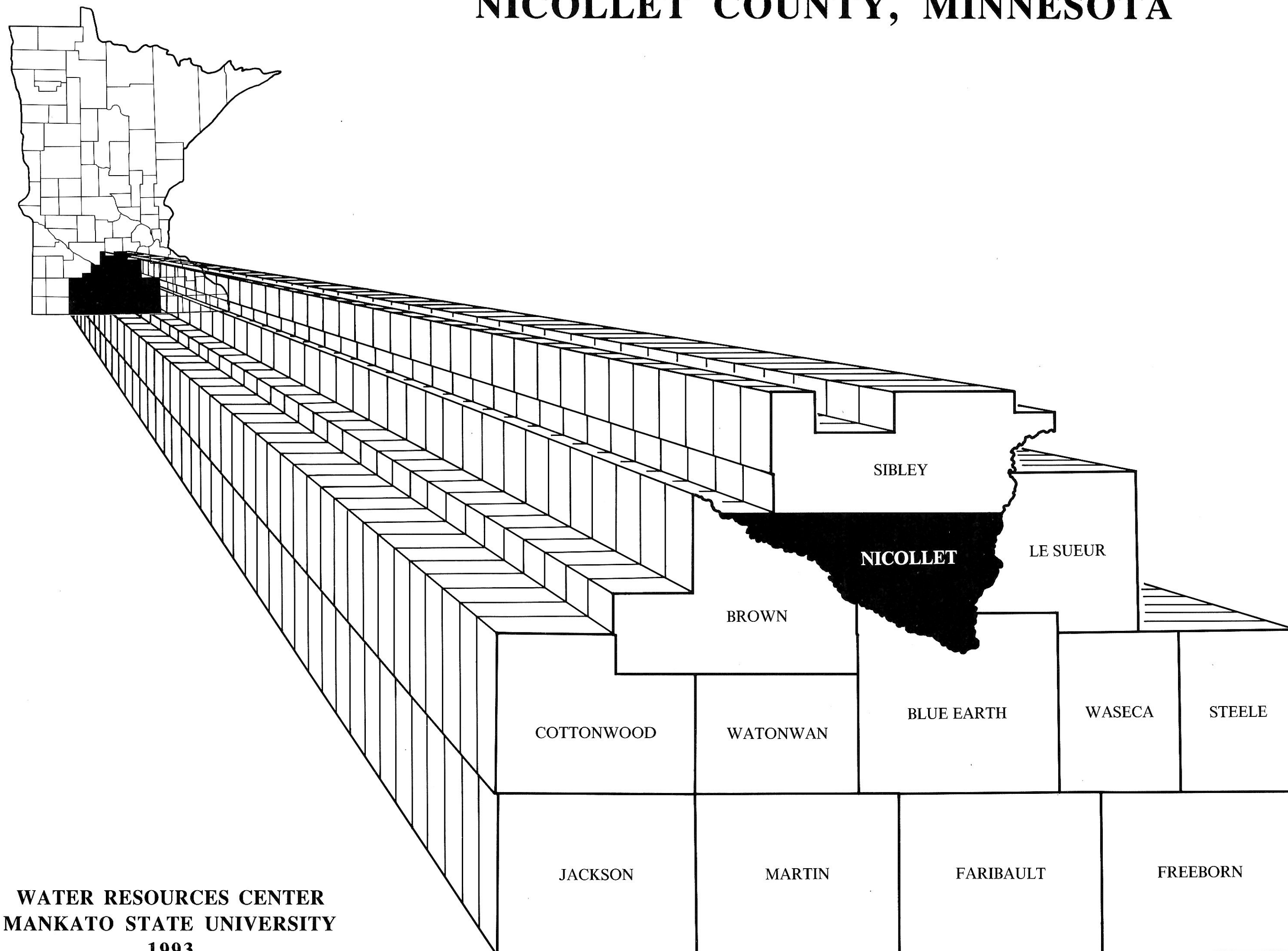


SURFACE WATER HYDROLOGY ATLAS

NICOLLET COUNTY, MINNESOTA



WATER RESOURCES CENTER
MANKATO STATE UNIVERSITY
1993

SURFACE WATER HYDROLOGY ATLAS NICOLLET COUNTY

**WATER RESOURCES CENTER
MANKATO STATE UNIVERSITY**

JULY, 1993

The Nicollet County Surface Water Hydrology Atlas was prepared and published with the support of a grant from the Legislative Commission on Minnesota Resources and the Nicollet County Board of Commissioners. The project involves the production of county surface water hydrology atlases for each of the 13 counties of south central Minnesota and a Geographic Information System (GIS) containing the maps and data presented in this atlas. In addition the GIS contains information on precipitation gauges, demography, and potential point source pollution. A separate lake data base for the 13 counties of South Central Minnesota has also been developed. Principal investigators for the project are John Rongstad, Cis Berg, and Henry Quade.

The following people and agencies have provided valuable assistance to this project by providing information, reviewing or contributing to the content, or by making helpful comments. While their contributions are acknowledged, the responsibility for errors or omissions rests with the principal authors.

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Fieldwork: Brad Bolduan, Chuck Broste, Scott Weinrich, and Tom Kujawa.

Cartography: Tom Kujawa, Dean Pederson, Jeff Hedlund, Scott Weinrich, Guy Lunz,
Tamara Korbelt, Phaylot Phrommany, and Tom Payne.

Photographic Reproduction: Dean Pederson.

Digitizing: Jesse Wohlfeil, Tom Kujawa, and Dean Pederson.

GIS: Jesse Wohlfeil and Jim Engfer.

Data Entry: Jennifer Stencil.

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SURFACE WATER HYDROLOGY ATLAS
NICOLLET COUNTY

INTRODUCTION

This is one of thirteen surface hydrology atlases that were prepared for the South Central Minnesota Comprehensive County Water Planning Project consisting of Blue Earth, Brown, Cottonwood, Faribault, Freeborn, Jackson, LeSueur, Martin, Nicollet, Sibley, Steele, Waseca, and Watonwan Counties. The basic surface water drainage information presented in these atlases was gathered from the thirteen county participants in the form of county ditch maps. The minor watershed boundaries were obtained from the U.S. Geological Survey Water Resources Division and the Minnesota Department of Natural Resources. Information pertaining to lakes and wetlands was obtained from the National Wetland Inventory. The maps and data presented in this atlas are available in GIS format at the Water Resources Center, Mankato State University. The surface hydrology atlases are the second of two reports on the water resources of south central Minnesota. Subsurface geology and groundwater resources were the subjects of a 13 county atlas series completed in 1991.

The primary objective of the 13 county surface water hydrology mapping project was to map county ditch systems, delineate ditchshed and lakeshed boundaries, and update minor watershed boundaries onto a standard map base. The U.S. Geological Survey 7-1/2 minute topographic map series was chosen as the standard map base for the project. The surface water mapping was coordinated with the St. Paul office of the U.S. Geological Survey Water Resources Division and the Minnesota Department of Natural Resources Division of Waters. Both of these agencies have previously mapped minor watershed boundaries for all or part of the state of Minnesota and are actively involved in updating minor watershed maps. Existing minor watershed boundaries, previously mapped by the USGS and MDNR were incorporated to provide consistent and compatible minor watershed mapping.

Nicollet County is located in south central Minnesota, in the third tier of counties north of the Minnesota-Iowa border. The county is triangular in shape and has an area of approximately 460 square miles. The population of Nicollet County, according to the 1990 census (U.S. Bureau of the Census, 1990), was 28,076. The largest center of population is the city of North Mankato, containing 10,164 people or about 36 percent of the total. Approximately 76 percent of the total population is located within urban areas that are served by municipal systems; the remaining population is located in rural areas that are served by private or cooperative systems.

PHYSIOGRAPHY AND DRAINAGE

The characteristics of the present land surface in Nicollet County, including the topography and nature of surficial materials, are the result of the action of glacial ice and flowing water. The surficial materials are chiefly glacial deposits, collectively called drift, from the continental glaciers that covered Nicollet County during the last million years. The continental glaciers were centered over southern Canada and extended into southern Minnesota. These continental glaciers expanded and contracted several times.

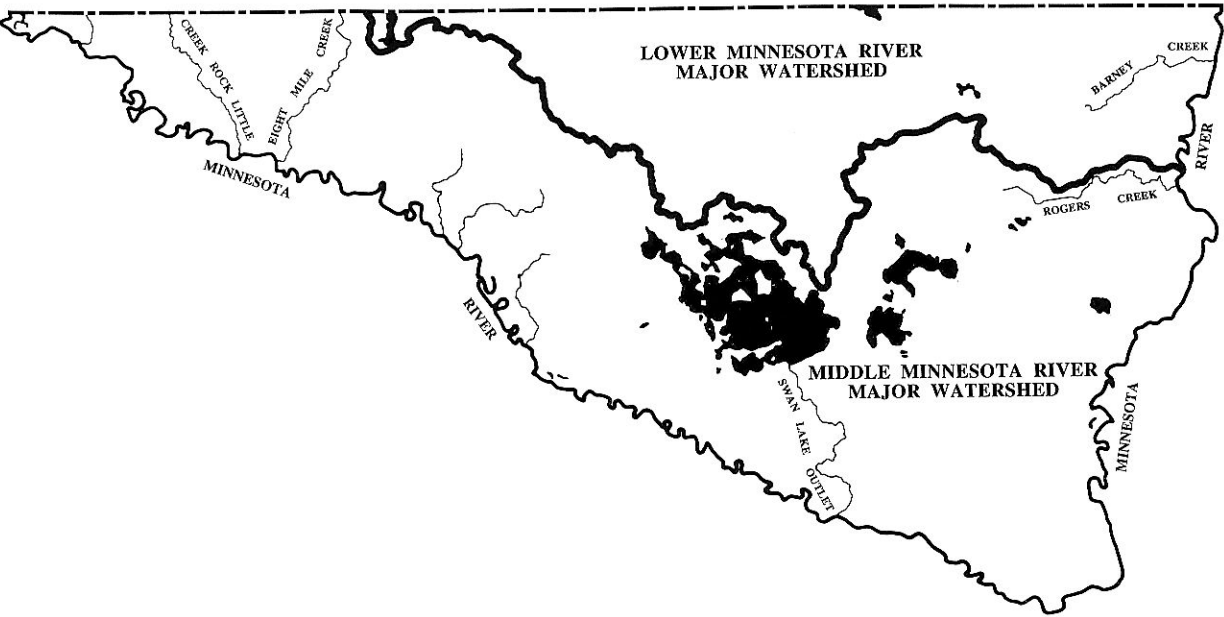


Figure 1. Major watersheds, drainage channels, and lake basins in Nicollet County.

The north central and northeastern portions of Nicollet County lie within the Lower Minnesota River major watershed (Figure 1). In this area the local drainage is from south to north and from west to east, toward the Minnesota River. The southern and western portions of Nicollet County lie primarily within the Middle Minnesota River major watershed. This area is drained by artificial systems that channel water to small tributaries of the Minnesota River. Little Rock Creek, Eight Mile Creek, Swan Lake Outlet, and Rogers Creek are natural water ways that represent the primary drainage channels of the Middle Minnesota River major watershed in Nicollet County.

Nicollet County is essentially a region of nearly flat to gently rolling ground moraine that is bordered on two of its three sides by steep bluffs along the Minnesota River Valley. Many of the nearly flat areas of the ground moraine are artificially drained to improve agricultural conditions. Small natural streams that drain the county have shallow meandering courses and have carved deep ravines to the bottom lands of the Minnesota River Valley. The south central portion of Nicollet County is dominated by Swan Lake which fills a shallow depressed lowland. The highest surface elevation, about 1020 feet mean sea level, is located in the central part of the county. The lowest elevation, about 730 feet mean sea level, is located in the northeast corner of the county where Minnesota River leaves Nicollet County. The maximum total relief is approximately 290 feet. The local relief ranges from 5 to 25 feet, except along the Minnesota River Valley where relief may be as great as 200 feet.

MINOR WATERSHEDS

The Minnesota Department of Natural Resources adopted height-of-land watershed delineation methodology and completed a standard delineation of minor watershed boundaries for the State of Minnesota in 1979. The MDNR defined minor watershed outlets and delineated height-of-land minor watershed boundaries for all watersheds greater than five square miles. Minor watershed boundaries were delineated onto U.S. Geological Survey 7-1/2 minute series topographic maps (1:24,000 scale) for most of the state. For areas of the state that 7-1/2 minute map coverages were not available, minor watershed boundaries were delineated onto U.S. Geological Survey 15 minute series topographic maps (1:62,500 scale).

The U.S. Geological Survey Water Resources Division delineated subsheds for gauging stations and waste treatment outfalls onto 7-1/2 minute topographic maps and reviewed the previously established minor watershed boundary lines for accuracy and consistency of height-of-land delineation within the Minnesota River Basin (1983-84). Data from field investigations and drainage ditch maps were included to improve the accuracy of minor watershed boundary line placement. The purpose was to develop a standard 7-1/2 minute topographic map base to digitize the watersheds into a Geographic Information System.

The Mankato State University Water Resources Center manually copied minor watershed boundary lines from the 7-1/2 minute topographic maps contained in files at the U.S. Geological Survey Water Resources Division and Minnesota Department of Natural Resources Division of Waters. Sheets of matte finish acetate were cut and taped onto the 7-1/2 minute topographic maps and the minor watershed boundaries were traced, using a 0.3 mm pencil, onto the acetate sheets; cross-hair targets drawn over the four corners of the topographic maps. The acetate sheets were removed and attached to paper copies of 7-1/2 minute topographic maps at the Water Resources Center. The minor watershed boundary lines were reviewed for accuracy and consistency of height-of-land delineation on the 7-1/2 minute series topographic maps (1:24,000 scale). For areas where minor watershed boundaries were only available on 15 minute series topographic maps (1:62,500 scale), the minor watershed boundary lines were re-delineated using height-of-land delineation methodology onto 7-1/2 minute topographic maps.

WATERSHED DELINEATION AND MAPPING PROCEDURE

HEIGHT-OF-LAND WATERSHED DELINEATION

The height-of-land method of delineating watershed boundaries requires an interpretation of the surface topography to determine the drainage pattern of surface water flow. The challenge of height-of-land delineation is to determine how precipitation, upon impact with the land surface, will run overland in rivulets and streams to rivers, lakes, or wetlands. The objective is to locate the watershed ridge line along which the surface relief slopes in downhill directions on both sides diverting surface water flow between neighboring watersheds. The chief merit of a height-of-land watershed boundary line is that it provides a physiographic water divide boundary; however, a height-of-land watershed boundary line gives no information about the physical relief over any part of its length.

The position of watershed outlets were located and used as starting points when delineating height-of-land watershed boundaries. Watershed outlets are commonly the confluence points of streams and rivers or lake inlets and outlets. Delineation of a height-of-land watershed boundary line started at the watershed outlet, and working uphill, the watershed line was drawn so that the surface relief would slope in downhill directions on both sides of the watershed boundary line (Figure 2). Water falling inside the watershed boundary line was interpreted to flow to the main drainage channel upstream from the watershed outlet while water falling outside the watershed boundary line was interpreted to flow elsewhere.

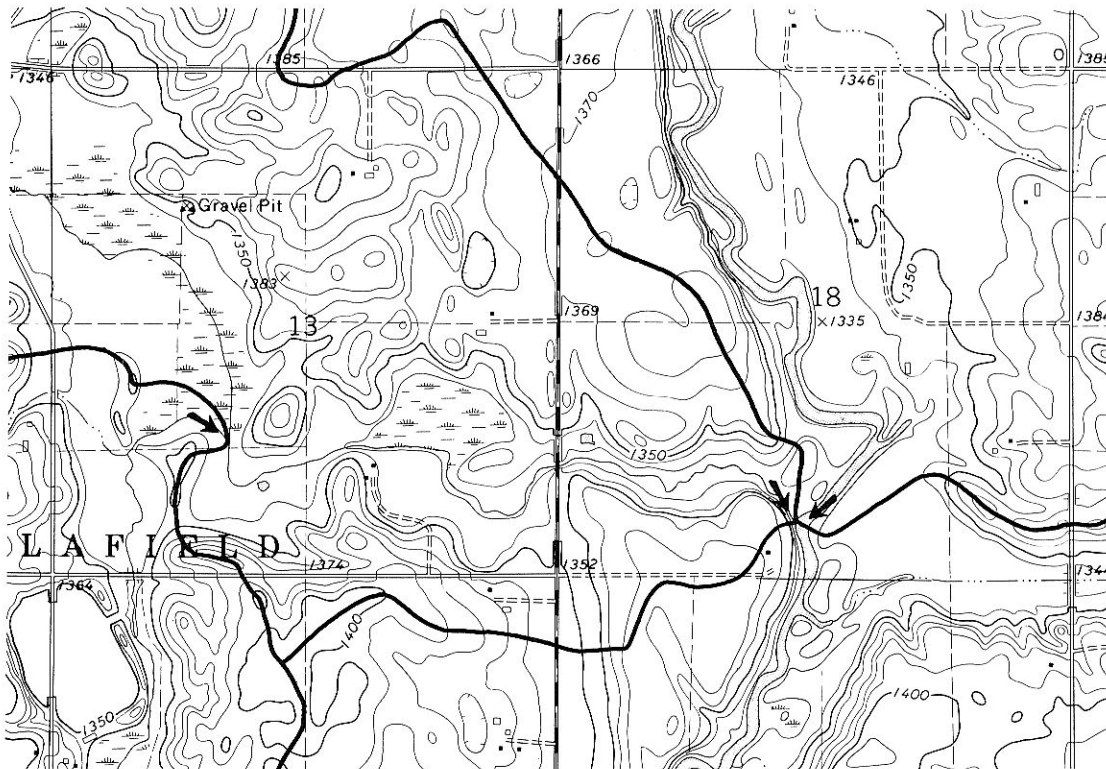


Figure 2. Minor watershed boundary lines that follow height-of-land delineation assessment through contour data on a 7-1/2 minute topographic map. Watershed outlets are marked by arrows (↖), showing direction of flow.

Guidelines for height-of-land watershed delineation:

1. Water tends to flow perpendicular across contour lines in the direction of decreasing elevation. Watershed boundary lines should be drawn perpendicular to and not parallel to adjacent contours of different elevation.
2. Ridges are indicated by "V" or "U" shaped contours that point downhill, in the direction of lower elevation. Watershed boundary lines will parallel contour lines of equal elevation along narrow ridges that represent the highest ground.
3. Drainage or water flow courses are indicated by "V" or "U" shaped contours that point uphill, in the direction of increasing elevation.
4. In areas of relatively flat topography that contain few contour lines and no continuous ridges, a watershed boundary line may follow impermeable cultural features such as roadway embankments. Drainage areas can be altered by culverts, storm sewers, or drainage ditch and tile lines.

Watersheds are not immediately discernible from a topographic map and the placement of a height-of-land watershed boundary line is not always apparent: many regions exhibit only subtle physical irregularities that are expressed as highly ambiguous patterns on a topographic map. The 7-1/2 minute topographic maps used in this study show streams, lakes, wetlands, forest vegetation, and a variety of cultural features that helped guide the positioning of watershed boundary lines. The position of watershed boundary lines in areas of relatively flat topography that contain few contour lines and no continuous ridges are more accurately delineated when the existing ditch and tile systems are taken into account.

IMPACT OF DRAINAGE DITCH SYSTEMS ON WATERSHED DELINEATION

The height-of-land delineation of a minor watershed boundary line may not represent the most accurate hydrologic boundary. More accurate hydrologic boundary lines may be determined by plotting the location of subsurface drainage ditch systems that artificially divert water through height-of-land barriers. Minor watershed boundaries that incorporate artificial surface water drainage systems are more accurate and will increase the reliability of assessing the environmental impact of present land use and future changes in land use for local water planning.

Copies of historic and current county drainage ditch maps were obtained by the Water Resources Center from each of the 13 counties. The information from each county drainage ditch map was manually transferred onto acetate sheets that overlay the 7-1/2 minute topographic maps. Open drainage ditches were drawn as solid lines and tile drainage ditches were drawn as dashed lines. Arrows were placed to indicate the direction of water flow through the ditch system. When plotting a drainage ditch line across adjacent topographic maps, the maps were edge-matched and the ditch line was matched up graphically, labeled appropriately, and arrows drawn to indicate direction of flow.

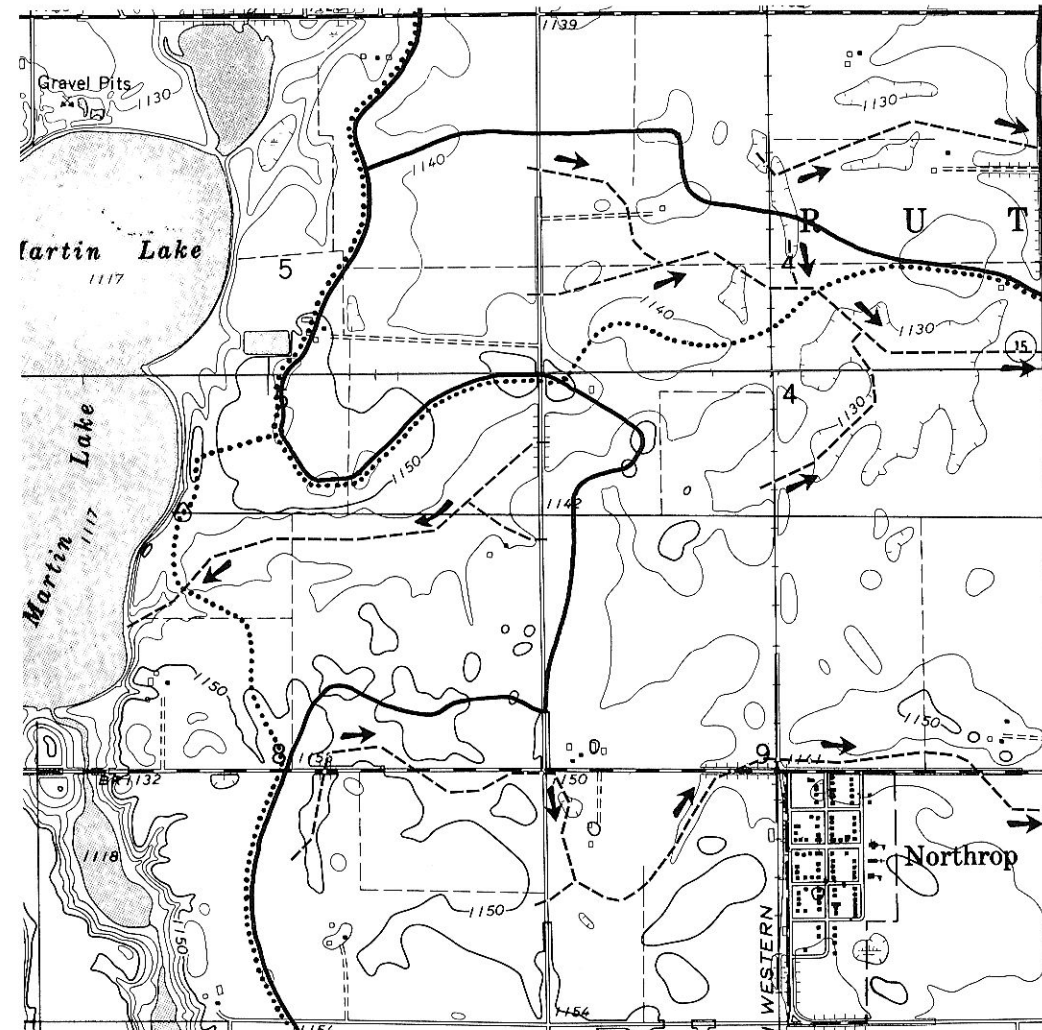


Figure 3. Dotted lines (· · · · ·) represent the previously established minor watershed boundary lines. The solid lines (—) represent the minor watershed boundary lines that were redelineated to accommodate county drainage ditches (tile lines). Dashed lines (-----) represent county tile lines. Arrows (↖) show direction of water movement through county tile lines.

Minor watershed boundary lines were re-delineated in areas where drainage ditches violate the previously established height-of-land minor watershed boundaries (Figure 3). The re-delineation of minor watershed boundary lines required a comparison of the location of ditchshed lines on the drainage ditch maps with the local topography presented on the 7-1/2 minute topographic maps. The placement of minor watershed boundary lines follow height-of-land interpretation of the local topography. The location of ditchshed lines were used as reference guides in areas where the local topography is such that several height-of-land interpretations of minor watershed boundary lines were equally valid.

DITCHSHED DELINEATION

Ditchshed boundaries were delineated onto the 7-1/2 minute topographic maps after the drainage ditch and tile lines had been mapped and minor watershed boundaries were adjusted to fit the artificial drainage systems. The ditchshed line presented on the ditch map was used for guidance while the placement of ditchshed boundary lines onto 7-1/2 minute topographic maps was determined by height-of-land delineation rules. Ditchshed boundary lines were drawn so that the surface relief and water flow courses were interpreted to channel water toward the open ditch or tile lines on the 7-1/2 minute topographic maps. Delineation of the ditchshed began at the ditch outlet, and working uphill, the ditchshed boundary line was drawn until it intersected a minor watershed boundary line. A ditchshed boundary line will follow an established minor watershed boundary line (Figure 4). The outlet point of a drainage ditch system may be a lake, wetland, stream, another drainage ditch, or the head of a ravine or other natural waterway that leads to a major river, lake, wetland or stream.

Guidelines for delineating ditchsheds:

1. A ditchshed includes all area upstream of the drainage ditch outlet.
2. When a drainage ditch serves as the main drainage channel for two or more minor watersheds, the ditchshed includes the area contained within each of the minor watersheds it drains.
3. The area drained by any natural waterway that outlets into a drainage ditch system is included in the ditchshed.
4. Within a large drainage ditch system there may be numerous tributary drainage ditch systems that outlet into the main channel of the larger ditch system; tributary ditchsheds are included as part of the major ditchshed.

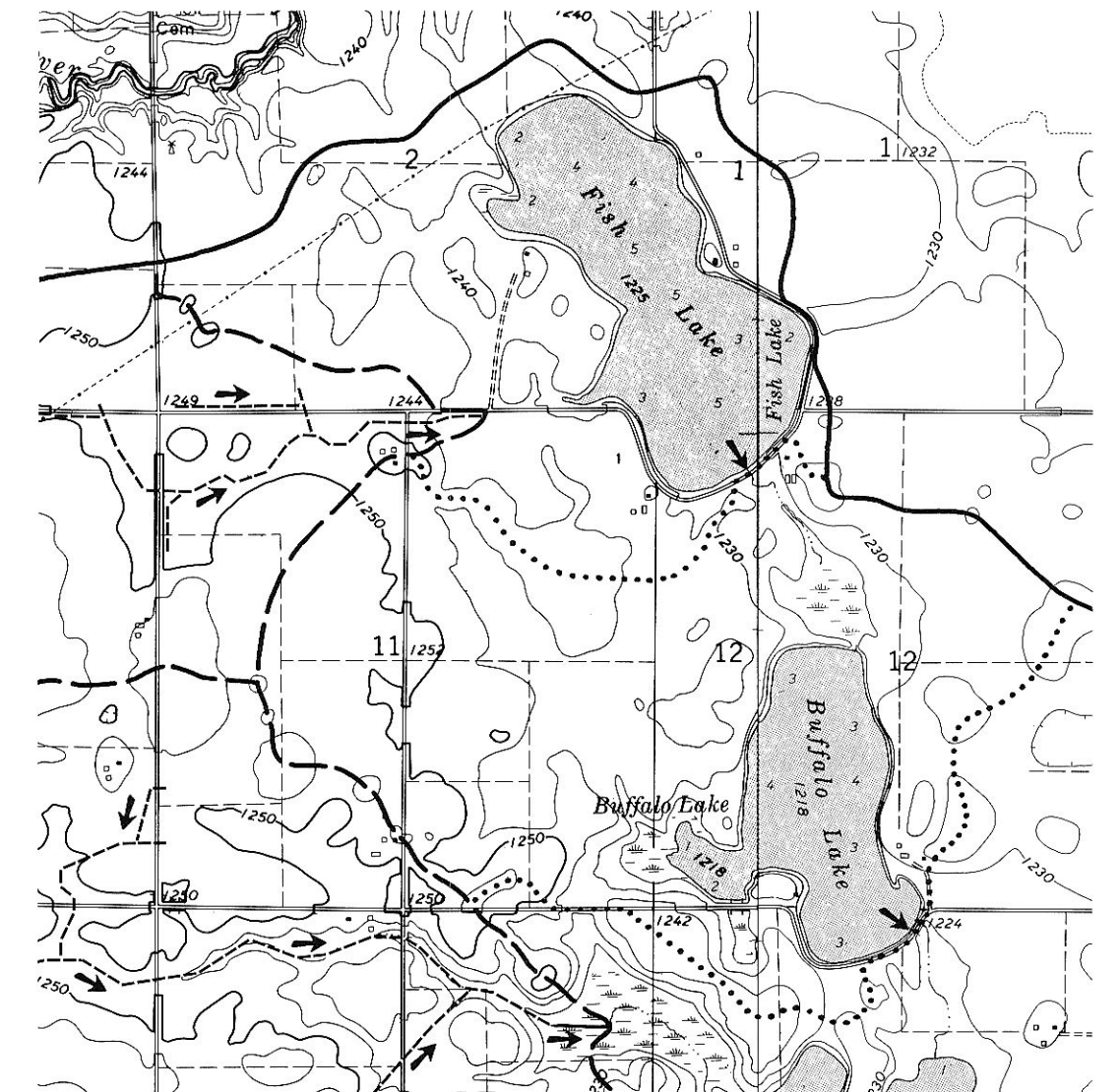


Figure 4. Shows the hierarchical relationship between the three kinds of watershed boundary lines that were delineated onto 7-1/2 minute topographic maps. Minor watershed boundary lines (—) were established first. The ditchshed boundary lines (-----), established second, were drawn until they intersected a minor watershed boundary line. The lakeshed boundary lines (· · · · ·), established last, were drawn until they intersected ditchshed or minor watershed boundary lines. Dashed lines (-----) represent county drainage ditch (tile lines). Arrows (↖) show direction of water movement through county tile lines.

LAKESHED DELINEATION

Lakeshed boundaries were delineated onto the 7-1/2 minute topographic maps after delineation of the minor watershed and ditchshed boundary lines was completed. The placement of lakeshed boundary lines onto the 7-1/2 minute topographic maps was determined by height-of-land delineation rules. Delineation of the lakeshed began at the lake outlet, and working uphill, the lakeshed boundary line was drawn until it intersected a previously established minor watershed or ditchshed boundary line. A lakeshed boundary line will follow an established minor watershed or ditchshed boundary line (Figure 4).

Guidelines for delineating lakesheds:

1. A lakeshed includes all area upstream of the lake outlet.
2. A lake is sometimes part of a natural waterway, a widening in a major river or stream that serves as the main drainage channel of a minor watershed. The area drained by any natural waterway that outlets into a lake is included in the lakeshed. A lakeshed may be very large, hundreds of square miles, if a major natural waterway outlets into the lake. A lakeshed may be very small, a subshed within a minor watershed, if a main drainage channel does not outlet into the lake.
3. When a drainage ditch system outlets into a lake, the ditchshed will be a subshed within that lakeshed. When a lake outlets into a drainage ditch system, the lakeshed will be a subshed within that ditchshed.

