county park.

The watershed is 23,551 acres or 36.8 sq. miles in size. It comprises about 3% of the Middle MN Basin and covers 8% of Nicollet County. The watershed study will be used as a template for other watershed projects within the eastern region of the Middle Minnesota Major Watershed. Since 1985 the ecological classification of the stream has been a class 1-D or marginal trout fishery, because of its cool water temperatures and ideal habitats. Other unique features include: the Seven Mile Creek County Park, which attracts thousands of visitors yearly and serves as an education site for area schools and colleges; the Red Top Farms Research Fields; and the St Peter Source Water Protection project.

Photo 1. Seven Mile Creek near the mouth with Seven Mile Creek County Park. Much of the lower reach of creek is surrounded by sandstone bedrock outcrops and mature deciduous forest on steep ravines.


Seven Mile Creek Watershed
Nicollet County, Minnesota
Map 4
Research Fields
Drinking Water Supply Management Area City of St. Peter
St. Peter
Traverse Twp.
Oshawa Twp.
Minorshed 062
Oak Leaf Lake
CD 13
CD 46
Little Lake
Grapply Twp.
Minorshed 066
Site 1
Site 2
Site 3
Seven Mile Creek
Minorshed 063
US 169
Minnesota River
Nicollet
Nicollet Twp.
Belgrade Twp.
CD 58
CD 24
2 0 2 4 Miles
BNC Water Board_2000
Legend
Seven Mile Creek
$ Water Quality Monitoring Site
Major Roads
Public Open Ditch
Public Ditch Tile
Seven Mile Creek County Park
City
Seven Mile Creek Watershed
Redtop Farms Research Fields
Wetlands

Recently several other developments within the watershed have increased its uniqueness as a water quality project. They Include:

- A paired watershed study involving Seven Mile Creek and Huelskamp Creek watersheds in western Nicollet County was recently funded though the Department of Agriculture Section 406. The outcomes of the three-year study will help determine the most cost-effective Best Management Practices to increase water quality within an agricultural setting.

- Northern Plains Dairy plans to construct one of Minnesota's largest dairies within the watershed. Proposed construction site is located on map 22.

- Innovative model developed by BNC and PCA staff to estimate sediment and phosphorus delivery pathways.

- McKnight Foundation of Minnesota is considering funding a pilot constructed wetland demonstration project to mitigate nitrate concerns in Seven Mile and Little Cottonwood watersheds.

- Considerations have been underway to convert county ditch tile 29 to an open drainage ditch or enlarge the existing drainage tile.

- Seven Mile Project and Little Cottonwood River Watershed Project recently formed partnership with Center for Agricultural Partnerships Mid-Western Water Quality Project. The project involves innovative nutrient management demonstrations involving nitrogen-rate demonstrations, yield monitor and GPS/GIS technologies, and economical optimum nitrogen rate analysis for corn producers within the watershed.

Unique Watershed Features

Trout Stream:

Seven Mile Creek flows through Nicollet County's only park. The 625-acre park is a visible site for public awareness, and is often used for picnics, and educational seminars by local schools and universities. Seven Mile Park has over 7 miles of hiking/biking/horse trails, as well as abundant bird and wildlife populations. Seven Mile Creek was the first release site of wild turkeys in the MN River Basin. The watershed also contains a few small lakes and larger wetlands.

Unique Stream

Seven Mile Creek is a designated trout stream. This type of fishery is very rare for an area like South Central Minnesota. A trout stream requires a certain mix of streambed geology, adequate groundwater, and compatible land use within the watershed in order for sensitive fish like trout to survive. One of the most important factors is temperature. Trout need cold water and cannot tolerate temperatures above 75 degrees. In an area where prairie and now cropland dominate, cool temperatures are not typical. Seven Mile Creek is an exception. Because the Seven Mile area contains steep gradients, heavily forested vegetation, and gravelly substrate, a very unique habitat and fishery can exist. The lower reaches of Seven Mile flow all year long due to groundwater upwelling from the Jordan aquifer. This also substantially increases fisheries habitat.

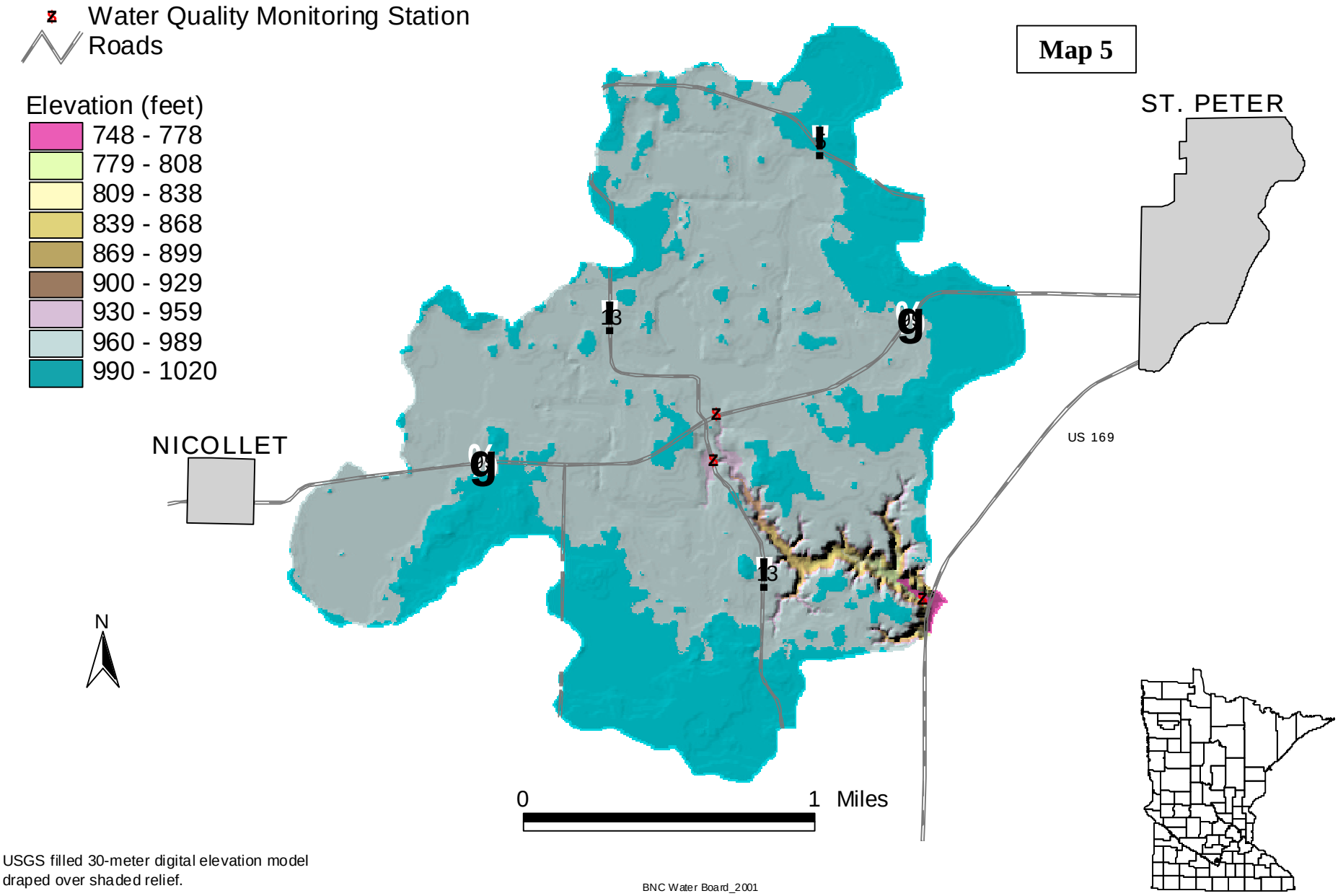
Topography

Topography of Watershed

A majority of the watershed is nearly level or gently sloping. The topography is steepest in the lower portion of the watershed. Land along the river is also steep as the river descends into the MN River valley. Map 5 is a Digital Elevation Model representing land slope within the watershed. Percentage of slope was reclassified into six categories (map 6). Both the land slope and shaded relief maps were derived from 30-meter resolution USGS Digital Elevation Models.

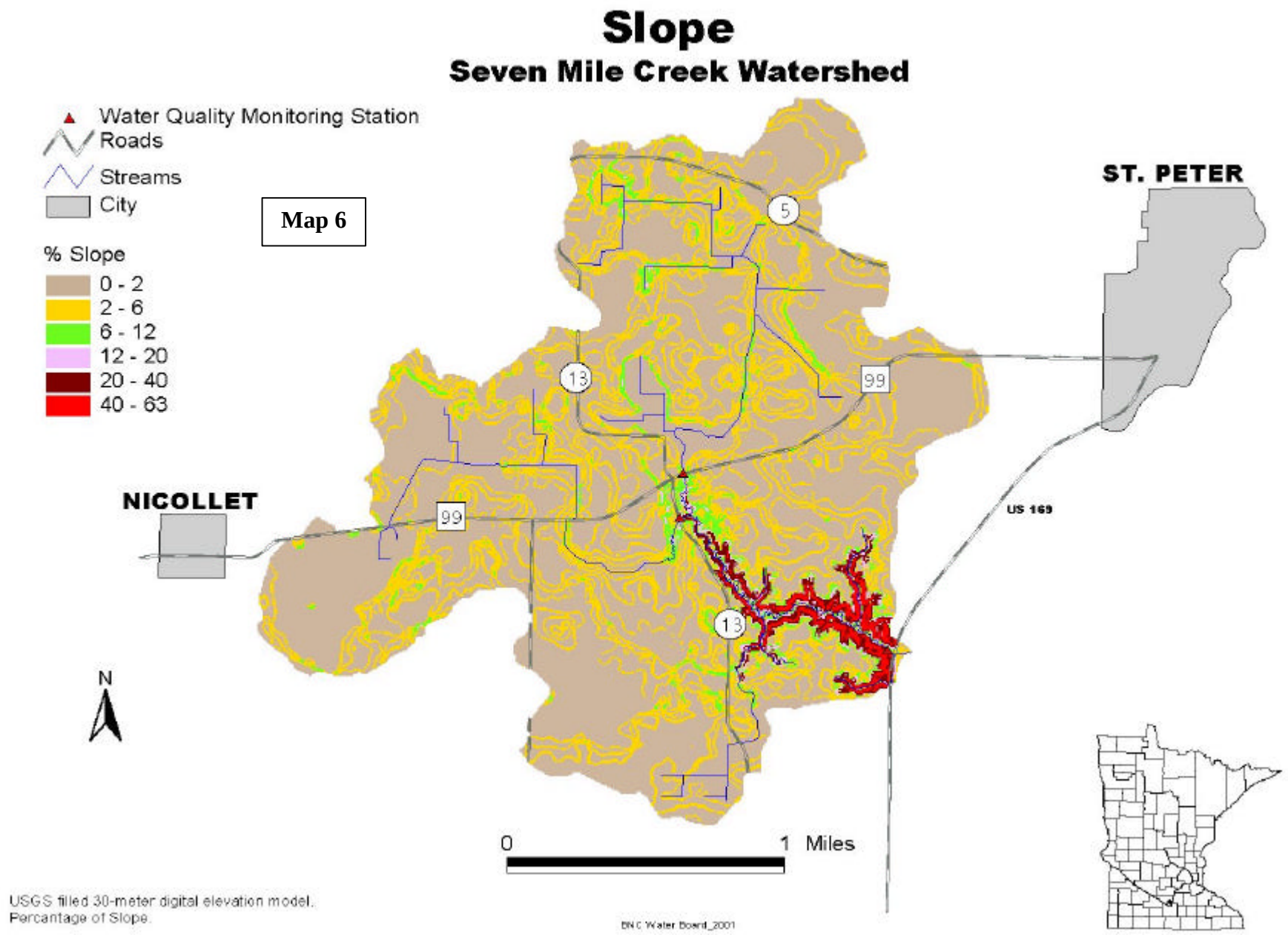
Elevation

Seven Mile Creek Watershed



USGS filled 30-meter digital elevation model draped over shaded relief.

BNC Water Board_2001


Slope
Seven Mile Creek Watershed
Water Quality Monitoring Station
Roads
Streams
City
Map 6
% Slope
0 - 2
2 - 6
6 - 12
12 - 20
20 - 40
40 - 63
ST. PETER
NICOLLET
5
13
99
99
13
US 169
N
0
1 Miles
USGS filled 30-meter digital elevation model.
Percentage of Slope.
BNC Water Board_2001

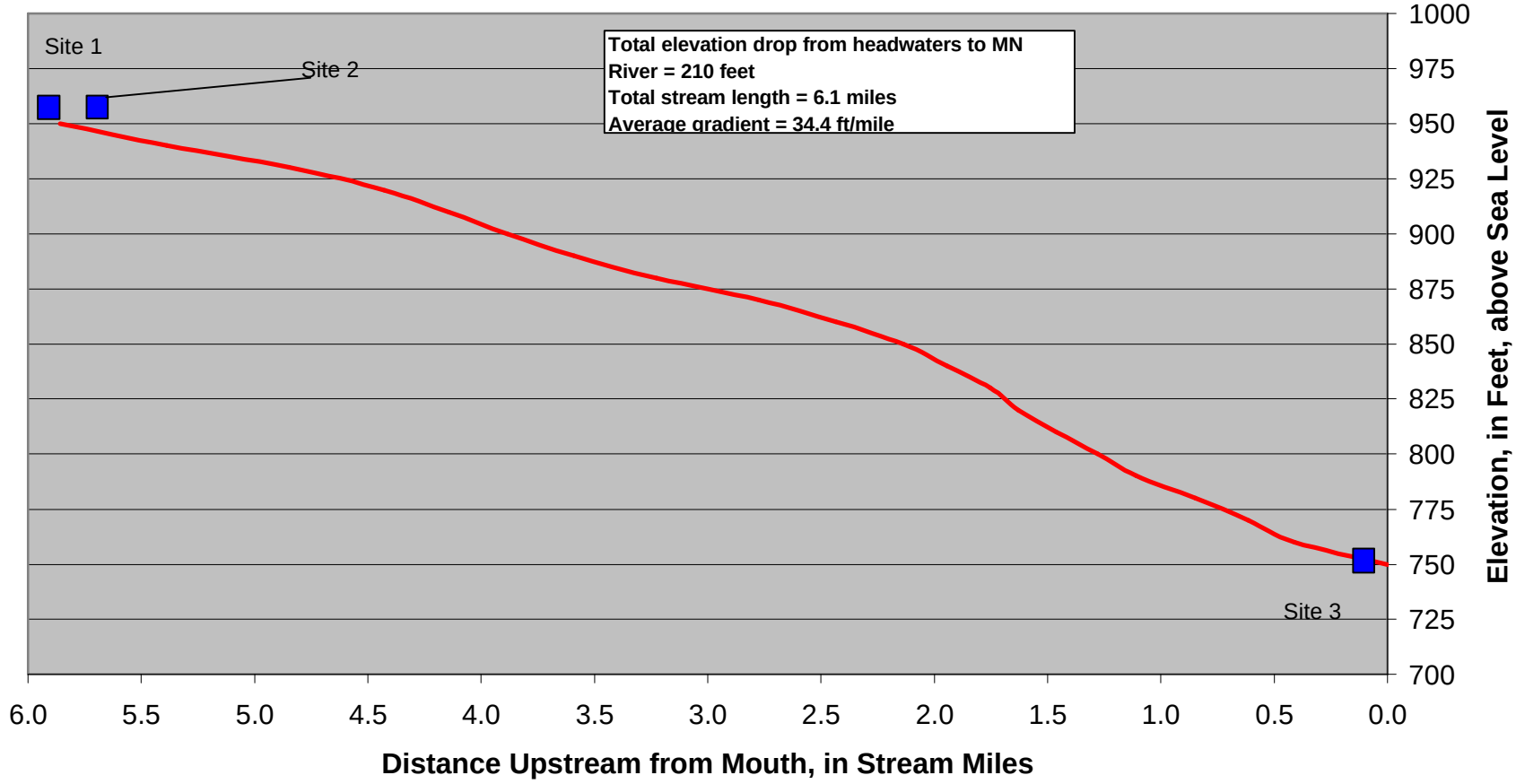
Topography of Seven Mile Creek Water Course

Seven Mile Creek is 6.1 miles long and receives most of the drainage of the watershed from two constructed ditches. (CD 58 and CD 13). Elevation of the surface water starts at 1020 feet. Elevation of the creek at the mouth is 748 feet. Overall the river drops a total of 210 feet from monitoring site 1 to monitoring site 3 at the mouth with an average gradient of 34.4 feet/mile. Figure 1 shows a cross-sectional view of the creek's gradient from state highway 99 to the confluence of the MN River.

