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DRAFT ENVIRONMENTAL IMPACT STATEMENT

FOR A 345 KV HIGH VOLTAGE TRANSMISSION LINE IN MINNESOTA FROM PRAIRIE ISLAND SUBSTATION OR KING SUBSTATION TO EAU CLAIRE, WISCONSIN

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PREPARED BY:

POWER PLANT SITING STAFF
MINNESOTA ENVIRONMENTAL QUALITY BOARD

CAPITOL SQUARE BUILDING
550 CEDAR STREET
ST. PAUL, MINNESOTA 55101

MEQB DOCKET: NSP TR-2 AMENDED
AUGUST 1980

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SUMMARY

PROJECT DESCRIPTION

Northern States Power Company (NSP), a Minneapolis-based, investor-owned electric utility, applied to the Minnesota Environmental Quality Board (MEQB) for a Construction Permit and Route Designation for the Minnesota portion of a single circuit 345,000 volt electric transmission line. The proposed facility would continue into Wisconsin, and require Wisconsin permits for that portion.

A construction permit application is required by the Minnesota Power Plant Siting Act (Minn. Stat. 1978, 116C.51 et seq.) and is further defined in the Rules for Routing High Voltage Transmission Lines and Siting Large Electric Power Generating Plants (6 MCAR § 3.071 - 3.082).

Northern States Power's original application was submitted in June, 1978 and accepted by the MEQB in September, 1978. That application sought a permit and route designation for a 345 kilovolt High Voltage Transmission Line (HVTL) from the Prairie Island Substation east to the Minnesota-Wisconsin boundary and ultimately to Eau Claire, Wisconsin. In November, 1979, NSP proposed an amendment to their original application which expanded the project to include routing alternatives for the proposed 345 kV HVTL from their Allen S. King Substation east to the Minnesota-Wisconsin boundary and ultimately to Eau Claire, Wisconsin. NSP seeks only one permit under the amended application; either from the Prairie Island Plant area or the King Plant area.

NSP's proposed action does not require a certificate of need from the Minnesota Energy Agency because it has less than 25 miles of its length in Minnesota (6 MCAR § .0601: Rules Governing Contents of Applications for Certificates of Need and Criteria for Assessment of Need for Large Electric Generating Facilities and Large High Voltage Transmission Lines).

NSP has proposed construction of a single-circuit, alternating current, 345,000 volt (345 kV) transmission line. Their original (Prairie Island area) and amended (King area) applications sought a construction permit for only one final route. The application requested in each case a transmission line on structures separate from any other existing circuits. Subsequent to submittal of their applications, and in the course of MEQB's study of alternate routes, NSP has proposed several possible options which involve removal of structures (towers) on existing rights-of-way lines and placement of the existing circuit(s) on a new structure with the proposed 345 kV circuit. These possible double-circuiting options do not alter the proposed voltage or capacity of the 345 kV line for which NSP has applied. The options could, however, alter the right-of-way dimensions required, cost of the transmission line, reliability, and environmental impact.

Summary

In routing situations where other linear facilities are not involved, the proposed 345 kV transmission line will require a right-of-way 150 feet in width. In general, total right-of-way requirements can be reduced by "sharing" (overlapping) right-of-way with other facilities, such as existing power lines, railroads, or major highways. Most of the alternative routes for this project provide opportunities for right-of-way sharing.

Construction permits will not be issued in either Minnesota or Wisconsin before late 1980. Following regulatory review, engineering and right-of-way acquisition will take 1 to 1½ years and construction another 1½ to 2 years. Assuming no additional major regulatory or legal delays, the completion date for the line ranges from mid-1983 to late 1984.

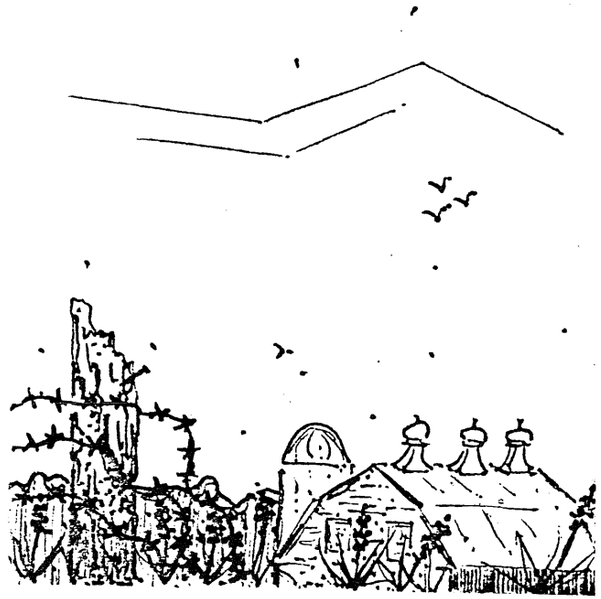
Project costs will depend on the final route and design selected by the MEQB. Total project costs in Minnesota, including a termination and full river span range between $2,199,000 and $7,932,000 (1982 estimates).

Fourteen alternative routes have been proposed for this project in Minnesota. There are 12 complete routes emanating from the Prairie Island substation and four complete routes which emanate from the 345 kV grid system at various points in Washington County, one point being the King Plant substation near Stillwater.

MAJOR ENVIRONMENTAL IMPACTS

Transmission line routes considered in this draft EIS range in length from less than a mile (.75 miles) to 17.13 miles. The two shortest routes (Prairie Island Route -.75 miles, and King Route A - .80 miles) will affect the fewest environmental elements. The major issue with the Prairie Island Route appears to be the potential for collisions of waterfowl with the proposed HVTL. Though the issue has been the subject of numerous studies, no definitive estimate of probable impact has been provided in this draft EIS. The potential impact on waterfowl is generally considered to be severe if the Prairie Island Route is selected.

The major impact issue on the King Route A is the potential effect of the proposed HVTL on the Lower St. Croix National Scenic Riverway. An existing 69/115 kV transmission line crossing from the King Plant substation to Wisconsin is available for a rebuild design, which would incorporate the proposed 345 kV line. A rebuilt line would require larger structures than those presently existing, but would not increase the number of circuits or structures at the river crossing.



The shortest of the remaining 14 routes is 4 miles in length. Most of the 14 routes are along existing rights-of-way, though several will have severe impacts. Impacts will be greatest on those routes which are along existing transmission lines and are much smaller (i.e., 69 kV) than the proposed 345 kV line, and pass through developed areas and areas with numerous natural resource features. Major impacts of the proposed routes will be one or more of the following:

Human Settlement:

- displacement of homes
- disturbance of settlement patterns, i.e., subdivisions

Agricultural Land Use:

- disturbance of farming patterns
- limitations on potential farming practices, i.e., irrigation

Recreational Land Use:

- disturbance of intensively used land and water recreational areas, both public and private
- impairment of visual quality

Natural Resources:

- disturbance of natural ecosystems
- loss of existing natural habitat
- possible loss or injury of wildlife
- disturbance of public lands

Reliability, Cost and Accessibility:

- both negative and positive reliability effects

REASONABLE ALTERNATIVES

The option of placing the proposed HVTL underground, at major river crossings has been studied in detail for this project. Several designs for undergrounding are feasible and available for construction. The cost of undergrounding the HVTL at river crossings is greater than an overhead design by an approximate cost range ratio of 5:1 (underground cost:overhead cost) to 15:1.

PERMITS REQUIRED

A permit for crossing navigable waters will be required from the U.S. Army Corps of Engineers for any of the alternative routes. An additional Corps permit will be required if placement of fill in wetlands is necessary during construction. A permit will be required from the U.S. Department of the Interior if the Prairie Island Indian Reservation is crossed.

At the state level, the Minnesota Environmental Quality Board must grant a Construction Permit for the proposed project. The Minnesota Department of Natural Resources must issue permits for HVTL crossings of state lands and waters and the Minnesota Department of Transportation must issue permits for crossings or uses of all highway rights-of-way.

CONTACT WITH AGENCIES, ORGANIZATIONS, AND INDIVIDUALS

Considerable contact with public and private agencies, organizations, and individuals has continued throughout the complex history of this project. The following general listing of contacts is provided.

Federal Agencies

U.S. Department of Agriculture
U.S. Army Corps of Engineers
U.S. Department of the Interior
U.S. Fish and Wildlife Service
U.S. National Park Service
U.S. Bureau of Indian Affairs
U.S. Coast Guard

State Agencies

Minnesota Department of Agriculture
Minnesota Energy Agency
Minnesota Department of Health
Minnesota Department of Transportation
Minnesota Pollution Control Agency
Minnesota Historical Society
Minnesota Metropolitan Council
Regional Development Commission - Region 10

Minnesota State Planning Agency
Wisconsin Public Service Commission
Wisconsin Department of Transportation
Wisconsin Department of Natural Resources

County Officials in

Washington County, Minnesota
Dakota County, Minnesota
Goodhue County, Minnesota
Pierce County, Wisconsin
St. Croix County, Wisconsin

Municipal Officials in

Red Wing, Minnesota
Hastings, Minnesota
Stillwater, Minnesota
Hudson, Wisconsin
Prescott, Wisconsin

All Townships in Study Area

Other Agencies and Organizations

The Nature Conservancy
Sierra Club
Audubon Society
Red Wing Wild Life Protective League
Gantenbein Inc.
Izaak Walton League of America, Inc.
University of Minnesota
Minnesota-Wisconsin Boundary Area Commission
Lower St. Croix Management Commission
Chicago, Milwaukee, St. Paul, and Pacific Railroad Company
Chicago and Northwestern Transportation Company
Badger Safe Energy Alliance
Northern States Power Company-Minnesota
Northern States Power Company-Wisconsin

ACKNOWLEDGEMENTS

Published Resources:

The following documents were major sources of information presented in Chapter 1.

Environmental Impact Assessment - St. Croix River Pool

North Star Research Institute for the St. Paul District, U.S. Army Corps of Engineers. November, 1973.

Baseline Environmental Inventory - Twin Cities Metro Area

Metro Waste Control Commission. December, 1977.

Lower St. Croix National Scenic Riverway Master Plan

U.S. Department of Interior, National Park Service. June, 1974.

Comprehensive Guide Plan - Red Wing, Minnesota

Barton, Aschman Associates, Inc., St. Paul, Minnesota. February, 1973.

A Management Proposal for the Cannon River

Minnesota Department of Natural Resources, Wild and Scenic Rivers Program. April, 1979.

Draft Environmental Impact Statement - Local Flood Protection Works, Vermillion River, Hastings, Dakota County, Minnesota

North Star Research Institute for the St. Paul District, U.S. Army Corps of Engineers. November, 1973.

Personal Resources:

Mr. Jim Alders of the Environmental and Regulatory Affairs Department, Northern States Power, provided technical information about the proposed project, and coordinated essential exchange of information with other NSP departments.

The Minnesota-Wisconsin Boundary Area Commission provided documents, referrals, and information on the Lower St. Croix National Scenic Riverway.

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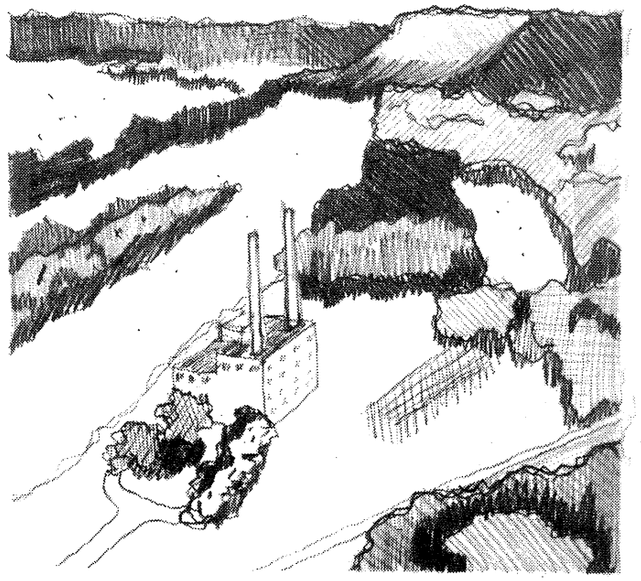

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chapter 1

ENVIRONMENTAL DESCRIPTION OF THE STUDY AREA

CHAPTER 1
THE ENVIRONMENTAL SETTING

1.1 INTRODUCTION

This chapter provides a basic regional overview of the study area to aid readers in evaluating the information found in this report.

1.2 THE GENERAL STUDY AREA

The proposed high voltage transmission line project will connect either Prairie Island Substation or the Allen S. King Substation with NSP's Eau Claire Substation. The principal routing question within the State of Minnesota, is the location of the best crossing of the Mississippi River if Prairie Island is chosen or the St. Croix River if Allen S. King is chosen.

Although the formal responsibilities of the State of Minnesota end in the middle of either river, the general study area for this environmental impact statement is the St. Croix River, the Mississippi River and their environs between Stillwater in the north and Red Wing in the south.

The study area in Minnesota includes the townships of Stillwater, Baytown, West Lakeland, Afton, and Denmark in Washington County; Hastings, Ravanna, Marshall and Douglas townships in Dakota County; and Red Wing, Featherstone, Vasa, Welch townships in Goodhue County. Figure 1-1 illustrates the location of the study area in Minnesota and Figure 1-2 shows detail of the general study area.

The exact area affected will depend upon the final route chosen. No proposed route in Minnesota extends further west of the Minnesota-Wisconsin state boundary than five miles.

1.3 CLIMATE

Minnesota has a continental climate characterized by warm, humid summers and cold winters. Continental polar air masses flow into the region throughout the year and prolonged periods of extreme cold occur during the winter when arctic air intrudes into the state. Conversely, prolonged periods of high temperatures are caused by warm air masses moving northward from the Gulf of Mexico and the southeastern United States. Mild, dry Pacific Ocean air masses moving eastward across the continent serve to moderate the state's climate throughout the year. The interaction between cold dry air from the north and warm moist air from the south causes marked daily weather changes. The climate within the study area is typical for east central Minnesota.

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REGIONAL MAP
NSP TR-2

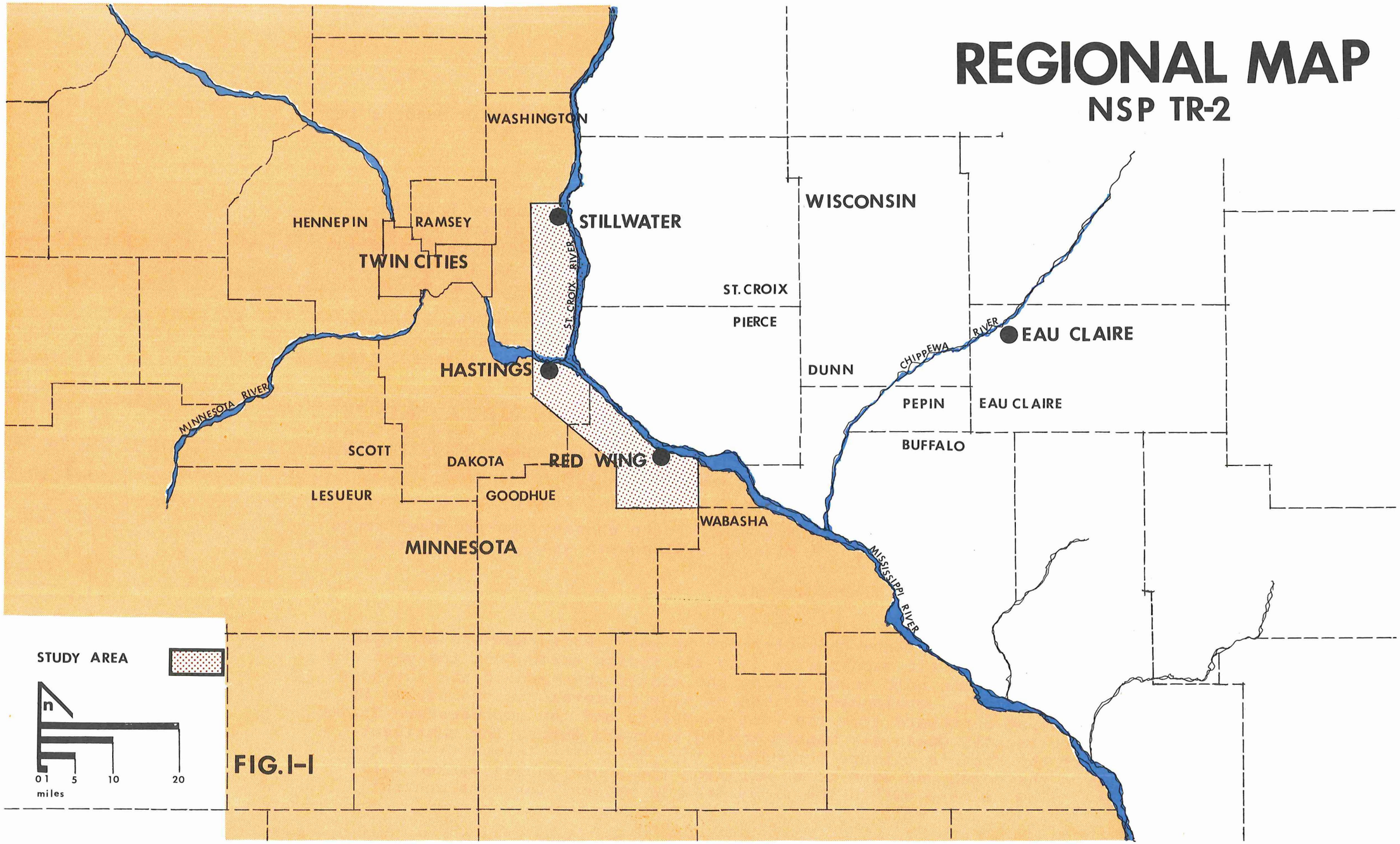


FIG. I-I

Soils occasionally freeze to a depth of several feet when very cold weather occurs before the ground is appreciably covered with snow. Usually the soil is frozen in only the top few inches to 1 foot, except where the snow cover has been removed.

High voltage lines have no effect on climate. However, climate may affect the construction and operation of the line. There are five major climatic factors which influence transmission line design.

Strong winds - determine strength requirements for structures and right-of-way widths.

Lightning - hazard that could damage a transmission line if not adequately protected.

Ice glazing - added weight of ice determines strength requirements.

Rainfall and humidity - affect corona.

Transmission lines are not designed to withstand tornados.

Minnesota lies north and somewhat to the east of the area of maximum tornado occurrence in the United States. This area, aptly named "Tornado Alley" consists of northern Texas, non-panhandle Oklahoma, and central and eastern Kansas. Minnesota has relatively few tornadoes and even fewer destructive ones. Nearly 50 percent of Minnesota tornadoes travel from southwest to northeast.

In general, the probability of a tornado striking a particular point is quite small in all Minnesota counties.

Twenty-three of the 27 tornados that occurred in the last 14 years, or over 85 percent of them, are found in two general swaths or alleys; both are oriented southwest to northeast across east-central Minnesota.

STUDY AREA
NSP TR-2

1-2

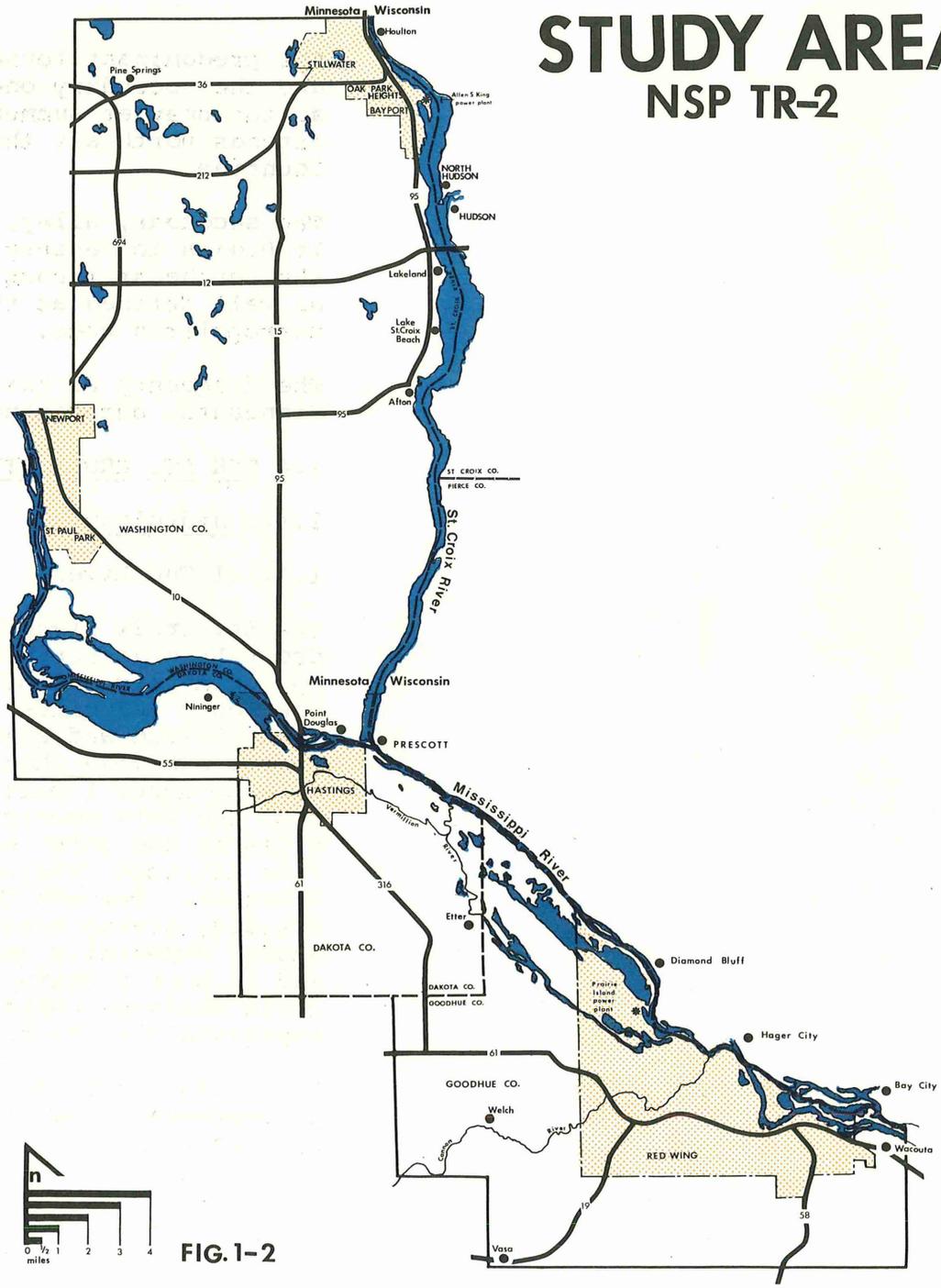


FIG. 1-2

The predominant tornado alley crosses the northwestern part of the metropolitan area and the secondary one crosses the southwestern part. The predominant alley, as well as the heavier summer precipitation pattern, starts in central Sibley County and extends northeast through Carver, Hennepin, Anoka, and into southern Chisago Counties.

The secondary alley, which includes part of the study area, is much less pronounced. It begins in eastern LeSueur County and extends through northwestern Rice County to the northeast through Dakota and into Washington County. This alley, however, is not as well defined as the primary one that crosses the northwestern part of the metropolitan area.

The frequency of hailstorms shows a high of 4 to 5 days annually in southwestern Minnesota, decreasing to near 2 days in the northern portion of the state.

1.4 THE ST. CROIX RIVER STUDY AREA

1.4.1 Hydrology

1.4.1.1 The River

The St. Croix River begins about twenty miles south of Lake Superior at Upper St. Croix Lake in northern Wisconsin . It flows southwesterly and then southerly for approximately 164 miles before entering the Mississippi River at Prescott, Wisconsin. The lower 127 miles of this stream forms the Minnesota-Wisconsin Boundary. With its sandy bottom and adjacent steeply, wooded hillsides, this river has experienced little man-made change. Below Taylors Falls, the average gradient is 1.3 feet per mile to about 1 mile north of where the Polk County line (Wisconsin) meets the river. From the Polk County line the gradient is only 0.5 foot per mile for the next 11 miles to the inlet of Lake St. Croix. There the channel broadens and the water surface altitude remains at about 675 feet in the 24 miles to the Mississippi River at Prescott. Between Taylors Falls and Lake St. Croix, the stream channel is highly braided, giving rise to many floodplain ponds and lakes. The upland part of the basin, especially north of the Washington County line, contains many lakes and swamps and is poorly drained, largely because of the flatness of the terrain. The St. Croix drainage basin includes about 7,650 square miles. Its vertical fall is approximately 340 feet from source to mouth.

Major land uses in the northern area of the river basin are silvicultural and recreational. Use in the southern portion of the drainage basin is primarily agricultural.

Lake St. Croix, which is the lower 26 river miles of the river extending from the mouth at Prescott to Stillwater, Minnesota, has an average width of 3,000 feet. The "lake" is a wide spread in the St. Croix caused by the damming effect of Point Douglas, which is a natural sediment deposition of the Mississippi River.

The St. Croix River is included in the National Wild and Scenic Rivers Act; the lower 26 miles (Lake St. Croix) being classified as "recreational." From Taylors Falls, onto Prescott, Wisconsin, the river is designated a National Scenic Riverway.

Runoff in the St. Croix River watershed varies from 15 inches in the northeastern most extent to about five inches in the southwest. Evaporation is greatest in the southern portion at 31 inches, and decreases to about 26 inches in the northeast.

The St. Croix River water has a moderate brown color caused principally by drainage from marshes and peat bogs. Additional discoloration is due to high quantities of sediments resulting from heavy spring runoffs. By the first week of August the stream clears until it is almost colorless and most of the bottom is visible.

1.4.1.2 Lakes and Streams

Within the counties bordering the Lower St. Croix River system there are numerous lakes and streams. The principal tributaries in the study area are Kinnickinnic River and Willow River from Wisconsin and Trout Brook from Minnesota. In addition, there are numerous small tributaries entering those rivers. Runoff and evaporation vary within the basin according to soil moisture content, vegetation cover, soil permeability, landslope, depth of water table, and frequency and duration of precipitation.

Relatively few lakes occur within the four Washington County townships affected by proposed routes.

1.4.1.3 Wetlands

Except for small areas of streamside wetlands along the St. Croix River, the study area contains very few lands which the U.S. Fish and Wildlife Service classify as wetland. Where wetlands do occur in Washington County, the predominant classification is shrub swamp. Shrub swamp wetlands occur mostly along sluggish streams, floodplains and in areas where woodlands are encroaching upon prairie wetlands habitat. Waterfowl use of these areas is limited.

1.4.1.4 Floods

Floods are a natural and inevitable part of life along rivers. They are considered serious when damage occurs to property or when activities are interrupted. The problem of flooding is partially the result of man's use of the floodplain. As the population increases and more of the floodplain is occupied and used, it is inevitable that damage from flooding will occur unless floodplain development is regulated.

Numerous major floods have occurred on the Lower St. Croix since the inception of flood data collection, the largest of these being the floods of 1950 and 1965. The largest recorded flood discharged occurred in 1950, when the Taylors Falls gauging station recorded a flow of 54,900 cubic feet per second, over 13 times greater than the average flow. However, the 1965 flood created higher stages at the lower end of the St. Croix because the higher waters of the Mississippi created a backwater effect on the St. Croix. This effect was particularly dramatic along Lake St. Croix where the maximum recorded stage was up to eight feet higher than the 1950 flood peak. Other large floods in the St. Croix basin occurred in 1945, 1952, 1954, 1969 and in 1972.

Maximum flows in the St. Croix generally occur during March, April, May, or June, while minimum flows are usually recorded in November, December, or January. Spring floods generally result from rapid snowmelt with occasional concurrent rainfall of long duration.

1.4.1.5 Groundwater

Groundwater in the study area occurs in Precambrian and Paleozoic sandstones, dolomites and limestones as well as in river alluvium and glacial drift. Groundwater levels may range from 50 feet below the surface in Paleozoic and Precambrian aquifers to five feet in areas where glacial clay deposits overlie aquifers in drift or bedrock.

Discharge areas are located along the St. Croix River and tributary valleys where numerous springs issue from Paleozoic sandstones exposed along the valley bluff. Groundwater recharge is derived from local precipitation on the watershed areas and occurs during the spring breakup and during intense storms of sufficient duration.

Large quantities of groundwater are present in the highly permeable surficial sand deposits. Many lakes and streams are located in these deposits. Rapid removal of groundwater from these aquifers generally induces water to move from the lakes and streams. These aquifers supply 95 percent of the water outside the large cities. They are similar in chemical composition from the Mississippi headwaters to the Twin Cities, except that in the Twin Cities they have only one-tenth to one-hundredth of the iron content.

Little appears to be known regarding groundwater supplies available or used specifically in the St. Croix River watershed. The Prairie du Chien-Jordan aquifer in Minnesota supplies some groundwater from a recharge area located approximately between Forest Lake and Cottage Grove, Minnesota. This groundwater is medium hard (average 412 ppm, 1961) and contains more dissolved solids, sulfates and bicarbonates, but less iron and chloride than the softer water in the lower Mt. Simon-Hinckley aquifer.

The groundwater resources in the metropolitan area are immense. Despite the fact that pumpage is increasing steadily, the groundwater reservoir is essentially full and actually is spilling some of its surplus water into the rivers.

There is no unique "recharge" zone or localized replenishment to the groundwaters of the study area. The majority of the region around the study area receives infiltration from rainfall. Consequently, even if infiltration were to cease entirely at localized areas of intense development, it would have no overall effect on the recharge potential of the aquifers.

Not all of the 35 inches of precipitation received annually in the study area is available as replenishment for the regional water resources. Between 85% and 90% of it is lost through evapotranspiration. The remaining 3.5 (approximately) inches of precipitation is available after evapotranspiration for surface runoff and groundwater recharge.

Industry is the largest user of groundwater resources of the region. Groundwater also serves as a source of water supply for many domestic water users. The available data suggest that groundwater pumpage would have to be nearly doubled to halt the overflow of the aquifers into the rivers. Use of groundwater has been increasing steadily, as shown by records dating back to 1885. Total groundwater pumped in 1959 was estimated to be 136 MGD (million gallons per day). The pumpage for 1976 was estimated to be approximately 194 MGD. The Jordan formation supplies an estimated 75 percent of total groundwater pumpage with the Mount Simon-Hinckley supplying 18 percent and the glacial drift Platteville Limestone and St. Peter Sandstone providing 7 percent.

In spite of this withdrawal, the bedrock aquifers in the St. Croix study area are still completely saturated with water. In some localities, water levels have been lowered due to pumping, but the cone of depression which exists throughout the Twin Cities is a normal result of well operation, and is not considered serious at this time.

The decline of water levels in the Minneapolis-St. Paul area has given rise to speculation that the groundwater is being mined, or that more water is being pumped than is being recharged to the aquifers. The drawdown, however, does not necessarily indicate an overdraft of groundwater supplies. In the few places where large drawdowns exist, it can be attributed to the overlapping of cones of depression from a number of closely spaced wells. Such problems are more a result of lack of planning and knowledge of groundwater hydrology than of an overdraft of the groundwater system.

1.4.1.6 Water Use

Sources and uses of water resources in Washington County (in millions of gallons per year) are as follows:

SOURCES

Source	Number	MGY
Lake	46	46
River, Stream Brook, Creek	40	102,469
Artificial Pit, Pond or Swamp	2	152
Natural Swamp Pond, Slough	1	0
Ditch	0	0
Well	76	6,948

USES

Use	Number	MGY
Rural	4	.27
Public Safety	34	2,428
Thermoelectric	16	3,235
Self Supplied Industrial	1	101,770
Dewatering	15	3,125
Irrigation	2	152
Miscellaneous	16	3,235

Rural uses include water for private water supplies and level control. Public supply uses refer to public water works usage. Thermoelectric power use refers to usage by mine processing or public water works. Self supplied industrial uses include road construction, industrial processing, industrial cooling and air-conditioning. Dewatering use refers to drainage for construction projects. Irrigation use includes water for wild rice, golf courses, and landscaping. Miscellaneous use refers to any uses not mentioned above.

1.4.2 Topography and Geology

The topography of the St. Croix River Valley consists of gently rolling summit areas atop bluffs which gently slope downward to a short bench, and then abruptly descend about 100 feet to a narrow floodplain adjoining the river.

The St. Croix River originates in Upper St. Croix Lake, Douglas County, Wisconsin. From its source in Wisconsin's northern highland region, the St. Croix flows in a southerly direction, between Minnesota's central lowland and Wisconsin's southwestern upland, to join the Mississippi River at Prescott, Wisconsin. This major tributary of the Upper Mississippi drains a 6,750 square mile basin which consists of gently rolling to hilly forested, agricultural and urban lands. This topography is derived mainly from the Pleistocene glaciers during the last million years, as subsequently modified by erosion, and more recently, by people. This topography, plus a climate which increases in moisture from west to east, the soils, and man's activities have led to a vegetational gradation. This gradation extends from the large mixed pine-hardwood forest studded with numerous lakes and streams in the northeast, to the rich, open farmland (much of which was formerly prairie) downstream dotted with marshes and laced with streams.

Downstream from Sunrise (Pine County, Minnesota) the St. Croix River leaves a broad, shallow, swampy valley and flows between rocky bluffs towering 100 to 300 feet above its surface. At Taylors Falls, Minnesota, the water falls 60 feet at the hydroelectric power dam and then rushes through a narrow rocky gorge, the St. Croix Dalles, where the largest gradient (9 feet per mile) occurs. The current slows in the lower 24 miles of the river, which is essentially impounded by the higher bed of the Mississippi. Thus, a natural slackwater pool is formed, known as Lake St. Croix.

Minnesota and Wisconsin are well known for evidences of glacial activity. This activity essentially formed the topography and soils of the Lower St. Croix Valley on a foundation of pre-Cambrian metamorphic and volcanic material.

There is very little alluvial land along the Lower St. Croix River below Bayport, but nearly level sand and gravel alluvial fans have formed at the mouth of almost every tributary entering the St. Croix. Above Bayport there are numerous low sandy islands and bars which are constantly forming and reforming as erosion eats away at the upstream end and deposits material at the downstream end.

St. Croix River flows through a deep valley with occasional bluffs of sandstone and limestone between Taylors Falls and Prescott. Many of these bluffs are covered with a

thin mantle of silt or sand loam over rock. Around Afton, these bluffs recede from the river forming large, somewhat level, terraces of sand and gravel. The few intermittent streams which enter the valley have created small outwash deltas which provide the only opportunities to get down to the river's edge. The majority of the valley is about half mile wide from bluff to bluff and averages about 150 feet deep to the water level. The valley sides are usually very steep and rocky.

1.4.3 Soils

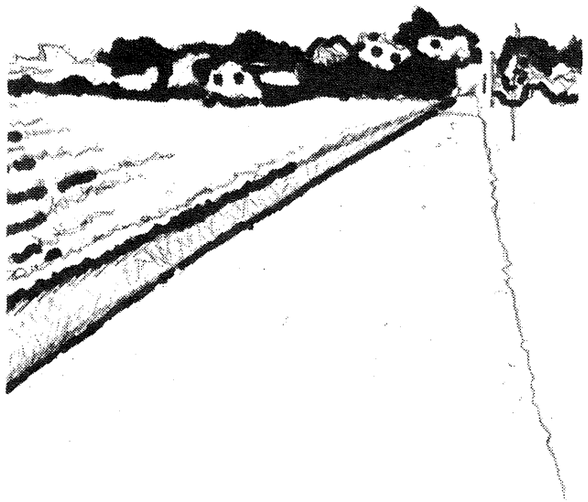
The soils found along the St. Croix on the steep slopes are very susceptible to erosion, but erosion has only occurred where vegetation has been removed.

From Bayport to Afton there are large, nearly level terraces composed of sand and gravel. There is very little alluvial land along this stretch of the river, but nearly level sand and gravel deltas and alluvial fans have formed at the mouth of almost every stream that flows into the river. These fans are often used for recreational purposes. Flooding is frequent on these fans and on the adjacent areas of alluvial land. There are several low sandy islands, bars and peninsulas in the river that are frequently used for picnicking, and other river-oriented recreation. The sandbars are heavily used as beaches by recreational boaters and canoeists. Other low areas are residential or city parks (Stillwater, Hudson, Afton). However, there is relatively little floodplain adjacent to Lake St. Croix.

The soils along the Wisconsin bluff in Pierce County belong to the Dakota-Waukegan association, except those soils bordering the Kinnickinnic River Valley. This latter group of soils belong to the Antigo-Onamia association. Soils in both associations are moderately deep, loamy soils of stream terraces, the former dark-colored, the Antigo-Onamia group light-colored. The former group of soils developed under oak savanna while the Antigo-Onamia group developed under a hardwood forest.

The parent material of the 30 to 60 inches of the soil profile was loess, which is a fine particled material or "rock flour" in the glacial drift. This loess was eroded by the strong winds from the glaciers, transported and deposited in the lee of the bluffs.

The slope of these soils ranges from zero to 12 percent, occasionally up to 20 percent. The percolation rate is 0.8 to 2.5 inches per hour in the upper 30 inches. The sand substratum below, in the Dakota-Waukegan soils, have a percolation rate of 5 to 10 inches per hour. The sand and gravel below the Antigo-Onamia soil has a percolation rate exceeding 10 inches per hour.



Generally, the Dakota-Waukegan soils are well-suited to crops; however, they tend to be droughty and susceptible to wind erosion in the area adjacent to Lake St. Croix. The Antigo-Onamia soils in the Lake St. Croix area are also droughty and are generally suited for pasture and trees.

1.4.4 Flora

Vegetation of the upper flat areas along the Lower St. Croix Basin behind the bluff line is oriented to agricultural use with the flat or gently sloping land under cultivation or in orchards. The more rolling terrain behind the bluff line is predominantly utilized for cattle grazing. The original vegetation of this area consisted of stands of white and red pine, with oak savanna on the flatter terraces. Early logging operations removed the white and red pine except for a few isolated stands which still exist on the very steep slopes. The only remnants of the original oak savanna can be seen in Afton State Park.

About 35 percent of the five counties bordering the Lower St. Croix is covered by forest, with the majority of this forest land occurring within the actual valley. The actual valley is close to 80% forest land. These forested areas are primarily utilized for watershed protection, wildlife habitat, and recreation.

Along the Lower St. Croix, early logging operations left few of the original white or red pine stands except in isolated, steeper situations. A few stands of these stately conifers still exist such as at Cedar Bend and in the Kinnickinnic Valley. The remaining pines are mainly second growth, principally located on the higher ground. They are intermixed with ironwood, elm, oaks, and silver and sugar maples. Basswood, hackberry, dogwood, paper birch, and aspen occurs less frequently. Near the river in moister situations and on most of the numerous islands, hundreds of acres are densely covered with deciduous trees. Box elder, silver maple, elm, ash, and cottonwood are well represented in this zone. Forming an understory on cut-over areas are such species as chokecherry, dogwood, mountain maple, thorn apple, highbush cranberry, and elderberry.

Periodic flooding of the lowlands has resulted in a river bottom ecology favoring hydrophytic species along many parts of the river. In selected lowland sites, white cedar, tamarack, spruce, willow, and alder appear.

Timber stands are generally composed of second growth. Dominated as it is by a variety of hardwoods with an interspersing of conifers, the lower St. Croix Valley is an impressive fall attraction. Autumn coloring is spectacular. Among the dominant trees and shrubs contributing to this colorama are the maples, oaks, hickory, and evergreens.

Ground cover plants are both numerous and varied. They range from primitive mosses and lickens through ferns and spermatophgytes. Flowering plants of interest include the trillium, anemone, water marigold, wild strawberry, jack-in-the-pulpit, skunk cabbage, solomon's seal, wild germanium, forget-me-nots, asters, goldenrod, and wild roses. Less popular species include poison ivy, stinging nettle, and beggar's ticks.

Various shrubs valued by both man and wildlife also occur. They include chokecherry, juneberry, dogwood, snowberry, elderberry, wild grape, pincherry, raspberry, and high-bush cranberry.

Aquatic vegetation is relatively sparse in the river channel. Periodic high water and floods have resulted in a scoured covered bottom above Lake St. Croix which has discouraged establishment of most aquatic plants. The most important exceptions are wild celery and river pondweed, both of which are valuable wildlife foods. In protected backwater areas and sloughs, other species of pondweeds, naiads, cattail, cottontail, rushes, sedges, satittaria, bur-reed, and duckweed appear.



Relatively steep slopes and riverbottoms offer a variety of habitats that enhance the ecological diversity of the area. An outstanding area of botanical interest occurs in the lower Kinnickinnic River Valley. An ongoing study of the Kinnickinnic Valley is being conducted by the Wisconsin State University--River Falls. A preliminary report from the University states:

> "Presently about 1,900 species of plants in 123 families and 535 genera are found in Wisconsin. Of this number 60 families, 148 genera, and 240 species of vascular plants have been identified from this valley and filed in the herbarium at Wisconsin State University, River Falls. However, this is by far an incomplete record of the vascular plants occurring in the valley. Potentially the valley may contain as many as 400-500 species of vascular plants to the list; the total composition of the valley will be considerably higher.

Steep Slope Associations

Plant communities in the study area are largely remnants of the vast acreages of the past. Today, natural forest and prairie lands are almost wholly restricted to lands which are not well suited for either agriculture or development, such as wetlands, steep slopes, poor soils and river corridors. Under the State and National Wild, Scenic, and Recreational River acts and the State Critical Areas act forested bluffs and lowlands in the river corridors have been afforded some degree of protection.

Steepness of slope, soil, drainage, and bedrock all contribute to the composition of these plant communities. The most important factor, however, is the orientation of a slope. South and west exposures have warmer temperatures due to the longer hours of sunlight received. These slopes often have micro-climatic conditions which enable vegetation characteristics of the more arid parts of the U.S. to flourish. Prairie communities, drought tolerant species of deciduous trees and shrubs, and red cedar often are found on the upper slopes.

North and east facing slopes tend to have cooler, moister climates due to the shaded conditions and retention of snow cover. Plant communities may contain conifer and deciduous species characteristic of northern boreal forests as well as mixed hardwoods.

Herbaceous plants tend to be shade and moisture tolerant with ferns and mosses quite common.

Economically Valuable Plant Species

Very few species of vegetation in the study area are considered economically valuable. Black walnut, though not abundant, is highly valued for veneer. Some sugar maple syrup production is carried on locally. A few orchards and vineyards produce crops primarily for the metropolitan market.

Collectively, the value of the vegetation cover of the study area is immeasurable in terms of watershed control, erosion and sedimentation control. Generally, as development occurs, sedimentation yields increase and water quality deteriorates. Row crops are major producers of fine sediments. With present technology, however, soil loss could be cut to a tolerable level of four tons per acre (2,560 tons/square mile) annually. These values vary considerably depending on the type of soil, topography, amount and intensity of rainfall, distance to water, in addition to the cover type.

Average sedimentation yields for different land uses are as follows:

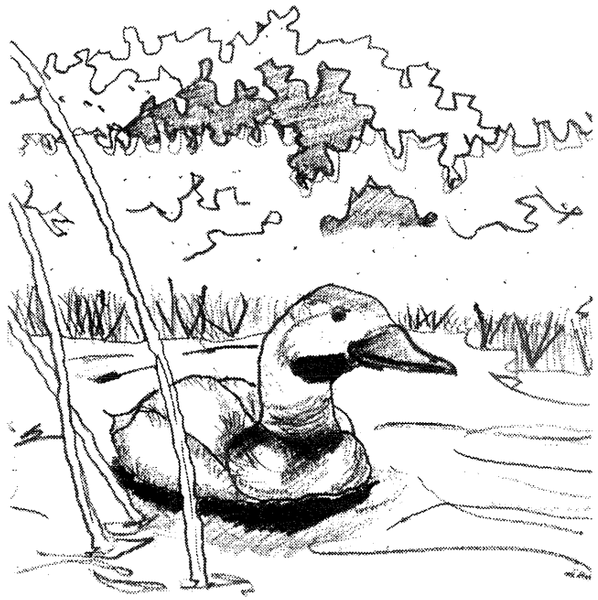
LAND USE	SEDIMENT (tons/Sq.Mile/Year)
Forest	less than 50
Urban and Suburban	50-100
Farm	1,000-5,000
Land Stripped for Construction	25,000-50,000

Vegetation cover is also economically important in terms of pollution, filtration, glare and temperature reduction, moisture retention, noise abatement, recreation use, marketability of desirable residential areas, and aesthetic value.

1.4.5 Fauna

The St. Croix Valley offers an attractive, protected habitat for a variety of wildlife. An abundance of waterfowl, marsh birds, upland game birds and songbirds inhabit the river valley. Mammals which inhabit the valley include white-tailed deer, mink, muskrat, racoon, squirrel, woodchuck, fox, rabbit, and skunk. Other smaller mammals include chipmunks, weasels, gophers, mice, moles, and shrews. There are also numerous species of amphibians and reptiles. There have been isolated sitings of eagles but no known nesting areas have been identified. All wildlife encountered within the valley is fairly adaptable and will tolerate some degree of human intrusion as long as their habitats are kept within reasonable conditions. There are sixty-seven known species of fish which inhabit the Lower St. Croix River. The fisheries are strongly influenced by the Mississippi River and the dam at Taylors Falls. Black crappie, white bass, bluegill and walleye are the predominant game fish. Other game fish include northern pike, small and large mouth bass, rock bass, yellow perch, and sunfish species. Boat fishing, bank fishing, and ice fishing represent one of many recreational uses of the St. Croix.

The St. Croix River audits shoreline provide a natural travel lane for wildlife, as well as permanent residences for many game and non-game animals. The relatively steep-walled valley is well covered with numerous species of trees, shrubs and herbaceous plants that are highly attractive to a variety of wildlife. Vegetation on the floodplain, riverbank and islands is lush in many portions of the river.



Many different species of waterfowl use the river proper during the annual spring and fall migrations. During migration, surface feeding ducks include widgeon, mallard, wood duck, blue and green-winged teal, pintail, gadwall, black duck, and shoveller. Diving ducks, primarily the lesser scaup, ringneck, goldeneye, canvasback, and redhead, frequent the river. The valley's breeding ducks are primarily confined to wood duck, mallard, and blue-winged teal.

Marsh and shorebirds include Wilson's snipe, rails, woodcock, gallinules, and several species of sandpipers. These birds occupy shoreline and lowland habitats along the lower St. Croix.

Great blue herons and American egrets are a prime viewing attraction each fall. Another autumn attraction is the hawk migration along the bluffs. In addition to numerous red-tailed hawks and other broad-winged species, falcons, ospreys, and eagles migrate through the valley. Turkey vultures, gulls and terns may be observed along the river, and the pied-billed grebe and green heron are frequently sighted. The spring and fall migrations of warblers are annual highlights for enthusiastic bird watchers.

Several species of upland game birds inhabit the lower St. Croix Valley. Ruffed grouse are present in limited numbers. Mourning doves are abundant throughout the river valley and are nesting residents. However, they are not a legal game bird in either Minnesota or Wisconsin. A few bobwhite quail and pheasants occur along the valley, principally in association with agricultural lands bordering the lower end of the valley.

There have been no specific inventories of the bird and animal life along the lower St. Croix River; however, fairly intensive surveys have been conducted on the lower Kinnickinnic River Valley by personnel from the Wisconsin State University-River Falls. Lists of birds and other animals are available for the lower Kinnickinnic River valley from the University.

The small mammals inhabiting the lower St. Croix region include shrews, bats, moles, mice, chipmunks, and ground squirrels. These small animals are gaining increasing recognition for their ecological role in the natural systems. They serve an important function as buffer species between predators and game birds.

Numerous reptiles and amphibians are natural to this area. These include salamanders, toads, frogs, turtles, snakes and skunks. These forms add considerable interest and variety to the area fauna.

The nut-producing trees, principally oak and hickory, provide an excellent food supply for grey squirrels and fox squirrels. Cottontail rabbits are common on the higher ground. Snowshoe hares occur in isolated locations where suitable cover exists. Other species heavily dependent upon woodland habitat include the porcupine, red squirrels, and flying squirrels.

White-tailed deer are common, especially upstream from Stillwater, probably making use of the ravines to gain access to the lake. They have made an excellent comeback along the river since the 1930's, because of the improved protection and management programs of both states.

Muskrats, mink, fox, and skunks are common along the lower St. Croix River, but probably are uncommon in and along Lake St. Croix. Beaver occasionally take up residence in the tributary streams. Otter and oppossum are present but uncommon. Trapping activity is generally very limited.

The diversified fauna of the St. Croix Valley attracts many people to the area. The rich variety of animal life, especially the birds, is caused by several factors. These include the midcontinental location, with overlapping ranges of eastern and western species, climatic conditions in the sheltered valley, and the merging of differing life zones. These factors have enabled a number of southern birds to extend their ranges northward in the valley. Among this group are the Carolina wren, mockingbird, cardinal and several warblers.

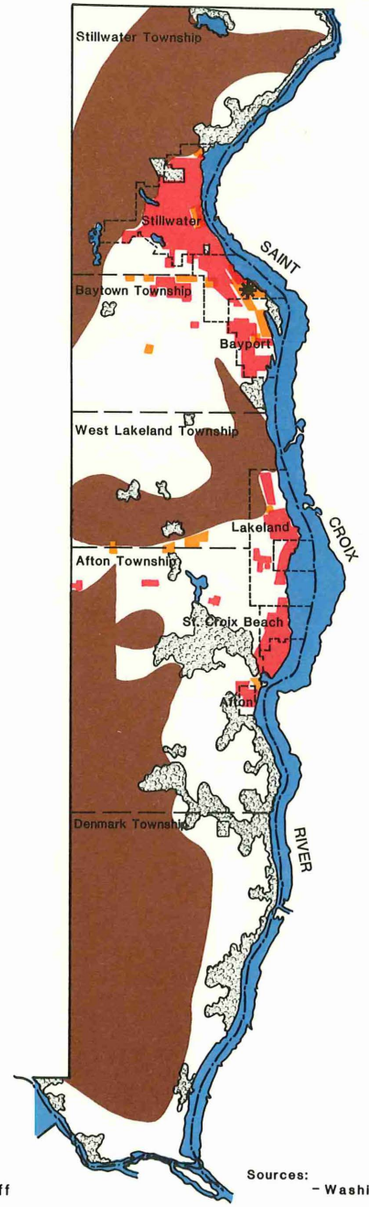
1.4.6 Economic Base

1.4.6.1 General

Existing land use in the St. Croix River study area is shown in Figure 1-3. The area is facing an extended period of rapid urbanization. The rate land is consumed for new development has been accelerating. Contributing to this increase have been low densities of residential development, a result of large-lot development in rural areas and, more recently, an increase in the percentage of single-family housing being built compared to other housing types. Residential land-use was the second largest consumer of land in the study area during the 1970-1975 period. Some gains in public and recreational land use categories occurred, which represent a change in ownership rather than a conversion to intensive urban type use.