The U.S. Fish and Wildlife Service established the National Wetland Inventory Project (NWI) in 1975. In 1980, the Fish and Wildlife Service adopted a wetlands classification system that was developed with assistance from various government agencies, private groups and individuals (Cowardin et al. 1979). The NWI process was designed to inventory wetlands and determine trends according to standardized environmental characteristics.

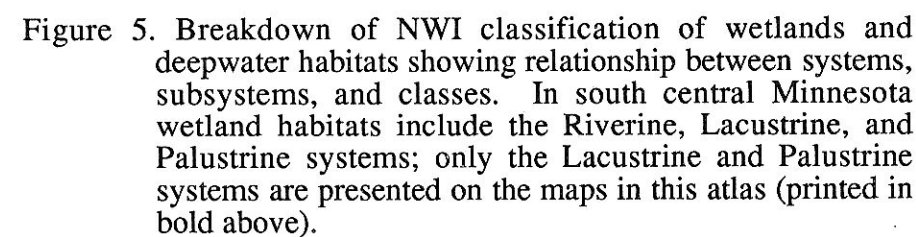
Remote sensing was the technique selected for inventorying the United States wetlands. The NWI selected high altitude aerial photography as its primary remote sensing tool and established an agreement with NASA to obtain 1:60,000 color infrared aerial photography for the United States. With this imagery the NWI was able to map wetlands, generally between 1-3 acres in size (minimum mapping unit). Stereoscopic analysis of high altitude color infrared aerial photographs makes it possible for an interpreter to identify trees from shrubs and the photo interpreter was not confused by slope, aspects or conditions of the vegetation, shadows, or variations in flooding. The wetlands were identified on the aerial photographs based on visible vegetation, hydrology, and geography. There is a margin of error inherent in the use of aerial photographs as they reflect conditions during the specific year and season when they were taken. Thus, revisions of wetland information established by the NWI may result from field checking and examination of other existing wetland information.

Principles to use when deciphering the NWI classification system:

The Riverine System (Rivers) contains the deepwater and wetlands associated with river or stream channels. The Riverine System is divided into four Subsystems: Lower Perennial, Upper Perennial, and Intermittent. The Tidal Subsystem is not present in Minnesota and the Intermittent Subsystem may not meet the definition of wetland in some areas.

The Palustrine System (traditional wetlands) are freshwater areas that do not contain deepwater habitats. These areas support emergent wetland plants where the water is usually at or near the surface or shallow water covers the land. Other areas may contain trees or shrubs.

Substrate Classes include rock bottom, rocky shore, unconsolidated bottom, unconsolidated shore, stream bed, and reef. Unconsolidated bottom and shore may be gravel, sand, mud, or organic. Rock bottom and shore are composed of 10 inch diameter or larger rocks.



To Native American people the land was not something to be owned by an individual person but was something to be used and shared. Because people of European ancestry thought about land as something they could own, the United States government had to devise an orderly system to describe the boundaries of each piece of land in terms which could be understood by settlers on the frontier. The system devised by the federal government was called the Land Ordinance of 1785, more commonly known as the United States Public Land Survey System (USPLS). The USPLS was based upon a rectangular grid system that partitioned the land into parcels that gave a checkerboard appearance to maps of the land. In Minnesota the first survey of government lands started in 1848 and the last survey crews finished in the 1890's. In south central Minnesota much of the land survey was done at the time when Minnesota was entering the union in 1858.

[illegible]

Surveyors were required to record all landmarks that lay in the path of the section lines and to note import resources within each section. In south central Minnesota the surveyors noted and mapped rivers, streams, marshes, wetlands, lakes, prairie, woodlands, and other natural resources. As the surveyors laid down townships and sections, the survey crews built monuments to mark the corners of each township and section, and to record the distance and direction to all major landmarks from the monuments. People who came later could look for the landmarks, locate the monuments, and determine the section line. Eventually surveyors took all of their records and information they had noted and drew maps of each township. The land office used the surveyors maps and notes to make the official plat maps of each township.

INTERPRETING ATLAS MAPS

SURFACE WATER HYDROLOGY MAPS

Preparation of the Surface Water Hydrology maps presented in this atlas required the evaluation of information concerning the land surface topography, natural waterways, and artificial drainage ditch systems. A Surface Water Hydrology map was constructed for each surveyor township at 1:32,000 scale. The Surface Water Hydrology maps include information on minor watersheds, ditchsheds, lakesheds, county drainage ditch systems, and area wetlands (NWI). U.S. Geological Survey 7-1/2 minute series topographic maps are printed as the background base for each Surface Water Hydrology map.

MINOR WATERSHED IDENTIFICATION

Minor watershed boundaries are delineated on the Surface Water Hydrology maps as thick black lines and are labeled along the edge of each Surface Water Hydrology map with a unique five digit minor watershed identification number that was assigned by the MDNR in 1981 (Figure 7). The minor watershed boundary lines follow the height-of-land delineation rules described on page 2 in this atlas; the height-of-land assessment is based upon contour data presented on USGS 7-1/2 minute series topographic maps.

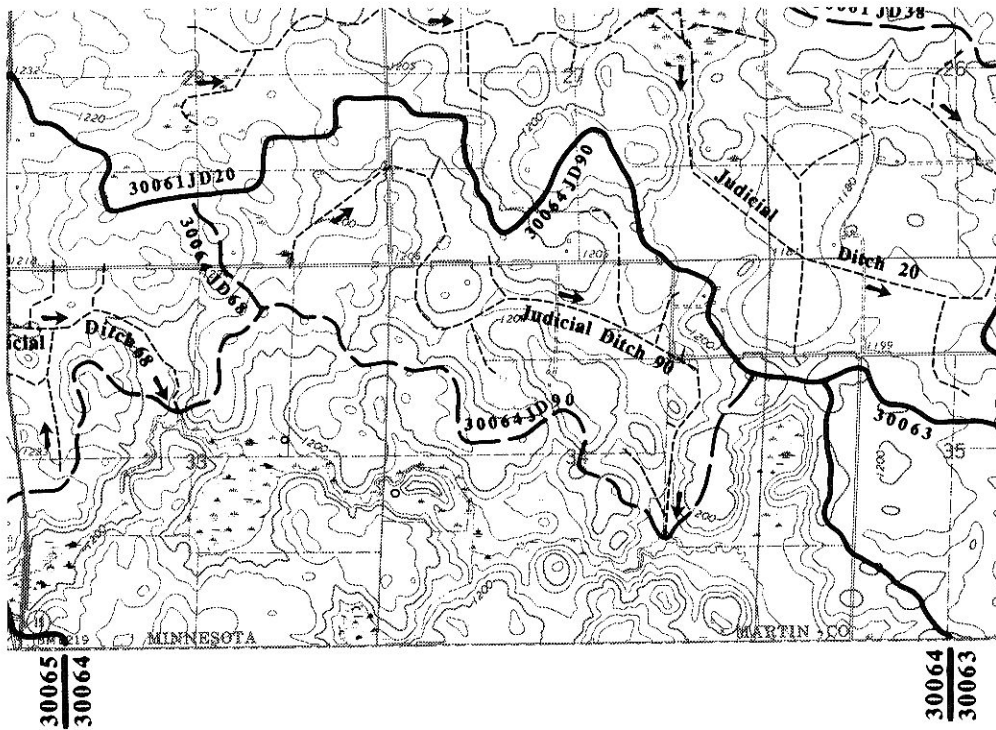


Figure 7. The above minor watershed, 30064, is delineated with a thick black line and labeled along the bottom edge of the map with its unique minor watershed identification number. Note that minor watershed 30064 is bordered on the west and east by minor watersheds 30065 and 30063 respectively.

The unique five digit minor watershed identification number can be broken down into two parts (Figure 8). The first two digits of the five digit minor watershed identifier establishes the minor watershed within a major watershed. For example: the Blue Earth River major watershed and the East Fork Des Moines River major watershed were assigned the identification numbers 30 and 53 respectively. The last three digits of the five digit minor watershed identification numbers were randomly assigned and are unique to each minor watershed within a major watershed. For example: minor watersheds that are located within the Blue Earth River major watershed are numbered 30001, 30002, 30003 and so on, while the minor watersheds located within the East Fork Des Moines River major watershed are numbered 53001, 53002, 53003 and so fourth.

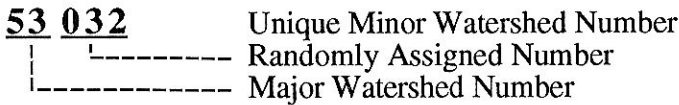


Figure 8. Breakdown of a minor watershed identification number.

Minor watershed 30031 (Figure 9) contains four drainage ditch systems; Judicial Ditch 2, Judicial Ditch 95, County Ditch 69, and Joint County Ditch 202. Judicial Ditch 2 serves as the main drainage channel for Minor Watershed 30031, hence, the minor watershed boundary line delineates the ditchshed boundary for Judicial Ditch 2. The interior side of minor watershed boundary line 30031 has been labeled with the unique ditchshed identifier for Judicial Ditch 2 (30031JD2). Judicial Ditch 95, County Ditch 69, and Joint County Ditch 202 represent tributary drainage ditch systems that outlet into Judicial Ditch 2. Separate ditchshed boundary lines are delineated for each tributary ditch system and the interior side of each ditchshed boundary line has been labeled with its unique ditchshed identifier; 30031JD95, 30031CD69, and 30031JC202. Note that Judicial, County, and Joint County ditches have been assigned the two letter abbreviations JD, CD, and JC respectively within the unique ditchshed identifier code.

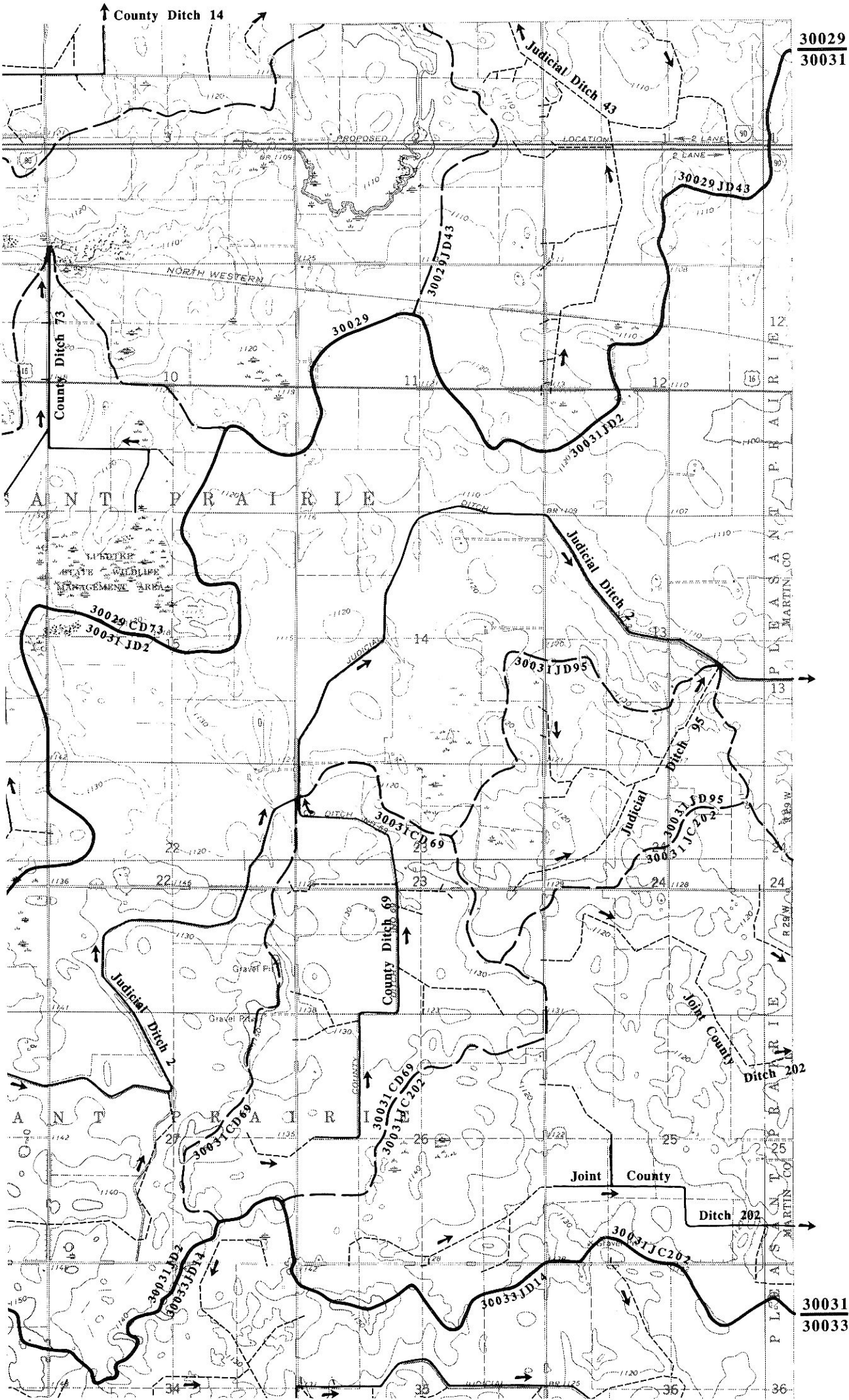


Figure 9. Drainage ditch and ditchsheds within minor watershed 30031.

The unique minor watershed identification numbers were assigned without regard to hydrologic relationships and therefore cannot be used to establish a hydrologic order among minor watersheds. The five digit numbers are simply codes that are used to identify a minor watershed with corresponding data that is stored in a data base system. A table of major watershed codes, unique minor watershed numbers, and corresponding data can be found on pages 8 and 9 in this atlas.

DRAINAGE DITCH SYSTEMS AND DITCHSHEDS

Drainage ditch systems that have been constructed and are presently maintained by the county have been plotted onto the Surface Water Hydrology maps in this atlas. Each drainage ditch system was plotted onto USGS 7-1/2 minute series topographic maps from copies of historic and current drainage ditch maps that were provided by the county. Open drainage ditches are shown on the Surface Water Hydrology maps as solid lines and tile drainage ditches are shown as dashed lines. Each drainage ditch system has been labeled with its proper name and arrows show the direction of water movement through the ditch system.

The ditchshed boundaries are delineated on the Surface Water Hydrology maps as long dashed lines and are labeled with unique ditchshed identifiers along their interior sides. The ditchshed boundary lines follow the height-of-land delineation rules that are described on page 2 in this atlas; the height-of-land assessment is based upon contour data as presented on USGS 7-1/2 minute topographic maps. A ditchshed boundary line is delineated from the drainage ditch outlet to a point of contact with an established minor watershed boundary line or another ditchshed boundary line.

The unique ditchshed identifier can be broken down into two parts. The first five digits of the ditchshed identifier is a unique minor watershed identification number. This number establishes the ditchshed within a minor watershed. The five digit minor watershed number is followed by an alpha-numeric sequence that represents the proper name of the drainage ditch system (Figure 10).



Figure 10. Breakdown of a unique ditchshed identifier.

Minor watershed boundary lines that delineate a ditchshed boundary line are labeled with a ditchshed identifier. Minor watershed boundary lines that are not part of a ditchshed boundary are not labeled or are labeled with five digit minor watershed identification numbers (Figure 11).

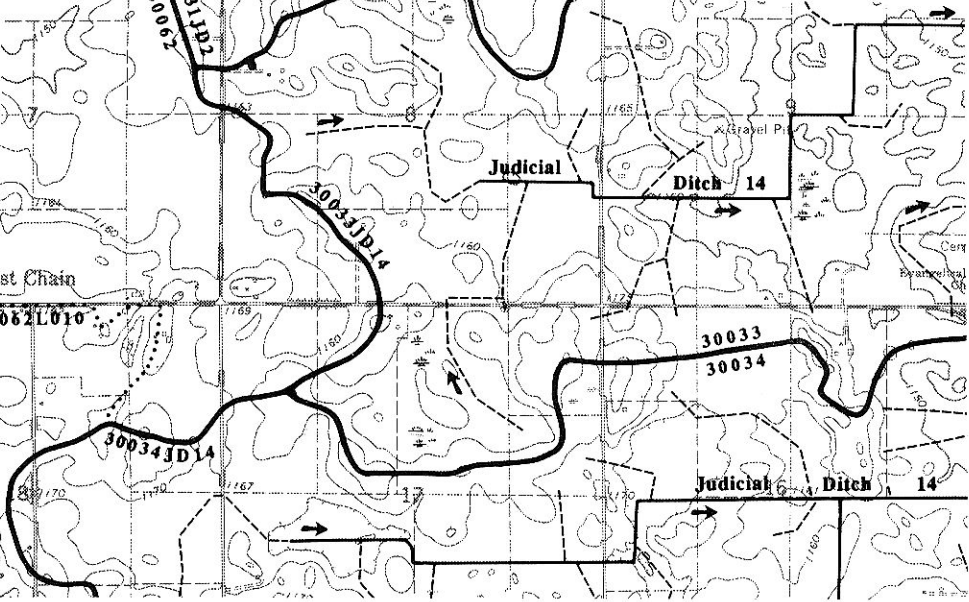


Figure 11. The above minor watersheds, 30033 and 30034, are drained by Judicial Ditch 14. The minor watershed boundary segments of 30033 and 30034 that delineate the Judicial 14 ditchshed are labeled 30033JD14 and 30034JD14 respectively. Note that the minor watershed boundary line that separates the two branches of Judicial Ditch 14 is not a ditchshed boundary line and therefore is labeled only with the unique five digit minor watershed identification numbers.

LAKE SHEDS

Lakeshed boundary lines are delineated on the Surface Water Hydrology maps as dotted lines and are labeled with unique lakeshed identifiers. The lakeshed boundary lines follow the height-of-land delineation rules that are described on page 2 in this atlas; the height-of-land assessment is based upon contour data as presented on USGS 7-1/2 minute topographic maps.

The interior side of each lakeshed boundary line is labeled with a unique lakeshed identifier. The unique lakeshed identifier can be broken down into three parts (Figure 12). The first five digits of the lakeshed identifier is a unique minor watershed identification number. This number establishes the lakeshed within a minor watershed. The five digit minor watershed number is followed by the letter "L" (for Lakeshed). The letter "L" is followed by the unique lake identification number that was assigned in MDNR Bulletin No. 25, An Inventory of Minnesota Lakes.

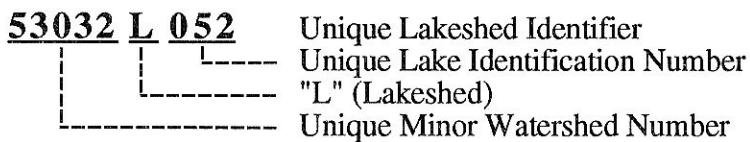


Figure 12. Breakdown of the unique lakeshed identifier.

A lakeshed will include all area upstream of the lake outlet. Some lakesheds will encompass only a few square miles and their total extent can be easily determined from the Surface Water Hydrology maps (Figure 13). However, when a main drainage channel outlets into a lake, the lakeshed may encompass hundreds of square miles and include many minor watersheds and ditchsheds within its drainage area. The total extent of a large lakeshed may be difficult if not impossible to determine from the Surface Water Hydrology maps in this atlas.

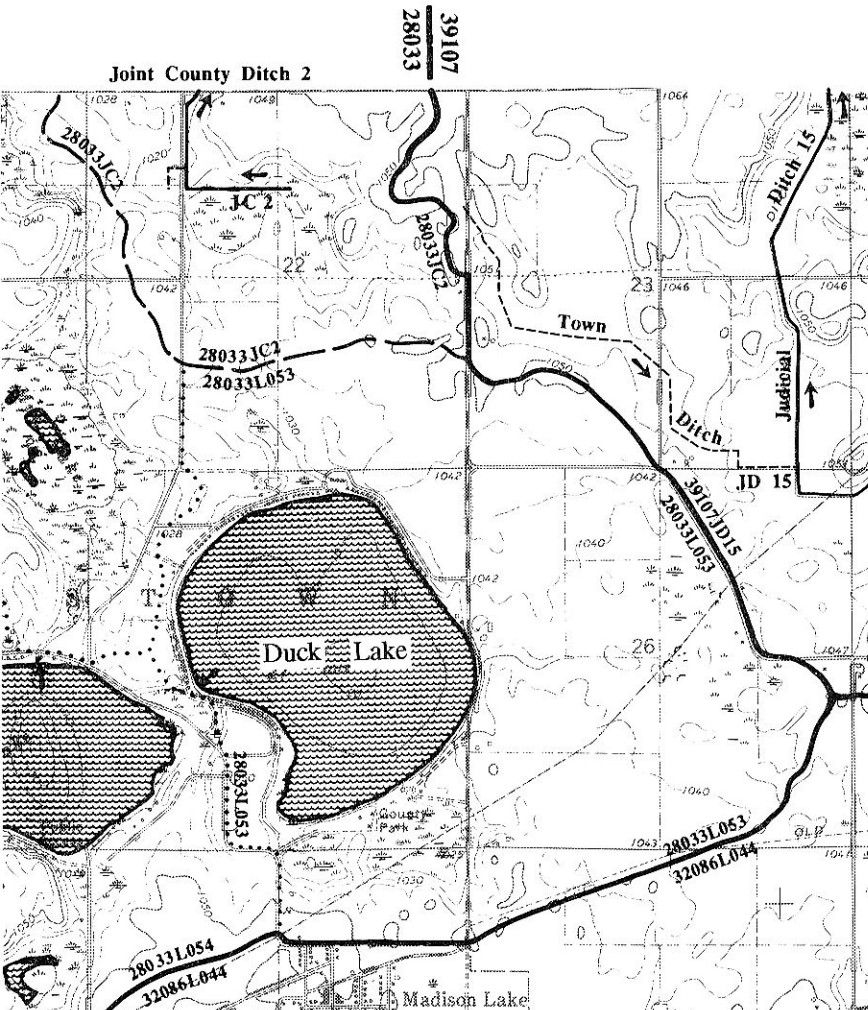


Figure 13. Above, the Duck Lake lakeshed is delineated with a dotted line from the lake outlet; south to minor watershed 28033 boundary line and north to Joint County 2 ditched boundary line. The sections of minor watershed 28033 boundary line that delineates the Duck Lake lakeshed are labeled with the lakeshed identifier 28033L053. Note: the section of ditched boundary line that delineates the northern part of Duck Lake lakeshed is labeled with the lakeshed identifier since the ditched is not included in the lakeshed.

The total extent of a lakeshed may not be immediately discernible from the Surface Water Hydrology maps due to the hierarchical relationship between the three kinds of watershed boundary lines that are delineated onto the atlas maps; minor watershed, ditchshed, and lakeshed boundary lines (Figure 14). Lakeshed boundary lines are delineated from lake outlets, as dotted lines, to a point of contact with established minor watershed boundary lines or ditchshed boundary lines. Lakeshed boundary lines are defined by sections of minor watershed boundary lines that delineate common drainage areas or by sections of ditchshed boundary lines that delineate common or adjacent drainage areas.

Guidelines used when labeling lakeshed boundary lines.

1. A section of minor watershed boundary line that delineates part of a lakeshed boundary line is labeled with a lakeshed identifier.
2. A section of minor watershed boundary line that delineates part of a lakeshed boundary line and ditchshed boundary line is labeled with a ditchshed identifier.
3. A section of ditchshed boundary line that delineates part of a lakeshed boundary line is labeled with the lakeshed identifier if the ditchshed is not included in the lakeshed.
4. A section of ditchshed boundary line that delineates part of a lakeshed boundary line is labeled with the ditchshed identifier if the ditchshed is included in the lakeshed.

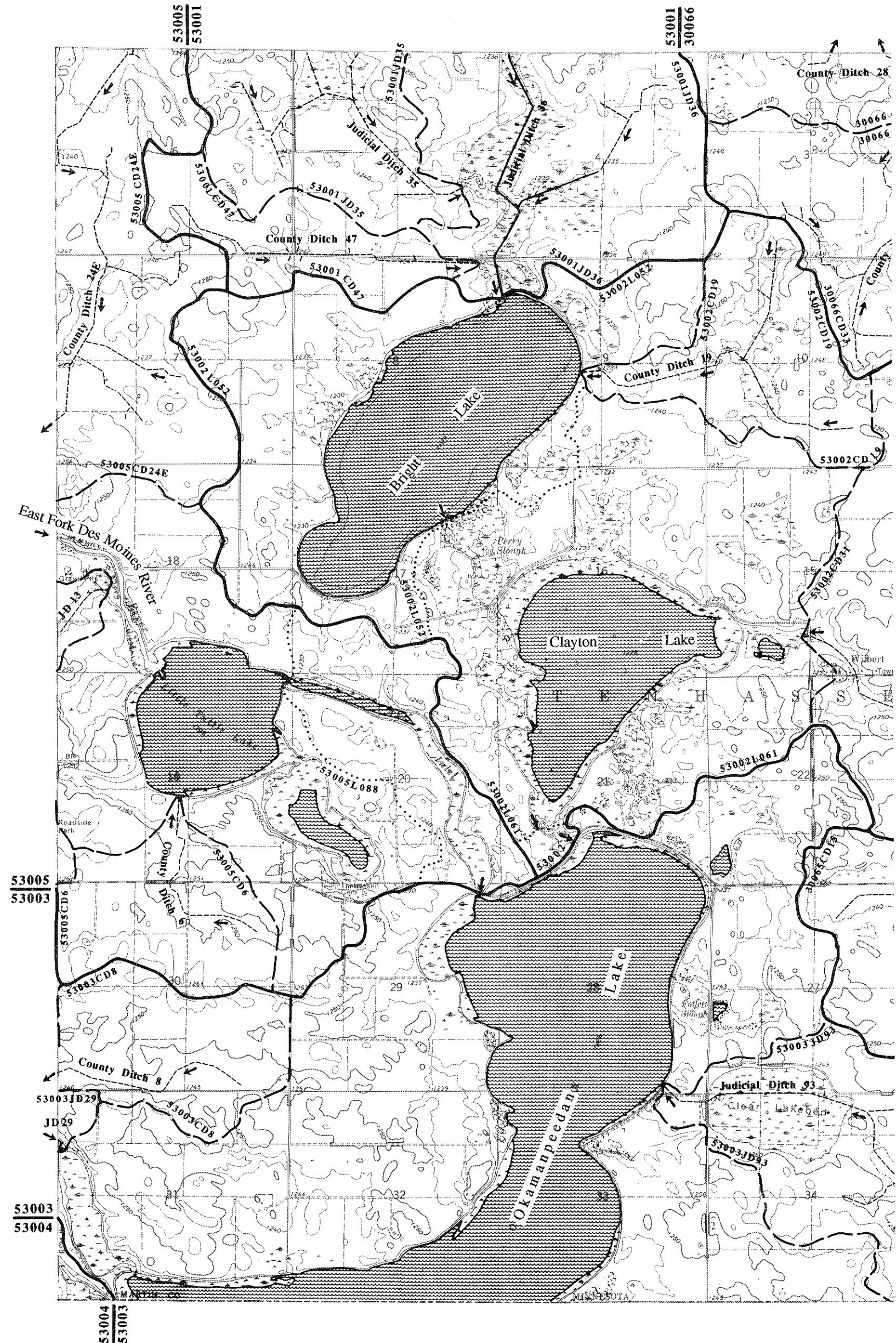


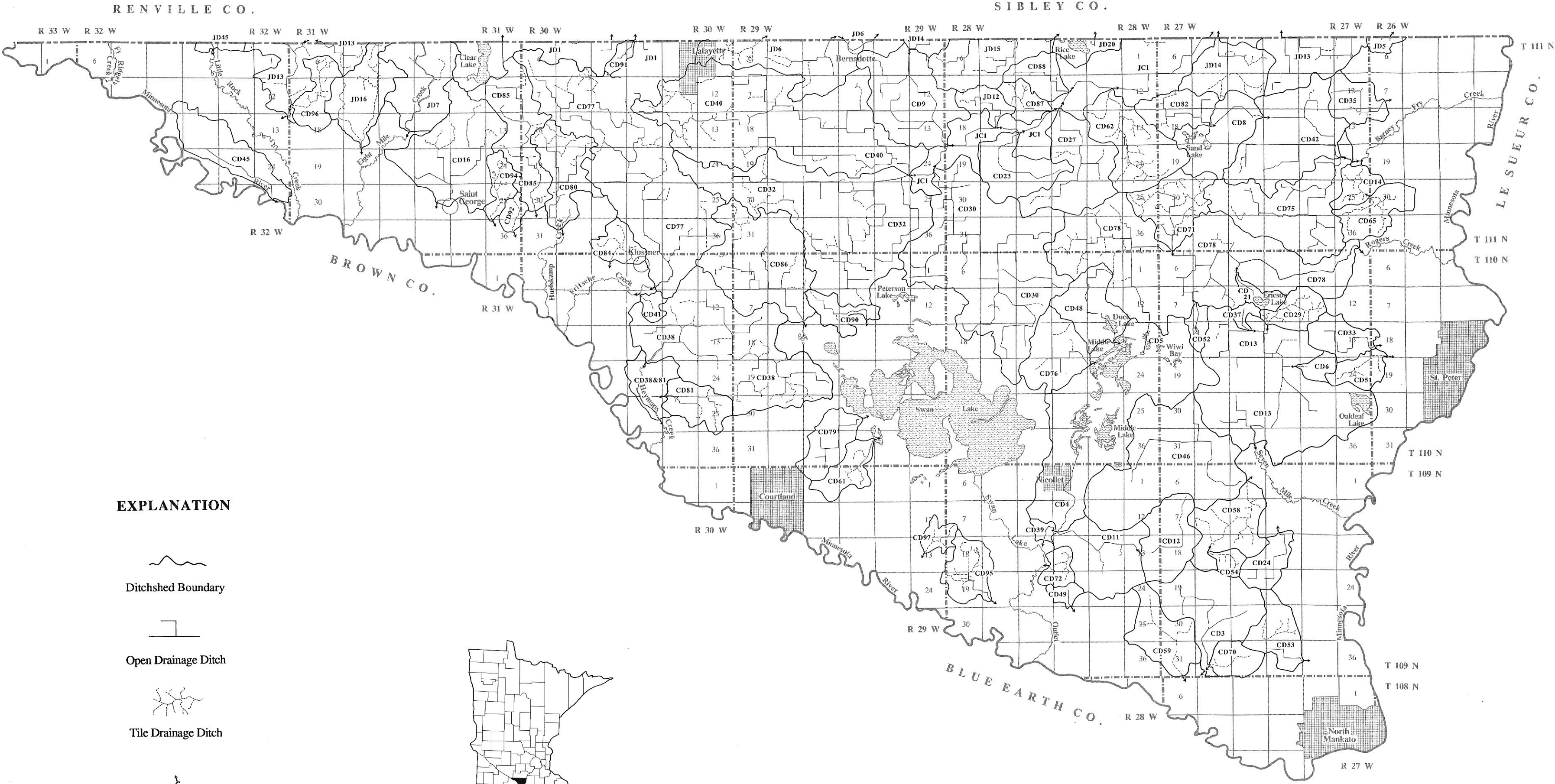
Figure 14. On the figure at the right the lakeshed boundary line for Bright Lake is delineated with a dotted line from the lake outlet north to County 19 ditchshed boundary line. The Bright Lake lakeshed boundary line intersects and follows County Ditch 19 ditchshed boundary line which, in turn, intersects and follows the minor watershed 53002 boundary line. County Ditch 19 outlets into Bright Lake, hence, the ditchshed is included in the lakeshed and the section of County 19 ditchshed boundary line that delineates part of Bright Lake lakeshed is not labeled with the lakeshed identifier since the ditchshed is included in the lakeshed. Minor watershed 53001 outlets into Bright Lake from the north and is included in the Bright Lake lakeshed.