Water Surface Elevation by Stream Mile

Seven Mile Creek

Figure 1



Climate

Seven Mile Creek Watershed is continental, with cold dry winters and warm wet summers. Climatic records from St. Peter, MN, which is just north of the watershed, show the average monthly temperatures in St Peter is 46.2 ^{o}C. Annual precipitation rates average 28.91 inches. Average annual runoff is estimated to be between 5-6 inches.[1]

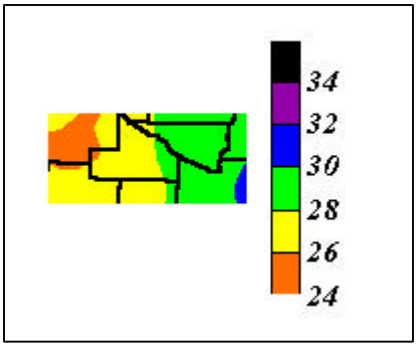


Figure 2. Normal average annual precipitation rates for the project area (inches) (1961-1990 State Climatology Office).

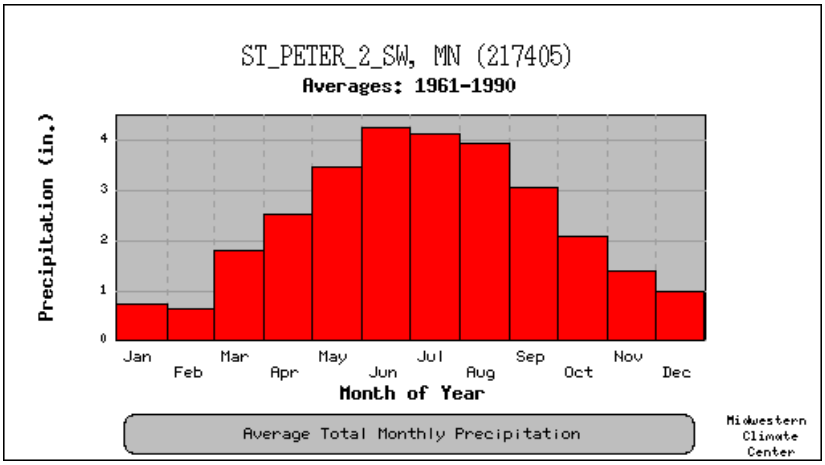


Figure 3. Normal average annual precipitation rates (inches) (1961-1990 State Climatology Office).

[1] Minnesota River, Basin Information Document, 1997, MPCA

Summary of Precipitation During Water Quality Monitoring Period

2000

Growing season (April-Sept.) rainfall amounts deviated from normal in the spring and fall. During these seasons the watershed experienced abnormally dry conditions. The months of April and September were below normal. No spring runoff conditions were present. Up until May 17 there was very little rainfall. In contrast, May proved to be above normal rainfall with very intense rainfall frequencies. On May 17/18 and July 10 the watershed received most of its precipitation. After May a more normal rainfall pattern occurred. June, July and August were normal. Rainfall for watershed was determined by averaging selected sights in and around the watershed. See map 7 for monthly precipitation totals.

2001

The winter of 2000 and 2001 proved to be one for the record books. Record snowfall amounts fell in the MN River Basin over the winter period and resulted in flood levels comparable to 1997. Fortunately, the snow melted gradually starting in mid March through the early part of April. The upper tributaries, CD13 and CD 46a, eventually opened up by the first week of April. Monitoring equipment was installed around this time with some difficulty. Large drifts of snow in some places up to 8 feet deep were deposited in and around the water quality monitoring sites. The sites had to be literally dug into the snow in an effort to capture the spring runoff conditions. Ice jams were consistent problems as well. Spring runoff conditions peaked around mid-April. Compounding the high water levels, over six inches of additional rainfall fell within the watershed in addition to the 4-6 inches contributed by winter snowfall. Several intense 2" rainfall events occurred in April. By May, rainfall levels decreased to normal levels. June, July and August rain levels decreased substantially. Total monthly rainfall levels for June and August were roughly half of what is considered normal rainfall for those particular months within the St. Peter area. By late July, the two main tributaries supplied little to no flow to the lower reach of the Creek. Groundwater dominated the source of flows in Seven Mile by late summer, which is very typical of this watershed. September rainfall levels were considered normal to just below normal.

Photo 2. Spring runoff conditions within the watershed. It is estimated that approximately 70% of the pollutants in 2001 came through the watershed during the spring snowmelt conditions. Phosphorus was the dominant source of pollution within the watershed during the snowmelt conditions.

Photo 3. Snowmelt conditions at monitoring site 2 on April 7, 2001.

Photo 4. April 11, 2001. Spring runoff conditions at site 2. The monitoring sites had to be dug into the snow pack in order to capture the spring runoff conditions.

Table 1. Monthly rainfall totals during growing seasons of 2000 and 2001

Rainfall in SMC Watershed growing season 2000

April	May	June	July	August	September	Total
0.75	6.19	5.19	4.32	3.21	0.67	20.34

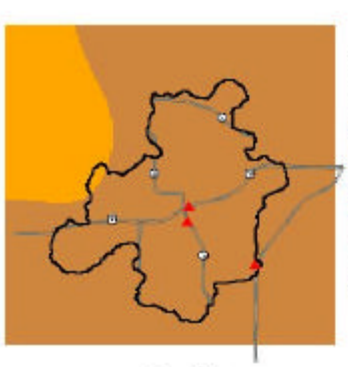
Rainfall in SMC Watershed growing season 2001

April	May	June	July	August	September	Total
6.10	3.53	3.28	4.13	1.57	2.83	21.44

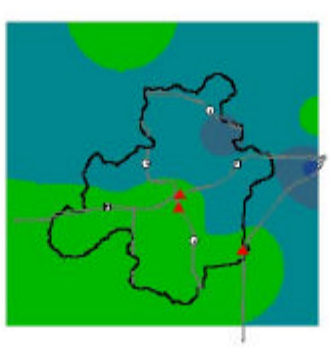
*Normal is simply a 30 –year arithmetic mean computed once per decade. The normals presented in the graph above use the observation period 1961-1990. These values are the benchmarks to be used throughout the 1990's and into the year 2000. New normals will be computed by the State Climatology Office in 2001 and will use data from 1971-2000.

Monthly Precipitation Totals

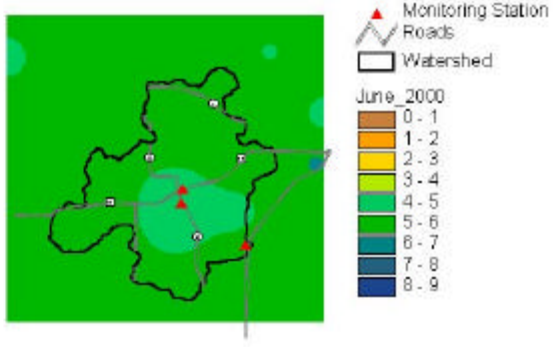
Seven Mile Creek Watershed, Growing Season 2000



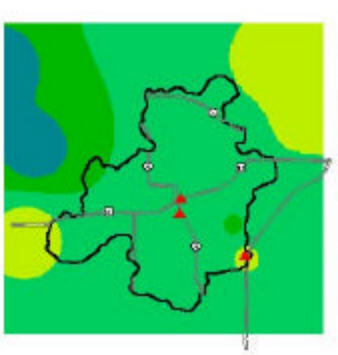
April



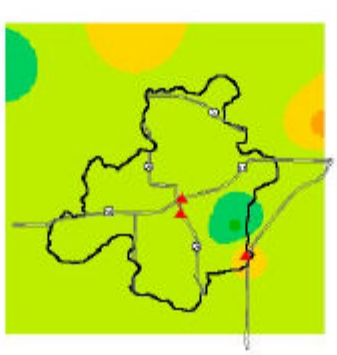
May



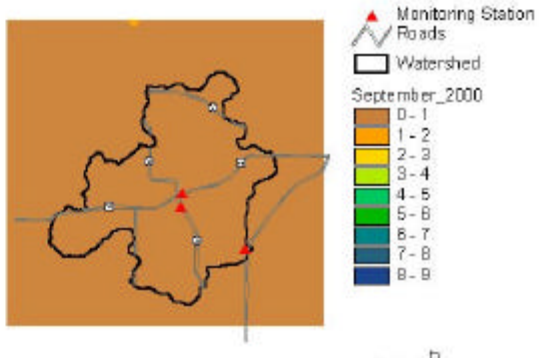
June



July



August



September

Total rainfall per month (expressed in inches)
based on 12 data points in and
around the watershed.
Interpolated GRID using IDW closest neighbor method.

Map 7

BNC Water Board_2001

Table 2. Monthly rainfall for SMC Watershed during 2000 growing season.

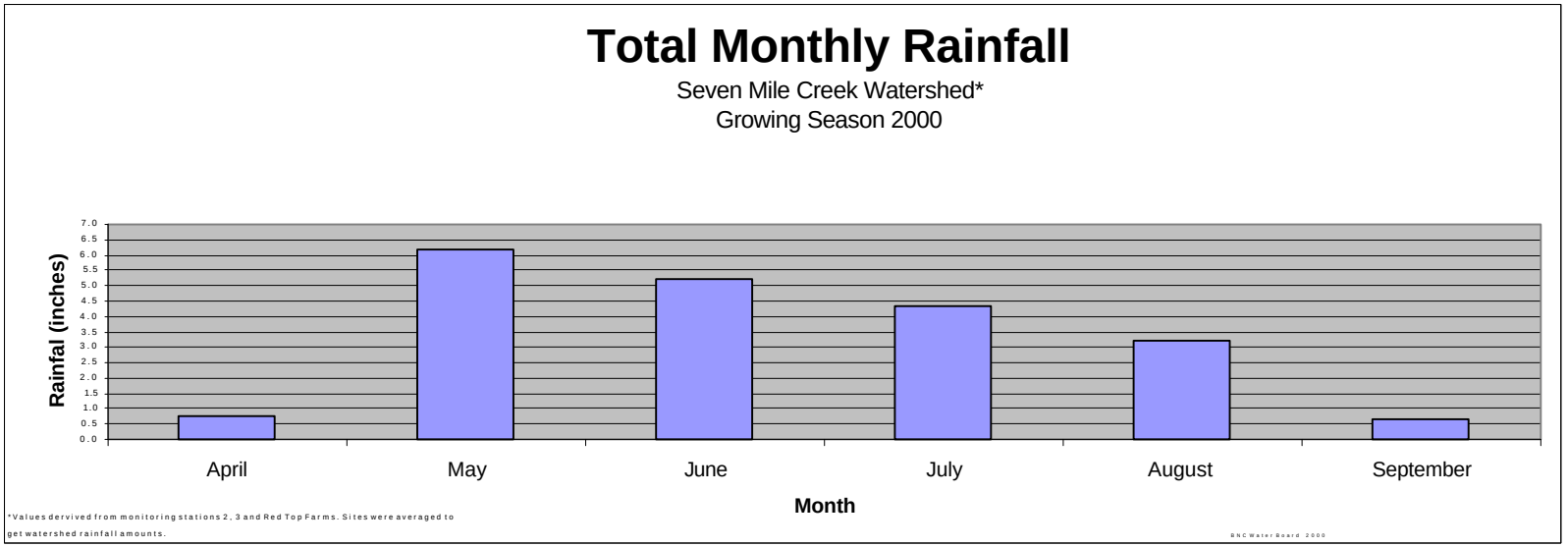


Table 3. Monthly precipitation totals for St. Peter and SMC Watershed during 2000 growing season.

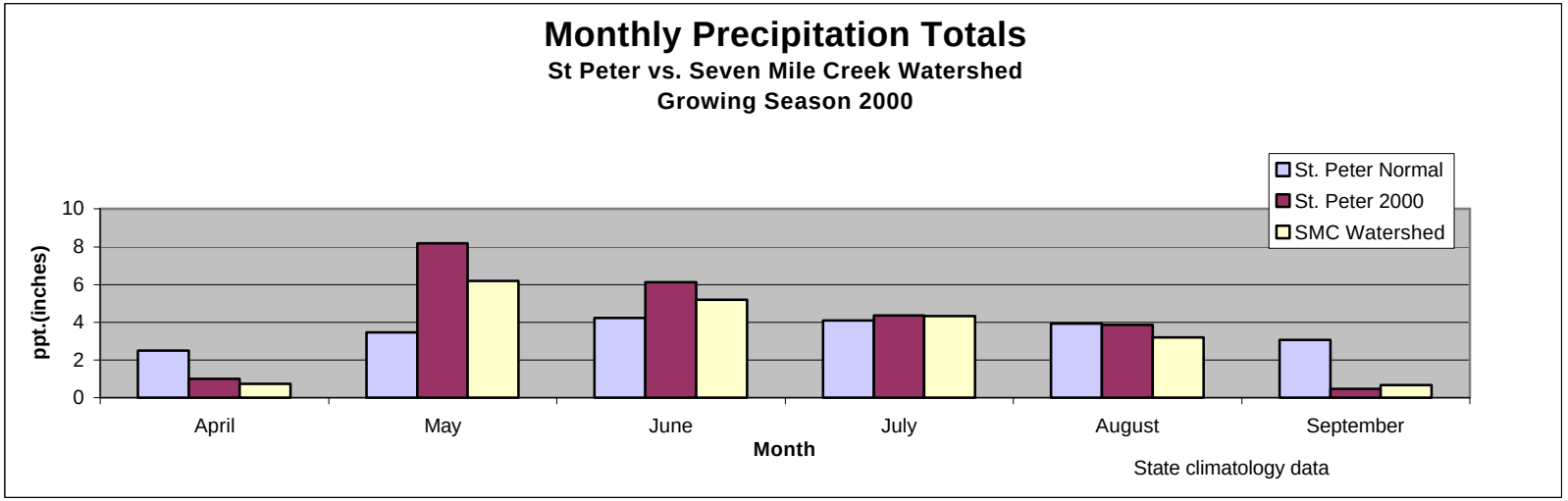


Table 4. Monthly rainfall for SMC Watershed during 2001 growing season.