SAINT CROIX RIVER STUDY AREA

Land Use & Transportation



- Residential
- Commerce & Industry
- Commercial Traffic
- Commercial Agriculture
- Woodland & Recreational Land
- Water Body
- County Boundary
- Township Boundary
- Municipal Boundary
- Allen S. King Power Plant
- Airport
- State, Federal or County Road
- Railroad



0 5 Miles

M E Q B Staff

Sources:
- Washington County Planning Advisory Commission 'Where We are Today. . . 1976
- Metropolitan Council of The Twin Cities,'Generalized Land Use Map' 1968

FIG. 1-3

The Washington County Planning Advisory Commission (1969) recommended the Constellation Cities development pattern. Such a pattern involve concentration of major urban densities along certain selected transportation "corridors" with major urban centers located at selected points along or near the corridors (Figure 1-4). The corridors selected which are in the study area are:

1. Highways 10 & 61 (Newport to Hastings)
2. Highways 12 & 94 (Maplewood to Hudson)
3. Highway 212 (Maplewood to Stillwater)

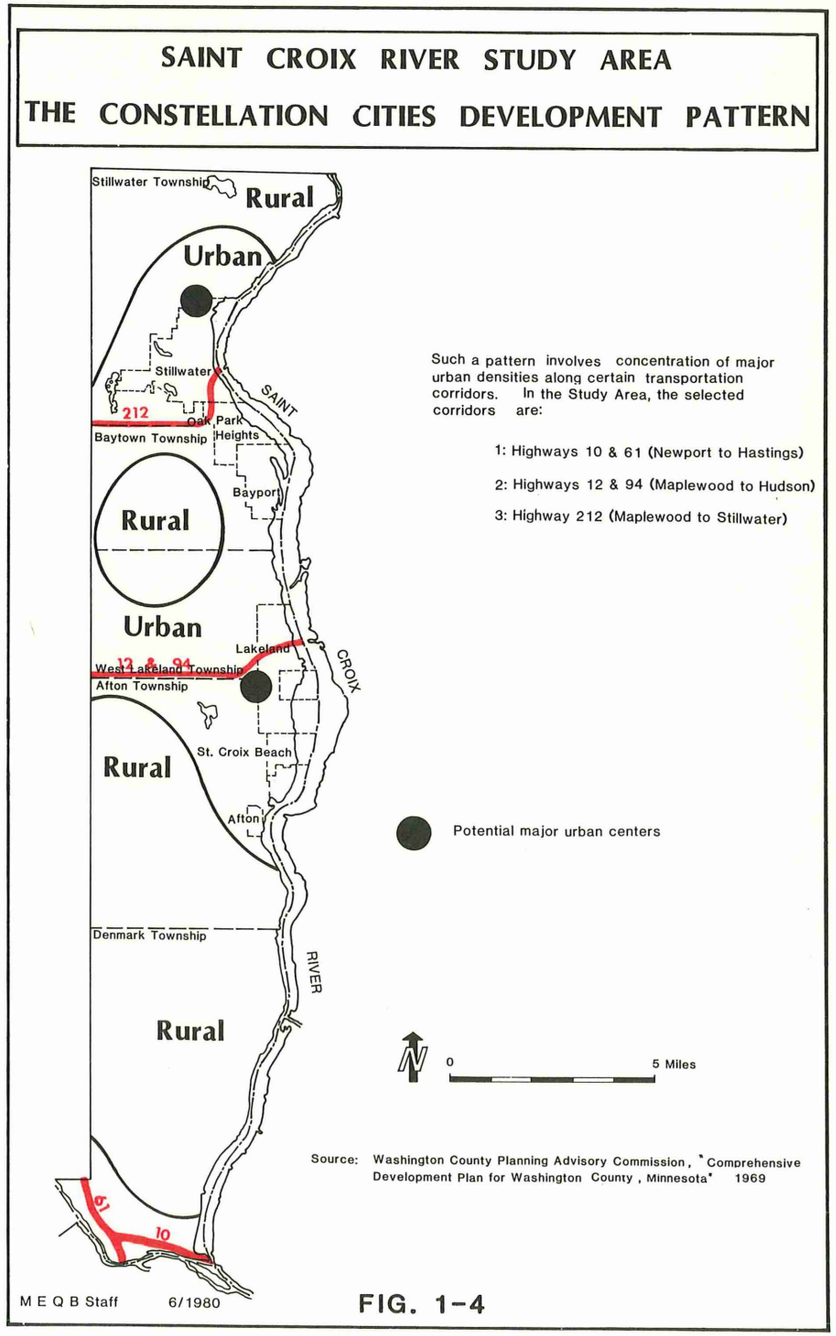
Industrial development in the St. Croix Valley as a whole has been rather slow in the past: indications are that future industrial development will probably not take place to any great extent in this area.

Almost all industrial and commercial land use in the study area is found in or immediately adjacent to Stillwater, Oak Park Heights, Hudson, and Prescott.

Development pressures generated by the growth of the Twin Cities, are being felt along the St. Croix, particularly in Washington County, and to a lesser extent in St. Croix, and Pierce Counties.

1.4.6.2 Forestry

Although logging in the St. Croix River Valley is an important part of Minnesota's history, forestry is no longer a vital economic activity within the study area.



1.4.6.3 Mining

Mining activities within the project area are limited to sand and gravel extraction. Deposits of buried sand and gravel occur randomly within the undifferentiated drift of Late Wisconsin glacial till and outwash. There is a concern about keeping existing pits far enough back from the edge of the river bluff to prevent the river side walls from collapsing. Mining and quarrying are subject to regulations on all claims and patents not approved before inclusion of the riverway into the Wild and Scenic River System. In essence, this means that minerals situated within one quarter mile of the river's bank are not withdrawn unless they are subject to a valid, existing right. Mining has not been a significant industry in the Saint Croix Valley in the past, with the exception of sand and gravel.

1.4.6.4 Manufacturing (Commercial and Industrial Use)

There are major industrial and commercial centers in the region. These coincide with the areas of high population density in the study area. The highest percentage of workers employed in manufacturing operations in the area are employed in the northern portion of the Dakota County and western Washington County close to the Twin Cities metropolitan area. Stillwater also has high employment and maunfacturing activities.

1.4.6.5 Services

Commercial services such as wholesale and retail trade, recreation, automobile servicing, finance, insurance, real estate, and professional services provide the majority of jobs within the study area. Consequently, off-farm employment is concentrated in Stillwater, South St. Paul, East St. Paul, and Hastings, although the majority of the population in the study area continues to live in rural areas.

1.4.6.6 Recreation

The study area has a large number of public and private outdoor recreational lands. The Lower St. Croix River lies within a one hour drive of some 2 million Twin Cities metropolitan area residents. Major access to the valley is provided by Interstate 94 and U.S. Highway 12 and there are other U.S., State, and County highways which provide access into the valley from the metropolitan area. While access to the St. Croix Valley is excellent for so many people, there are few opportunities to actually enjoy or experience the linear quality of the St. Croix River other than by boat.

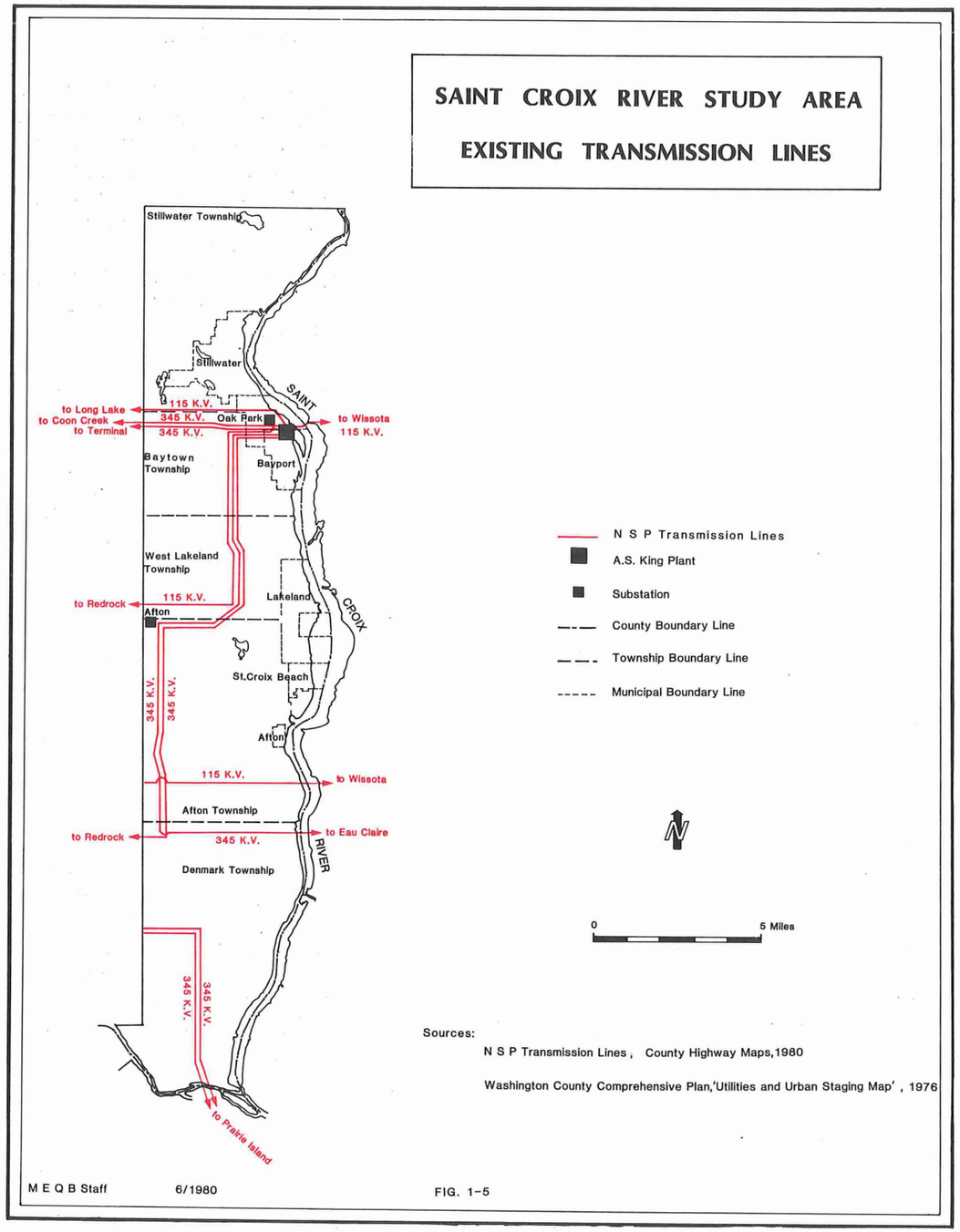
The lower St. Croix River is predominantly utilized as a day-use facility with heavy use on the weekends by metropolitan residents. It is not known as an extended vacation area nor are there many existing facilities for extended vacations.

Three state parks - Afton in Minnesota and Willow River and Kinnickinnic in Wisconsin, are on or lie very close to the Lower St. Croix.

While these are the major existing or proposed recreational facilities within the area, there are a number of other smaller, specific use units. Troy Beach in Wisconsin provides swimming. There are a few municipal parks within Afton, one of which is Steamboat Park, adjacent to the St. Croix River. Afton Alps, which lies adjacent to Afton State Park provides skiing opportunities. An existing recreational trail runs between U.S. Highway 12 and the City of Afton.

1.4.6.7 Existing Transmission Lines

All existing transmission lines in the St. Croix study area are owned by NSP. They are shown in Figure 1-5.



1.5 MISSISSIPPI RIVER STUDY AREA

1.5.1 Hydrology

1.5.1.1 The River

Of focal interest in this sub-study area is the Mississippi River Valley in the vicinity of Red Wing and the Prairie Island Generating Plant. The valley in this area is about three miles wide and 340 feet deep. Typical of old eroded river systems, steep wooded bluffs rim the flat valley floor. The river channel itself winds back and forth through the valley creating a complex of backwaters, floodplain lakes, marshes, and interconnecting channels and islands. Chief tributaries in the area are the Vermillion River, the Cannon River, and the Trimbelle River. Lock and Dam No. 3, approximately one mile downstream of the Prairie Island Plant and four and one-half miles upstream of Red Wing, has expanded considerably the water area around Prairie Island.

The Mississippi River plays a significant role in the economic life of Goodhue and Dakota County. The river provides an important resource for transportation, navigation, recreation, and water supply. Because of its importance to the region and state as a whole, the Mississippi River Corridor has been designated a State Critical Area. The critical areas planning process requires local governments to identify important historic, cultural, and natural areas and prepare plans for their use.

The Mississippi River floodplain is absent of any direct affects of glaciation. However, the wide river valley was formed by enormous flow of water generated by glacial meltwater. In the glacial era (Pleistocene) the Minnesota River Valley and Mississippi River Valley below it were the channels for the glacial River Warren. The River Warren flow was far larger in volume than the Mississippi today and was comparable in size to the St. Lawrence Seaway. The River Warren drained glacial Lake Agassiz, a very large glacial lake in Canada and Northwestern Minnesota. As the flow of water in the River Warren diminished, a series of beach terraces formed at former water levels. One such beach ridge is visible on the bluff above Spring Lake in Nininger Township.

Today the flow of the Mississippi River meanders through a wide floodplain. In places the channel is slowly being stabilized as development encroaches on the floodplain and flood control structures are erected. South of Hastings, the Mississippi River flows unimpeded through Ravenna Township of Dakota County. The floodplain is quite wide through this area as the land is low and swampy. Being subject to yearly flooding, it is unsuitable for most urban uses. Its soil consists of fine materials that have been eroded elsewhere and deposited by the river in the floodplain.

1.5.1.2 Lakes and Streams

The Mississippi River portion of the study area encompasses an extensive system of surface hydrology associated with the main channel of the river. The system varies in width from approximately one mile at Barnes Bluff in Red Wing to two and one half miles wide between Red Wing and Hastings. Numerous lakes, sloughs and side channels predominate the floodplain. This surface system is fed by the Mississippi River and two primary streams, the Cannon and Vermillion Rivers. Environmental descriptions of these two primary streams are provided in a subsequent section.

1.5.1.3 Wetlands

Aquatic vegetation is relatively sparse in the portion of the Mississippi study area as would be expected. These are no large flooded areas other than North Lake and Sturgeon Lake which are a portion of Gores Management area at the upper end. The most extensive marshland habitat borders North Lake.

The current velocities and constant scouring by commercial navigation and recreational boat traffic deter any growth by submerged or emergent macrophytes along the main stream of the main channel of the Mississippi. The river is relatively narrow in this area, creating strong wave action on the shoreline.

1.5.1.4 Floodstream

Two types of flooding occur in the upper Mississippi River basin -- open-water flooding and backwater flooding. While open-water conditions prevail, flooding is caused by runoff of rains or melting snow, or a combination of the two. Backwater flooding is usually caused by ice jams. The most serious flooding throughout the basin has been associated with excessive snowmelt and rainfall. Major floods occur on the average 2-3 years out of 10. The occurrence of floods shows the greatest

frequency in April during the spring thaw. A second peak occurs in June due to thunderstorm-type rains. A smaller peak occurs in the fall. Local flash floods occur in the smaller streams during the spring thaw and also in the warmer seasons due to intensive rainfall.

The maximum flood of record (since 1928) for the upper Mississippi River occurred in April 1965. Records for the gauging station at St. Paul indicated that this was probably the maximum flood since 1851. This flood resulted from a severe winter and a combination of climatic events that led to a deep snow cover on top of an ice layer. Moderate to heavy rainfall and a return to normal temperatures during April produced rapid melting and extremely high runoff.

The average discharge is 15,600 cfs as measured at Prescott, Wisconsin. There are no major sources of water between Prescott Lock and Dam #3. Flood flows are not materially affected by any water storage behind Lock & Dam #3.

1.5.1.5 Groundwater

Regionally, the movement of groundwater is toward the Mississippi River and its main tributaries. The groundwater table slopes from the higher, partially glaciated bedrock areas toward these surface streams, generally at low gradients. Groundwater enters the river valley from along the base of the bordering bluffs in the form of springs or as subsurface flow.

Beneath the flood plains and low terraces that border the Mississippi River, groundwater levels closely coincide with the elevations of the river surface and vary in accordance with river fluctuations. The average groundwater gradient in these bottomlands is downstream and essentially parallel to the stream gradient.

1.5.1.6 Water Use

The surface waters are not used for municipal water supply for many miles downstream from Red Wing because of the ready availability of groundwater in this area. Groundwater is obtained from aquifers in Keweenawan, Cambrian, and Ordovician rocks and from overlying Quaternary alluvial and glacial deposits. The Hinckley formation of the Keweenawan period is an important aquifer. The most productive Cambrian aquifers are the Mount Simon and Galesville members of the Dresbach formation and the Jordan sandstone. The principal Ordovician aquifer is the St. Peter sandstone.

In the vicinity of Red Wing the Mississippi River valley has been cut through the Ordovician and approximately the upper 300 feet of the Cambrian rocks. Glacial and alluvial deposits in the valley cover the bedrock formations to a thickness of about 150 to 200 feet. These deposits yield small to large supplies to farms and small industrial users. Some municipal supplies in the valley are obtained also from the Mount Simon sandstone and from some wells that tap the Hinckley formation, the uppermost pre-Cambrian rocks. At some distance from the valley, the St. Peter sandstone is frequently tapped by wells for small to moderate supplies.

1.5.2 Topography and Geology

At least four glaciation periods occurred in this area in the last million years, the advances and retreats leaving debris in patterns which helped determine waterways of the St. Croix River and the Mississippi. The upper part of Pool 3 ends at the Hastings Faults and the lower pool receives its water from the main stream of the Mississippi as well as the waters of the St. Croix which are directed along the Afton-Hudson anticline. The bluffs along either side of the river downstream of the St. Croix juncture range in height from 200 to 390 feet over the flat pool of 675 feet. The bluffs are Shakopee Dolomite overlying New Richmond Sandstone overlying Oneota Dolomite on the middle portion of the pool on the Wisconsin side; while on the Minnesota side, and on the lower side of the Wisconsin shore, the bluffs are of Jordan Sandstone overlying St. Lawrence Dolomite overlying Franconia and Dresbach formations of Sandstone. The interconnection of the St. Croix River and main stem Mississippi creates a very mixed geologic formation and an interface of several soils types.

1.5.3 Soils

The soils in the study area are primarily pedalfer and vary from sandy clay loams to loamy sands. On the bluff tops, the soils vary in thickness and quality, generally being medium to coarse sandy.

In the floodplain, the soils are organic river-bottom types to sandy, being inundated periodically and generally poorly drained. The very fine silt-load of the Mississippi tends to clog the soils for drainage, leaving many untillable "potholes."

Most of the study area in northeastern Goodhue and eastern Dakota counties encompasses soils formed in outwash or recent alluvium. Lowest elevations within floodplains are generally Marsh-McPaul-Radford association, which are very poorly drained marshes and moderately well to somewhat poorly drained, medium textured soils. As elevations increase from the bottom lands, soils associations are Estherville-Wankegan Alluvial (nearly level to sloping) and Timula-Frontenac (sloping to very steep).

Sandy, nearly level soils of the Hubbard and Nymore groups occur in a small area southeast of Hastings. These soils are droughty and are irrigable.

1.5.4 Flora

Within the river valley and its feeder coulees, the lowlands are a portion of the Dorer State Memorial Hardwood Forest, consisting of an elm/ash/cottonwood complex in the lowest areas, and an oak/maple/hickory complex as the elevations increase from the water level of the pool. Much of the original forests have been cut over in what was once a very rich forested area.

The forested lands are generally part of the Gores Pool #3 Wildlife Area, which is managed as a special use area by the Minnesota Department of Natural Resources. Forest areas are generally zoned as "recreational" in the pool.

There are three loosely defined forest habitats in the cross-section from Minnesota to Wisconsin. First are river bottom forests which are most obvious, second are sandy shores and mudflats, and third are the upland hardwood forests.

The river bottom forests occur adjacent to rivers and mainly are found on flood plains. The common names of the principal woody plants are: elm, ash, cottonwood, box elder, oaks, basswood, soft maple, willows, aspen, some pines, hackberry, and arbor vitae. The herbaceous component consists of: smartweed, wild millet, fall panicum, cockleburr, and tealgrass.

The sandy shores and mudflats have willows, cottonwoods, and some elms in wooded portions. The herbaceous and shrub-like flora are: the same herbs as seen in the river bottoms plus sedges, carex, canary reed grasses, wild rice, and many of the emergent vegetation expected in marshes.

In the upland hardwood forests, the common woody components of the habitat includes: bur, white, red and black oaks, elm, basswood, with maples as a dominant, ash, hornbeam, aspen, birch, wild cherry, hickory, butternut, and black walnut.

Much of the non-wooded area consists of cropland (corn and small grains) or abandoned fields. Small areas planted to conifers (chiefly shelterbelts) and natural or planted prairie also occur. Chief planted evergreen species are red and scotch pine. Native and planted prairie areas contain such species as big and little bluestem, sideoats grama and switch grasses.

1.5.5 Fauna

The fauna, as well as the flora, of the upper Mississippi River headwaters and river waterways, are very diverse, which results in the overlapping of the ranges of the Eastern with the Western species. An interspersion of life zones and varied habitat types, ranging from river bottom deciduous forests to marshlands, large open pools, and hill prairies of the upper elevations, all of which attract a wide variety of animal life.

The general animal population mix now considered as being present includes about 46 mammals, 285 birds, and 35 forms of amphibians and reptiles. About ten species of the larger game and predatory mammal species have disappeared from the pool area. Of the avifauna, a single species seem to have been extirpated, the passenger pigeon. Otherwise, most of the other animal life present at settlement of the white man remains present, although, in very reduced numbers.

Terrestrial forms of wildlife are dispersed according to habitat and vegetation zones of preferences for the various species. In the marshes are to be found the aquatic mammals, grebes, rails, waterfowl, and smaller bird life unadapted to wading or swimming, yet inhabiting the zone. Terns, blackbirds, amphibians and reptiles are common.

In the Damp Meadows, marsh-songbirds, herons, rails, a few waterfowl, and amphibians and reptiles are found.

In the sandy shorelines and mudflats are some typical shorebirds, a few waterfowl species, and aquatic mammals. The riverbottom forests contain deer, songbirds, and smaller woodland mammals.

The upland forests contain deer, small mammals, some amphibians, reptiles, and songbirds. The hill prairie contain ground nesting bird species, a few reptiles, gophers and mice.

Of the birds of the region, about 97 are considered as summer residents and/or nesting species. The rest constitute regular or occasional migrants, or those of variable status, including some of rare or accidental occurrence. As with other wildife of the region, the overlapping Eastern/Western areas of the United States, as well as the varied habitats afforded by the Mississippi River Valley both contribute to the large numbers of species identified in and around the study area. One swan,

four kinds of geese, and 26 kinds of ducks have been observed in the area. Birds of prey, including the Southern form of the Bald Eagle, are well represented. Rails, many species of shorebirds, gulls, and terns are abundant in the marshes and pool areas.

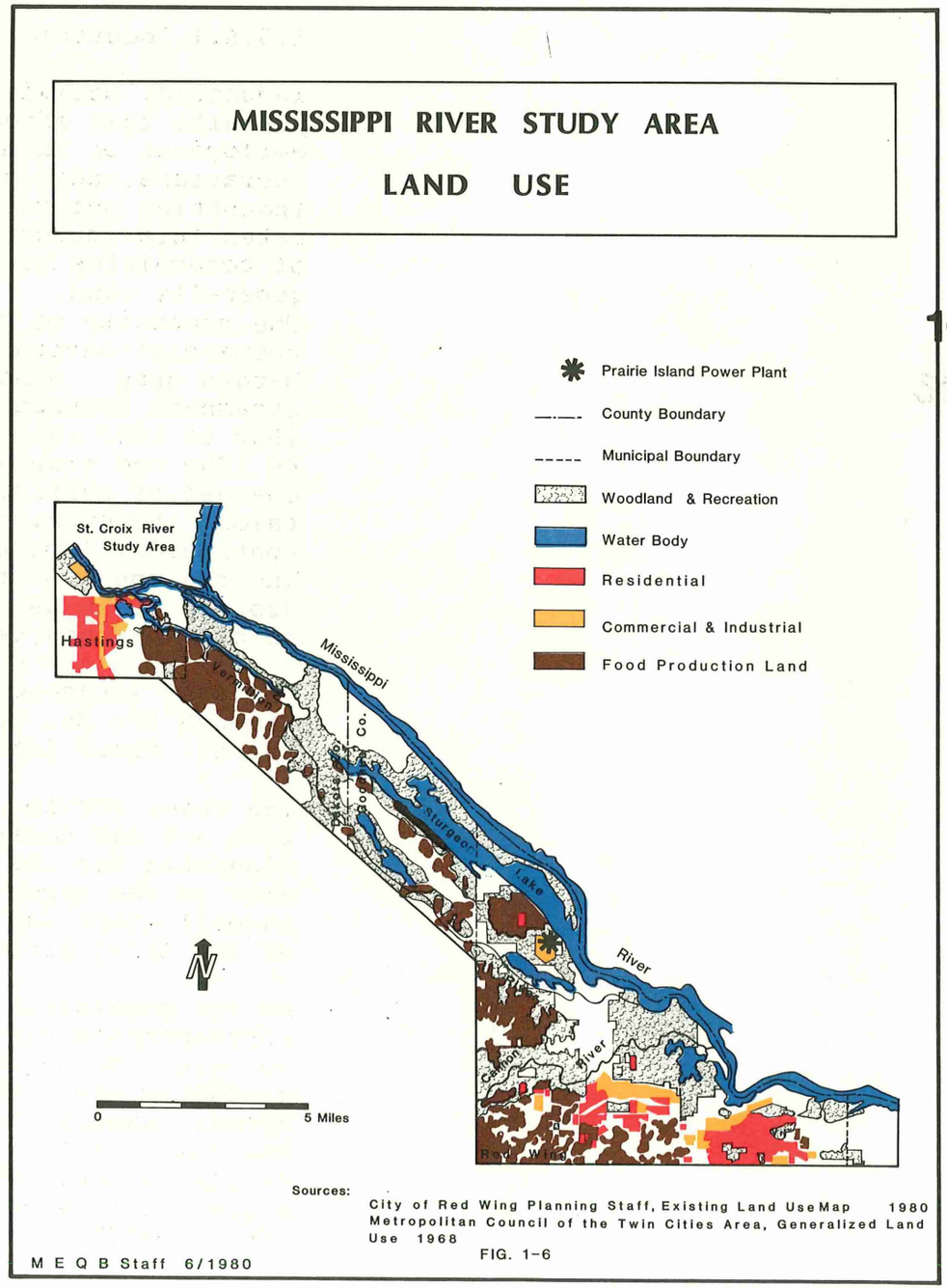
Aquatic vegetation in marsh areas harbors various species of ducks (wood duck, mallard, etc.) and fur bearers such as muskrat. A heron rookery is located approximately two miles southwest of Lock and Dam No. 3 or about three miles downstream from the Prairie Island plant site. In 1976 this rookery covered approximately 50 acres and contained 154 nests. Most birds were Great Blue Herons but American Egrets were also present.

The valley study area is part of the Mississippi flyway. Through this area large numbers of waterfowl funnel through the valley. The marsh and lake complexes act as staging areas for the migrants. Large numbers of waterfowl rest in the area and move back and forth between open water and feeding areas. There is also a substantial population of waterfowl that nest in the area. The Gantenbein/Sturgeon Lake area seems to receive the heaviest use. A large amount of low altitude movement has been observed in the area.

Apparently because of the open water at the generating plant and below the dam, a small population of bald eagles are found in the area during parts of the winter.

1.5.6 Economic Base

The economic base of the Mississippi River study area is described in the following sections on industrial, recreational, and cultural resources. (See Figure 1-6.)



1.5.6.1 Industrial Activity

Industrial activity includes agricultural, manufacturing, transportation, and related pursuits that affect employment and income in the study area directly; this includes employment on farms, in barge operations, commercial dock facilities, lock and dam operations, and commercial fishing. While it is probably most desirable to measure industrial activity in terms of jobs or dollars generated, lack of available data makes this impossible. As a result, indices of this industrial activity-such as tons of commodities moved, industrial facilities constructed, or pounds of fish caught-are generally used.

The necessity of modifying the natural course of the river to make it suitable for commercial navigation gradually became apparent as the size of the river boats and barges grew. Since the first river steamboat arrived at Fort Snelling in 1823, steamboat transportation for freight and passenger use grew to a peak in the decade 1850 to 1860 when over 1,000 steamboats were active on the entire length of the river. By 1880 the growth of the railroad system in the United States and the lack of a channel of sufficient depth marked a decline in the use of the river for transportaion. However, on the upper reaches of the Mississippi, growth in freight traffic continued. A peak was reached in 1903 with 4.5 million tons moved between St. Paul and the mouth of the Missouri River. A subsequent rapid decline coincided with a drop in river use for moving logs and lumber. In 1916, only 0.5 million tons were shipped on this section of the river.

The last large-scale commercial lumbering in the study area ended in about 1911. Through the St. Croix an estimated 12,444,281,720 feet of lumber was rafted out of the St. Croix into Pool #3 from 1837-1915.

The major portion of the rafted logs floated through what is now Pool #3, prior to lock and dam construction. One of the major areas of destination was Winona, Minnesota for its log mills. There was a major sawmill in the Stillwater, Minnesota area in the upper portion of the St. Croix River which is now part of Pool #3. The sawmill chips and shavings are still a part of the bottom substrate in the vicinity of the Allen King Power Plant on the St. Croix River.

As the population and industry of the upper Midwest region grew, there was a corresponding growth in the need for cheap coal for power generation. A technological consequence of this need was the development of the barge and towboat which gradually replaced the steamboat on the river. The barge and towboat required a deeper channel than the earlier steamboats. The need for coal in the Upper Midwest was complemented by the need to ship large quantities of grain south to other centers of population. Thus, economies were realized by having at least partially compensating cargoes going both directions on the upper reaches of the river. In the later 1920's large grain shipments from Minneapolis began.



Although four-foot and six-foot channels had been authorized in recognition of the increasing role of the river in the transportation network of the U.S. and technological developments in barges and tugs led to the authorization of a nine-foot channel to Minneapolis in 1930. By 1940 the channel and the requisite locks and dams were essentially complete.

The shipping season for most of the Mississippi River within the study area is approximately eight months, from mid-April to mid-December.

1.5.6.2 Recreational Activity

Recreational activity has two aspects of interest. One is the psychological value to the users themselves of being on or near the Mississippi River for leisure activities. A second effect is the impact of the recreational activity on employment and income. Recreational activity is more indirect in its effect on employment and income than is industrial activity and relates mainly to leisure-time activities of people using the Mississippi River for recreational purposes. Examples include boating, sport fishing, hunting, sightseeing, camping, and picnicking. Recreational activities frequently use units of measurement like number of boaters or fisherman using a lake or river, fishing licenses sold, or visitor days. It is often very difficult to find such measures for a particular area on the Mississippi River. For example, the number of sport fisherman observed annually by lock and dam attendants are taken as a measure of fishing activity in the pools, even though this is not as precise a measure as desired.

A significant portion of the recreational activity on the Upper Mississippi is due (1) to the improved navigation opportunities for large pleasure craft on the river, and (2) to improved fish and game habitat resulting from higher water levels in the river. The potential for improved fishing and hunting is not always realized because increased industrialization along the river has polluted the river and has reduced the available hunting areas, which often more than offset the increased habitat.

Boating Activity and Related Facilities

As noted above, much of the increased boating in the study area of the river-and virtually all of it for the deeper-draft pleasure boats-is made possible by the improved navigational opportunities provided by the system of locks and dams.

The number of pleasure boats moving through each lock in the study area increased by an average of about 1,500 boats during the twelve-year period between 1960 to 1972. The number of pleasure boats moving through Lock #3 increased considerably above the average for the district during this period. This sharp increase is largely due to the existence of the marina and yacht harbor known as King's Cove where a large

number of the larger boats (many owned by Twin City residents) are kept. The yachts conveniently docked at Hastings, Minnesota lock through Lock #3 to utilize the extensive pool of Lake Pepin.

Although no Federal and State parks border the river in the study area, a variety of other facilities have developed on the river mainly to serve hunting and fishing uses. These include boat access sites and landings, as well as picnic and camping sites. The major portion of visitation to the pool is accommodated by various Federal and non-Federal agencies and private interests. Most of the sites have been constructed to provide water-access for on-water type activities and, in most instances, the provision of facilities for other activities is incidental. One site is accessible only by water and one has no access to water.

Precise measures of the number of sport fishermen using a specific pool area are not available. Probably the best data available are the number of sport fishermen observed annually by attendants at lock and dam sites. Attendants to each lock and dam observe the river pool areas above and below their site at 3:00 p.m. each day and record the number of sport fishermen seen; the annual data are simply a sum of these daily estimates.

There has been little change during the ten-year period of the number of sport fishermen observed. Because fish tend to seek water with a high concentration of dissolved oxygen and the dams tend to aerate the water, the bulk of the sport fishermen are probably in the pool downstream from the lock and dams. In 1970, about 6,000 sport fishermen were observed in Pool 3 and 8,000 in Pool 4.

Sport hunting of waterfowl along the Mississippi River study area is large. However, no statistics are available that measure this activity.

1.5.6.3 Cultural Considerations

The study area contains numerous historical and archaeological sites.

The following sites on National Register of Historic Places are located in the City of Red Wing.

E. S. Hoyt House, 300 Hill Street;
Octagon House, 927 West 3rd Street;
St. James Hotel, Main and Bush Streets;
T. B. Sheldeon Mansion, 805 West 4th Street;
T. B. Sheldeon Memorial Auditorium, 443 West 3rd Street;
Minnesota State Training School, East 7th Street;
Carlson Lime Kiln, Barn Bluff; and
Tower View, north of the junction of Highway 61 and Highway 19 west of Red Wing.

The Cross of Christ Lutheran Church at Welch is also a National Registered Site.

The following historic sites in Red Wing have been nominated for the National Register of Historic Places:

Red Wing Iron Works, Bush and Levee Streets;
Keystone Building, Main Street;
Gladstone Building, Bush Street;
Kapel Wagon Works, 221 West Road;
Minnesota Stoneware Company, 1997 West Main Street;
Dr. Charles Hewitt Laboratory, 216 Dakota;
Pratt-Tabor House, 706 West 4th Street;
Town-Akenson House, 1121 West 3rd Street;
Judie B. Nelson House, 219 West 5th Street; and
Red Wing City Hall, Bush and West 4th Streets.

In addition, two historic districts have been nominated for the National Register of Historic Places. These are the Red Wing Historic Mall District along East and West Avenues from the Mississippi River to 7th Street and the West Red wing Historic Residential District in the vicinity of West 3rd and West 4th Streets.

There are a number of significant prehistoric, historic, and architectural resources in the Hastings vicinity. The Minnesota Historical Society has identified the following as important cultural resources in the Hastings area:

Frietag Mounds
Nininger Mound
Dakota County Courthouse
Gardner Hotel
Gardner Mill
Ramsey Mill
Guardian Angels Church
J. F. Norrish House, and
Allen E. Rich House

In addition to these, the LeDuc House has been given recognition as a Nationally Registered building because of its historical and architectural significance.

There are 124 known archaeological sites within the study area. The precise locations of these sites have been mapped and are on file with the Minnesota Environmental Quality Board. The sites are primarily village sites and mounds.

1.5.6.4 Transportation:

Existing transportation systems in the Mississippi River study area are shown in Figure 1-7.

Railroad

The Milwaukee Road (Chicago, Milwaukee, St. Paul and Pacific) has a main passenger line which generally follows the Mississippi River and goes through Red Wing. This is the only rail line on the Minnesota side of the Mississippi River.

Abandoned trackage of the Chicago Northwestern Railroad, which linked Cannon Falls to Red Wing, approaches Red Wing along the Cannon River.

River Transportation:

Goodhue County also benefits from its location on the Mississippi River. In addition to the tremendous use of the river received from small pleasure craft, a number of barges land at Red wing. Barge service is not large relative to the importance of highways and railroads and is limited to two types of service at present. Potential for increased barge traffic terminating in Goodhue County may exist in relation to flat lands along the river. The area has attractive industrial characteristics.

The main kind of barge traffic is concerned with the transfer of grain to barges at the Central Grain Terminal in Red Wing. The second type of barge operation is involved with the shipment of coal into the municipal dock at Red Wing.

Airport Facilities:

The Red Wing Municipal Airport is located in Pierce County, Wisconsin, since the terrain along the Minnesota side of the Mississippi River is too hilly for such a facility. A 75 by 3,000 foot paved runway is provided. Fuel and tiedowns are available. The airport is attended only part-time although the runway is lighted from dusk to dawn. Airport expansion plans are discussed in Chapter 4.

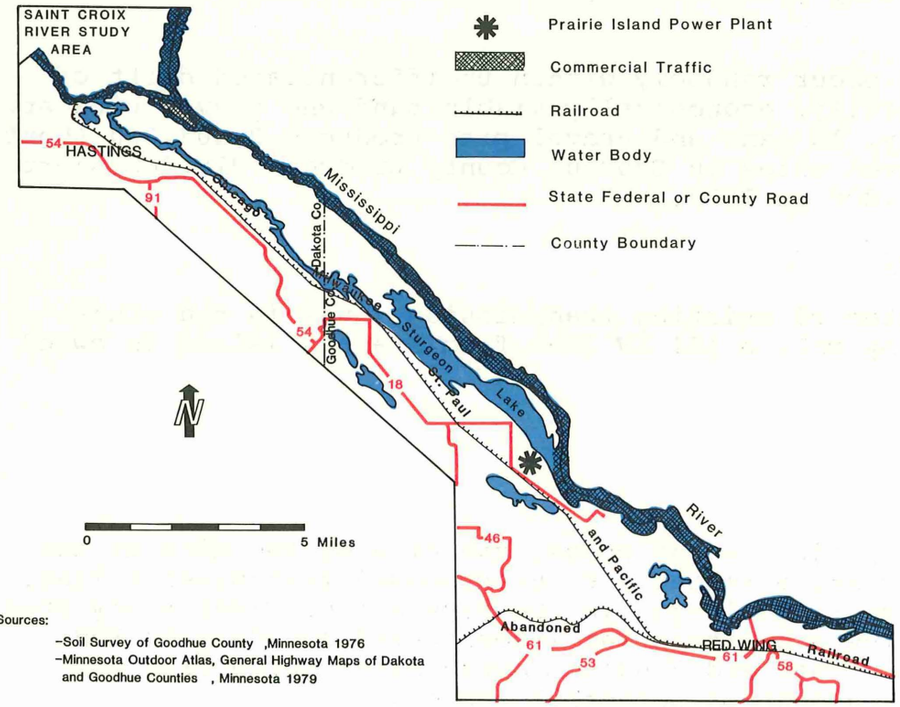
Three private landing strips exist in the study area. Only one is potentially affected by the project, and is discussed in Chapter 4.

Highways:

U.S. Trunk Highway 61 is one of the most important carriers of traffic in Goodhue County, and is the main highway in the project area. It is only affected by the pro-

MISSISSIPPI RIVER STUDY AREA

TRANSPORTATION



Sources:

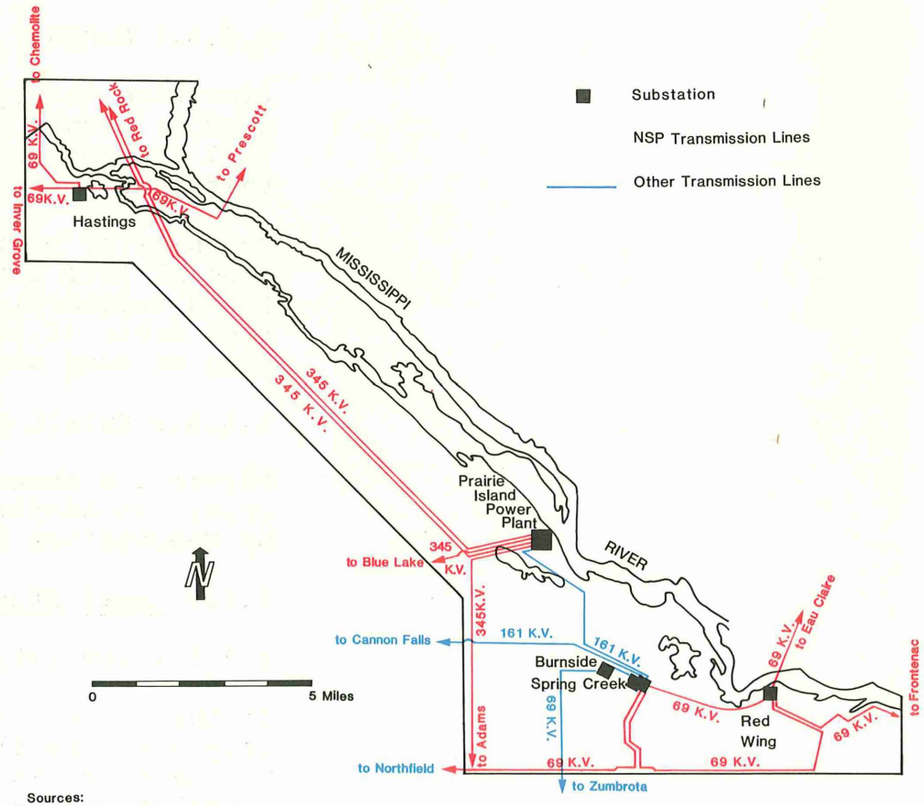
-Soil Survey of Goodhue County ,Minnesota 1976
-Minnesota Outdoor Atlas, General Highway Maps of Dakota and Goodhue Counties , Minnesota 1979

M E Q B Staff 7/1980

FIG. 1-7

MISSISSIPPI RIVER STUDY AREA

EXISTING TRANSMISSION LINES



Sources:

-Corps of Engineers Navigation Charts ,Upper Mississippi River ,1978
-NSP Transmission Lines , County Highway Maps , 1980

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FIG. 1-8

posed transmission line routes in the city of Red Wing. Trunk Highway 61 approaches Red Wing from the southeast as a 2-lane roadway and then transitions to 4-lanes near the east city limits. The 4-lane roadway extends through the central business district and to the junction of County Road 53 where it tapers back to 2-lanes just before crossing Spring Creek. The 4-lane section is alternately divided, undivided, and then divided again.

The Minnesota Department of Transportation has proposed to improve that section of Highway 61 in Red Wing that extends from the north end of the existing 4-lane roadway (near County Road 53) to just beyond the junction with Minnesota Trunk Highway 19. The improvement will expand from 2 to 4 lanes for a distance of three miles, and include two new bridges over Spring Creek.

1.5.6.5 Mining

Limestone quarrying is a historic activity within the study area. Seven quarries in Goodhue County produced 120,000 short tons of crushed limestone worth $207,000 in 1977 and two quarries in Dakota County produced 345,000 short tons worth $725,000 that year.

Deposits of buried sand and gravel occur randomly within undifferentiated drift of glacial till and outwash. Consequently, economically viable sand and gravel pits are found frequently. In Dakota County, 13 sand and gravel pits produced 2,507,000 short tons worth $4,323,000 in 1977. Seven sites in Goodhue County produced 218,000 short tons of sand and gravel worth $351,000 in 1977.

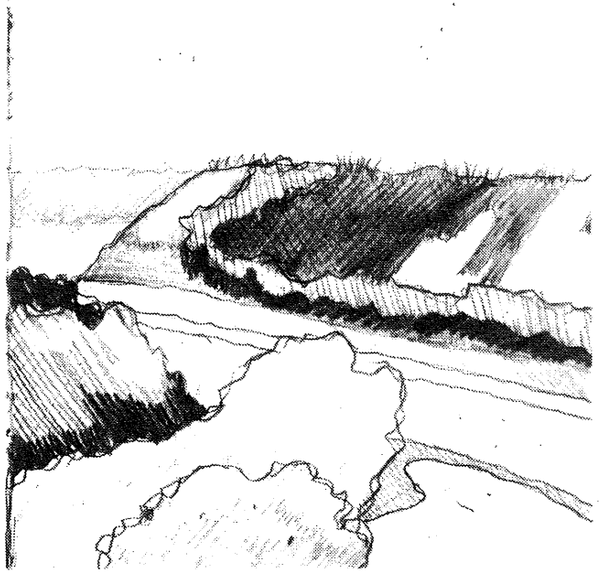
1.5.6.6 Existing Transmission Lines

Figure 1-8 shows the schematic system of existing transmission lines in the study area. In addition to lines owned by NSP, a 161 kV line from Prairie Island is owned by Cooperative Power Association.

1.5.7 Local Study Area Features

1.5.7.1 The City of Red Wing

Of the several communities in both project study areas, the city of Red Wing is the only one directly affected by alternative routes for the proposed transmission line. Of the 68 miles of total alternative route length in the Mississippi River study area (Goodhue and Dakota County), 51 miles are within the incorporated boundary of Red Wing. The following edited excerpts from Red Wing's Comprehensive Guide Plan are included here as background for assessment of potential impact.



The Red Wing terrain is characterized by a number of bluffs rising above the elevation of the Mississippi River by some 300 feet. The Mississippi River has created a wide river valley which periodically floods substantial land areas within the corporate limits of the city. In addition to the Mississippi River, three major streams drain the area in a southwest to northeast direction, largely through the southern portion of the Burnside Area. These streams, the Cannon River, Hay Creek and Spring Creek create ravines through the bluff areas. The Cannon River and Spring Creek have created wide river valleys subject to periodic flooding.

The rugged terrain has forced development to be located along the river plains, as in the case of the older portion of the City of Red Wing, and along the ravines and ridges which are accessible in the area.

Densely wooded natural vegetation consisting primarily of hardwood trees is common to the bluff sides as well as the stream flood plains.

The bluffs, streams and natural vegetation make the Red Wing area one of exceptional environmental quality. These unique features also present substantial problems to development and transportation movement. Due to the steep side slopes of the bluffs (most have slopes of over 30%), development has been limited to the lower valley plains not subject to flooding, to the ravines and the ridges, and, in some cases, to the bluff plateaus where they are accessible. Direct transportation accessibility in most areas of Red Wing is extremely difficult due to the rugged terrain.

The large flood plain areas created by the Mississippi River, the Cannon River, and Hay Creek render a substantial amount of flat land within the area undevelopable for most urban uses.

Over the past 70 years Red Wing has been a stable community. Its population has ranged between 8,000 to 10,000 people during that time period. In 1970, the City initated the first major annexation in its history. It annexed approximately 358 acres to the south of the former City Limits. Also around this time Northern States Power Company began constructing a nuclear generating plant in the Burnside Area on Prairie Island. In 1971, the former City of Red Wing consolidated with Burnside Township to form the new City of Red Wing, increasing the corporate limits of the City of Red Wing by 19,265 acres. The availability of developable land, the quality environment, and a continued steady increase in employment potential are factors which should serve to stimulate population growth in the City of Red Wing.

Fully 80 percent of the existing land in Red Wing is classified as open space. More importantly, however, this area is made up of large amounts of agricultural land and river bottoms as well as the steep forested slopes that define the scenic bluffs of the Red Wing area (Figure 1-6).

Transportation, predominantly street, highway and rail rights-of-way, and residential uses are the next largest categories of use in Red wing. Red Wing area residents show an overwhelming preference for single-family dwelling unit types with nearly 85 percent of existing residential acreage being found in single-family development.

Land uses and land-use densities vary significantly about the new City of Red Wing. The older, former City of Red wing has been developed at urban densities and contains the normal spectrum of urban land uses. The Burnside Area has been developed in a suburban-urban fringe nature with a general overall low density. Residential land uses in the Burnside Area include single-family units on large lots whose owners often keep animals as a hobby; single-family units on small urban-type lots and mobile homes, both in parks and located on single lots. Commercial uses are, for the most part, scattered along U.S. 61 between Trunk Highway (T.H.) 19 and the western boundaries of the former City of Red Wing. These uses are generally auto-oriented and include gasoline stations, motels, cafes, mobile home sales, etc. The largest concentration of commercial establishments can be found in the vicinity of the intersection of U.S. 61 and Tyler Road. The major industrial uses are those located in the Red Wing Industrial Park in the vicinity of U.S. 61 and Spring Creek; Meyer Industries, located at two sites in the area; an industrial laboratory located at the intersection of T.H. 19 and U.S. 61; the Northern States Power Company's Nuclear Generating Plant located near the northwestern boundary of the city. The largest portion of the Burnside Area is of an open space nature. This land includes the bluff slopes and the low land areas along the rivers subject to flooding. Agriculture is the next largest use in terms of land area in the Burnside Area.

1.5.7.2 The Cannon River

The following description of the Cannon River was taken from a report, Cannon River Resource Analysis, prepared by the Wild and Scenic Rivers Program, Minnesota Department of Natural Resources, April, 1979.

The Cannon River drops an average of about 4.9 feet per mile in its path to the Mississippi River near Red Wing. The drainage area of the river is 1,462 square miles. The largest tributary is the Straight River, which joins the Cannon at Faribault.

The Cannon River valley is generally characterized by level to gently sloping uplands, steep valley slopes and bottomlands prone to flooding.

The Cannon's floodplain (bottomland) is generally unsuitable for commercial or residential development. It is variably suited for agricultural cultivation, permanent pasture, hay, woodlands and wildlife habitat. The low fertility and low water retention capacity of certain bottomland soils (for example, the Estherville soils) restricts their suitability for agricultural production.

Three basic landform/soil types are found on the bottomlands of the Cannon River valley. Closest to the river are alluvial lands subject to frequent flooding showing little soil formation and generally unsuitable for agricultural crops. West of Cannon Falls on the higher bottomlands are soils of the Colo-Estherville-Waukegon association. This association is composed of poorly to excessively drained loams of medium to coarse texture. East of Cannon Falls the Marsh-McPaul-Radford association can be found. It is characterized by depressional, very poorly drained marshes and nearly level, moderately well to poorly drained medium-textured soils.

The uplands encompass two basic landforms: generally level toplands and steep valley walls. Four primary soil associations occur both on the toplands and valley walls. The Lester-Hayden-LeSueur and Ostrander-Maxfield-Klinger associations are found west of Cannon Falls; east of Cannon Falls are the Seaton-Racine-Marlean and Timula-Frontenac associations. These contain well to poorly drained loams formed in glacial tills loess, very recent alluvium and bedrock residuum.

Closest to the river these soil associations occur on steep to very steep valley walls, where they are often excessively drained and prone to drought, very rapid runoff, and erosion. The valley walls are unsuitable for development, agricultural crops or heavy grazing.

Water quality of the Cannon River from Faribault to Red Wing is good to fair. It is suitable for most wildlife and recreation.

The Cannon River exceeds the maximum fecal coliform count set by the Minnesota Pollution Control Agency (PCA). The river's water quality meets most other PCA standards.

Before white settlement, the Cannon River between Faribault and Red Wing flowed through three major types of vegetation: the "Big Woods," tall grass prairie and river bottom forest. Of these three, only the river bottom forest remains essentially unchanged.

The Big Woods, a translation of the early French name grand bois, covered much of central and east-central Minnesota. Along the Cannon River, it was found from Faribault to Northfield. The Big Woods was dominated by sugar maple, elm, basswood and red oak. Much of the woods was lost to logging in the 1850s and its fertile soils were converted to farmland. Only a few patches remain today.

Farther east, the river traveled through the tall-grass prairie region. Extending from Northfield to Cannon Falls, the prairie supported a rich variety of grasses and herbs such as big bluestem, Indian grass and prairie clover. A few small shrubs and

trees such as wild roses grew here. Because the prairie depended on periodic fires to maintain itself, it has been nearly eradicated through fire prevention practices and agriculture.

The rich river bottom forest grew on the floodplain from west of Welch to the Cannon's mouth at the Mississippi. This forest was similar to the Big Woods except for such species as cottonwood, ash, box elder, willow, soft maple and hackberry. Most of this plant community remains today. With the establishment of fire controls it has spread westward into the region that was formerly prairie.

Oak openings and aspen-oak lands also were found in scattered areas along the Cannon. Sparsely wooded lands with small stands of oak or hickory were characteristic of the oak openings. The aspen-oak lands contained dense young stands of quaking and bigtooth aspen. Oaks, elms, ash and basswood were also present. Both of these vegetative types were fire dependent and, therefore, were lost due to fire control practices. Vegetation was also lost to cultivation and development.

Along the river bottomlands, the plant species of two centuries ago are still present today. American elm, green ash and soft maple are frequently observed species of trees. Other trees found near the river include cottonwood, box elder, black walnut, butternut, bitternut, red oak and basswood. The undergrowth includes red osier dogwood, wild black currant, gooseberry and red raspberry. Virginia creeper and wild grape are also common.

The warmer, drier south-facing bluffs of the Cannon host such plant species as sumac, red cedar, box elder, slippery elm, hackberry, wild plum, prickly ash, quaking aspen, bittersweet, and burr and red oak.

The so-called "goat prairies" are found on the steeper south-facing bluffs. Resembling the tall-grass prairies, they are in fact unique assemblages of plants from the tall-grass prairies, the sand plains and the more westerly shrub-grass prairies. Dependent on periodic fires for maintenance, the goat prairies have been reduced by the invasions of juniper aspen, smooth sumac and prickly ash. Several plants found here are compass plant, silky aster, blazing star, nodding ladies tress and Indian grass.

Along the cooler, wetter north-facing slopes are sugar maple, red oak, paper birch and ironwood.

Two plant species along the Cannon River are rare not only in Minnesota but in all of North America. They are the Minnesota trout-lily (Erythronium propullans), a small spring wildflower of the lily family, and the prairie bush-clover (Lespedeza leptostachya), a member of the legume, or pea, family. The prairie bush-clover has been found in Cottonwood, Crow Wing, and Goodhue Counties. It also grows in Illinois, Wisconsin, and Iowa, but is always rare and local.

The Cannon River valley provides habitat for a wide variety of wildlife. In addition to the woods, prairie, wetlands and croplands in the valley, rock outcrops, springs, farm buildings, bridges, and cutbanks provide habitats attractive to some species.