Two minor watersheds, 53002 and 53005, outlet into Okamanpeedan Lake from the north. Minor watershed 53002 contains Bright Lake lakedshed which is described above. The East Fork Des Moines River serves as the main drainage channel for minor watershed 53005 which outlets into Okamanpeedan Lake from the north. Okamanpeedan Lake lakedshed includes all area upstream that contributes water to the East Fork Des Moines River. Consequently, Okamanpeedan Lake lakedshed includes the entire Major Watershed of the East Fork Des Moines River which includes hundreds of square miles.





MINOR WATERSHED INDEX MAP

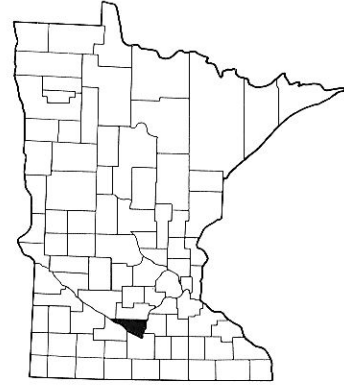


PUBLIC DRAINAGE DITCH AND DITCHSHED MAP

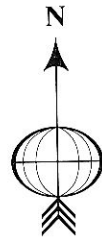
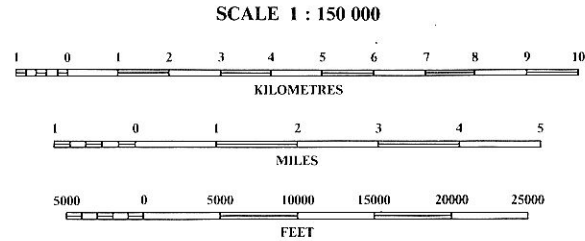


EXPLANATION

-  Ditchshed Boundary
-  Open Drainage Ditch
-  Tile Drainage Ditch
-  Drainage Ditch Outlet
(Arrow points in direction of flow)



LOCATION DIAGRAM



NICOLLET COUNTY MINOR WATERSHEDS

DATA TABLES

The data tables describe the minor watersheds in Nicollet County. The minor watersheds are ordered sequentially and therefore grouped by the Middle Minnesota River and Lower Minnesota River major watersheds. The following information is contained in the data tables:

ID# identifies the minor watershed with a unique five digit number. The first two numbers identify the major watershed river which will receive drainage from the minor watershed. The last three numbers are randomly assigned and are unique within the major watershed.

Major Watershed names the major watershed identified by the first two digits of the ID#.

Outlet Stream Name identifies the stream, ditch, or lake which flows out of the minor watershed. All surface runoff will exit the minor watershed through the outlet stream.

Outlet Location (Twp, Rgn, Sec, USGS Quad) locates the outlet of the minor watershed within a specific township, range and section using the U.S. Public Land Survey numbering system. USGS Quad is the name of the U.S. Geological Survey 7 1/2 minute series quadrangle where the minor watershed outlet is located. When the minor watershed outlets in Iowa, the USGS quad locates the outlet stream as it exits Minnesota into Iowa.

Area is the square miles of land area which contributes surface runoff and subsurface drainage to a receiving stream within the defined minor watershed boundary. Area may include water storage basins such as wetlands or lakes which do not contribute drainage to the minor watershed. Total area includes all drainage of the minor watershed extending beyond county boundaries. County area refers to that portion of the minor watershed drainage area which lies within the county boundary. Minor watershed boundaries were digitized from USGS 7 1/2 minute series quadrangles using AutoCAD and converted into ARC/INFO for area calculations.

Order is a hydrologic classification of minor watersheds within a drainage network. Using this classification system, a 1st order minor watershed has no surface water flowing into it, similar to Strahler's 1st order (headwater) stream. Order of a minor watershed will increase after receiving the outflow of two minor watersheds of the same hydrologic order. For example, two 1st order minor watersheds join to create a 2nd order; two 2nd order minor watersheds join to create a 3rd order, and so forth. When two minor watersheds of different hydrologic order join, the higher order will be assigned to the minor watershed receiving the outflow. For example, a 1st order minor watershed joins with a 2nd order to create a 2nd order. A minor watershed may receive outflow from another minor watershed at any point along its outlet stream. For example, when a 1st order minor watershed joins a 1st order minor watershed at the upper reaches of the outlet stream, the receiving minor watershed becomes 2nd order (Figure 14).

Minor Watershed Identifier			Outlet Location				Area (sq. miles)		Order	CSAW Number	
ID #	Major Watershed	Outlet Stream Name	Twp	Rgn	Sec	USGS Quad	Total	County		Stream	Minor Watershed
28022	Middle Minnesota River	Fort Ridgely Creek	111	32	7	Sleepy Eye NW	10.63	0.63	3	1-55-110	18-28-1
28023	Middle Minnesota River	Little Rock Creek	111	31	30	St. George	12.60	7.21	2	1-55-105	18-26-1
28026	Middle Minnesota River	Creek to Little Rock Creek	111	32	11	Sleepy Eye NW	14.07	5.57	1	1-55-105-1	18-26-1-1
28029	Middle Minnesota River	Minnesota River	111	32	7	Sleepy Eye NW	12.85	1.89	5	1-55	18-29
28030	Middle Minnesota River	Minnesota River	111	32	21	Sleepy Eye NW	9.62	4.02	5	1-55	18-28
28034	Middle Minnesota River	Creek to Minnesota River	109	26	18	Mankato West	9.71	0.03	2	1-55-69	18-17-1
28038	Middle Minnesota River	Minnesota River	111	26	33	St. Peter	21.38	11.07	6	1-55	18-15
28040	Middle Minnesota River	Minnesota River	109	27	12	North Star	6.60	4.89	6	1-55	18-17
28042	Middle Minnesota River	Minnesota River	109	27	25	Mankato West	26.88	8.62	6	1-55	18-18
28043	Middle Minnesota River	Minnesota River	108	27	14	Mankato West	10.75	6.81	5	1-55	18-19
28052	Middle Minnesota River	Minnesota River	108	27	7	Mankato West	7.36	4.63	5	1-55	18-20
28054	Middle Minnesota River	Minnesota River	108	28	2	Judson	8.86	5.36	5	1-55	18-21
28056	Middle Minnesota River	Minnesota River	109	29	25	Cambria	12.17	7.93	5	1-55	18-22
28058	Middle Minnesota River	Minnesota River	109	29	16	Courtland	17.41	11.56	5	1-55	18-23
28059	Middle Minnesota River	Eight Mile Creek	111	31	31	St. George	37.13	12.90	1	1-55-104	18-26-1
28060	Middle Minnesota River	Minnesota River	110	26	28	St. Peter	11.69	4.31	6	1-55	18-16
28061	Middle Minnesota River	Rogers Creek	110	26	4	St. Peter	27.50	27.50	1	1-55-59	18-14-1
28062	Middle Minnesota River	Creek to Seven Mile Creek	110	27	33	North Star	15.56	15.56	1	1-55-67-1	18-16-1-1
28063	Middle Minnesota River	Seven Mile Creek	109	27	12	North Star	6.99	6.99	2	1-55-67	18-16-1
28064	Middle Minnesota River	Creek to Minnesota River	108	27	7	Mankato West	10.47	10.47	1	1-55-80	18-19-1
28065	Middle Minnesota River	County Ditch 11	109	28	10	Nicollet	7.03	7.03	1	1-55-84-1-1	18-21-1-1-1
28066	Middle Minnesota River	Seven Mile Creek	110	27	33	North Star	14.25	14.25	1	1-55-67	18-16-2
28067	Middle Minnesota River	Creek to Swan Lake Outlet	109	28	16	Judson	19.96	19.96	2	1-55-84-1	18-21-1-1
28068	Middle Minnesota River	Swan Lake Outlet	109	28	33	Judson	9.75	9.75	2	1-55-84	18-21-1
28069	Middle Minnesota River	Swan Lake	109	28	6	Nicollet	35.61	35.61	1	1-55-84	18-21-2
28070	Middle Minnesota River	County Ditch 86	110	29	8	Courtland	7.03	7.03	1	1-55-84	18-21-3
28071	Middle Minnesota River	Heymans Creek	110	30	34	New Ulm	16.61	16.61	1	1-55-96	18-24-1
28072	Middle Minnesota River	Fritsche Creek	110	30	17	New Ulm	20.66	20.66	1	1-55-98	18-24-1
28073	Middle Minnesota River	Minnesota River	110	30	34	New Ulm	7.72	4.79	5	1-55	18-24
28074	Middle Minnesota River	Huelskamp Creek	110	30	7	New Ulm	6.37	6.37	2	1-55-99	18-25-1
28075	Middle Minnesota River	Creek to Huelskamp Creek	111	30	31	New Ulm	5.80	5.80	1	1-55-99-1	18-25-1-1
28076	Middle Minnesota River	Minnesota River	110	30	17	New Ulm	14.31	5.67	5	1-55	18-25
28077	Middle Minnesota River	Creek to Minnesota River	110	31	3	Essig	7.71	7.71	1	1-55-101	18-25-1
28078	Middle Minnesota River	Minnesota River	110	31	3	Essig	13.72	2.83	5	1-55	18-26
28079	Middle Minnesota River	Minnesota River	111	31	30	St. George	8.06	4.49	5	1-55	18-27
33044	Lower Minnesota River	Minnesota River	112	26	25	LeSueur	14.67	2.67	6	1-55	18-13
33045	Lower Minnesota River	Minnesota River	111	26	10	LeSueur	8.66	5.12	6	1-55	18-14
33054	Lower Minnesota River	Judicial Ditch 1	112	30	27	Lafayette	18.40	2.27	1	1-55-51-1-3	18-12-1-2-2
33055	Lower Minnesota River	Judicial Ditch 6	112	29	35	Bernadotte	19.68	9.11	2	1-55-51-1-3	18-12-1-2-1
33064	Lower Minnesota River	County Ditch 40	111	29	24	Bernadotte	16.39	16.39	1	1-55-51-1-1-3	18-12-1-1-2-1
33065	Lower Minnesota River	South Branch Rush River (JC1)	111	27	5	Norseland	13.07	0.55	2	1-55-51-1	18-12-1-2
33066	Lower Minnesota River	County Ditch 9	111	28	19	New Sweden	6.87	5.93	1	1-55-51-1-1-1	18-12-1-1-1-1
33067	Lower Minnesota River	Rice Lake Outlet (JD20)	112	28	35	New Sweden	5.79	4.20	1	1-55-51-1-2	18-12-1-2-1
33068	Lower Minnesota River	Joint County Ditch 1	111	27	5	Norseland	24.15	24.15	2	1-55-51-1-1	18-12-1-1-1
33085	Lower Minnesota River	County Ditch 32	111	29	24	Bernadotte	14.37	14.37	2	1-55-51-1-1	18-12-1-1-2
33086	Lower Minnesota River	County Ditch 30	111	29	24	Bernadotte	15.07	15.07	1	1-55-51-1-1-2	18-12-1-1-1-1
33097	Lower Minnesota River	South Branch Rush River	112	26	17	Henderson	22.34	6.42	3	1-55-51-1	18-12-1-1
33099	Lower Minnesota River	County Ditch 47	111	27	24	Norseland	11.82	11.82	1	1-55-54-1	18-13-1-1
33100	Lower Minnesota River	County Ditch 75	111	27	24	Norseland	6.56	6.56	1	1-55-54	18-13-2
33101	Lower Minnesota River	Barney Fry Creek	111	26	10	LeSueur	15.01	15.01	2	1-55-54	18-13-1

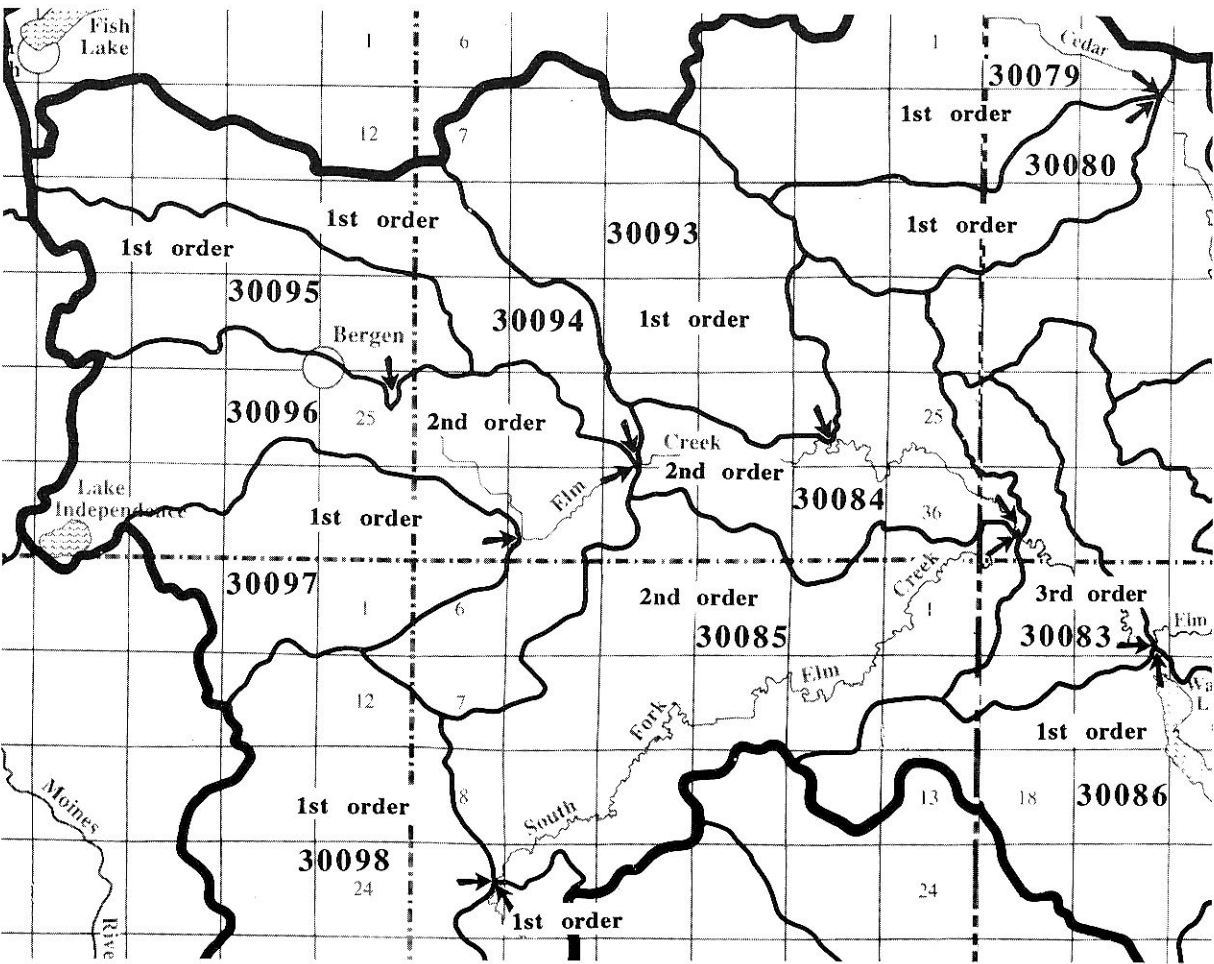


Figure 14. Hydrologic Order of Minor Watersheds. The outflow from 1st order minor watershed 30095 enters minor watershed 30096, creating a 2nd order minor watershed; 30096 remains a 2nd order minor watershed after receiving the outflow of 1st order minor watershed 30097. 1st order minor watershed 30094 joins with 2nd order minor watershed 30096, to create 2nd order minor watershed 30084; 2nd order minor watershed 30084 joins with 2nd order 30085 to create 3rd order minor watershed 30083.

DATA TABLES

Order (continued) This system of hydrologic order relates the minor watershed to the water quality of its outlet stream. Water quality of the outlet stream from a 1st and 2nd order minor watershed reflects the physical nature of its watershed as well as land use activities. The water quality of an outlet stream from a higher order minor watershed (3rd through 6th) represents its watershed drainage, cumulative upstream drainage, and in-stream processing; consequently, the effect of surface runoff from land use of the related minor is not as apparent as in a 1st and 2nd order minor watershed. A minor watershed assessment to determine relationships between water quality and land use activities involves consideration of minor watershed order, physical characteristics and biological processes for meaningful comparison of water quality results.

CSAW Number refers to the Common Stream and Watershed (CSAW) Numbering System, developed by the Minnesota Department of Natural Resources in 1981 to identify hydrologic order among the minor watershed drainage areas for the state of Minnesota. The Minnesota Land Management Information Center maintains the CSAW numbering system data base. The CSAW number is comprised of two parts: the first half of the number identifies the main stream draining the minor watershed; the second half of the CSAW number relates the location of the minor watershed drainage area to a stream segment within the drainage network. Numbers in each part of the CSAW number are separated by a hyphen. A space or a slash separate the stream number from the minor watershed number. A one to one relationship is always maintained between the stream numbers and the minor watershed numbers. Assigning the numerical code to the stream and to the minor watershed is done independently; the codes are then combined to form the CSAW number as follows:

1-55-76-12 18-18-4-7
(stream number) (minor watershed number)

CSAW NUMBERING PROCEDURE

The CSAW stream numbering procedure is a hierarchical approach of ordering, reflecting the drainage pattern of each stream. Minnesota is divided into four drainage systems for the stream numbering procedure: St. Lawrence, Hudson Bay, Mississippi, and Iowa. Each system has one or more terminal streams through which surface water flows out of Minnesota. The terminal stream begins the sequence of hyphenated numbers which describe the relative position of the stream as tributaries join other tributaries, draining toward the terminal stream.

In south central Minnesota, stream flow is a part of the Mississippi or Iowa drainage systems. In the Mississippi drainage system, the Mississippi River is the terminal stream and is numbered as stream 1. The Iowa drainage system is comprised of many streams which flow out of Minnesota into Iowa or South Dakota before confluence with the Mississippi River. Each stream flowing out of Minnesota into Iowa or South Dakota is designated as a terminal stream. Consecutive numbering of these streams begins at the southeastern border of Minnesota along the southern state line to the western Minnesota border, continuing north along the western state line.

Tributaries to the terminal stream and the tributaries to tributaries are numbered consecutively upstream to reflect the order of each stream's confluence along the terminal stream or main tributary. These tributary numbers are added to the sequence of hyphenated numbers following the number of the tributary joined. In the Mississippi drainage system, the stream number 1-55 identifies the Minnesota River as the 55th tributary to the Mississippi River from the southern state border. The stream number 1-55-76 identifies the Blue Earth River as the 76th tributary to the Minnesota River; stream number 1-55-76-12 identifies Elm Creek as the 12th tributary to the Blue Earth River. In the Iowa drainage system, stream number 37 is the West Fork Des Moines River which is the 37th stream from the eastern border of Minnesota. The stream 37-11 refers to Judicial Ditch 6 which is the 11th tributary to the West Fork Des Moines River.

The second half of a CSAW number (1-55-76-12 / 18-18-4-7) identifies the hydrologic order of the minor watershed drainage area. A sequence of numbers, separated by hyphens, orders the minor watershed relative to the minor watersheds downstream and its hydrologic association to the terminal stream and any other tributary streams. Minor watershed numbers are assigned as follows :

Minor watersheds of terminal streams are numbered consecutively upstream, beginning at the Minnesota state line, reflecting the minor watershed's position along the terminal stream (18-18-4-7).

Minor watersheds of tributary streams are numbered consecutively upstream from their junction with the terminal stream (18-18-4-7).

Minor watersheds of tributary to tributary streams are numbered consecutively upstream from their junction with the tributary stream (18-18-4-7).

CSAW numbers are used to determine hydrologic relationships among the minor watersheds. Figure 15 shows minor watersheds located in the Blue Earth River Major Watershed. Elm Creek is the main tributary stream which outlets minor watersheds 30096, 30084, and 30083. 30096 is the 7th minor watershed upstream from the mouth of Elm Creek and is located upstream from 30084 and 30083. Surface water from minor watershed 30096 will flow into 30084; 30084 will flow into 30083; therefore surface water exiting minor watershed 30084 is impacted by surface drainage from minor watershed 30096, but not affected by surface drainage from 30083.

Minor Watershed	CSAW Number
30083	1-55-76-12 / 18-18-4-5
30084	1-55-76-12 / 18-18-4-6
30096	1-55-76-12 / 18-18-4-7
30095	1-55-76-12-9 / 18-18-4-7-1
30097	1-55-76-12-8 / 18-18-4-7-1

The outlet stream of minor watershed 30095 is the 9th tributary to Elm Creek and therefore is upstream from the outlet stream of minor watershed 30097, which is the 8th tributary to Elm Creek. 30095 is the 1st minor watershed along its tributary stream; 30097 is the 1st minor watershed along its tributary stream. Minor watersheds, 30097 and 30095, enter Elm Creek at its 7th minor watershed, 30096. The surface water outflow from minor watershed 30095 does not enter 30097; the outflow is related only by the receiving stream, Elm Creek. Surface water flow from minor watershed 30096 can be followed through the drainage network toward the terminal stream using the CSAW numbers.

Elm Creek is the outlet stream of minor watershed 30096 at the 7th minor watershed upstream from the confluence of Elm Creek with the Blue Earth River. Elm Creek travels through 7 minor watersheds before joining the Blue Earth River.

Elm Creek enters the Blue Earth River (1-55-76) at the 4th minor watershed (18-18-4) upstream from the outlet of the Blue Earth River.

The Blue Earth River enters the Minnesota River (1-55) at the 18th minor watershed (18-18) upstream from outlet of the Minnesota River.

The Minnesota River enters the terminal stream, the Mississippi River (1) at the 18th minor watershed (18) from the Mississippi River's exit from the state of Minnesota.

Surface water drainage from minor watershed, 30096 will travel through 47 minor watersheds before exiting Minnesota through the Mississippi River (18+18+4+7).

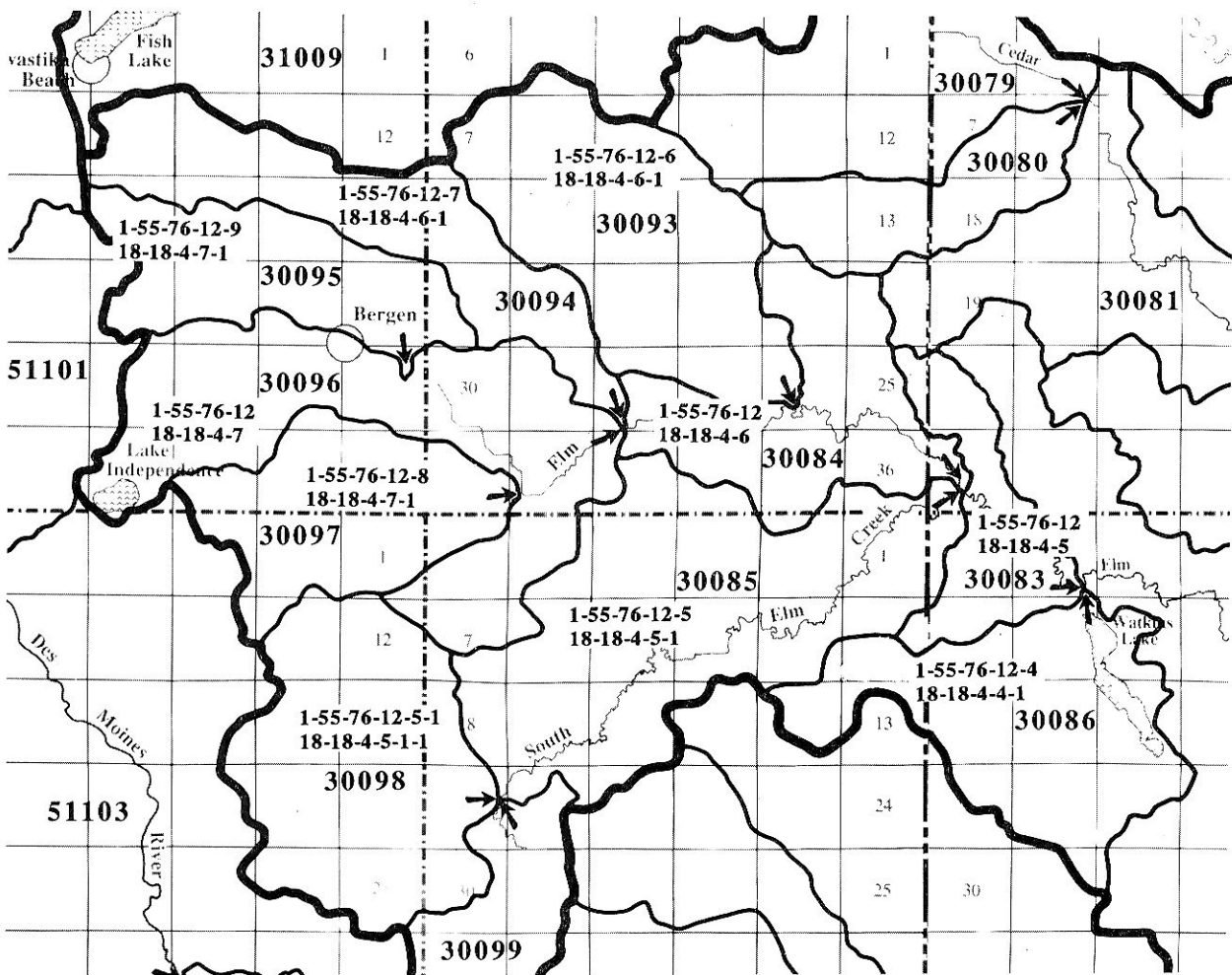
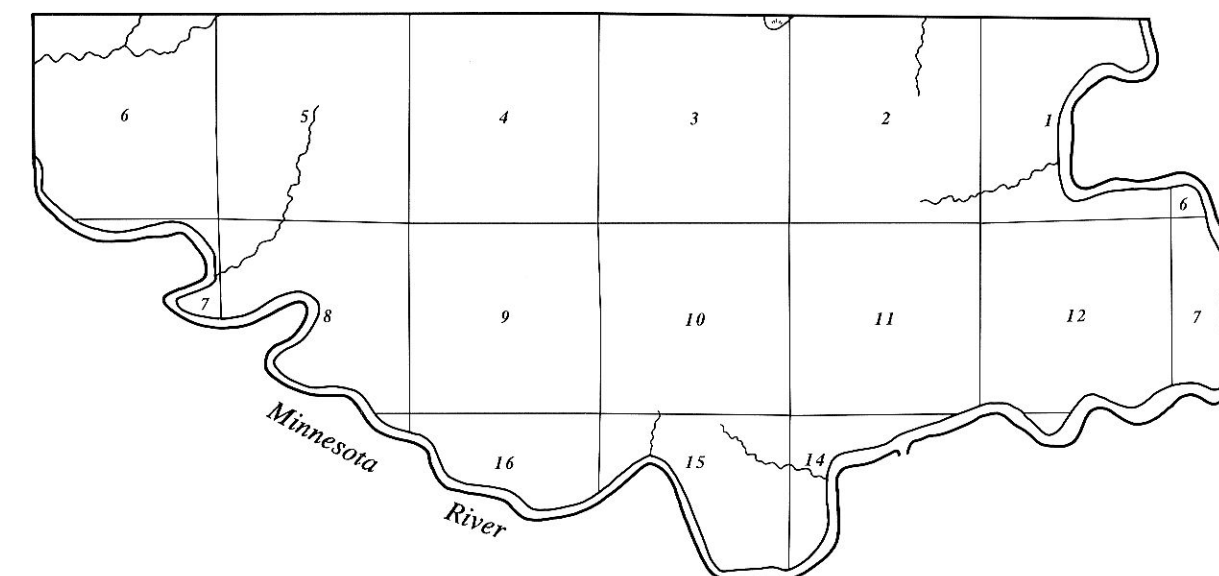
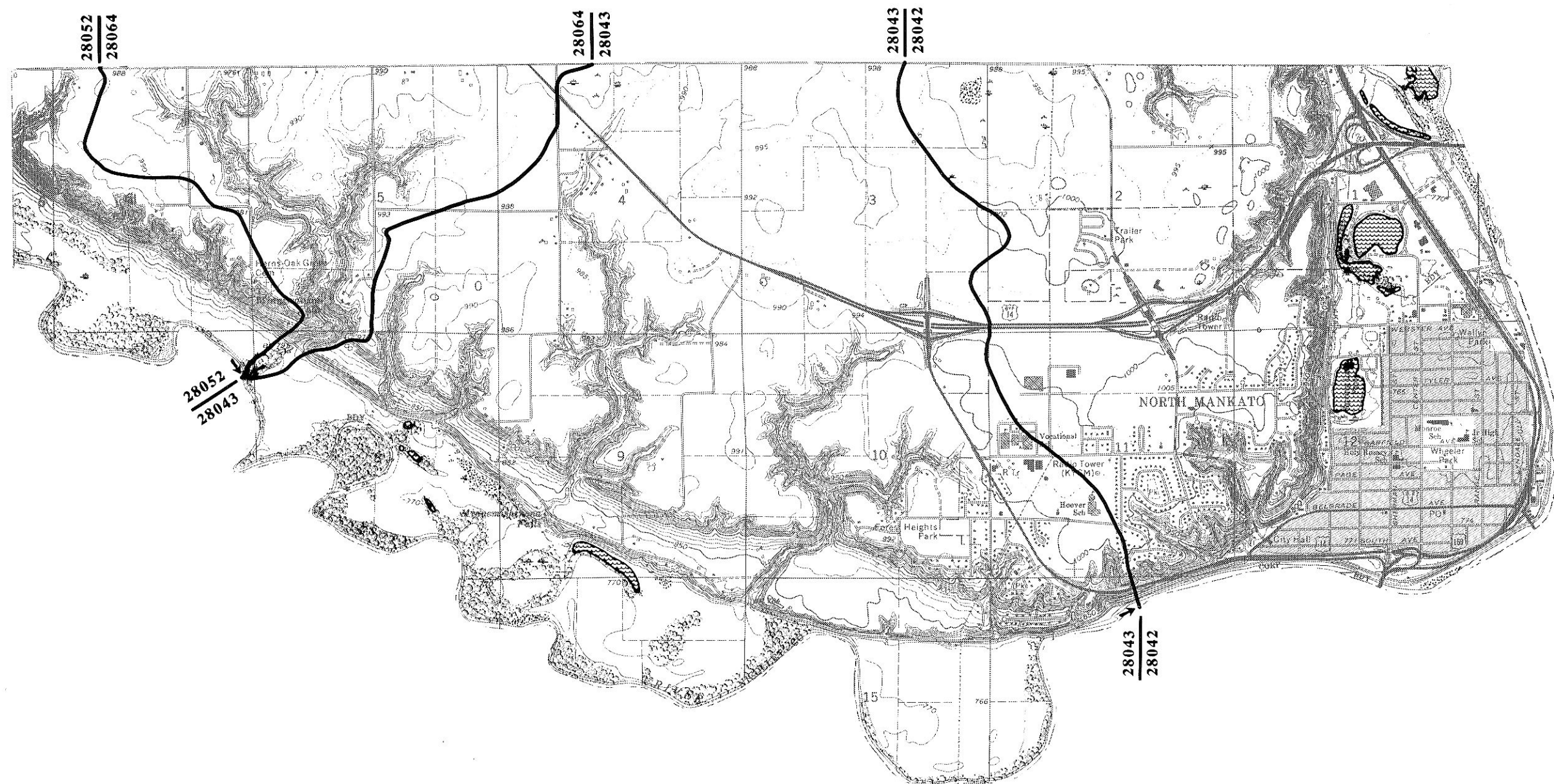


Figure 15. Hydrologic relationships of minor watersheds using CSAW numbering system.