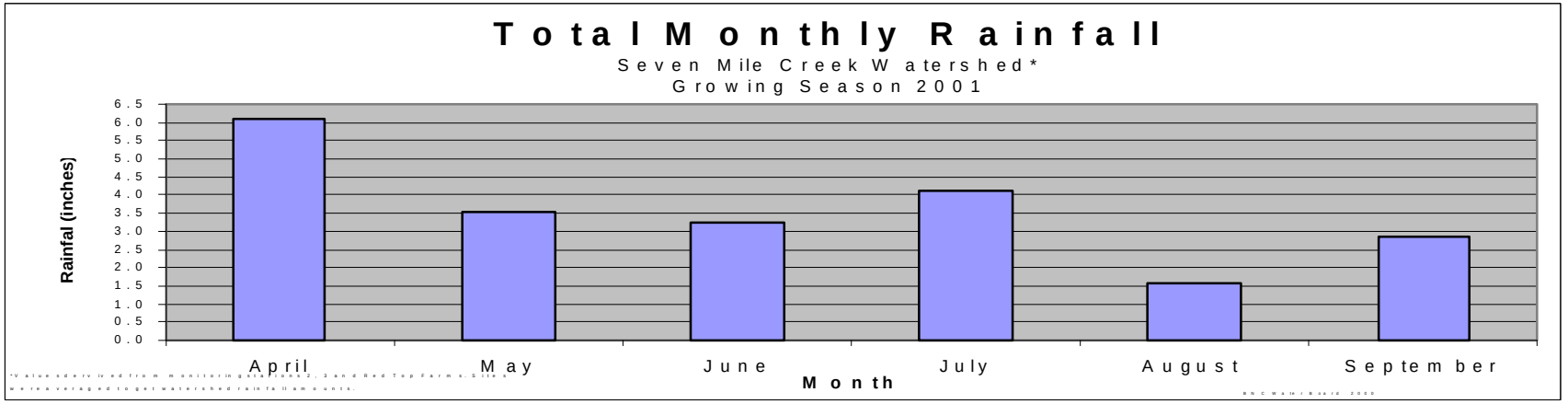
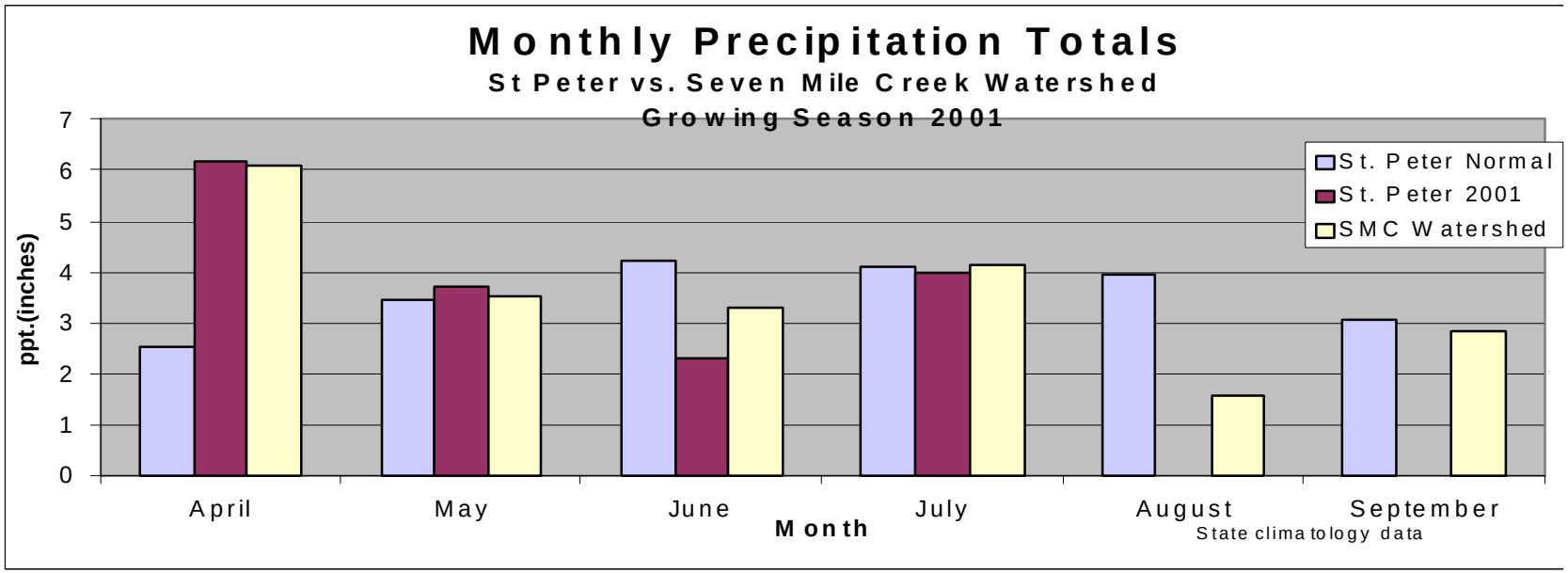


Table 5. Monthly precipitation totals for St. Peter and SMC Watershed during 2001 growing season.



Land Use

Since the 1850s the watershed has been transformed from open prairie and wetlands to an intensively developed agricultural area. Whereas the market for the products of the early farmers was limited to areas only about 30 miles away, much of the current agricultural production is marketed around the U.S and overseas. Roads on virtually every section line provide transportation routes[2].

Cultivated crops are the predominant land use (corn and soybeans), with some pasture and occasional feedlots, and small forested areas. No municipalities exist within the watershed. Land use within Seven Mile Creek Watershed is primarily agricultural, accounting for approximately 86% of the land area. Two- year corn/soybean rotations comprise close to 90% of cropped lands within the watershed; small grains-oats, peas, hay, and grasslands and areas enrolled in the Conservation Reserve Program make up the majority of the balance.

Residential development is becoming more common in and around Seven Mile Creek Park. Current recreational use of watershed waters is medium to high. Land cover is based on 1990 land use (map 8).

Table 6

1990 Land Use and Land Cover

Land use	Acres	% of Area
Cultivated Land	20181	86
Deciduous Forest	1478	6
Wetlands	649	3
Grassland	643	3
Farmsteads and other rural Developments	438	2
Water	154	0.7
Other Rural Developments	6	0.02
Grassland-Shrub-Tree (deciduous)	1	0.01

[2] Soil Survey, Nicollet County, USDA, 1994.

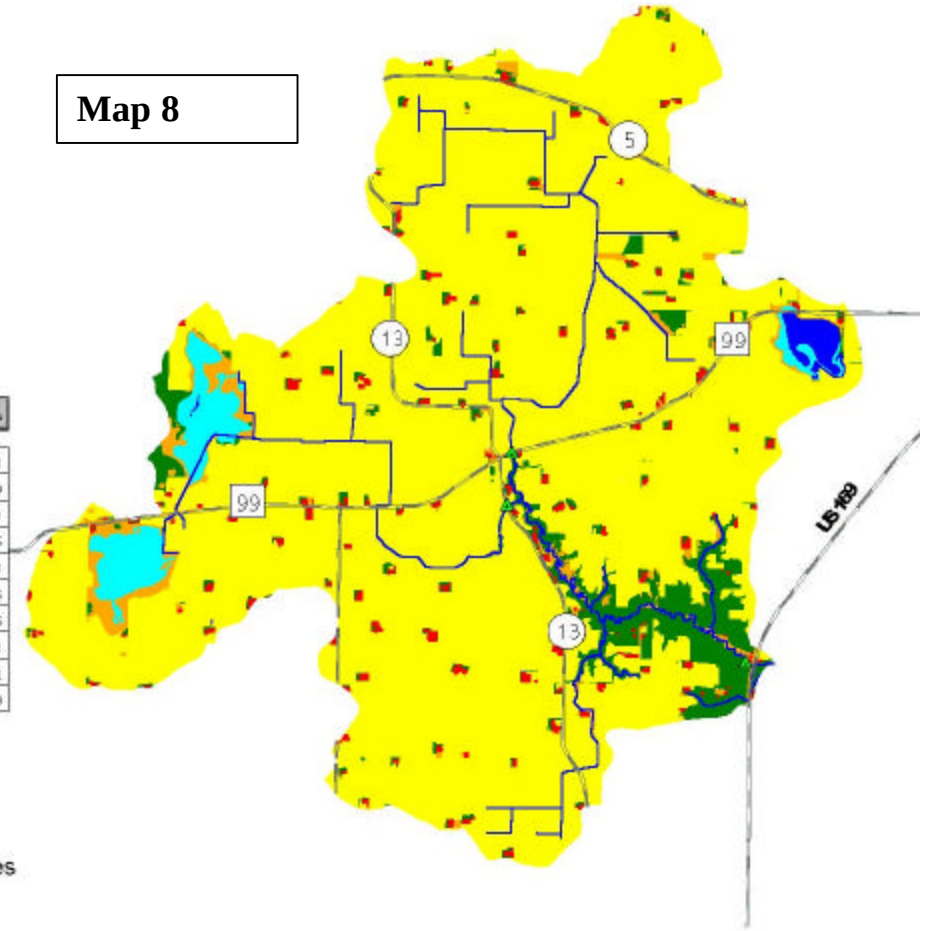
1990 Land Use

Seven Mile Creek Watershed

Water Quality Monitoring Sites
Stream and Tributaries

1990 Land Use
- Cultivated Land
- Deciduous Forest
- Exposed Soil; Sandbars and Sand Dunes
- Farmsteads and Rural Residences
- Grassland
- Grassland-Shrub-Tree (deciduous)
- Other Rural Developments
- Water
- Wetlands

Map 8



Land Use	Acres	% of area
Total	23551.0000	100.00
Cultivated Land	20180.9100	85.69
Deciduous Forest	1478.4200	6.28
Wetlands	648.8500	2.76
Grassland	643.3700	2.73
Farmsteads and Rural Residences	438.0200	1.86
Water	153.5800	0.65
Other Rural Developments	5.8100	0.02
Grassland-Shrub-Tree (deciduous)	1.3800	0.01
Exposed Soil; Sandbars and Sand Dun	0.6100	0.00

N

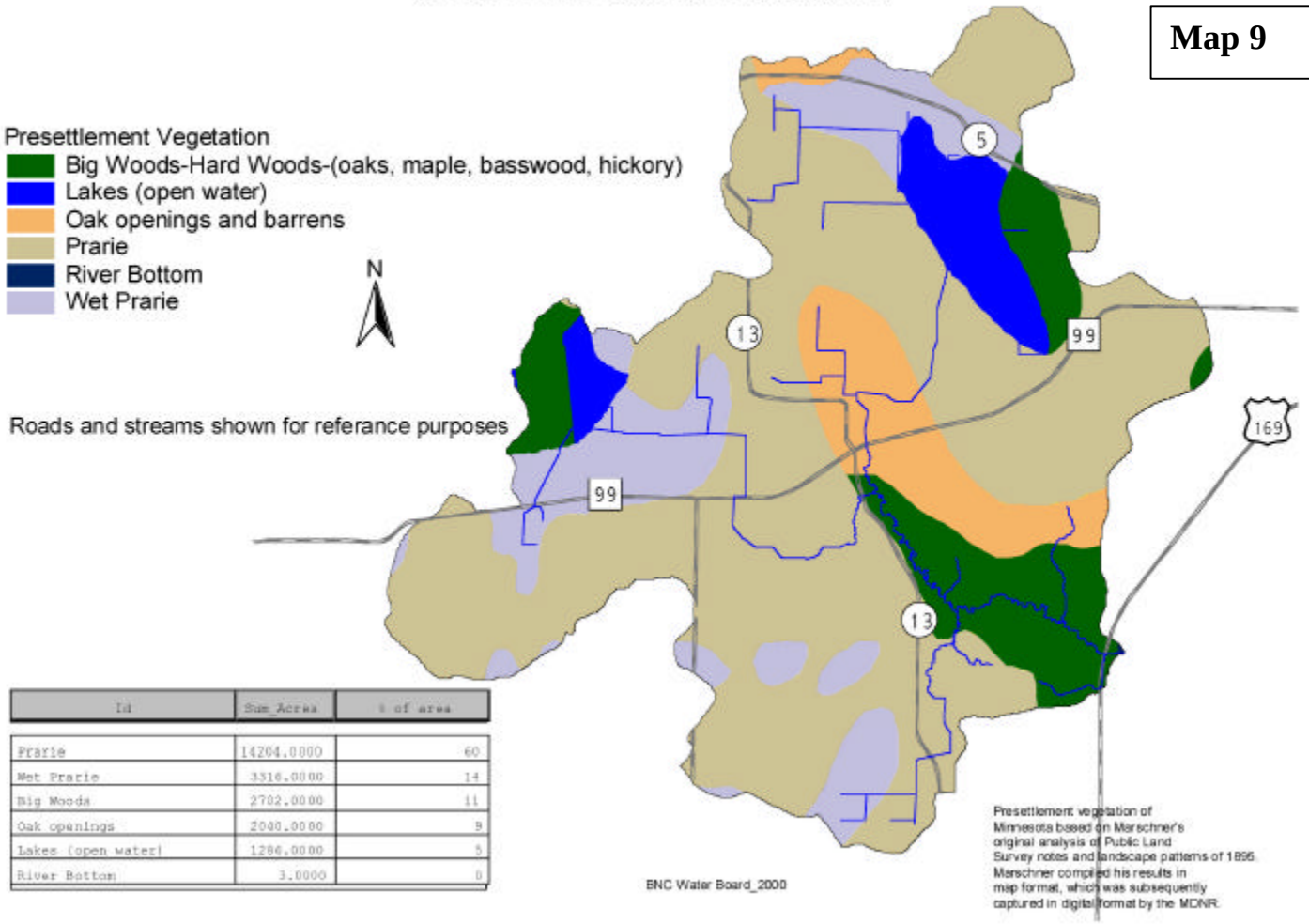
1 0 1 Miles

BNC Water Board_2000

Presettlement Vegetation

Seven Mile Creek Watershed

Map 9



Id	Sum_Acres	% of area
Prarie	14204.0000	60
Wet Prarie	3316.0000	14
Big Woods	2702.0000	11
Oak openings	2040.0000	9
Lakes (open water)	1286.0000	5
River Bottom	3.0000	0

Soils

According to the University of Minnesota's Department of Soil, Water and Climate the Lower Middle MN Major Watershed is mainly comprised of wetter Blue Earth Till deposits. These deposits are a complex mixture of relatively flat (2-6%) well drained soils and very flat (0-2%) poorly drained soils. Soils within these deposits are generally loamy in texture.

Adopted from Nicollet County Soil Survey, 1994

Because the water table is high in about 62% of the soils, artificial drainage systems were installed in the 1880s to enhance crop production within Nicollet County. The systems incorporated open ditches and tile drains. Today more than 24 miles of open ditches and approximately 15 miles of public drain tile exist in Seven Mile Creek Watershed. Private tile line is expected to be three to four times this. The use of most drained areas has changed from pasture and hay to cash crops, such as corn and soybeans. This change in land use has resulted in a shift from the many small dairy and hog farms to just a few mostly confined systems. Most of the watershed is a nearly level and gently undulating upland till plain that is characterized by dark, loamy soils that formed glacial deposits. Some soils bordering in the lower reaches of Seven Mile Creek as it empties into the MN River Valley were formed in weathered bedrock and alluvium. The original vegetation in the watershed was predominantly tall prairie grasses and wetlands, but small areas of mixed deciduous hardwood forests were scattered in the eastern portion of the watershed. Remnants of this oak, beech and maple forest can be seen in the 320 forested acres of Seven Mile Creek County Park.

As the creek descends into the MN River a much older relief can be seen. Very steep wooded bluffs separate the upland from the floodplain. This Paleozoic sandstone and dolomite was deposited about 570-480 million years ago in a shallow sea environment. Outcrops of these stratified rock outcrops (Jordan Sandstone) can be seen in the park. The Seven Mile Creek channel was formed by the melt waters released during the retreat of the Des Moines lobe ice sheet about 12,000 years ago.

Physiography, Relief, and Drainage

Most of the upper portion of the watershed lies in the Olivia Till Plain section of the MN Lowlands province. It is covered by a thick mantle of glacial drift varying in thickness of 50-200 feet. The nearly level terrain, which has many small depressions, marshes, swales, and low drainage, is characteristic of the immature drainage network of a young till plain.