Twenty-six species of amphibians and reptiles are known or expected to be common along the Cannon River. Among them is the mud puppy, the largest salamander in Minnesota and the only one that regularly retains its larval state throughout life. The once abundant leopard frog, recently reduced in numbers, perhaps by disease of pesticides, is also found here. The venomous timber rattlesnake inhabits rocky bluffs above the river east of Cannon Falls.

Species reported along the Cannon but rare in Minnesota include the wood turtle, Blanding's turtle, map turtle and massasauga rattlesnake. All are at or near the northwestern extreme of their ranges. Other species at or near the northwestern include the cricket frog, sixlined racer, false map turtle, pickerel frog and brown soft-shelled turtle.

More than 100 species of birds are known or expected to breed regularly along the Cannon. Twenty-two other species, rare, irregular or reduced in numbers, may breed here.

Game birds found in the area include the mallard, gadwall, pintail, green-winged teal, blue-winged teal, redheard, wood duck, ruffed grouse, bobwhite, ringnecked pheasant, gray (Hungarian) partridge, snipe, woodcock, rail and coot.

Thirty-six native species of mammals are known to be or are expected to be common along the Cannon. These include the spotted skunk, whose numbers have recently declined, perhaps because of rabies. There are reports of bobcats, formerly very common in southeastern Minnesota, but decimated by trapping, hunting and loss of habitat. Otters, once common throughout the state but also decimated, are probably present in small numbers. The coyote, fairly common in northern Minnesota, is rare along the Cannon.

Although the distribution of small mammals has not been fully researched and reported, a number of these species are expected to be found along the Cannon because of habitat conditions. These include the pine vole, rock vole, pocket mouse, harvest mouse and least weasel.

Game species present in the river valley include the cottontail, rabbit, gray and fox squirrel, raccoon, red and gray fox, mink, muskrat, beaver, and white-tailed deer.

Because of its generally good water quality, the Cannon River supports a wide variety of fish life, including several popular game and pan fish. Fish frequently travel from the Mississippi up the Cannon to the Welch Dam; this area is reported to be a good fishing spot.

There are about 50 fish species that are known residents of the Cannon. Such sought-after game fish as walleye, sauger, rock bass, smallmouth bass, largemouth bass, white bass, northern pike and black crappie are found here. Other fish harbored in the Cannon include black bullheads, bluegills, pumpkinheads, suckers, redhorses and carp. A more complete list of species is presented at the end of this section.

There are a few fish found in the Cannon that are relatively uncommon in Minnesota. The suckermouth minnow, for example, is found only in the southeastern counties of the state. The southern redbelly dace is found only in the southern tributaries of the Mississippi River and reaches its northern most range in the Cannon. A recent find in the Cannon is the burbot, rare in this part of the state.



The banded darter, at one time thought to be rare, has since been found to be abundant in southern Minnesota. In the Cannon, it is the most common darter.

The Cannon River valley's resources lend themselves naturally to a variety of outdoor activities, including fishing, hunting, canoeing, inner-tubing, camping and hiking.

The Cannon valley and surrounding areas provide excellent habitat for both large and small game. Migratory waterfowl find resting and breeding areas in the many marshes and potholes near Red Wing. The river supports a fair game fish population that includes walleyes, smallmouth bass and sunfish.

The Cannon is popular with canoeists. During the paddling season the water is generally at a level that permits canoeing. The river's moderate current and the absence of difficult rapids make the river ideal for novice boaters and family outings. The high bluffs and other beautiful scenery in the valley contribute to the river's appeal.

Floating the river in inner tubes is another popular activity on the Cannon, especially near Welch. The Cannon receives heavier tubing use than most other streams in the state. In fact, it is one of the few state rivers where an outfitter caters to inner-tubing.

The natural character of the river valley also encourages camping, hiking, nature observation and photography.

The Cannon River valley is one of the most important archaeological areas in Minnesota. By 1000 A.D. the area near the junction of the Cannon and Mississippi Rivers was a major center of prehistoric Indian life. This Oneota Indian culture, apparently related to the great Middle Mississippian center at Cahokia, Illinois, was probably the closest prehistoric Minnesota people came to an urban society.

Earlier prehistoric cultures of the Middle Woodland period antedate the Oneota and numbers of the burial mounds of the region can be attributed to these forerunners. Pre-pottery cultures of the Archaic and PaleoIndian periods also exist in the Cannon River area. Although none of the archaeological sites of these very early times have been excavated, surface collections of artifacts from the uplands bordering the river valley demonstrate that such sites do exist.

The Cannon River was part of an east-west route that linked the peoples of the eastern rivers with those of the western plains. Instead of ascending the Mississippi to its junction with the Minnesota River and continuing west up the Minnesota, it was more common to take the Cannon westward and portage from its upper reaches to the Minnesota.

About 25 burial mound concentrations and five village sites have been recorded along the Cannon River. Thousands of burial mounds, once common along ridgetops and high river terraces, have been lost to cultivation and construction. But archaeologists, excavating mounds and village sites that escaped destruction, have pieced together a picture of life in this society.

Two such sites along the Cannon River are the Bryan Village and Fort Sweeney sites. Fort Sweeney, listed in the National Register of Historic Places, is across the Cannon River from Welch. Situated on a high hill overlooking the river valley, the Fort Sweeney site contains 41 pits, mounds and other earthworks. Excavation has led archaeologists to believe that this was a burial ground or ceremonial place.

The Bryan Site, a large prehistoric village and burial area, lies on a high terrace immediately south of the Cannon River near Red Wing. A rich deposit of gravel was discovered in this terrace and was leased by the Minnesota State Highway Department.

When the gravel was removed from the eastern end of the area, a number of burials were exposed and later investigated. When the topsoil was stripped off land further to the west, a large number of black dirtfilled holes indicated storage pits and the presence of an ancient Indian village were revealed. The site has since been destroyed.

The Cannon River, winding through the rich farming country of southeastern Minnesota, has played a significant role in the development of this area. First a transportation route for Indians and fur traders, the Cannon later attracted settlers, powering sawmills and grist mills in the prosperous communities on its banks.

French fur traders called the Cannon La Riviere aux Canots, "the river of canoes." Indians and traders frequently hid their canoes near the river's mouth as they set out to hunt in the adjoining prairie lands.

The river's present name, a mispronunciation of the original French, comes from the narratives of explorer Zebulon Pike's expedition in 1805-06. Pike used the name Canoe River when telling of this journey up the Mississippi, and the name Cannon River in the account of this return trip.

As settlers came to the Cannon River valley, counties were established and cities platted.

Goodhue County was established March 5, 1853, and named in honor of James Madison Goodhue, the first printer and editor in Minnesota, who's influential writing helped persuade settlers to come to the state.

Red Wing, the location of a mission to the Dakota Indians in 1837, was first settled for farming and Indian trading in 1850-52; was chosen to be the county seat in 1853; and was incorporated as a city in 1857. Red Wing was the name of a succession of Dakota chiefs whose band resided where the city now stands. The Dakota name for this place was Rhemnicha. Formed by three Dakota words: Rhe, a high hill or ridge, mini, water, and chan, wood. The name refers to the Barn Bluff and other high river bluffs, and to the abundance of water and wood, which made it an ideal campground.

Welch, settled in 1857 and organized in 1864, was then named Grant, in honor of General U.S. Grant, but it was renamed Welch in 1872 to commemorate Abraham Edwards Welch of Red Wing. He volunteered at Lincoln's first call for troops at the outbreak of the Civil War and was a first lieutenant in the First Minnesota regiment. Later he was a major in the Fourth Minnesota regiment, and died from wounds received at the battle of Vicksburg.

Dakota County was established October 27, 1849 and named for the Dakota Indians, whose name means alliance or league.

1.5.7.3 The Vermillion River

The following description of the Vermillion River was taken from an environmental statement prepared by the Corps of Engineers for the Vermillion River Flood Protection Works, 1973.

The source of the Vermillion River is near the town of New Market, Minnesota, in the eastern part of Scott County, Minnesota. The river flows northeast for approximately 47 miles to its junction with the Mississippi River below Hastings. Several tributaries join the Vermillion River from the north and south in the upper two-thirds of its course. The main tributary is the South Branch of the Vermillion River, which joins the main river near the town of Empire, Minnesota. The Vermillion River watershed drains an area of approximately 217 square miles at the Highway 61 bridge in Hastings.

Throughout most of its course upstream of Hastings, the river flows in a narrow channel formed in gently rolling farmland. The riverbanks are generally open with occasional clusters of trees. At the Peavy Mill in Hastings the river drops approximately 90 feet over a small dam and natural waterfall and joins the floodplain of the Mississippi River. Throughout the rest of its course the river follows a meandering channel bordered by dense growth of trees and shrubs.

Elevations in the Vermillion River basin range from a maximum of 1,200 feet at the western end of the basin to 665 feet in the stream bed at the mouth. The total length of the Vermillion River above the study area is approximately 35 miles. Upstream from Farmington, Minnesota, the average slope is about 20 feet per mile. Below this point the slope averages about 5-7 feet per mile. Throughout the study area upstream of Peavy Mill Dam, the river has an average slope of 5.5 feet per mile. Below the dam the slope decreases from 5 feet per mile to less than 1 foot per mile in the Vermillion Slough area near the confluence of the Vermillion and Mississippi Rivers.

The Vermillion River basin lies in the Western Lake section of the Central Lowlands Physiographic province. The river flows in a shallow channel incised into a smooth, gently rolling outwash plain formed on material deposited by water from melting glaciers. Underlying the sandgravel plain at generally shallow depths are the St. Peter Sandstone and Prairie du Chein dolomite formations of Ordovician Age.

In the project area the Vermillion River flows in a shallow channel across a rock terrace formed by the glacial Mississippi River approximately 120 feet above the present Mississippi River floodplain. Sands and gravels blanketing the area were deposited by glacial meltwaters and reworked or redeposited by the Vermillion River.

Bedrock exposed or lying at shallow depth is dolomite sandstone of the Prairie du Chein formation. The present Peavy Mill Dam at the downstream edge of the project is founded on exposed bedrock. Approximately 950 to 1,200 feet upstream of the dam, bedrock is exposed in the channel bottom. The limestone bedrock forms minor rapids in the natural channel from 950 to 1,040 feet upstream of Peavy Mill Dam. Downstream of the dam, the river drops into a gorge eroded in the limestone. Within the gorge, the rock walls rise vertically for 55 feet. The proposed floodway channel joins the natural river channel approximately 1,340 feet upstream from Peavy Mill Dam. Based on boring information along the natural channel alignment, bedrock can be expected to lie from 1 to 4 feet above the channel bottom along the lower 650-foot reach of the proposed floodway. The remainder of the floodway excavation can be expected to be in natural sand and gravel deposits.

Agricultural soils belong to the Dakota, Estherville, and Waukegon series, which are well-drained, darkcolored soils of moderately high organic matter content that have developed on outwash plains under native grass. Low to moderately high fertility rates are characteristic of these soils, and moisture is often a limiting factor to high crop yields.

The flora found in the project area can best be described as a north temperate river valley forest. The forest is composed of a tree canopy and an understory of shrubs, forbs, and grasses. The open meadow through which the floodway will pass was probably a tall grass meadow before being converted to agricultural uses.

The riparian forest within the area occupies a narrow zone along the river corridor. The canopy vegetation of the river riparian community is composed of cottonwood, willows, box elder, American elm, basswood, and red cedar. Common shrubs in the gallery are red-osier dogwood, wild grape, prickly ash, hazelnut, gooseberry, smooth sumac, and honeysuckle. The most common forbs are goldenrod, thistle, milkweed, alfalfa, sweet clover, clover, bindweed, giant ragweed, pigweed, and burdock. The common grasses are smooth brome, bluegrass, quackgrass, and timothy.

The riverine aquatic plants found in the project area are sedges, and filamentous algae.

Fauna occupying the area is limited due to the close proximity of Hastings, the quality of Vermillion River water and shifting beds of silt and sand in the stream bed. The terrestrial invertebrates are chiefly annelid worms, nematodes, insects, and spiders. The aquatic invertebrates are water fleas, chironomid larvae, water striders, backswimmers, mosquito larvae, mayfly nymphs, snails, roundworms, bloodsuckers, and a few clams. Such pollution-sensitive species of invertebrates as mayflies and clams were found to be scarce. Frogs, toads, newts, turtles, and garter snakes represent the herpetological fauna in the project area.

Pollution and erosion occurring over most of the watershed have caused this stream to be generally poorly suited for gamefish. The lower Vermillion River has potential for a future smallmouth bass fishery, pending water quality improvement; but the remainder of the river above the Vermillion Falls is classed as a minnow-rough fish fishery. Some of the more common fish species are the common sucker, the bluntnose minnow, and the johnny darter; however, dace, shiners, and chubs can also be found in the portion of the river included in the project. Cottontail rabbits, moles, mice, rats, chipmunks, shrews, and squirrels are the common mammals in the project area. Common birds to the area include sparrows, wrens, flycatchers, meadowlarks, brown thrashers, chickadees, robins, blackbirds, woodpeckers, crows, and bluejays. Migratory birds such as warblers are transient visitors to the area during spring and fall migrations. Other birds such as pheasants, wood ducks, hooded mergansers, and kingfishers are found in the area occasionally. There are no rare or endangered plants or animals unique to the project area.

Water quality of the Vermillion River at Hastings is quite variable. The communities of Apple Valley, Farmington, Vermillion, Lakeville, and Hampton, Minnesota, discharge effluent from their sewage treatment plants either directly or indirectly into the Vermillion River. Since the river's flow is generally less than 50 cfs at Hastings, the assimilative capacity of the stream is probably heavily taxed near the sewage outfalls. Several dairy farms located along the Vermillion river permit drainage from barnyards to flow into the river. Manure spreading during the winter is practiced in the Vermillion watershed, and the runoff from this cover material also degrades water quality.

Erosion in several areas of the Vermillion River watershed contributes silts and clays to the stream, lowering the value of the stream for wildlife and recreational purposes. The river is practically devoid of streambank vegetation in many areas, allowing water temperature to reach ambient air temperature during the summer, severly limiting available habitat for sport fish.

Present uses of river water can be categorized as being for recreation, agriculture, and sewage effluent disposal.

Throughout most of its length, the river flows through rapidly urbanizing agricultural areas. In many reaches pastures are adjacent to the riverbank, with no barrier between pasture and river, and so the river is used for stock watering. The river also serves as a water supply for wildlife and as a source of water for irrigation of cropland. Possibly one of the main uses of the river today is as a receiving watercourse for disposal of sewage effluents.

Hastings has two marinas on the Mississippi River. Hastings is currently studying a proposal to develop the Vermillion River floodplain corridor as a greenbelt or parkway to increase the amount of city parkland. Snowmobilers use the Vermillion River and adjacent areas extensively during the winter months, which serves to safely move this form of traffic out of the city into open farm country. Present water quality of the Vermillion River within the project area is not conducive to swimming. Although the river does not receive heavy fishing pressure, potential for a future fishery is considered to be good. The Vermillion River has about 38 miles of waters which generally provide some canoeing during late spring and early summer.

Hastings is endowed with the scenic Vermillion River gorge, embracing the upper and lower waterfalls, which drop some 90 feet into the floodplain of the Mississippi River. The first flour mill in Dakota County was constructed at the upper falls by William LeDuc in 1853. Its competitor, the Ramsey Mill, was constructed at the lower falls in 1857. In 1865, William LeDuc sold his mill interests to Stephan Gardner. Mr. Gardner pioneered the use of middlings in the manufacture of flour, and this innovation created a superior product from the spring wheat grown in Minnesota at that time. Thus, the Gardner Mill, the falls that powered it, and the picturesque stream that feeds the falls introduced an innovation in milling technology that rooted the industry more strongly in Minnesota. The original Gardner Mill is now part of the King Midas Milling Company (Peavy Mill), but portions of the original building and original dam can be seen from the upper falls. The Vermillion River milling corridor, beginning at the Peavy Mill Dam and extending down through the gorge to the Ramsey Mill, is deeply involved with the history of the State of Minnesota.

1.6 GENERAL FEATURES OF BOTH STUDY AREAS

The following environmental characteristics are descriptive of the combined study areas, which includes the eastern portions of Washington, Dakota, and Goodhue Counties.

1.6.1 Population of the General Study Area

Current population figures of the study area are only available in the form of estimations. The only comprehensive population count available in Minnesota is from the decennial census of the U.S. Bureau of the Census. There are two estimates available for counties in the Twin Cities Metropolitan Area. One from the Minnesota State Planning Agency which provides estimates for each county in the state, and another from the Metropolitan Council of the Twin Cities which generates estimates for the seven metropolitan counties.

There will be a population of 154,000 in Washington County by the year 2000, which is an increase of over 35% from the present. The greatest growth in Washington County occurred in the 1970's and is expected to grow at the same level during the 1980's. The County will gain people in the earlier age groups, therefore, needs more households than State average. By 1985 there will be a 60 to 70% increase in households, 10% to 1990, 10% to 1995 and 2000.

The population growth of Dakota County from 1920 to 1970 has been quite rapid. On the average, the population of the county has grown by almost 8% a year over this 50 year period. Most of this growth occurred between 1960-1970. The most dramatic growth occurred outside the study area in the two communities of Burnsville and Apple Valley.

Current population estimates indicate that the growth rate betwen 1970 and 1977 is approximately half that of the average annual rate of the preceding 50 years. The suburban areas still exhibit rapid growth, but the rural areas have shown increased growth. In Dakota County, 34% of its population growth is the result of immigration. According to the Metropolitan Council, Dakota County is the fastest growing county in the Metropolitan Area.

The 1960 Goodhue County population of 33,035 was only about 1,500 greater than the 1940 population. This growth was considerably slower than Minnesota or the region within which the county is located. Rural areas of the county have been losing population while municipalities or the area around them have been gaining population.

TABLE 1-1
STUDY AREA POPULATION 1960-1970

County	1960	April 1st 1970	1960-1970 Percent of Change	July 1st 1977	1970-1977 Percent of Increase
WASHINGTON COUNTY	52432	93003	58.2	111833	34.7
Stillwater Twp.	822	10191	23.4	16208	59.0
Baytown Twp.	471	723	53.5	879	21.6
West Lakeland Twp.	433	772	78.3	1032	33.7
Afton Twp.	1023	1993	70.6	2656	33.3
Denmark Twp.	736	923	25.4	894	-3.1

GOODHUE COUNTY	33035	34804	5.2	38934	11.9
Featherstone Twp.	658	646	-1.8	792	22.6
Red Wing Twp.	10528	12438	-0.8	14111	10.0
Vasa Twp.	803	784	-2.4	834	6.4
Welch Twp.	510	529	3.7	570	7.8
DAKOTA COUNTY	78303	139808	78.5	184102	31.7
Douglas Twp.	537	552	2.8	574	4.0
Hastings Twp.	8965	12179	35.9	16183	32.9
Marshan Twp.	692	1186	71.4	1187	0.1
Ravenna Twp.	274	550	100.7	555	0.9

SOURCE: U.S. Bureau of Census, Population Estimates and Projections. Table 1, July 1st 1977.

The northern part of the county, which includes the southern portion of the study area, has generally shown more growth than the southern part. Rural areas of Goodhue County will continue to lose population as the result of decreasing agricultural employment. Overall county population is expected to increase more rapidly than in the past due to the influence of the expanding Twin Cities area. Total population should reach at least 40,000 by 1990.

1.6.2 Human Settlement

To understand the present day development pattern of the study area, one must examine some of the events and decisions made decades ago. The study area has developed as a function of not only changing technologies, but also man's changing perceptions of the land and how it should best be used. There can be no doubt that the early white settlers viewed the land far differently than did the original Indian inhabitants. For instance, the fact that the Mississippi River was relatively narrow at the present day site of Hastings, made bridge river crossings feasible and consequently was one of the stimuli to Hastings' growth.

The settlement history of the study area can be divided into four development eras: Pre-Settlement Era, Settlement and Rail era, Auto Era, and Suburban Era.

The automobile era or the use of the automobile had the highest impact on settlement pattern on the study area. Beginning in the 1920's road grading and surfacing programs at a pace far ahead of such work in previous decades. The result was a high degree of accessability to all parts of the three county areas.

As a result of suburbanization, an increasingly large percent of the study area population is living in urban areas.

Five human settlement types exists in the study area: urban residences, rural residences, isolated features, rural junctions, and towns. The St. Paul-Minneapolis metropolitan area with its more specialized, higher order economic and cultural activities is within easy travelling distance.

A number of rural junctions are distributed throughout the study area. Junction population averages between 10 to 50 people and they are more important as centers of rural social activities and as foci for rural identity than as economic service centers.

More extensive and complex socio-economic functions are found in larger settlements that serve larger populations. These major settlements are Stillwater, Hastings, and Red Wing. These are the sites of mass wholesaling, retailing, and light industry and are major locations for residences and social activities.

Rivers were rapidly developed as power and transportation sources for commercial and industrial use. The result is a major urban core along the Mississippi in both Minneapolis and St. Paul. Residential development is concentrated in the outlying river reaches and around metropolitan area lakes.

Residential development along the rivers occurs in the communities of Red Wing, Prescott, and Hastings on the Mississippi River; Afton, St. Mary's Point, Bayport and Stillwater on the St. Croix. Nearly all the region lakes which did not receive early protection by parklands experienced residential development. Lakes which are not fully developed continue to receive heavy development pressure.

1.6.3 Government

Both study sub-areas involve the state boundary between Minnesota and Wisconsin. The proposed project will, in either study area, require a crossing from Minnesota to Wisconsin. Neither state has jurisdiction for the location of the proposed transmission line in the other state. However, coordination of route planning by the two states is being attempted throughout the routing process, though there is no statutory requirement or formal agreement to do so.

In Minnesota, the Environmental Quality Board will determine the final route for the proposed transmission line. This decision in Wisconsin will be made by the Public Service Commission. In both states, the state-level decision will supercede all county and local government authority.

Both study sub-areas have major rivers as boundaries. The location of the state's boundary is, for the purposes of this document, accepted as that boundary shown on the current USGS quadrangle maps.

St. Croix River Study Area:

This northernmost of the two study sub-areas includes Washington County in Minnesota and St. Croix and Pierce County in Wisconsin, separated by the lower St. Croix River.

In Minnesota, Washington County is in Planning Region II, which is the Metropolitan Council region. In Wisconsin, St. Croix County is in the West Central Wisconsin Planning Region and Pierce County is in the Mississippi River Planning Region.

Mississippi River Study Area:

The southern study sub-area includes portions of Goodhue and Dakota Counties in Minnesota and Pierce County in Wisconsin, again separated by a major river, the Mississippi.

In Minnesota, Dakota County is in Region II/Metro Countil and Goodhue County is in Region 10.

1.6.4 Radio and Television Stations

The following television stations serve the study area:

KMSP, Minneapolis - St. Paul, Channel 9;
KSTP, Minneapolis - St. Paul, Channel 5;
KTCA, Minneapolic - St. Paul, Channel 2;
KTTC, Rochester, Channel 10;
WCCO, Minneapolis - St. Paul, Channel 4; and
WTCN, Minneapolis - St. Paul, Channel 11.

The following local radio stations serve the study area in addition to numerous ones from the Minneapolis-St. Paul metropolitan area:

KCUE (AM), 1250 Khz, Red Wing;
KCUE (FM), 105.5 mhz, Red Wing;
KDWA (AM), 1460 Khz, Hastings; and
WAVN (AM), Stillwater.

The possibility of radio and television interference caused by 345 kV transmission lines is discussed in Section 3.1.6.5.

chapter 2

PROJECT DESCRIPTION

CHAPTER 2
PROJECT DESCRIPTION

2.1 PROJECT APPLICATION

Northern States Power Company (NSP) a Minneapolis-based, investor-owned electric utility, applied to the Minnesota Environmental Quality Board (MEQB) for a Construction Permit and Route Designation for the Minnesota portion of a single circuit 345,000 volt electric transmission line. The proposed facility would continue into Wisconsin, and require Wisconsin permits for that portion.

A construction permit application is required by the Minnesota Power Plant Siting Act (Minn. Stat. 1978, 116C.51 et seq.) and are further defined in the Rules for Routing High Voltage Transmission Lines and Siting Large Electric Power Generating Plants (6 MCAR § 3.071-3.082).

Northern States Power's original application was submitted in June, 1978 and accepted by the MEQB in September, 1978. That application sought a permit and route designation for a 345 kilovolt High Voltage Transmission Line (HVTL) from the Prairie Island Generating Plant substation east to the Minnesota-Wisconsin boundary and ultimately to Eau Claire, Wisconsin. In November, 1979, NSP proposed an amendment to their original application which expanded the project to include routing alternatives for the proposed 345 kV HVTL from their Allen S. King Generating Plant substation east to the Minnesota-Wisconsin boundary and ultimately to Eau Claire, Wisconsin. NSP seeks only one permit under the amended application; either from the Prairie Island Plant area or the King Plant area.

2.2 PROJECT PURPOSE

NSP's purpose for constructing the proposed 345 kV transmission line is as follows:

The proposed Minnesota to Eau Claire 345 kV line is needed to provide additional support to western Wisconsin's electric system. Without the 345 kV line a number of different equipment failures during periods of peak electrical demand would jeopardize service in western Wisconsin.

The Wisconsin terminal for the line is fixed at Eau Claire. Eau Claire is the only 345 kV terminal in the western Wisconsin region and acts as the electric hub for the area. From there lower voltage lines radiate to the rest of the region.

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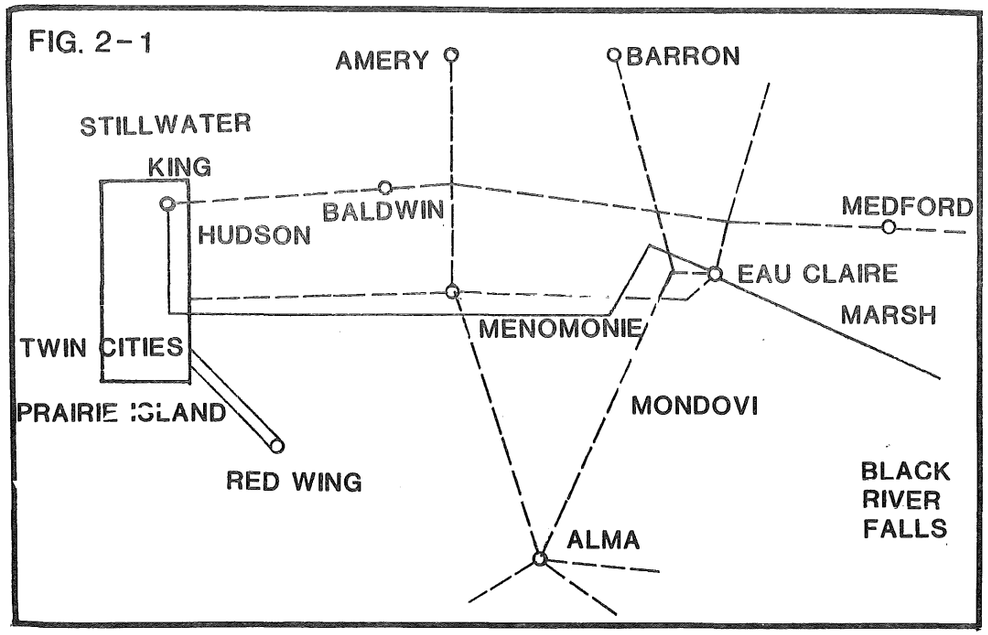
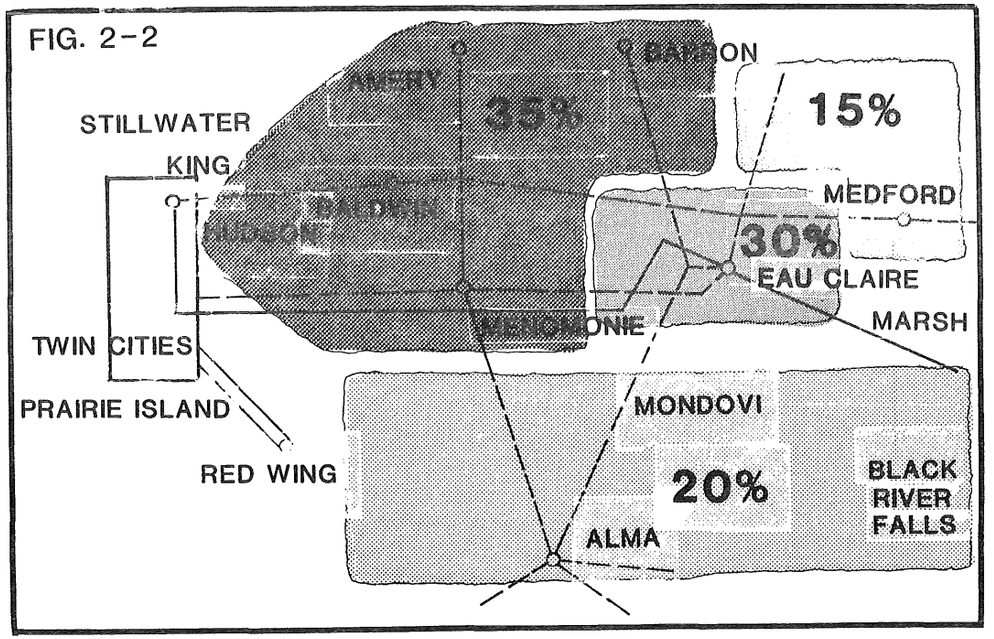




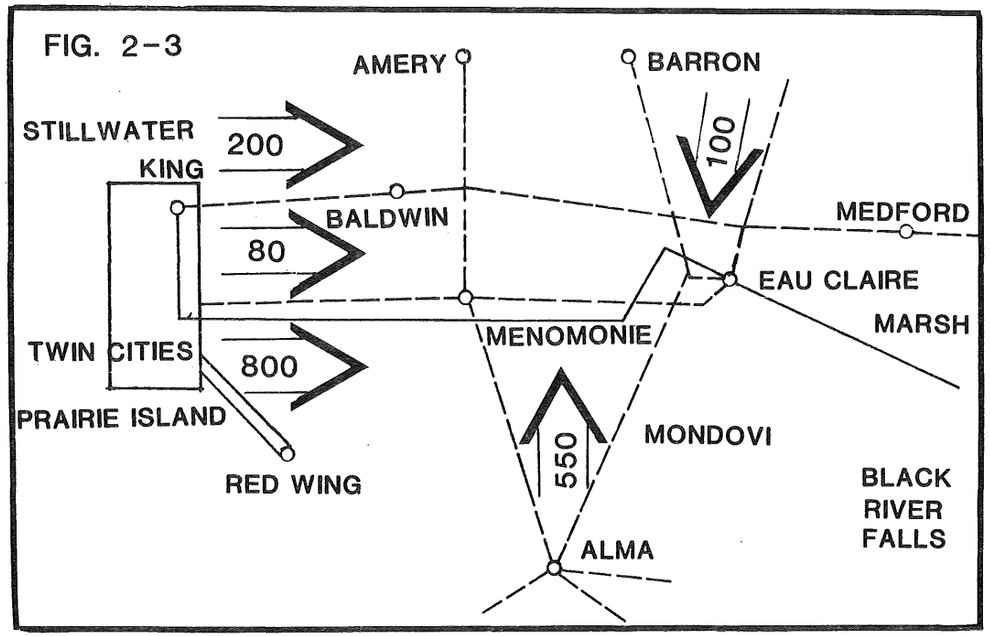


FIG. 2-1 1980 ELECTRIC TRANSMISSION SYSTEM IN WESTERN WISCONSIN

FIG. 2-2 GEOGRAPHIC LOCATION OF ELECTRIC LOAD IN WESTERN WISCONSIN

FIG. 2-3 ELECTRICAL CAPACITY IN WESTERN WISCONSIN

550 MW — DIRECTION OF POWER FLOW

——— EXISTING (1980) 115 OR 161 KV

——— EXISTING 345KV

The Minnesota terminal for the line is not fixed but must provide a strong, reliable source of power. The 345 kV electric grid in the Twin City metro area can provide that power source. Existing substations on that grid capable of accommodating a 345 kV line are: the Chisago County Substation near North Branch; the King Substation in Oak Park Heights near Stillwater; the Red Rock Substation in Newport; and the Prairie Island Substation near Red Wing. In addition a new terminal could be built anywhere along the 345 kV lines that connect the substations mentioned above.

The electric transmission system in northwestern Wisconsin as it exists in 1980 is shown in Figure 2-1. This electrical transmission network includes a 345 kV line from the King Substation to Eau Claire which continues on to eastern Wisconsin. Also, there is a network of 115 and 161 kV transmission lines that deliver electric power from 345 kV substations located in the Twin Cities area and Eau Claire and from generating facilities in Wisconsin to various areas in northwestern Wisconsin where power is redistributed to individual communities on a low voltage 69 kV network. Portions of the 115 and 161 kV transmission facilities shown in Figure 2-1 are owned by NSP and Dairyland Power Cooperative (DPC). Both utilities serve electric loads in northwestern Wisconsin.

The anticipated peak summer load that would be affected by the proposed line from the Twin Cities grid to Eau Claire is about 740 MW, which includes service to electric customers of both NSP and DPC. The generating capacity currently located within northwestern Wisconsin to serve this load includes about 100 MW of hydro generation which consists primarily of generators located on the Chippewa River, about 550 MW of coal generating facilities located at Alma on the Mississippi River and 300 MW of oilfired peaking generation located primarily in Eau Claire. NSP has projected that by 1982 costly oil-fired generation or additional transmission facilities which tap the Twin Cities 345 grid will be required to meet peak load demands in northwestern Wisconsin. By the mid-1980's, considering the expected electric load growth in northwestern Wisconsin, there will not be enough generating capacity in that area, including the oil-fired generation, to serve the peak load.

The geographic location of the electric load located in northwestern Wisconsin is shown on Figure 2-2. Again, this electric load includes customers served by NSP and by DPC. The majority of the electric load, in addition to the Eau Claire metropolitan area, is located east from the St. Croix River to Menomonie and north to the Barron-Spooner area.

Figure 2-3 shows the location and the amount of capacity of generating facilities in northwestern Wisconsin and transmission facilities from the Twin Cities area which

serve the electric load in the areas indicated. The two primary sources for this power supply include the coal-fired generation located at Alma and the King-Eau Claire 345 kV line. The existing King-Eau Claire 345 kV line delivers power to the Eau Claire substation, from which it is distributed into the 115 and 161 kV systems. NSP is proposing a new 345 kV line between Minnesota and Eau Claire to provide reliable service to northwestern Wisconsin. The utilities are concerned about the potential situation where the King-Eau Claire 345 kV line is out of service while the largest generating unit at Alma (350 MW) is also out of service. According to NSP, with these two major power sources out of service, the remaining generating capacity in the northwestern Wisconsin area will not be sufficient to supply the peak electrical load in northwestern Wisconsin. The transmission system from Minnesota and eastern Wisconsin would then be required to supply the deficit. Two problems will occur. First, the voltage level on the transmission network will drop to a level that could result in brown outs or cause damage to electric motors owned by electric service customers. Secondly, the 115 kV transmission lines from Minnesota could overload and have to be taken out of service to prevent damage which would result in a black out for the entire northwestern Wisconsin area.

During this outage condition in service the 345 kV line from Eau Claire to eastern Wisconsin would remain in service. The northwestern Wisconsin area does get some support from this 345 kV facility, however, generating resources in eastern Wisconsin that could supply this northwestern Wisconsin region are more than twice the distance from the load area as generating facilities located in the Twin Cities area that normally serve this load. There is not sufficient support from the 345 kV line from Eau Claire to eastern Wisconsin to adequately serve the electric load in northwestern Wisconsin. A 345 kV line between the Twin Cities grid and Eau Claire will eliminate the problem.

It is anticipated that NSP and DPC will be installing generating units in northwestern Wisconsin by the late 1980's. In planning transmission facilities system planners attempt to recognize all of the requirements and contingencies that could effect the need and the location for these facilities. The Twin Cities grid to Eau Claire 345 kV line, if developed in the early 1980's, will maintain adequate power sources to the load in northwestern Wisconsin in the absence of additional generating facilities. In the long-term this proposed transmission line could also provide outlet capacity for generating units located in northwestern Wisconsin.

2.3 PROJECT NEED

NSP's proposed action does not require a certificate of need from the Minnesota Energy Agency because it has less than 25 miles of its length in Minnesota (6 MCAR § 2.0601: Rules Governing Contents of Applications for Certificates of Need and Criteria for Assessment of Need for Large Electric Generating Facilities and Large High Voltage Transmission Lines).

Most of the total line length is in Wisconsin, and the proposed action will undergo a full need assessment by the Wisconsin Public Service Commission (WPSC). The WPSC's Final EIS provides the following description of need for the transmission line.

2-4

> "Based upon studies of area needs, NSP has made application for the construction of a 345 kV transmission line from the Prairie Island generating station to the Eau Claire substation. Various long-term and short-term alternatives to the utility proposal were developed by the Public Service Commission staff, other agencies, and participants at public meetings. Each alternative was examined in enough detail to determine whether or not it was feasible. A discussion of each rejected alternative and reasons for its rejection is provided in the supplemental information."
>
> "Of the solutions considered that could potentially provide long-term (long-lasting) benefit to the system, the most feasible appears to be a 345 kV transmission line to be constructed from the Minnesota 345 kV grid to Eau Claire. The two routes considered for this transmission line are: Prairie Island-Eau Claire (the NSP preferred route) and A.S. King-Eau Claire (SPERCA alternative)."
>
> "Alternatives providing relief for the area for a short period were also considered with the intent of spending a lesser amount of money for an adequate short-range system until the uncertainties concerning location and types of future generation related transmission outlets are known. Such an expenditure is worthwhile, considering generation uncertainties, if additional studies show that the proposed more expensive facility is not needed or that the future system with the proposed facility is more expensive than it otherwise would have been. The only feasible short-range alternative appears to be replacing the existing conductors with larger conductors (reconductoring) on the Red Rock-Crystal Cave 115 kV transmission line to eliminate the overloading problem and the installation of capacitors throughout the system to mitigate the under-voltage problem."

The WPSC Final EIS includes the following conclusion:

"It is not viable to continue with the existing system for the following reasons:

a. There is a risk involved with doing nothing and that risk will increase each year as loads continue to increase. A risk will still remain if loads remain constant and will only decrease if loads decrease.

b. Even if the expected outage occurs only once, the resulting cost to consumers and the utilities could be great, depending upon the circumstances.

c. NSP would not be fulfilling its responsibilities to MAPP, MARCA and interconnected utilities, in addition to its responsibilities to provide adequate service to its customers.

"Assuming loads do grow in western Wisconsin as presently projected by NSP, a need exists for additional transmission support of the western Wisconsin area."

"A 345 kV transmission line routed from either NSP generating station located near the Minnesota-Wisconsin border to the Eau Claire area is, of the facilities NSP proposes to construct in its current long-range plans, the most economic and effective to construct initially."

2.4 PROJECT HISTORY

2.4.1 Pre-MEQB Project History

The Prairie Island-Eau Claire portion of this project was originally part of NSP's and Dairyland Power Cooperative's application for the Tyrone Nuclear Energy Plant to the U.S. Nuclear Regulatory Commission (NRC) in 1974 and the Wisconsin Public Service Commission (WPSC) in 1976. The proposed HVTL was planned as an outlet for the proposed Tyrone Plant. In December, 1977, the NRC granted a construction permit for Tyrone. The permit recognized two alternate transmission routes in Wisconsin and four alternate Mississippi River crossings to be acceptable.

In 1978, NSP made applications to the MEQB and the WPSC for a new 345 kV line from Minnesota to Eau Claire. NSP projected that western Wisconsin would need additional power supply before the Tyrone Plant could be completed.

2.4.2 MEQB Project History

On July 21, 1978, NSP filed an application with the MEQB for a route designation and construction permit for a 345 kV HVTL and associated facilities extending from the Prairie Island Substation to the Minnesota/Wisconsin border.

Pursuant to Minn. Rule 6 MCAR § 3.073 (B)., the MEQB on September 21, 1978, formally accepted the NSP Prairie Island-Tyrone-Eau Claire (EQB Docket No. NSP-TR-2) application for a Construction Permit and Route Designation for the Minnesota portion of a single circuit 345 kV alternating current transmission line and associated facilities. This MEQB action started Minnesota's one-year routing process. NSP proposed four alternative routes in Minnesota (Prairie Island, Trenton 1, North Red Wing 1 and 2). A public information meeting was held on October 25, 1978, at the Red Wing Public Library to explain the project and MEQB power line routing process to the public. Pursuant to Minn. Stat. § 116C.59 and Minn. Rule 6 MCAR § 3.075, a citizens route evaluation committee (CREC) was appointed to assist the MEQB in evaluating routes. The committee met several times in 1978 and at their December 13 meeting recommended that the MEQB consider one additional route (Trenton 2). 2-6

Between January and May of 1979, there was very little project activity in Minnesota because the WPSC had not yet accepted NSP's application, had rejected the Tyrone application, had expanded the range of system alternatives being examined, and then suspended work on the application. In June, the MEQB accepted routes for public hearing and ordered preparation of an EIS. MEQB staff had recommended seven additional routes (North Red Wing 3 and 4, South Red Wing 1, 2, and 3, and Prescott 1 and 2). Because the study area was expanded to include routing alternatives in Dakota County, the CREC was expanded to include representatives from Dakota County. It continued to meet and discuss the routing alternatives being considered in Minnesota and review all information and data. On November 7, 1979 the CREC selected their preferred route (Prairie Island) and an alternate route (Trenton 2). The CREC, was informed that NSP would file an amendment proposal to their application to include routing alternatives from the Allen S. King plant. The CREC, representing only Goodhue and Dakota Counties, did not want to become involved with routing alternatives that cross the St. Croix, as they felt another citizens committee composed of residents from Washington County would be more appropriate. On September 19, 1979, the MEQB chairman granted a 90-day extension for the purpose of coordinating siting processes with the WPSC. This 90-day extension expired on December 21, 1979.

An amendment proposal was submitted by NSP on November 21, 1979, and accepted by the MEQB on December 20, which permitted Minnesota to consider the same two "system" alternatives and many of the same routes being considered by the Wisconsin Public Service Commission. In effect, this began Minnesota's 12 month route designation process again. Staff of the MEQB and WPSC met in December, 1979 and worked out a coordinated time-table which anticipated final route decisions in each state at about the same time, i.e., October or November, 1980.

A second citizens route evaluation committee was appointed from Washington County, Minnesota to advise the MEQB in selecting a route in the vicinity of the King Generating Plant across the St. Croix River to Wisconsin. Public information meetings were held in Washington, Dakota and Goodhue Counties in late January, 1980. The committee began meeting in February, and in April recommended that the MEQB accept for study three routes (B,C,D) in addition to NSP's proposed route (A). After MEQB acceptance of the three additional routes, the committee continued meeting to study the four routes which crossed the St. Croix River. On May 27, 1980 the committee selected as their first choice a "no route" recommendation and as their second choice the "A" route, which crosses the St. Croix River at the King Generating Plant.

2.4.3 WPSC Project History

The WPSC siting process differs in many ways from the EQB's HVTL siting process. Unlike the EQB, the WPSC has much broader jurisdiction, which includes approval of: advance plans, generation and transmission systems, individual transmission line applications, and environmental impact statements as they apply to electrical facilities. Another major difference is the time required for regulatory review. The WPSC's siting process is approximately six months long and begins when the application is formally accepted. The Prairie Island-Eau Claire application was submitted to the WPSC on July 21, 1978; however, it was not accepted until January 22, 1979. Then on March 6, 1979, the WPSC, recognizing the need for a power plant, other than nuclear, rejected NSP's Tyrone Nuclear Generating Plant and then directed NSP to submit an application for a 400-800 megawatt coal-fired plant. Because the Prairie Island-Eau Claire transmission line was to pass through the proposed Tyrone site and in the absence of an approved advance plan, other transmission systems assumed a new significance. On May 9, 1979, the WPSC suspended work on the Prairie Island-Eau Claire transmission line project, for the purpose of establishing an acceptable generation and transmission plan. In July, the WPSC resumed work on the transmission project and in August issued a draft EIS which reviewed several end points (system alternatives), project need, future utility plans and land-related resources.

The WPSC then narrowed down the number of alternatives being considered to:

1. Deferral of construction (by various means) to enable area generation decisions to be made prior to commitments to transmission line construction.

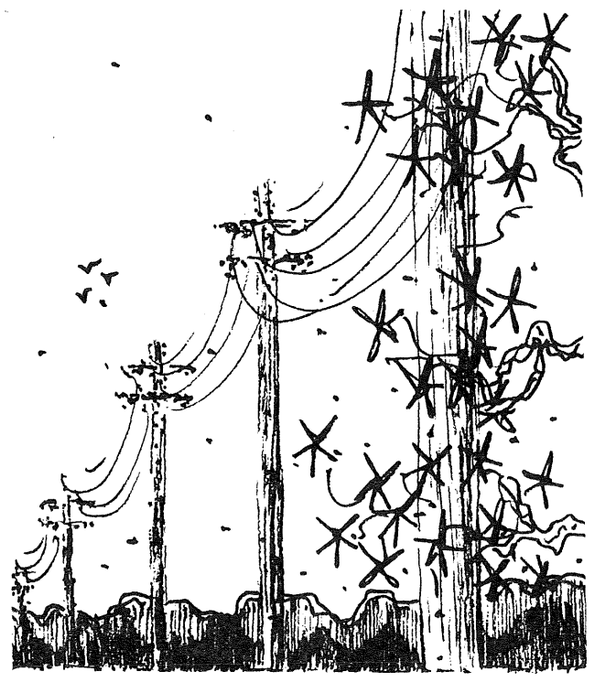
2. Construction of a 345 kV HVTL from the substation at the Allen S. King Plant to the Eau Claire Substation, primarily routed along Interstate Highway 94.

3. Construction of a 345 kV HVTL from the Prairie Island Substation to the Eau Claire Substation.

In the WPSC decision-making process a decision on need, system alternative, line route and EIS will be made at the end of their siting review process. An immediate decision on deferral of the application in Wisconsin could also necessitate suspension of the MEQB siting process. On October 9, 1979, the WPSC issued an order which directed NSP to make an application to the EQB for the Minnesota portion of a King-Eau Claire HVTL.

2.5 PROPOSED FACILITIES

2.5.1 Transmission Line



NSP has proposed construction of a single-circuit, alternating current, 345,000 volt (345 kV) transmission line. Their original (Prairie Island area) and amended (King area) applications sought a construction permit for only one final route. The application requested in each case a transmission line on structures separate from any other existing circuits. Subsequent to submittal of their applications, and in the course of MEQB's study of alternate routes, NSP has proposed several possible options which involve removal of structures on (towers) existing lines and placement of the existing circuit(s) on a new structure with the proposed 345 kV circuit. These possible double-circuiting options do not alter the proposed voltage or capacity of the 345 kV line for which NSP has applied. The options could, however, alter the right-of-way dimensions required, cost of the transmission line, reliability, and environmental impact. These option situations are discussed where appropriate in the detailed route descriptions (Chapter 4).

Design Standards

In designing a high voltage transmission line, a number of electrical, structural, and environmental standards and requirements must be considered. The National Electric Safety Code (American National Standard Institute Number C2) which is considered an acceptable standard by the State of Minnesota, sets safety standards relating to clearances, electric field strength, and structural requirements. Various environmental, safety, and general design requirements are also usually set forth in the MEQB construction permit.

Several different design alternatives are available to meet reliability, environmental, and safety standards. Often the choice of a structure type will depend on specific site conditions. The final choice of conductor may depend on economic considerations at purchase time. Span length between structures and conductor clearances depend on site specific parameters.

The following paragraphs generally summarize design concepts for the proposed 345 kV transmission line.

Structures

Three different structure types are currently being considered by NSP for the Minnesota part of the King Plant-Eau Claire or Prairie Island-Eau Claire 345 kV HVTL. The precise type of structure to be used will be specified by the MEQB in the Construction Permit.

The wood K-frame structure (Figure 2-4) consists of two wood poles with wooden crossarms and supports from which the conductors are suspended. Tangent structures usually do not need external guying. However, guys are required at major angles and dead end structures. The wood K-frame tangent will probably be used where no specific treatments are necessary.

The steel lattice tower is a four legged structure that requires no external guys for support. The structure is usually supported by concrete footings at each base. The steel lattice tower may be used at locations where extreme spans require additional strength and where guyed structures would adversely impact existing land uses. Figure 2-4 shows a double circuit structure which could be used where existing lines are rebuilt to be combined with the proposed 345 kV HVTL.

A third basic design is the single steel pole structure. It is a free standing design anchored in a single concrete foundation. Figure 2-4 shows both single and double-circuit designs. The double circuit design could be used where an existing line is rebuilt to be combined with the proposed 345 kV HVTL.

The utility indicates that structures can be selectively spotted as to exact location in order to minimize impacts, once the final centerline location is determined. NSP states that structure design will meet or exceed the guidelines of the National Electrical Safety Code (NESC), 1977 edition.

NSP has proposed that structures on either side of the river crossing (either Mississippi or St. Croix Rivers) be the steel lattice type. Due to the typically

ALTERNATIVE TANGENT STRUCTURE TYPES

A. 345 KV DOUBLE CIRCUIT LATTICE STRUCTURE

B. 345 KV DOUBLE CIRCUIT STEEL POLE STRUCTURE

C. 345 KV SINGLE CIRCUIT STEEL POLE STRUCTURE

D. 345 KV "K FRAME" WOOD POLE STRUCTURE

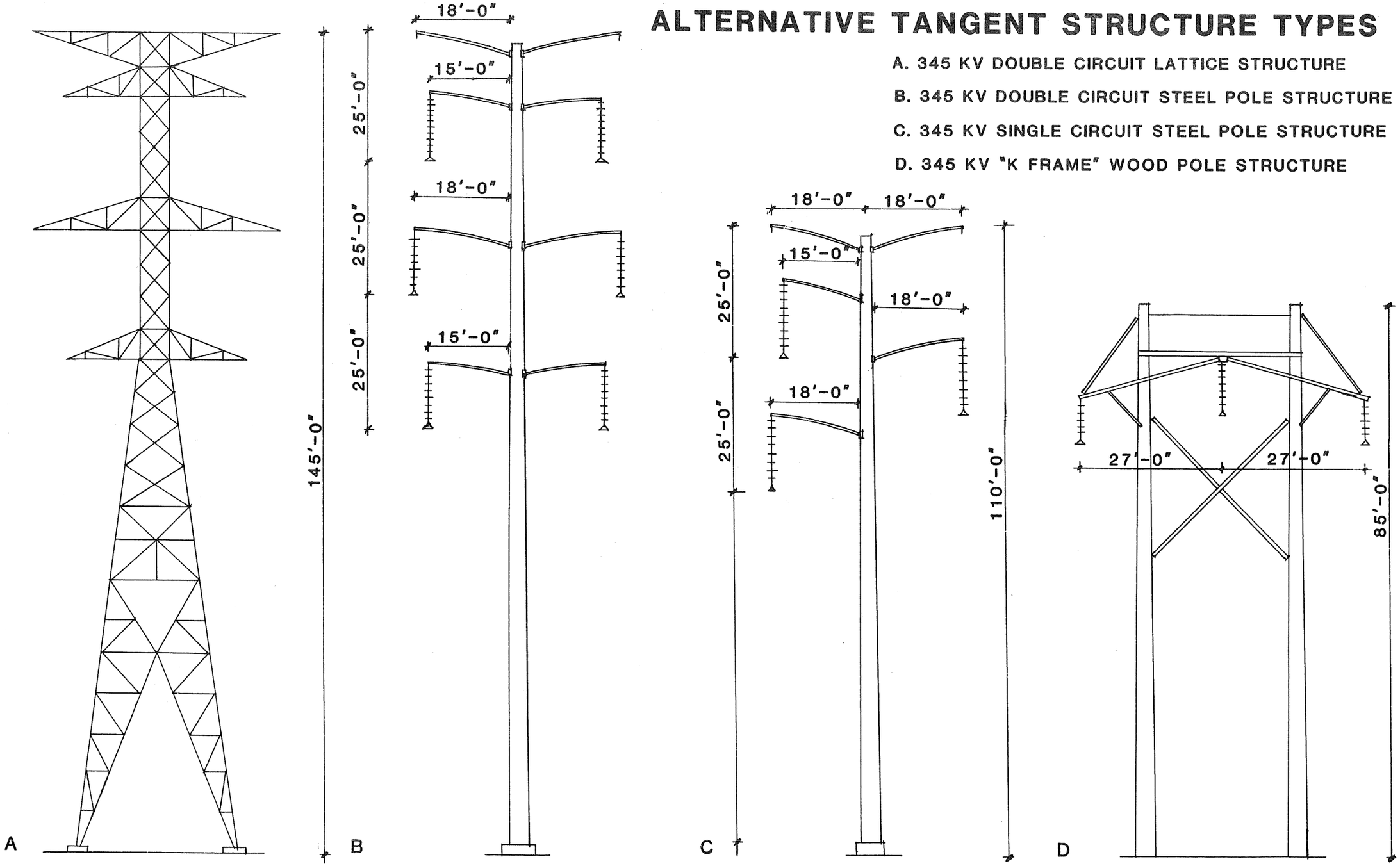


FIG. 2-4

wide crossing spans needed, which increase conductor weight and tension, and the need for typical dead-end design at such crossings, the take-off structures on either side will be larger and heavier than normal overland structures. Additional discussion on proposed overland and river crossings are in Section 2.8, Project Costs, and Chapter 4, Route Descriptions.