SURFACE WATER HYDROLOGY MAP

T. 108 N. R. 26-27 W.

GENERAL LAND SURVEY MAP



SCALE: 1 : 64,000 1 inch = 1 mile

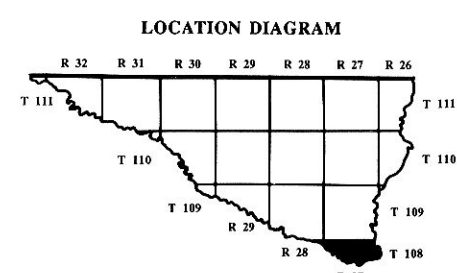
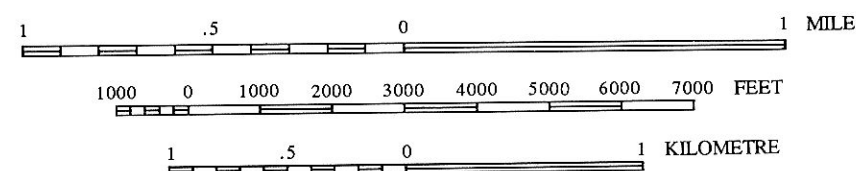
EXPLANATION



EXPLANATION Surface Water Hydrology Map



SCALE 1:32,000



Minor Watershed Boundary



Ditchshed Boundary



Lakeshed Boundary



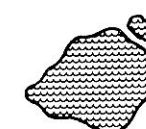
Open Drainage Ditch
(Arrow points in direction of flow)



Tile Drainage Ditch
(Arrow points in direction of flow)



Open Water
(NWI Lacustrine; Limnetic and Littoral
Palustrine: Unconsolidated Bottom
and Aquatic Bed)



Emergent Wetlands
(NWI Palustrine: Emergent)



Shrub Wetlands
(NWI Palustrine: Scrub-Shrub)



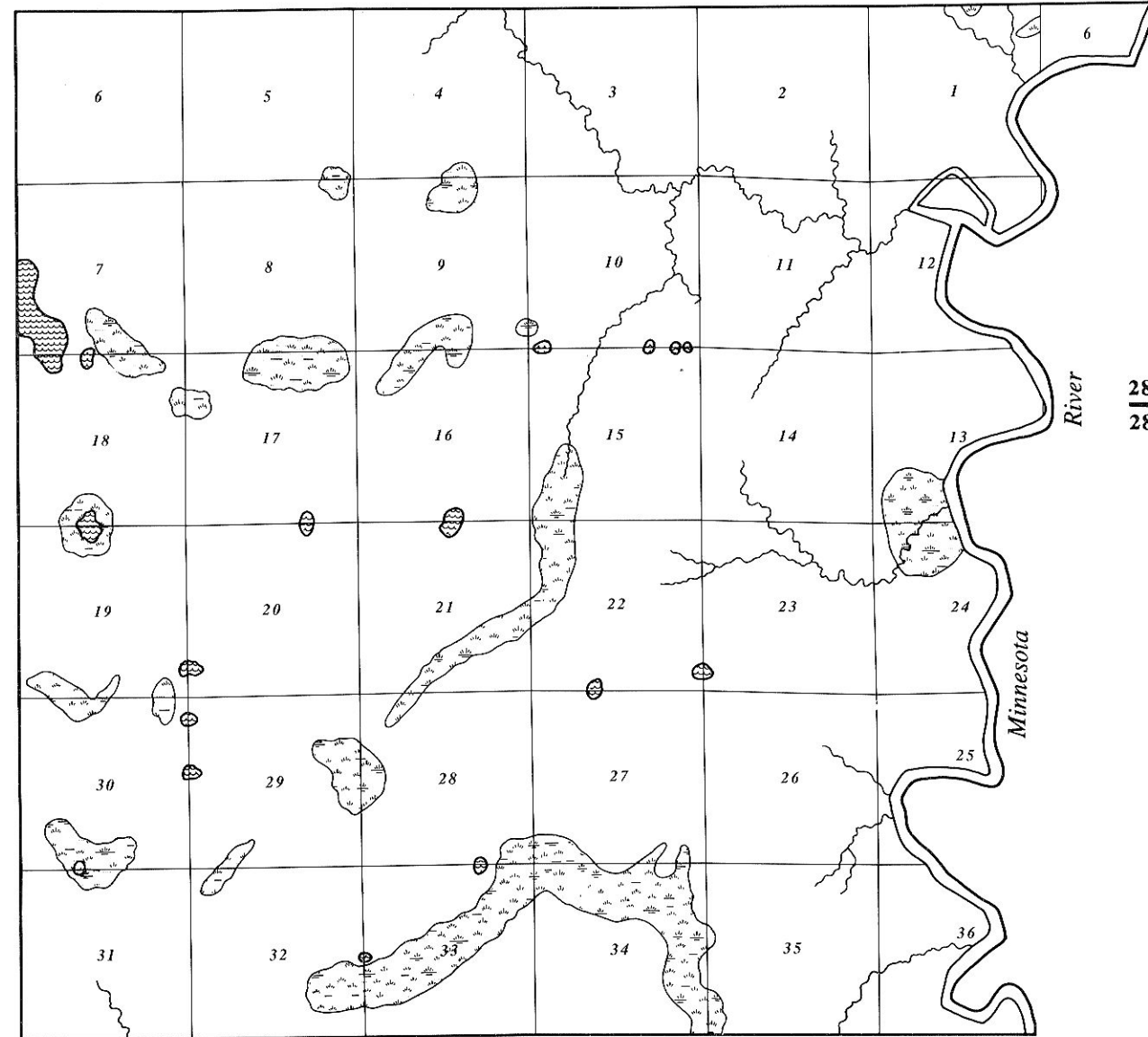
Forested Wetlands
(NWI Palustrine: Forested)



T. 109 N. R. 26-27 W.

SURFACE WATER HYDROLOGY MAP

GENERAL LAND SURVEY MAP

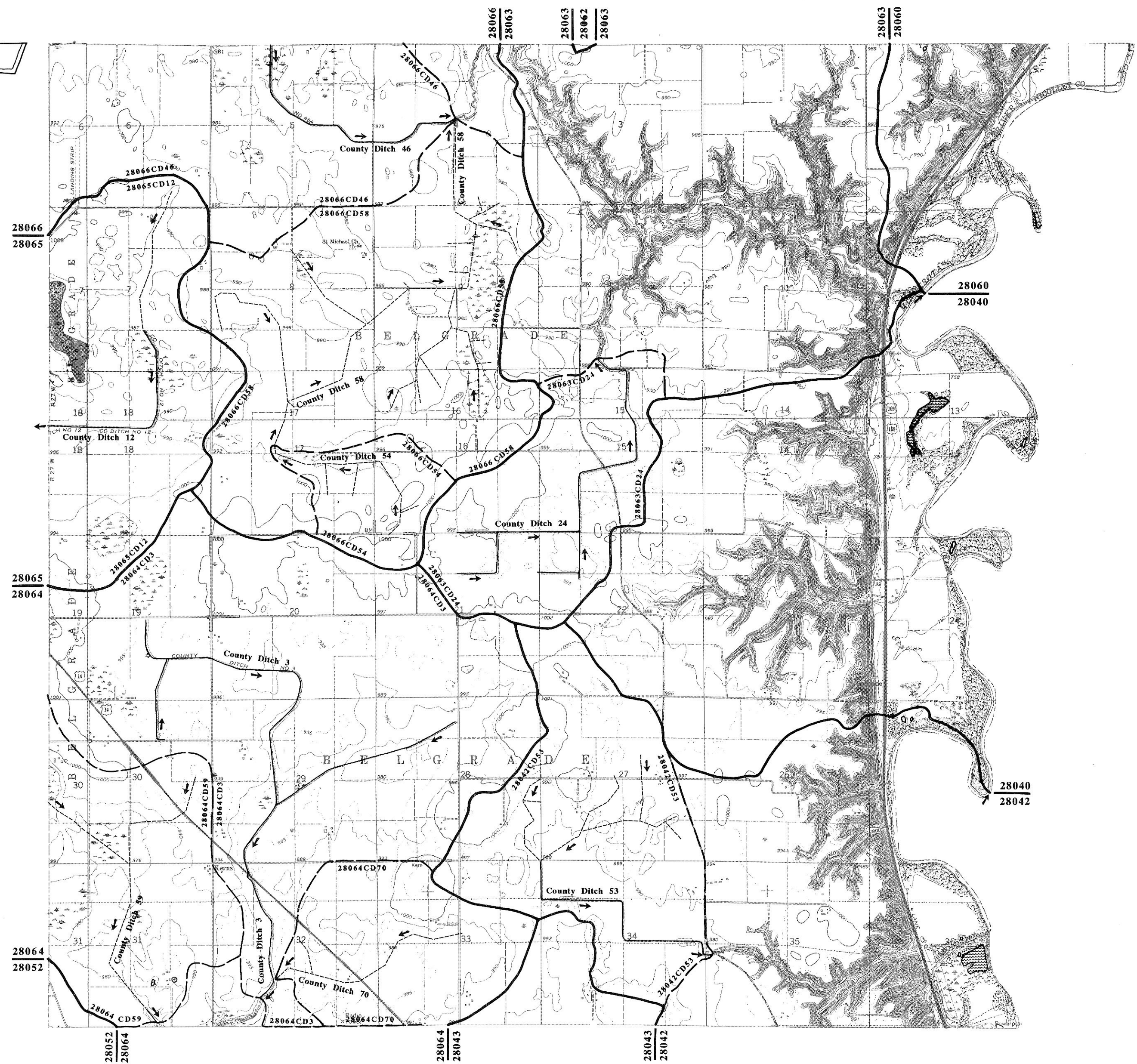
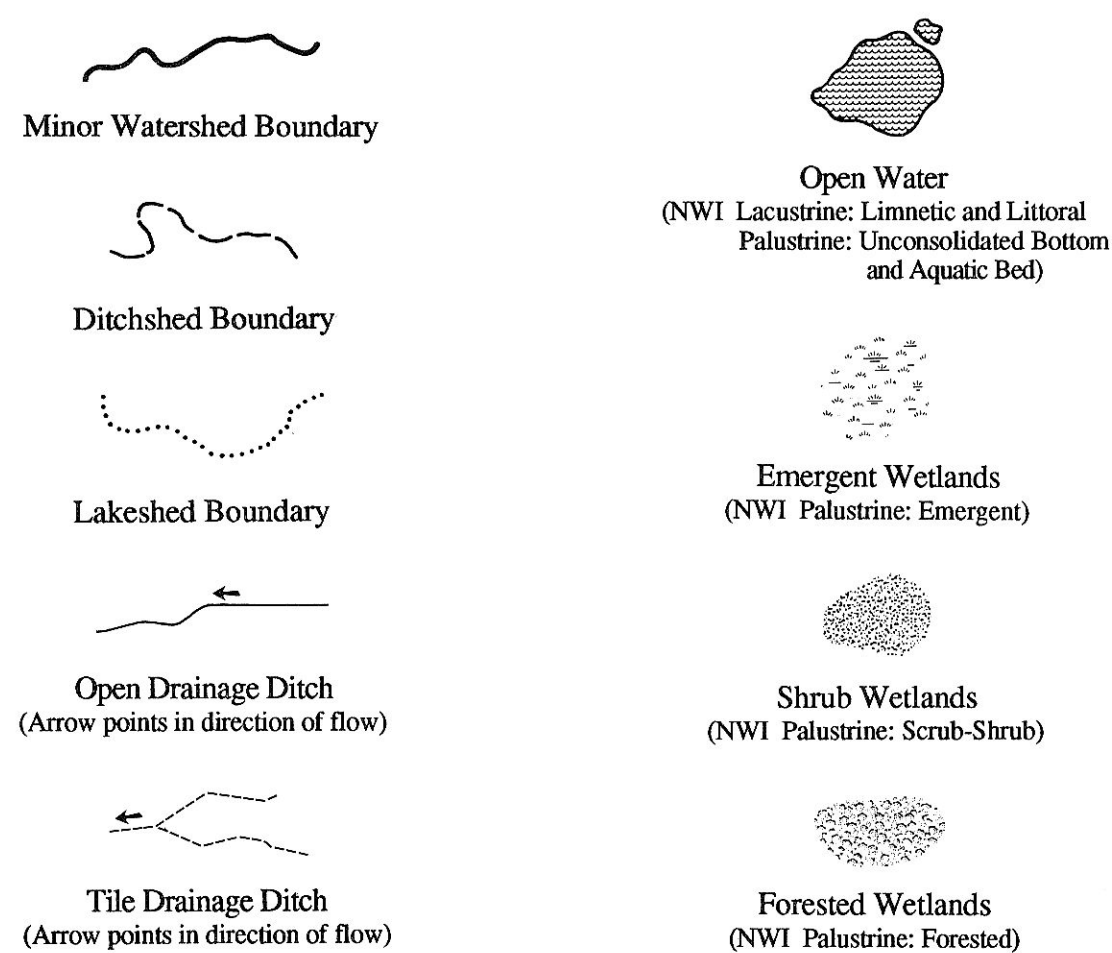


SCALE: 1 : 64,000 1 inch = 1 mile

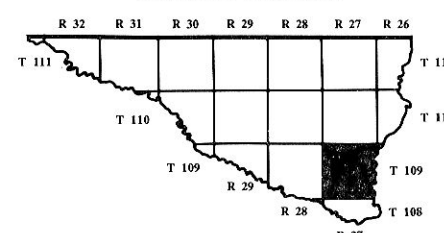
EXPLANATION



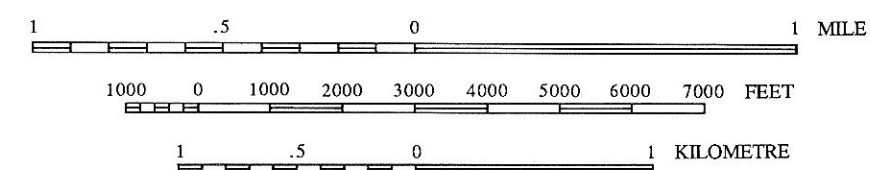
EXPLANATION Surface Water Hydrology Map



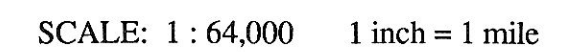
LOCATION DIAGRAM



SCALE 1:32,000



T. 109-108 N. R. 28 W.



Wetland
(Marsh, Slough)

Open Water
(Lake, Pond)

Riverine
(River, Stream)

Minor Watershed Boundary

Ditchshed Boundary

Lakeshed Boundary

Open Drainage Ditch
(Arrow points in direction of flow)

Tile Drainage Ditch
(Arrow points in direction of flow)

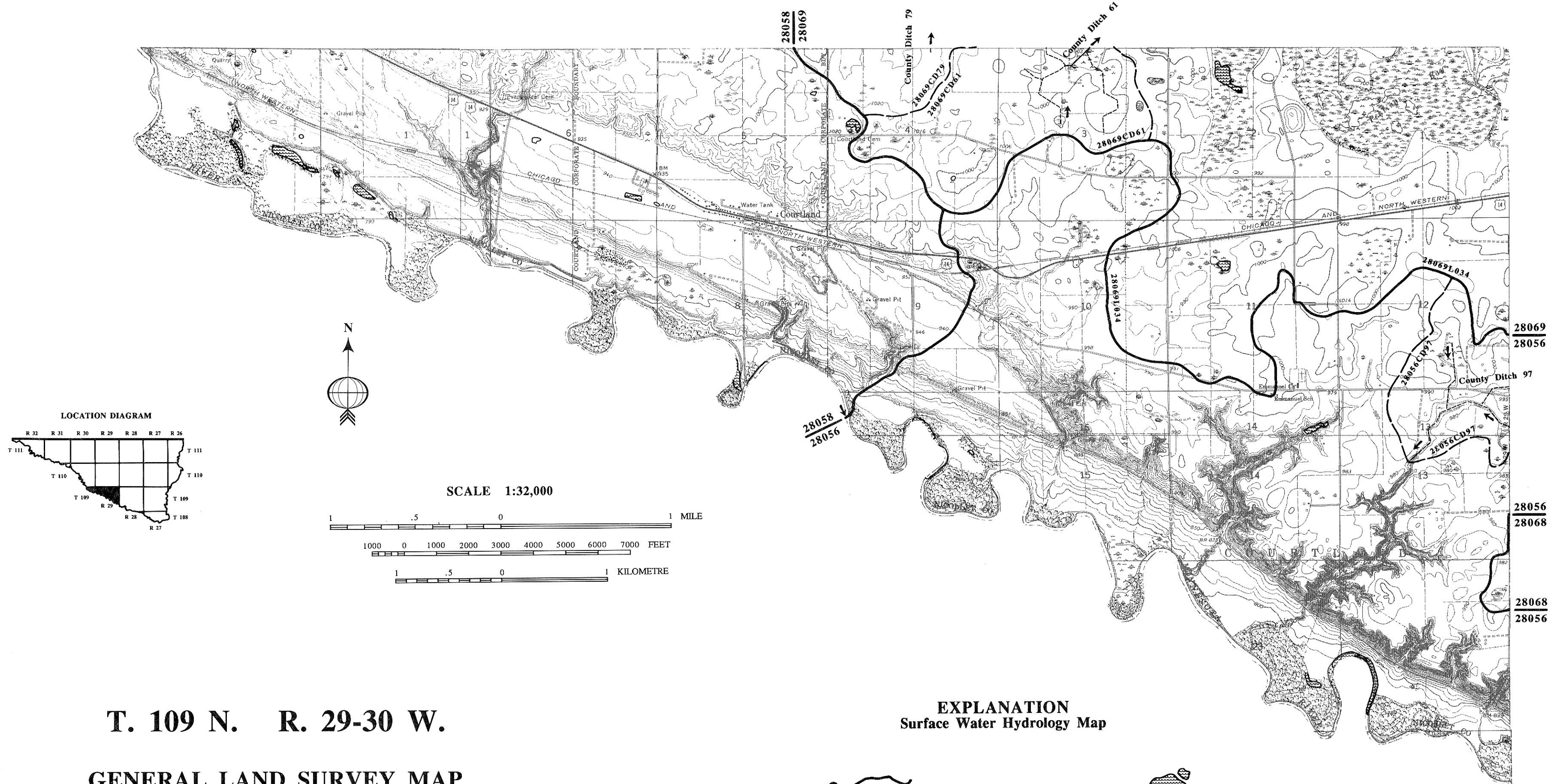
Open Water
(NWI Lacustrine: Limnetic and Littoral
Palustrine: Unconsolidated Bottom
and Aquatic Bed)

Emergent Wetlands
(NWI Palustrine: Emergent)

Shrub Wetlands
(NWI Palustrine: Scrub-Shrub)

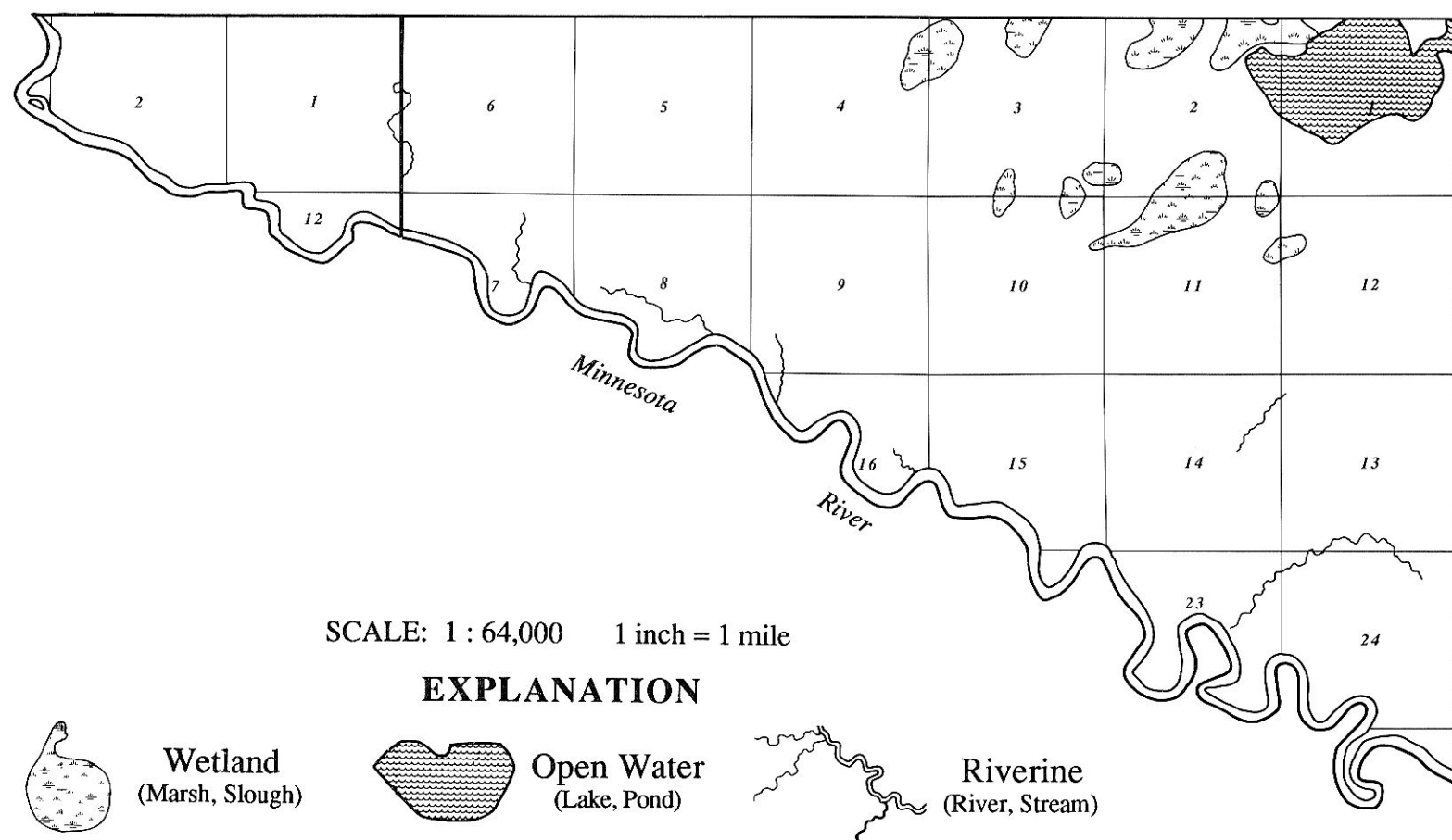
Forested Wetlands
(NWI Palustrine: Forested)

SURFACE WATER HYDROLOGY MAP



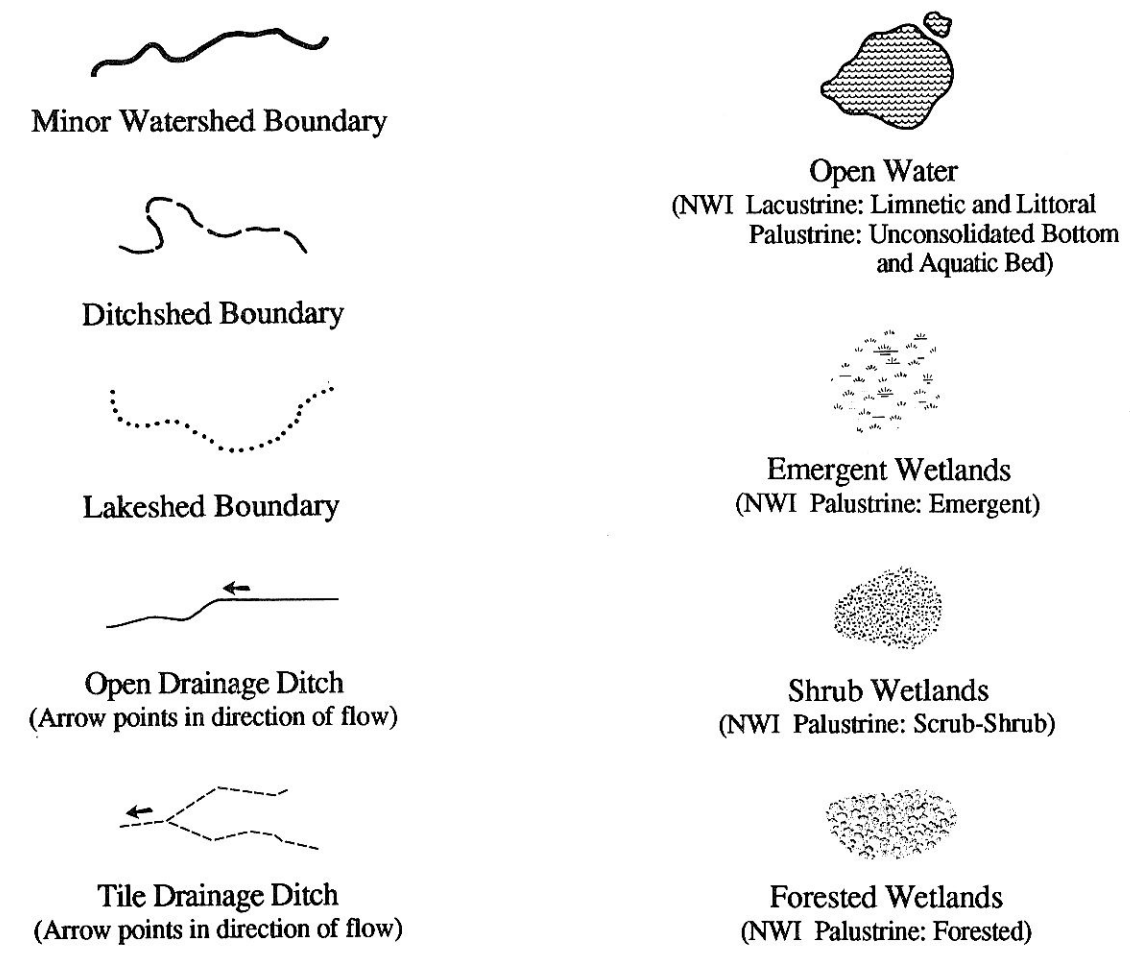
T. 109 N. R. 29-30 W.

GENERAL LAND SURVEY MAP



EXPLANATION

Surface Water Hydrology Map



T. 110 N. R. 26 W.

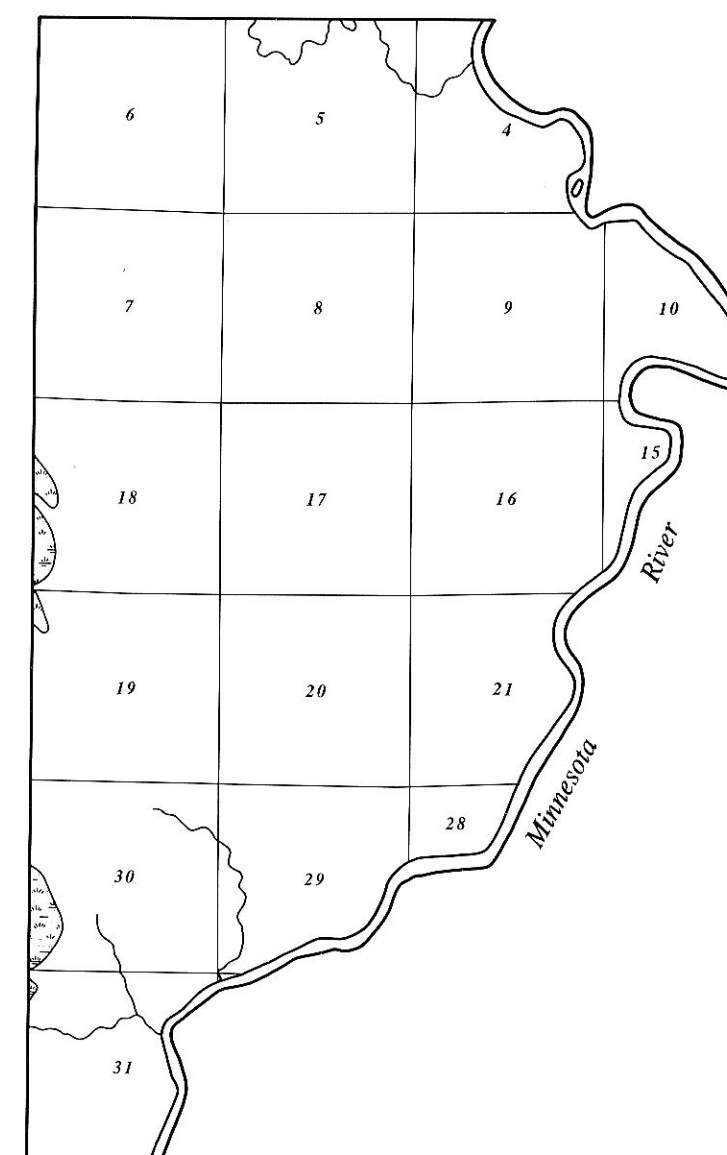
This is a detailed topographic map of Traverse des Sioux, Minnesota, and its surrounding areas. The map features a grid system with section numbers (e.g., 16, 17, 19, 20, 21) and township/range coordinates. Key locations include the city of Traverse des Sioux, St. Peter, and the Traverse des Sioux State Park. The map shows various geographical features such as hills, valleys, and water bodies. A location diagram in the bottom right corner provides a broader context of the map's position within a larger grid system.

Map Labels:

- Traverse des Sioux
- St. Peter
- Traverse des Sioux State Park
- County Ditch 33
- County Ditch 51
- 28061
- 28038
- 28038
- 28060
- 28062
- 28062
- 28060

Location Diagram:

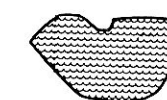
The location diagram shows a grid of sections (R 27, R 28, R 29, R 30, R 31, R 32) and townships (T 108, T 109, T 110, T 111). The map area is highlighted in the bottom right corner of the diagram.