Geomorphilogical composition of the SMC Watershed is predominantly till plains. Most of the soils in the watershed were developed in glacial till, under tall grass prairie conditions and are of the Mollisol soil order.

Near the mouth of the creek alluvial deposits and coarser textured materials dominate. Water erosion potentials are moderate on 46% of the land within this geomorphic setting.

The three dominant soil series within the watershed are the Canisteo Glencoe complex, Cordova clay loam and Canisteo clay loams. Together these soils comprise nearly 40% of

the watershed area. Map 10 shows the spatial occurrence of the various soil series in the watershed and is based on the 1994 soil survey. The three dominate soil series are color coded to stand out from the rest of the minor soil series.

Canisteo Glencoe Complex and Canisteo Clay Loam Series

These soils are characterized as very deep, very poorly drained, formed out of Glacial till, slightly alkaline and have slopes in the 0-2% range.

Cordova Clay Loam

These soils are characterized as very deep, poorly drained with moderately slow in the upper part and moderate in the lower part permeability, formed from ground moraines in glacial till and have slopes in the 0-2% range.

Most of the watershed contains excellent soils for crop production with some limitations as can be seen in following maps (maps 10-15). Over 85% of the watershed is classified as prime farmland and many areas, which have been considered un-prime, have been extensively tiled to convert to prime. Other limitations for crop production, besides poor drainage, include steeper slopes near the lower portion of the watershed. The Revised Universal Soil Loss Equation was used to identify highly erodible areas. Areas with soil loss above five tons per acre/year should have special conservation practices associated with them.

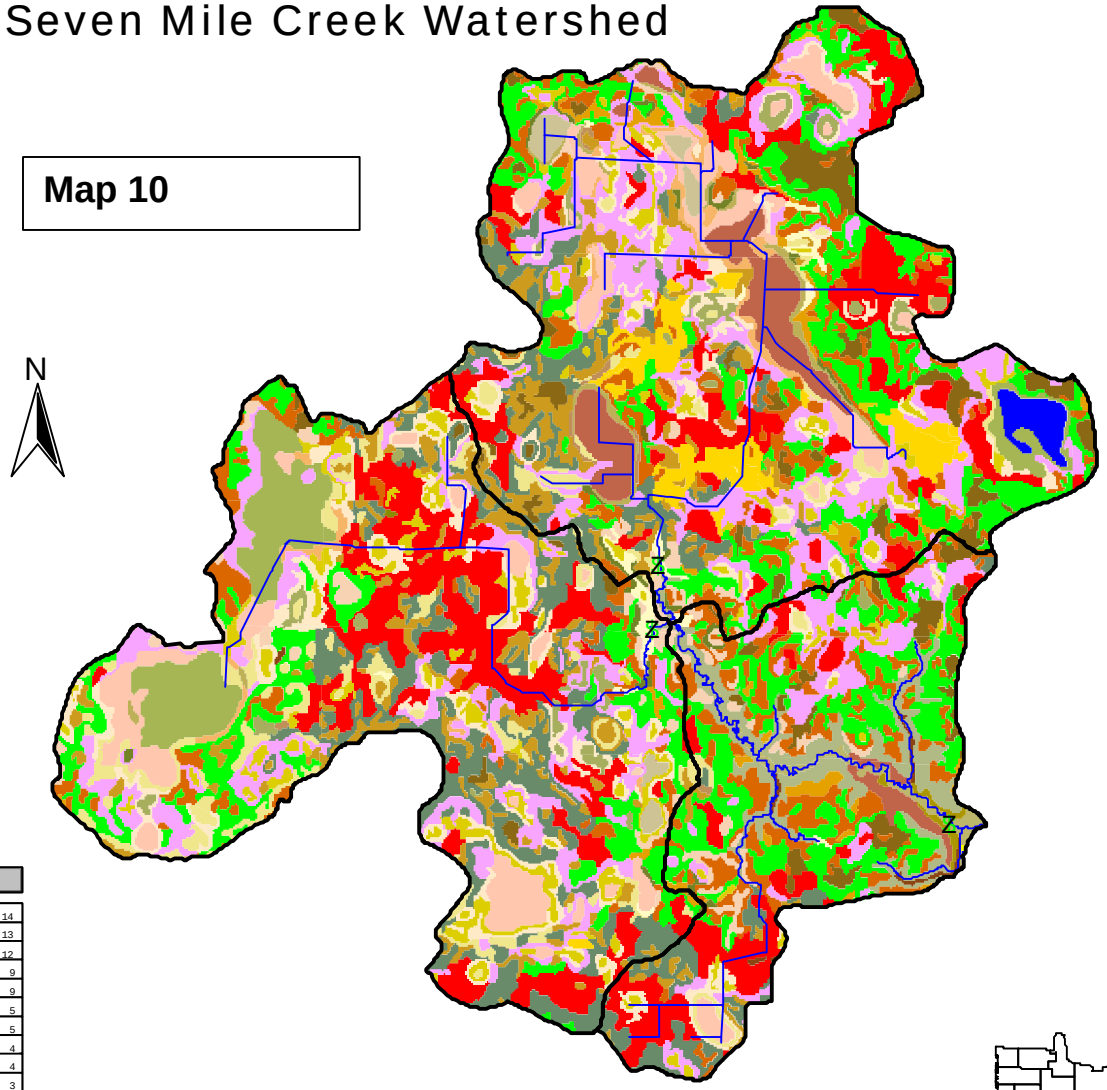
Severe limitations for septic systems exist for most of the watershed and most need a more expensive mound treatment system.

The organic matter map (map 14) indicates areas of drained wetlands or historic locations of lake beds within the watershed (red areas).

Soil Survey

Seven Mile Creek Watershed

Map 10



Top Three Soils

- CANISTEO-GLENCOE COMPLEX
- CORDOVA CLAY LOAM
- CANISTEO CLAY LOAM

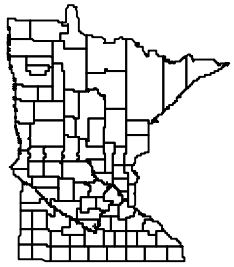
Soil Descriptions

- BLUE EARTH MUCKY SILT LOAM
- BROWNTON SILTY CLAY
- CANISTEO SILTY CLAY LOAM; DEPRESSIONAL
- CHASKA LOAM
- CLARION LOAM; 2-6 % SLOPES
- CLARION-STORDEN COMPLEX; 2-6 % SLOPES
- CLARION-STORDEN COMPLEX; 6-12 % SLOPES; ERODED
- CLARION-STORDEN-HAWICK COMPLEX; 2-6 % SLOPES
- COPASTON-ROCK OUTCROP COMPLEX; 2-60 % SLOPES
- CORDOVA-ROLFE COMPLEX
- CRIPPIN LOAM
- DELFT CLAY LOAM
- ESSEXVILLE SANDY LOAM
- GLENCOE SILTY CLAY LOAM
- HARPS CLAY LOAM
- KLOSSNER MUCK
- KLOSSNER-MUSKEGO SOILS; PONDED
- LE SUEUR CLAY LOAM
- LE SUEUR-LESTER COMPLEX; 1-6 % SLOPES
- LESTER LOAM; 2-6 % SLOPES
- LESTER LOAM; 6-12 % SLOPES; ERODED
- LESTER-STORDEN COMPLEX; 18-70 % SLOPES
- LESTER-STORDEN-ESTHERVILLE COMPLEX; 18-70 % SLOPES
- MARNA SILTY CLAY LOAM
- MINNEISKA SANDY LOAM; 0-2 % SLOPES
- MINNEISKA-KALMARVILLE COMPLEX; FREQUENTLY FLOODED
- MUSKEGO MUCK
- NICOLLET CLAY LOAM
- OKOBOJI MUCKY SILTY CLAY LOAM
- OKOBOJI SILTY CLAY LOAM
- OSHAWA SILTY CLAY LOAM
- TERRIL LOAM; 1-6 % SLOPES
- WATER
- WEBSTER CLAY LOAM

- Sub-shed
- Water Quality Montitoring Sites
- Stream and Tributaries

Top 20 Soils

Soil Description	Acres	% area
CANISTEO-GLENCOE COMPLEX	3184.5270	14
CORDOVA CLAY LOAM	3164.3180	13
CANISTEO CLAY LOAM	2771.7860	12
LE SUEUR CLAY LOAM	2031.4630	9
WEBSTER CLAY LOAM	2035.4360	9
HARPS CLAY LOAM	1083.6710	5
NICOLLET CLAY LOAM	1285.8370	5
KLOSSNER MUCK	1023.2000	4
GLENCOE SILTY CLAY LOAM	918.2150	4
KLOSSNER-MUSKEGO SOILS; PONDED	785.4900	3
CORDOVA-ROLFE COMPLEX	768.4200	3
LESTER LOAM; 2-6 % SLOPES	408.8870	2
LESTER-STORDEN COMPLEX; 18-70 % SLOPES	564.1420	2
CLARION LOAM; 2-6 % SLOPES	493.7370	2
MARNA SILTY CLAY LOAM	390.5060	2
BLUE EARTH MUCKY SILT LOAM	505.3020	2
ESSEXVILLE SANDY LOAM	120.5110	1
DELFT CLAY LOAM	138.1230	1
OKOBOJI SILTY CLAY LOAM	246.6000	1
WATER	122.3490	1