Conductors and Shield Wires

There are several choices of conductors that will reliably transport the proposed capacity. However, with any conductor some energy is lost due to corona discharge, and resistance. As conductor size increases line losses decrease. At the same time cost increases with larger conductors. It then becomes a matter of balancing the cost of line losses with the cost of larger conductor alternatives.

The following specifications have been developed by NSP. Each of the three phases of the 345 kV line will consist of a two-conductor bundle with 18 inch conductor spacing. The conductor will be at least 954,000 circular mil aluminum conductor steel reinforced (ACSR). It consists of seven steel core strands and 54 outer aluminum strands and is 1.302 inches in diameter. Market conditions at construction time may be such that a larger conductor is economical.

Two shield wires will be installed above the conductors to provide protection from lightning strikes. The shield wires will be 3/8 inch galvanized steel high strength cables. A slightly larger cable may be required at the river crossing because of the extreme span length.

The transmission line will have a summer rating of 1302 MVA and a winter rating of 1697 MVA (million volt amperes).

Ground Clearance and Span Length

Clearance between the ground and the point of maximum conductor sag varies substantially with air temperature, wind speed and the amount of electricity being conducted. The NESC formula for minimum clearance is based on line voltage, line temperature, and a five milliampere maximum available induced short circuit current. Minimum clearance, when the conductor temperature is 120°F, is 32' 6". Where it is reasonable to assume a large vehicle (bus or semi-trailer truck) may cross under the line, clearances will be adjusted, if necessary, to limit available induced short circuit current of five milliamperes.

Clearance at River Crossings

Conductor spans between structures usually vary from 400-1,200 feet and can be even longer. Span length depends on a number of site specific factors including terrain, land use, and property boundaries. Where a low profile line is desired, span length will be relatively short. The length of the river crossing span will depend on the route chosen. The shortest river crossing would be about 2,000 feet.

2.5.2 Substations

NSP's original application provided for expansion of the existing 345 kV substation adjacent to the Prairie Island Generating Plant, to accommodate the termination of a Prairie Island-Eau Claire route. This would not require purchase of additional private lands. Prairie Island route alternatives studied in the MEQB review process require no additional substations or changes in NSP's proposed substation expansion.

The amended application proposal also provided only for expansion of the existing 345 kV substation at the Allen S. King Generating Plant. NSP did, however, indicate that a new substation could be installed anywhere along the existing King-Eau Claire 345 kV line which leaves the west side of the King Plant and turns south for 13 miles before angling east to Wisconsin. Subsequently, three additional routes were accepted for study by the MEQB, each requiring a new 345 kV substation where it joins the above mentioned 345 kV transmission line.

Substation requirements are discussed in further detail for each route in Chapter 4 Route Descriptions.

2.6 RIGHT-OF-WAY REQUIREMENTS

In routing situations where no other linear facilities are involved, the proposed 345 kV transmission line will require a right-of-way 150 feet in width. In general, total right-of-way requirements can be reduced by "sharing" (overlapping) right-ofway with other facilities, such as existing power lines, railroads, or major highways. Most of the alternative routes for this project provide opportunities for right-of-way sharing. The following figures indicate the additional right-of-way widths required for typical right-of-way sharing situations which exist on this project.

Existing Right-of-Way Type	Required Additional Right-of-Way
345 kV	90 ft.
161 kV	115 ft.
115 kV	140 ft.
69 kV	140 ft.
Railroad	90 ft.
Major Highway	90 ft.*

*Assuming no overhang of facility over highway right-of-way. Could be less if overhang were permitted.

The above figures will vary as existing situations vary. The figures are presented here as general reference only.

In general, the width of a right-of-way must be at least that required to provide adequate clearance for the conductors. Width is thus influenced to some degree by line voltage. Many other factors also determine right-of-way width, including safety and maintenance, structure configuration, and requirements to minimize radio and TV interference and audible noise. The positioning of the circuit phases is also a determinant. For example, a horizontal configuration is wider than a vertical arrangement. The right-of-way width is further dictated by the extent to which the conductors sag between structures and how far they will swing outward in the wind. Many of these factors also determine to what extent trees and buildings must be removed and/or restricted.

2.7 PROJECT SCHEDULE

An earlier section described the project history, implying NSP is now well behind their proposed inservice date of 1982. Construction permits, if provided, will not be issued in either Minnesota or Wisconsin before late 1980. Following regulatory review, engineering and right-of-way acquisition will take 1 to 1½ years and construction another 1½ to 2 years. Assuming no additional major regulatory or legal delays, the completion date for the line ranges from mid-1983 to late 1984.

The impacts of project delays are not addressed in this draft EIS because they are related to need and the question of need for the line was not reviewed by the State of Minnesota.

2.8 PROJECT COSTS

Estimated costs for the Minnesota portion of the proposed route alternatives have been provided by NSP, and are shown in Table 2-1. Estimates are based on 1982 cost projections, and can be expected to be higher for a 1984-85 construction schedule. Inflationary increases average 9% per year.

Costs for each route have been calculated from the beginning point in Minnesota to the first structure in Wisconsin after crossing either the Mississippi or St. Croix Rivers. Costs are "not figured" (see Table 2-1) for wood K-frame structures for routes where that design would not be an option for visual compatibility reasons. River crossing costs assume heavy steel lattice structures for both sides of the rivers, and a third structure on an island for three Prairie Island routes.

2.9 CONSTRUCTION AND MAINTENANCE

Centerline Determination

Following MEQB designation of a route, NSP engineering, right-of-way and environmental personnel will determine the exact alignment of the proposed transmission line within the designated route (See Section 5-Associated Regulatory Requirements-for a description of MEQB Permit Compliance Program). The alignment will be determined by use of aerial photographs and by information obtained by field reconnaissance. Property owners will not be contacted at this time since the utility will restrict their reconnaissance efforts to areas accessible by public roads.

Once a centerline alignment has been established, a plan view and ground profile drawing of the area traversed by the transmission line will be prepared from aerial photography by photogrammetric processes. In areas of dense ground cover, or where additional information to adequately describe the location of the transmission line is required, field survey crews will be used. The property owners will be contacted by NSP right-of-way agents prior to the survey to obtain written permission for this activity on their property.

Right-of-Way Acquisition

Once the exact alignment has been established, NSP will identify the owners of all lands which will be affected by the transmission line. NSP will then conduct a land evaluation study to determine the market value of the lands. From this study, a payment schedule will be developed to determine the price to be paid for land rights in the form of an easement. Right-of-way agents from NSP will then contact each property owner in a reasonable amount of time, as dictated by the project schedule. If the property owner and NSP do not agree on a price for the easement, NSP has the option to petition the court to initiate condemnation proceedings in accordance with the laws of eminent domain.

TABLE 2-1 NSP-TR-2 ALTERNATE ROUTE COSTS[1]

Route (Nodes)	Minnesota Route to River Steel Pole	Minnesota Route to River Wood K-Frame	River Crossing	Substation	Total Minnesota Costs Steel Pole	Total Minnesota Costs Wood K-Frame
Route A (A1-A2)	294,000	Not Figured	425,000[5]	1,480,000[2]	2,199,000	----------
Route B (B1-B2)	1,288,000	Not Figured	525,000	3,000,000	4,813,000	----------
Route C (C1-C2)	1,066,000	693,000	425,000	3,000,000[3]	4,491,000	4,118,000
Route D (D1-D2)	1,040,000	674,000	400,000	3,000,000[3]	4,440,000	4,074,000
Prairie Island (1-2)	176,000	158,000	580,000[4]	1,480,000[2]	2,236,000	2,218,000
Trenton 1 (1-3 - 4-6)	1,382,000	1,029,000	360,000[4]	1,480,000[2]	3,222,000	2,869,000
Trenton 2 (1-3-5)	1,134,000	836,000	454,000[4]	1,480,000[2]	3,068,000	2,770,000
North Redwing 1 (1-3-7-8-9-10-11)	2,056,000	1,477,000	310,000	1,480,000[2]	3,846,000	3,267,000
North Redwing 2 (1-3-7-8-9-10-12)	1,959,000	1,383,000	530,000	1,480,000[2]	3,969,000	3,393,000
South Redwing 1 (1-13-14-15-16-17)	5,575,000	4,191,000	450,000	1,480,000[2]	7,505,000	6,121,000
South Redwing 2 (1-3-7-8-15-16-17)	6,002,000	4,423,000	450,000	1,480,000[2]	7,932,000	6,353,000
South Redwing 3 (1-3-7-8-9-16-17)	5,414,000	4,073,000	450,000	1,480,000[2]	7,344,000	6,003,000
Prescott 1 (1-18-20-21)	3,130,000	2,128,000	290,000	1,480,000[2]	4,900,000	3,898,000
Prescott 2 (1-13-19-20-21)	3,969,000	2,653,000	290,000	1,480,000[2]	5,739,000	4,423,000

1. Calculations based on 1982 cost projections for overhead construction; annual inflation increase is 9%.
2. Costs for 345 kV termination equipment at an existing 345 kV substation
3. Costs for a new 345 kV substation
4. Requires an island (mid-river) structure
5. Cost for single-circuit line adjacent to (parallel) but separate from existing double circuit line. Alternative design costs provided in Section 4.2.2.2.

Ground Survey

Following the acquisition of right-of-way, the major construction activities will commence and proceed in as continuous a manner as possible. The first activity will be a ground survey to establish and stake the centerline of the transmission line. Staking for right-of-way clearing will also be done at this time in areas requiring clearing.

Right-of-Way Clearing

Clearing of the right-of-way, the first major phase of transmission line construction, is necessary to provide required clearances for the conductor, to eliminate possible hazards to the line from falling trees, as well as to facilitiate construction operations. The width of the right-of-way to be cleared for the project will vary with the opportunities for right-of-way sharing. Trees outside the cleared right-of-way which present a potential hazard to the line will also be removed. The utility will obtain special permission to remove "danger trees" which are outside the right-of-way.

In areas of low growing brush and swamps, right-of-way clearing normally will be confined to approximately the center one third of the right-of-way (i.e., 25 feet on either side of the centerline).

Foundation Installation

Following the clearing of the right-of-way, the foundations for the structures will be installed. The foundations will be of two basic types; reinforced concrete with drilled shafts and foundation anchors or direct burial.

The reinforced concrete drilled shafts will be dug using a truck or crane mounted drilling rig capable of augering holes three to eight feet in diameter. During the drilling, the hole will be kept open by means of either temporary steel casing or a bentonite slurry. When the hole has been drilled to design depth, the reinforcing steel will be placed, and ready mix trucks will deliver concrete to the site for placement. The 15 to 40 cubic yards of soil excavated for each structure site will be leveled evenly around the site, or if requested by the landowner, it will be hauled away for disposal.

Structure Installation

The assembly and placement of structures will follow the installation of foundations. The structures will be transported to the structure sites unassembled. Generally a 150-foot square area adjacent to the foundation will be required to assemble the structure. If the site is uneven, some grading may be necessary. The assembly crews will consist of eight to 10 workers and a 15 to 30-ton mobile crane. Assembly of each structure will require an average of two to three days. Wood K-frame structures require less assembly time. After the structure has been assembled on the ground, the assembly crew will move to the next site and the installation crew will follow to erect the structure on the foundation. The installation crews will consist of eight to 10 workers and a rubber-tired or track-mounted 75 to 90-ton crane. Depending upon access to the sites, two to four structures per day can be installed by one crew.

Conductor Stringing

The stringing of the shield wires and conductors is a multifaceted activity. During a stringing operation 40 to 50 men and a large amount of specialized equipment will be required. A normal stringing operation will entail stringing up to four miles of line in one set-up of equipment, and will require one to three weeks to complete.

Prior to the stringing operation, stringing dollies, which are neoprene lined sheaves, must be hung on each structure along with the required insulator assemblies. During this same period, "guard poles", temporary structures consisting of two wood poles with a wood cross arm between, are placed at all locations where the transmission line crosses roads, railroads or existing overhead facilities. Lead lines of polypropylene rope are then installed between the structures in the section to be strung and are placed in the stringing dollies. At one end of the operation, the tugger, mounted on a truck or semi-trailer, is moved into position. The tugger consists of a series of motor driven drums and reels that pulls the conductors into position. At the other end of the set-up, the tensioner, also mounted on a truck or semi-trailer, is moved into position along with the conductor trailers, reel strands and reels of conductor. The tensioner consists of two motor driven wheels per conductor, that provide braking action during the stringing operation to prevent the conductor from touching the ground, and to facilitate pulling the conductor up to proper sag.

Before the conductors are strung, steel cables and shield wires are attached to the polypropylene lead lines and the tugger reels up the lead line pulling the steel cable and shield wires into position. Temporary anchors are used to secure them until the set-up is completed. The conductors are then strung, one phase at a time, which results in two conductors being strung in one operation. When all conductors and shield wires have been pulled into position, they are pulled up to the proper sag, and final attachments are made at each structure.

The construction activities discussed above will be performed sequentially. It will take many months to complete all construction activities in any one section of line. Activities will not be continuous but will occur periodically as different crews move from site to site.

Debris Removal

Clean-up and restoration of the right-of-way will be the final activity and will entail removing excess materials and general construction debris as well as repairing damages done to the right-of-way. Debris removal will be an ongoing activity throughout the construction schedule. Damage settlements will then be secured from the individual property owners.

Right-of-Way Restoration

Following construction and final cleanup grading is done where natural slope or relief needs to be restored. In areas susceptible to erosion, grading and/or seeding is done immediately to establish a dense ground cover which slows water run-off and binds soil particles.

Right-of-way Maintenance

According to their application, NSP's right-of-way maintenance program is generally limited to those areas where initial clearing was necessary and is designed to meet three objectives.

1. Prevent re-establishment of tall growing species that could interfer with the operation of the line.

2. Prevent potential erosion that might occur along the right-of-way.

3. Incorporate plans and techniques into the maintenance program that will benefit wildlife.

Ongoing maintenance consists of chemical and mechanical vegetation control done at intervals of 3-5 years. It is the aim of the program to establish a grass and herbacious plant community along the access lane and a dense low growing shrub community on the rest of the right-of-way. Once established these plant communities inhibit the growth of tall growing species. During initial clearing operations and during ensuing maintenance operations, the stumps of freshly cut trees are treated with herbicide to kill the root system of the plant and prevent regrowth. The chemical presently used by NSP for this purpose is Dupont Ammate X. Ammate X is applied as a dry crystal by hand to the outer growth ring of the stump within 24 hours of cutting.

When undesirable woody vegetation invades the right-of-way or regrowth occurs from stumps, a basal spray application of herbicide is applied. The chemical presently used by NSP for this purpose is Amchem Weedone 170. The first application is generally made within 2-3 years of initial clearing. Intervals between applications lengthen as the objective of establishing a new shrub community is approached.

In the basal spray application the herbicide is mixed with an oil carrier and applied by hand to the root collar and lower 12-24 inches of the stem using a low pressure spray system. Hand cutting using saws, power clippers and power saws is also done in areas where herbicide application is not appropriate. Occasionally large power equipment, such as brush mowers to hydro axes, may be used. Herbicides will not be used within 100 feet of any open water body and care will be exercised to avoid material reaching open water through spray drift.

Herbicides are not used in meadows, pastures, or cultivated fields. In fact, herbicides are only used where the landowner agrees that they may be used. Written permission for the use of herbicides is obtained in the easement document and it is NSP's general practice to obtain verbal permission from each property owner to spray herbicides on their property just prior to application.

2.10 ABANDONMENT AND RESTORATION OF RIGHT-OF-WAY

Historically, 345 kV rights-of-way have not been abandoned. The proposed line will become a long-term integral link in NSP's 345 kV grid system, and will be maintained as such as long as NSP's present power supply system exists. Right-of-way easements are acquired for perpetuity.

2.11 PROPOSED ROUTES

Fourteen alternative routes have been proposed for this project in Minnesota. There are 12 complete routes emanating from the Prairie Island substation and four complete routes which emanate from the 345 kV grid system at various points in Washington County, one point being the King Plant substation near Stillwater. Route segments are shown in Figure 2-5 (in pocket).

2.11.1 Prairie Island Routes (Mississippi River)

The 12 alternative routes from the Prairie Island substation terminate at the Minnesota-Wisconsin state boundary in the Mississippi River. However, where necessary for a practical understanding of the routes, discussions are provided for continuations of the routes into Wisconsin. The ten complete routes are comprised of one or more "segments." Intersecting points have been labelled "nodes" and assigned numbers. Thus, complete routes are represented by several numbers, such as 1-3-4-6 which means the route begins at node 1 (Prairie Island substation), passes through node 3, then to node 4 and terminates at node 6 (Minn.-Wisc. boundary). Figure 2-5 illustrates all segments which are being considered.

PROPOSED ROUTES

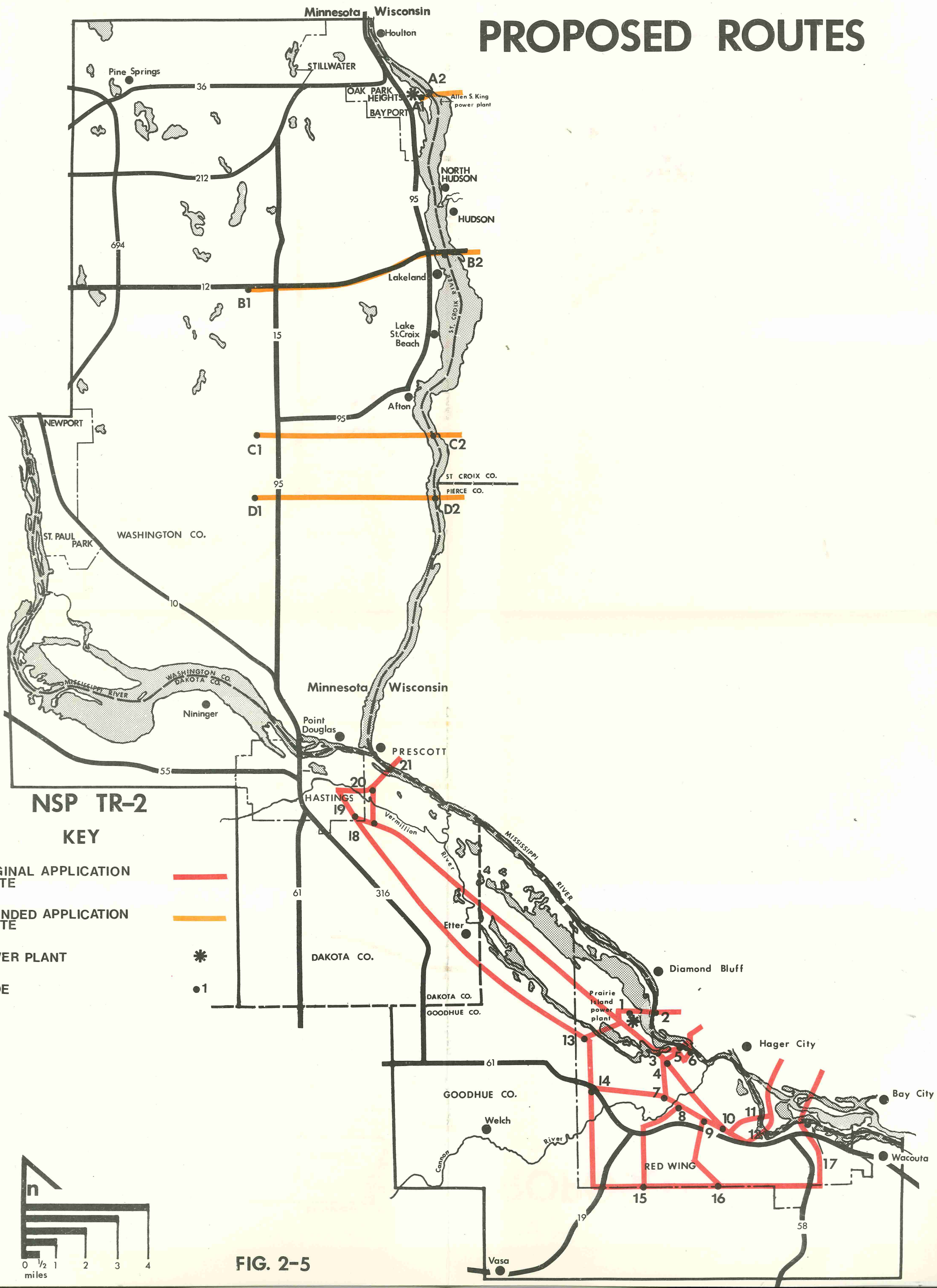


FIG. 2-5

If the MEQB designates one of the Prairie Island routes, the route will be continuous to the state boundary, and consist of one or more connecting segments.

Of the 12 Prairie Island routes, four were initially proposed by NSP in their application (June, 1978). These were:

Prairie Island route	Nodes 1-2
Trenton I Route	Nodes 1-3-4-6
North Red Wing I Route	Nodes 1-3-7-8-9-10-11
North Red Wing II Route	Nodes 1-3-7-8-9-10-12

The Prairie Island Citizens Route Evaluation Committee proposed a variation of NSP's Trenton I Route which is:

Trenton II Route	Nodes 1-3-5

Route proposals added by the MEQB Power Plant Siting staff in June, 1979 are:

North Red Wing III Route	Nodes 1-3-4-10-11
North Red Wing IV Route	Nodes 1-3-4-10-12
South Red Wing I Route	Nodes 1-13-14-15-16-17
South Red Wing II Route	Nodes 1-3-7-8-15-16-17
South Red Wing III Route	Nodes 1-3-7-8-9-16-17
Prescott I Route	Nodes 1-18-20-21
Prescott II Route	Nodes 1-13-19-20-21

2.11.2 King Routes (St. Croix River)

The four routes associated with the King Plant substation do not all directly emanate from the King substation. Three of the four routes will require new substations at points south of the King Plant along an existing 345 kV double circuit line. The three routes are thus not technically King Plant routes, but are associated due to the nature of NSP's amended application and the "two study areas" format of this draft EIS.

Technically, all routes being considered connect the Eau Claire substation with the Twin Cities 345 kV grid. The 16 alternative routes emanate from five substation sites within that grid. Two of the five substation sites are existing (Prairie Island and King) and three are potential sites (all in southern Washington County).

NSP proposed Route A in their amended application submitted in November 1979. It connects Nodes A1-A2. The King Citizens Route Evaluation Committee added three additional alternative routes in April, 1980: Route B (Nodes B1-B2), Route C (Nodes C1-C2), and Route D (Nodes D1-D2).

2.12 FINAL ROUTE DESIGNATION

Of the 14 routes being considered in Minnesota, one will be designated at the completion of the MEQB's routing process, which will occur in late 1980. At the writing of this draft EIS, there is no specific coordination mechanism to insure that the MEQB and WPSC designate routes which meet at the states' boundary. This issue will be fully explored in public hearings and further agency communications, so that a solution to the potential problem of a non-continuous route is pre-determined.

chapter 3

GENERAL ENVIRONMENTAL IMPACTS

CHAPTER 3

GENERAL ENVIRONMENTAL IMPACTS

3.1 INTRODUCTION

The construction, operation and management of a high voltage transmission line (HVTL) can generate a wide range of impacts on the human environment, natural features and general economic activities. This chapter describes the "generic" impacts which are generally associated with all 345 kV overhead transmission lines. The broad-based knowledge of generic impacts has been reviewed by MEQB staff, and summaries provided in this chapter of appropriate topics. Information here applies to all routes under evaluation for this project. Site specific impacts for individual route segments are discussed in Chapter 4 Route Segment Impacts.

3.2 GENERAL IMPACTS ASSOCIATED WITH ELECTRICAL PHENOMENA

The transfer of electrical energy by overhead conductors gives rise to three electrical phenomena that affect the environment. These are corona discharge, electric fields, and magnetic fields. The major known environmental effects of these phenomena are summarized in the following text. Where known, potential mitigating measures are also presented.

3.2.1 Corona Discharge - Description

Corona discharge is an electrical phenomenon that occurs around a conductor and related hardware whenever electrical field strength at a conductor surface exceeds the electrical breakdown strength of the surrounding air. As this occurs, the molecules and atoms in the air react with electrical energy from the line. The end result is the formation of gaseous chemicals, visible light, audible noise, and/or electromagnetic interference. All of these electrical effects represent a loss of electrical energy being carried by the transmission line. As a result, corona discharge decreases the transfer efficiency of a HVTL.

The occurrence of corona discharge varies with line voltage, electric field strength, conductor geometry and condition, and weather conditions. Corona is more likely to occur where the electric field is concentrated by conductor surface irregularities such as nicks, scratches, contaminants, insects, water droplets, or dust.

DRAFT

Considerable research has been conducted on various side effects of transmission line corona discharges. Four general effects are of particular note. These are gaseous effluents, audible noise, radio interference and television interference.

3.2.1.1 Corona Discharge - Effects

Corona discharges from HVTL's can result in the production of ozone and nitrogen oxide. The precise amount and concentration of these elements generated varies with atmospheric conditions and the design and operational characteristics of the transmission line.

Ozone is a reactive gas which consists of three oxygen atoms. Its reactivity is due to the tendency of the gas to lose one oxygen atom to other chemical elements. As the oxygen atoms dissociate they combine with oxidizable materials. This process is commonly known as oxidation. If the oxidation process is highly concentrated, it can potentially affect a wide range of chemical and biological processes. Table 3-1 shows some of the biological effects of ozone at different concentration levels. Estimates for ozone production are between 0.5 to 5.0 grams of ozone per kilowatt-hour of corona energy lost. For a 345 kV alternating current (ac) transmission line it is estimated that the maximum one hour concentration of ozone will be approximately 0.007 parts per million (ppm). This is well below the National Ambient Air Quality Standard of 0.12 ppm for oxidants. This level is also below the more stringent standards of 0.07 ppm (130 micrograms per cubic meter) set by the State of Minnesota's Pollution Control Agency for oxidants. Based upon ozone studies conducted by the U.S. Department of Health Education and Welfare, it does not appear that the 345 kV transmission line will impose serious health hazards due to ozone production.

In addition to ozone, corona discharges can produce nitrogen oxides. The amount of nitrogen oxide produced by a high voltage transmission line is usually one order of magnitude smaller than for ozone. Nitrogen oxides may reach concentrations of only 0.1 to 2.0 parts per billion (ppb) at ground level near a transmission line. Nitrogen oxides (NO_2) are generally less toxic to plants than other oxidants. The level of potential plant damage resulting from NO_2 is closely related to NO_2 concentration and exposure time. Figure 3-1 is a threshold curve indicating the NO_2 doses that result in the death of plants, foliar lesions, and metabolic effects. The various threshold levels are concentrations emitted by the transmission line.

3.2.1.2 Corona Discharge - Audible Noise

Another side effect of corona discharge is the emission of audible noise from the transmission line. The noise can be described as either crackling, sizzling or humming sounds. The level and frequency of noise emissions are dependent upon the

TABLE 3-1
A SUMMARY OF THE BIOLOGICAL EFFECTS OF OZONE

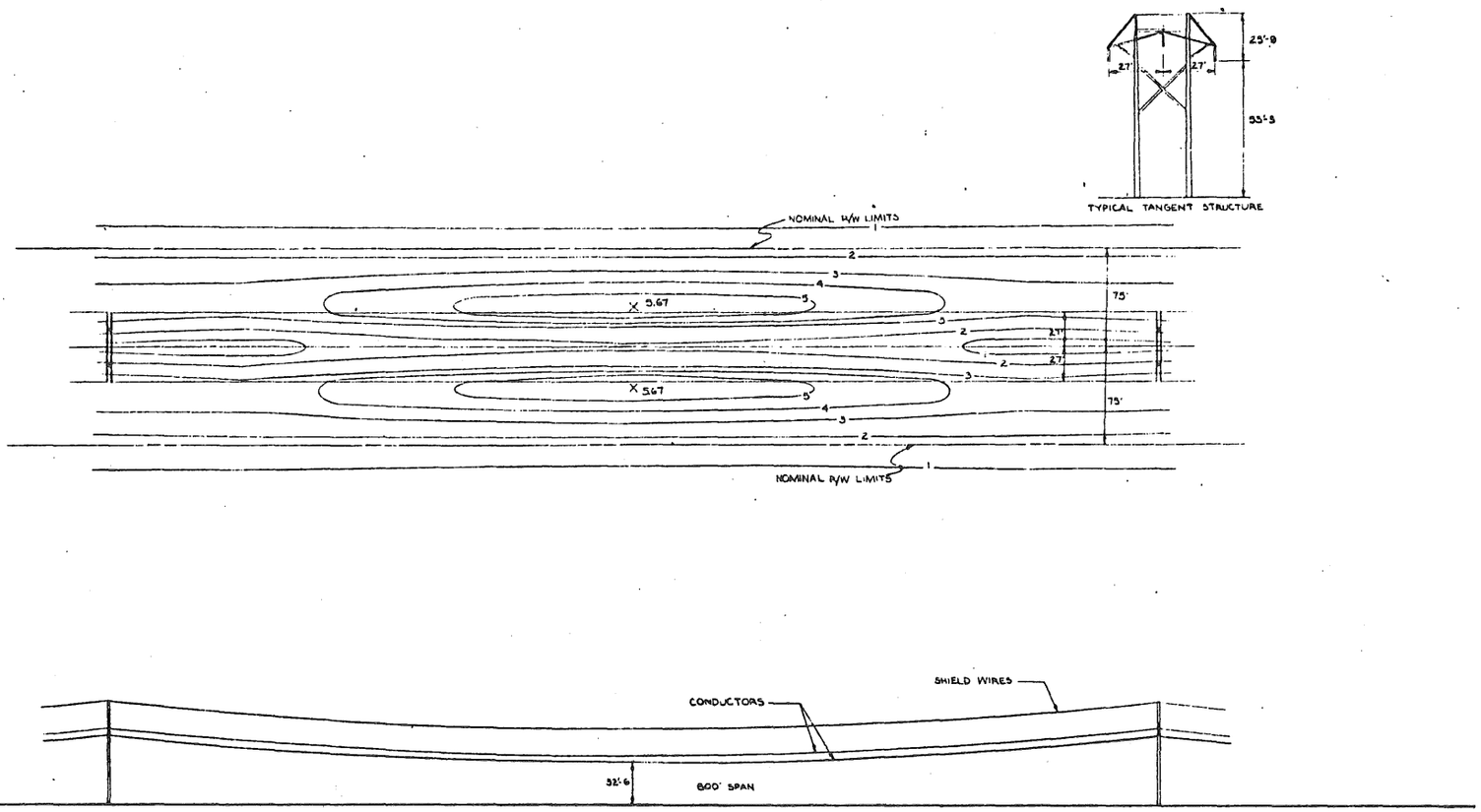
Concentration (ppm)	Effect
.010	Olfactory threshold for keen smell
.015	Normal human threshold
.020-.040	Sensitive plant injury (8 hour exposure) -- 5% injury
.060-.120	Sensitive plant injury (8 hour exposure) -- 20% injury
.100-.300	Dryness and burning in nose and throat
.200	Blood changes in animals
.150-.250	Sensitive plant injury (1 hour exposure) -- 5% injury
.200-.350	Sensitive plant injury (1 hour exposure) -- 20% injury
.250-.500	Reduced visual acuity and darkness adaption
.300-1.700	*Recurrent headaches, fatigue, and breathing difficult after two-week exposure
.500	*Chronic irritation of bronchial tissues
.600-1.000	Choking and coughing (1+ hours)
1.000	Hemoglobin changes in man
9.000	Acute pulmonary edema

*Long term exposure effect

SOURCE: Michigan Public Service Commission Health and Safety Effects of EHV Transmission Lines. 1979

ELECTROSTATIC GRADIENTS

345 KV TRANSMISSION LINE



NOTES:
1) ELECTROSTATIC GRADIENTS INDICATED ARE IN KV PER METER AT ONE METER ABOVE GROUND LEVEL.
2) SAGS AND CLEARANCES INDICATED ARE AT 120° F CONDUCTOR TEMPERATURE.
3) LINE VOLTAGE IS 362 KV BEING A NOMINAL 345 KV WITH A 5% OVER VOLTAGE CONDITION.

FIG. 3-1

condition of conductors, line voltage, and weather conditions. Generally speaking, the loudest and most frequent noise emissions occur during heavy rainstorms or other wet conditions.

Based upon past experiences and the results from a recent noise study conducted on 765 kV transmission lines, NSP has stated that even under the most adverse conditions, the proposed 345 kV transmission line will produce a maximum audible noise level of 45.5 decibels (db) and will not exceed 43.0 db at the edge of the right-of-way. This noise is within acceptable noise limits established by the Minnesota Pollution Control Agency (See Table 3-2 for Ambient Noise Standards). Although the average sound level does not appear to be excessively loud, people have different tolerance levels to noise and even low level sounds could be annoying to some individuals.

3.2.1.3 Corona Discharge - Electromagnetic Interference with Communication Equipment

Corona discharges can produce electromagnetic fields which may interfere or disrupt the efficient operation of communication equipment. Although this disruption is not a direct health or public safety problem, "static" or "snow" interferences can be annoying to radio listeners or television viewers.

Interference related to transmission line operation can originate from two sources: gap discharge and corona discharge. Gap discharges are electrical discharges across small gaps resulting from loose transmission hardware or connections. As such, gap discharge interference can usually be located and eliminated. Gap discharge should not therefore pose any long-term impacts on reception or transmission of radio or television. Corona discharge produces short bursts of current which can cause electromagnetic energy to be generated over a wide range of radio frequencies. This corona energy can be carried as induced current for long distances by the conductors. Thus, if a radio or television receiver is located near a transmission line, a corona discharge that originates at distant points on the line can still cause reception interference.

The impact of transmission lines upon radio signal reception depends upon three factors: radio signal strength, ambient radio noise level, and the line-generated radio noise level. The quality of reception under ambient conditions depends upon the difference between the radio signal strength and the ambient radio noise level. This reception quality is measured by an ambient signal-to-noise ratio (ASNR). High quality reception will result from either a high signal strength or low ambient noise levels. The level of interference that a transmission line may impose is measured as the difference between the radio signal strength and the line-generated noise level. This ratio is described as the signal-to-noise ratio (SNR).

TABLE 3-2

MINNESOTA AMBIENT RECEPTOR NOISE STANDARDS

	Day (7 am - 10 pm)		Night (10 pm - 7 am)	
NAC	L_{50}	L_{10}	L_{50}	L_{10}
1	60db	65db	50db	55db
2	65db	70db	50db	55db
3	75db	80db	75db	80db

NAC-1 (Noise Area classification-1) includes the following land use categories: Residential, hospital, educational and religious activities, designated camping and picnicking areas, cultural activities and natural exhibits.

NAC-2 includes: Railroad, bus, airport and marine terminals, retail trades, commercial services, governmental services, parks and recreational activities.

NAC-3 includes: Manufacturing, transportation, fairgrounds, amusement parks, agricultural, mining and fishing activities.

L_{50}: Noise level not to be exceeded more than 50% of the time.

L_{10}: Noise level not to be exceeded more than 10% of the time.

If both ASNR and SNR are high, the quality of signal reception will also be high and the transmission line should have no noticeable effect. If both ratios are low, existing poor reception should not be made noticeably worse by the line. However, if ASNR is high and SNR is low, impact on signal reception may be noticeable. In general, the nature of radio frequency interference from transmission lines is such that the interference diminishes rapidly as a function of distance away from the line. Therefore, interference is usually a localized problem.

Most of the impacts on communication equipment can be minimized by altering antennas or other receiving equipment. NSP states in their application that should the operation of the 345 kV transmission line cause disruptions in communication equipment, NSP will be responsible for correcting the problems.

3.2.2 Electrical and Magnetic Field Effects

The operation of alternating current (ac) overhead transmission lines produces electric and magnetic fields. Both fields have the ability to "couple" with objects located within them and transfer electrical energy to the objects without direct physical contact. This energy transfer is known as induced voltages and currents. These voltages and currents can couple or interact with objects that exist within the transmission line's electrical fields. The "coupled" objects can be: living organisms such as people, animals or plants; or inanimate conductive objects such as fences, vehicles or other metallic items.

If induced directly onto living tissues, electrical voltages and currents that are sufficiently large can cause direct biological, physiological or psychological effects. Voltages and currents induced onto inanimate objects are also of concern. This is because of the potential shock hazard present when a person or animal comes into contact with the electrified object. Induced currents can also adversely affect the normal function performance of different types of objects. For example, concentrated fuel vapors may be ignited or electronic equipment may be affected.

The induction of voltages and currents by a transmission line can be divided into the effects due to electrical fields, termed electrostatic induction impacts, and effects due to magnetic field effects, termed electromagnetic induction impacts.

3.2.2.1 Electrostatic Field Impacts

An electric field can induce a voltage and current on conductive objects located within the field. The field presence whenever the line is electrically energized, and the field's strength, are a function of the line geometry and voltage. The voltage

that the field will induce on an object depends on the size and shape of the object, the strength of the field, how well the object is grounded, and the location of the object relative to the line.

According to NSP, the maximum electric field at ground level caused by the proposed line will be 5.67 kV/m (kilovolts per meter). The ground level field strength will decrease with increased line height; therefore, maximum field strength would occur generally near the center of each span. A span is the linear distance between two supporting structures (towers). Also, the ground level electric field decreases with an increased distance from the line. (See Figure 3-1 and Table 3-3.) For reference, the MEQB has established 8 kV/m as the maximum electric field strength at one meter (or 39.37 inches) above the ground for some transmission lines. It would appear that the field strength associated with the 345 kV line will fall below the MEQB's maximum standard.

The principal problem with the voltage induced on conductive objects by the electric field is with large metallic objects such as farm equipment, vehicles, structures with large metal components, wire fences, etc. If a metal object is not adequately grounded when a person touches it, a current can flow through the person's body to the ground. This can, depending on the circumstances, be potentially hazardous or simply result in an annoying shock similar to "carpet shocks." Whether these currents will be induced by the electric fields associated with the 345 kV transmission line will depend upon the factors discussed in the first paragraph of this section.

Adequate grounding of conductive objects near the transmission line can eliminate potential shock hazard. Electric and non-electric wire fences, metal buildings and other stationary structures can, where necessary, be readily grounded to reduce the level of shock current.

Because multiple use of transmission line rights-of-way for agricultural, transportation and other compatible uses is encouraged, it is quite possible that certain types of vehicles and machinery will be exposed to the electrostatic fields. The vehicle or machinery will collect induced currents and may transmit the current to an individual. The current transmitted will depend on the size of the vehicle, how well the object is insulated from the ground, and the strength of the electrical field in which the object is located. Generally speaking, the larger the object, the greater the potential current. Table 3-4 lists estimated induced current levels that may be delivered to a grounded person under a 345 kV line from different types of agricultural and construction equipment.

TABLE 3-3

ELECTRICAL FIELD STRENGTH AT
VARYING DISTANCES FROM THE
CENTERLINE OF A 345 kV TRANSMISSION LINE

Distance from Centerline in Feet	Electrical Field Strength in kV/m.(1)
0	1.97
25	5.34
30	5.66
50	3.87
75	1.65
100	0.79

(1) Field strength calculated under the following conditions:

a) 10% average
b) midspan location
c) conductor clearance of 32.5 feet
d) field strength one meter above the ground.

Source: NSP Application

TABLE 3-4

INDUCED CURRENTS DELIVERED TO A GROUNDED PERSON
UNDER A 345 KV LINE
(WORST CASE CONDITIONS)

Test Vehicle	mA/(kV/m)	Current (mA)	
		Worst Case*	Typical
Tractor-Trailer	0.59	3.35	0.27
School Bus	0.41	2,32	0.19
Tractor-Tanker	0.40	2.27	0.18
Combine	0.39	2.21	0.18
Farm Tractor with Wagon	0.31	1.76	0.14
Pickup Truck	0.10	0.57	0.05
Station Wagon	0.08	0.45	0.04
Compact Sedan	0.07	0.40	0.03

*Assumes a:

1. Well grounded person (artificially grounded through a metal rod)
2. Highly insulated vehicle (free from dirt, dust, moisture or carbon particles on tires which might conduct current to the ground)
3. High ambient temperature (40°C, or 104°F)
4. High relative humidity (90% or higher)
5. Maximum operating voltage.

Source: Matias, T.R., and H.L. Colbeth. Record Proceedings Cases 26529 and 26559, New York Public Service Commission, January 16, 1978.

A potential secondary impact which may result from electrostatic shock is involuntary reaction to the shock such as jerking an arm away. This reaction may cause personal injury, particularly when working around machinery.

The voltage built up on an ungrounded vehicle has the theoretical possibility of causing fuel ignition. If a vehicle near the line were refueled from a metal can, there is a possibility of a spark jumping from the vehicle to the can, thus igniting fuel vapors. There are currently no regulations relating to refueling under a transmission line but NSP recommends in their application that no refueling be done within the right-of-way.

If the ground level electrostatic field is a problem, its strength can be reduced by lowering the line's operating voltage, by moving the conductors further away from the ground, or by adding shielding between the line and the ground. Because the electric field of a transmission line is a function of the voltage of the transmission line, reducing the voltage of the line will reduce the electric field caused by the transmission line. However, this would require an increase in the current carried by the line (assuming the capacity for transmitting power is to remain the same). This increased current would require larger conductors (increasing the cost of the line), increased energy losses of the line, and increased magnetic fields caused by the line. Because of the greatly increased costs and energy losses accompanying a reduction in voltage, this method of reducing the electric field strength is normally not utilized.

The electric field strength under a transmission line is roughly proportional to the inverse of the distance from the transmission line conductors to the ground. Therefore, the higher the conductors are, the lower the field strength at ground level will be. Another commonly used method of controlling exposure to the electric fields is to increase the width of the right-of-way to reduce the electric field strength at the edge of the right-of-way.

Another way to control the ground level electric field strength is to install ground wires between the conductors and the ground. These wires "shield" the ground from the electric field. This method is typically used only in extreme cases.

3.2.2.2 Electromagnetic Field Impacts

The currents carried in each of the conductors of the 345 kV transmission line will generate a magnetic field. This magnetic field can induce currents and voltage in long, parallel conductors such as fences or telephone cables. The induced voltage is dependent on: line geometry, the current carried on the line, the distance to the

conducting object, the distance that the conducting object is parallel to the transmission line, the grounding of the conducting object, and the shielding of the conducting object. According to the applicant, the maximum calculated ground level magnetic field produced by the 345 kV line under normal operating current would not exceed .3 gauss.

In general, electromagnetic induction effects are only of concern or importance where long conducting objects such as metal fences or telephone cables parallel the transmission line. There are two conditions of concern where electromagnetically imposed voltage on a parallel conductor may pose special problems:

1. Partially Grounded Parallel Conducting Circuits.

   Major difficulties arise in the case of very long conductors close to the ground, such as a telephone circuit which parallels a transmission line and is only grounded at one end. Through induction gradients, a voltage will develop at the end of the circuit opposite the ground. This can cause a significant current to flow to a person coming into contact with the partially grounded conduit. This is principally a problem for construction crews installing parallel transmission lines or other services on a common right-of-way.

   The procedure followed by the power companies on grounding fences or other similar objects can effectively minimize the problem for the general public.

2. Long Objects Below the Ground.

   The issue of whether ac voltages induced on underground pipelines cause increased pipeline corrosion is highly debatable. The overall work on this problem is still in progress and no definitive results are yet available.

The operation of telephone cables and other cable communication systems can be affected by both the magnetic fields occurring during normal operations and the much larger magnetic fields occurring during a fault.

Another concern that is often expressed is the possible interference with cardiac pacemakers. Pacemakers in operation today are usually unaffected by magnetic fields of less than 1 gauss. The proposed transmission line will create a maximum field at the edge of the right-of-way at ground level of 0.15 gauss.

Concern has also been raised regarding potential long term health impacts. These impacts are discussed in greater detail in section 3.2.2.3.

When the normal magnetic fields caused by a high voltage transmission line are a problem, the only ways of reducing the field strength at the object, short of reducing the current in the transmission line, are to either move the conductors further away from the object experiencing the problems or to shield the object from the magnetic field. As in the case of the electric field, increasing the distance between the transmission line conductors and the object affected by the magnetic field will reduce the strength of the magnetic field. This can be done either by increasing vertical or horizontal distance between the conductors and the object, or by moving the object. If this is not a practical solution, the object, e.g., a communications cable, can be electrically shielded by a metallic sheath. The exact combination of measures used depends on the specific conditions encountered.

The one situation representing a potential public safety hazard is associated with a line-to-ground fault (a short circuit between a conductor and the ground, that causes extremely high and unequal currents to flow in the conductors). This high current induces hazardous voltages on parallel conductors for as long as the fault continues. Besides using the mitigative measures mentioned above, the effects of these magnetic fields can be reduced by insuring that the transmission line is deenergized as quickly as possible when a fault occurs. NSP states that available protection equipment will deenergize the line in less than a quarter of a second.

3.2.2.3 Public Health Impacts from Electric Fields

Adverse health effects resulting from the direct exposure of humans to the high voltage overhead transmission line field environment are a matter of considerable public concern. Although it is not possible to say that there is no risk, the Minnesota Department of Health (MDOH) Public Health and Safety of High-Voltage Overhead Transmission Lines (1977), states that thus far both epidemiological and laboratory studies have failed for various reasons to indicate that the energy transferred directly from transmission lines to humans is a health hazard. The authors of the MDOH study conclude that there is no evidence suggesting any effect on health or upon one's sense of well-being from the intermittent exposure experienced in the transmission line environment. No theoretical basis for the presumption of effects has been postulated. This is a particularly important point, for it forces research into the biological effects of power frequency fields to be exploratory or observational, rather than rigorous experimental studies designed to accept or reject specific hypotheses.

While ac electric fields are not strong enough to cause tissue heating or nerve stimulation, the possibility of more indirect effects has prompted research in this area. Human and animal studies on the biological effects of ac electric fields have generally yielded conflicting results. One major reason for discrepancies is differing experimental exposure parameters, i.e. frequency, gradient and exposure duration. In addition, many experiments have not had adequate experimental design, controls for extraneous variables, and/or statistical analyses of experimental data.

Biological effects, if they exist, are likely to be subtle. Recognition of true effects demands investigation utilizing a systematic, interdisciplinary approach to assure well-designed, closely controlled research. At the time of this analysis, such a comprehensive study was not available.

Another potential health hazard is related to accidental contact with the transmission line or flashover. Accidental direct contact of a conducting object with the conductor of a high voltage transmission line, or by accidental flashover from a conductor to a conducting object, can cause electrocution. The hazards associated with accidental contact or flashover are summarized below in a quote from a University of Minnesota study on compatibility of transmission lines with agricultural activities. The summary concentrates on agricultural operations, since it is the major area of concern in the study area, but it also applies to any similar operations.

> "Accidental contact of a grounded conducting object with a conductor presents an obvious safety hazard. . . . Contact can result in a current passing from the conductor through a person to ground. This problem is not unique to high voltage lines. Local distribution lines present more potential problems for contact because they are located much closer to the ground. Movement of tall objects, such as elevators or grain augers which may be near any electrical lines, require caution. Handling of irrigation pipe is another instance where caution to avoid contact is necessary. If clearance requirements for flashover . . . are met, direct contact with EHV transmission lines should not be encountered . . . [a utility] has recommended that no part of the equipment or load pass any closer to the conductors than 8 feet for 115 kV, 10 feet for 230 kV, and 15 feet for 500 kV."1

1Robert J. Gustafson, etal., Report on an Investigation of Electric Power Transmission and Agricultural Compatibility in the MAPP Region, Agricultural Experience Station, University of Minnesota, 1978, pp. 72, 74.

By adding the clearance requirements, in this case 15 feet, to the height of the largest farm equipment that is likely to be used under the transmission line, the minimum safe conductor clearance can be calculated. Based on the University of Minnesota report, the maximum equipment height expected to be used for farming under a transmission line is 15 feet; this translates to a 30 foot minimum clearance for a 345 kV transmission line. NSP has proposed a 32 foot 6 inch minimum clearance for the 345 kV line.

3.3 HUMAN SETTLEMENT IMPACTS

3.3.1 Population Centers



Development activities and buildings place numerous constraints on transmission line routing. The National Electrical Safety Code and the Minnesota State Electrical Code specify minimum safety clearances that must be maintained between transmission line conductors and all buildings and structures. These clearance standards vary with the type of building structure and land use activity. Generally the actual right-of-way area of a transmission line must be clear of buildings and/or structures. Thus, location of transmission line routes through areas with many buildings often necessitates the acquisition and removal or relocation of existing structures. Because of the minimum safety clearance requirements, any building construction activity within a 345 kV transmission line right-of-way is usually precluded.

In addition to the direct impact that a transmission line right-of-way imposes on existing and proposed population centers, there are several construction related impacts which must be considered. These impacts include: increased noise; traffic congestion; dust; and physical disruptions to public services such as water, sewer and road construction. Although many of these impacts are temporary, they may constitute inconveniences and short term negative environmental impacts. Construction related impacts will can be addressed more thoroughly in the MEQB's construction permit program.

3.3.2 Land Use

High voltage transmission lines can influence urban land use development patterns in a variety of ways. The impact on land use development trends, however, is most noticeable in areas that are not yet fully developed.

The actual degree to which a transmission line may influence land use development patterns is difficult to measure because of the wide range of economic, political, social and geographic variables associated with land use development activities.

Nonetheless, HVTL's constitute a physical and psychological barrier to development that presents major construction and urban design constraints for future land uses. In addition, the presence of HVTL's can affect the overall desirability of adjacent property for some categories of land uses.

The impact of a HVTL on land use will depend upon the perceived compatibility of the line with the surrounding land use setting. The greatest adverse impacts will be associated with the placement of HVTLs in locations with low intensive land uses such as residential areas. Other areas where potential land use conflicts may arise include sites that present unique passive and aesthetic amenities or sites that serve a recreational use. Conversely HVTLs pose the least potential impact upon areas of more intensive use or areas in which greater noise, odor, light and dust levels are perceived as acceptable. Such areas might include industrial lands, liquid and solid waste disposal lands or major transportation corridors.

3.3.3 Easements and Land Values

The construction of a HVTL can change the use and character of the land over which it passes, and the acquisition of a utility right-of-way will alter the landowner's rights to his property. But it is not entirely clear to what extent the presence of the transmission line and the utility easement will influence the future real estate value of the property. The existing land use and the potential for future land use changes are critical factors to consider.

Once the precise location of the transmission line is determined, the utility must acquire, whether by voluntary sale or by involuntary eminent domain proceedings, an easement (i.e. legal property rights), for the use of required rights-of-way. Since the transmission line occupies only a portion of the land over which it passes, fee simple ownership is not always necessary. However, negotiated easement prices can be equal to or more than the normal purchase price for the land itself, and may include additional payments based on the number and type of poles on a parcel of land. In addition, the utility is liable for specific damages to crops, other physical properties, or land damage caused by construction and maintenance of the transmission line.

The most immediate legal consequence of granting an easement to the utility is the loss of certain rights of the use of the land. Thus, when the landowner sells property having utility easements, he is selling something less than what he originally purchased. The purchaser of land with utility easements is also obligated to abide by the restrictions and limitations imposed by the easement. In this respect, because the easement restricts full and uninhibited use of the land, the real estate value could be perceived as being diminished.