EXPLANATION



Wetland
(Marsh, Slough)

 Open Water
(Lake, Pond)

Riverine
(River, Stream)

EXPLANATION
Surface Water Hydrology Map



Minor Watershed Boundary



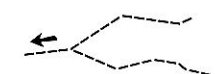
Ditchshed Boundary



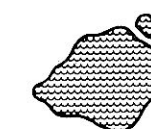
Lakeshed Boundary



Open Drainage Ditch
(Arrow points in direction of flow)



Tile Drainage Ditch
(Arrow points in direction of flow)



Open Water
(NWI Lacustrine: Limnetic and Littoral
Palustrine: Unconsolidated Bottom
and Aquatic Bed)



Emergent Wetlands
(NWI Palustrine: Emergent)



Shrub Wetlands
(NWI Palustrine: Scrub-Shrub)

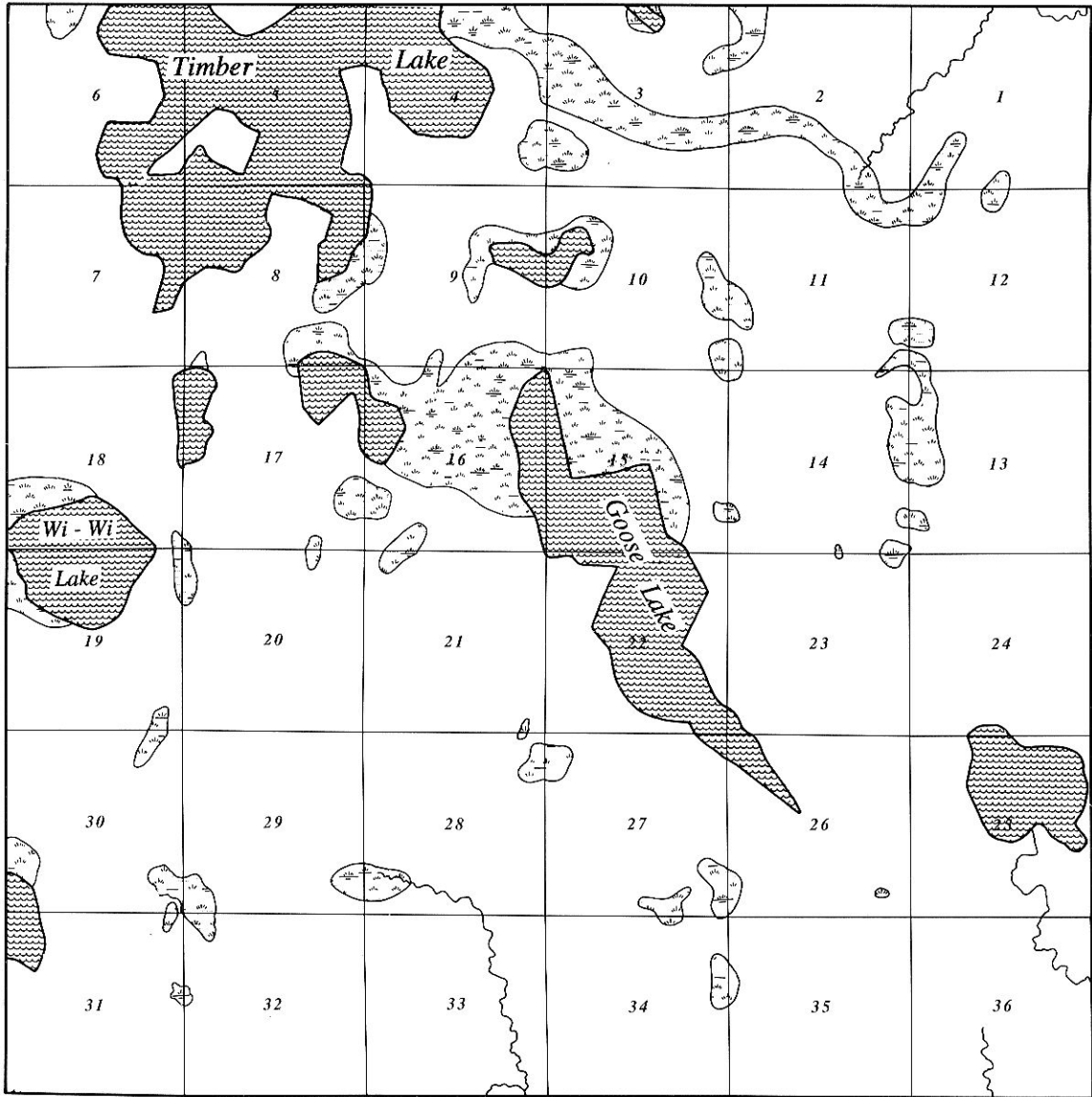


Forested Wetlands
(NWI Palustrine: Forested)

T. 110 N. R. 27 W.

SURFACE WATER HYDROLOGY MAP

GENERAL LAND SURVEY MAP

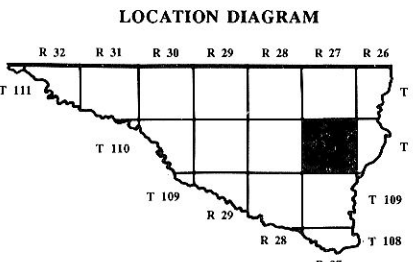
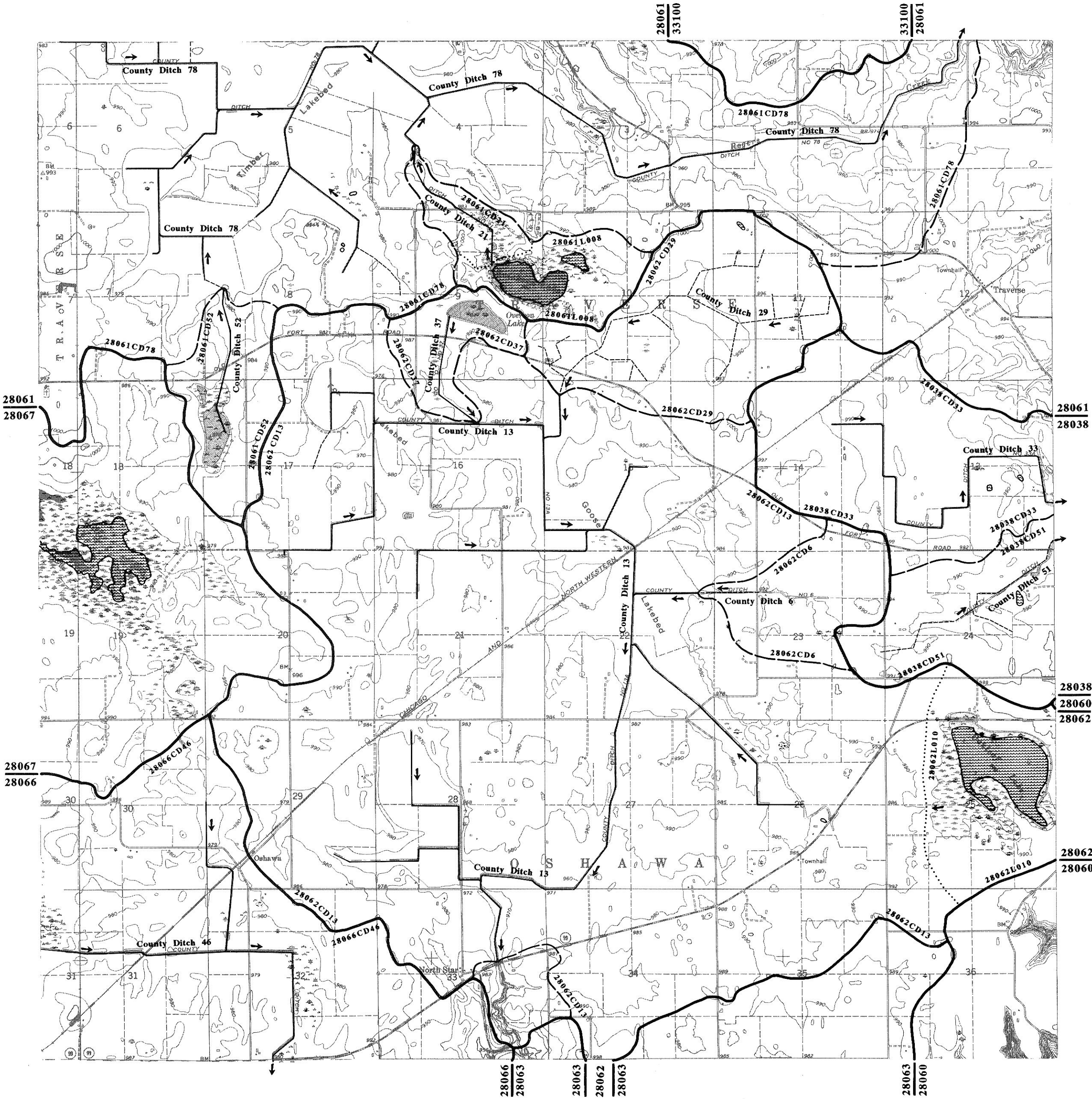
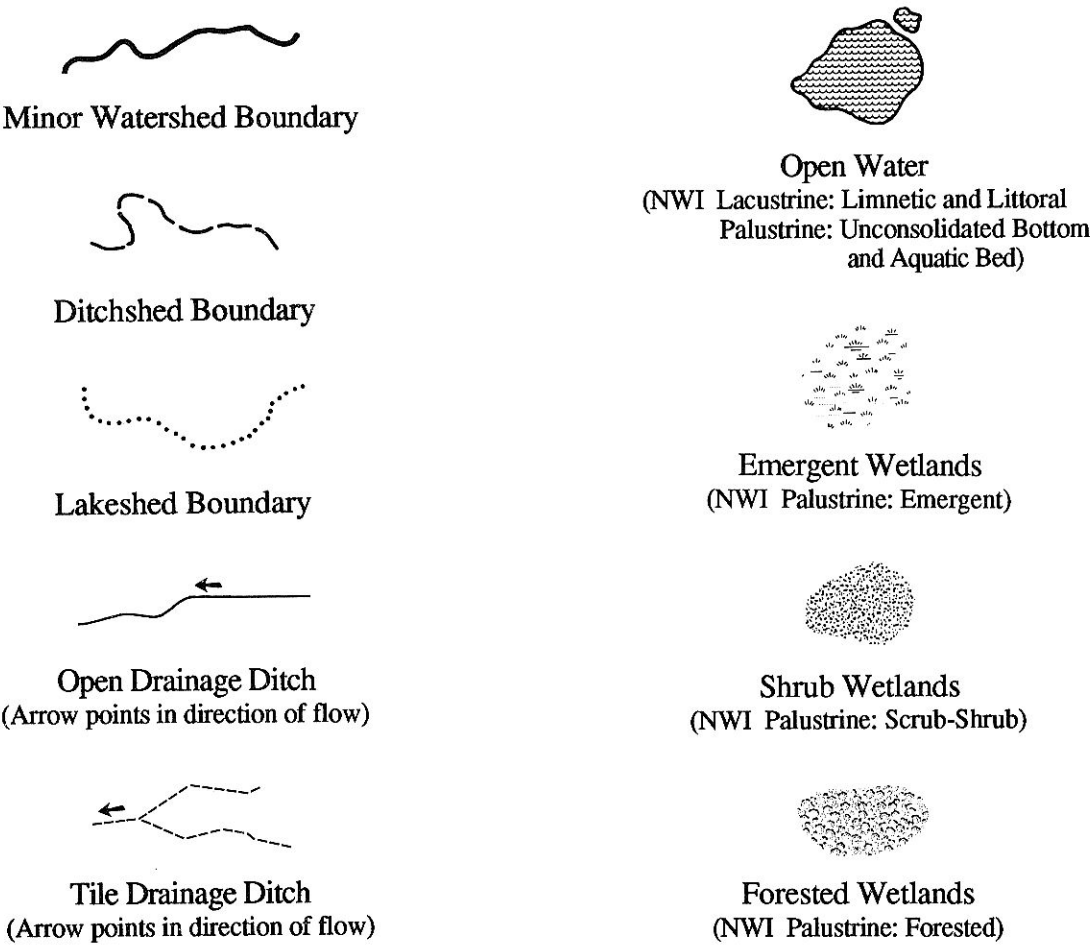


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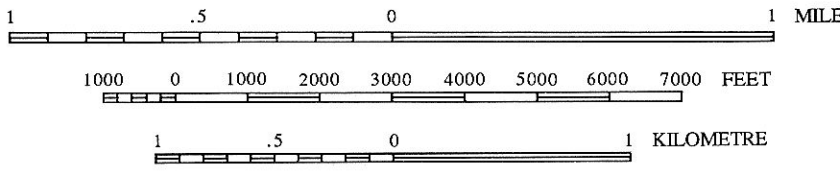
EXPLANATION



EXPLANATION
Surface Water Hydrology Map

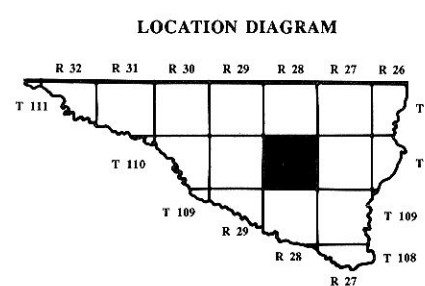
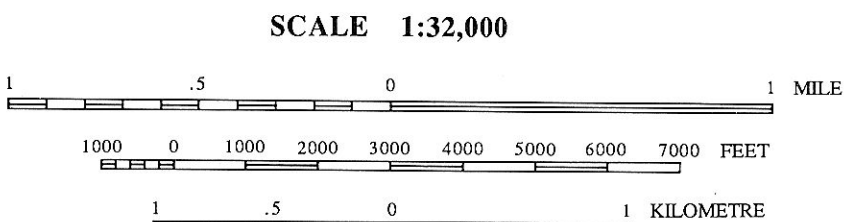
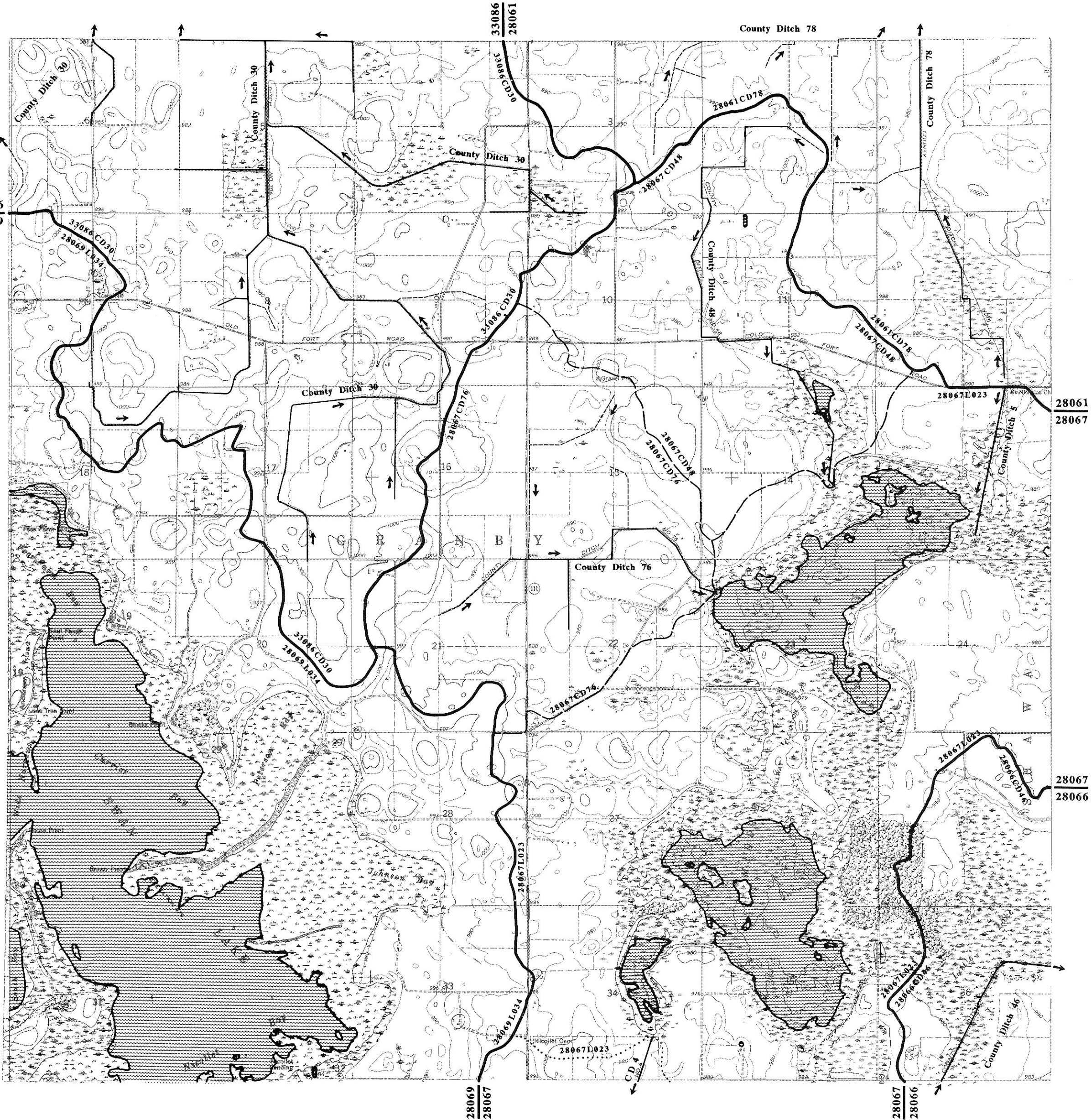


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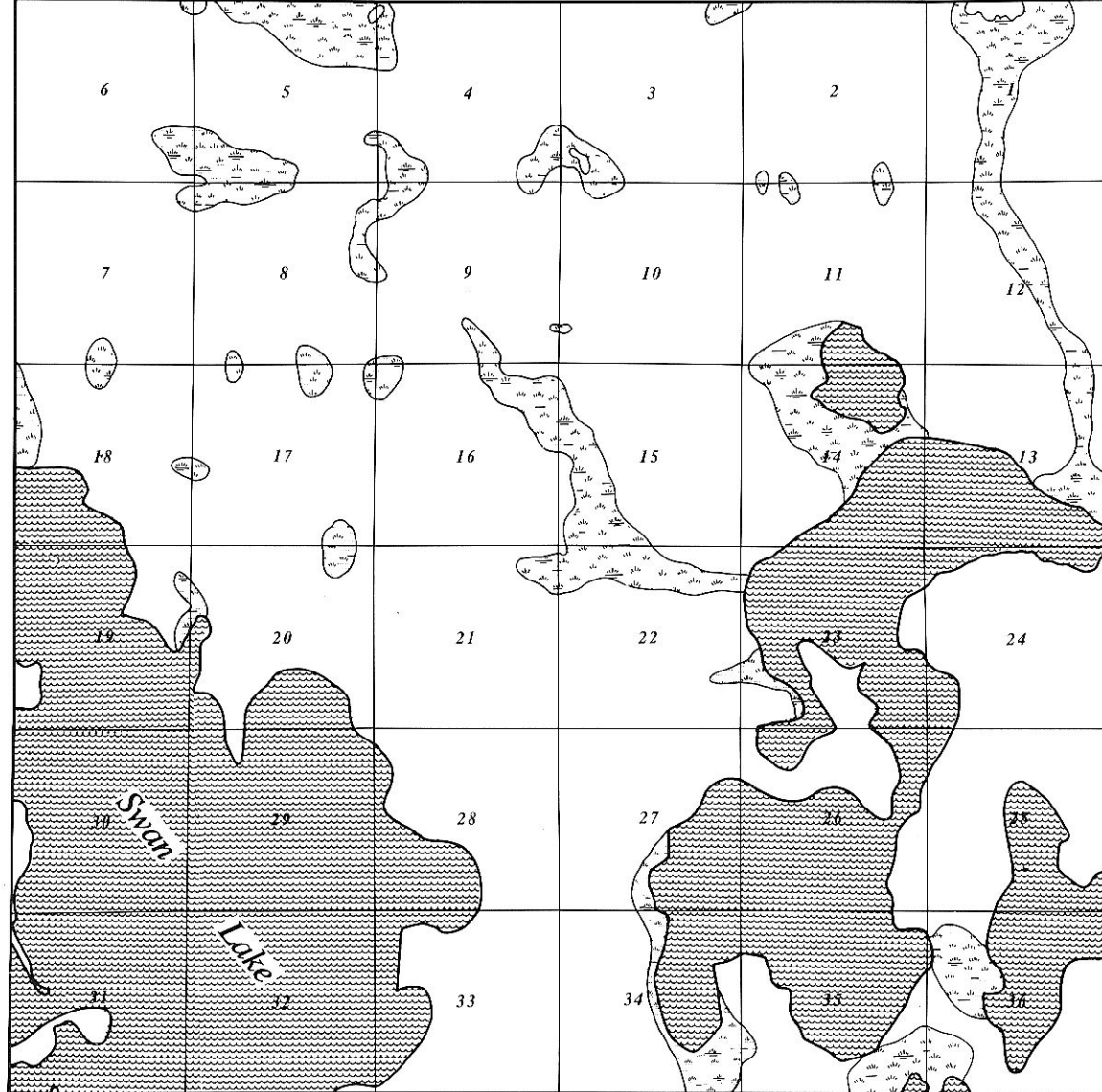


SURFACE WATER HYDROLOGY MAP

T. 110 N. R. 28 W.



GENERAL LAND SURVEY MAP

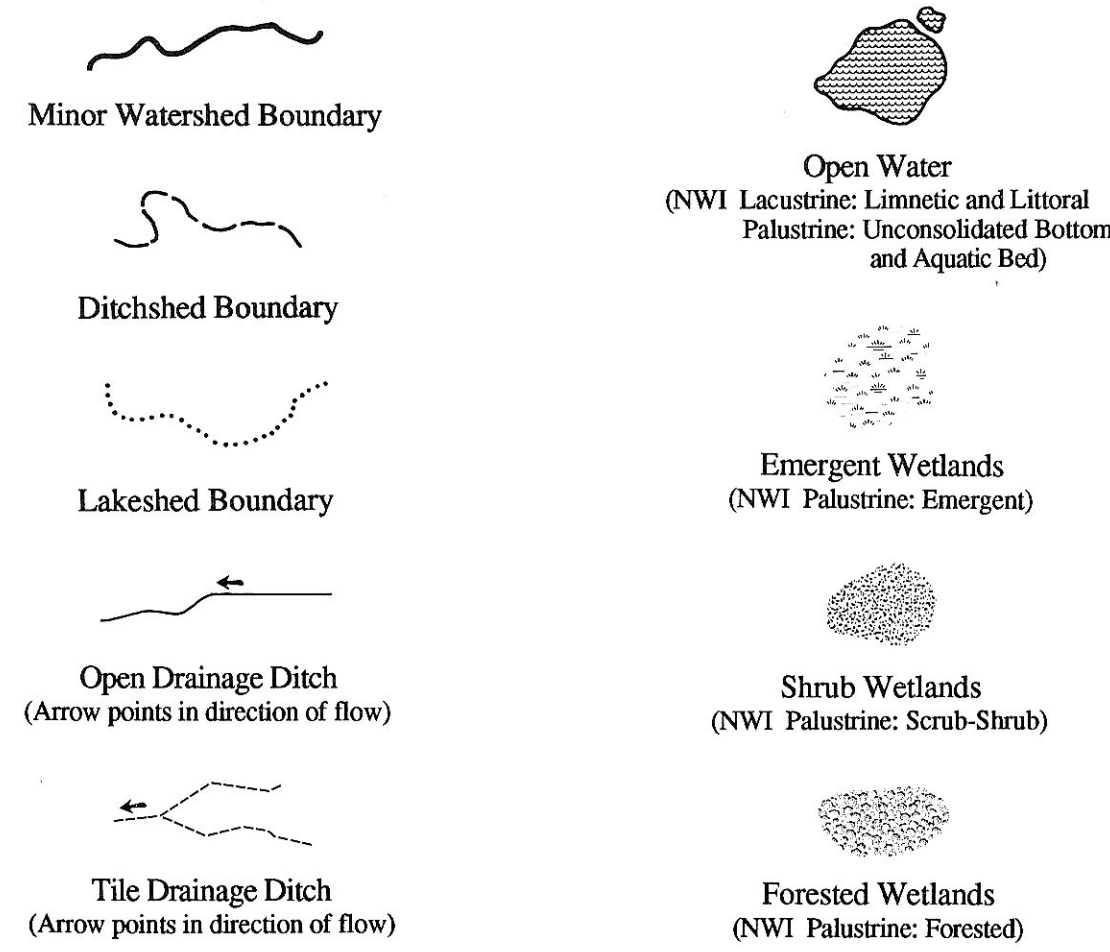


SCALE: 1 : 64,000 1 inch = 1 mile

EXPLANATION

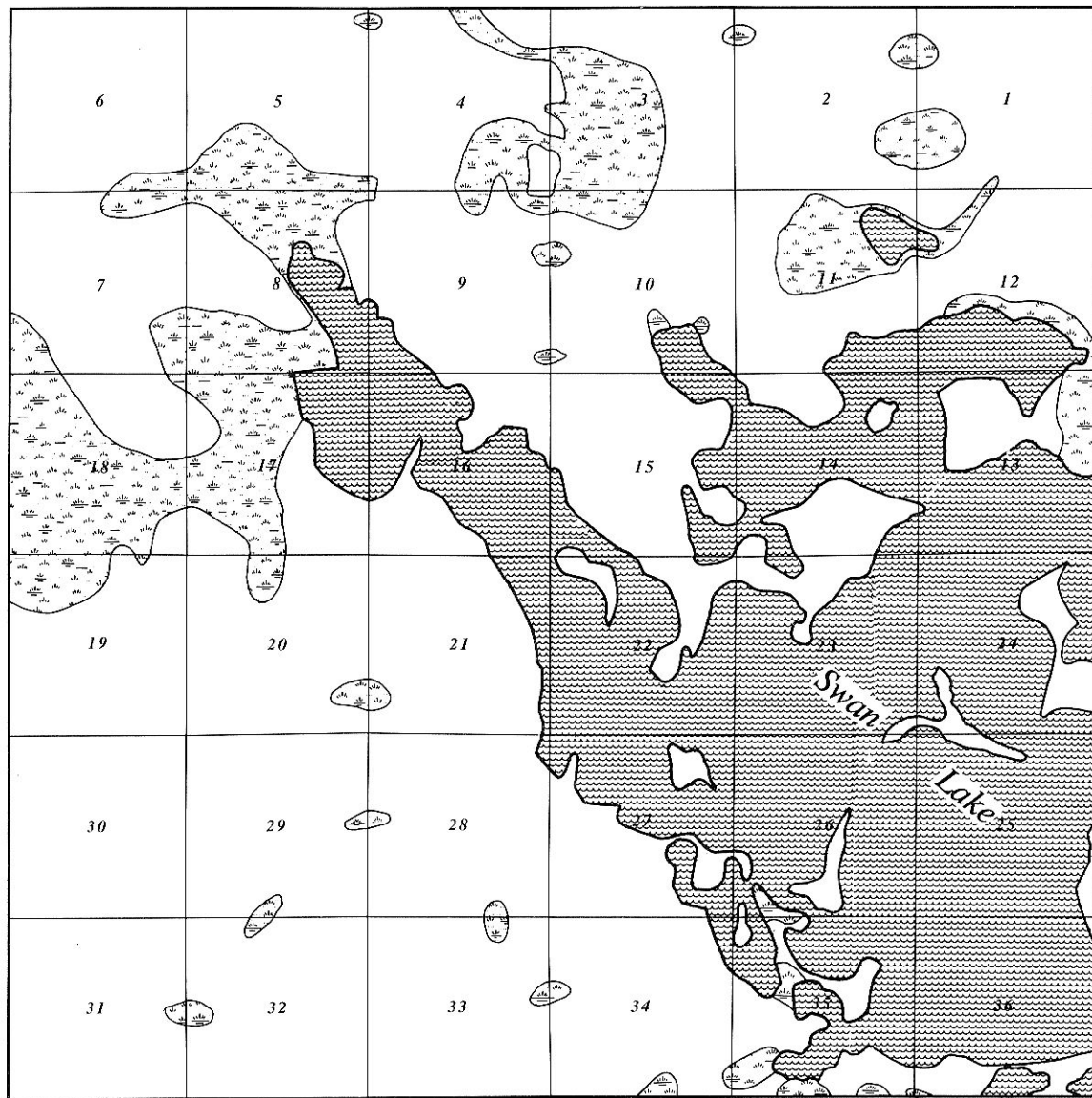


EXPLANATION
Surface Water Hydrology Map



T. 110 N. R. 29 W.

GENERAL LAND SURVEY MAP



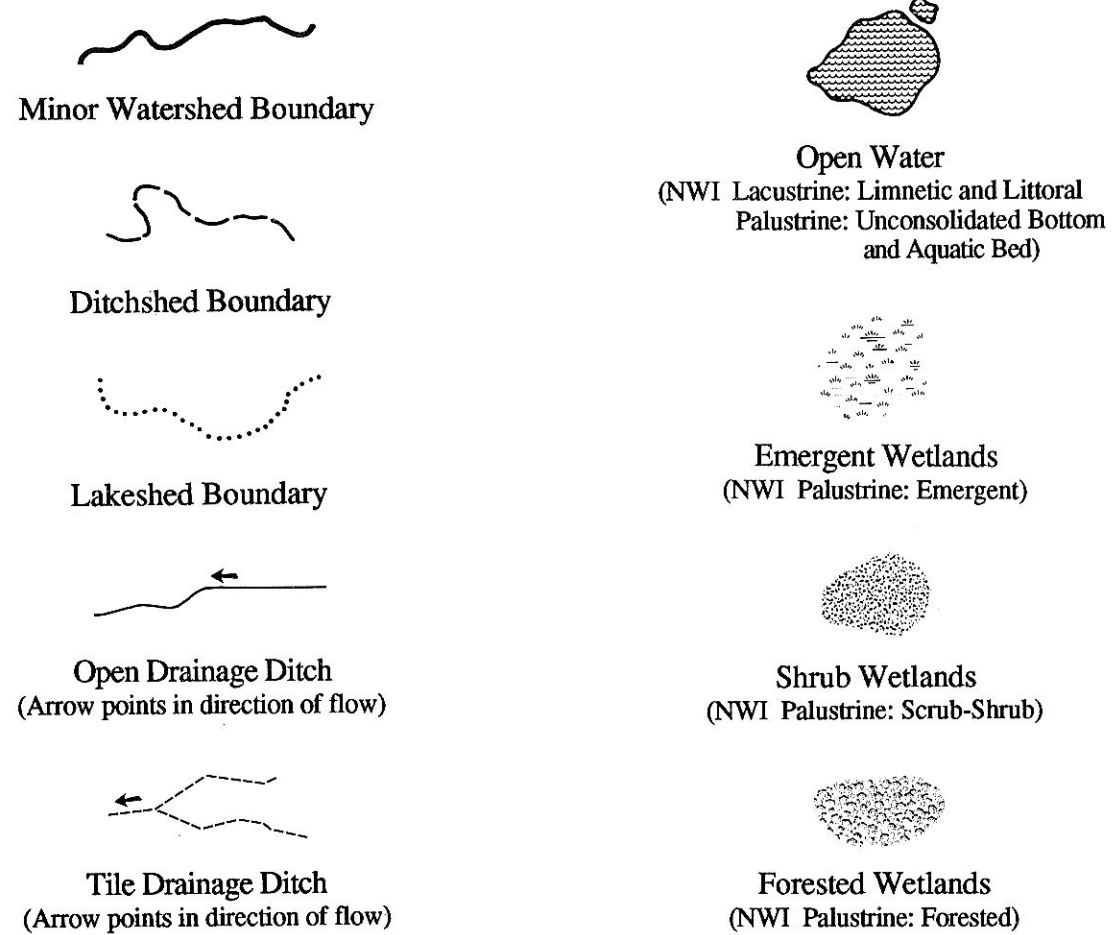
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EXPLANATION