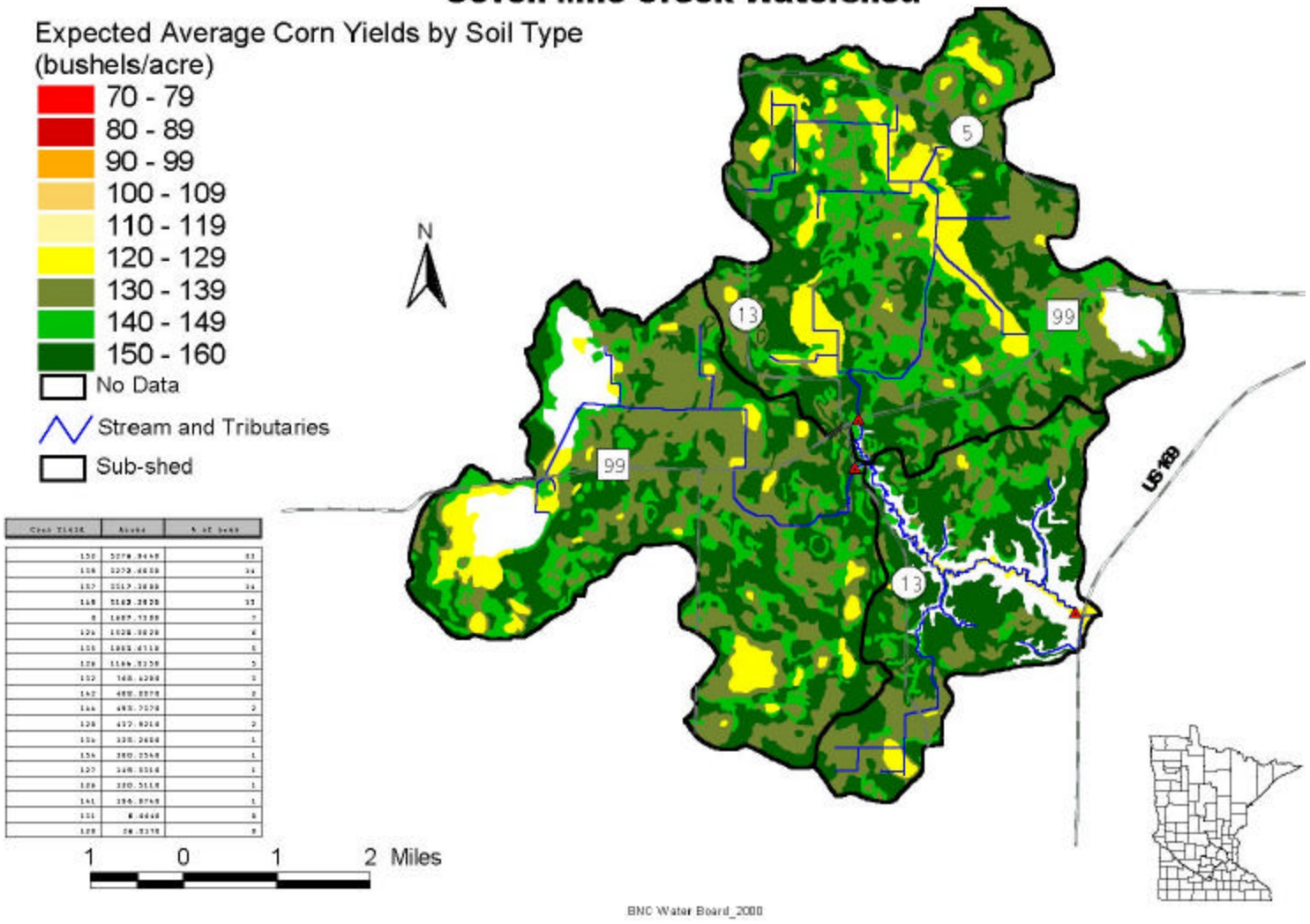


BNC Water Board

Expected Average Corn Yield By Soil Type

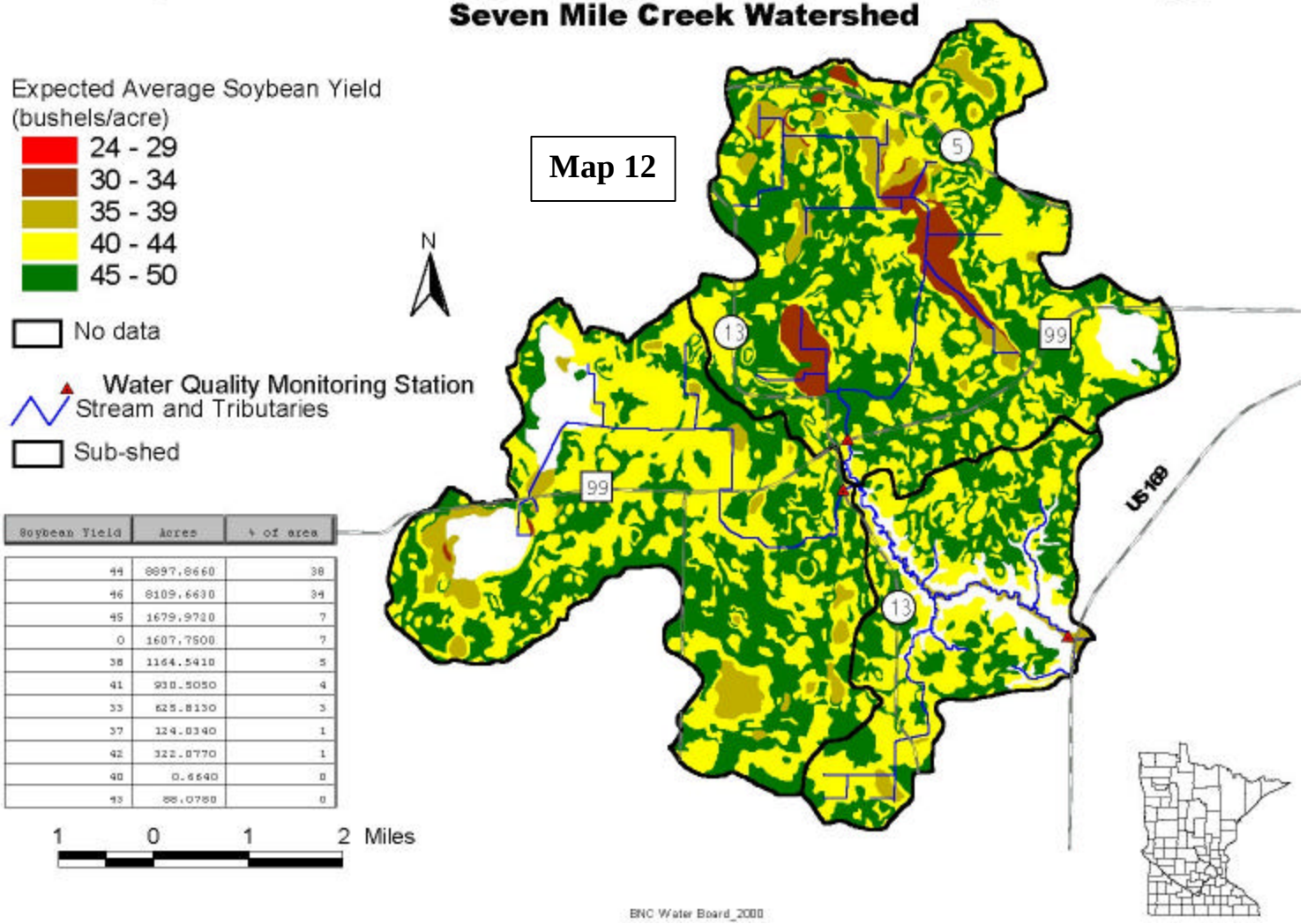
Seven Mile Creek Watershed

Map 11



Expected Average Soybean Yields By Soil Type

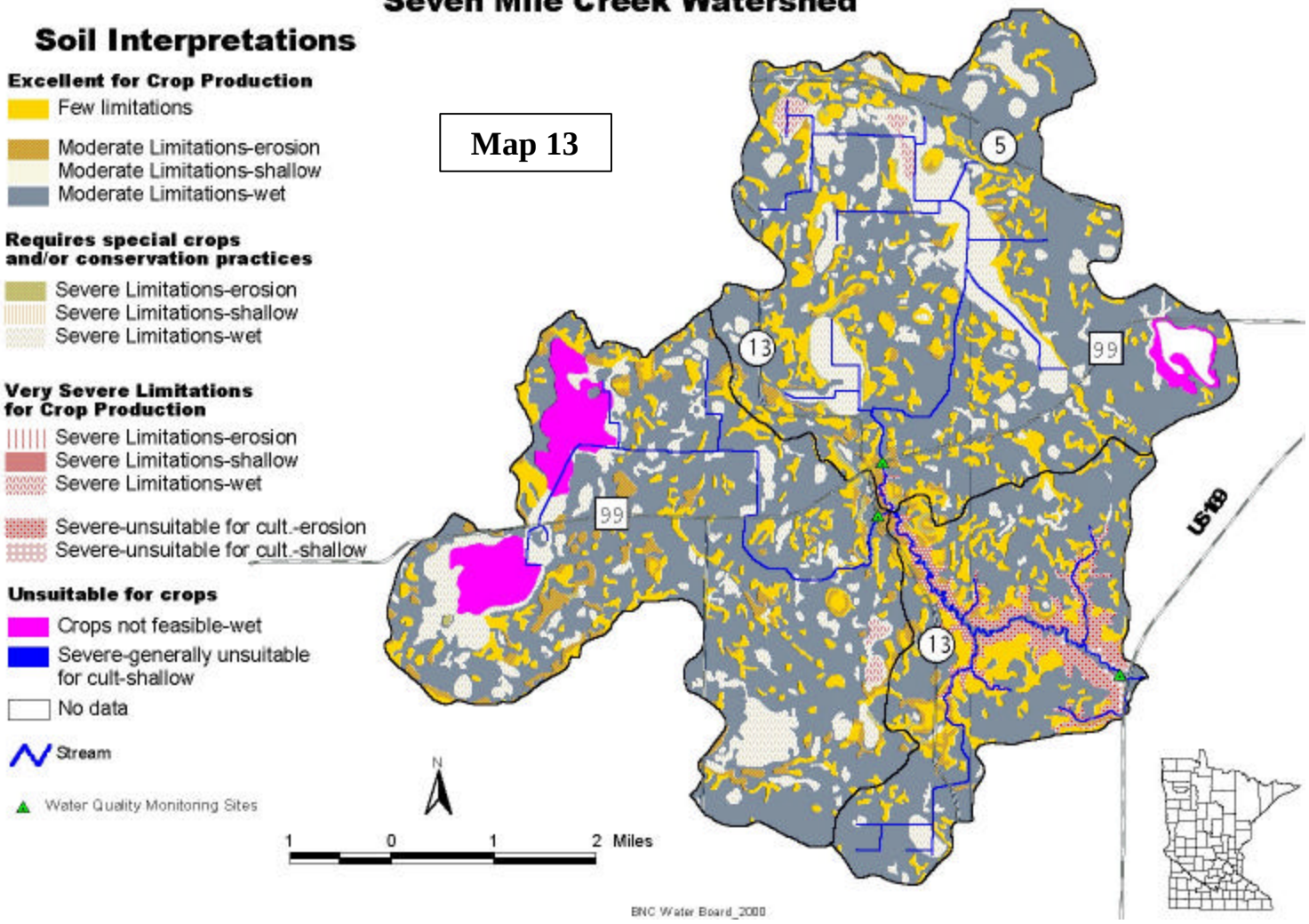
Seven Mile Creek Watershed

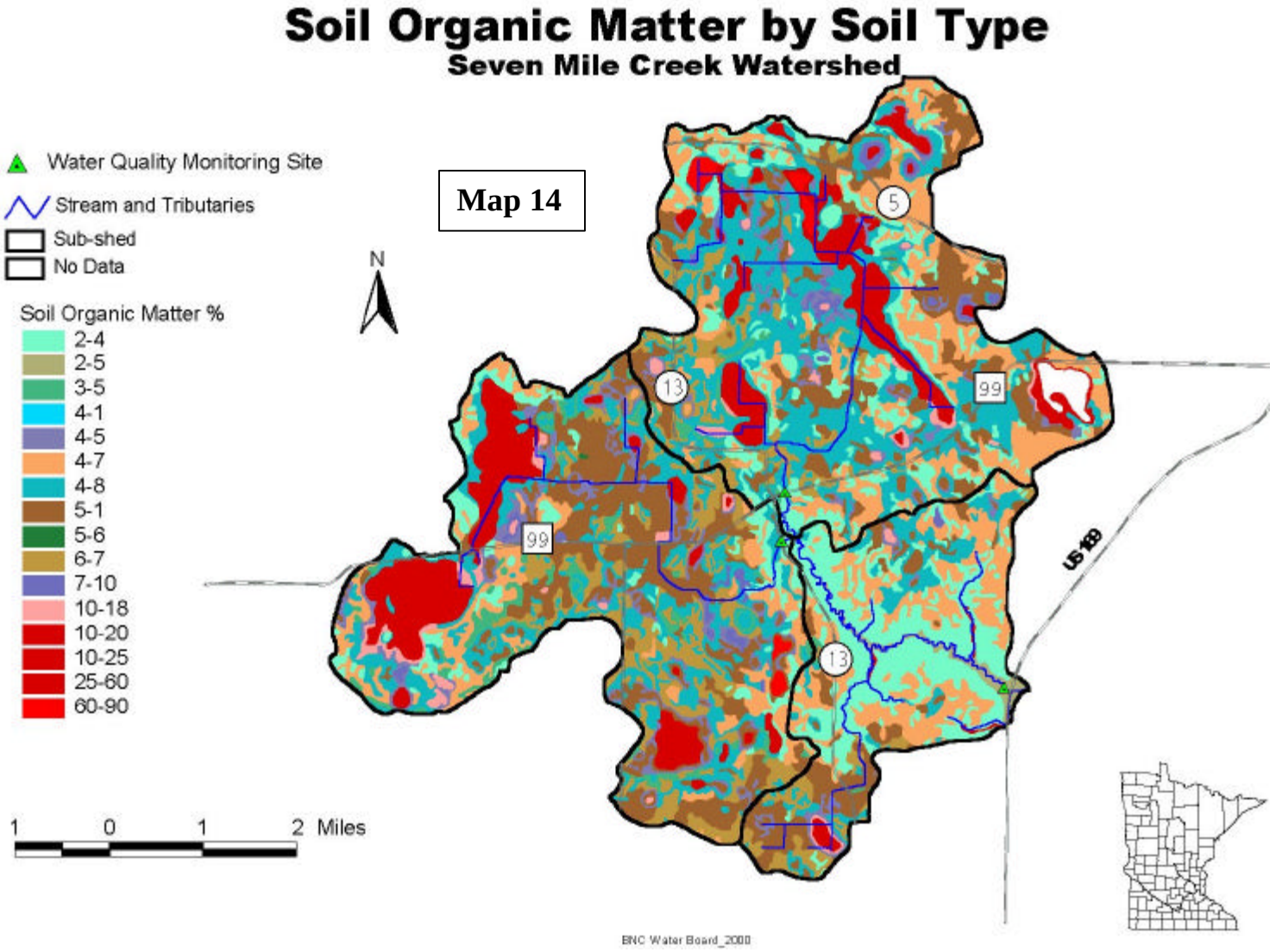


Soybean Yield	Acres	% of area
44	8897.8660	38
46	8109.6630	34
45	1679.9720	7
0	1607.7500	7
38	1164.5410	5
41	930.5050	4
33	625.8130	3
37	124.0340	1
42	322.0770	1
40	0.6640	0
43	88.0780	0

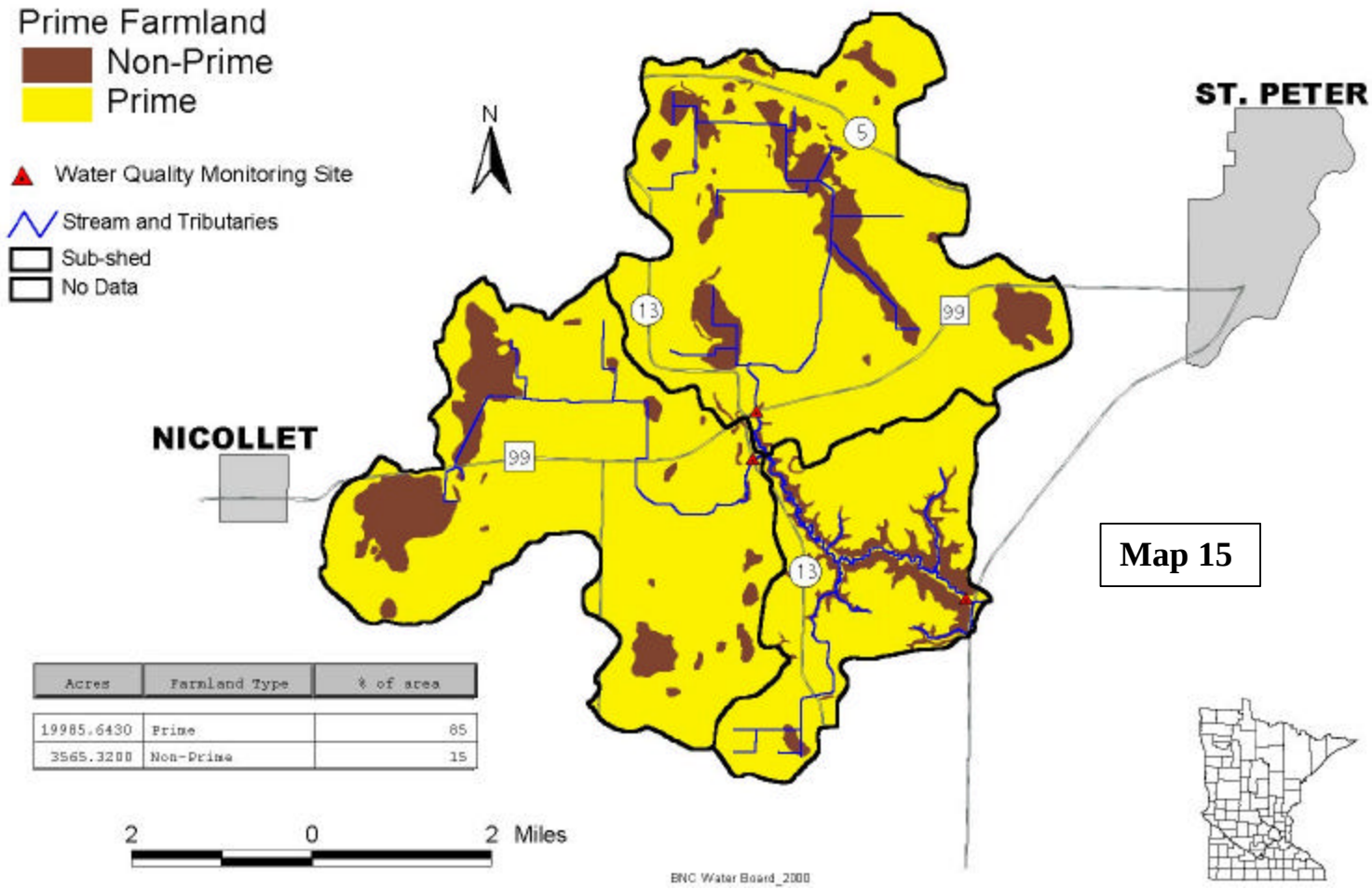
Land Capability Based on Soils

Seven Mile Creek Watershed




Soil Organic Matter by Soil Type
Seven Mile Creek Watershed
Map 14
Water Quality Monitoring Site
Stream and Tributaries
Sub-shed
No Data
Soil Organic Matter %
2-4
2-5
3-5
4-1
4-5
4-7
4-8
5-1
5-6
6-7
7-10
10-18
10-20
10-25
25-60
60-90
N
1 0 1 2 Miles
5
13
99
99
13
US 169
BNC Water Board_2008

Prime Farmland
Seven Mile Creek Watershed



Acres	Farmland Type	% of area
19985.6430	Prime	85
3565.3200	Non-Prime	15

Map 15

Soil Erosion Potential Model

Soil erosion is frequently associated with sediment and phosphorus transport to surface water bodies. Identifying the extent and location of area with high erosion will help managers pinpoint areas where Best Management Practices should be implemented (i.e. buffer strips, or conservation tillage). To estimate the amount of soil loss specific to the watershed the Revised Universal Soil Loss Equation (RUSLE) was used. RUSLE is a USDA-NRCS derived model used to assess the degree of rill and interrill erosion (in tons per acre per year), identify situations where erosion is serious, and guide development of conservation plans to control erosion. RUSLE is a widely used model to predict soil loss on any field condition where soil erosion by water is possible.

RUSLE is applicable to sheet and rill detachment only. It does not estimate erosion in channels or compute deposition. Map 16 displays the results of the model.

Table 7 describes the numerical results of analysis. The table shows the amount of acres and percent of minorshed by erosion category. Table 8 takes the data a step further by listing the amount of RUSLE erodible acres within 300 feet of a tributary within the watershed.