Aside from these legal implications, the actual presence and operation of the transmission line may have an influence upon the selling price of the property. Transmission lines may also create land management difficulties when located on agricultural land. The landowner must adjust his operations in order to minimize safety hazards, loss of productive crop land and loss of time. In addition, the transmission line is an obstacle which may make future changes such as the installation of a new irrigation system or the subdivision of property for housing difficult or impossible. The consequent loss of future opportunities could have an impact upon the value of the land, especially for a new owner who may wish to alter the present land use.

Finally, the impact of transmission lines upon aesthetic values, especially in residential and scenic areas, may have an important influence upon future land values. Since few potential buyers are likely to perceive transmission lines to be aesthetically pleasing, the existence of the line may depress land values in areas where visual considerations are an important selling feature.

Overall, studies of the impact of utility easements upon land values have been inconclusive. Due to the large number of variables which affect land value, no reliable quantitative measure is yet available. Nevertheless, it is likely that the presence of HVTL's will not contribute to improved land values.

3.4 TRANSPORTATION SYSTEMS

Airports and communication facilities may be affected by the location of transmission lines. The Federal Aviation Administration and Minnesota Department of Transportation have established relatively complex restrictions on the distance and orientation of any structure located within airport approach zones. Power line equipment may also affect ground-to-air communication and navigation systems as well as other types of communication facilities, such as: radio and television towers; microwave communications; VORTAC; and VOR nondirectional beacon systems. Transmission lines can affect these facilities by: absorption and consequent re-radiation of radio waves; attenuation of radio waves caused by the physical obstruction of transmission equipment; and potential reflection of certain frequencies of waves.

Transmission lines may also affect existing and potential ground transportation networks, particularly highways. In certain cases it may be desirable to construct HVTLs adjacent to highways in order to reduce the amount of land needed for the right-of-way, and to avoid impacts on other land uses. However, transmission lines constructed on or immediately adjacent to a highway right-of-way may interfere with highway expansion or improvement plans, and may require costly future relocation of

the HVTL towers. In addition, access to a transmission line which is located along a controlled access roadway is often difficult and may require the construction of additional access roads over private property. Transmission lines which parallel major highways can also adversely affect the scenic value of these highways. Where scenic roadways have been identified, the routing of a HVTL parallel to the highway may conflict with the scenic qualities of the roadway. Finally, Federal laws and regulations continue to restrict the placement of HVTL structures on the right-of-way of federally funded limited access highways.

3.5 SIGNIFICANT HISTORICAL AND ARCHAEOLOGICAL SITES



The potential impact that a HVTL may have upon an historical or archaeological site depends upon the individual characteristics of the site, and the amount of disruption caused by the line. The general impact upon the area's historical and archaeological resources depends also upon the relative significance of the individual site.

Physical destruction or the need to relocate or salvage the resource are the most serious consequences of the construction of a transmission line. In other instances, the impact can be more subtle. The visual impact of a HVTL within the vicinity of an historical site, although secondary and subjectively measured, can be important. This is especially true where the historical feature has unique architectural significance or where preservation of the surrounding landscape in a relatively natural setting is important, such as in the example of historic battlegrounds or Indian encampments.

Where archaeological sites exist, the construction of a transmission line can destroy the archaeological value of a site. Clearing rights-of-way and the placement of structures in undisturbed or minimally disturbed locations can adversely affect the scientific value of these sites. This is less likely to happen where road construction and other modern developments have already disturbed the ground. Accordingly, the Minnesota Historical Society is specifically concerned about lines that may be built in undisturbed areas. The State Historic Preservation Officer may request that an archaeological site survey be conducted before any construction is initiated on the right-of-way. This survey may lead to minor right-of-way location changes or salvage archaeology, where necessary.

3.6 VISUAL AND AESTHETIC VALUES

Aesthetic values are difficult to define because "beauty" and visual amenities are functions of individual perceptions. Nevertheless, numerous efforts to quantify aesthetic values consistently list diversity in vegetation, topography, ground cover, existence of water bodies and distance of vistas as reliable indicators of visual diversity.

High voltage transmission lines can adversely affect the visual quality and aesthetic intregrity of a region. The visual impact of a transmission line is greatest where the line is in a prominent location and highly visible for long distances. In addition, visual impact is proportional to the number of individuals that can visually observe the line. Structure type, structure height, topography, and vegetation screening all influence the potential visual impact of a transmission line. (See Section 4.4.1, Visual Impacts.)

3.7 SOCIO-ECONOMIC EFFECTS

The socio-economic effects of a transmission line during the construction phase are generally considered to be minimal. The impact of the construction on the local labor force is negligible since almost all the work is done by non-local personnel. Because work on a HVTL is constantly shifting in location and is relatively short in duration, the impact on an area's housing and public services is usually not noticeable. As a result, expenditures in any one locality during the construction period are comparatively small and limited to food and lodging, gasoline and entertainment.

Once the HVTL is operational and if the line is properly maintained, local economic impacts are generally negligible. A relatively small number of utility personnel will be required to maintain and inspect the line. In fact, much of the inspection may actually be done by air.

The effect on the local tax base is proportional to the size of an area's tax valuation prior to the construction of the HVTL. In rural areas with relatively small tax bases, the added valuation resulting from transmission lines can be significant. The exact amount of taxes contributed to the local economy by a HVTL depends on several factors. These include: the total value of the line; the proportion of total transmission line value located within a specific taxing unit; and the mill levy of the taxing unit. In addition, state personal property tax laws specify, by formula, the allocation of taxes by various local taxing units.

3.8 IMPACT ON ECONOMIC ACTIVITIES

A HVTL can generate a variety of adverse impacts affecting the economic operation of commercial, industrial and agricultural activities. The greatest potential economic impact in the project area will be on agricultural operations. The number and distribution of other economic activities in the region are relatively insignificant. The impact of the construction and operation of transmission lines on productive farmland has been the subject of an increasing number of studies. These studies are

in response to the growing conflicts which have arisen over the routing of HVTL's whose impacts are felt to affect farm operations from an economic standpoint. Other impacts, specifically health and safety effects, and the impact on agricultural land values, are discussed in sections 4.2.2.3 and 4.8.2.2 respectively.

3.8.1. Potential Temporary Impacts From Construction Activities

Agricultural land is primarily susceptible to the following kinds of temporary impacts generated during the construction and maintenance of transmission facilities: 1) soil compaction, 2) soil erosion, and 3) interference with cropping or planting operations.

3.8.1.1 Soil Compaction

Excessive compaction alters soil structure. Soil structure is critical to the physical soil properties which influence the soil water content, water exchange capabilities, level of aeration, transfer of gasses, and the ability of a soil to transmit or retain heat. Adverse soil conditions resulting from the impairment of any of these properties can affect plant growth and reduce crop yields.

Compaction of soil is a general and ongoing problem in most types of cropland. This is a result of today's mechanized farming practices and the trend toward larger and heavier farm machinery. However, compaction associated with transmission line construction can be particularly severe along a right-of-way where traffic from heavy construction equipment and trucks is more intensively concentrated. This intense concentration subjects soil to stresses which often are much greater than those associated with typical farm machinery. Table 4.5 compares compaction pressures of typical construction equipment and farm machinery.

On transmission line construction sites, soil compaction damage is predominantly the result of heavy truck traffic. The trucks used in the construction process are usually laden with construction materials and often have to make several trips across agricultural fields. Other kinds of machinery which are typically used in the construction of a transmission line include cranes and augers. These vehicles, however, are used less frequently. The first pass of a wheel on loose soil accounts for about 80 percent of the total compaction which might result from four passes over the same spot. However, subsequent passes of equipment frequently affect untouched soil, so that the percentage of soil area compacted can increase with each pass of a vehicle.

The condition of the soil at the time of construction can affect the amount of compaction which occurs. Freshly tilled and very wet soils are particularly susceptible to severe compaction because of their plasticity. Proper construction scheduling can help to minimize this problem.

3.8.1.2 Erosion

Right-of-way clearing, grading, and other disturbance of the soil during construction can increase the possibility of soil erosion. A number of different factors including slope, type of soil, vegetation, and local rainfall all influence the potential for soil erosion. In general, steep, silty, impermeable and unconsolidated soils are most prone to erosion. These soils are often

TABLE 3-5

COMPACTION PRESSURES OF TYPICAL CONSTRUCTION & FARM EQUIPMENT

EQUIPMENT	WEIGHT (POUNDS)	GROUND PRESSURE (psi)
50 Ton Crane and Auger	125,000	7.65
955 Cat Loader	32,000	11.10
35 Ton Crane	74,920	7.59
60 Ton Crane	128,940	9.80
90 Ton Crane	234,325	12.10
D8 Cat W/Blade	70,000	12.50
D8 Sag Cats	75,000	12.13
2 Wheel Tractor (without dual tires)	15,000	9.5
2 Wheel Tractor (with dual tires)	15,000	5.3
4-Wheel Drive Tractor	30,000	11.3

SOURCE: Minnesota Department of Agriculture: High Voltage Transmission Lines: Agricultural Issues and Impacts, 1979.

associated with present and former river systems, with some glacial outwash deposits, and with rugged terrain.

Specific practices can be used during construction to minimize erosion. These practices include: soil contouring, backfilling, seeding, and mulching of disturbed soil. In addition, careful consideration of where construction vehicles should be driven and prompt filling and grading of any deep tire tracks can minimize soil rutting and gullying.



Right-of-way preparation and clearing can also accelerate wind erosion problems if critical windrows are removed. In general, an area with a topographic slope greater than 6% can, if unprotected, experience erosion problems. Wind erosion can occur on any sandy surface where winds are not blocked or the ground surface is not sheltered.

3.8.1.3 Vegetation

The effects of construction on pasture vegetation are usually short term. Field crops, however, are usually severely damaged in the right-of-way and along those areas where construction equipment must travel across fields. Root compaction by heavy equipment could stunt or kill some tree species. In addition, limbs may be damaged or broken by the movement of construction equipment. All damaged trees should be treated and/or removed so as to prevent disease. Where tree plantations are present, special care should be exercised in selecting and using any herbicidal material. Where the transmission line right-of-way crosses woodlots or windrows it may be necessary to clear tall growing species.

Compensation by NSP for vegetation damages should be a requirement of the MEQB's construction permit.

3.8.1.4 Other Temporary Impacts

The movement of heavy vehicles across fields can damage or destroy drainage tiles unless the location of the tile network is known and avoided by equipment operators during the construction of a transmission line. While the utility must repair all damaged tiles, a broken tile may not be readily apparent to the farm operator. Ensuing drainage problems could develop in affected fields and result in damaged crops or reduced yields. Precautionary or remedial measures on the part of the construction contractor to locate, protect, and avoid drainage tiles will reduce this impact. Where tiles have been damaged, NSP will be responsible for replacing them.

3.8.2 Potential Long-Term Impacts

3.8.2.1 Cropland Lost to Production

The amount of cropland removed from production due to the construction of a transmission line structure varies widely with: 1) the size and type of the tower or pole; 2) structure location; 3) line orientation; 4) crop and cropping patterns; 5) topography; 6) equipment; and 7) farming operations.

In a recent study of compatibility between agriculture and transmission lines, researchers at the University of Minnesota have estimated the amount of land that will be lost to production once a transmission line is constructed. These estimates are shown in Table 3-6. Table 3-6 shows that the area lost to production increases as the size of the structure increases for H/K frame structures; the area increases and then remains relatively constant for lattice towers. It remains approximately constant for single shaft poles as their size increases; however, data for single shaft poles was very limited in this study. Losses for structures in row crops tend to be larger than those in small grains and forages. This is due in part to the differences in farm equipment used for row crops.

The presence of guy wires, which are commonly used to support corner or angle structures with H/K frame and single shaft poles, greatly increases the amount of land lost to production. The comparison between the results measured for different structure types is in Table 3-7. Guy wires appear to have additional effects on field operating patterns and also present a safety hazard. Use of stubbed guys (pole-mounted guy wires) is one way of diminishing the interference and hazards associated with guying.

TABLE 3-6

AVERAGE LAND LOST FROM PRODUCTION BY GENERAL CROP TYPE AND STRUCTURE TYPE AND SIZE

Structure Type	Structure Width (Ft.)	Land Lost From Production (Ft^2) Tangent Structures			Corner Structures		
		Row Crop	Small Grain	Forages	Row Crop	Small Grain	Forages
H/K Frame	0-19	636	360	302	-	-	-
	20-24	732	604	366	-	-	-
	25-29	1,051	316	310	-	-	-
	35-	77	-	-	-	-	-
Single Pole	0-19	97	99	93	-	-	-
Steel Lattice	0-19	1,734	1,061	570	-	-	-
	20-24	2,012	1,127	785	2,604	-	618
	25-29	2,812	2,004	1,830	4,015	-	4,426
	30-34	2,514	1,557	1,538	3,635	787	1,756
	35-	2,562	1,145	1,658	1,651	-	-
Modified* H/K Frames	0-19	-	-	-	-	-	630
	20-24	1,167	2,269	-	-	-	112
	25-29	1,587	821	-	3,968	-	168
	30-34	5,871	885	10,080	2,818	1,300	860
	35-	4,680	-	900	2,543	-	-

* Structures commonly used as corners for H/K Frame lines. Consist of two or more poles located on a straight line possibly with supporting guy wires.

SOURCE: Report of an Investigation of Electric Power Transmission and Agricultural Compatibility in the MAPP Region, University of Minnesota Agricultural Experiment Station, 1978.

TABLE 3-7

AVERAGE AREA LOST FROM PRODUCTION (FT^2) BY STRUCTURE TYPE AND LOCATION

Structure	No Boundary within 100 ft	Boundary within 100 ft	Head-land**	Straddling Boundary	Adjacent to Boundary	In Corner	In Corner
161							
H/K	487(88)*	536(96)	630(19)	481(42)	687(91)	701(12)	208(4)
Modified							
H/K Frame	1,425(3)	3,900(5)	1,300(1)	580(1)	2,090(8)	5,510(2)	--
230							
H/K Frame	678(60)	545(158)	576(40)	380(13)	929(23)	491(35)	--
Lattice	2,454(143)	1,893(63)	2,274(13)	2,271(43)	2,060(23)	2,263(13)	1,920(2)
Modified							
H/K Frame	1,918(2)	2,396(7)	2,626(2)	2,548(1)	--	1,017(3)	--
345							
H/K Frame	988(337)	799(167)	1,009(37)	1,264(2)	954(50	1,170*18)	146(2)
Lattice	1,557(80)	1,835(56)	1,114(3)	1,597(16)	1,743(6)	1,554(11)	--
Modified							
H/K Frame	--	1,487(4)	4,678(3)	3,310(1)	4,878(4)	1,480(3)	--
Single Pole	112(13)	88(8)	--	80(2)	91(1)	--	--

* Bracketed numbers indicate numbers of observations.
** A headland is the area at the end of a field commonly used for turning.

SOURCE: Report of an Investigation of Electric Power Transmission and Agricultural Compatibility in the MAPP Region, University of Minnesota Agricultural Experiment Station, 1978.

3.8.2.2 Impacts on Field Operations

Transmission line structures placed on the edge or within cultivated fields may require a farmer to spend additional time to undertake various field operations. The amount of additional time required is a function of the number of interruptions and extra trips required to maneuver machinery around the structures.

There are several studies which estimate the additional time spent to work around transmission line structures. One study, prepared by Doane Agricultural Services, Inc. indicates that farmers estimate each transmission line structure can add between 30 minutes to 2 hours of field work. The most common response reported in the Doane report was one hour. Larger and more complex farm machinery could conceivably increase the time needed to maneuver around transmission line structures. A summary of time loss estimates is shown in Table 3-8.

The location of structures within cultivated land also increases the problem of soil compaction from farm equipment. The increased number of passes necessary to till, plant, cultivate and harvest crops through and around pole structures is likely to create paths around the towers with excessively compacted soil. In addition, field operations around and through structures increase the risk of damage to equipment. If damage does occur, there are costs to the farmer in terms of repair of the equipment, inconvenience, and loss of valuable time during critical farming periods.

Weed problems normally occur around transmission line towers and poles where weed control through cultivation is impossible. These areas must be hand sprayed to prevent the propagation and spread of weeds throughout the field. The extra time and labor involved in the hand operations can raise production costs.

3.8.2.3 Impacts on Irrigated Farmland

The potential conflict between irrigation systems and rights-of-way for transmission lines constitutes one of the most significant agriculturally related impacts in the study area. In recent studies conducted by the University of Minnesota School of Agriculture, the possible effects of transmission line rights-of-way on irrigated land, irrigation costs, monetary return to the farmer, and safety of operations have been evaluated. The results of these analyses are summarized in the following paragraphs.

TABLE 3-8

TIME LOSS STUDIES RESULTS

Operation	Location	Structure Type	Extra time/tower
Plowing	Illinois	Steel towers	6 minutes
Harrowing	Missouri	Steel towers	50 seconds
Corn Planting (4-row planter)	Illinois	Steel towers diagonally in field	5 min., 28 sec.
Corn Planting (4-row planter)	Missouri	Steel towers Open legs*	1 min., 10 sec.
Corn Planting (4-row planter)	Indiana	Steel towers	2 min., 9 sec.
Corn Planting (6-row planter)	Iowa	2-pole structures	3 minutes
Discing (12 ft. disk)	Illinois	H-poles, parallel	10 seconds
Discing & Harrowing (Tandem)	Illinois	2-pole structures	40 seconds
Cultivation (soybeans)	Indiana	Steel towers diagonally in field	49 seconds

*Operator was able to work under the structure .

SOURCE: A Preliminary Study of Powerline Damages, Doane Agricultural Service, Inc. St. Louis, Missouri, 1969.

Center pivot and traveling gun row irrigation systems are the irrigation methods most commonly used in the study area. Center pivot systems consist of an anchored pivot point, a water supply pipe supported on electric or hydraulic powered drive unit, and sprinklers located on a support pipe 10 to 15 feet above the ground. Center pivot irrigation systems may also have an end gun located on the outer end of the supply pipe. In order to maximize the amount of crop area watered, center pivot systems are most effective when used in square, rather than rectangular or odd shaped fields. Typically one center pivot system will cover 126 acres (80%) of a square 160 acre field.

The traveling gun system consists of a high water pressure gun mounted on a movable carriage. The carriage consists of a water supply hose and a power supply unit, a motorized winch, and a spool of cable. The carriage is pulled in a straight line across the field by means of attaching one end of the cable to an anchor point located at the opposite end of the field. The winch and power unit are then allowed to wind up the cable. The lanes in which the carriage travels are usually 10 to 12 feet wide and are commonly spaced such that 8, 9, or 10 lanes will allow the gun system to irrigate 80 acres.

a. Land Lost to Irrigation Due to Transmission Line Right-of-Way

The amount of land lost from irrigation due to the presence of a transmission line right-of-way varies with right-of-way width, right-of-way alignment, and the orientation and type of irrigation system used. When using center pivot systems, the greatest land loss occurs when the full right-of-way is located on the field boundary, and the center pivot is fixed at the center of the field. In avoiding the right-of-way, the center pivot creates a sprinkling pattern which leaves a pie-shaped wedge adjacent to the right-of-way unwatered.

For row irrigated fields, a greater portion of a field can be irrigated when the lanes run parallel to the right-of-way than if they are perpendicular to it. The least amount of impact on a gun irrigation system occurs when the centerline of the right-of-way coincides with a field boundary and the irrigation lanes parallel the right-of-way. Conversely, impact on traveling gun irrigation systems are greatest when the right-of-way is parallel to, but not on the field boundary, and the lanes run perpendicular to the right-of-way.

While the amount of land that cannot be irrigated due to the presence of a transmission line along the edge of an irrigated field is significant, the added annual operating costs of irrigation are not noticeably affected. The average annual costs for irrigating an acre of land are relatively constant. A reduction in irrigated acreage is accompanied by reductions in the size or amount of equipment needed and energy used to irrigate that acreage. A transmission line can, however, increase operating costs if the right-of-way is placed diagonally across the field. In this case, the field must be irrigated by two center pivot systems.

b. Monetary Impact of a Right-of-Way Crossing Irrigated Land

To determine the approximate financial impact of a transmission line on irrigated farmland, researchers at the University of Minnesota evaluated nine possible interactions. The study used a variety of assumptions about: the location of the right-of-way; type of irrigation system; and the status of the loan used to finance the capital cost of the system.

The study concluded that the loss of revenues associated with the location of a transmission line in the right-of-way on irrigated land is much more significant than that for non-irrigated land. It also concluded that the location of a transmission line right-of-way centerline along property lines has less total effect than the placement of the full right-of-way on one side of the property lines.

c. Safety of Irrigation Operations Near a Transmission Line Right-of-Way

Potentially hazardous situations can develop when an irrigation system is located parallel, and in close proximity to, a high voltage transmission line. Accidental contact between conductors and irrigation equipment is an obvious hazard. This safety hazard can be avoided by controlling or selecting irrigation systems that maintain adequate clearances. When a stream of water ejected from a high volume irrigation nozzle is directed into a high voltage transmission line, flashover from the conductor to the irrigation tower can be initiated. By preventing a steady stream of water from hitting transmission line conductors and by maintaining adequate clearance between individual irrigation systems and nearby conductors, the possibility of flashovers can be minimized. The probability of the irrigation equipment carrying leakage currents

can be enhanced when fertilizers or other substances are present in the irrigation water. These water additives can reduce the electrical resistivity of water. Dangerous levels of electric current can be avoided by sufficient grounding of the equipment or by maintaining adequate clearance between the water spray irrigation equipment and the conductor.

3.8.2.4 Impacts on Aerial Application of Pesticides and Fertilizers

The construction of transmission lines can reduce the effectiveness of fertilizer and pesticide treatment in areas where these treatments are applied by aerial spraying. Pilots must pull up sooner to avoid lines located at the edges of fields, thus creating greater drift of the applied material and resulting in poorer coverage. This can be compensated for with double applications, but the cost of additional pesticide or fertilizer, and the additional time involved, increases the cost per acre of treating such fields.

Transmission lines also pose a safety hazard to the pilots treating the crops. Lines which cross fields diagonally are a particular problem because it is more difficult for a pilot to judge the location of the lines when flying over a field.

3.8.2.5 Removal of Windrows

Locating a transmission line right-of-way along field boundaries lined with mature trees can have long term adverse impacts on agricultural activities. This is especially true where the trees were specifically planted to function as shelterbelts to protect farm fields from wind erosion. In most cases windrow trees exceed the height limitations placed on objects permitted within a transmission line right-of-way. As such, the trees would have to be removed or "topped" during the right-of-way clearing phase of the high voltage transmission line construction.

In areas where the land is relatively flat and open, wind can cause a significant amount of soil erosion. Removal of the windrow trees along the right-of-way of a transmission line damages or eliminates the protection which these trees provide, greatly increasing the potential for wind erosion.

Little can be done to minimize this long term impact. It may be possible to replace the original windrow trees with species which, at maturity, do not exceed height limitations. To achieve maximum efficiency, however, the trees take 20 to 30 years to develop. A second measure could be to locate the right-of-way adjacent to, rather

than centered on, field boundaries when windrows are present. Such an action however could result in increasing another type of impact i.e., loss of cropland.

3.8.2.6 Effect of Transmission Lines on Other Farming Practices

The presence of transmission lines may restrict the farmer's ability to modify or expand farming operations. In particular, transmission lines may: prevent or limit the consolidation of fields for more efficient management and operation; prohibit the use of larger, more efficient equipment; and restrict installation or expansion of irrigation equipment.

Transmission line construction, operation and maintenance can have a negative impact on poultry farms. Turkey farming is particularly vulnerable because of the nature and temperament of turkeys. Turkey farms also require large buildings which could be affected by right-of-way alignment.

3.9 COMMUNICATIONS

Whenever a communications cable is parallel and close to a high voltage transmission line, the transmission line may "induce" a voltage and current on the communications cable. Induced voltage and current vary depending upon the voltage of the transmission line, the current on the transmission line, the separation between the transmission line and the communication cable, and the distance that the transmission line parallels communication cable.

3.9.1 Telephone Operations

Induced current occurs on all telephone cables that parallel high voltage transmission lines. However, it is much more of a problem on "toll" or long distance service cables than on distribution cables serving individual subscribers. This is due to a number of resaons:

(1) the electronic equipment used with toll cables is much more sensitive to extra voltage and current than equipment used with cables serving individual subscribers;

(2) telephone companies are often unable to use protective devices on toll cables that are available for cables serving local subscribers;

(3) toll cables are continuous, while subscriber cables end in each town. Since the effects of high voltage transmission lines are cumulative over the entire length of the cable, this can result in higher voltages on toll cables; and

(4) if induced voltage or current interferes with service on a toll cable, a greater number of people are affected than if a cable that services individual subscribers goes out of service.

All telephone cables are protected to some extent from these induced voltages and currents. A metal sheath surrounding the cable usually provides electrical shielding. "Protectors," similar to lightning arresters, can also be used to protect the individual wires of the cable from high voltages.

A major problem that may be caused by transmission lines is related to the current and voltage that would appear on the toll cable when there are "faults" (lightning strikes, short circuits, etc.) on the transmission line. These faults cause larger amounts of current to appear on the transmission line. This current, in turn, induces large currents and voltages on the toll cable. While the voltage and current caused by these faults may not harm the cable itself, it could cause the electronic equipment to fail, thus isolating the communities along the cable from telephone service to any other towns. The time without service could range from a few seconds, where automatic corrections can solve the problem, to at least a day where equipment replacement is needed. Extra noise or interference on the toll cable may also be caused by the normal voltage and current on the transmission line.

3.9.2 Railroad Communications

Electrical interference with railroad communications may occur where a HVTL is located near railroad facilities. On a railroad system such as that in the study area, the communications and signalling systems are usually 12 volt direct current. Should the route segments along the railroads be selected, some mitigative measures may be required in order to minimize the susceptibility of these systems to the fields produced by the transmission line.

3.9.3 Radio Interference

In most circumstances, the level of transmission line induced radio interference is not significant in comparison with the strength of the broadcast signal. Most radio stations have sufficient broadcast signal-to-noise ratios to insure that interference is not a problem.

If radio interference from transmission line corona does occur, satisfactory reception from AM radio stations presently providing good reception can be obtained by the addition to, or appropriate modification of the receiving antenna system. Refer to Section 3.2.1.3 of this section for a more complete discussion of this interference.

Interference to FM broadcast station reception is generally not a problem because: 1) corona generated radio frequency noise currents decrease in magnitude with increasing radio frequencies and are quite small at the FM broadcast band frequencies of 88-109 MHz; and 2) the excellent interference rejection properties inherent in FM radio systems make them virtually immune to amplitude disturbances.

As noted in Section 3.2.1.3, NSP states in their application that should the operation of the 345 kV transmission line cause disruption in communication equipment, NSP will be responsible for correcting the problem. **3-32**

3.9.4 Television Interference

Corona generated radio frequency noise is quite small in the very high frequency range used for television transmission. As a result, TV interference from a corona discharge will generally be negligible. Loose and/or damaged hardware on the transmission line may also cause TV interference. If television or radio interference is caused by the HVTL in those areas where good reception is presently obtained, NSP will be required to take such action as may be necessary to restore reception to the present level including the appropriate modification of receiving antenna systems.

3.10 RAILROAD OPERATIONS

Railroad corridors are often considered as suitable locations for transmission line routing. This is because railroads offer existing linear rights-of-way that can be easily paralleled. Some problems, however, can arise if high voltage transmission lines are placed too close to actively used railroad routes. The level of negative impact on railroad operations is usually proportional to: the distance which a transmission line parallels a railroad line; the volume of traffic or activity along the railroad line; the type of cargo transported along the railroad line; and the size and voltage of the transmission line. In general, the types of problems which might be encountered by railroads in the study area include:

1. Transmission line poles and/or conductors within a railroad right-of-way which could interfere with proper track and right-of-way maintenance. A safety hazard to railroad employees could result if metal maintenance equipment comes in direct contact with energized conductors.

2. Transmission line structures which pose a potentially hazardous obstacle to derailed passenger and freight cars. In addition, freight trains often transport tank cars carrying flammable substances which are susceptible to sparks from a downed line.

3. Electrical fields generated by the transmission line which may interfere with train signals, crossing guards, and train communication systems, although these impacts can be easily minimized.

3.11 IMPACTS ON THE NATURAL ENVIRONMENT

High voltage transmission facilities, wherever they are located, necessitate some alterations in the existing natural environment. These changes are brought about by: construction processes; the location of the line; operation, maintenance and repair of the facilities; or by right-of-way maintenance. The level of impact varies both with the type of activity, and with the nature of the existing environmental features.

3.11.1 Soil Impacts

The most significant impact imposed by a transmission line on soils occurs during the right-of-way clearing and transmission line construction. The range of impacts include: soil compaction and rutting due to heavy vehicle use (See Section 3.8.1.1); topsoil stripping; topsoil and subsoil mixing; soil pollution; and surface erosion. Erosion is a particular problem because not only is topsoil lost and gullies established, but the resultant sedimentation which occurs can generate numerous adverse impacts on aquatic environments.

Several control measures are available to minimize most soil related impacts. These measures include: careful scheduling of construction activities so as to minimize equipment movement; restricting construction activities during wet periods; immediate seeding, mulching or other such protective actions to protect exposed slopes; prohibiting topsoil and subsoil mixing; and prohibiting equipment cleaning, such as washing-out of cement trucks, in right-of-way areas. The removal of windrows or other vegetative cover providing protection against wind erosion can also be minimized.

3.11.2 Impacts on Vegetation

Impacts on vegetation within a transmission line right-of-way are unavoidable because vegetation must be either altered or removed to maintain the minimum clearances required under a transmission line. In addition, some clearing or modification of vegetation outside the right-of-way may be necessary.

Depending upon the age, species, degree of exposure to wind and sunlight, and other variables, vegetation located along the fringe of a transmission line right-of-way may be impacted. Vegetation impacts experienced during the operation and maintenance of a transmission line are generally more subtle. This is because the management of the right-of-way requires occasional cutting of non-compatible species, and/or the application of herbicides to control weeds and undesirable species. In developing a right-of-way management program, NSP will be required to consult and coordinate with property owners. Periodic maintenance or repair of the line, requires repair vehicles to enter the right-of-way. This may result in some temporary damages to vegetation. NSP will compensate property owners for any vegetation damage that might result from routine right-of-way maintenance.

In wooded areas, the number of trees that will be eliminated is of principal concern. Important considerations include the frequency of occurrence, life span, and time to maturity of the affected trees. It is potentially more serious to eliminate stands of long-lived slow-growing trees requiring many years to reach full maturity than fast growing vegetation that will replace itself more readily.

Finally, certain types of vegetation, such as wetlands, are particularly susceptible to damage during construction of a transmission line. Wetlands are extremely productive communities that provide breeding and spawning grounds for many species of birds and other wildlife. In addition, wetlands perform many other necessary functions within the local ecosystem. They are quite fragile and should be preserved as closely as possible in their natural state. Damage from construction vehicles and intrusion by access roads could easily disrupt the water and nutrient circulation and subsequently ruin large parts of the wetland. In addition, filling or sedimentation of wetlands can adversely affect drainage patterns and result in increased flooding damages. For these reasons, it is desirable for transmission lines to span wetland areas completely so as to preclude the possibility of significant impacts.

3.11.3 Impacts on Wildlife

The most significant impact of a transmission line on wildlife is related to the destruction of habitat during construction of the line. Wildlife can also be affected by the maintenance of cleared rights-of-way. Most studies however, indicate that these impacts tend to be temporary, with the original wildlife populations gradually reestablishing themselves or even expanding along rights-of-way after construction activity has ceased. Transmission line rights-of-way, due to their edge effect, can provide food and valuable cover for many species of wildlife. This benefit can be enhanced in wooded areas by the use of selective cutting, rather than clear cutting techniques.

The use of herbicides in right-of-way maintenance can have both positive and negative impacts. Studies conducted for Edison Electric Institute (1976) assessed chemically sprayed transmission line rights-of-way for actual and potential wildlife use. The results indicated that rights-of-way were comparable or superior in wildlife foods to adjacent unsprayed plots. Other studies, however, indicate that on clear cut rights-of-way, which have had a long history of spraying, an "herbicide climax" consisting of dense low-growing species can develop and dominate(2). As a result, the vegetative diversity of the right-of-way diminishes, and a corresponding reduction of the number and types of animals using the area is usually noted. This impact can often be avoided by selective clearing and by carrying out a selective herbicide spraying program for right-of-way maintenance.

3.11.3.1 Impacts on Bird Populations

Documented impacts of transmission lines on birds range from a temporary disturbance of bird life during construction of a line to marked reduction of populations due to destruction of habitat, and death caused by electrocution or collision with the towers and conductors. The magnitude of the potential impacts on bird populations depends on the type of habitat crossed and the size and type of the original bird population. Important mating, feeding or nesting grounds, and bird sanctuaries represent the most sensitive areas. During periods of bad weather and reduced visibility the potential for waterfowl collisions with the transmission line could be a serious problem. Line and right-of-way maintenance which occurs during the breeding season can be hazardous to bird life in and near the transmission line rights-of-way, since most species are particularly vulnerable at this time. Impacts from these activities include destruction of nests and young birds, and the secondary effects of drifting herbicide spray which can injure fauna as well as flora. Additional information on the potential for bird collisions in provided in Appendix B.

3.11.4 Impacts on Aquatic Life

Aquatic ecosystems which are located near, or crossed by transmission lines can sustain damage during the construction process or be adversely affected by changes in water quality as a result of activities during construction and right-of-way maintenance. Potential impacts include: the introduction of sediment and other pollutants during construction; increased runoff pollutants (including herbicide

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(2)Kenneth L. Carvell, "The Effects of Herbicidal Management of Electric Transmission Line Rights of Way on Plant Communities," Proceedings of the First National Symposium on Environmental Concerns in Right of Way Management, 1976.

residues), and the possibility of temporary shore or channel modification where construction equipment has to enter the body of water. Most of these impacts are relatively temporary, being restricted to the construction phase, and can be mitigated with adequate care during right-of-way design and construction. Estuaries and wetlands adjacent to fishing lakes and streams are particularly sensitive areas because they serve as important breeding and food supply zones.

3.11.5 Impacts on Recreational Resources

The impact of high voltage transmission lines on recreational lands and waters is primarily a visual impact. The degree of impact depends on the topography, vegetative cover, the size and type of towers, distance of the line from the recreational area, and subjective factors such as the attitude of the viewer toward transmission lines. In addition the desirability of future recreational or open space acquisitions and facilities in an area traversed by a transmission line can be diminished. Conversely some recreational activities that require a linear network of open areas such as hiking or bicycling can be a compatible multiple use for a transmission line right-of-way.

chapter 4

ENVIRONMENTAL DESCRIPTIONS OF PROPOSED ROUTES

CHAPTER 4

ENVIRONMENTAL ANALYSIS OF THE PROPOSED ROUTES

4.1 ROUTE SELECTION PROCESS

The proposed routes and route segments discussed in this section are the result of the route alternative selection process required by the Minnesota Power Plant Siting Act, as amended in 1977 (Minn. Stat. § 116C.51 et seq.), and the accompanying Agency Rules for Routing High Voltage Transmission Lines and Siting Large Electric Power Generating Plants (6 MCAR § 3.071-3.082).

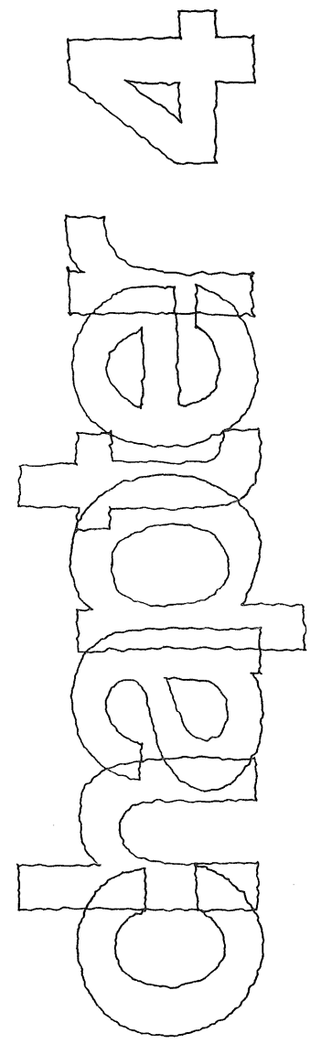
The "routes" referred to in this analysis are defined in the Power Plant Siting Act as "the location of a high voltage transmission line between two end points [with] a variable width of up to 1.25 miles"; a "route segment" is a portion of a route. The proposed routes and route segments have been divided into sections by a system of nodes (a common point of intersection of two or more segments). Most of the routes follow a sequence of nodes which progresses from low to high numbers or uses letters of the alphabet to indicate directional sequence.

An earlier section (2.11, Proposed Routes) discussed selection of routes being considered.

MEQB rules require that an application for a construction permit include at least two proposed routes for the line. In their original application submitted in June 1978, NSP denoted four alternative routes emanating from the Prairie Island Substation which they considered reasonable. In their amendment proposal, accepted by MEQB in December, 1979, NSP identified one additional alternative route from the King Plant Substation to Eau Claire. NSP has thus proposed five of the 14 alternative routes. Throughout the MEQB routing process, no additional alternative routes were formally proposed by individual citizens or state agencies.

Two Citizens Route Evaluation Committees, which were active on this project, added four alternative routes (Prairie Island - 1, King - 3). With each committee, additional route proposals were the result of numerous meetings and field study. The MEQB formally accepted all alternative routes proposed by the two committees.

The MEQB Power Plant Siting staff, which provides support to the MEQB, proposed five additional alternative routes (Prairie Island-5, King-0). These routes were proposed in response to the Minnesota Supreme Court "PEER" decision (People for Environmental Enlightenment and Responsibility vs. MEQB, 1978) which requires consideration of routes which utilize or parallel existing rights-of-way.



The total of 14 routes was accepted in two MEQB actions; the 10 "Prairie Island" routes in June, 1979 and the four "King" routes in April, 1980.

4.2 ROUTE SEGMENT ANALYSIS

There are 26 alternative route segments comprising the 10 complete routes crossing the Mississippi River and four segments comprising the four routes crossing the St. Croix River. The four St. Croix (King) segments do not intersect and therefore the four independent routes do not share common segments as the Mississippi River (Prairie Island) routes do.

The two sections of this segment analysis present first, an inventory of environmental information for each segment, and then a general description of the alignment and potential impacts of each segment. A summary for complete routes is provided in a subsequent Section 4.3 (Summary of Route Impacts).

4.2.1 Route Segment Environmental Inventory

The route segments were inventoried using a checklist of environmental features. Table 4-1 describes the features which were measured and Table 4-2 lists the data tabulated for each route segment. A summary comparing the features of the main routes appears in Section 4.3.1 (Table 4-3).

Data for the various segments were calculated on the basis of a reference centerline established by NSP. This approach was used in order to approximate the impact of the actual transmission line and right-of-way. Depending on final engineering and design, however, the reference centerline may not represent the final alignment of the actual right-of-way. The purpose of this analysis is largely to provide a means of assessing the potential impact of the proposed project on a facsimile of the actual right-of-way. Therefore, while it is recognized that the environmental features and potential impacts discussed in this section may vary slightly from those associated with the right-of-way which is ultimately used, they should be reasonably accurate approximations. In cases where it is necessary to assure that certain critical impacts are minimized, the MEQB may specify the route width to constrain the centerline location to whatever degree is necessary.

The individual route segments to be examined in terms of specific impact are shown on separate U.S. Geological Survey (USGS) maps (at a scale of one inch=2,000 feet) contained in this section. The segment reference centerline under discussion is highlighted in color, and existing transmission lines by black dashed lines, with voltage noted along the line.

4.2.2 Route Segment Descriptions

4.2.2.1 Mississippi River (Prairie Island) Route Segments

Segment 1-2

Route segment 1-2 is .75 mile in length, connecting the existing Prairie Island substation (node 1) with the Minnesota-Wisconsin state boundary (node 2) which is at the main channel of the Mississippi River. Within Minnesota, the segment would require no right-of-way outside of the present NSP property ownership associated with the Prairie Island nuclear generating plant. Termination equipment would have to be installed at the existing substation (see Section 2.8: Project Costs). The reference centerline crosses the lower end of Sturgeon Lake to an unnamed, narrow island that separates the Mississippi River channel and Sturgeon Lake. NSP proposes to place a structure on this narrow island to reduce the size and cost of full span structures. The reference centerline continues from the island to node 2 at mid-river, and then, in Wisconsin, across seasonally flooded marsh areas within which structures will be constructed. The Sturgeon Lake span will be approximately 2,500 feet and the Mississippi River span approximately 2,000 feet (1,000 in Minnesota, 1,000 in Wisconsin). NSP proposes that three crossing structures be of lattice steel design. The take-off structures on either side (not the island structure) will be a larger "deadend" design. Foundations for the structures will be specially designed for 100 year flood conditions. Colored spherical warning devices will be required on shield wires in compliance with air navigation requlations.

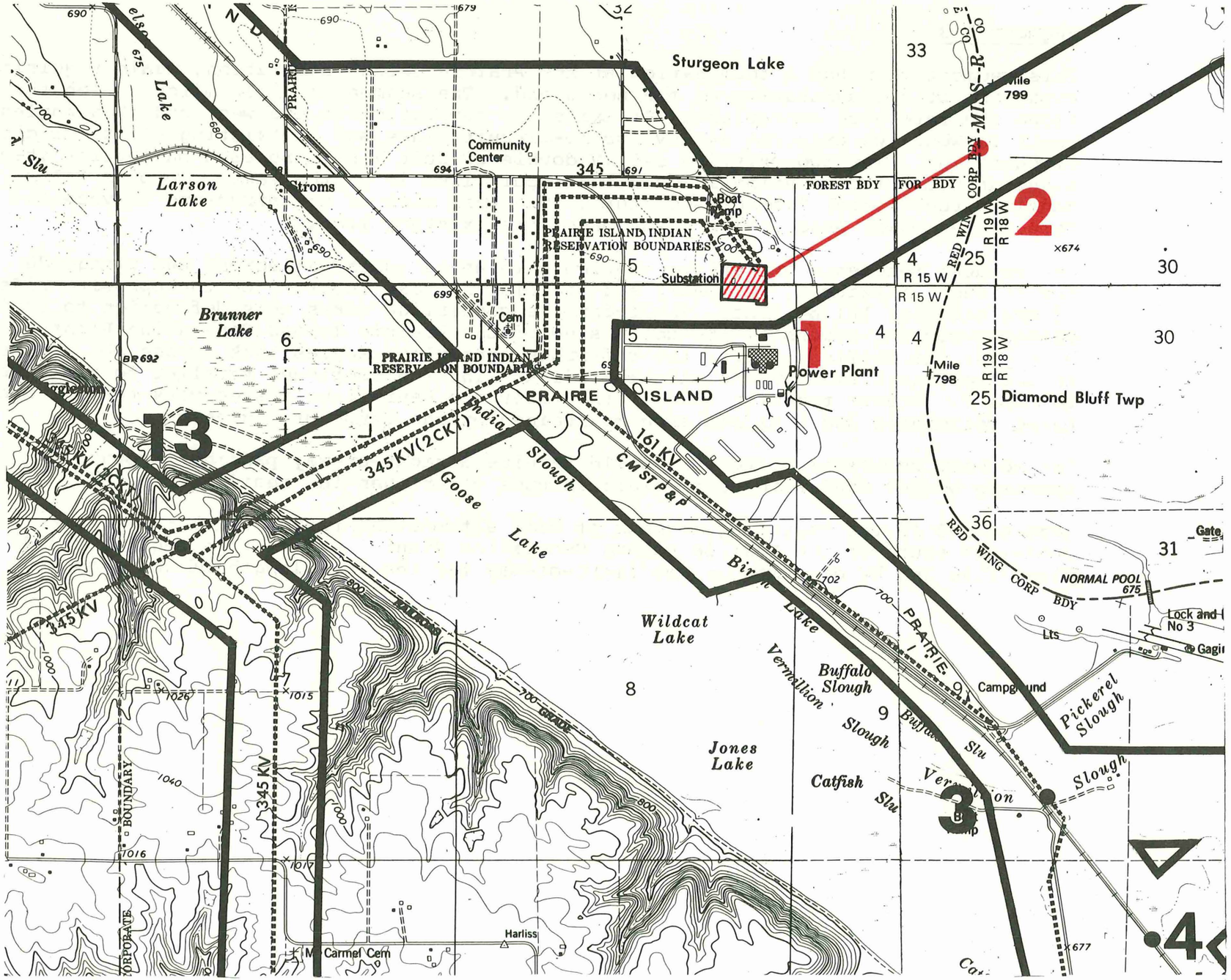
NSP has proposed to limit construction operations to the winter months, both to gain more stable access under deep frost conditions and to avoid impact in other higher-activity seasons.

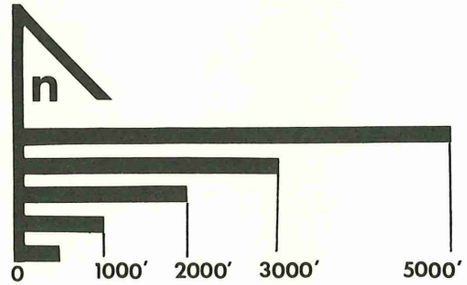
Potential impacts of this segment in Minnesota are not great; however, continuation of line construction through lowlands on the Wisconsin side do pose significant potential impact. The immediate physical impact will be reduced to the extent NSP is able to construct the river crossing in the coldest winter months. Otherwise, access within the lowlands during non-frozen months will create much surface disturbance along the right-of-way, making restoration more difficult and less complete. The right-of-way in Wisconsin continues to the east through forested lowlands, across Chicago Burlington Railroad and County Trunk Highway E, and over the northern end of Skidmore Bluff.

A major issue with this route segment (also a complete route) is the potential effect of the line on waterfowl populations of the river lowlands. The reader is referred to Appendix B, which presents detailed descriptions and opinions on this issue.

The data presented in Table 4-2 were calculated by the Environmental Division of NSP and spot-cheched by MEQB Power Plant Siting staff. In some data categories which were tabulated (e.g., wetlands), the figures listed are estimations based on a comparison of aerial photographs, USGS topographical maps, and field observation. Discrepancies in these data may be present.

Inventory data have not been developed for Wisconsin portions of route segments or complete routes. However, some descriptions of impacts in Wisconsin are provided in Section 4.2.2 for route segments which cross the Mississippi and St. Croix Rivers.





route boundary

node

reference centerline

existing transmission line

proposed route segment 1-2

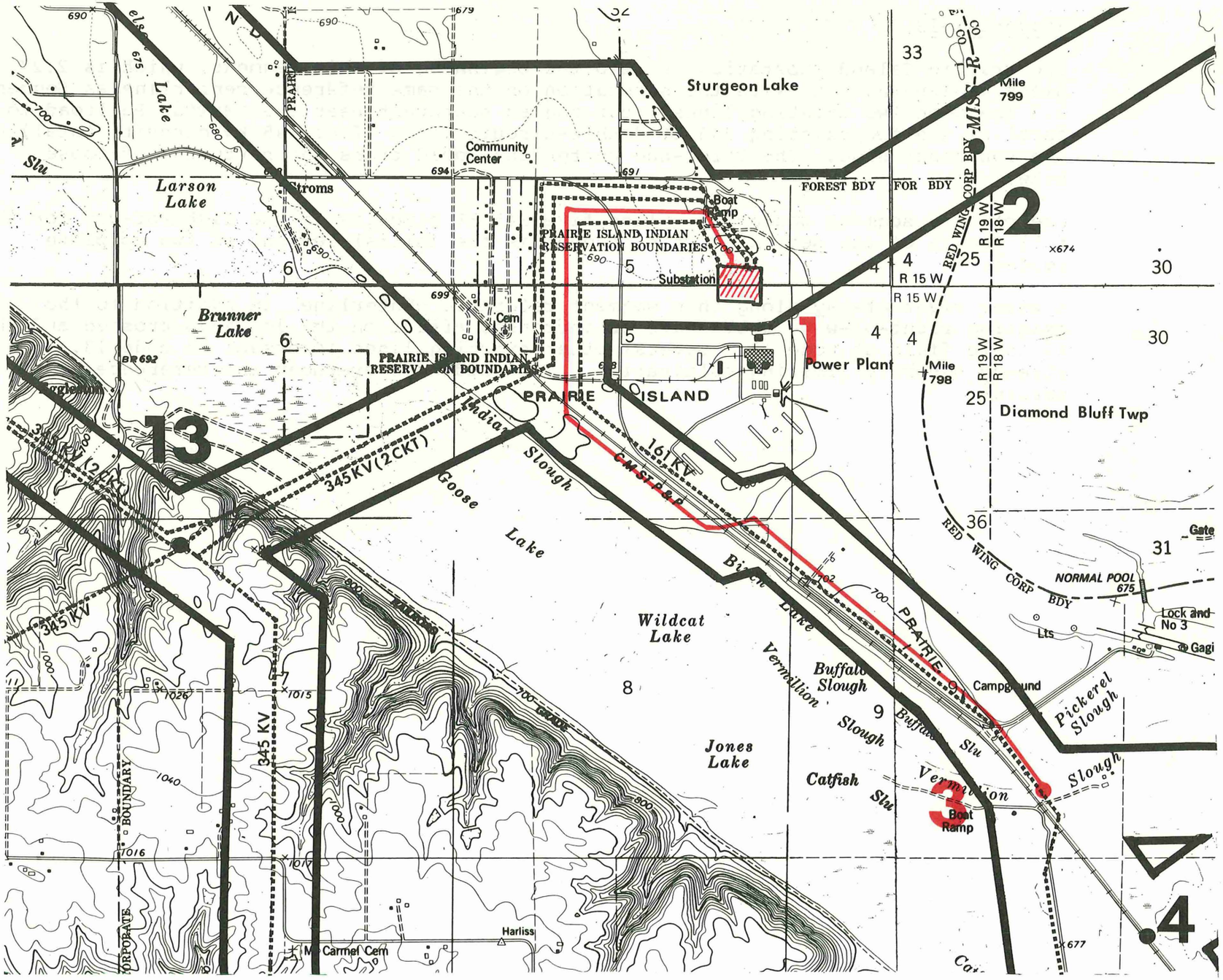
Segment 1-3

This segment also has a termination at the Prairie Island substation, again requiring expansion of the substation on the north end. The segment is 3.10 miles in length along the reference centerline. It exits the substation to the west and then angles south between two existing 345 kV double-circuit lines and an existing 161 kV single-circuit line. The two existing 345 kV double-circuit lines are each on lattice steel structures and the existing 161 single-circuit line is on the east side of a 161 kV double-circuit steel lattice structure. The west side of the structure is vacant. Cooperative Power Association (CPA) owns this existing line.

The segment reference centerline continues to angle southeast across and alongside the Chicago, Milwaukee, St. Paul, and Pacific Railroad (CMSP&P) on the opposite side of the existing 161 kV line. The reference centerline makes this deflection to avoid existing cooling towers on the south side of the Prairie Island Generating Plant. Once past the cooling towers, the reference centerline angles back across the tracks to the northeast side of the existing 161 kV line and continues parallel to the line to node 3. Before reaching node 3, the reference centerline passes very near or over three residences and a picnic area maintained by the Corps of Engineers.

The segment reference centerline would require a right-of-way passing through sparsely wooded land with no specialized uses other than the residences noted.