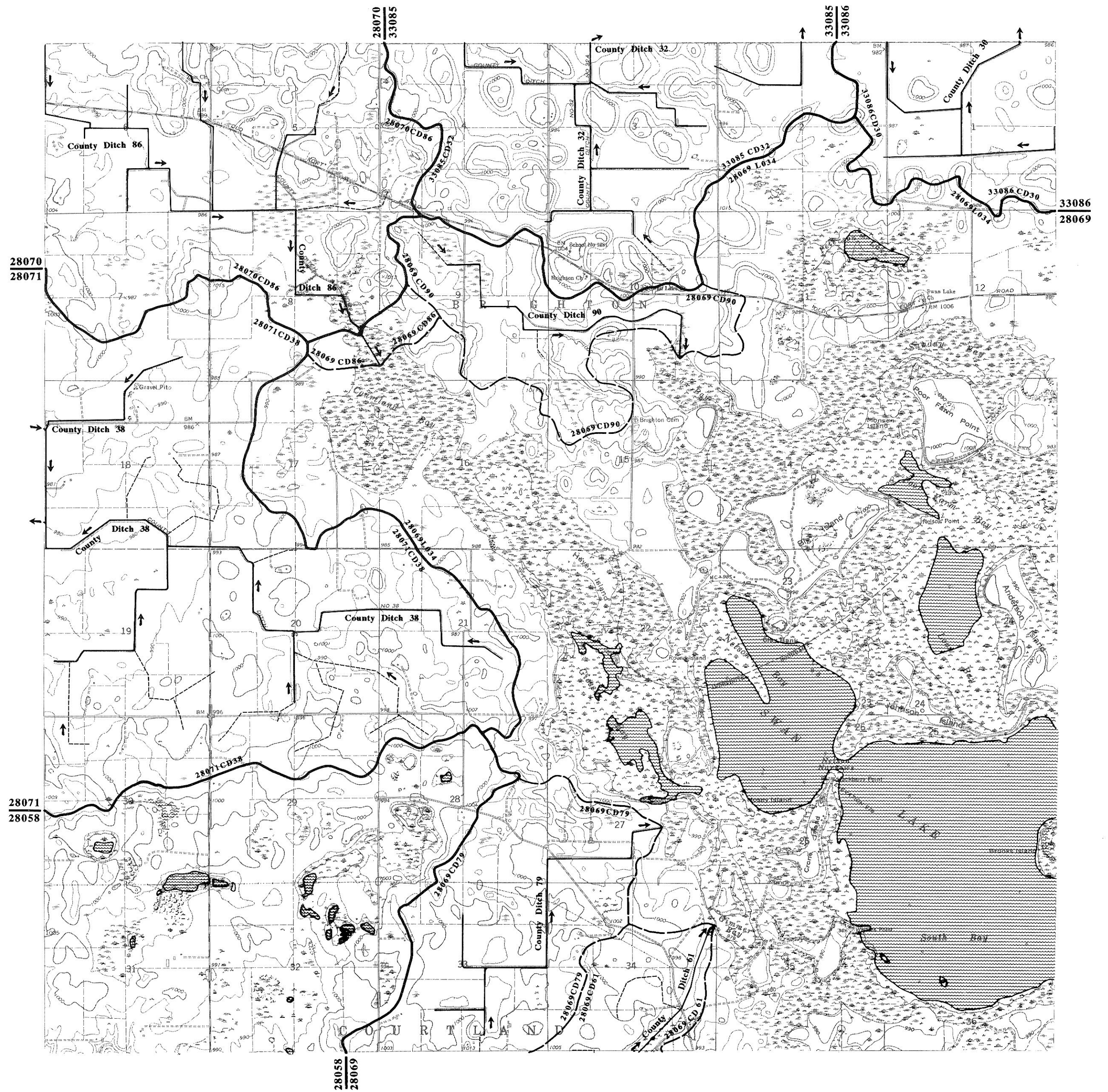


EXPLANATION

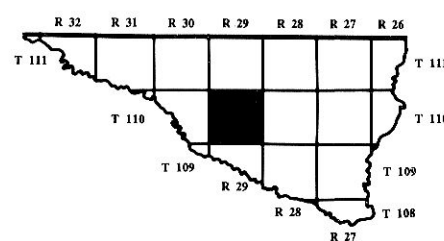
Surface Water Hydrology Map



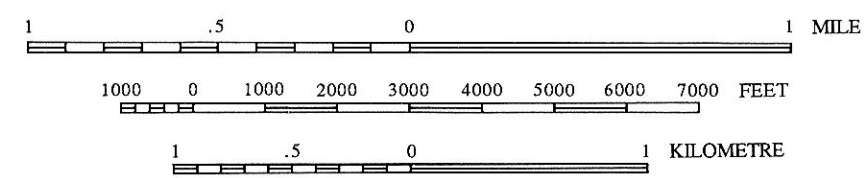
SURFACE WATER HYDROLOGY MAP



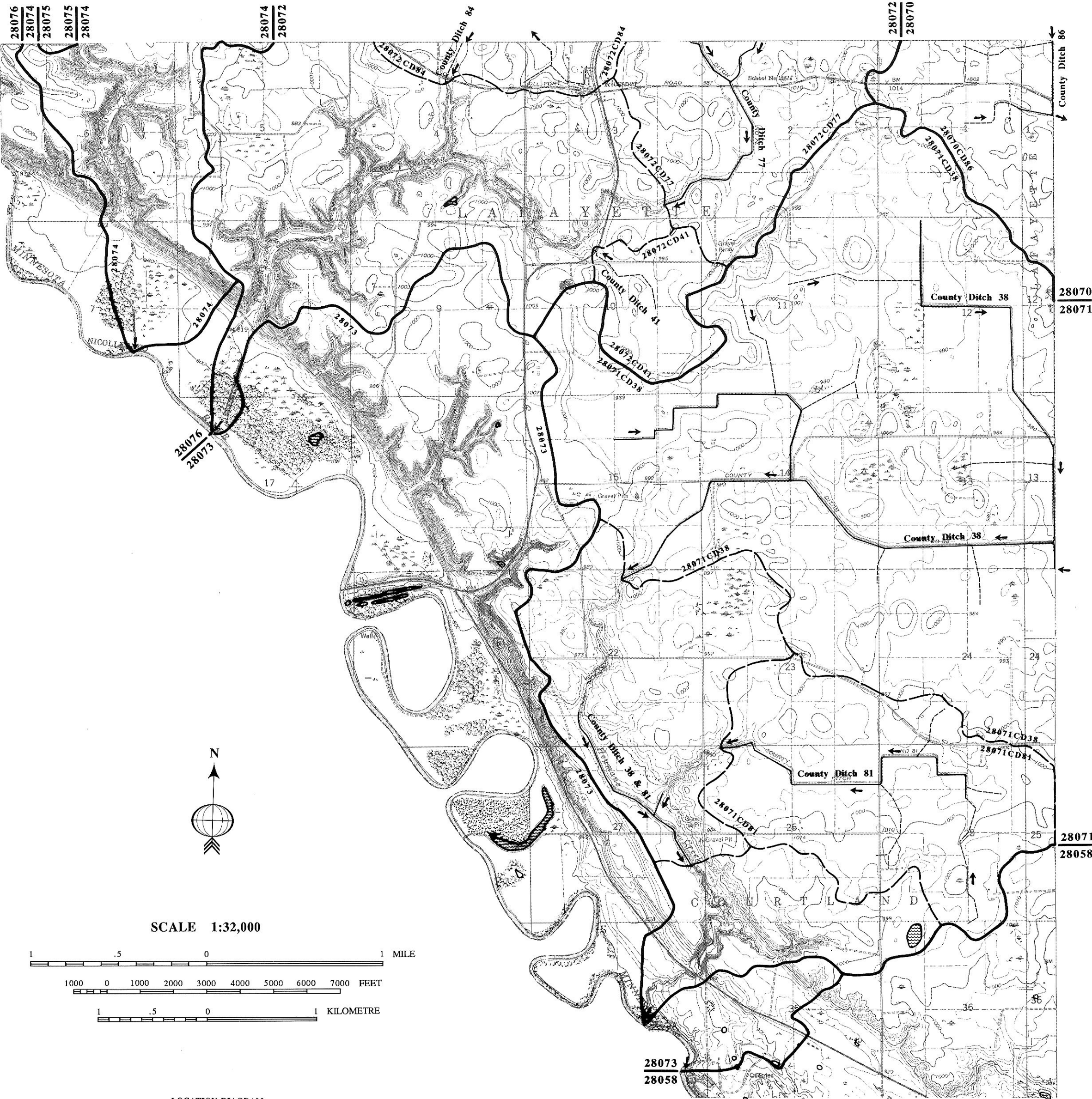
LOCATION DIAGRAM



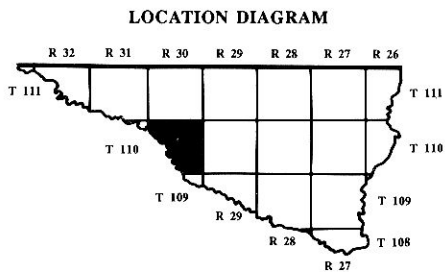
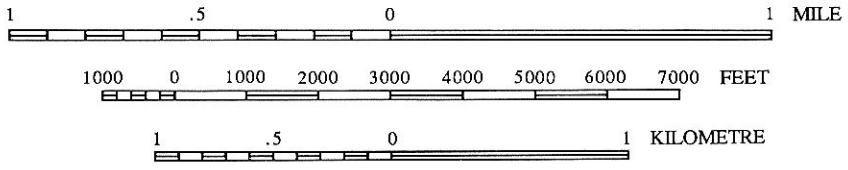
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SURFACE WATER HYDROLOGY MAP

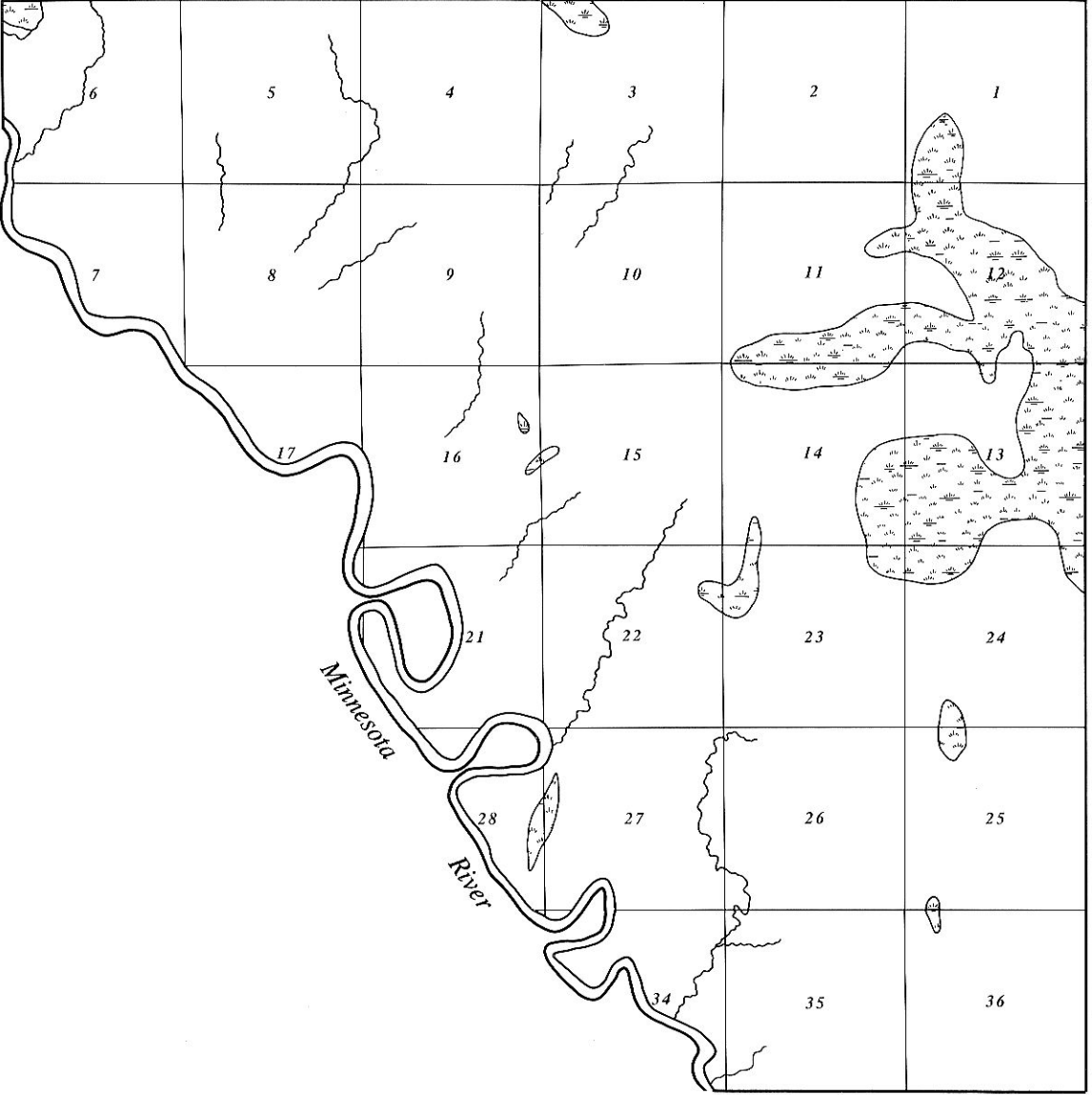


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T. 110 N. R. 30 W.

GENERAL LAND SURVEY MAP

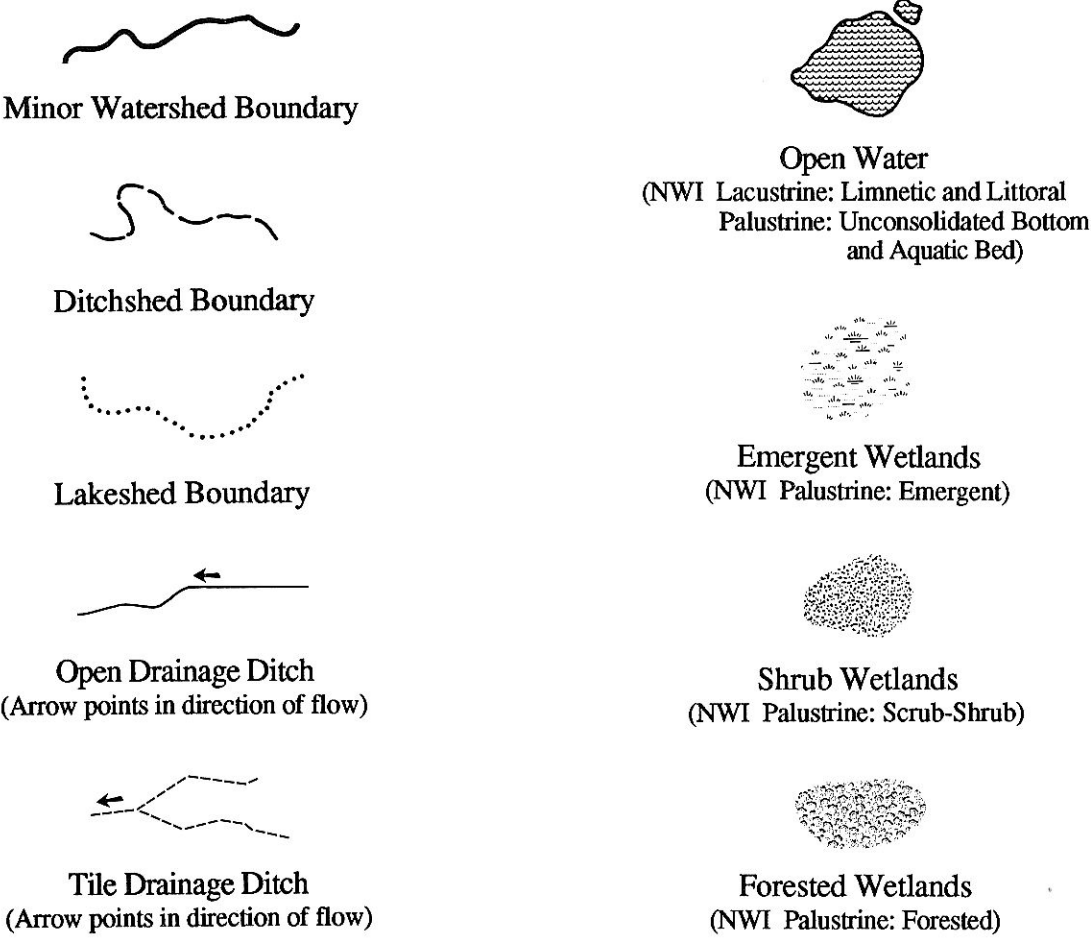


SCALE: 1 : 64,000 1 inch = 1 mile

EXPLANATION

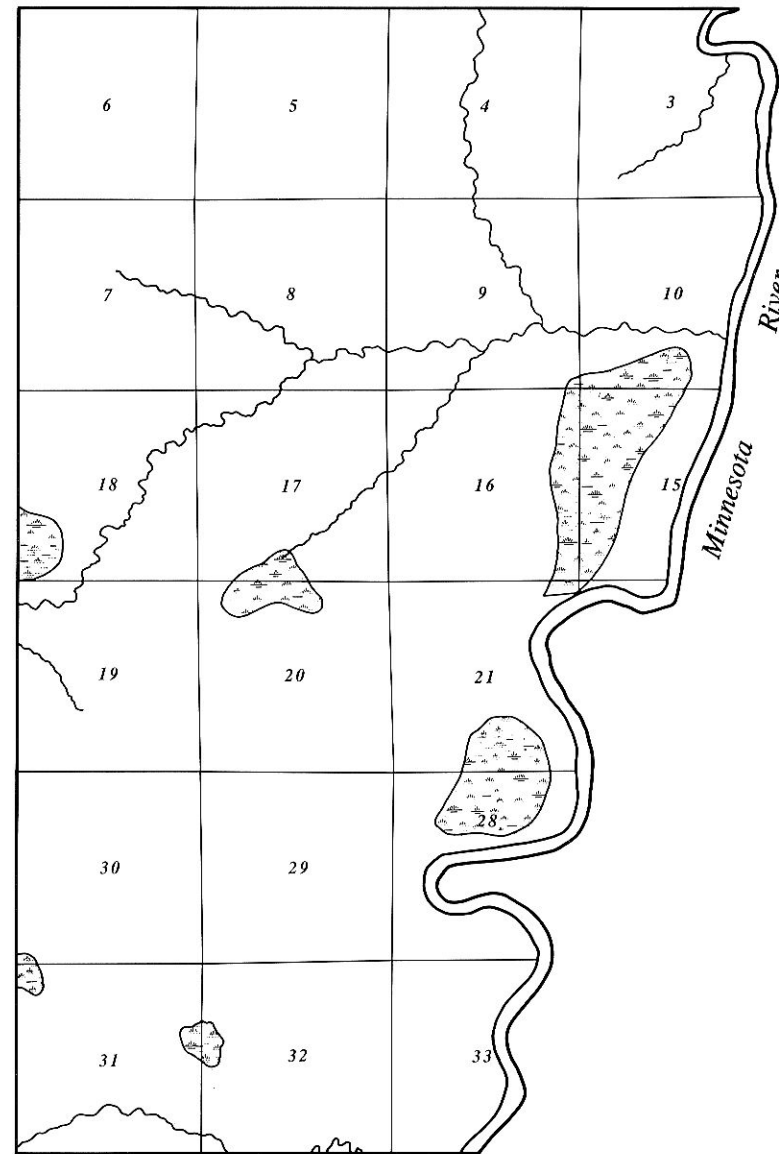


EXPLANATION
Surface Water Hydrology Map

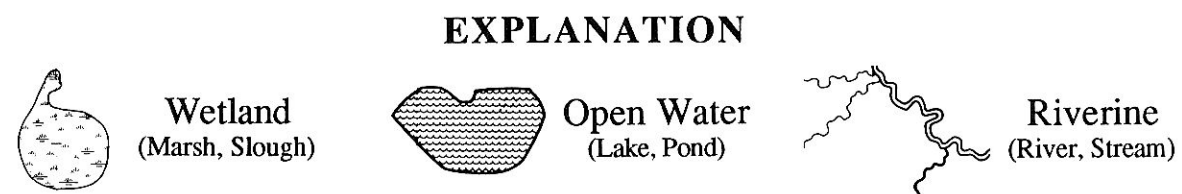


T. 111 N. R. 26 W.

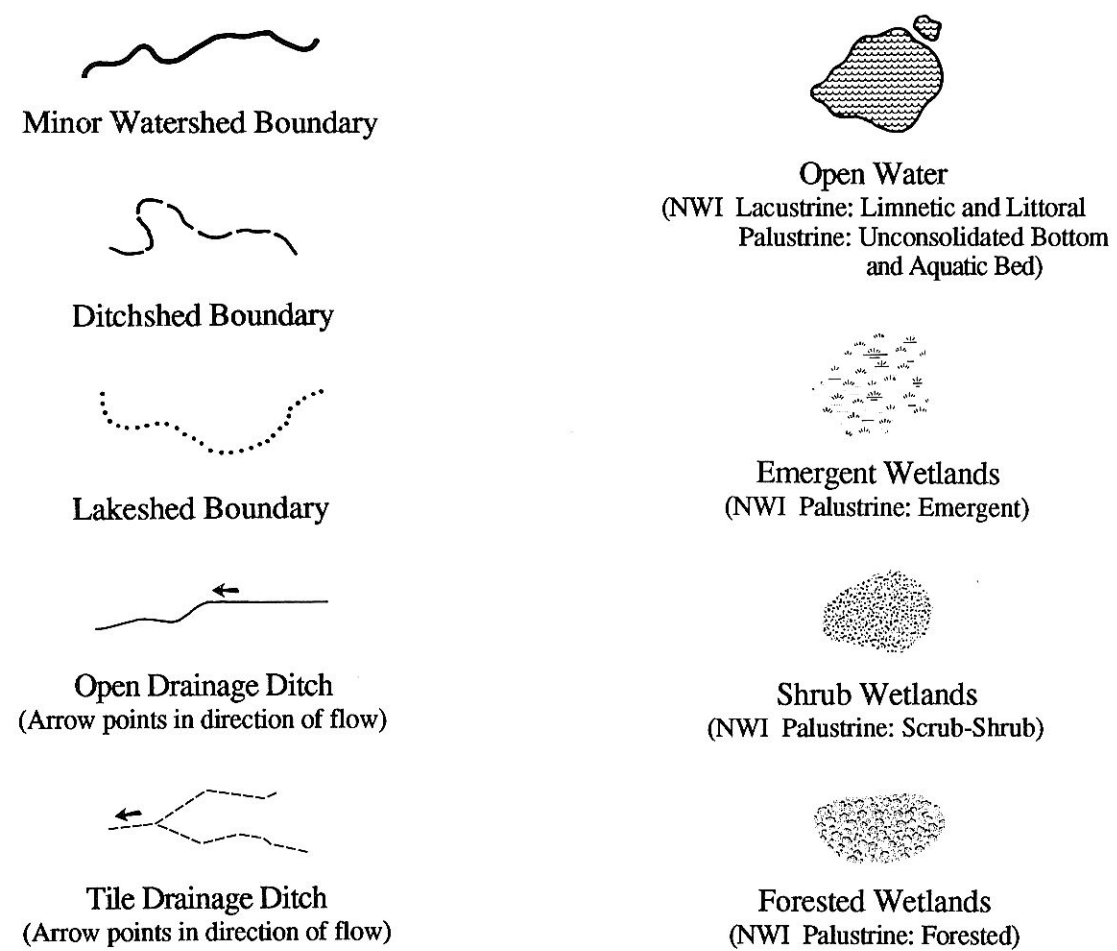
GENERAL LAND SURVEY MAP



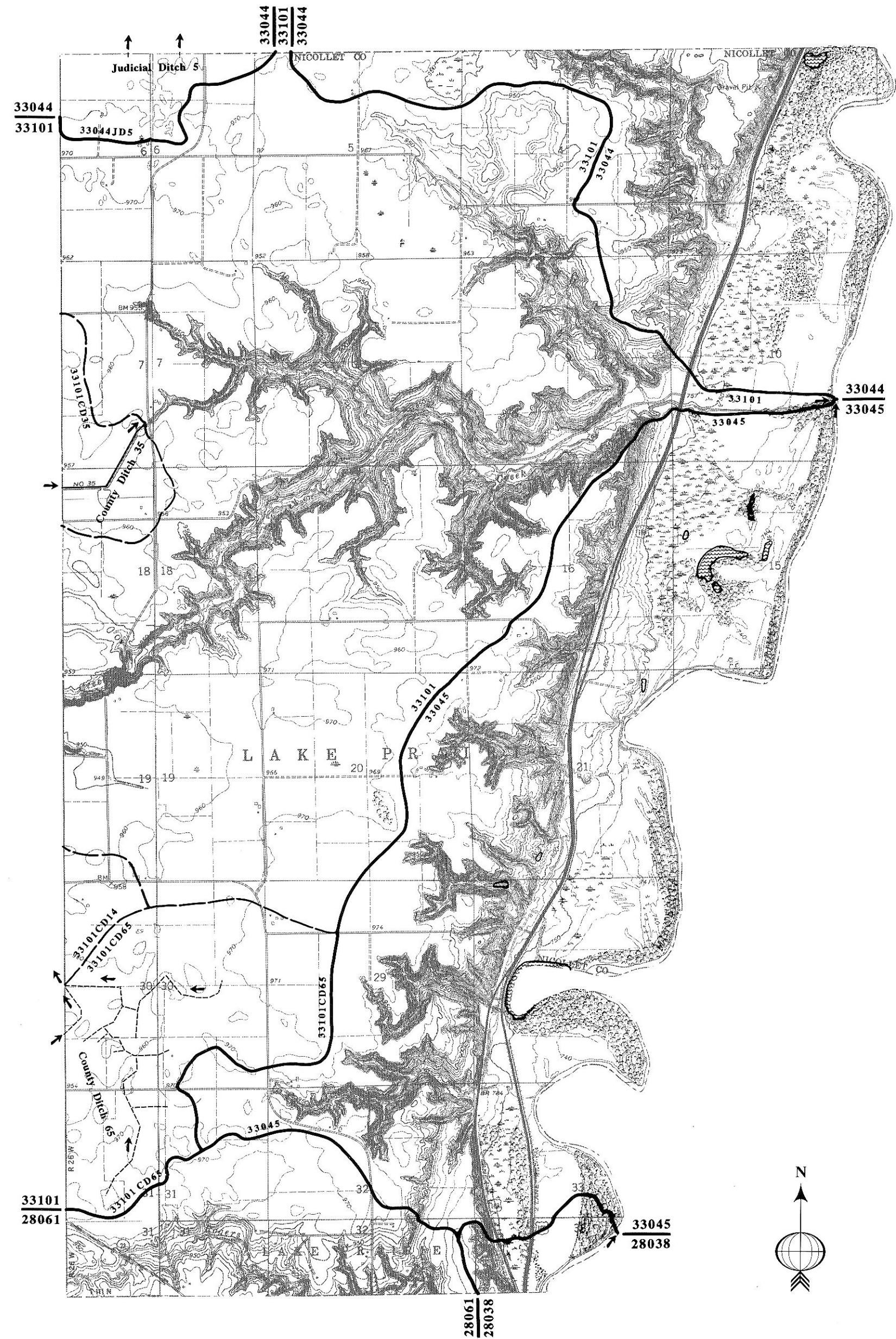
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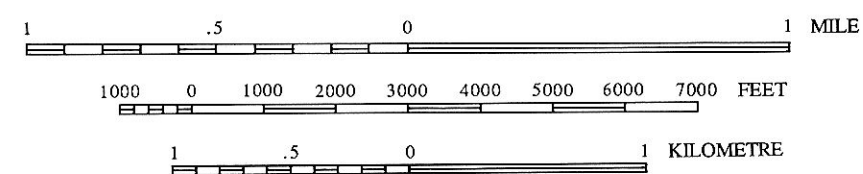
EXPLANATION Surface Water Hydrology Map



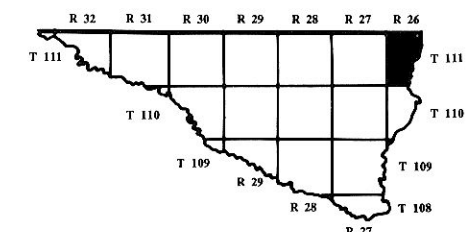
SURFACE WATER HYDROLOGY MAP



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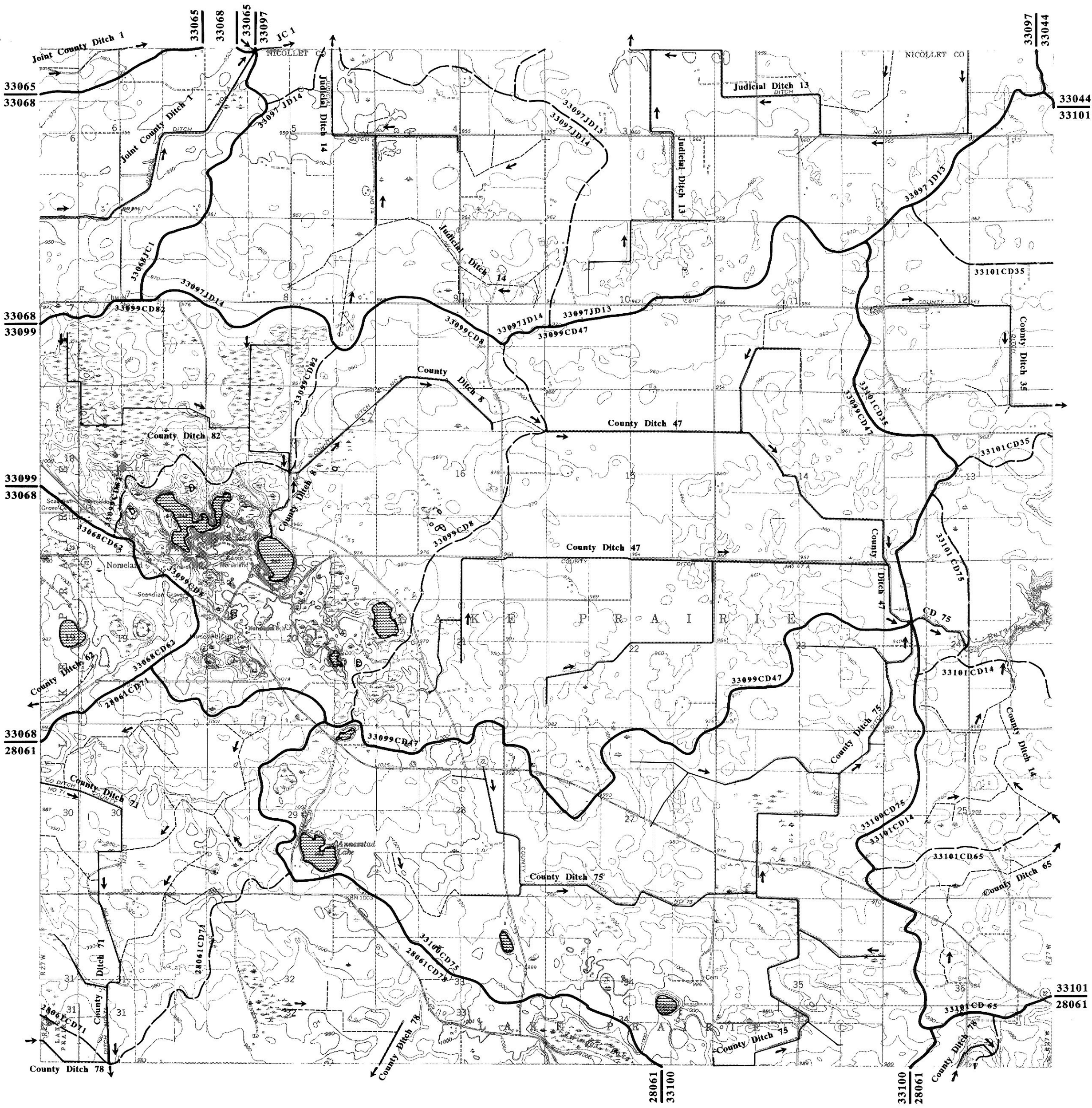