Table 7

Percent of Sub-shed and acres by RUSLE erosion category

	Soil Erodibility Category (Tons/Acre/Year)				
Subwatershed	0-3	3-5	5-15	15-30	> 30
28062 WS 1	99% (9639 a)	0.95% (91.2 a)	0.05% (4.6 a)	0	0.03% (2.5 a)
28066 WS 2	99.7% (8293 a)	0.33% (27.3 a)	0.01% (1.0 a)	0	0.004% (.32 a)
28063 WS 3	98% (4374 a)	0.7% (31.4 a)	0.8% (35.4 a)	0	0.74% (33.3 a)

Table 8

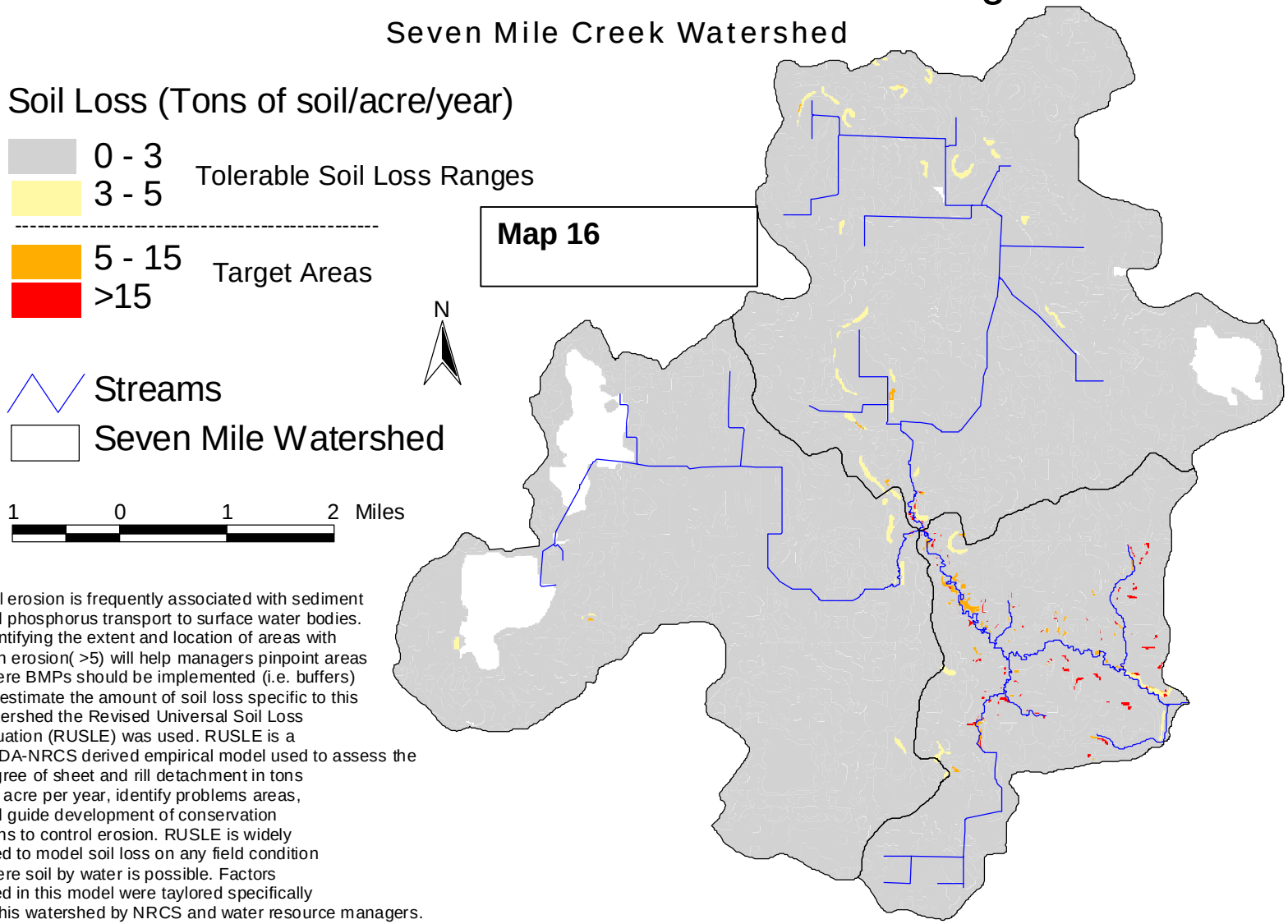
Number of acres within 300 feet of a waterway by Soil Loss Category (T/A/Yr)

subwatershed	3-5	5-15	15-30	> 30
28062 WS 1	10.0	1.8	0	2.5
28066 WS 2	4.1	0.31	0	0.32
28063 WS 3	0	1.5	0	12.0

For 28063, 100 foot buffer around upland and dendritic drainage interface was used in addition to 300 feet buffer around drainage ditch tributary.

Modeled Rainfall Erosion Loss using RUSLE

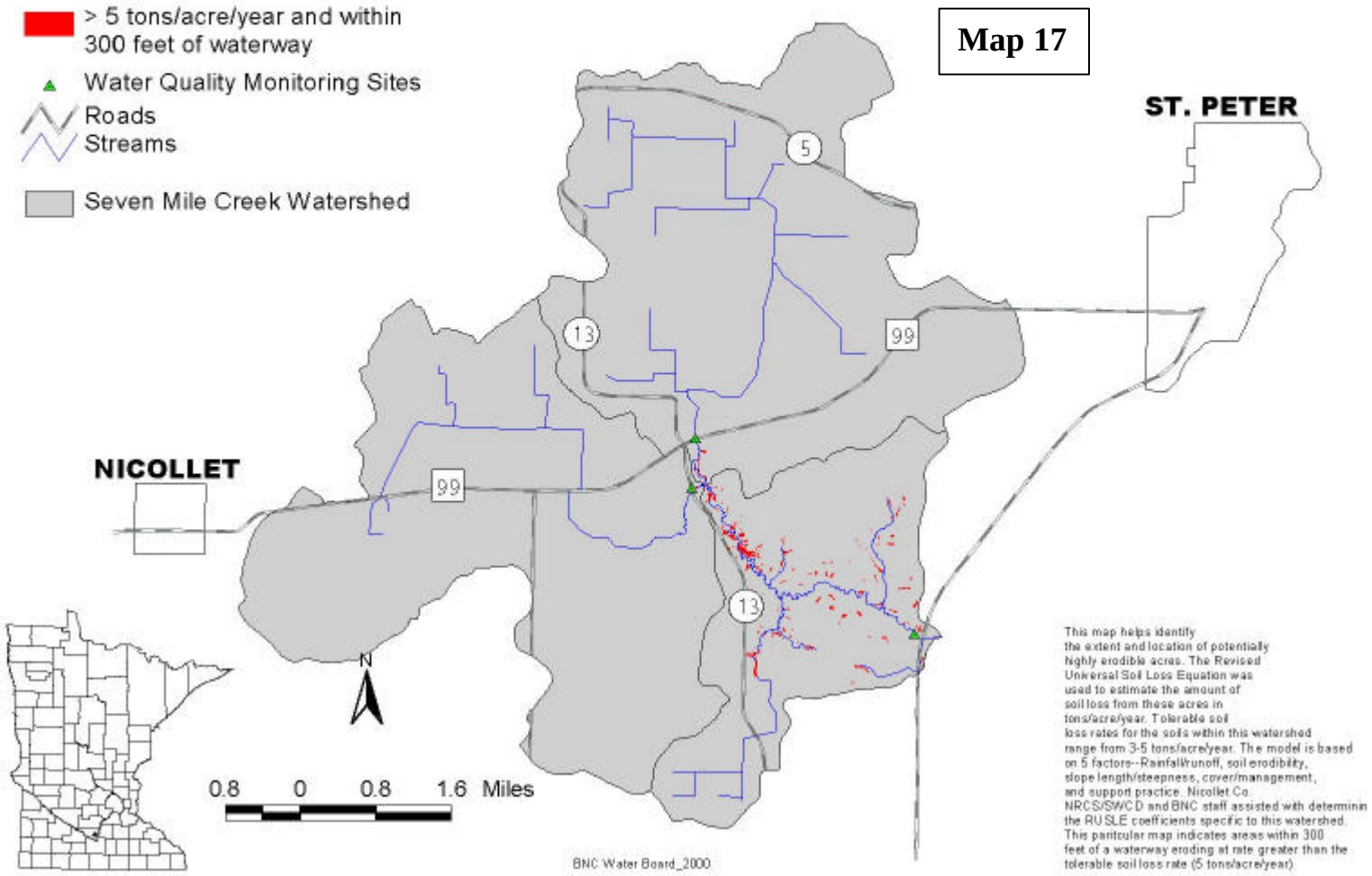
Seven Mile Creek Watershed



Soil erosion is frequently associated with sediment and phosphorus transport to surface water bodies. Identifying the extent and location of areas with high erosion(>5) will help managers pinpoint areas where BMPs should be implemented (i.e. buffers) To estimate the amount of soil loss specific to this watershed the Revised Universal Soil Loss Equation (RUSLE) was used. RUSLE is a USDA-NRCS derived empirical model used to assess the degree of sheet and rill detachment in tons per acre per year, identify problems areas, and guide development of conservation plans to control erosion. RUSLE is widely used to model soil loss on any field condition where soil by water is possible. Factors used in this model were taylored specifically to this watershed by NRCS and water resource managers.

Seven Mile Creek Watershed

Modeled Soil Erosion Potential using RUSLE



Soils and Slope Classes

Areas of land with higher % of class A, B, C, D, E and F slopes have high potential for soil erosion (table 9). Table 10 below lists those sub watersheds, which have a higher percentage of the six slope classes. Although the majority of the soils with slopes in D and F classes have permanent vegetation they are still listed for management purposes.

Table 9

Slope Classes

Slope Classes	% Slope
A	0-2
B	2-6
C	6-12
D	12-20
E	20-40
F	>40

Table 10

Subwatersheds and Slope Classes

Subwatershed	A slope % of Area	B slope % of Area	C slope % of Area	D slope % of Area	E slope % of Area	F slope % of Area
28063	na	na	na	na	na	na
28066	na	na	na	na	na	na
28063	na	na	na	na	na	na

Wetlands

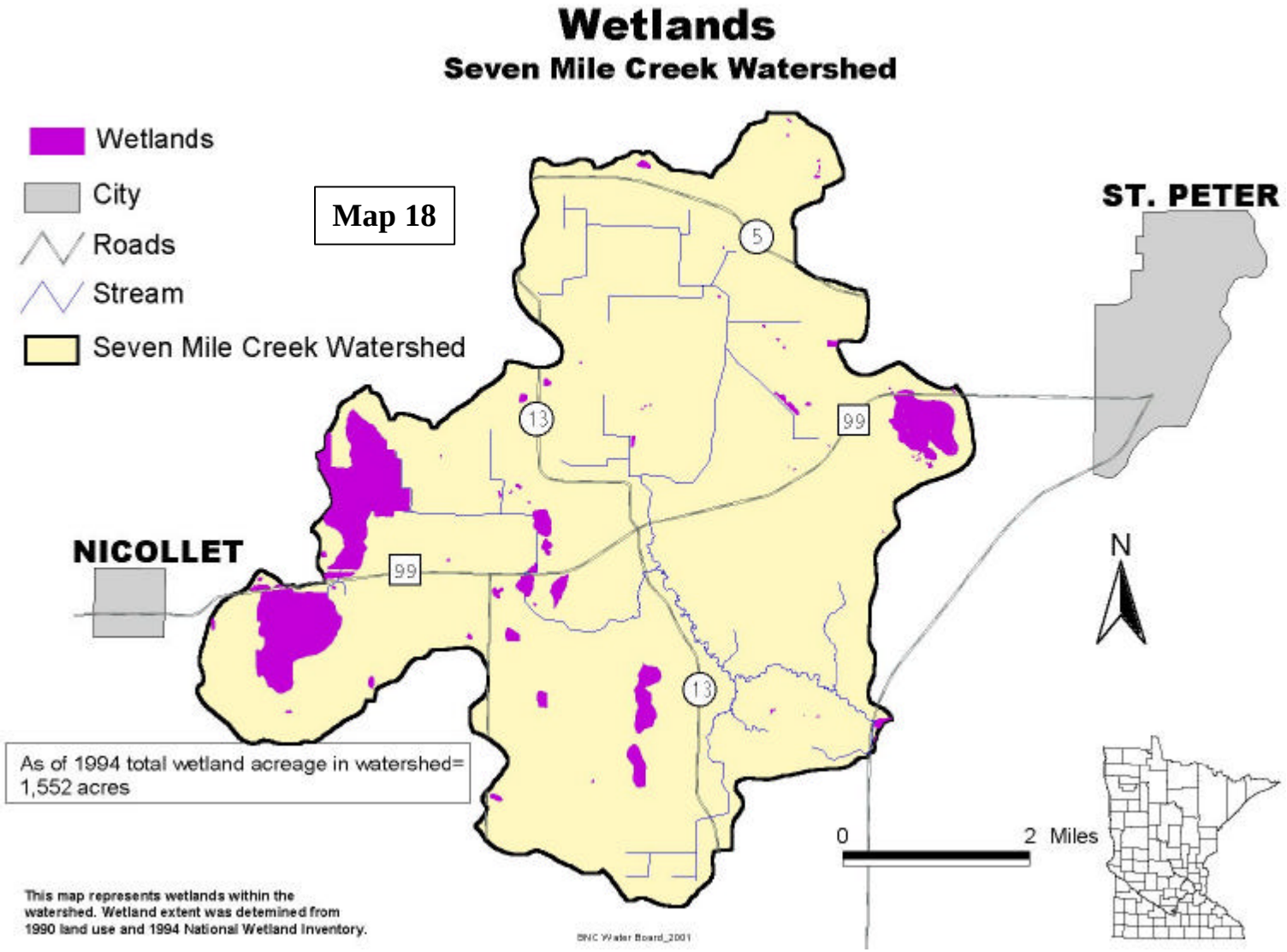
The National Wetlands Inventory (NWI) of the U.S. Fish and Wildlife Service produces information on the characteristics, extent, and status of the Nation's wetlands and deepwater habitats. Map 18 shows current wetland status as of the 1995 NWI survey and map 19 shows the potentially restorable wetlands within the Seven Mile Creek Watershed.