Segment 1-3 is the beginning segment of five alternative routes which have river crossings south of the Prairie Island Generating Plant. Use of this segment would place five 345 kV circuits in one right-of-way for the full length of the segment.



n

0 1000′ 2000′ 3000′ 5000′

route boundary

node

reference centerline

existing transmission line

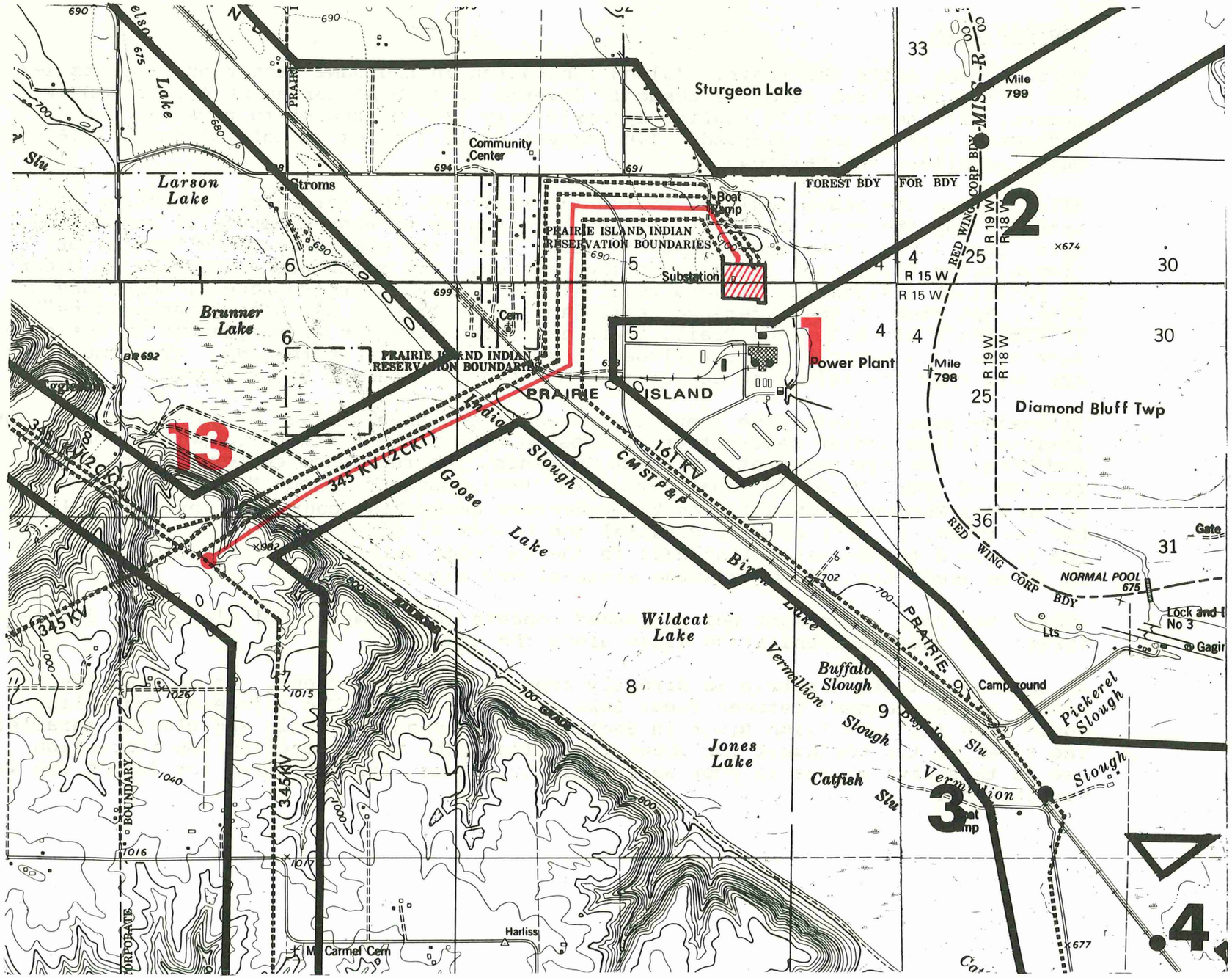
proposed route segment 1-3

Segment 1-13

The Prairie Island substation is also the beginning of this segment, which is 2.27 miles in length. It exits the substation on the same reference centerline as Segment 1-3 (between two existing lines), but angles southwest near the CMSTP&P Railroad to parallel the two existing 345 kV double-circuit lines (four 345 kV circuits total) on the southeast side. The reference centerline would cross the north end of Goose Lake.

Use of this segment would also place five 345 kV circuits in one right-of-way for the full length of the segment. This segment is the initial segment of two complete routes.

A wider right-of-way along this segment reference centerline, in addition to the existing right-of-way, would have an increased effect on the lowlands crossed and the tillable field at node 13. Several other existing lines intersect at node 13, already severely limiting cultivation. No residences are near the reference centerline.



n

0 1000′ 2000′ 3000′ 5000′

route boundary

node

reference centerline

existing transmission line

proposed route segment 1-13

Segment 1-18

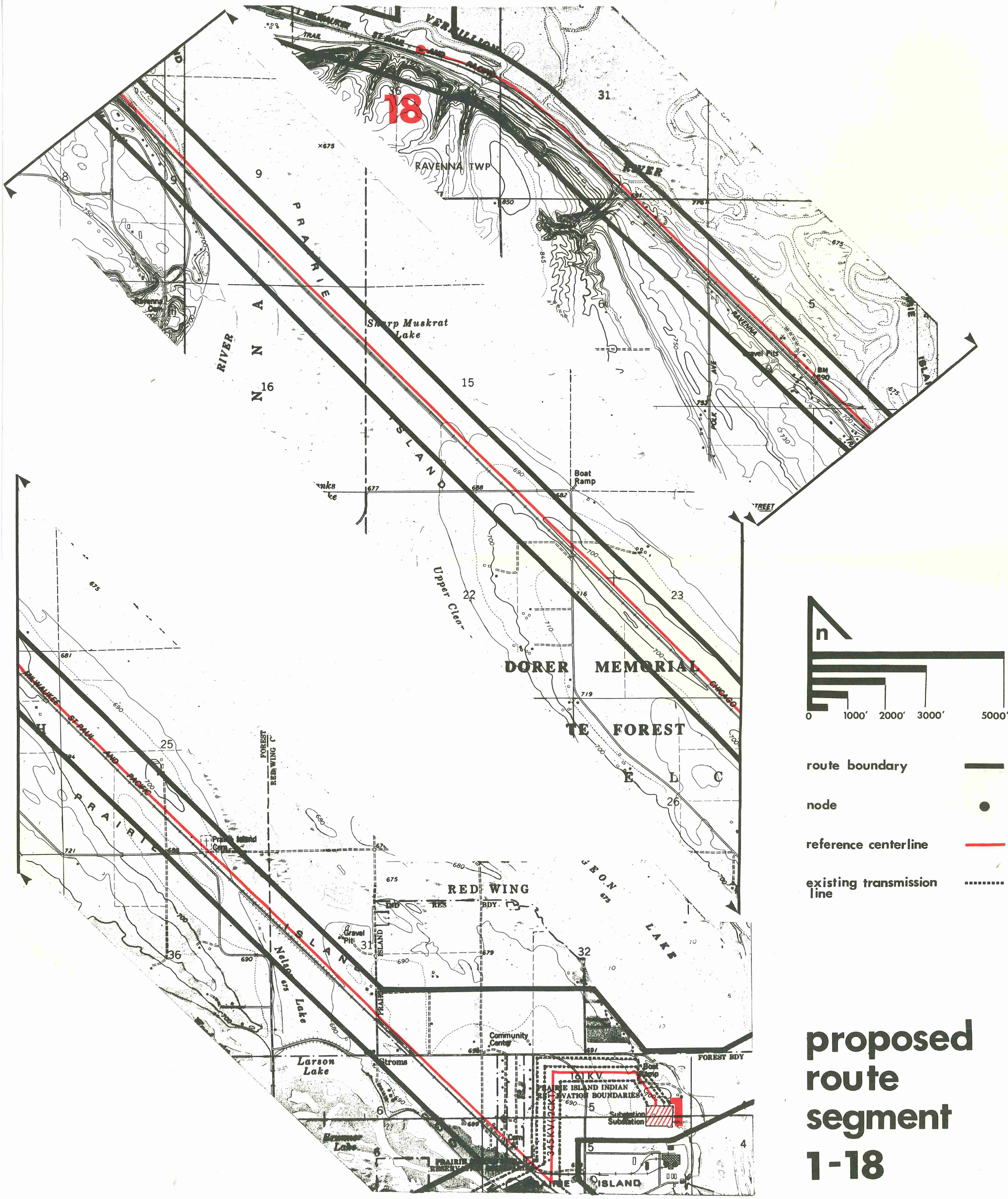
This segment exits the Prairie Island substation in the same manner as segments 1-3 and 1-13. The three segments commonly diverge at a point northeast of the CMSP&P tracks, with segment 1-18 angling approximately 135° northwest to parallel the northeast side of the railroad. The segment is 11.7 miles in total length, 10.5 of which parallels the railroad.

After making the sharp angle to follow the railroad, the reference centerline continues along the south and west edge of a community of approximately 15 residences. With three large lines existing on the east side, the community would have major transmission facilities close in on three sides. The reference centerline is clear of potential residential impacts until it nears node 18, where several homes are within 500 feet of the reference centerline in sections 5 and 6 of Ravenna Township. In section 8 along Ravenna Trail, there is a concentration of residences on the opposite side (southwest) of the railroad from the reference centerline. Two cemeteries are very near the reference centerline on the north side of the railroad.

Extensive public lands have been designated in the area crossed by this segment. The Prairie Island Indian Reservation is crossed within the northern corporate bounds of Red Wing. Further northwest in Welch Township, the reference centerline crosses a portion of Gores Wildlife Management Area (WMA), managed by the Minnesota Department of Natural Resources (MDNR). As the reference centerline continues northwest along the railroad, it will closely parallel the bounds of the Gores WMA. Construction of the proposed transmission line next to the railroad will have less extensive impact on these areas than if no existing right-of-way were available.

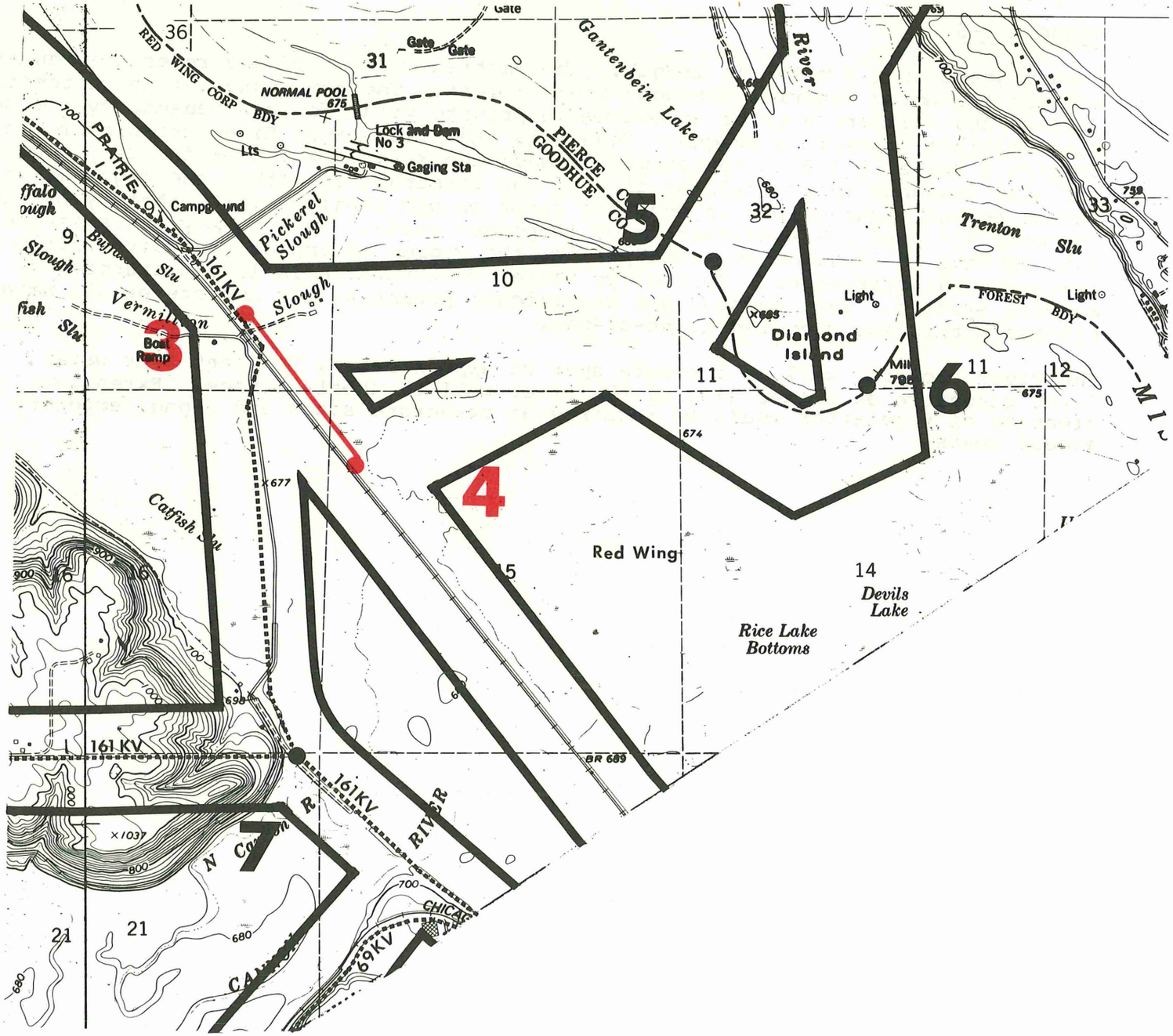
CMSP&P Railroad management has expressed concern about impacts of electrical interference on their communication lines along the tracks.

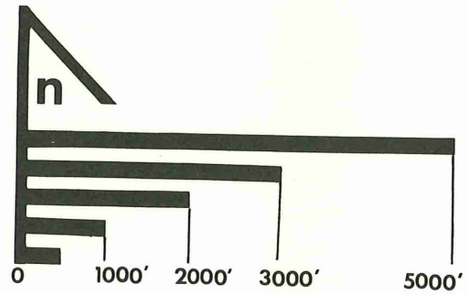
An unnamed private airstrip is directly crossed by this segment. It is near the middle of the segment between Clear Lake and North Lake. The reference centerline would span the Vermillion River in Section 8 of Ravenna Township and closely parallel the river to the northwest for about two miles. The river receives low recreation use in this stretch due to poor water quality, though its potential for future use is significant.


18
VERMILLION
TRAIL
ST. PAUL AND PACIFIC
RAVENNA TWP
RIVER
PRAIRIE
ISLAND
Sharp Muskrat Lake
Boat Ramp
Upper Clear
DORER MEMORIAL FOREST
CHICAGO
MILWAUKEE ST. PAUL AND PACIFIC
RED WING
Gravel Pit
Community Center
Nelson Lake
Larson Lake
Farmer Lake
Stroms
FOREST BDY
161 KV
PRAIRIE ISLAND INDIAN
ELEVATION BOUNDARIES
345 KV
Substation
Subtation
0
1000'
2000'
3000'
5000'
route boundary
node
reference centerline
existing transmission line
proposed route segment 1-18

Segment 3-4

This segment is .49 miles long and is located on the northeast side of the CMSP&P railroad. It crosses the Vermillion Slough and primarily lowlands. All of the area crossed is a part of the Richard J. Dorer Memorial Hardwood State Forest, managed by the MDNR. No other inventory features were identified along the reference centerline of this segment. The segment follows the existing 161 kV line reference centerline and the railroad for only a short distance before angling south to continue as segment 3-7.





route boundary

node

reference centerline

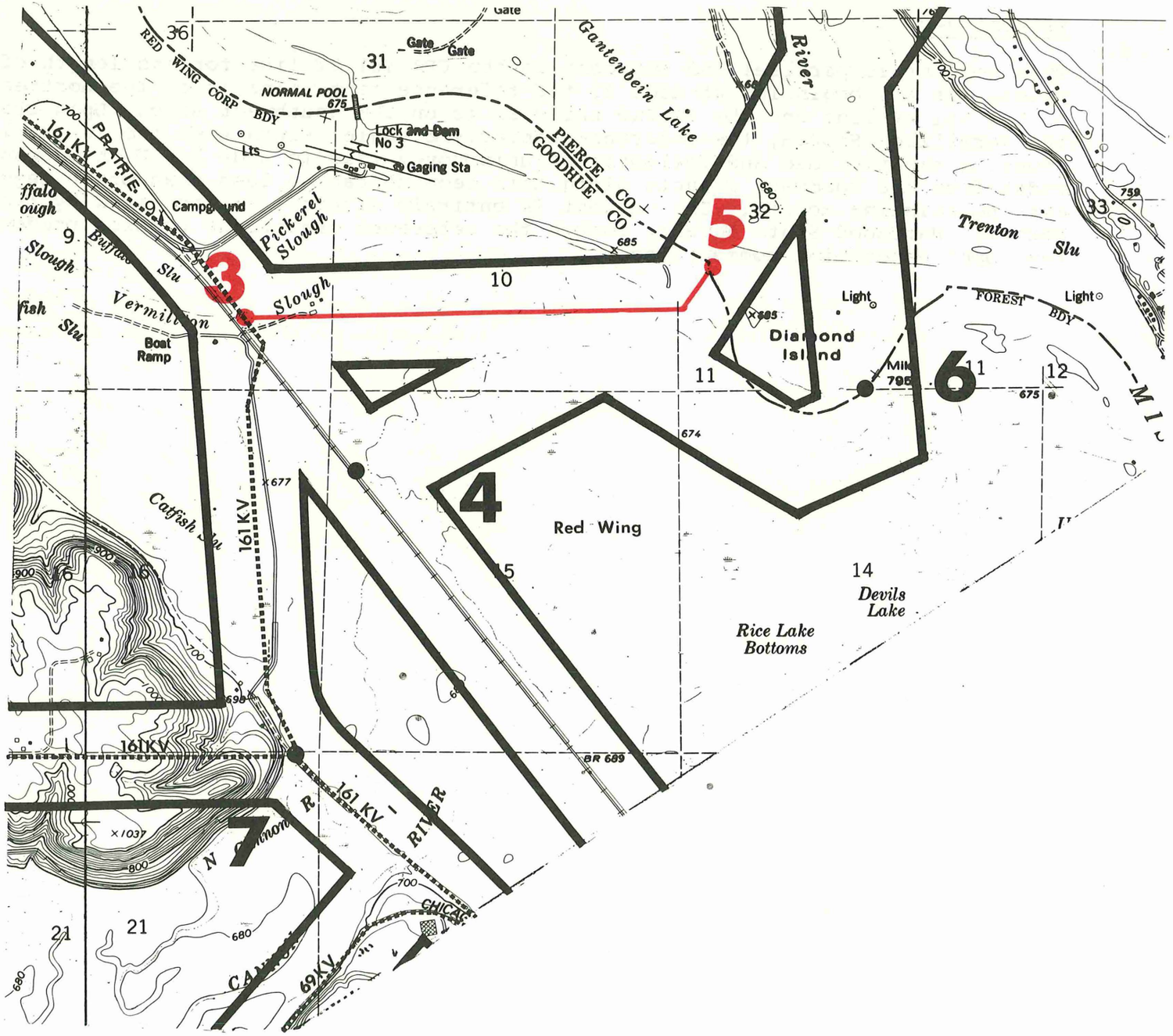
existing transmission line

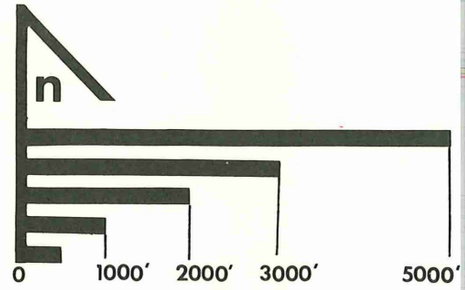
proposed route segment 3-4

Segment 3-5

This segment is 1.3 miles in length. The initial portion of the reference centerline crosses the Dorer Memorial Hardwood State Forest. The remaining reference centerline follows the northern edge of an extensive private wildlife area managed by the Red Wing Wildlife Protective League. Node 5 is the Mississippi River crossing for the Trenton 1 Route (1-3-5). Approximately half the reference centerline length crosses forested lowlands which would be cleared for construction within the right-of-way. Access to the right-of-way is possible along an old logging trail, thereby possibly reducing the need for construction of temporary roads. As with any transmission line construction in lowlands and floodplains, the degree of impact can vary greatly with seasonal characteristics. Typically, winter construction is less disturbing to natural systems. This segment has significant potential for impacts on all natural systems within the proposed right-of-way.

The river crossing will be a single span of approximately 800 feet over water. The first structure on either side of the river will be steel-lattice. Extensive clearing of vegetation would be required at structure sites and along temporary access roads.





route boundary

node

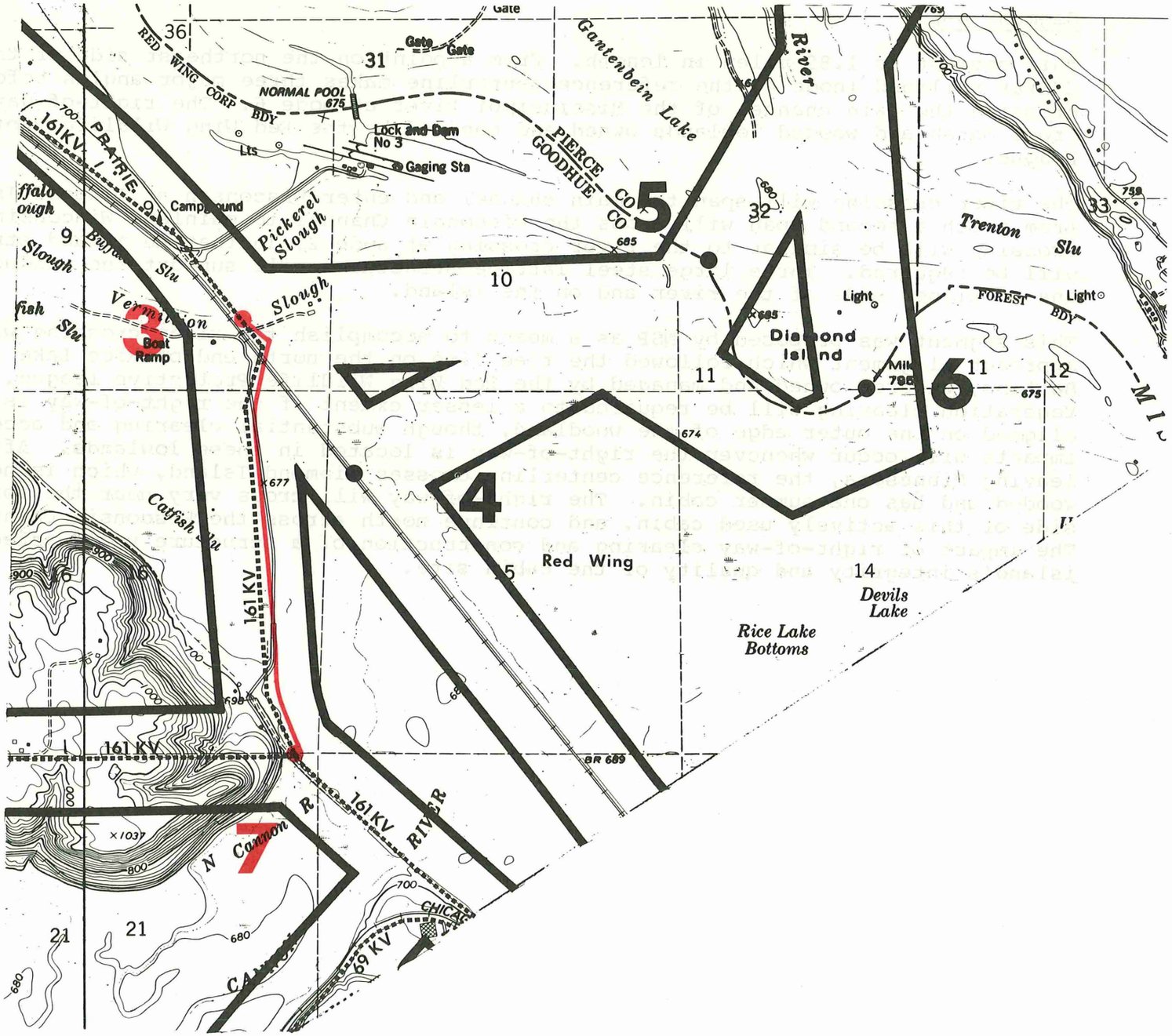
reference centerline

existing transmission line

proposed route segment 3-5

Segment 3-7

This segment is parallel and adjacent to the CPA 161 kV line for its length of 1.25 miles. At its beginning at node 3, the reference centerline is on the northeast side of the 161 kV line and the CMSP&P railroad is on the southwest side. Upon crossing the Vermillion Slough, the reference centerline angles south with the 161 kV line, crossing the railroad and following an unimproved road to node 7. With access provided from the roadway, impacts along this segment can be less than other segments with no existing access. The segment is entirely within lands acquired by the Dorer Memorial Hardwood State Forest, though the reference centerline crosses predominantly low, open vegetation communities.



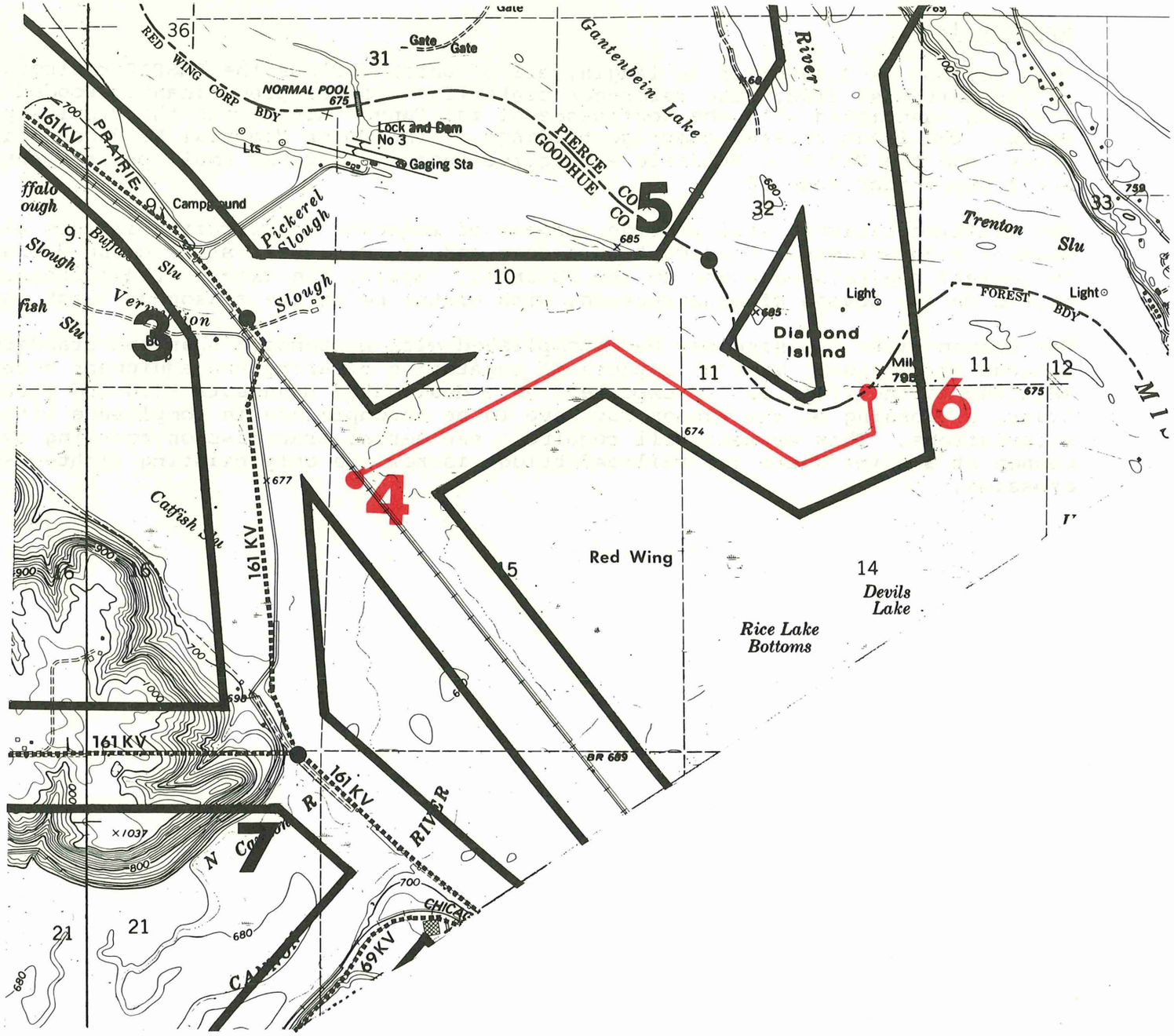
proposed route segment 3-7

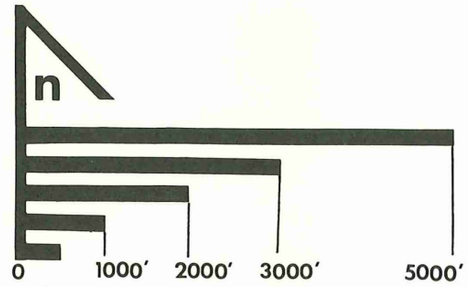
Segment 4-6

This segment is 1.82 miles in length. From a point on the northeast side of the CMSP&P railroad (node 4) the reference centerline makes three major angles before crossing the main channel of the Mississippi River at node 6. The right-of-way will cross marsh and wooded lowlands owned and managed by the Red Wing Wildlife Protective League.

The river crossing will span the main channel and enter Wisconsin at Diamond Island, from which a second span will cross the Wisconsin Channel to mainland Wisconsin. The crossing will be similar to the river crossing at node 2, in that an island structure will be required. Three large steel lattice structures will support the conductors, one on either side of the river and on the island.

This segment was proposed by NSP as a means to accomplish the river crossing with an approach alignment which followed the tree line on the north end of Rice Lake Bottoms, an area owned and managed by the Red Wing Wildlife Protective League. Vegetation clearing will be required to a lesser extent if the right-of-way is aligned on the outer edge of the woodland, though substantial clearing and access impacts will occur whenever the right-of-way is located in these lowlands. After leaving Minnesota, the reference centerline crosses Diamond Island, which is heavily wooded and has one summer cabin. The right-of-way will cross very near the south side of this actively used cabin, and continue north across the Wisconsin Channel. The impact of right-of-way clearing and construction of a structure would affect the island's integrity and quality of the cabin site.





route boundary

node

reference centerline

existing transmission line

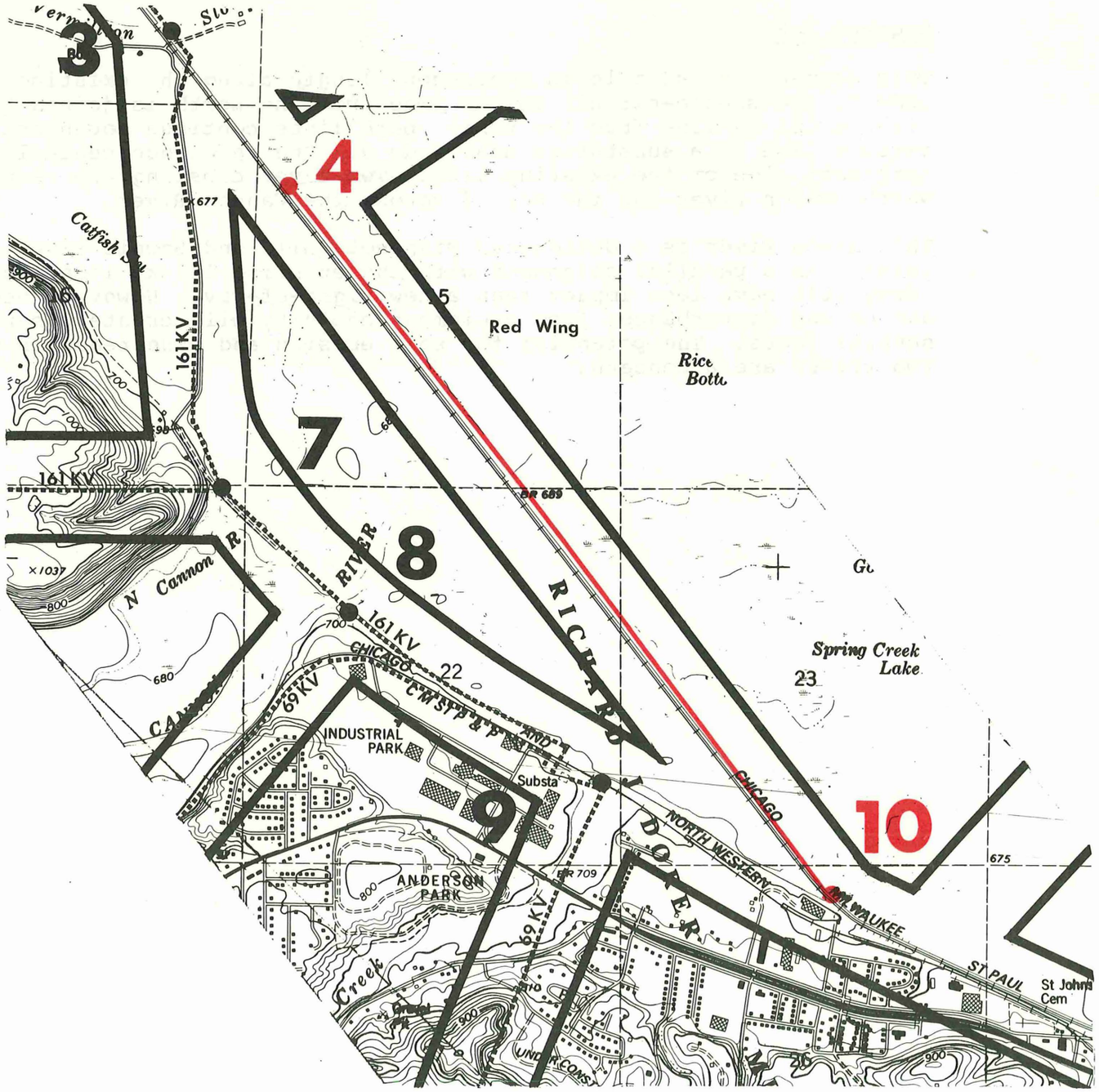
proposed route segment 4-6

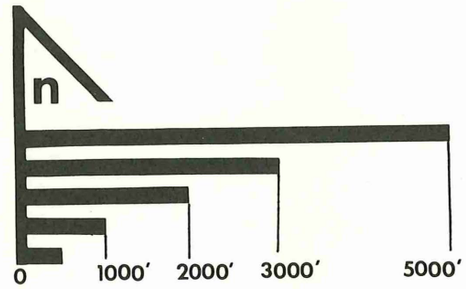
Segment 4-10

This segment is 2.35 miles in length, all of which follows the CMSP&P railroad tracks on the northeast side. The reference centerline crosses predominantly wooded lowlands associated with the confluence of the Cannon River with the Mississippi River. The lands crossed comprise holdings of the Dorer Memorial Hardwood State Forest and the Red Wing Wildlife Protective League. Several small private parcels are crossed near node 10.

The existing railroad will provide a means of reducing construction impacts along the segment right-of-way. Construction access and clearing will still cause disturbances to lowland habitats adjacent to the railroad. Again, the extent of disturbance will depend on the season of construction, with winter being the season of least impact.

The Cannon River crossing may be accomplished with a standard span and standard tangent structures. Typical impacts of vegetation clearing and equipment access adjacent to the river can be expected. As a designated Minnesota Wild and Scenic River, a crossing of the Cannon may have to be accomplished in compliance with MDNR stipulations. This segment will require a new aerial transmission crossing over the Cannon at a point where the railroad bridge is now the only existing right-of-way crossing.





route boundary

node

reference centerline

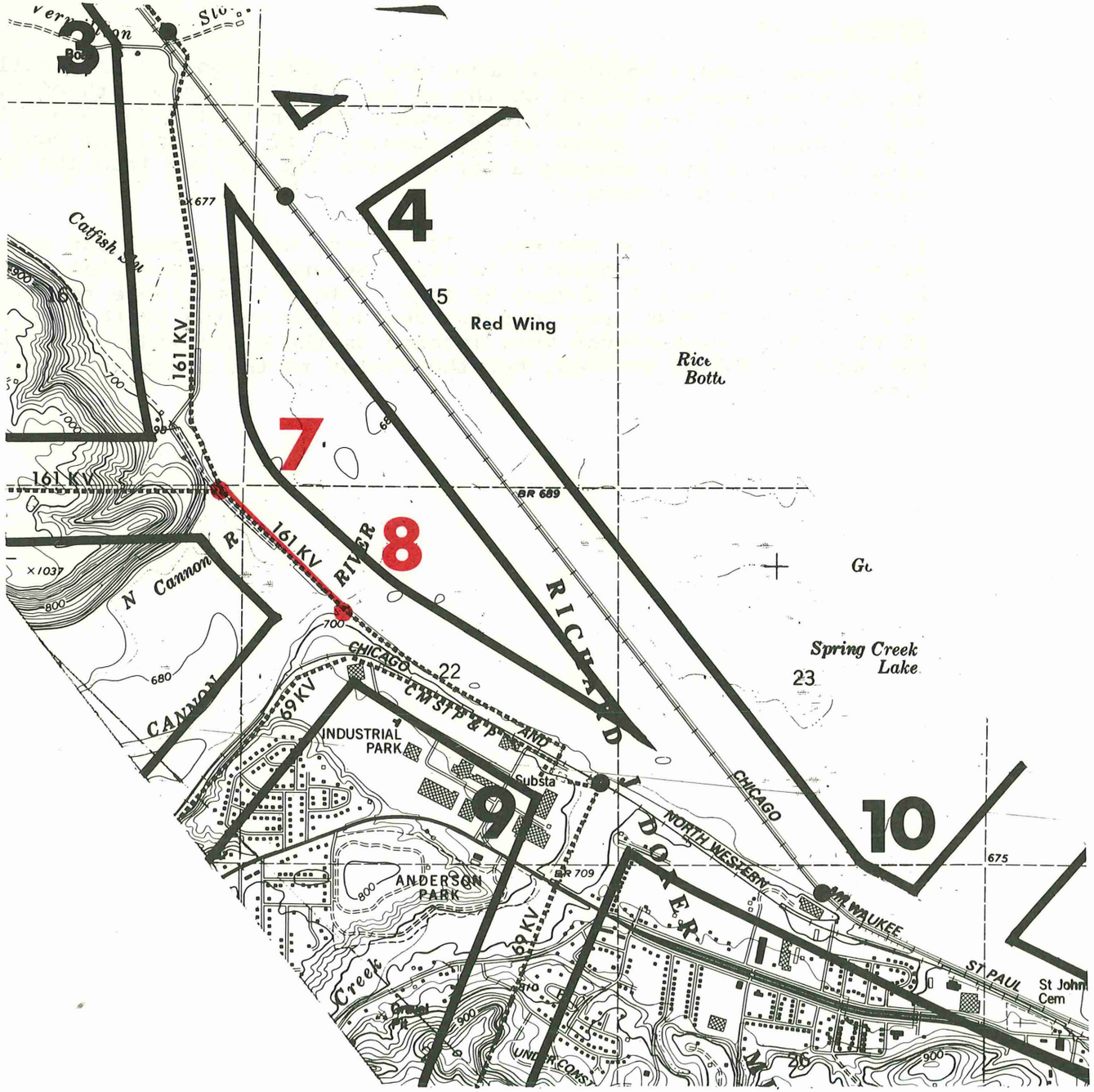
existing transmission line

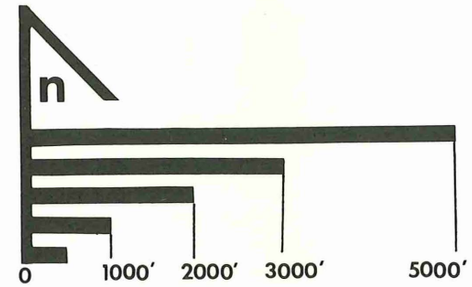
proposed route segment 4-10

Segment 7-8

This segment is .45 mile in continuous length along the existing CPA 161 kV line. At node 7, the single-circuit 161 kV line from the north is joined by another single-circuit 161 kV line from the west: both lines continue southeast on one double-circuit line to a substation near node 9. The reference centerline is on the northeast side of the existing line. Two river crossing are required: one across the North Cannon River and the second across the Cannon River.

The Cannon River is a designated Minnesota Wild and Scenic River at this crossing point. As a parallel alignment with the existing 161 kV line, the proposed right-ofway will have less impact then a new right-of-way. However, vegetation clearing and ground disturbances from equipment activity will create observable disruption for several years. The potential for soil erosion and a decrease in water quality of the two rivers are a concern.





route boundary

node

reference centerline

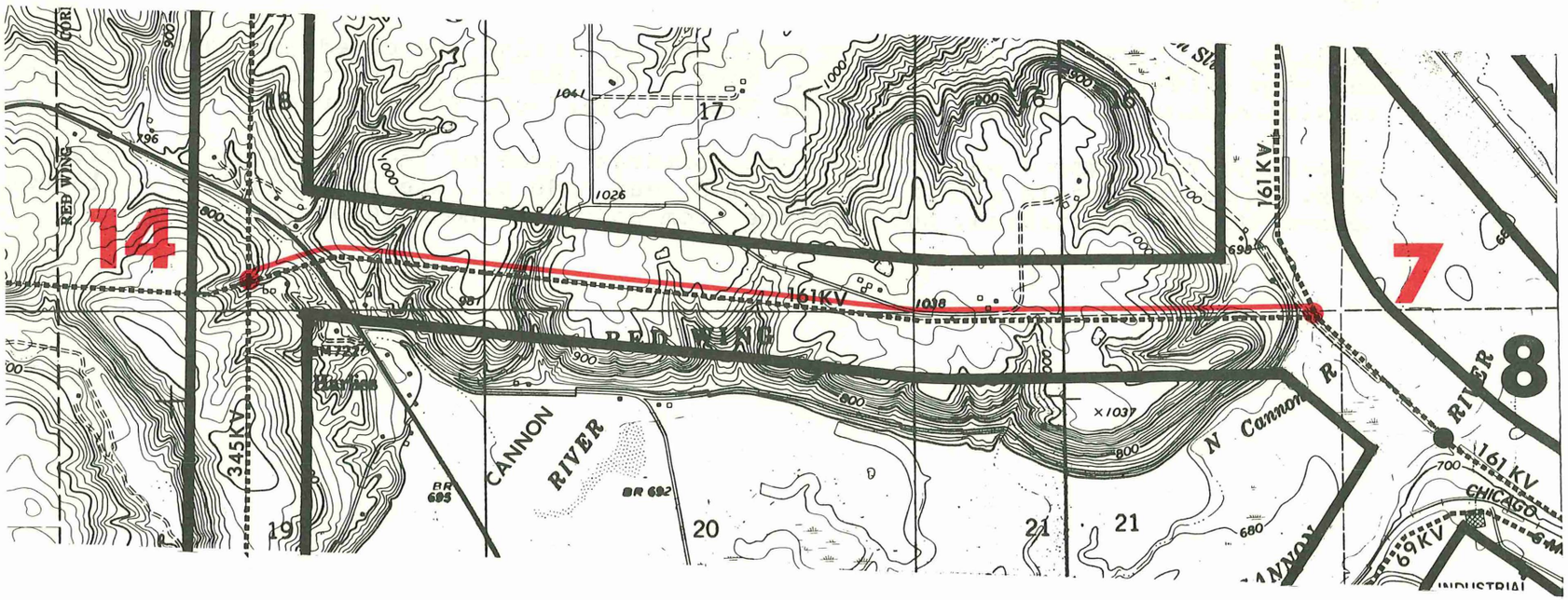
existing transmission line

proposed route segment 7-8

Segment 7-14

This segment would require a major angle west at node 7 to parallel an existing CPA 161 kV single-circuit line on the north side for its length of 2.46 miles. The reference centerline parallels a gravel township road for a quarter mile and crosses U.S. Highway 61 just north of the community of Harliss. At node 14, the 161 kV single-circuit line crosses a north-south 345 kV line from the Prairie Island substation to Adams, Minnesota.

The terrain crossed by segment 7-14 is very hilly except for slightly rolling cultivated land near the segment's center. Several separate fields are crossed. The fields are irregularly shaped as they conform to tillable terrain. The reference centerline will pass very near two residences on the north side of the gravel road. If the final right-of-way were located on the south side of the existing 161 kV line, the homes would be avoided, but the fields to the south would be crossed by both lines.



n

0 1000' 2000' 3000' 5000'

route boundary

node

reference centerline

existing transmission line

proposed route segment 7-14

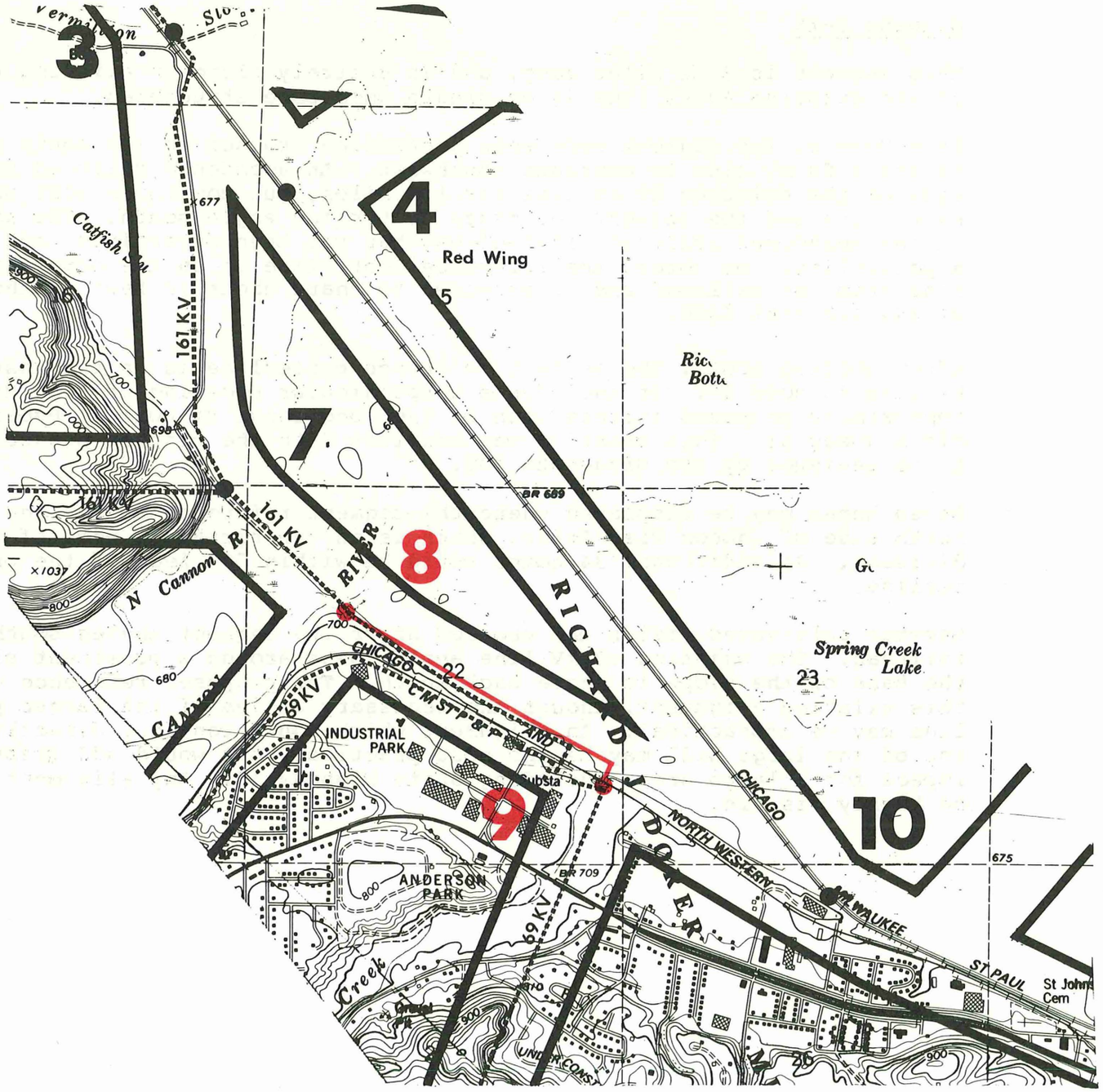
Segment 8-9

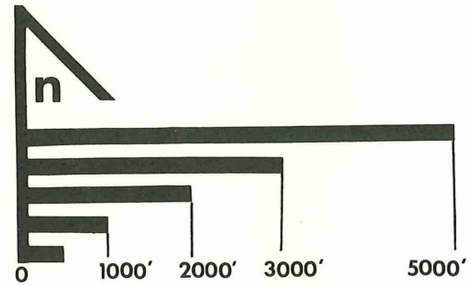
From node 8 on the south side of the Cannon River, segment 8-9 continues parallel to and on the northeast side of the CPA double-circuit 161 kV line. This existing line parallels an abandoned railroad bed and a NSP 69 kV single-circuit line, which are on the southeast side of the reference centerline and the 161 kV line. A narrow, unimproved lane follows the northeast side of the 161 kV line. The segment is .81 mile in length.

The existing rights-of-way are used for access by the public to the Cannon River. Access for construction of the proposed line will be along the existing rights-of-way.

Lands to the northeast side of the reference centerline are owned and managed by the Red Wing Wildlife Protective League. Node 8 and the initial portion of the segment is within acquired lands of the Dorer Memorial Hardwood State Forest.

Generally, the segment passes along the northeast side of the Red Wing Industrial Park. A substation is within the park and near node 9. The proposed line would not connect to the substation, but continue from node 9 to node 10 or 16.





route boundary

node

reference centerline

existing transmission line

proposed route segment 8-9

Segment 8-15

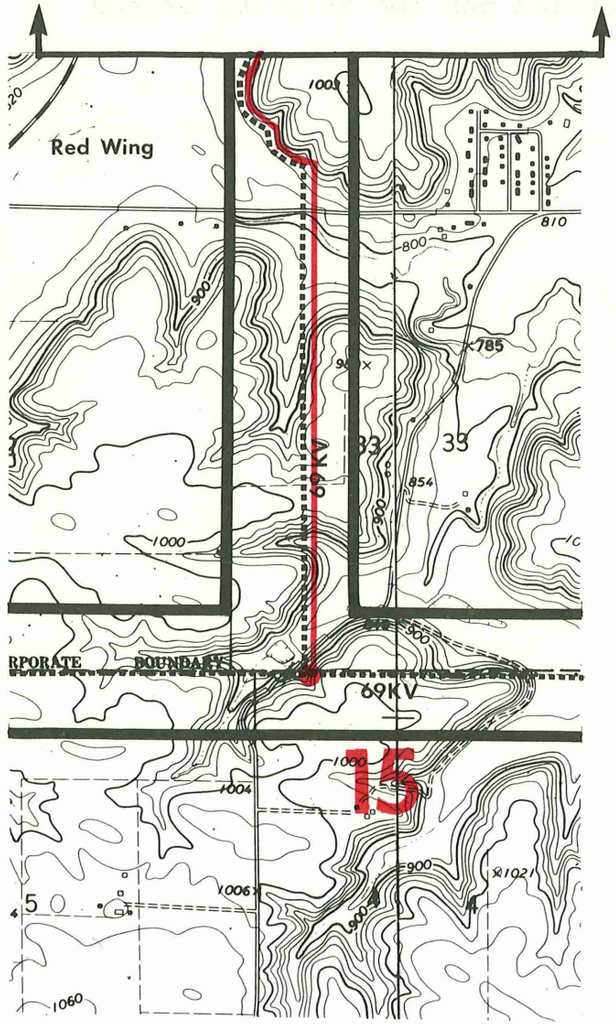
This segment is 3.52 miles long, and is entirely along an existing 69 kV line. Much of the existing 69 kV line is on single wood pole structures.