LOCATION DIAGRAM

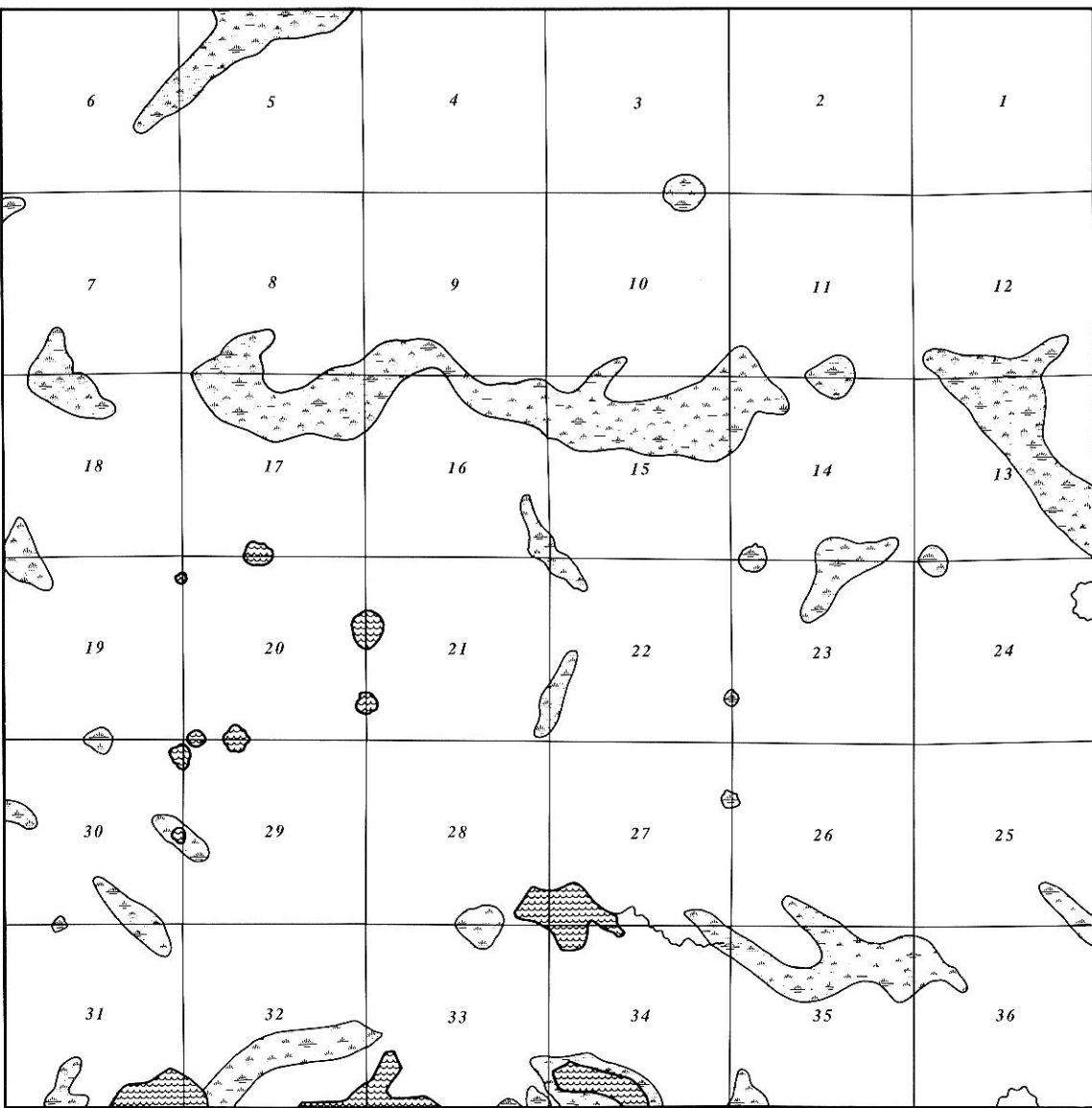


SURFACE WATER HYDROLOGY MAP

T. 111 N. R. 27 W.



GENERAL LAND SURVEY MAP

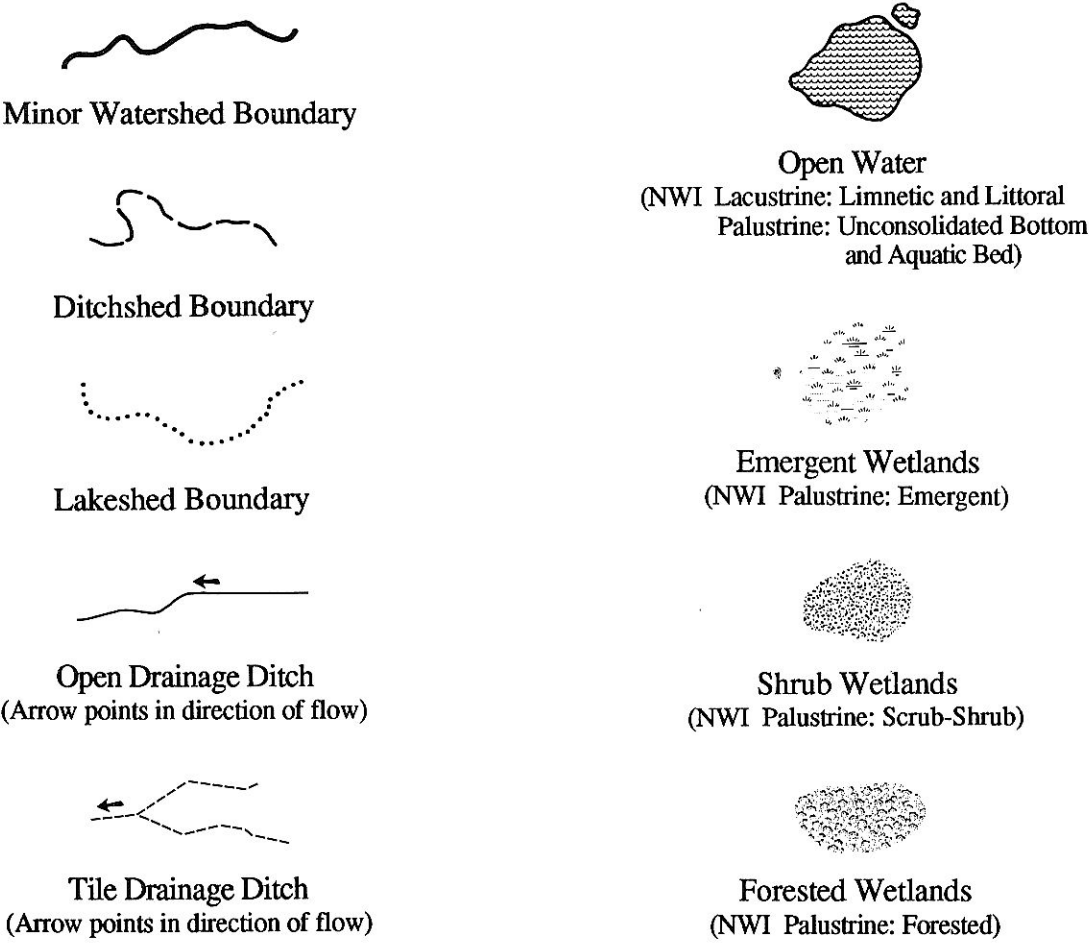


SCALE: 1 : 64,000 1 inch = 1 mile

EXPLANATION

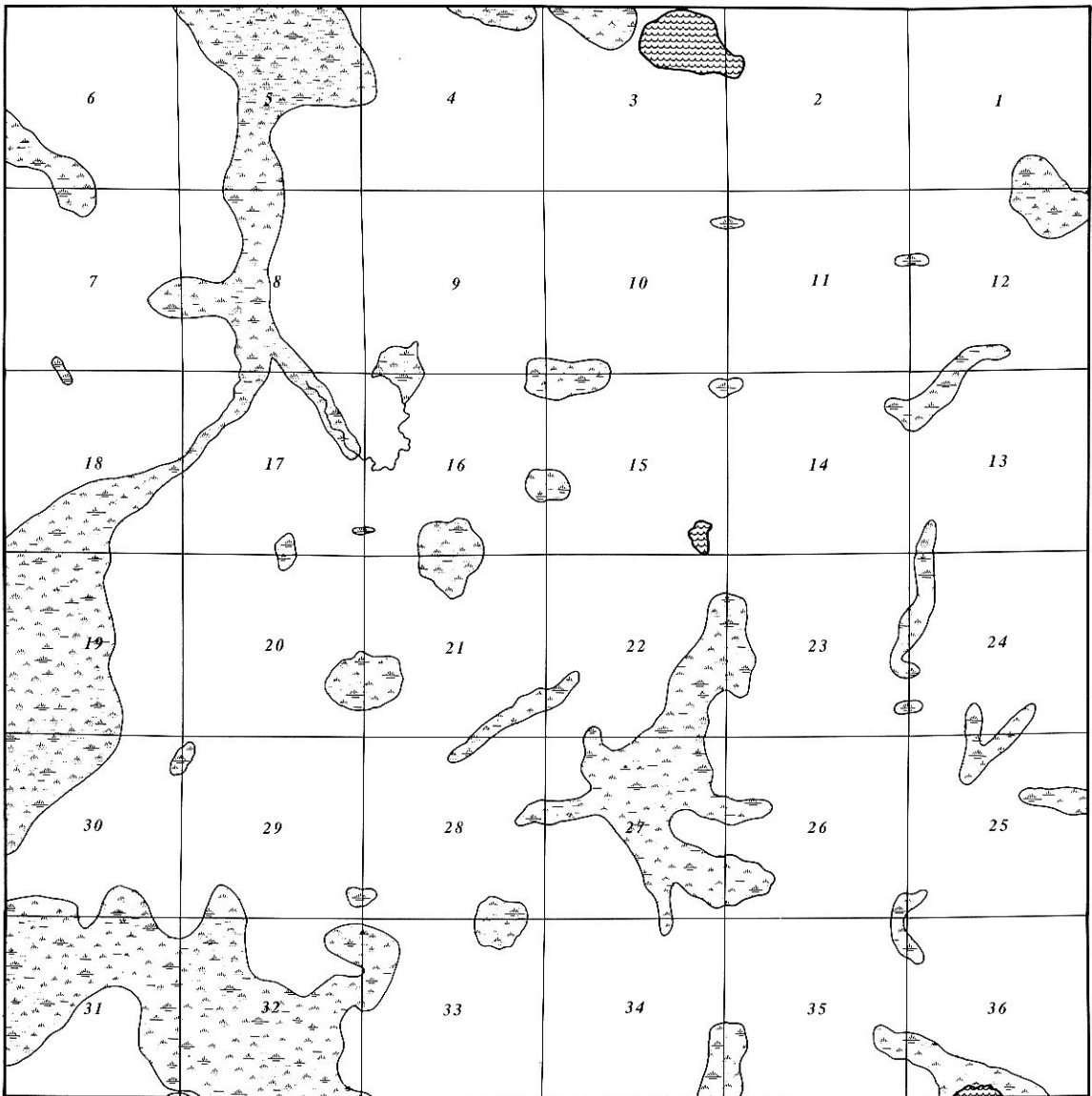


EXPLANATION Surface Water Hydrology Map



T. 111 N. R. 28 W.

GENERAL LAND SURVEY MAP

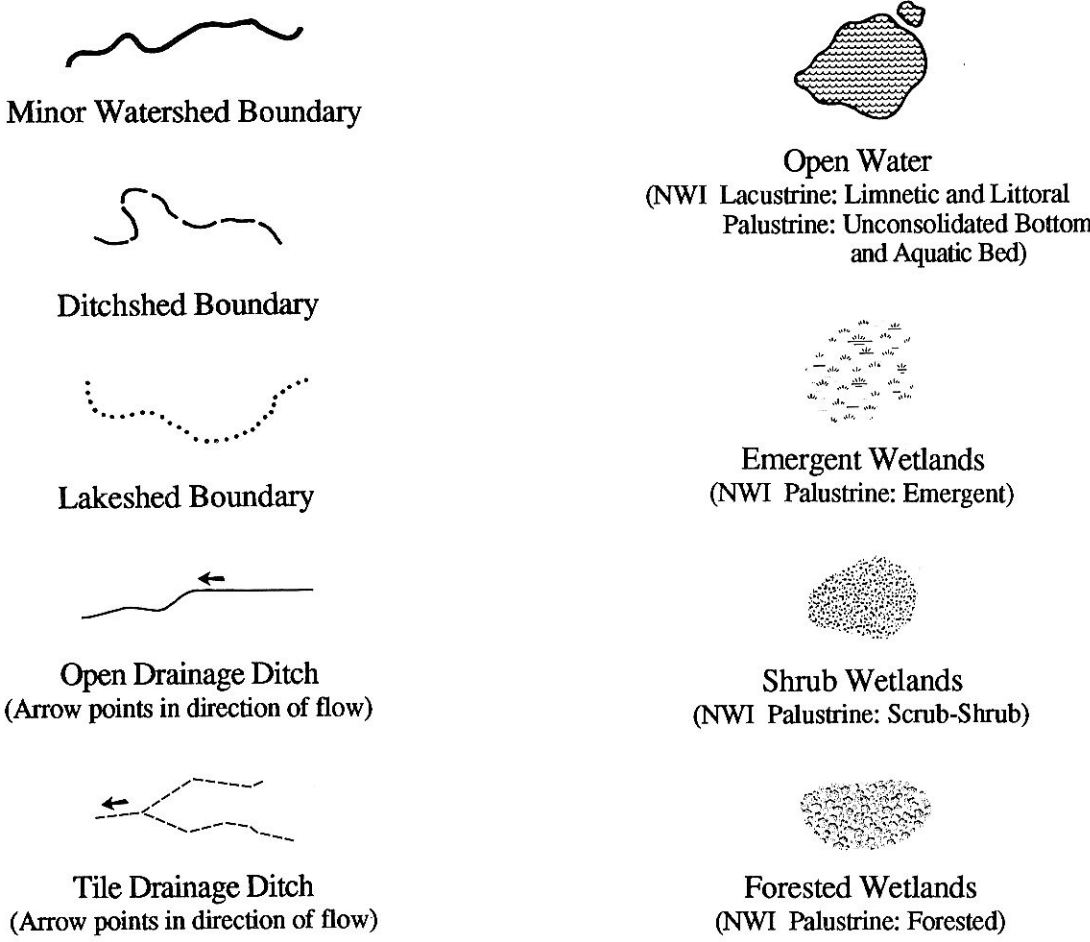


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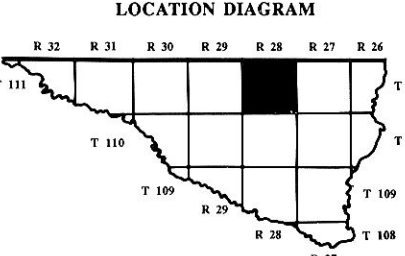
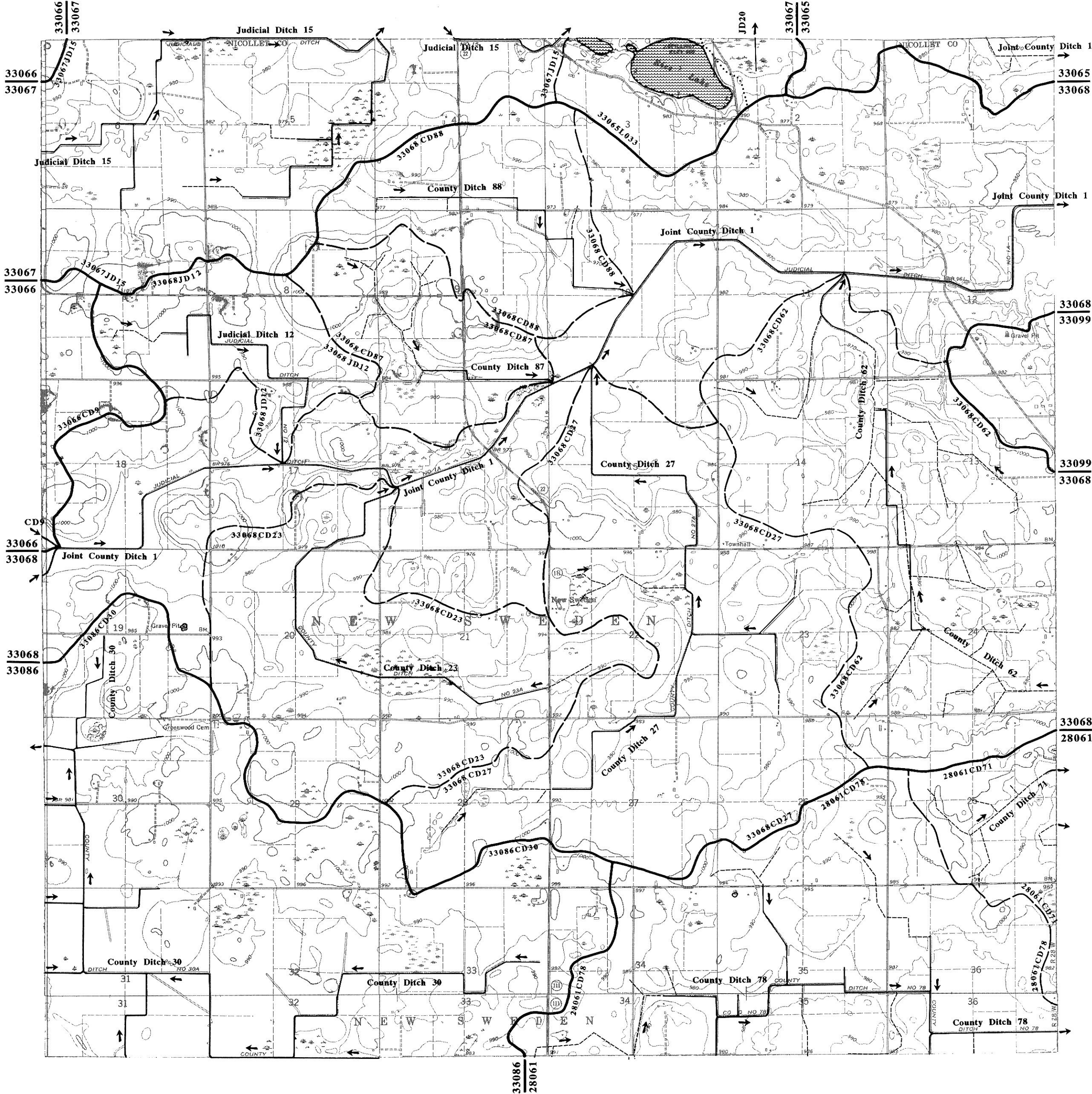
EXPLANATION



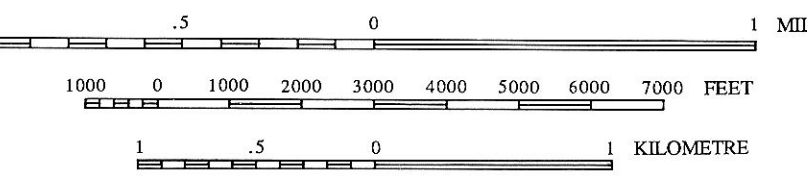
EXPLANATION
Surface Water Hydrology Map



SURFACE WATER HYDROLOGY MAP

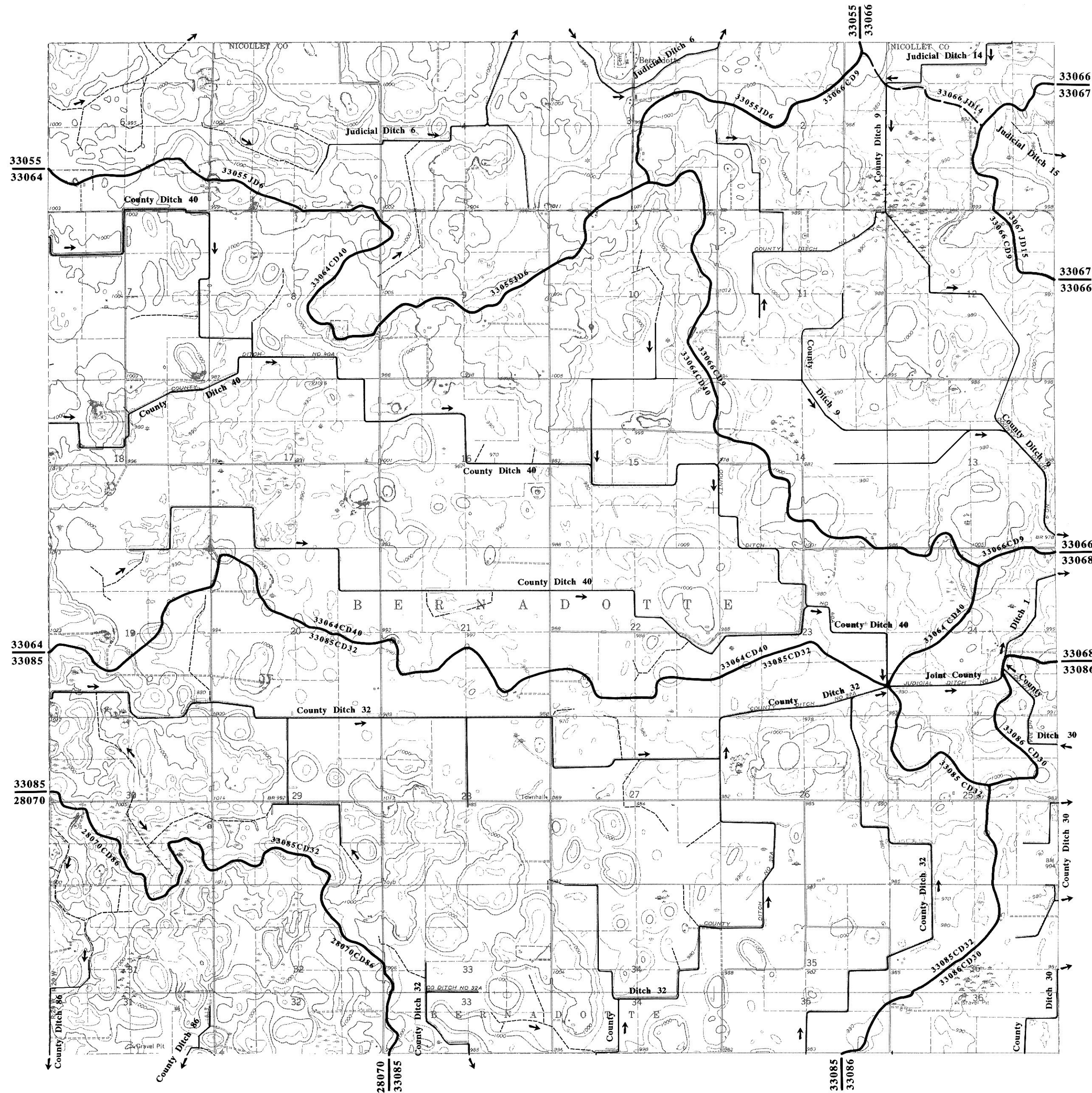


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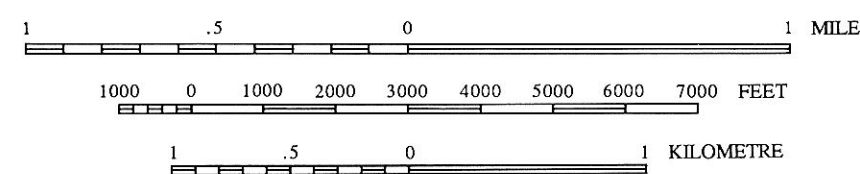


SURFACE WATER HYDROLOGY MAP

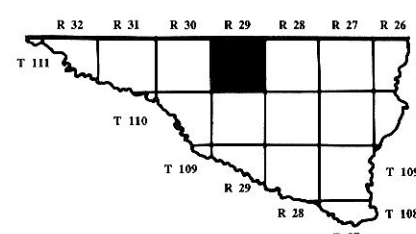
T. 111 N. R. 29 W.



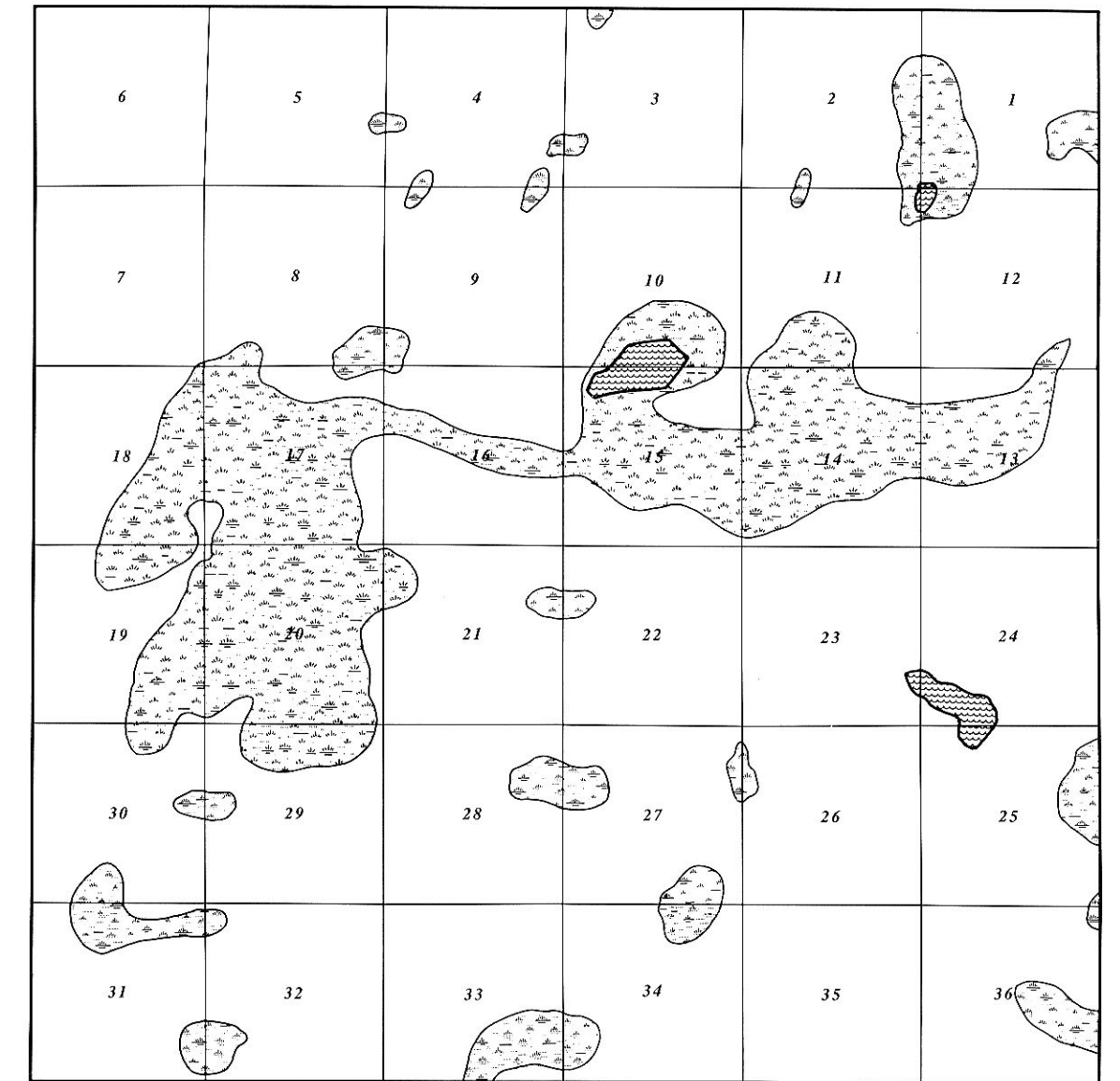
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LOCATION DIAGRAM