According to the National Wetland Inventory approximately 1552 acres of the watershed land area is classified as a wetland habitat ecosystem

Table 11

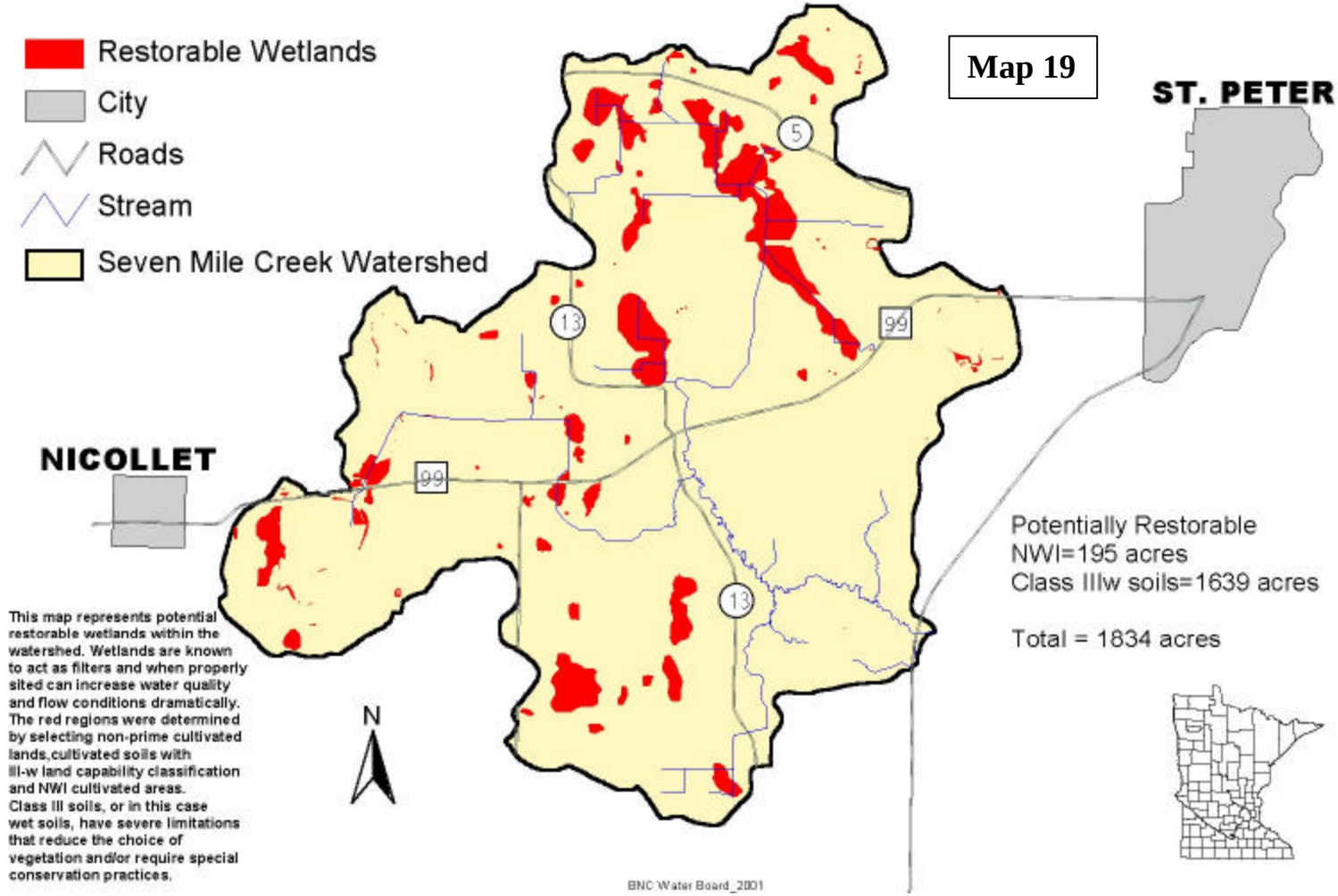
Wetland Characteristics

Subwatershed	Acres of wetlands(NWI)
28062	283
28066	1259
28063	10


Wetlands
Seven Mile Creek Watershed
Wetlands
City
Roads
Stream
Seven Mile Creek Watershed
Map 18
ST. PETER
NICOLLET
5
13
99
99
13
N
As of 1994 total wetland acreage in watershed= 1,552 acres
0
2 Miles
This map represents wetlands within the watershed. Wetland extent was detemined from 1990 land use and 1994 National Wetland Inventory.
BNC Water Board_2001

Potentially Restorable Wetlands

Seven Mile Creek Watershed



Drainage

More than 24 miles of open ditches and approximately 15 miles of public drain tile with many more miles of private tile lines are located within the watershed. Private tile lines are not shown on the included map. This network of drainage, has converted much of the watershed into some of the most productive soils in the state, and country. However, the concerns over large-scale drainage projects within the watershed in terms of quantity and quality have steadily increased along with the amount of drainage the past 10 years.

Permitted Feedlots

The figures shown below are the result of on farm visits and the review of permitted feedlot applications by Nicollet county staff. The figures are current as of 2000. It is likely the size and number of the feedlots have changed somewhat since the 2000 survey. **The animal units associated with each feedlot represents the maximum capacity the feedlot is permitted for and does not necessarily indicate the actual amount of animal units during the time of the survey.** Map 20 shows the locations and relative size of the feedlot operations within the watershed. Table 13 takes the feedlot data a step further. Table 13 provides estimates of livestock manure contributions to the 2000 total phosphorus load from the watershed. This analysis of the feedlot data helped to establish realistic phosphorus goals for the watershed. For example, table 13 helps to estimate how much of the phosphorus load came from direct runoff of feedlot sources. Being conservative, and assuming only 1% of the manure reached Seven Mile Creek in 2000, approximately 7.4% of the total phosphorus load (4633 lbs.) was derived from feedlot sources. In addition, if only 5% of the livestock associated phosphorus reaches the river, this could account for almost 40% of the phosphorus load. Other scenarios with higher delivery percentages are given in the table.

Watershed 28062 has eight feedlots with an average density of 1,245 acres per feedlot. Watershed 28066 has six feedlots with an average of 1,520 acres per feedlot. These are primarily hog feedlots in the size class range of 100-999 animal units. Watershed 28063 has six feedlots with an average of average of 746 acres per feedlot. Animal units per acre of agricultural land for watershed 28062, 28066, and 28063 are 0.23, 0.43, and 0.45 respectively. If Northern Plains Dairy constructs the Jersey Dairy as planned, feedlot numbers would increase from 1,464 to 4,464 animal units within minorshed 28063.

Table 12. Feedlot statistics of Seven Mile Creek Watershed by sub-shed.

	FEEDLOTS		*ANIMAL UNITS*				
MINOR WS #	**# OF FEEDLOTS**	**% OF FEEDLOTS IN MINOR WS**	**SUM**	**MAX**	**MIN**	**MEAN**	**% OF AU IN MINOR WS**
28066	6	30	3306	1210	38	551	48
28062	8	40	2091	800	48	261	30
28063	6	30	1464	848	48	244	21
TOTAL	20	100	6861				100

Table 13. Analysis of Potential Phosphorus Contribution From Livestock in Seven Mile Creek Watershed

Part I. Low, Medium, and High estimates of total phosphorus produced by livestock (lbs./ animal unit)

	Low	Medium	High	Adapted from:
lbs./year/a.u.	5	11	26	Livestock Waste Facilities Handbook-3rd ed.
Cattle and Swine				Midwest Plan Service, Iowa State Univ., 1993
				Converted to total phosphorus (TP)
				using TP = 0.44 x P_2O_5

Part II. Estimated livestock numbers and low, medium, and high estimates of mass of phosphorus produced by livestock in Seven Mile Creek watershed (lbs./year)

minor watershed	a.u.'s	Low	Medium	High
28066	3306	16530	36366	85956
28062	2091	10455	23001	54366
28063	1464	7320	16104	38064
Totals	**6861**	**34305**	**75471**	**178386**

Part III. Estimated number of acres required for land application of all manure produced in watershed based on application rate of 80 lbs./acre P_2O_5

Acres of crop land in	Low	Medium	High
Seven Mile Creek Watershed: 20,181	975	2144	5068

Part IV. Comparison of annual load of total phosphorus to estimate of phosphorus produced by livestock

	Low	Medium	High
Livestock estimate (pounds per year)	34305	75471	178386
2000 measured load (pounds)	4632.5	4632.5	4632.5

Part V. Percent of 1999 load that could be from livestock manure based on different assummed delivery percentages

		% of annual load from livestock*		
Explanation of delivery percentages:	1%	7.4%	16.3%	38.5%
A 5% delivery, for example, means	5%	37%	81%	193%
that 5% of the total phosphorus	10%	74%	163%	385%
associated with manure makes its way	20%	148%	326%	770%
from feedlots or fields to the	50%	370%	815%	1925%
Seven Mile Creek	100%	741%	1629%	3851%

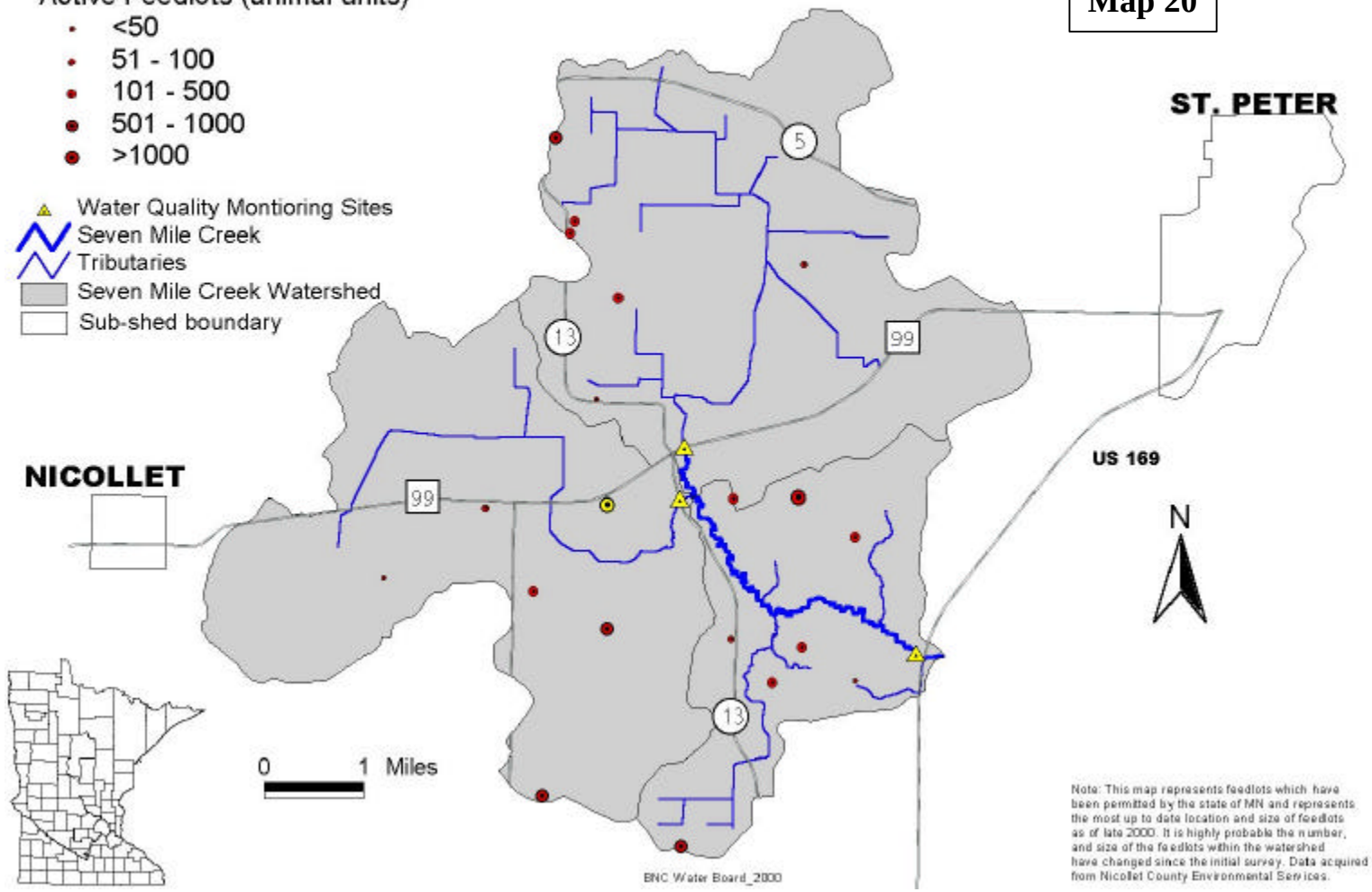
* A percentage greater than 100 indicates more phosphorus than was measured in 2000.

The type of analysis done in Part III. could be applied to individual minor watersheds In either case, it is important to recognize that manure could be land applied in different minor watersheds from where it is produced, or outside of the Seven Mile Creek watershed altogether.

Feedlots

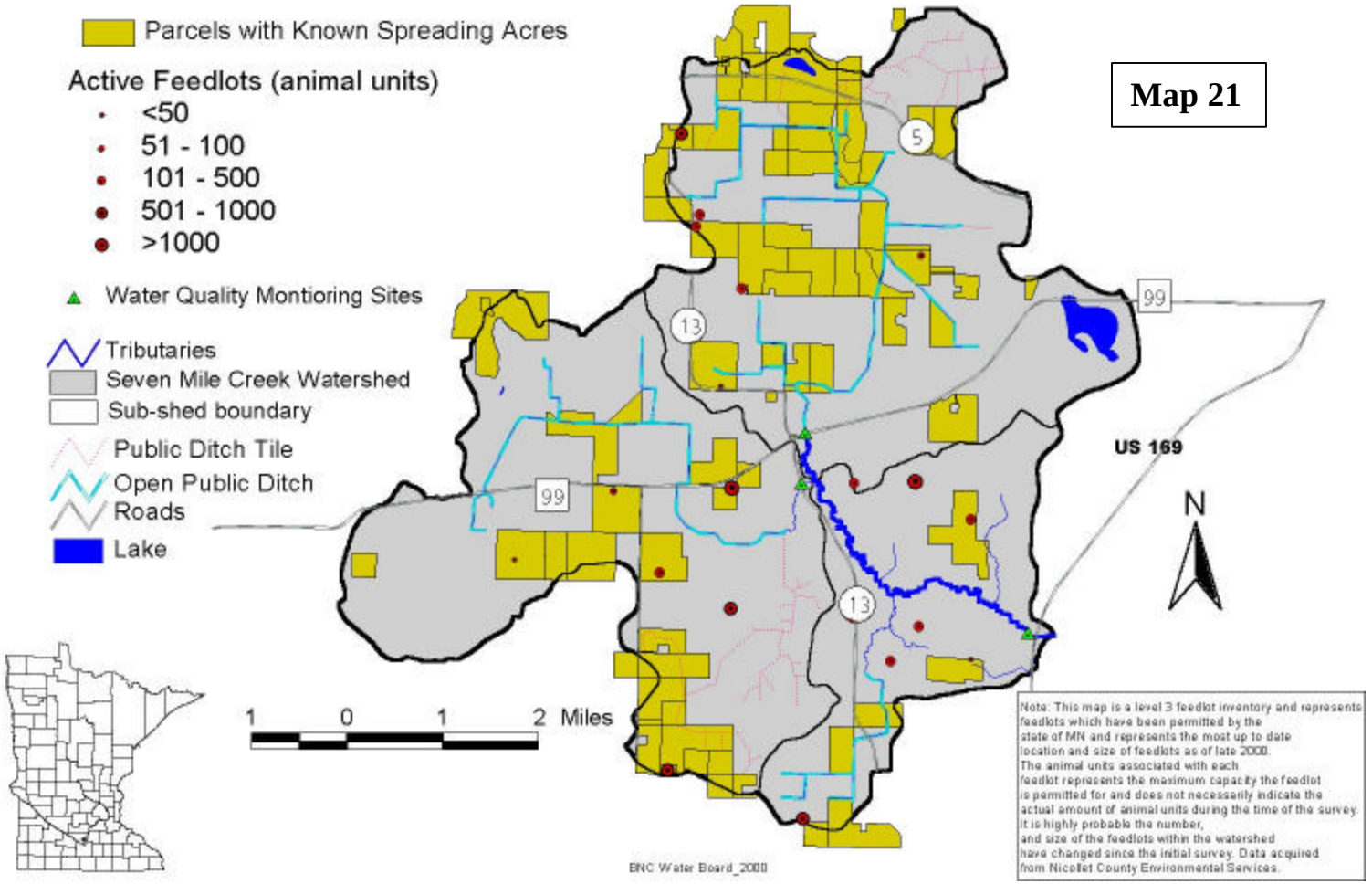
Seven Mile Creek Watershed

Map 20



Parcels with Known Spreading Acres

Seven Mile Creek Watershed



Northern Plains Dairy

Adopted from MPCA Water Quality/Feedlot July Newsletter

Northern Plains Dairy is proposing to construct a dairy in Oshawa Township, Nicollet County, approximately 4.5 miles southwest of St. Peter in Seven Mile Creek Watershed (watershed 28063, Sec. 34 of Oshawa Twp.). This site plan follows two previous proposals at different locations and incorporates several new environmentally protective features that were not in the two previous plans. The "third site" is currently being evaluated by the MPCA through the permit and environmental review process as this report is being written. If the dairy passes state and county review, construction for one of the states largest dairies could start in the fall of 2001 or spring of 2002. Most of the spreading acres will be in minorshed 28062. The dairy will increase manure acres by an estimated 2500 acres within the watershed, or a 50% increase.