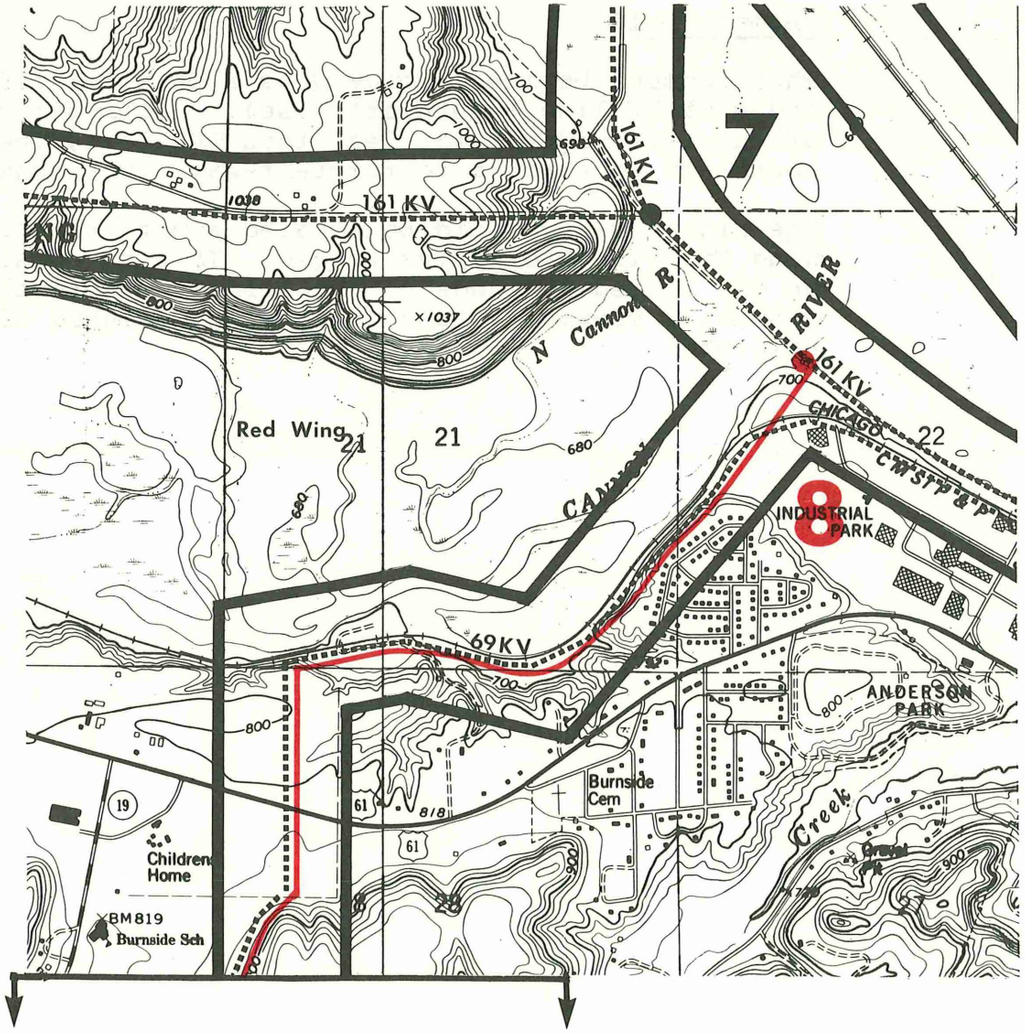
From Node 8, the segment reference centerline crosses to the south side of the existing 69 kV line to continue southwest. An abandoned railroad bed is on the north side of the existing 69 kV line for 1.5 miles, but continues west when the existing 69 kV line and the segment reference centerline angle south. The potential for use of the abandoned railroad right-of-way has not been determined, but can be considered a possiblity. As noted, the reference centerline is on the opposite side of the 69 kV line from the railroad and is proposed to share about 10 feet of the existing right-of-way for that line.

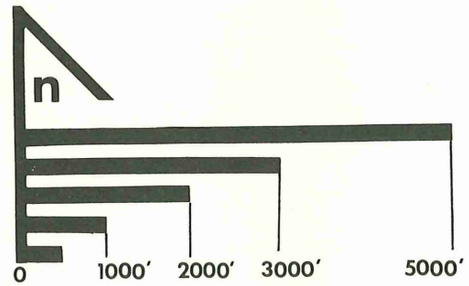
After angling south, the segment reference centerline is on the east side of the 69 kV line to node 15. It includes a perpendicular crossing of U.S. Highway 61 at the approximate proposed intersection of the long range Highway 61 Bypass project with old Highway 61. This crossing may conflict with the highway project, and would have to be reviewed by the Minnesota DOT.

Seven homes may be displaced where the segment reference centerline passes near the north side of Cannon View Drive, which is on the northwest edge of a large subdivision. An additional 34 homes would be within 500 feet of the proposed centerline.

Several cultivated fields are crossed after the segment angles south away from the railroad. The existing 69 kV line angles west around a prominent slope and follows the base of the slope to angle back south. The proposed reference centerline follows this existing alignment, though the necessary angles of the larger proposed 345 kV line may be impractical. An alignment which would continue directly south over the top of the large hill may be the most practical, but would add greatly to visual impact for a large area, including State Highway 19. Any alignment in the area would be highly visible.







route boundary

node

reference centerline

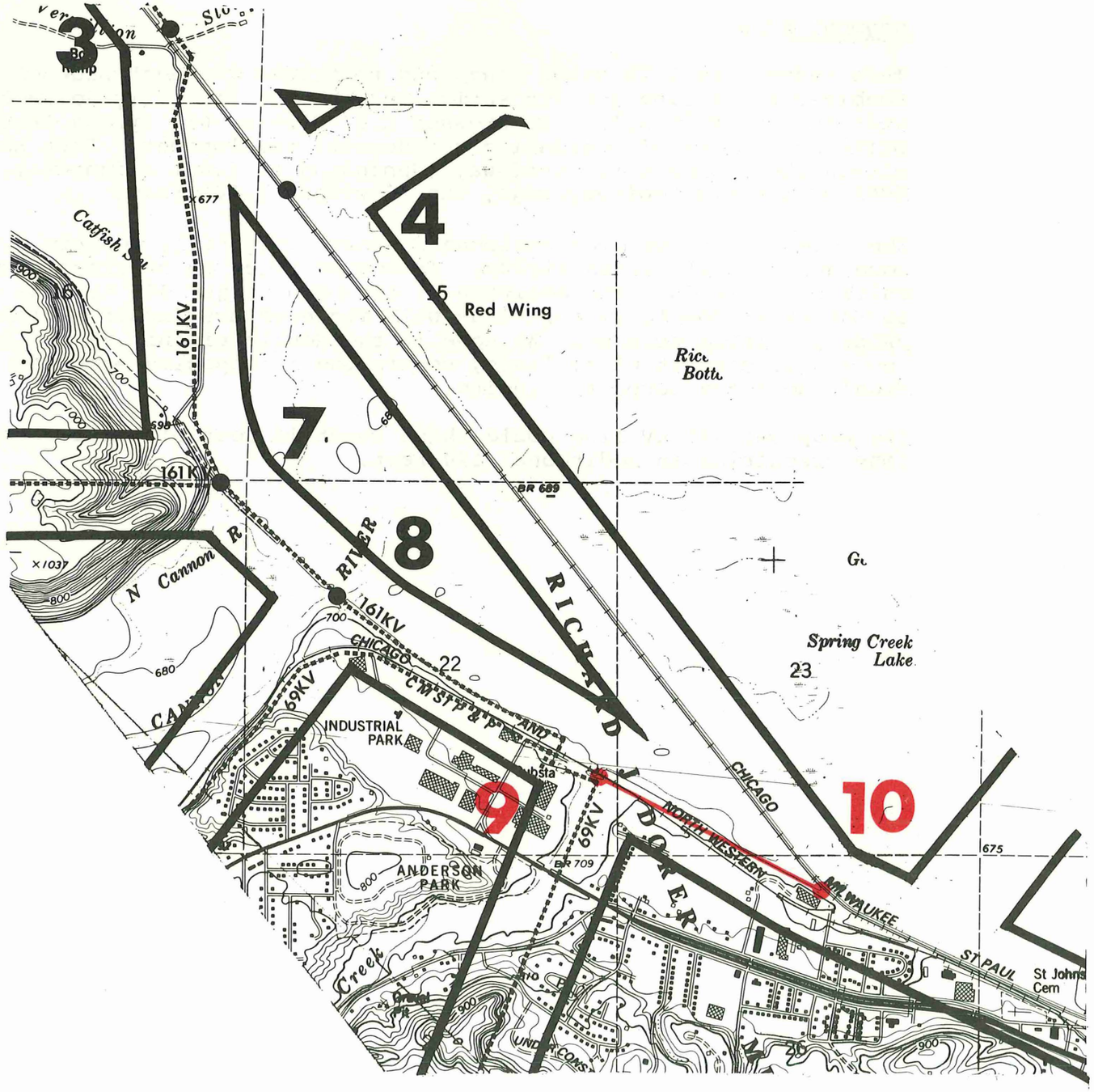
existing transmission line

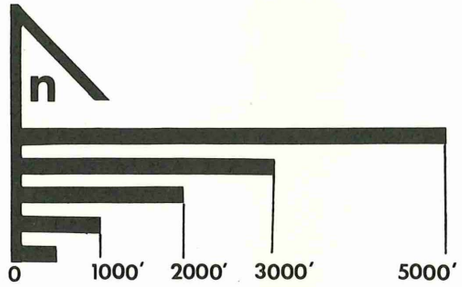
proposed route segment 8-15

Segment 9-10

This segment begins at node 9 as a parallel alignment with the abandoned railroad bed and a 69 kV line (southwest side). The reference centerline is on the northeast side of the railroad bed for less than 500 feet, then leaves the bed at a slight angle southeast on a separate right-of-way. The segment is .66 miles in length.

The right-of-way would be located along the southern edge of lands managed by the Red Wing Wildlife Protective League. It also crosses Spring Creek near node 9. Impacts on the wooded lowlands of the Wildlife Protective League would be lessened by the segment's proximity to the Red Wing business district and the existing CMSP&P Railroad.





route boundary

node

reference centerline

existing transmission line

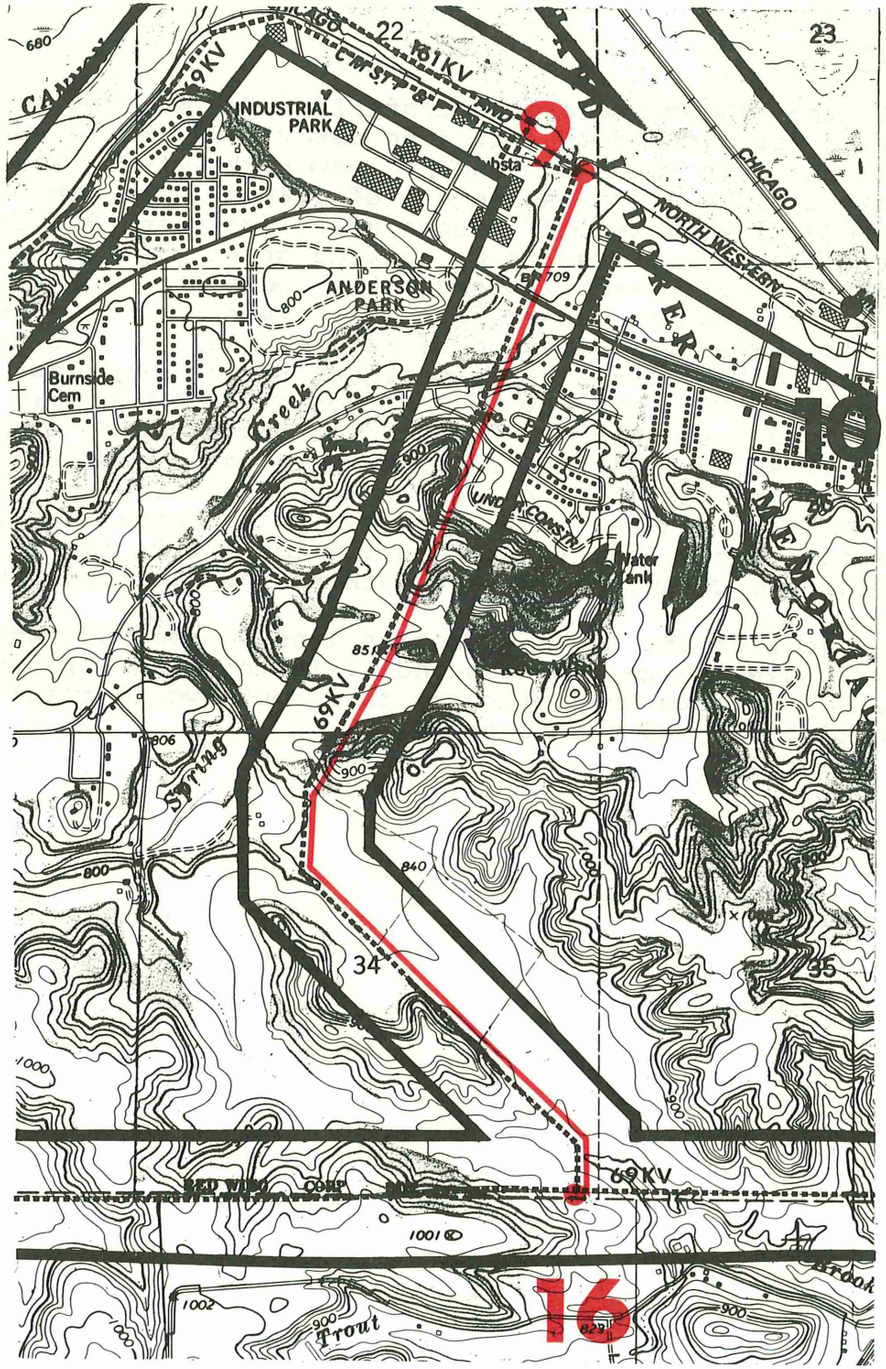
proposed route segment 9-10

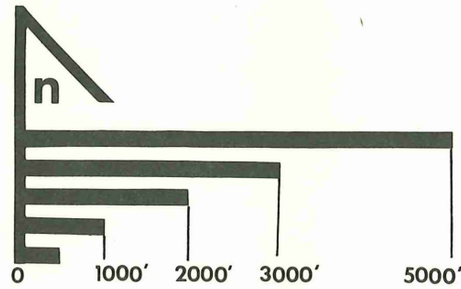
Segment 9-16

This segment is 2.58 miles long, and parallels the east side of an existing 69 kV double-circuit line for its entire length. It initially follows Spring Creek southwest for about ½ mile. It crosses U.S. Highway 61, Spring Creek Avenue and Graves Drive in an area of continuing residential development. Four homes are very near or within the proposed right-of-way (depending on final alignment), 26 are within 500 feet of the right-of-way edge, and 72 within 1,000 feet.

The reference centerline continues through very hilly terrain with interspersed woodland and cultivated fields. It angles twice to continue southeast through mostly cultivated fields. The addition of the much larger 345 kV line on longer spans next to the 69 kV double circuit line will increase the farmer's difficulty in cultivating crops in fields crossed. At node 16 the double circuit 69 kV line diverges to become two single-circuit 69 kV lines, continuing in opposite east-west directions along Red Wing's southern corporate limits.

The proposed 345 kV line could share about 10 feet of right-of-way with the existing line, requiring an additional 140 feet.





route boundary

node

reference centerline

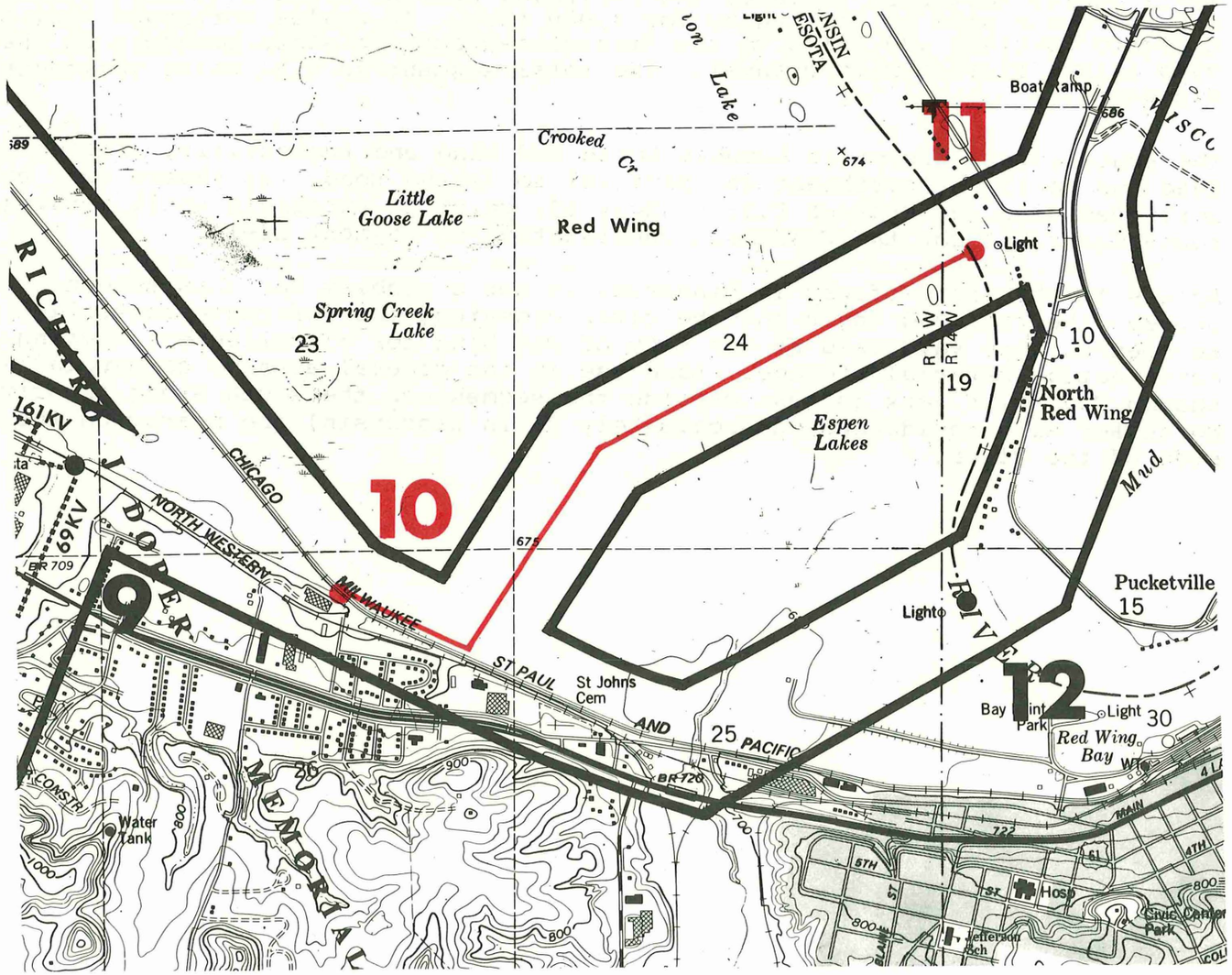
existing transmission line

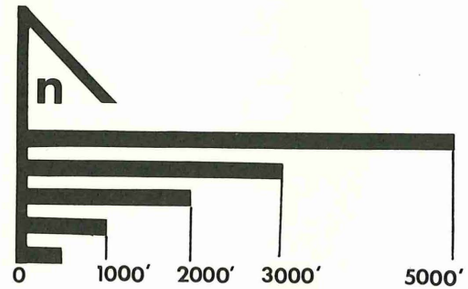
proposed route segment 9-16

Segment 10-11

From node 10, the segment reference centerline follows the northeast side of the CMSP&P Railroad for 1,500 feet. It then makes a 90° angle northeast to continue 1.56 miles across the Espen Lakes lowlands on new right-of-way to the Minnesota-Wisconsin state boundary at node 11 (total length of 1.88 miles). The Mississippi River crossing at node 11 will require a span of at least the 800 foot width of the water surface (normal level). Large steel lattice structures are typically used, though for this comparatively narrow crossng, steel pole structures could probably be used. In Wisconsin, this segment passes through a river front residential area north of North Red Wing. Extensive clearing of mature trees in this residential community will be required. The route in Wisconsin continues northeast along a frontage road on the west side of U.S. Highway 63 and crosses the Wisconsin Channel. To avoid existing boat landings, docks, a parking lot and a supper club at the channel crossing, the existing distribution line would have to be removed and replaced by the 345 kV line with the distribution line attached underneath. Crossing the channel parallel to the U.S. Highway 63 bridge, the route parallels U.S. Highway 63 northeast across County Road VV, the Burlington tracks and County Highway E and continues northeast to connect with the southern route alternative to Eau Claire.

In Minnesota, most of the segment crosses lands owned and managed by the Red Wing Wildlife Protective League. Becausenno existing right-of-way is available after the segment angles away from the railroad, this route would result in significant initial impacts from clearing and construction.





route boundary

node

reference centerline

existing transmission line

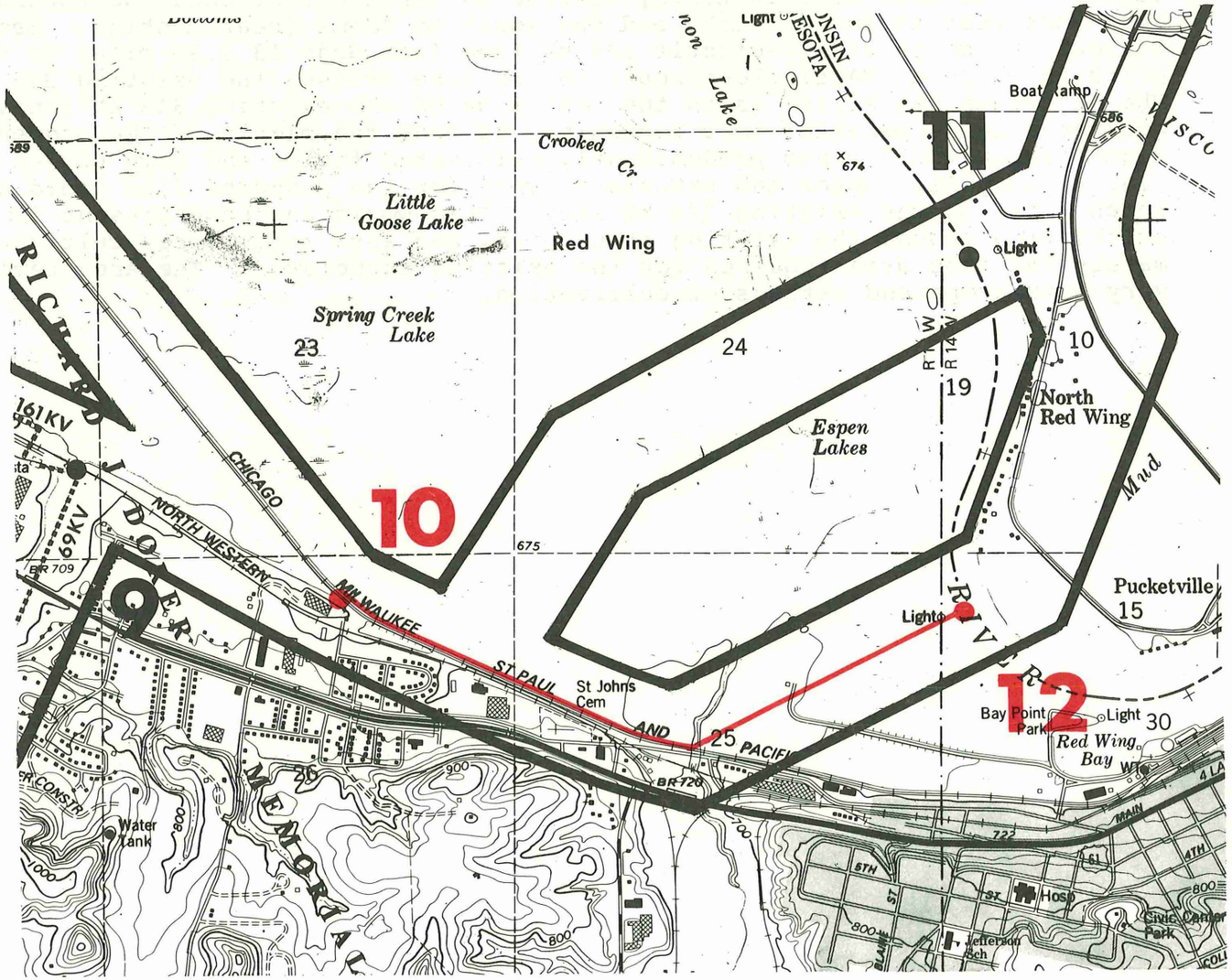
proposed route segment 10-11

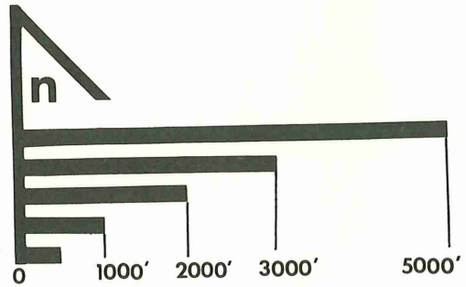
Segment 10-12

Continuing from Node 10, this segment has the same initial 1,500 linear feet of reference centerline along the CMSP&P railroad as does segment 10-11. Where segment 10-11 angles northeast to leave the railroad, segment 10-12 continues southeast along the northeast side of the tracks for 3,000 feet. It angles northeast very near Hay Creek to continue .70 miles to the Minnesota-Wisconsin state boundary at the Mississippi River's main channel. The total segment is 1.61 miles in length in Minnesota.

The route enters Wisconsin between North Red Wing and Pucketville, crosses Island Road and continues northeast and parallel to Island Road. It passes near homes in North Red Wing and crosses U.S. Highway 63, which it parallels until merging with the route described for the Wisconsin continuation of segment 10-11.

Access to the right-of-way in Minnesota is not a problem for this segment. Midway between the railroad angle and the river crossing, the reference centerline crosses an open storage yard used by the City of Red Wing for miscellaneous dumping and construction material storage. Land use in the general area is commercial in nature, though Bay Point Park is just outside the segment on the south along the river and North Red Wing residences (approximately 34 in Wisconsin) are nearby on the Wisconsin side of the river.





route boundary

node

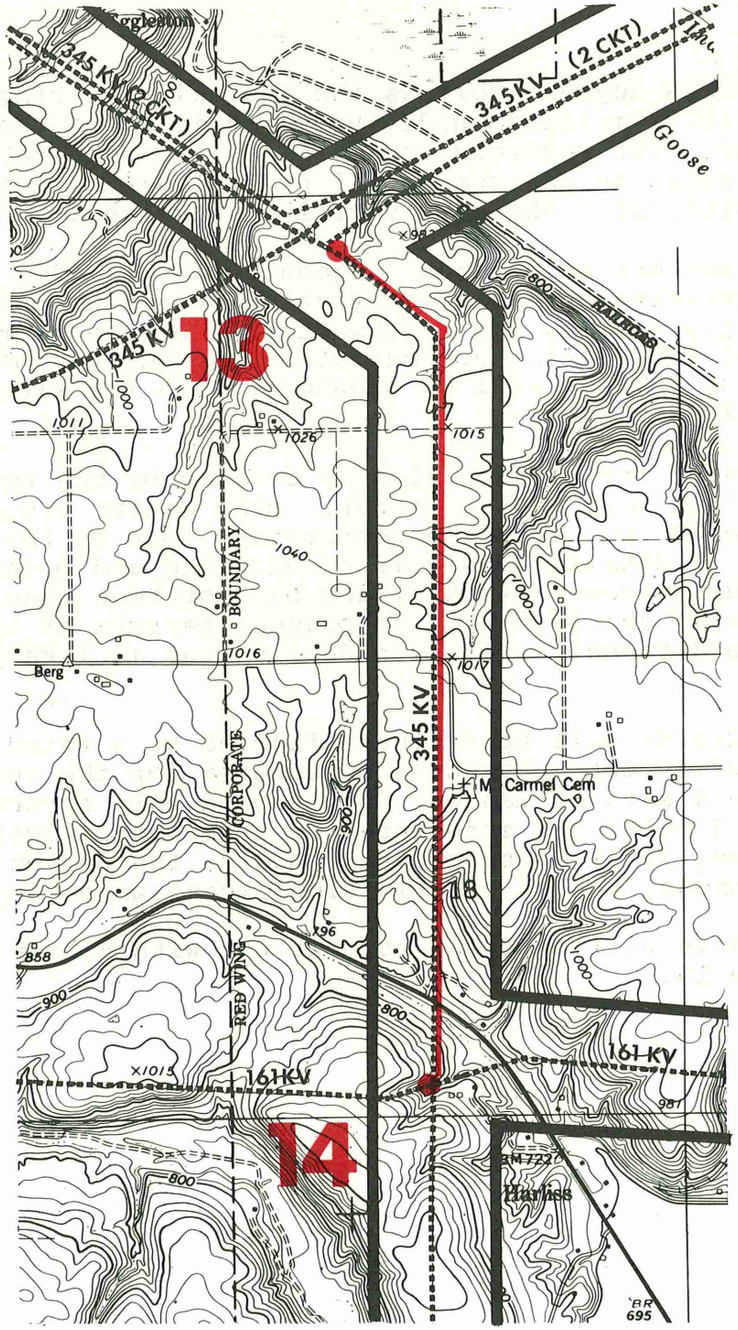
reference centerline

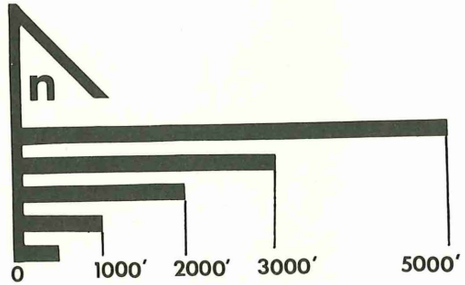
existing transmission line

proposed route segment 10-12

Segment 13-14

Node 13 is the point at which four 345 kV circuits coming southeast out of Prairie Island on two sets of structures, diverge in three directions: two northwest to Red Rock, one west to Parkers Lake and one south to Adams (near Austin). Segment 13-14 follows the south single-circuit 345 kV line from Node 13 1.99 miles to Node 14, which is where a CPA single-circuit 161 kV line crosses the existing 345 kV line. The reference centerline is on the east side of the existing 345 kV line, and for a quarter mile is parallel to a township road near the middle of the segment. The right-of-way would cross predominantly cultivated fields and some wooded slopes near U.S. Highway 61. Spans and structure types for the proposed line would probably match those on the existing 345 kV line. This would increase present limitations on cultivation around the existing structures, and also remove from cultivation approximately the same area required for the existing structures. The area removed will vary with crops and methods of cultivation.





route boundary

node

reference centerline

existing transmission line

proposed route segment 13-14

Segment 13-19

From node 13, this segment follows the two existing single-circuit 345 kV lines northwest for 10.72 miles to node 19, which is where the existing lines cross the CMSP&P railroad. The reference centerline is on the northeast side of the existing lines. New structures and spans will probably match those existing. Approximately 90 feet of additional right-of-way will be required.

The reference centerline extends diagonally across land lines for the full length of the segment, crossing extensive cultivated areas and numerous wooded slopes. The segment generally follows the southwest side of the Vermillion River, its closest distance to the river being approximately one quarter mile. Numerous wooded ravines and intermittent streams will be crossed within the first few miles between node 13 and the community of Etter.

A concentration of irrigated fields is crossed by the reference centerline and the two existing lines northwest of Etter. Nine center pivot irrigation systems are within one mile of the reference centerline, four on the northeast side and five on the southwest. A detailed analysis of existing and potential impacts of the two existing and one proposed 345 kV lines has not been made. However, a review of soil characteristics of the area and the present pattern of irrigation indicates that a limitation on additional irrigation development is likely if this segment is designated.

Non-irrigated fields will be further affected by a third single-circuit 345 kV line on a diagonal alignment. Matching structures for the two existing and one proposed line will place 3 sets of tangent double-wood-pole structures together. Slight angles require 3 poles per structure, or nine for 3 lines. Large angles require four-legged steel lattice structures. Again, the degree of impact will depend on cultivation methods, but is clearly significant under any cultivation method.

Several residences will be close to, but not within, the right-of-way near Etter and again near node 19.

ASSUMED NORTH

TRUE NORTH

* NORTH ARROW FOR THIS SECTION OF SEGMENT MAP ONLY

19

13

345 KV (2 CKT)

CHICAGO MILWAUKEE TRAIL

RAVENNA

175TH STREET

180TH STREET

POMEROY AVE

COLBERT AVE

HARDWICK RD

GOODHUE CO

DAKOTA CO

RIVER

Upper Rattling Springs Lake

Lower Rattling Springs Lake

Rattling Springs

Etter

Bru. Lake

Eggleston

BM

BR692

N

0 1000' 2000' 3000' 5000'

route boundary

node

reference centerline

existing transmission line

proposed route segment 13-19

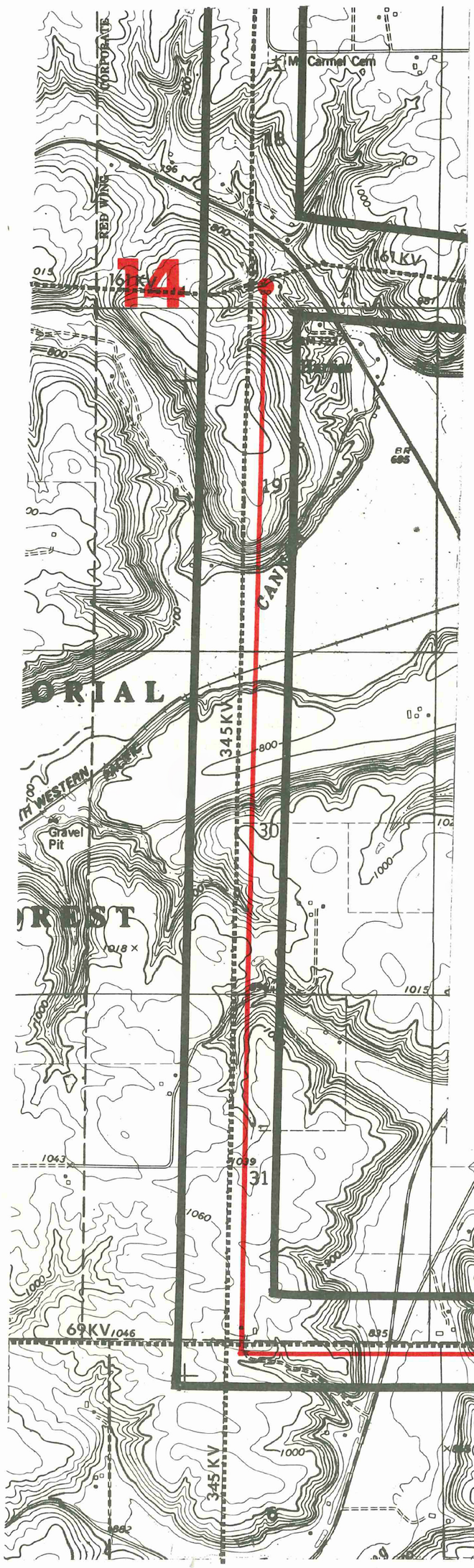
Segment 14-15

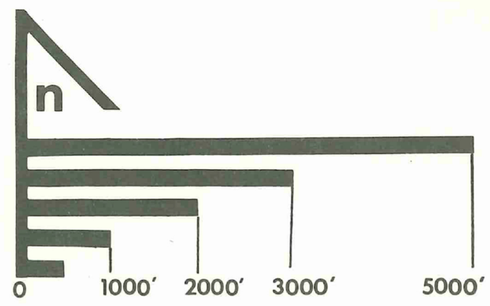
This segment extends 3.09 miles from node 14 to a 90° angle east, then 1.70 miles directly in a straight alignment to node 15. The total length is 4.79 miles. Node 14 is the point at which a CPA single-circuit 161 kV line from Prairie Island crosses a north-south, NSP single-circuit 345 kV line. The segment reference centerline parallels the existing single-circuit 345 kV line (also from Prairie Island) south. At the crossing point of a east-west NSP single-circuit 69 kV line with the existing north-south 345 kV line, the reference centerline crosses the 69 kV line and turns immediately east to follow it (south side) on full section lines to node 15.

This alignment is along the south corporate boundary of Red Wing. Existing and proposed structures and spans on the initial three miles can be matched (new structures next to existing structures) since the two lines are the same voltage and can be similar in design. The remaining 1.7 miles of proposed 345 kV line will not match the existing 69 kV line.

Over half the segment length crosses cultivated lands, which will cause farming limitations in addition to those now experienced with existing lines. Farmsteads would be very near the right-of-way at node 19 and at the major 90° angle.

The Cannon River is crossed by the existing 345 kV line and this proposed 345 kV segment. The river at this point is a designated Minnesota Wild and Scenic River, and as such, would require detailed analysis at the crossing point to limit impacts. Special provisions for clearing, access and structure locations will be required.





route boundary

node

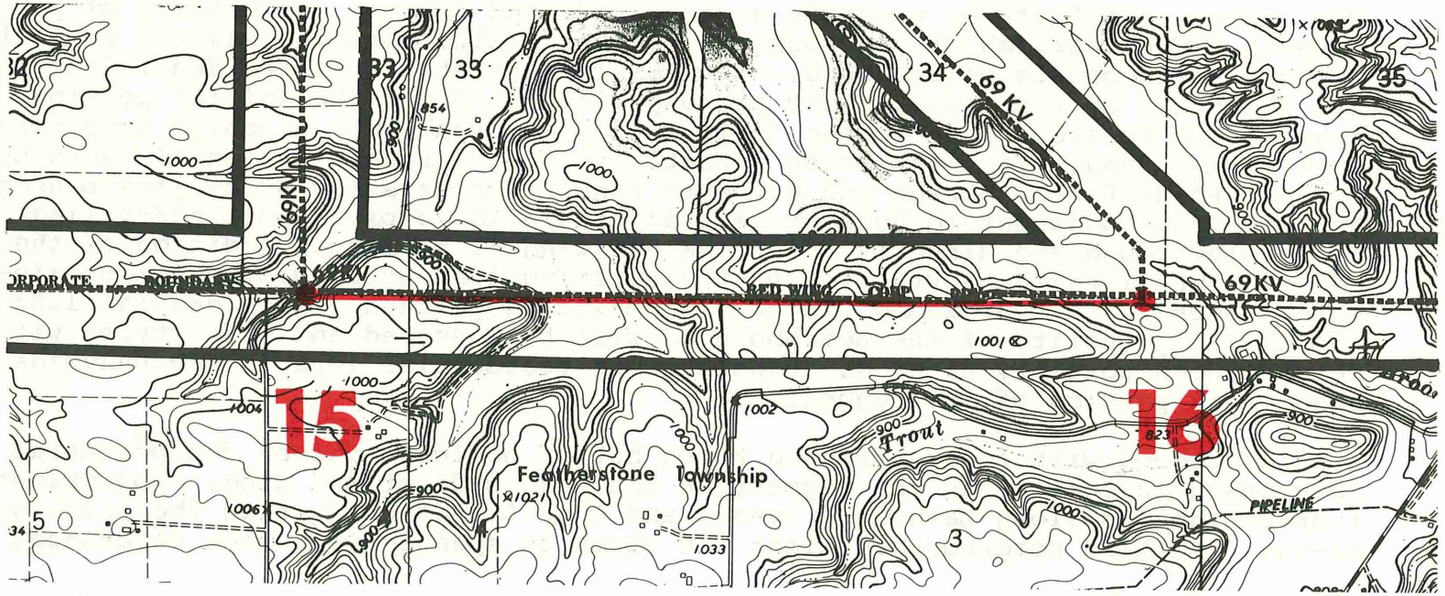
reference centerline

existing transmission line

proposed route segment 14-15

Segment 15-16

This segment continues along the existing NSP single-circuit 69 kV line (south side) for 1.64 miles between node 15, which is a connection point of a single 69 kV from the north, and node 16, which is the diverging point of a double 69 kV line from the north. The segment reference centerline follows both full section lines and Red Wing's southern corporate boundary. It crosses mixed cultivated fields and wooded slopes. Typical impacts of crossing such land types can be anticipated.



n

0 1000' 2000' 3000' 5000'

route boundary

node

reference centerline

existing transmission line

proposed route segment 15-16

Segment 16-17

This segment is 6.44 miles in length, and includes a Mississippi River crossing at node 17. Node 16 is the point where a double-circuit 69 kV line from the north splits east and west. Segment 16-17 follows the east bound single-circuit 69 kV line for its full length. The proposed reference centerline is on the south side of the existing alignment and follows both full section lines and the southern corporate boundary of Red Wing. From the 90° angles north, the reference centerline parallels the 69 kV line on the east side for most of the remaining segment length. Before crossing the Mississippi River, the reference centerline crosses to the west side of the existing 69 kV line.

The segment right-of-way presents an extensive and diverse composition of potential impacts. Continuation of the route in Wisconsin also exhibits several probable impacts which should be assessed. Several concentrations of residential development are traversed by the existing and proposed lines. Along the initial portion of the segment the reference centerline follows Comstock Road past a mobile home park adjacent to the road. It then passes directly through a concentration of homes between Pioneer Road, Burton Street and Gernentz Lane. The existing 69 kV line passes through lawns adjacent to homes. Several sidewalks, a paved walking/cycling trail, and a playground are directly under the existing 69 kV line. Addition of the larger 345 kV line along the south side of the existing line would displace approximately three homes in this area and disturb the existing pattern of residential land use. The existing quality of the neighborhood will be lessened and life styles within the neighborhood possibly altered. Considerable residential impacts are unavoidable along this portion of the segment.

A neighborhood with fewer affected homes but of no less concern for potential impacts is crossed further along the segment on the east side of Red Wing. Approximately four residences along Langsdorf Avenue and Bush Street are within the existing right-of-way. A third neighborhood along 7th Stret is spanned with high clearances by the

existing 69 kV line from the bluff in Soldier's Park to a lower ridge between 7th and 5th streets. A similar adjacent span for the proposed 345 kV line would also cross homes, but may not require displacement if clearances can be kept high enough. Without further analysis, the primary known impacts will be visual to all homes in the neighborhood.

Finally, a residence would be directly crossed by the reference centerline before the segment crosses the Mississippi River at node 17. It is the caretaker's home for the Izaak Walton League property and clubhouse. The residence would probably be displaced.

Two schools would be within 500 feet of the proposed right-of-way: Twin Bluffs Junior High School in south Red Wing, and Prairie View-Ellsworth School on the Wisconsin side near Highway 35 (not shown on the map). Calvary Cemetery is directly crossed south of Red Wing near Minnesota Highway 58. **4-26**

Soldiers Memorial Park is traversed in east Red wing by the existing line and the proposed reference centerline. Both rights-of-way will cross a parking lot, picnic area, and observation point on the north side bluff line. The point overlooks Red Wing, Barns Bluff, the Mississippi River and the Wisconsin Bluffs. An existing takeoff structure for the 69 kV line is in the parking lot at the edge of the bluff. The proposed 345 kV take-off structure will be on the east side of the existing structure, and will require extensive reconstruction of the park layout. Disturbance of the site will occur during structure installation. Impacts on park facilities, recreation and visual features will be severe.

Where the segment reference centerline passes near the east end of Barnes Bluff, the historic Carlson Limestone Kiln would be in or very near the right-of-way. This site is on the National Register of Historic Sites.

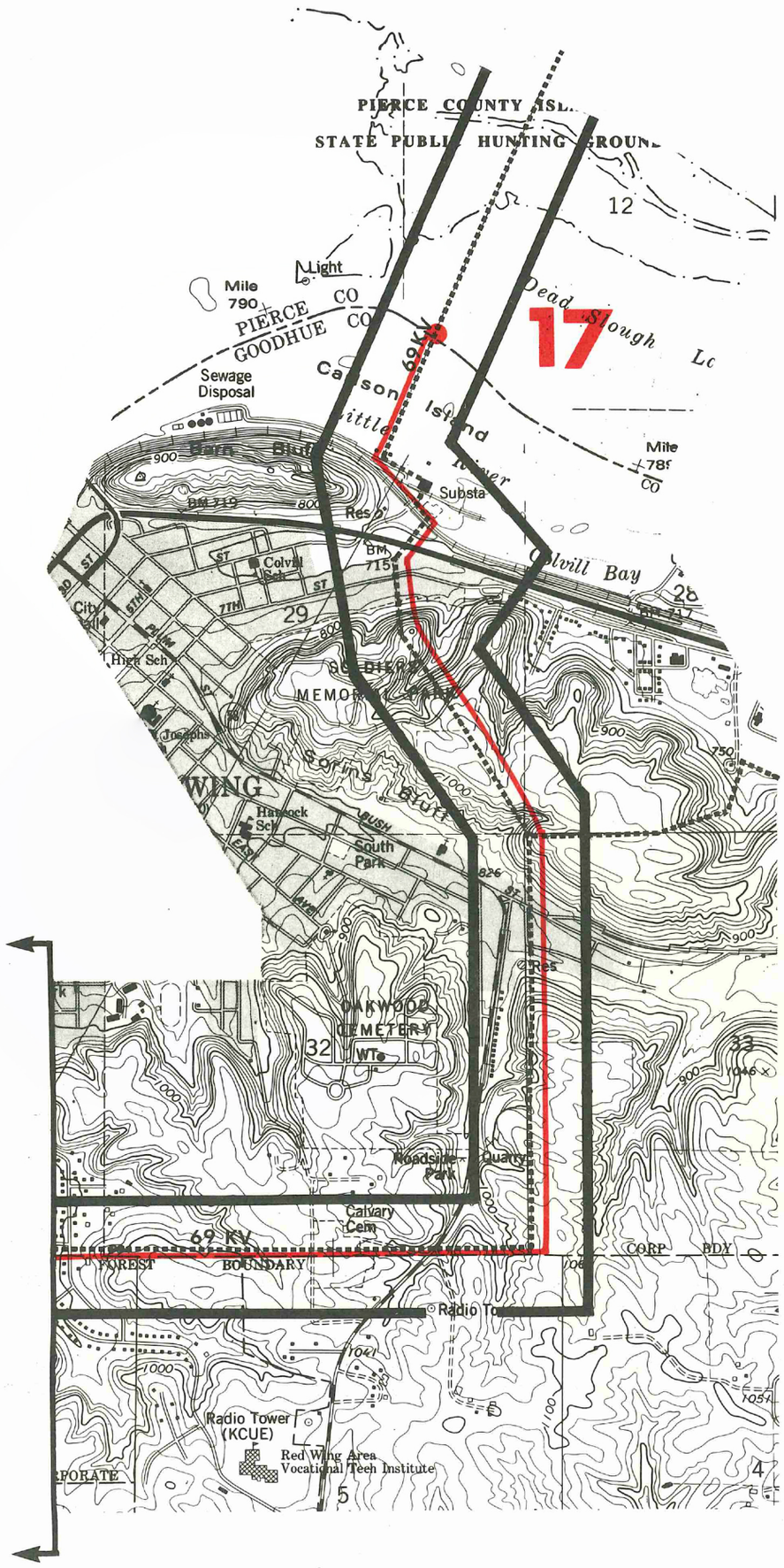
Two large communication towers are near the proposed reference centerline for this segment. Both are near Minnesota Highway 58 in southeast Red Wing. KCUE Radio Station is within 2,000 feet of the reference centerline on the south side and the Red Wing Cablevision Tower is within 500 feet on the same side. Analyses of the potential for communication interference have not been performed. Typically, large radio and television towers within this distance are studied in detail to determine probable impacts and mitigating measures. This would be necessary if this segment were designated.

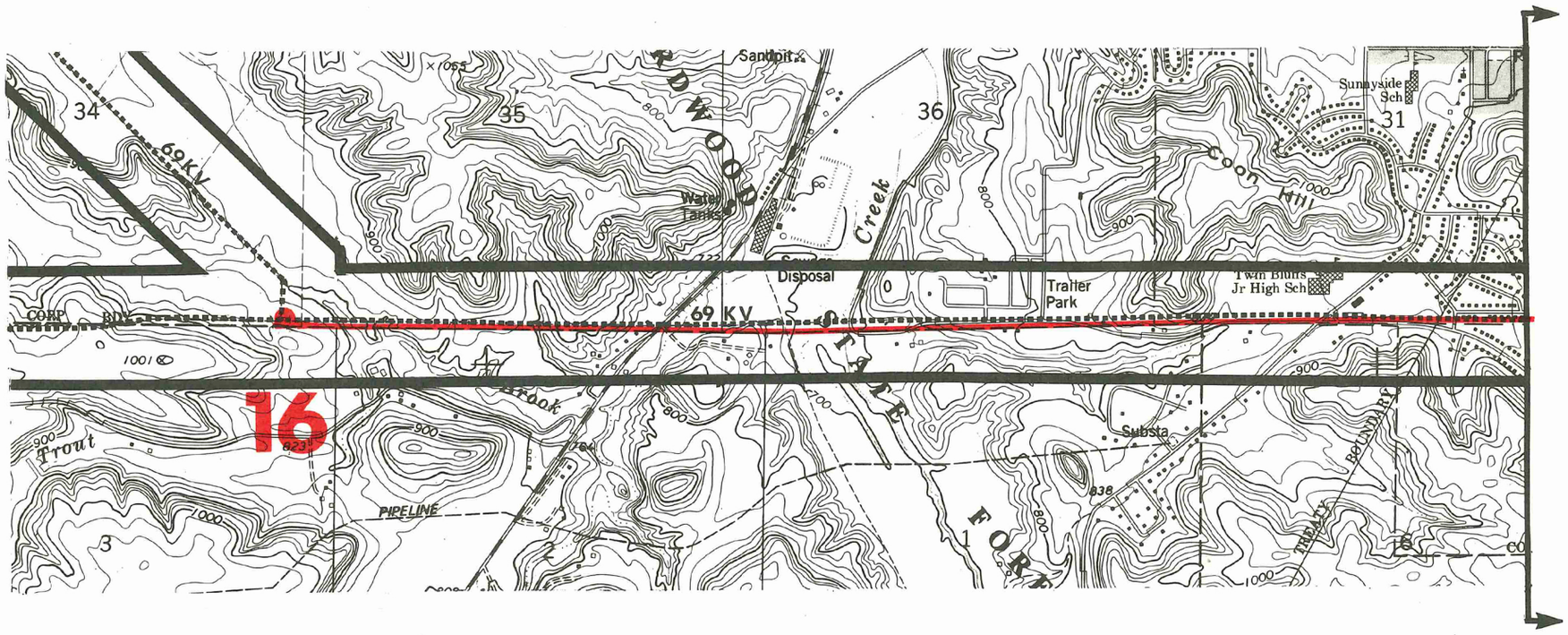
The reference centerline crosses public roads or highways 17 times within its 6.5 mile length. The CMSP&P Railroad is parallelled for 500 feet before the segment crosses the river at node 17.

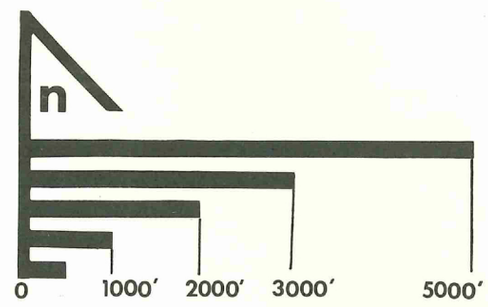
In Minnesota, the proposed 345 kV line would not connect to the existing NSP wood/coal generating plant or substation at the south end of Barnes Bluff.

A span from the railroad tracks which are across Little River (channel of the Mississippi River) to Carlson Island is required before the reference centerline spans the Mississippi River at node 17. The initial span crosses private recreation property of the Izaack Walton League. Carlson Island is uninhabited. The Mississippi River span is approximately 500 feet wide at the proposed crossing, probably requiring only slightly larger than normal steel lattice structures on either side.