GENERAL LAND SURVEY MAP

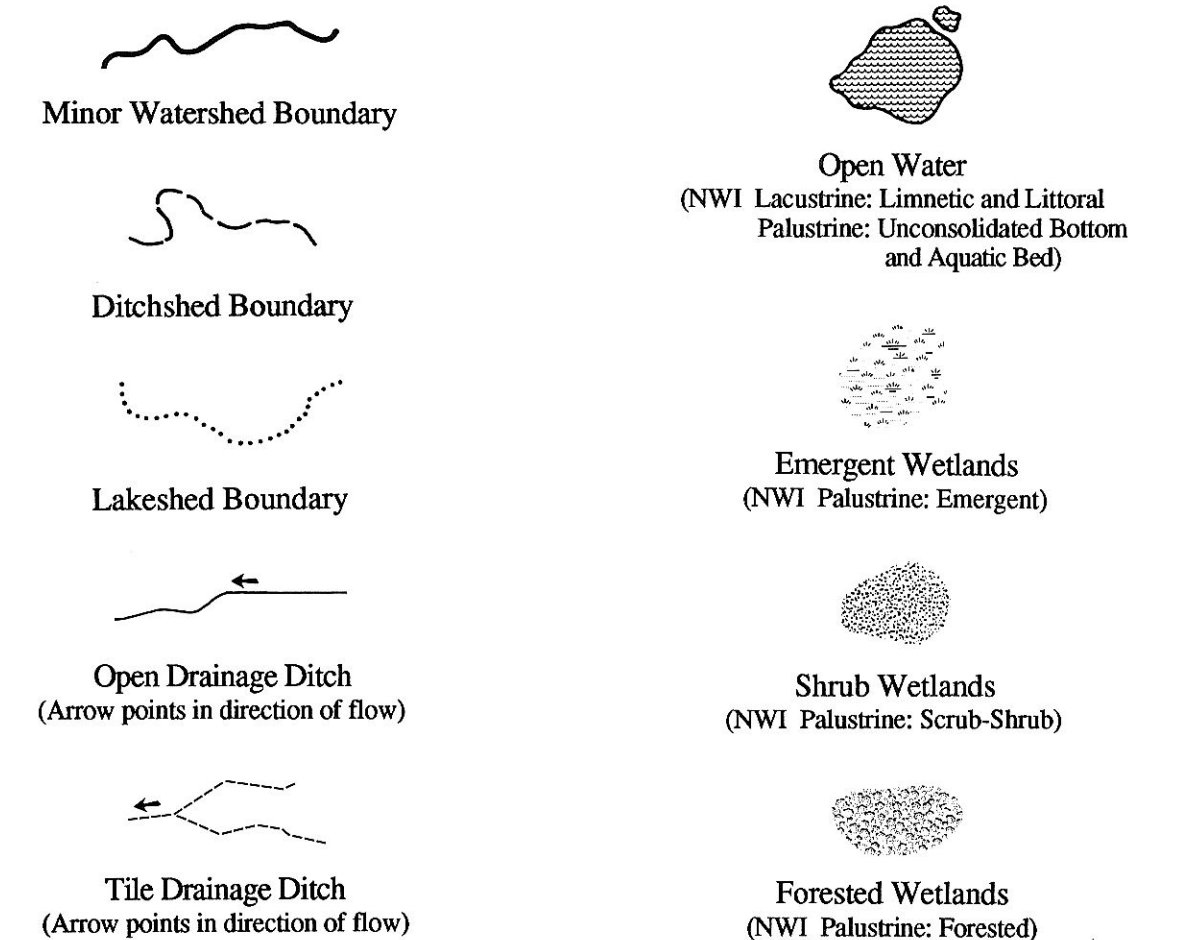


SCALE: 1 : 64,000 1 inch = 1 mile

EXPLANATION



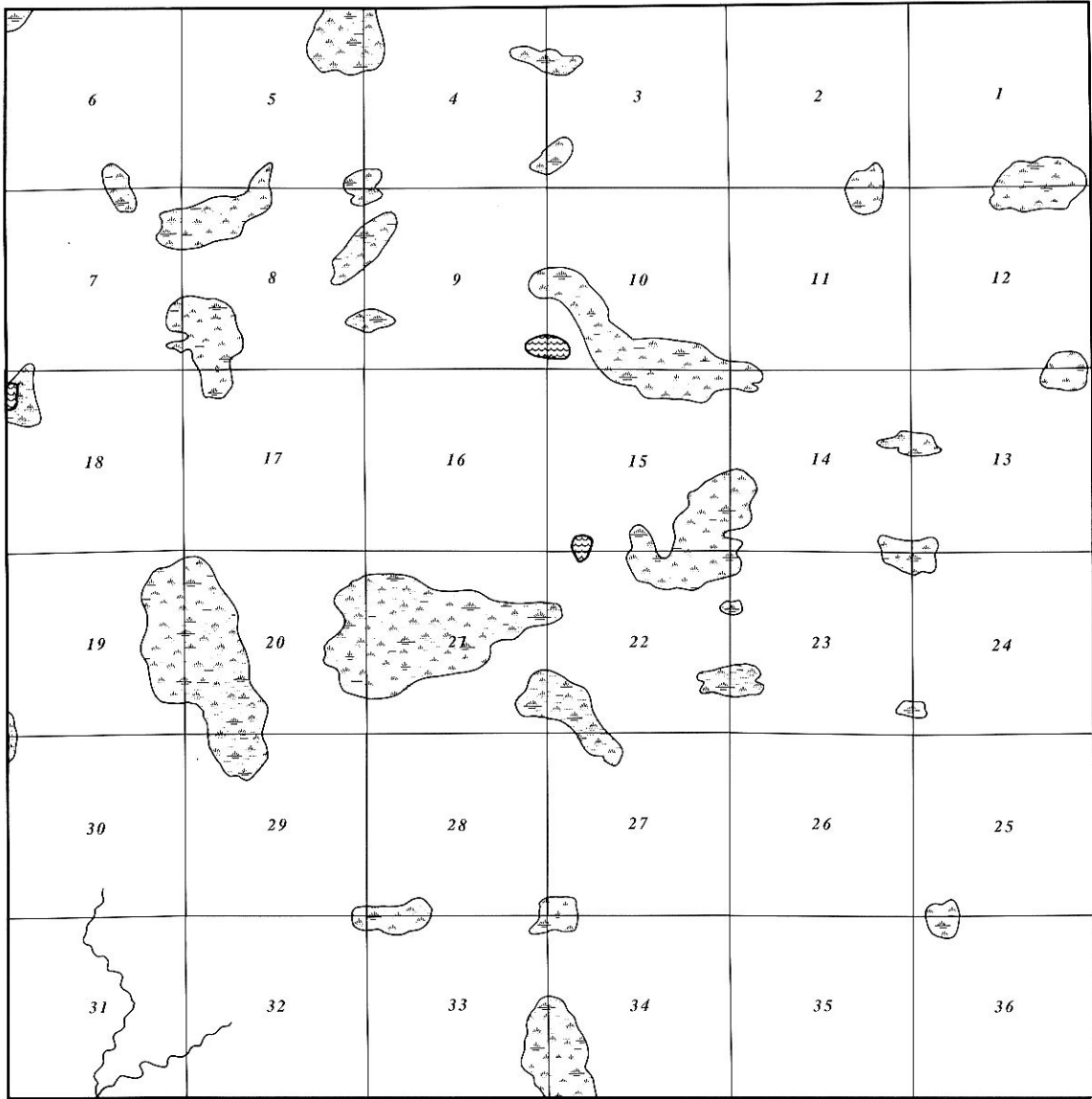
EXPLANATION Surface Water Hydrology Map



T. 111 N. R. 30 W.

SURFACE WATER HYDROLOGY MAP

GENERAL LAND SURVEY MAP



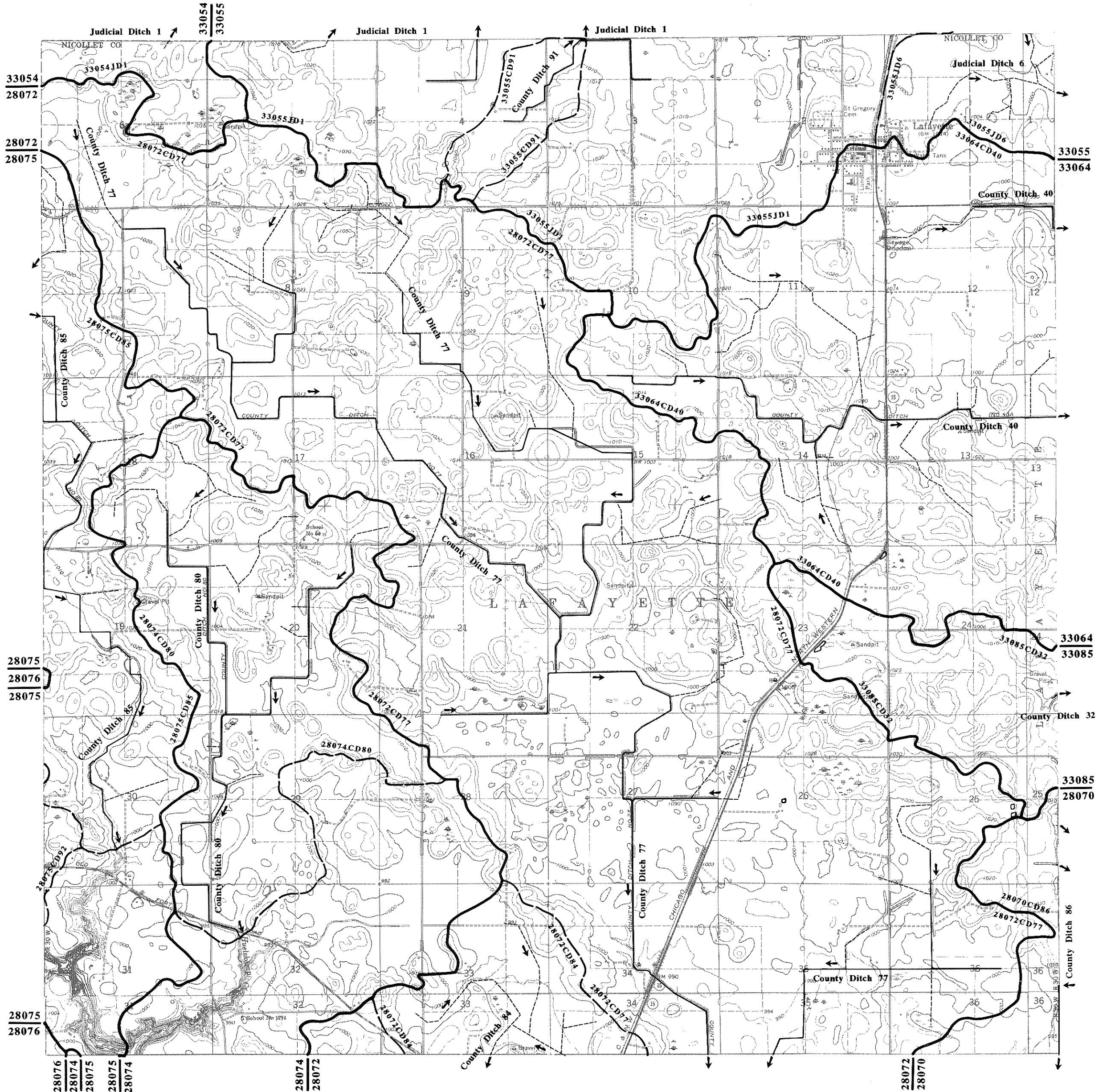
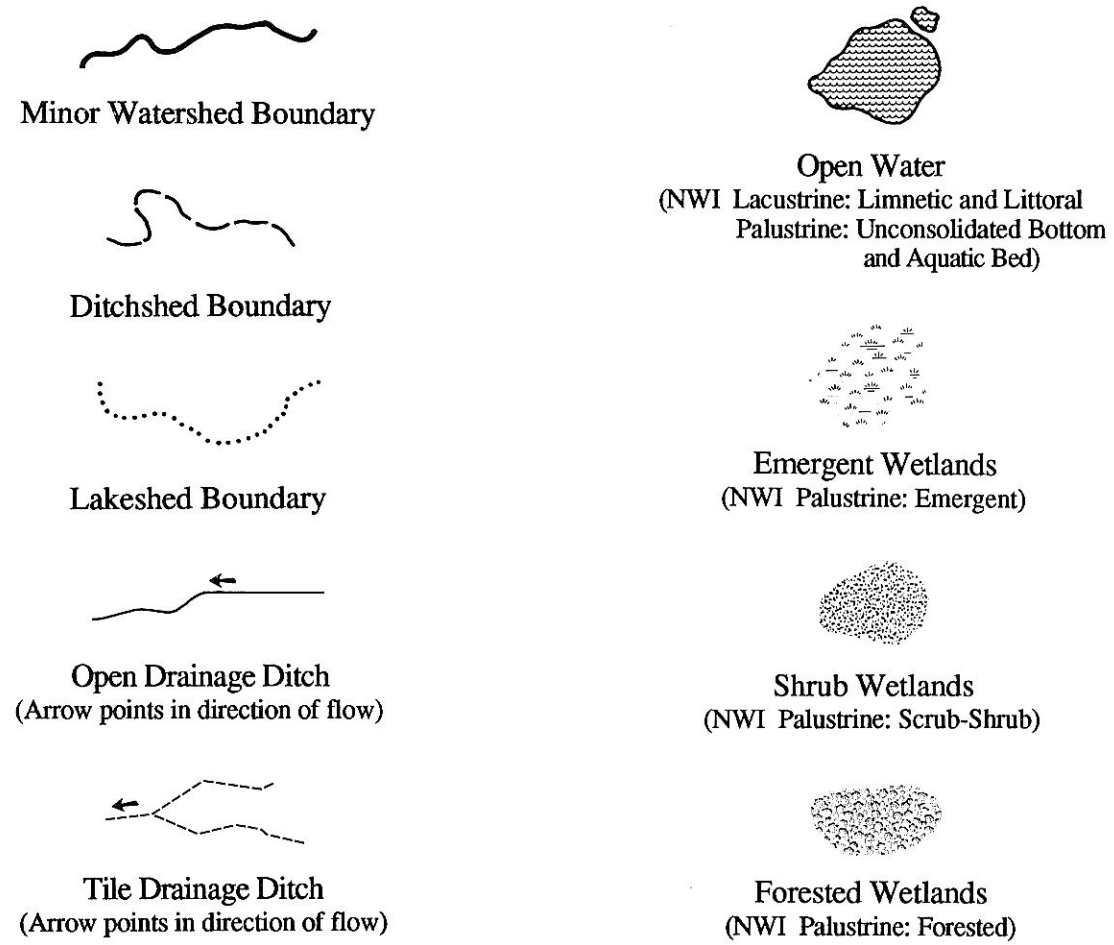
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EXPLANATION

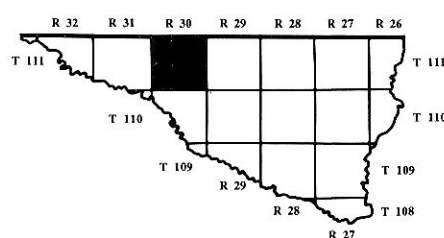


EXPLANATION

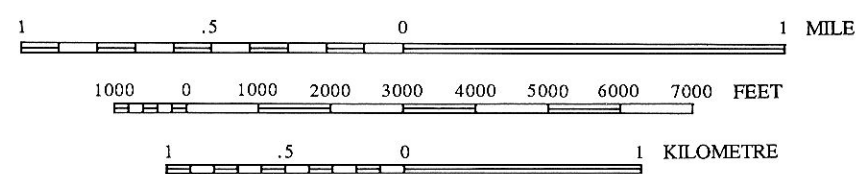
Surface Water Hydrology Map



LOCATION DIAGRAM



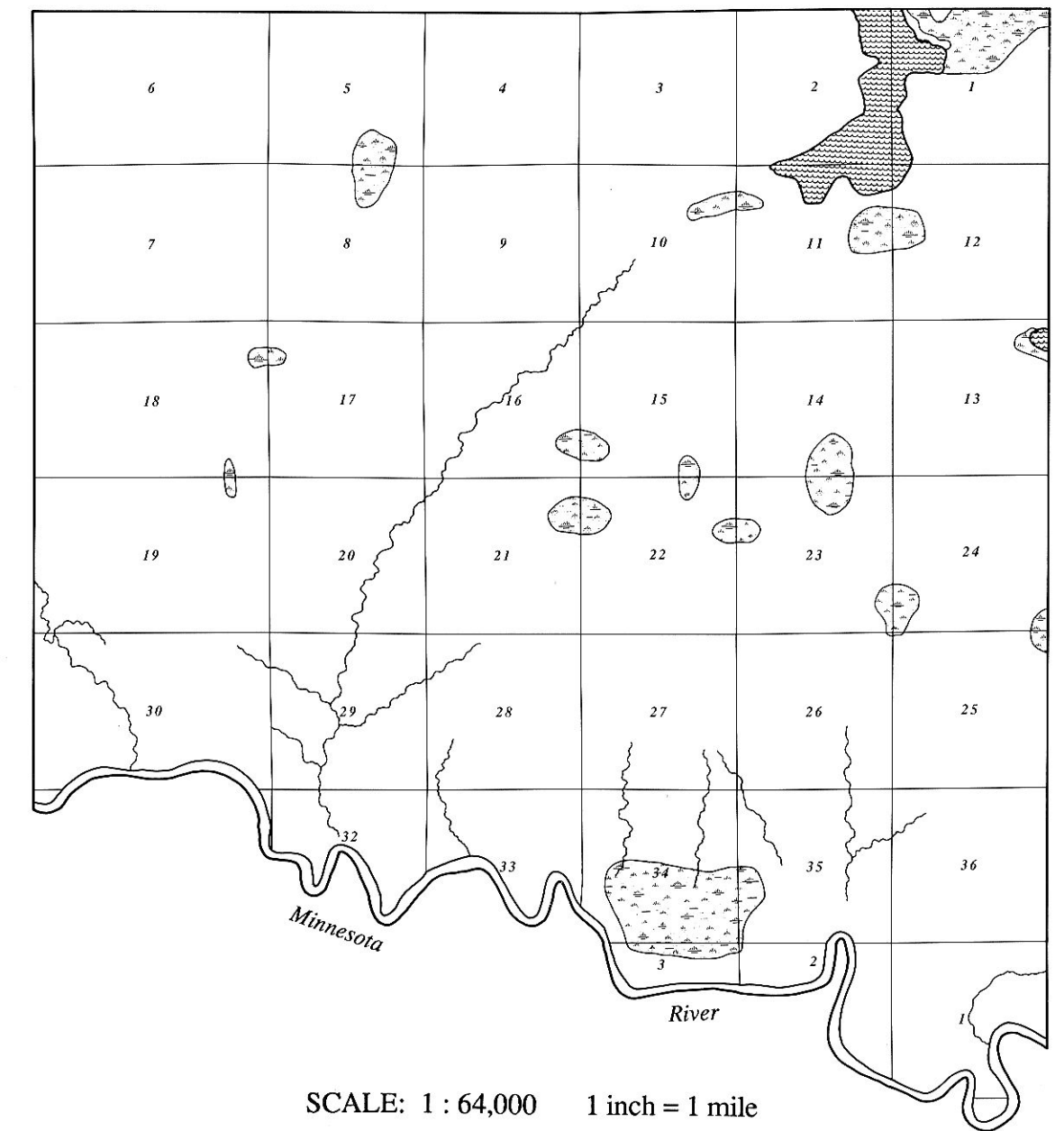
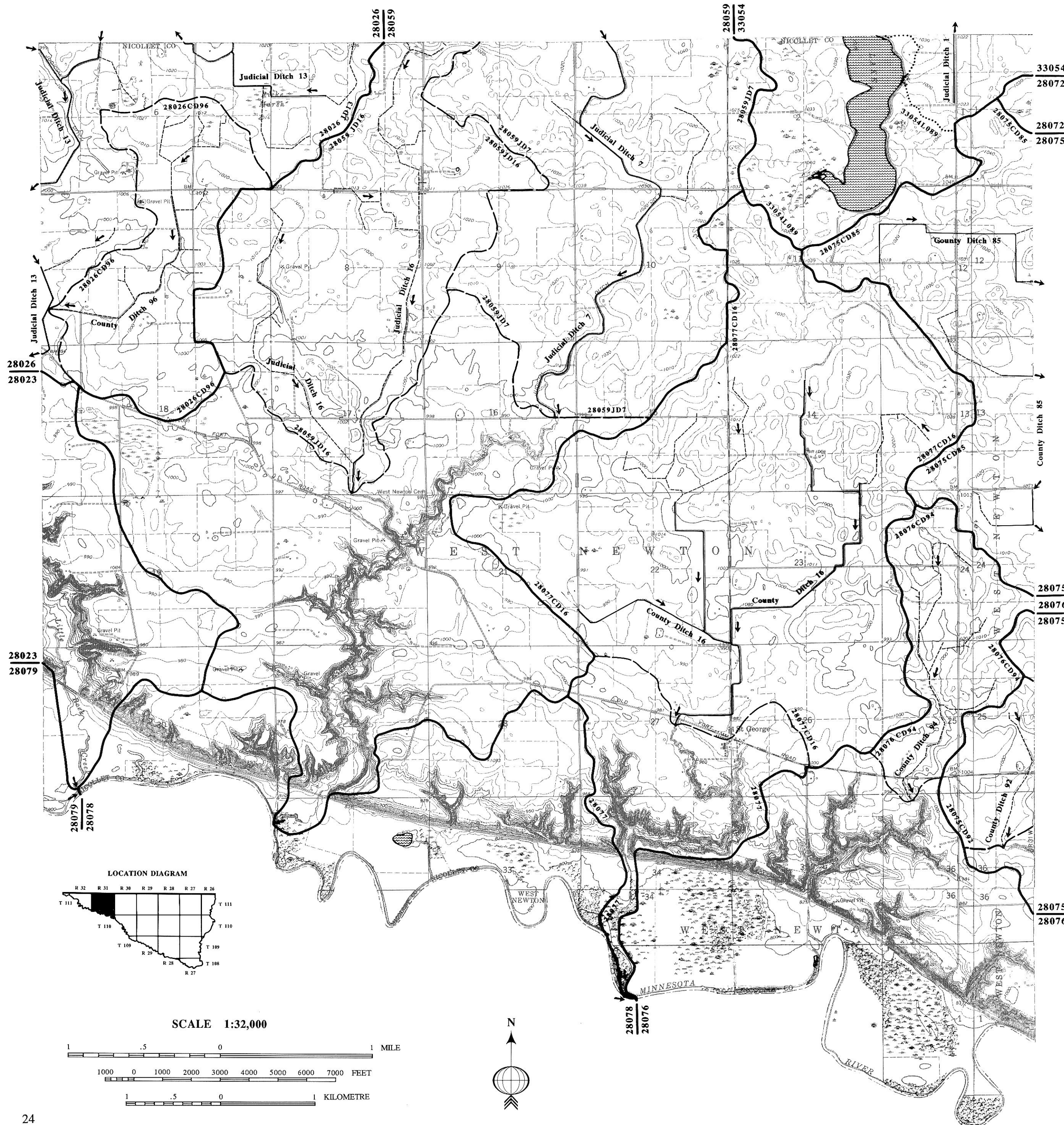
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SURFACE WATER HYDROLOGY MAP

T. 111-110 N. R. 31 W.

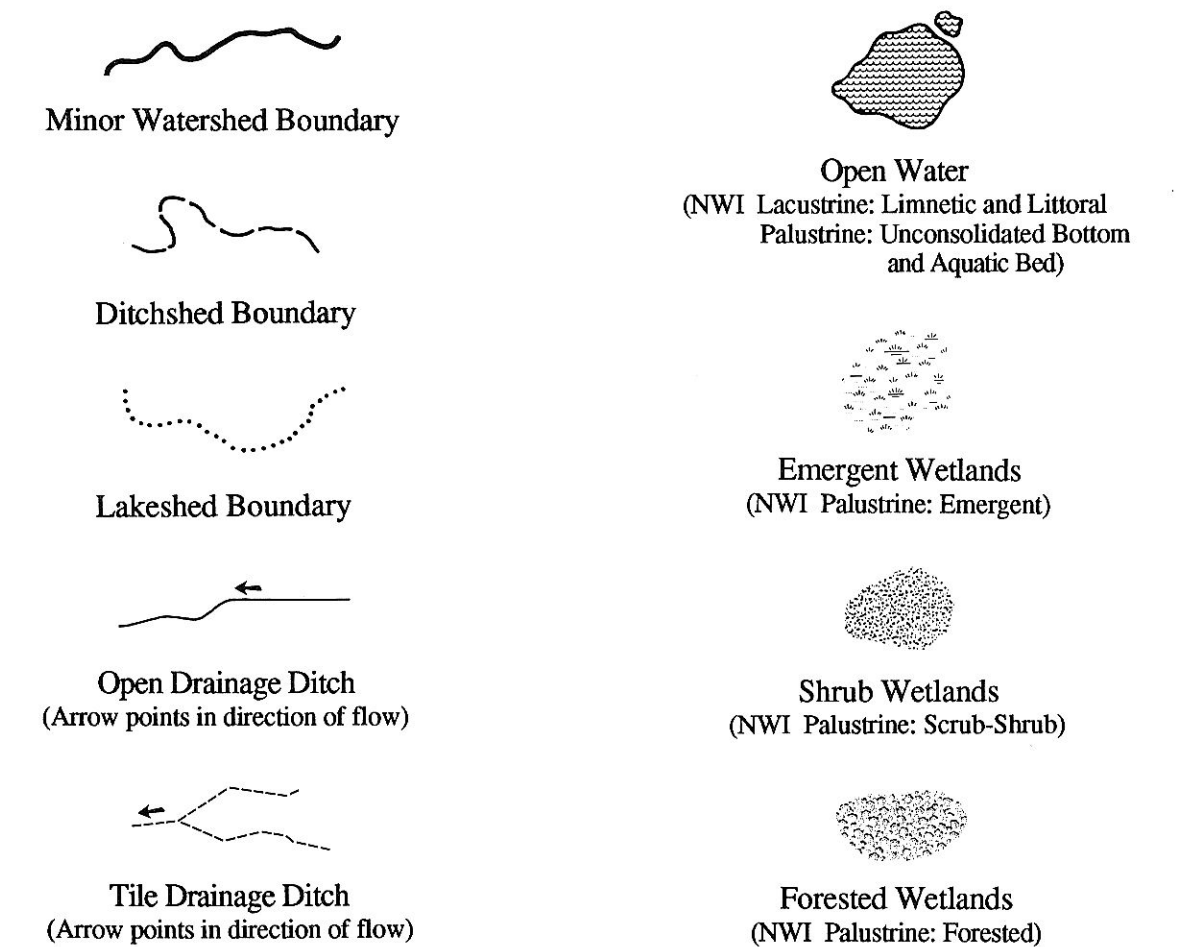
GENERAL LAND SURVEY MAP



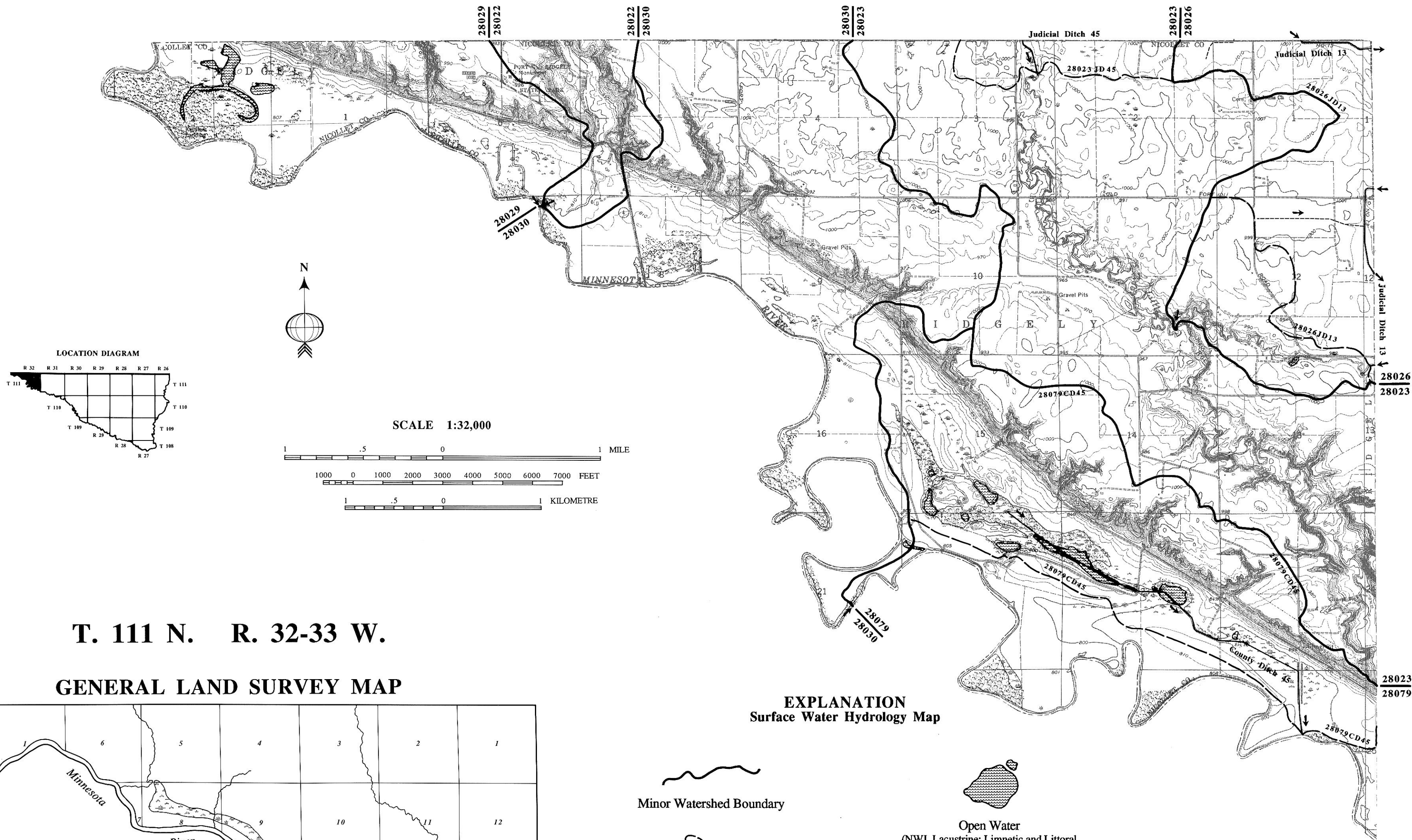
EXPLANATION



EXPLANATION Surface Water Hydrology Map

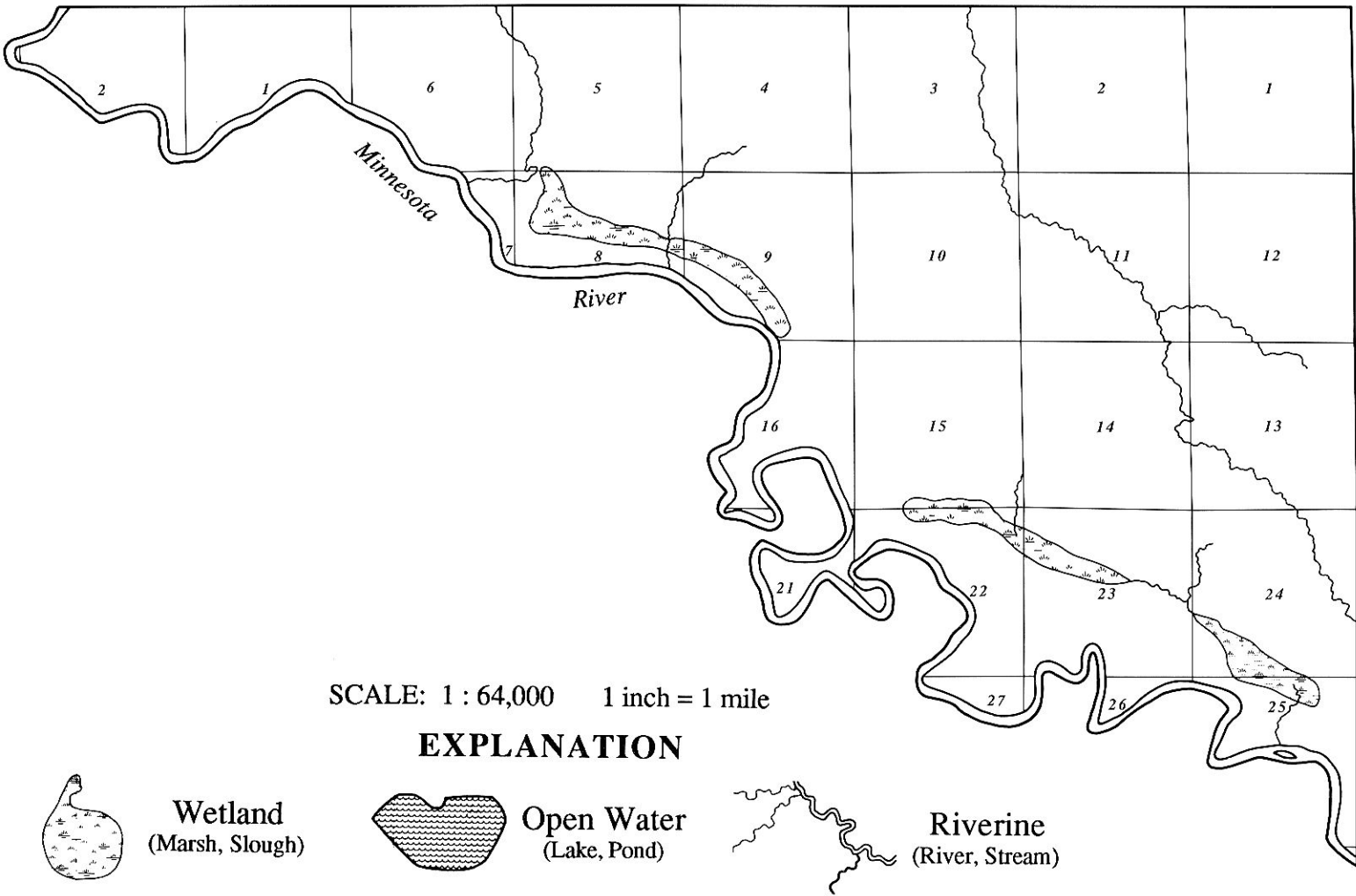


SURFACE WATER HYDROLOGY MAP



T. 111 N. R. 32-33 W.

GENERAL LAND SURVEY MAP



EXPLANATION
Surface Water Hydrology Map

- Minor Watershed Boundary
- Ditchshed Boundary
- Lakeshed Boundary
- Open Drainage Ditch
(Arrow points in direction of flow)
- Tile Drainage Ditch
(Arrow points in direction of flow)
- Open Water
(NWI Lacustrine: Limnetic and Littoral
Palustrine: Unconsolidated Bottom
and Aquatic Bed)
- Emergent Wetlands
(NWI Palustrine: Emergent)
- Shrub Wetlands
(NWI Palustrine: Scrub-Shrub)
- Forested Wetlands
(NWI Palustrine: Forested)