General Site Information

The proposed project is for a 3,000 Jersey cow dairy feedlot (3,000 animal units). The dairy will be located on a portion of the 102-acre site owned by one of the three investors. The feedlot includes three total-confinement barns using freestall housing, a holding area, milking parlor, and administrative offices. Two anaerobic digesters and solid separators would be used to treat the manure prior to storage of treated effluent in an earthen basin that has a maximum design capacity of 39 million gallons. The basin, consistent with applicable federal and state rules, is capable of storing 15 to 18 months of treated manure, barn floor wash water, and precipitation from a 5" rainstorm. As a result of its larger capacity, the present design allows for greater flexibility of manure application during wet periods compared to a conventional design. A majority of the basin's construction will be at or below ground level with one corner of the dike proposed to be approximately 2 –3 feet above ground.

Location of the dairy in respect to the watershed and wellhead protection area can be found on map 22.

Manure Management/Anaerobic Digestion

Anaerobic digestion is a biological treatment process used to treat feedlot waste. This process generates methane, a bio-gas, that can be collected and used as fuel in gas-powered electrical generators. The anaerobic digester at the dairy would generate approximately 280 kilowatts of electrical energy. Excess electrical energy will be sold to a local power company and supply power for up to 90 homes.

In addition to the electrical power generation benefits, the anaerobic digestion process also: reduces odors; converts nitrogen into a source of nitrogen that is more available to crops; creates nitrogen that is valuable to crops; creates a waste that is valuable as a soil amendment, destroys many of the pathogens found in manure; and separates solids from the anaerobic digester so that manure can be easily composted for reuse as an animal bedding.

Affects of the Dairy on Seven Mile Creek Watershed

Many concerns about the dairy from the Department of Natural Resources and local citizens near the dairy have been raised since its inception. The major concerns have been centered on the environment. Those concerns include odor issues, increase in truck traffic, power line development, and potential impacts of manure and silage on groundwater and surface water resources within the watershed. Conversely, proponents argue that the dairy features technologies that will mitigate the environmental concerns with the use of manure digestion. Nonetheless, Northern Plains Dairy will continue to be controversial and closely scrutitzed. From a water quality perspective, watershed staff also see costs and benefits associated with the construction of a large concentrated dairy operation.

Benefits

- Increase in the amount of alfalfa acres within the watershed. It is proposed that approximately 400 acres will be needed within the watershed for feed sources for the Jersey based dairy. By increasing another crop into the corn/soybean rotation, nitrogen and sediment losses can be minimized.

- Comprehensive Manure Nutrient Plan (CMNP) developed on spreading acres. As per Minnesota feedlot rules, a CMNP is required for larger confined animal feedlot operations. Northern Plains Dairy plans on incorporating fall stalk nitrate test, spring nitrate soil test, manure crediting and other manure Best Management Practices. Approximately 2,500 spreading acres is needed within the watershed. If the CMNP is managed properly, the 2,500 acres would switch from an inorganic commercially applied source of nitrogen to a organic form. In the long-term this should supply the watershed with a more efficient and less wasteful form of nitrogen fertilizer.

- Opportunity to scientifically demonstrate whether or not large confined animal feedlot operations have dramatic impacts on water quality. Seven Mile Creek has several years of extensive water quality data that can be used to help answer that complex question. Through phase II funding, monitoring will continue to be a large component and therefore document any water quality changes as a result of the new dairy operation.

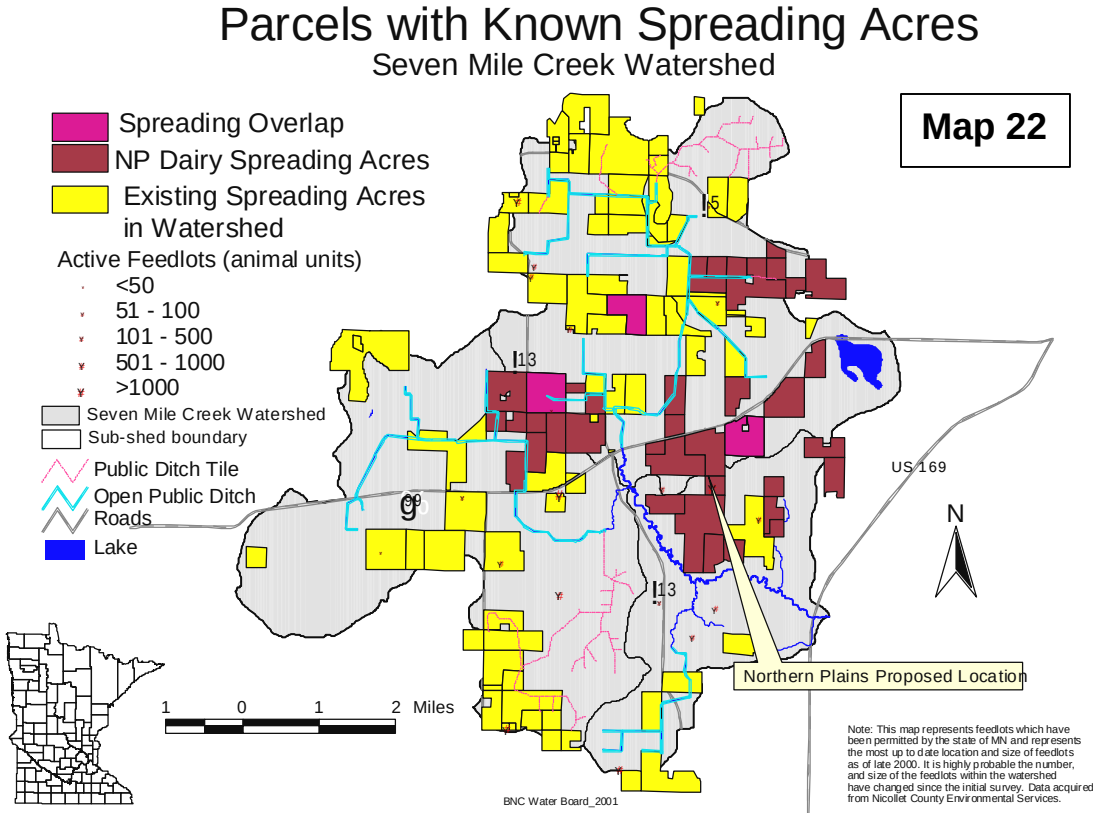
- Opportunity for the watershed project to partner with NP Dairy to address mutual concerns. It is planned NP dairy and Seven Mile Watershed Project will coordinate on various activities such as filter strips along ditches, nutrient management field days, new manure management technologies, and assistance with educational outreach and promotion of Best Management Practices.

Disadvantages

- Higher probability of less conservation tillage. All of the liquid digested manure will need to be applied in the fall via incorporation onto soybean residue. According to the 2001 tillage transect survey, bean ground was very low in conservation tillage. With manure incorporation in the fall via chisel points, bean residue will be reduced.

- 50% increase in manured spreading acres within the watershed. Increase in manured acres increases the potential of phosphorus, low dissolved oxygen, ammonia, and bacteria levels within Seven Mile Creek, which could have detrimental effects on the aquatic life of Seven Mile Creek.

Watershed staff are working closely with Baumgartner Environics of Olivia, MN (NP Dairy environmental engineers) to help address some of the environmental concerns. They have expressed their support for the watershed project and will be a crucial link in the long-term success of the watershed project.



- Present spreading acres vs. proposed NP dairy. Location of Dairy in respect to the watershed. Proposed NP Dairy location- Sec. 34 of Oshawa Twp.

Septic Systems

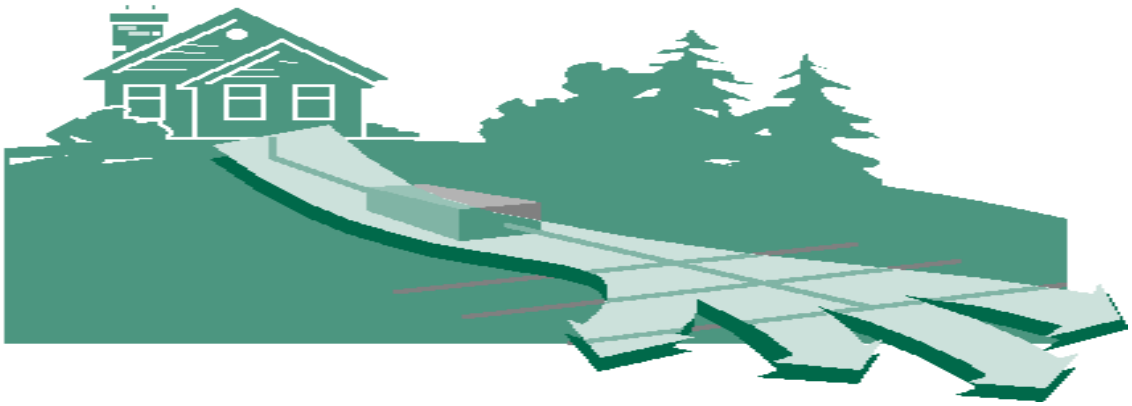
Norm Kuhlman (ESD)

The Nicollet County Environmental Services Department (ESD) has records for 483 (24%) of existing septic systems built prior to 1995. Installation records go back as far as 1980 but inspections of all installations may not have been done until the late 1980s. These records lack much of the information required today to make any determination as to whether these systems are in compliance. Based on compliance inspections done on existing systems over a three period from 1998 –present, most of these septic systems are not in compliance (failing) and would require upgrading within 5 years after the system has been determined as failing as required in the Nicollet County Ordinance.

The status of approximately 1000 (47%) of septic systems from rural households in Nicollet County is unknown. Based on the age of these residences, past experience (compliance inspections at point of sale of property and discovery by ESD staff) most of these systems constitute an imminent threat to public health (ITPH) as defined by the state of Minnesota. An ITPH is defined as a discharge of sewage to the ground surface, discharge of sewage to drain tile or surface waters, sewage backup into dwelling or any situation with potential to immediately and adversely impact or threaten public health or safety.

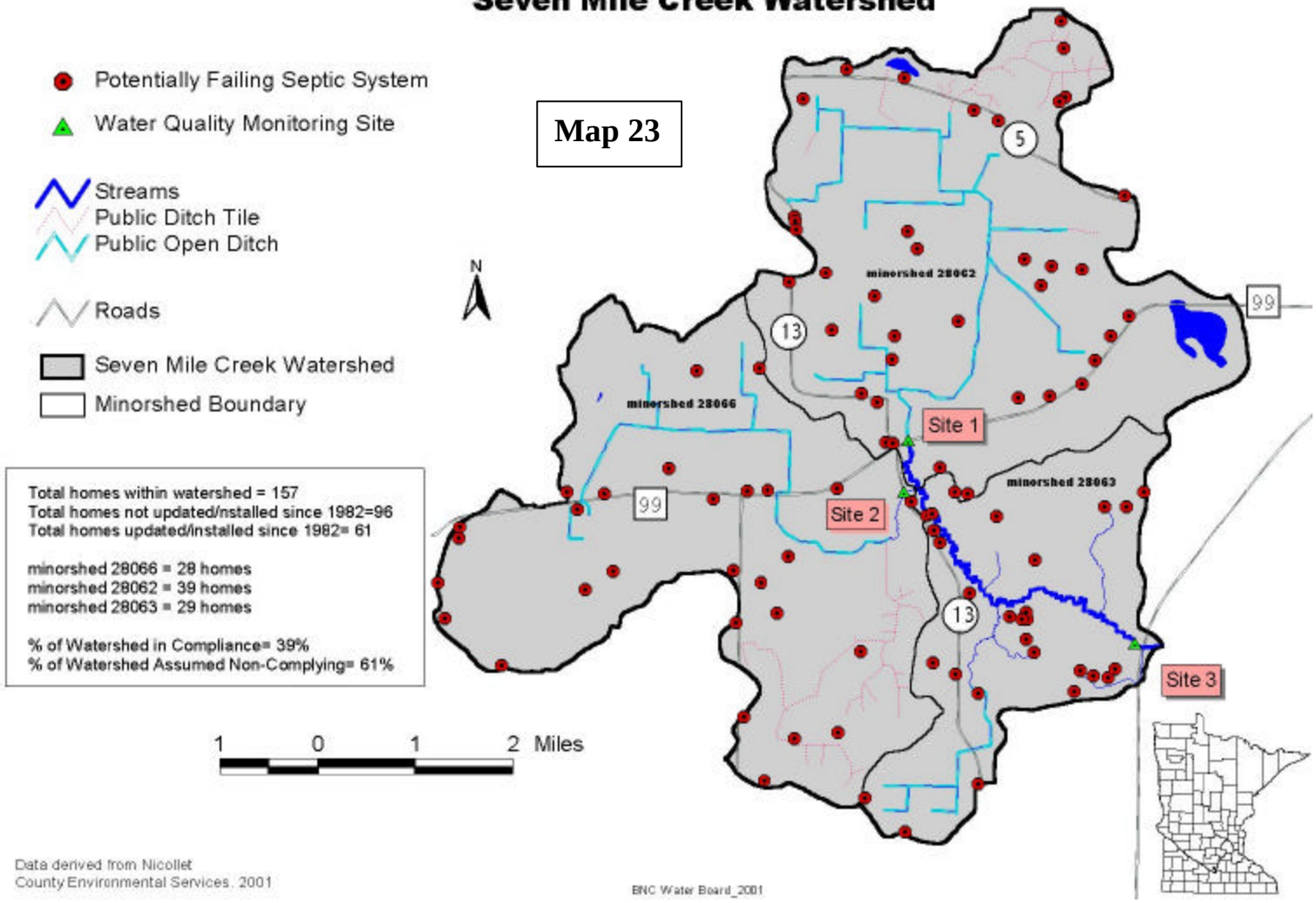
Based on records from Nicollet county ESD and consultation from Norm Kuhlman of ESD (25 years experience with septic systems and soils) it is estimated that within Seven Mile Creek Watershed 39% of the watershed homes have systems, which are in compliance. This leaves 61% of the homes in the watershed assumed to be potentially discharging sewage into tiles, ditches, and eventually Seven Mile Creek. See map 23 for details. At average cost of $7,500 per household, $720,000 would need to be spent to upgrade the 96 imminent threats to public health at today's construction costs. Approximately 100 Individual sewage treatment systems are being constructed annually. At the current rate of installations it would take about two years to bring those systems that constitute imminent threat to public health into compliance. An additional 1-2 years would be needed to bring failing non-ITPH systems into compliance.

It is estimated that approximately 60% of households within the watershed are non-complying. That amounts to nearly $720,000 needed in low-interest loan money for septic system improvements.



Potentially Failing Septic Systems

Seven Mile Creek Watershed



Lakes

Oakleaf Lake

Oakleaf is a high quality, type IV wetland and designated as a waterfowl feeding and nesting area.

Game Management Lakes are defined as, “lakes shallower than six feet, which ordinarily contain water throughout the year. They are ordinarily deeper marshes.” Game Ecological Classifications are used to describe lakes that are, “of very high fertility, usually with an abundance of aquatic vegetation present. Winterkills may occur annually. This type of lake is characterized by substantial populations of muskrats and/or waterfowl.”

Population

Based on SIDWELL dwelling locations it is estimated there are a total of 157 homes within the watershed. With an average household containing 3.3 people the watershed population is estimated at just over 500 people. See map 24 for household locations within the watershed.

Rare Natural Features of Seven Mile Creek County Park

The 625-acre park at the mouth of the watershed has three bird species and two plant species that are of special concern according to the MN Department of Natural Resources. In addition the Yellow Sandshell mussel, a state endangered species, has been found where Seven Mile joins the MN River.

Rare Natural Features

Birds

- Cerulean Warbler
- Louisiana Waterthrush
- Acadian Flycatcher

Plants

- American Ginsing
- Snow Trillium

Mussel

- Yellow Sandshell Mussel

Residential Locations

Seven Mile Creek Watershed

Map 24