In Wisconsin, the route crosses wooded lowlands of the Pierce County Island State Public Hunting Grounds, and continues along the existing 69 kV line (west side) across the Wisconsin channel and several miles into Wisconsin. The Red Wing Municipal Airport is potentially affected by the proposed 345 kV line. The west end of the existing east-west airport runway would be approximately 1/2 mile from the proposed reference centerline. Future expansion plans propose lengthening the runway 500 feet towards the proposed reference centerline. A definite conflict would result. Alternatives to the conflict, such as undergrounding the proposed 345 kV or moving the airport runways are costly.







route boundary

node

reference centerline

existing transmission line

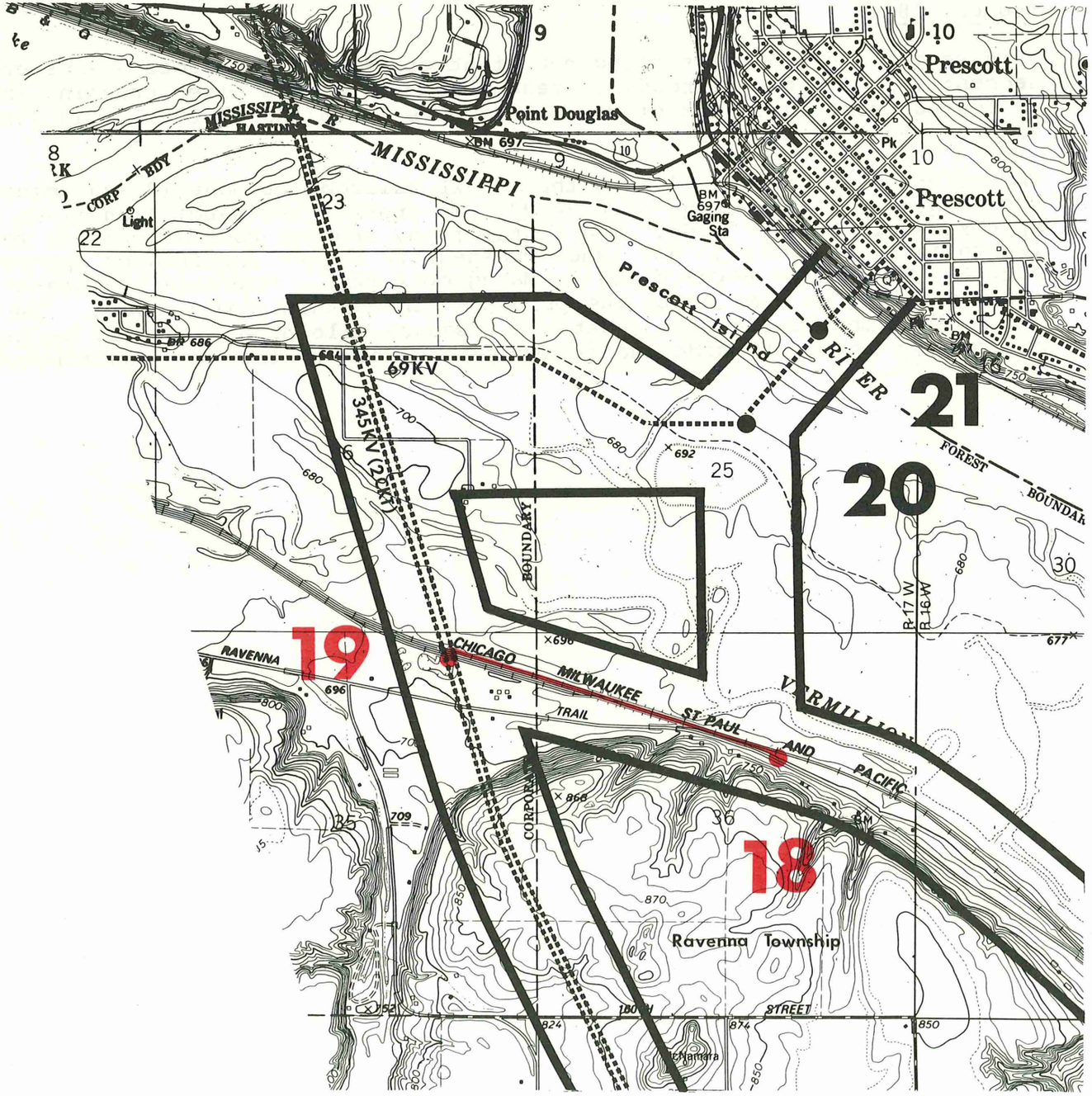
proposed route segment 16-17

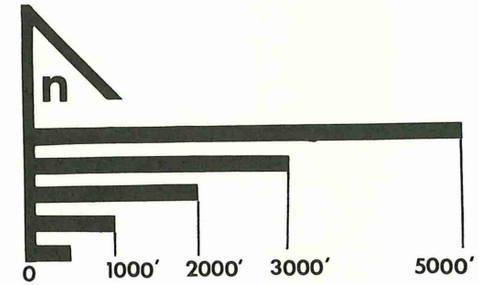
Segment 18-19

This segment is parallel and adjacent to the north side of the CMSP&P Railroad for .87 miles. The segment would intersect an existing NSP double-circuit 345 kV line.

Wooded lowlands adjacent to the Vermillion River would be traversed. The river is within 500 feet of the right-of-way at one point.

Four homes along Ravenna Trail are within 500 feet of the proposed right-of-way, but are on the opposite side of the railroad from the reference centerline.





route boundary

node

reference centerline

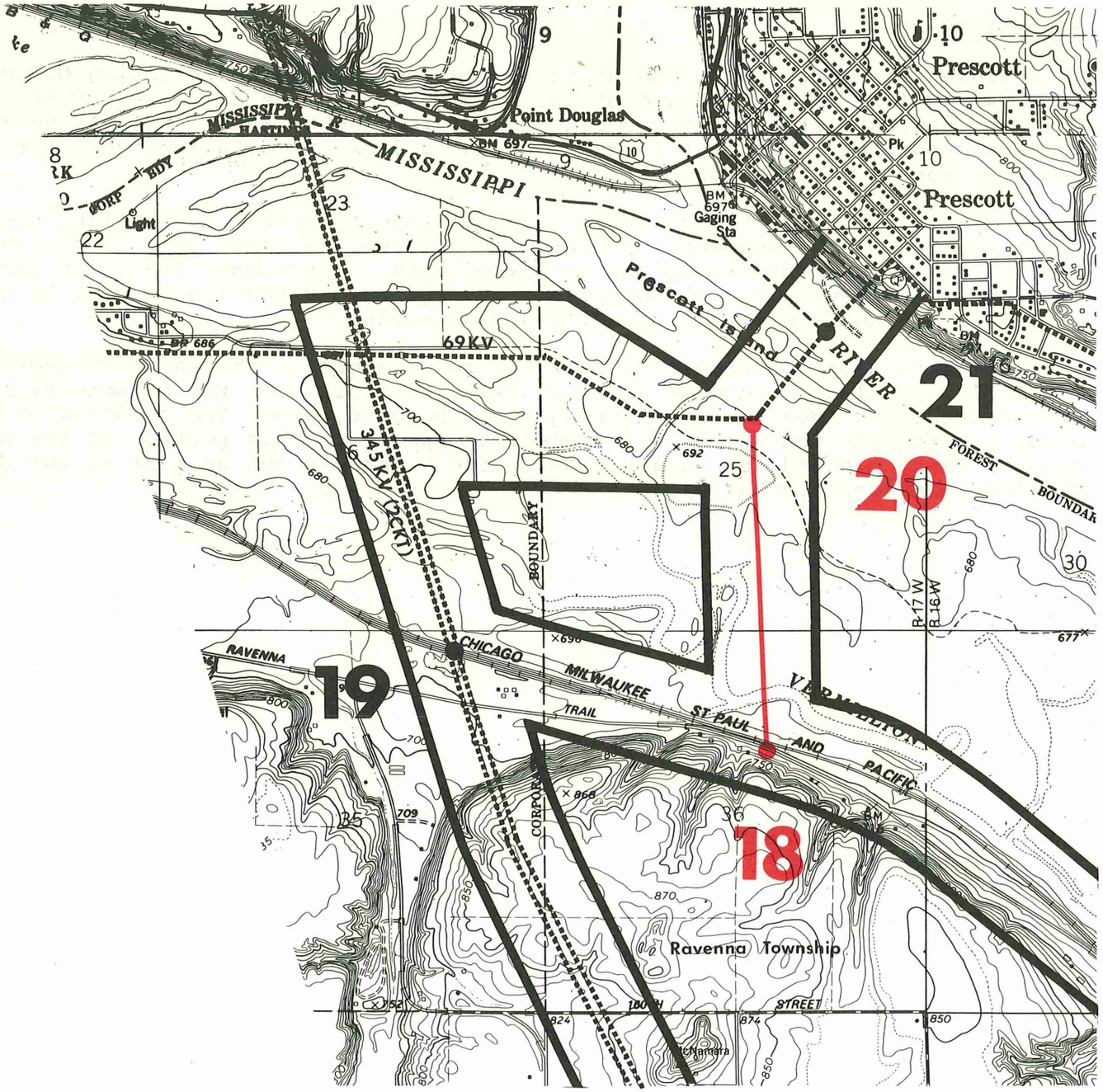
existing transmission line

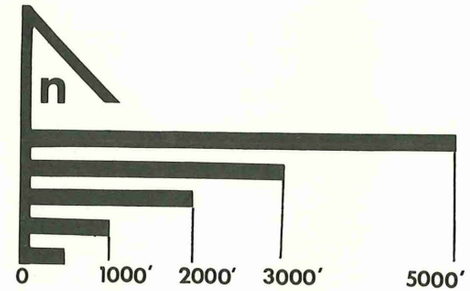
proposed route segment 18-19

Segment 18-20

This segment is .85 miles along new right-of-way. It provides a shorter means for segment 1-18 (along railroad) to reach the Mississippi River crossing (node 21) than following existing rights-of-way on segments 18-19 and 19-20. It is 1.86 miles shorter than segment 1-18.

The reference centerline leaves the CMSP&P railroad at node 18 and joins an existing NSP single-circuit kV line at node 20. It crosses the Vermillion River at a point approximately 50 feet wide. The right-of-way crosses wooded lowlands for most of its length in this segment. All lands crossed are either acquired or approved for acquisition for the Gores Wildlife Management Area. Potential management activities could possibly be limited by the proposed line within this segment. The right-of-way would close the fourth side (east) of a square mile area presently having the railroad on the south side and transmission lines on the west and north.





route boundary

node

reference centerline

existing transmission line

proposed route segment

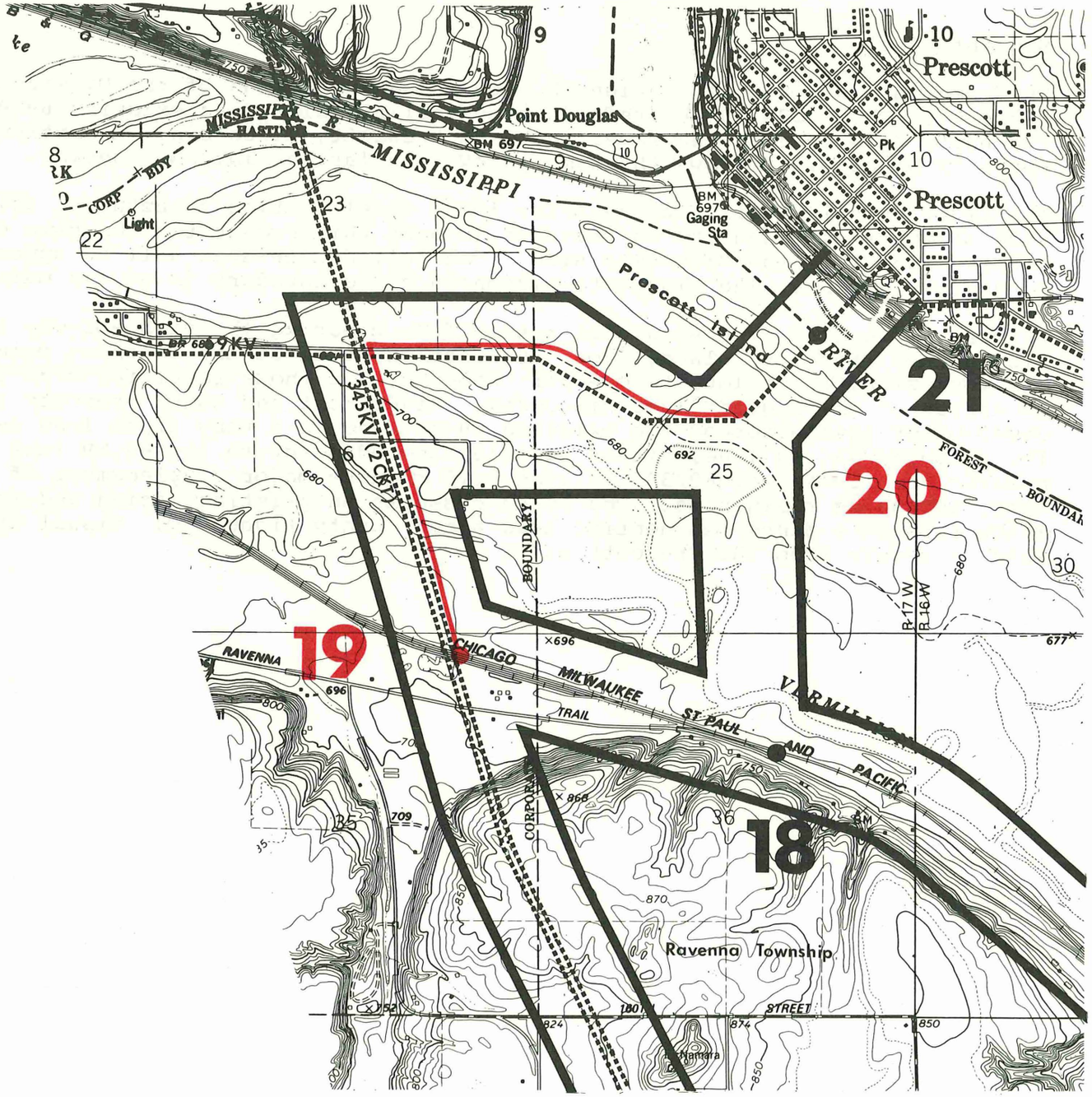
18 - 20

Segment 19-20

This segment is parallel and adjacent to the east side of an existing NSP doublecircuit 345 kV line for a distance of .83 miles. It crosses an east-west oriented 69 kV line and angles east along the north side of the 69 kV line, parallelling it for 1.01 miles to node 20. The total segment length is 1.84 miles, all along existing transmission line rights-of-way.

The proposed line will be the third parallel single-circuit 345 kV line along the first portion of the segment. Matching structures and spans will be possible, and 60 feet of existing right-of-way can be shared with the proposed line. An additional 90 feet of right-of-way will be required. Several cultivated fields will be crossed, further limiting farming efficiency and production.

The second half of the segment (after the major angle to the east) crosses predominantly low woodlands. Access along an existing trail will reduce potential impacts of construction. Vegetation clearing will, however, widen the existing 69 kV rightofway and require removal of all tree-sized species. This portion of the segment crosses lands planned for acquisition by the Minnesota DNR as part of the Gores Wildlife Management Area.



n

0 1000' 2000' 3000' 5000'

route boundary

node

reference centerline

existing transmission line

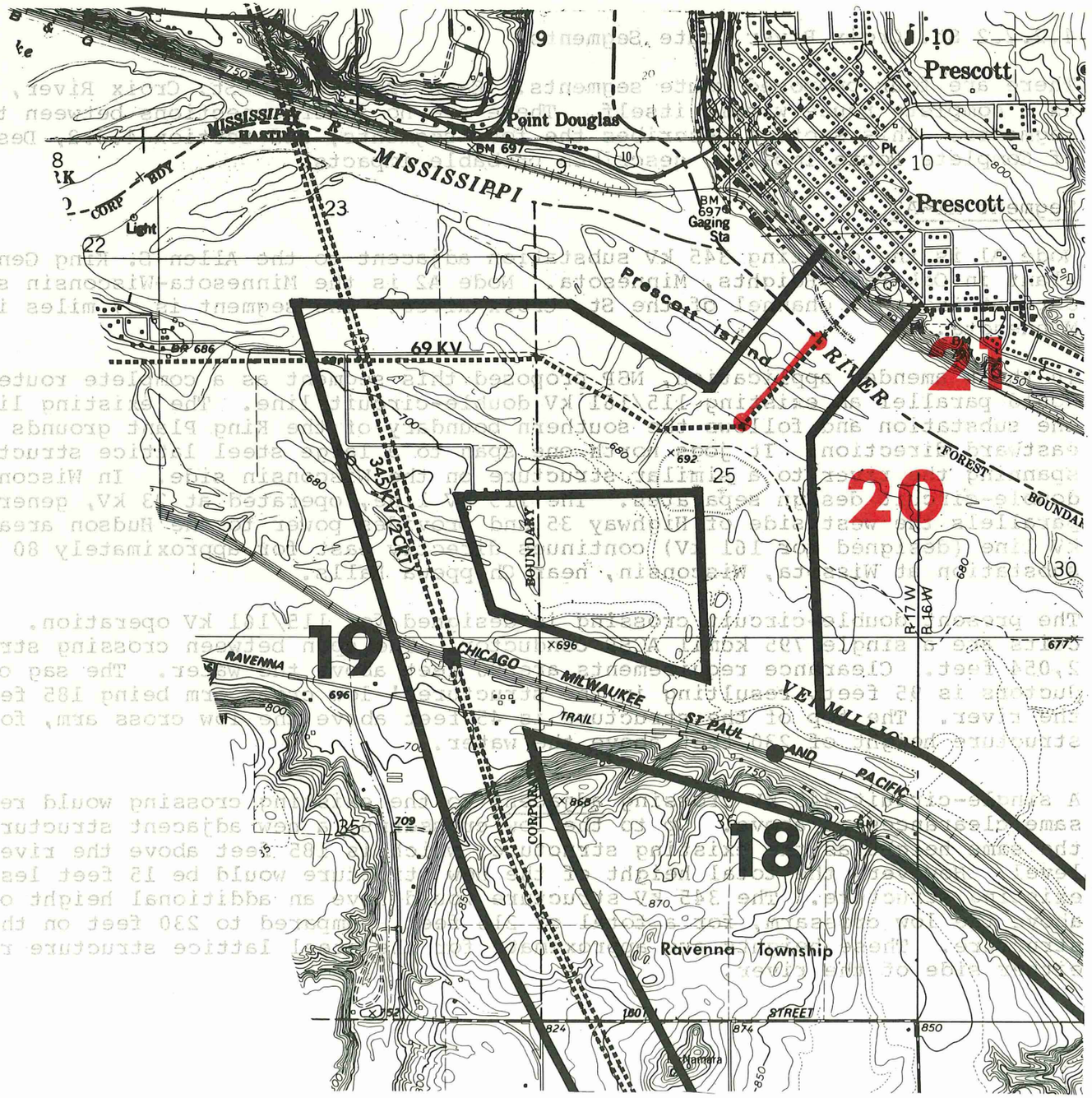
proposed route segment 19-20

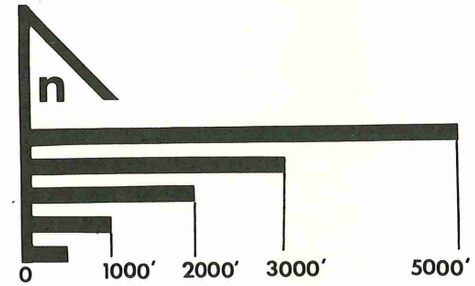
Segment 20-21

This segment is .28 miles in length, providing a crossing of the Mississippi River at Prescott. From Node 20 the reference centerline follows an existing 69 kV line, on the north side, across the river and into Prescott, Wisconsin. A continuation of the route in Wisconsin follows the same 69 kV line farther into Wisconsin.

The river crossing will include three large steel lattice structures, one on either side of the river, and one on Prescott Island, which separates the main channel from a back channel on the Minnesota side. The full double-span will be approximately 2,500 feet across. The Minnesota-Wisconsin state boundary is at the main channel.

Primary impacts in Minnesota will result from clearing the right-of-way and construction across Prescott Island, about 500 feet in width at the crossing point. The most significant impacts overall, however, are those resulting from a continuation of the segment into Wisconsin. Riverfront and south Prescott residential development have absorbed the existing 69 kV line in a very tight land use pattern. The proposed 345 kV line, either parallel and adjacent to the 69 kV line or as a rebuilt double-circuit 69/345 kV line will require major displacement of present land uses, including residences. The route dissects an existing marina and then angles south through a dense residential area along County Highway Q. Visual effects would also be severe from the Prescott side.





route boundary

node

reference centerline

existing transmission line

proposed route segment 20-21

4.2.2.2 St. Croix River Route Segments

There are four proposed route segments. Each crosses the St. Croix River, and each is a complete route within itself. There are no interconnections between these four segments. This section describes the four segments, and Section 4.3.2, Description of Complete Route Impacts, describes probable impacts.

Segment A1-A2

Node A1 is the existing 345 kV substation adjacent to the Allen S. King Generating Plant in Oak Park Heights, Minnesota. Node A2 is the Minnesota-Wisconsin state boundary at the main channel of the St. Croix River. The segment is .7 miles in Minnesota.

In their amended application, NSP proposed this segment as a complete route which would parallel an existing 115/161 kV double-circuit line. The existing line exits the substation and follows the southern boundary of the King Plant grounds in an eastward direction. It jogs north one span to a large steel lattice structure before spanning the river to a similar structure on the Wisconsin side. In Wisconsin, the double-circuit design separates. The 115 kV line, operated at 23 kV, generally parallels the west side of Highway 35 and provides power to the Hudson area. The 115 kV line (designed for 161 kV) continues directly east for approximately 80 miles to a substation at Wissota, Wisconsin, near Chippewa Falls.

The present double-circuit crossing is designed for 115/161 kV operation. Both circuits are a single 795 kcmil ACSR conductor. The span between crossing structures is 2,054 feet. Clearance requirements are 90 feet above the water. The sag of the conductors is 95 feet, resulting in the structures' low cross arm being 185 feet above the river. The top of the structure is 45 feet above the low cross arm, for a total structure height of 230 feet above the water.

A single-circuit 345 kV crossing adjacent to the existing crossing would require the same clearances as above. Up to the low crossarms, a new adjacent structure would be the same height as the existing structure, which is 185 feet above the river water level. However, the total height of the new structure would be 15 feet less than the existing structure. The 345 kV structure would have an additional height of 30 feet above the low crossarm, for a total of 215 feet, compared to 230 feet on the existing structure. These heights are approximate for the steel lattice structure required on either side of the river.

A new double-circuit crossing adequate for the proposed 345 kV and the existing 115 kV circuit would be 185 feet to the low crossarm. If designed with a delta configuration, the second crossarm would be 35 feet above the low arm and the shield wire supports 25 feet higher. The overall height of the single structure would be 245 feet above the river water level. The 345 kV circuit would have three sets of double conductors and the 115 kV circuit would have three single conductors. Two shield wires the top of the structure would then total 11 wires crossing the river.

This rebuilding concept requires abandonment of the existing 115 kV line, operated at 23 kV, which feeds Hudson. This circuit is presently on the south side of the existing double-circuit line. NSP has indicated that this circuit could possibly be abandoned and service to Hudson provided from a substation east of Hudson (in Wisconsin).

If the existing 115 kV line (designed for 161, operated at 115), which is now on the north side of existing double-circuit line, were taken out of service while constructing the new double-circuit line, the risk of outages of other critical facilities would increase as the down time increased. Thus, the potential for low voltage conditions and line overloads also increases. Removal of the existing river crossing and construction of a new 115/345 kV double-circuit on the same centerline would extend the length of time the 115 kV line was out of service.

An alternative procedure is to leave the existing circuits in service while a new doublecircuit structure is constructed immediately adjacent to the existing structure, probably on the north side. The existing 115 kV circuit would then be out of service only for the time required to move it to the new structure. The new 345 kV circuit would then be strung, the existing 115 kV line (operated at 23 kV) removed, and the existing structure removed.

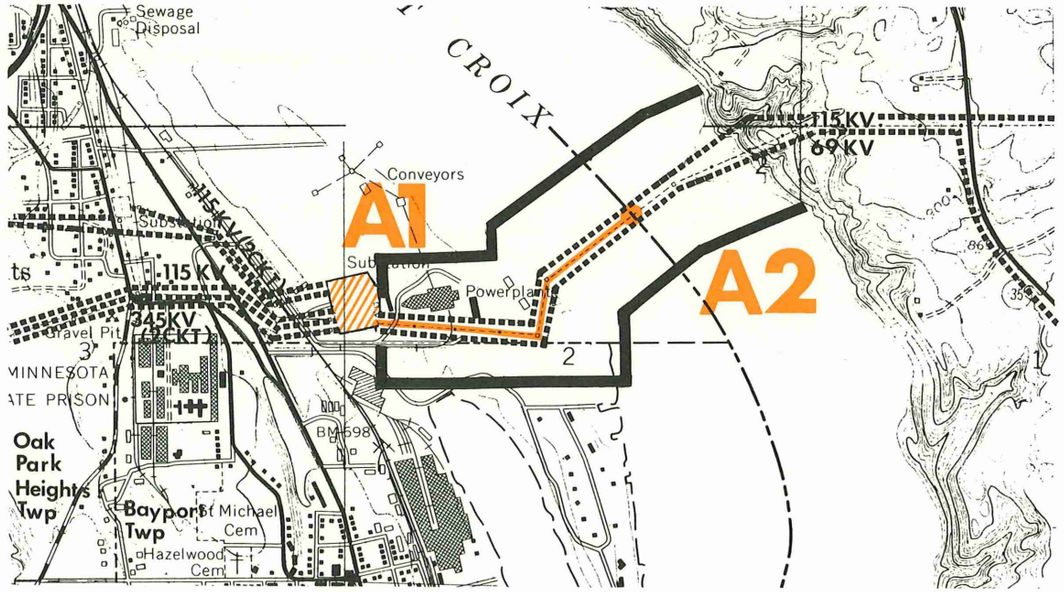
Right-of-way requirements for the two design alternatives described above are 140 feet additional width for an adjacent parallel line and 50 feet additional for an adjacent double-circuit rebuild. Cost for the separate, parallel design is $425,000 (river crossing, structure to structure). The rebuild design would cost $575,000, which includes removal of the existing line upon completion of the new one. The above figures do not include right-of-way costs.

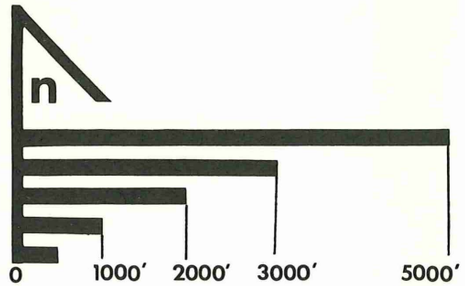
A third design alternative is to construct a 345 kV double-circuit river crossing, but operate one circuit at 345 kV and the other at 115 kV until some time in the future when a second 345 kV may be required. Both existing circuits would be removed after the new double-circuit line is in service. This design alternative results in still a double-circuit design but on much larger structures. The cost would be approximately $675,000, exclusive of right-of-way. As with the first rebuild option, the new structures would be installed as close as possible to the existing structures.

Thus, the two basic options for the segment A1-A2 river crossing result in three circuits on two separate lines for the parallel/adjacent design, and two circuits on one line for the rebuild designs (115/345 kV or 345/345 kV). The existing situation is two circuits on one line.

In Minnesota, the parallel/adjacent design, if installed on the south side of the existing line, would require acquisition of some additional right-of-way from Andersen Window Company. As noted earlier, an additional 140 feet would be required. The two rebuild designs may be able to remain entirely on NSP property associated with the King Generating Plant.

Right-of-way requirements in Wisconsin will be more complex and affect both individual and group properties. The existing double circuit line diverges at the first lattice structure in Wisconsin, which is at the river's edge, and the two lines continue up the steep bluffs on separate wood-pole structures. The two lines come together again as parallel but separate lines past the bluff line. They diverge again west of Highway 35, the 115 kV (operated at 23 kV) turning south to Hudson and the 161 kV (operated at 115 kV) continuing east across Highway 35 to Wissota, Wisconsin.





route boundary

node

reference centerline

existing transmission line

proposed route segment A1-A2

Segment B1-B2

This segment begins at an existing NSP 115 kV substation site in section 6 of Afton Township (B1) and extends 4.8 miles east along U.S. Highway 12 (I-94) to the Minnesota-Wisconsin state boundary at the main channel of the St. Croix River (B2). In Wisconsin, a continuous route would follow I-94 east to Eau Claire.

The NSP 115 kV substation (B1) is under construction. Expansion to tie the proposed line in with the existing Twin Cities 345 kV grid would be necessary at this substation. The site is adjacent to a double-circuit 345 kV line which runs from the King Generating Plant generally south to southern Washington County where it splits. One 345 kV circuit runs to the Twin Cities and the other 345 kV circuit runs to Eau Claire.

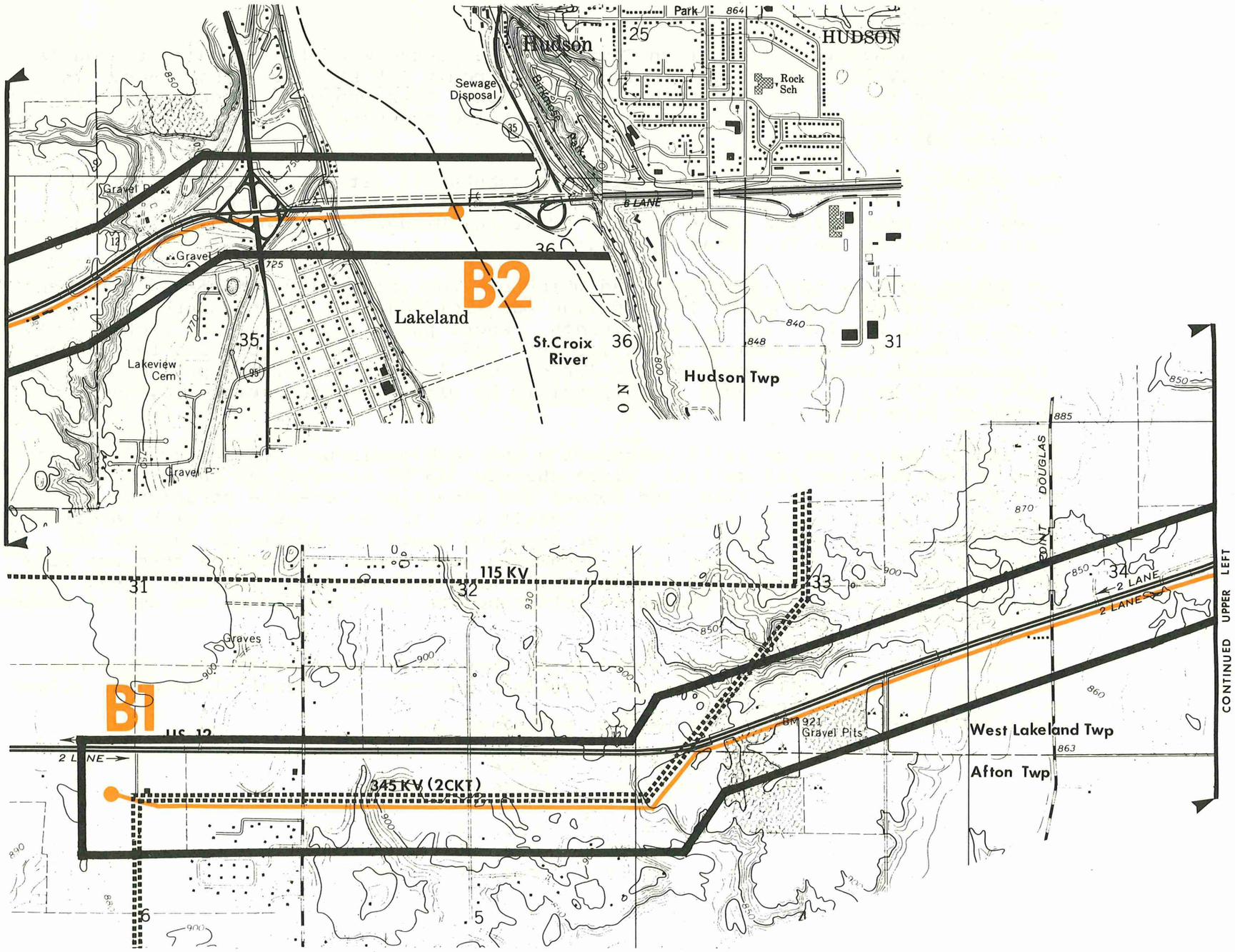
The reference centerline for this segment has two optional alignments after exiting the substation at B1. It can follow either side of the existing double-circuit 345 kV line east to where it crosses U.S. Highway 12, or it can be adjacent to Highway 12 for the same distance, which is 1.67 miles. At the point where the existing double-circuit 345 kV line crosses U.S. Highway 12 to contine north, the segment reference centerline continues east along the south side of U.S. Highway 12.

The interchange at the juncture of U.S. 12 and Minnesota Highway 95 would be crossed on the south end. Exact locations for structures have not been determined, but generally the interchange area is congested with associated highway facilities and residences in close proximity on the southeast side, providing limited access without extensive disruption of existing land uses. A take-off structure for a single span crossing of the St. Croix River would be near the interchange to utilize the height, or nearer the river edge to reduce the span. In either case, the take-off structures on both sides of the river will be a very large steel lattice design. The river is 3300 feet wide at the reference centerline crossing point. The span will be longer depending on structure sites selected.

In Wisconsin, the reference centerline would cross the I-94/Wisconsin 35 interchange south of Hudson. A large structure would have to be within the interchange area or further up on the side or top of bluff adjacent to the south side of I-94. Continuing east, the right-of-way would possibly displace one or more commercial buildings near the Hudson House Restaurant, or, as an option, angle south away from I-94 to avoid displacement, returning to the interstate highway once past the buildings. From this point, the right-of-way would follow I-94 to Eau Claire.

A primary consideration in assessing the potential of this segment is the planned reconstruction of the U.S. 12-Minnesota 95 interchange in Minnesota. This is the "missing link" of the I-94 Chicago route, and extensive construction is planned within the next five years. Approximately 2 and 3 miles west of the river, a weigh station and a combination rest area/tourist information center are planned for the new interstate. The proposed tourist center is of an atypical configuration, perpendicular to the freeway, and extending approximately ½ mile north of the freeway.

The potential for the proposed line sharing rights-of-way with U.S. 12 (in Minnesota) is limited unless displacement of commercial buildings and homes occurs. Along the section where the existing double-circuit 345 kV line parallels U. S. 12 (approximately 800 feet to the south), a new right-of-way could follow the south side without displacing existing buildings. This right-of-way would share 60 feet with the existing right-of-way and require 90 feet of additional right-of-way.



proposed route segment B1-B2

Segment C1-C2

Node C1 is in section 30 of Afton Township at a juncture of the north-south double-circuit 345 kV line and an east-west single-circuit 115 kV line. The 115 kV line passes under the 345 kV line with no connection. This proposed segment would require a new 345 kV substation at this point to link the proposed 345 kV line with the existing 345 kV line.

The segment reference centerline exits the substation site to the east along the existing 115 kV line. It extends in a straight alignment for approximately four miles along half section lines to node C2 at the Minnesota-Wisconsin state boundary (main channel of the St. Croix River).

Two design options have been proposed which use the existing right-of-way alignment. The first design would place the new line parallel/adjacent on the south side of the existing line for the full segment length. Where possible, 10 feet of right-of-way could be shared, requiring at least 140 feet additional and at most 150 feet. The river crossing would be spanned with large steel lattice structures placed on either sides' bluff top. Four homes would possibly be within, or very close to, the right-of-way or very close.

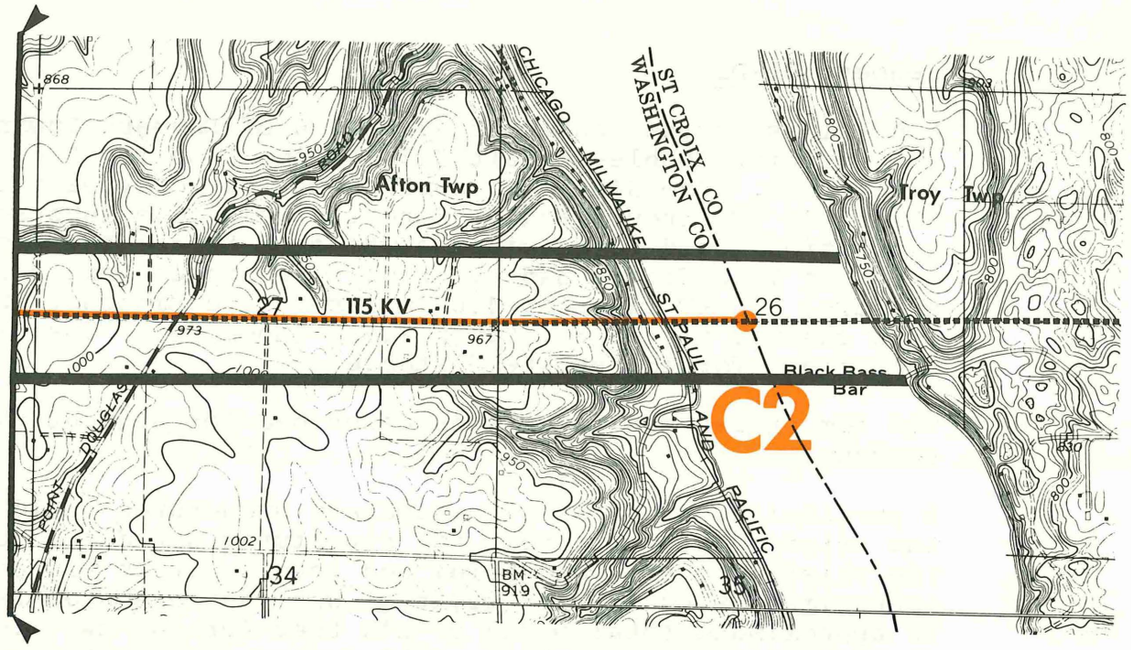
The second design option is to construct a new double-circuit 115/345 kV line adjacent to the existing 115 kV line, place the new 345 kV circuit and the existing 115 kV circuit on the single line, and remove the remaining wood-pole structures now supporting the existing 115 kV line. The result is still one line, but with larger structures and two circuits. The river crossing would be rebuilt to support the double-circuit 115/345 kV line, also requiring much larger structures than are presently there. Additional right-of-way would be required, probably about 50-60 feet. The major advantage of this design is retaining the two circuits on one set of structures rather than two.

A variation of the above option would be to rebuild and consolidate the two lines (existing and new) only at the river crossing, and retain a parallel/adjacent alignment from C1 to the river.
Costs projected for the design options mentioned are:

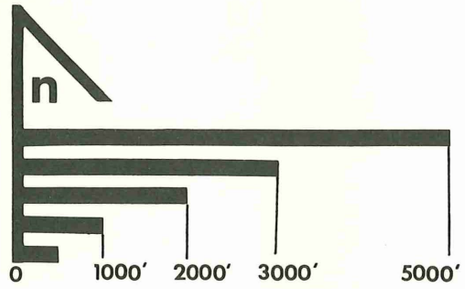
	Node B1 to River	River Crossing	Total
Parallel/Adjacent	$1,066,000*	$425,000	$1,491,000
Rebuild Entire	1,919,000	800,000	2,519,000
River Rebuild Only	1,066,000*	800,000	1,866,000

*Steel pole costs

Other costs are shown in Table 2-1, Alternate Route Costs.







route boundary

node

reference centerline

existing transmission line

proposed route segment C1-C2

Segment D1-D2

Node D1 is at the center of section 6 of Denmark Township. It is the point at which the existing double-circuit 345 kV line from the King Plant diverges in opposite directions. One 345 kV circuit angles directly east to continue to Eau Claire; the other 345 kV circuit angles directly west to a substation at Newport. A new 345 kV substation would be required at Node D1 to tie the proposed 345 kV line with the existing Twin Cities 345 kV grid. The segment exits Node D1 directly east along the existing 345 kV line for 4.07 miles to the Minnesota-Wisconsin state boundary at the main channel of the St. Croix River (Node D2). The alignment follows half section land lines for the entire distance.

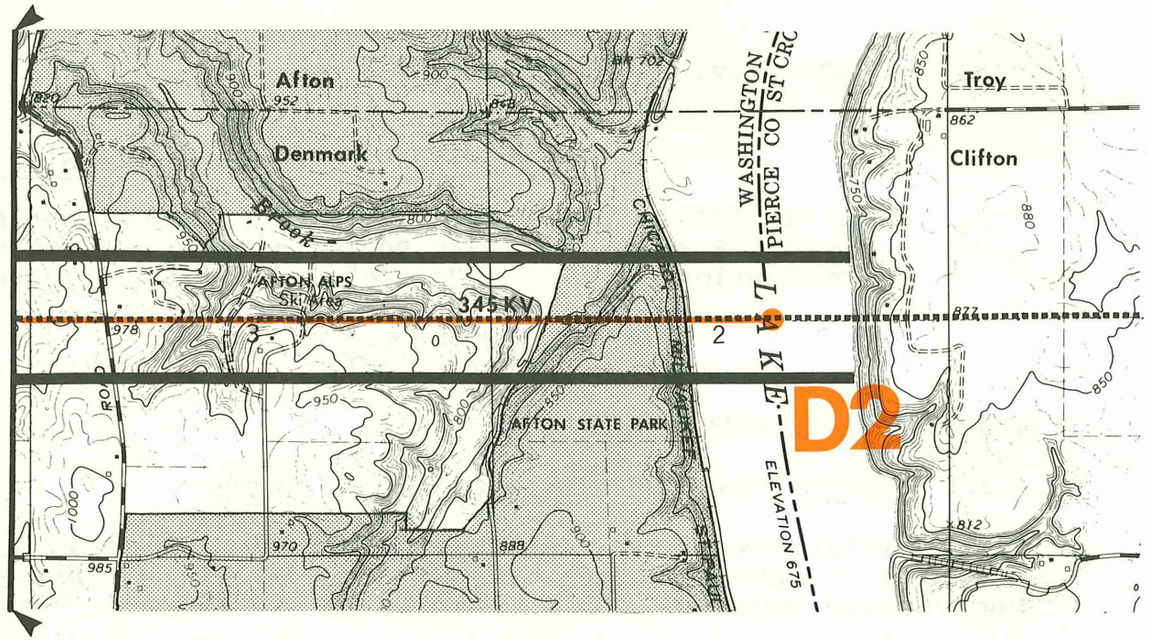
The same three design options described for segment C1-C2 are available for this segment.

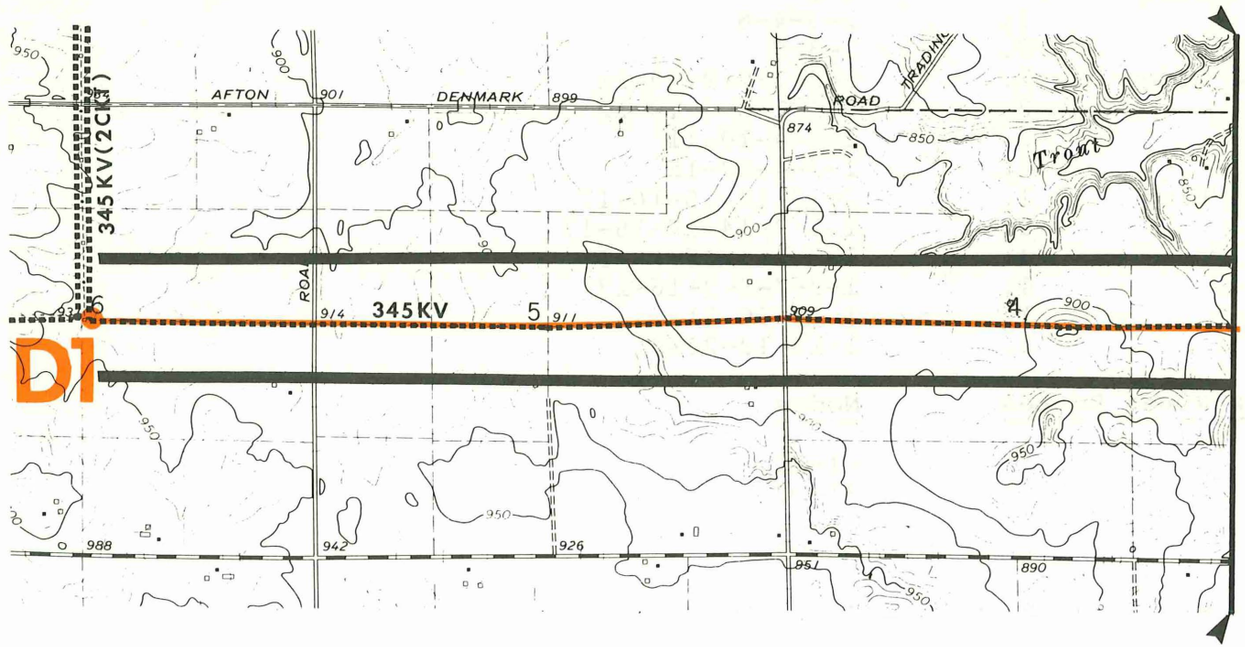
A parallel/adjacent line on separate structures could be installed on either side of the existing 345 kV line. New structures would probably be the same configuration as the existing ones (wood-pole) and spans between new and old matched closely. Approximately 60 feet of right-of-way can be shared requiring 90 feet additional, for an approximate total width of 240 feet for the two lines. The river crossing for a new parallel/adjacent line would require large steel lattice structures very similar to the two existing structures.

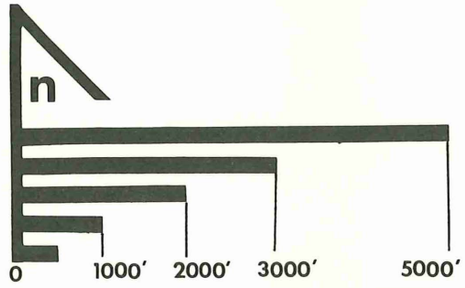
The second option would involve installation of a new double-circuit 345 kV line as close as possible to the existing 345 kV line probably on the south side then moving the existing 345 kV circuit to the new structure and stringing a new 345 kV circuit to complete the double-circuit. The old wood pole structures would then be removed.

The new double-circuit line would probably be a single steel pole design. Depending on the line's final configuration, very little, if any additional right-of-way will be required. The St. Croix River crossing will require much larger steel lattice structures than exist now on the bluffline above either side of the river. The existing span between structures is 2,740 feet. This would be the approximate span for any new crossing. Existing structures are approximately 125 feet in height.

A combination of the two design options described above would involve construction of a new parallel/adjacent 345 kV line from node D1 to the river bluff, and a rebuild of the existing line to consolidate the old and new single-circuit lines on one double-circuit line. This design would require approximately 90 feet of additional right-of-way, except perhaps at the river crossing structures where it may be less.







route boundary

node

reference centerline

existing transmission line

proposed route segment D1-D2

Costs for the above options are as follows:

	Node D1 To River	River Crossing	Total
Parallel/Adjacent	$ 674,000*	$400,000	$1,074,000
Rebuild Entire	1,546,000**	750,000	2,296,000
Combination	574,000*	750,000	1,424,000

*Wood-pole
**Steel pole

4.3 SUMMARY OF ROUTE IMPACTS

4.3.1 ENVIRONMENTAL INVENTORY TOTALS FOR ROUTES

Environmental inventory items shown in Table 4-2a-e have been totaled for the combinations of segments which make up complete routes. For reference the routes are again listed here:

Mississippi River Routes		Nodes
Prairie Island		1-2
Trenton	1.	1-3-4-6
	2.	1-3-5
North Red Wing	1.	1-3-7-8-9-10-11
	2.	1-3-7-8-9-10-12
	3.	1-3-4-10-11
	4.	1-3-4-10-12
South Red Wing	1.	1-13-14-15-16-17
	2.	1-3-7-14-15-16-17
	3.	1-3-7-8-15-16-17
	4.	1-3-7-8-9-16-17
Prescott	1.	1-18-20-21
	2.	1-13-19-20-21

St. Croix River Routes	Nodes
A	A1-A2
B	B1-B2
C	C1-C2
D	D1-D2

The inventory totals are shown in Tables 4.3 a-e.

4.3.2 DESCRIPTION OF COMPLETE ROUTE IMPACTS

4.3.2.1 Mississippi River (Prairie Island) Routes

Twelve complete routes have been accepted by the MEQB as alternatives which would cross the Mississippi River. All of the twelve alternatives begin at the existing Prairie Island substation, but terminate at seven different river crossing points. The routes vary in complexity from only a single segment to a combination of seven segments.

Prairie Island Route (Nodes 1-2)

The Prairie Island route is a single segment, connecting the existing 345 kV substation at Prairie Island (Node 1) to the state boundary at mid-river (Node 2). It is .75 miles long and is the shortest of the 12 alternative routes which cross the Mississippi River. The route was proposed by NSP in their original application. 4-40

In Minnesota, the route crosses no human settlement or private property other than NSP's property at the generating plant. The island spit crossed is public lands controlled by the U.S. Corps of Engineers. An important characteristic of the route is that it does not include any type of existing right-of-way.

Construction of the river crossing will require vegetation clearing at structure sites and on much of the 150 feet wide right-of-way. The MEQB will consider requiring that vegetation screens at the river crossing remain uncut, except those trees which immediately violate safety clearances, or have the potential to do so within the next growing season. Use of herbicides will not be permitted in the river floodplain. These two stipulations will apply to all river crossings discussed in this report.

Continuation of this route in Wisconsin presents more significant potential impacts than in Minnesota. The focal area of concern is the marsh area adjacent to the main channel in Wisconsin. The route crosses the marsh area for approximately 4000 feet before reaching higher ground near County Highway E. NSP has proposed the possibility of constructing the line on double steel poles through the marsh area. This would allow short spans between structures of about 500 feet, and shorter structures approximately 70 feet tall. Therefore, the lower sag would place the conductors at or below the tops of the adjacent trees in most places, thus minimizing the potential of waterfowl flying into the conductors.

The potential for bird kills (referred to often as avian mortality) resulting from collisions is a concern of many citizens and both state and federal natural resource agencies. The loss of productive waterfowl habitat is also a possiblity and a concern. Several reports and/or positions have been submitted to the MEQB staff regarding potential impacts of the proposed line on waterfowl and, to a lesser extent, on eagles. These reports/positions are provided, in part, in Appendix B.

Interested parties generally agree there will be some waterfowl collisions if the proposed line is within this route. The number of potential collisions cannot be projected without additional detailed field studies. This issue has been the subject of several research efforts in other parts of the country, and the primary topic of numerous publications. It continues to be a controversial consideration in transmission line projects which are proposed to cross waterfowl habitat, particularly within major migratory routes.

Since waterfowl collisions with the proposed line can be reasonably expected to occur, though the extent cannot be determined, efforts to reduce the collision potential should be undertaken. NSP has proposed a lower than normal line design through the marsh area as a means of keeping the conductors as near to average tree height as possible. The crossing of the Mississippi River will have to be high enough to meet clearance requirements. Use of a double span with an island structure will reduce overall structure heights. Large colored spheres will be placed on the highest shield wires as required for aircraft navigation.

The MEQB has no authority to stipulate design or construction requirements on the Wisconsin side of the river crossing, and will therefore consider mitigative efforts on the Minnesota side only. This does not preclude coordinated mitigation planning by the two states.

Trenton 1 Route

This route is 5.41 miles in length, and runs between the Prairie Island substation (Node 1) and the Minnesota-Wisconsin state boundary at Diamond Island (Node 6). The crossing of the Mississippi River at Diamond Island is narrow, measuring approximately 250 feet. Diamond Island is on the Wisconsin side of the state boundary.

The initial segment of the route will affect three houses along the CMSP&P railroad tracks. The proximity of the houses to a final centerline cannot be determined at this time. It is possible those the houses would have to be removed.

The alignment along the CMSP&P tracks may affect communciations now in place, and require mitigation. The CMSP&P Railroad Company has objected to this route and other routes along their tracks on the basis of anticipated inductive and magnetic coupling with the railroad's transcontinental signal and communication systems. Further analysis is required to determine the extent of this impact. An additional concern is potential train derailment where the transmission line parallels the railroad right-of-way.

Much of the route would cross lands under present or planned ownership of the Dorer Memorial Hardwood State Forest. The Red Wing Wild Life Protection League also owns extensive habitat area along the last segment of the route. This last segment requires 1.82 miles of new right-of-way across open and wooded wetland.

The river crossing would require a double span with a center structure on Diamond Island. Two of the three structures would be in Wisconsin. The proposed transmission line will cross the island at a point just south of a cabin on the east side of the island. The span from the island to the Wisconsin mainland will be highly visible from two points to the south: the community of Trenton on the Wisconsin side less than a mile away, and a public beach less than a half mile away on the Minnesota side. The public beach is provided by the Red Wing Wild Life Protective League.

Trenton 2 Route

Trenton 2 route is 4.4 miles in length, about a mile shorter than Trenton 1. The Trenton 2 route was added by the Prairie Island Citizens Route Evaluation Committee as an alternative to Trenton 1. Refer to the Trenton 1 route description for discussion of segment 1-3, whch is common to Trenton 1 and 2 routes.

The primary difference between Trenton 1 and 2 is a crossing of the Mississippi River north of Diamond Island. Trenton 2 has a shorter and more direct alignment through the wooded lowlands south of Lock and Dam No. 3. The river crossing would be a single span, continuing in Wisconsin to cross the south end of Canterbeim Lake. The lake and marshes to the north of it are owned and managed for waterfowl production by a private hunting club. There would be low visibility of the river crossing from riverfront developments or Lock and Dam No. 3.

North Red Wing (NRW) Routes 1-4

Four routes provide two alternative means of reaching two river crossing points. All four routes emanate from the Prairie Island substation (Node 1) and have Segment 1-3 in common for its 3.10 mile length.

North Red Wing 1 and 2 routes also have in common Segments 3-7, 7-8, 8-9 and 910. They then diverge at Node 10 to have separate river crossings using segments 1011 (NRW 1) and 10-12 (NRW 2).

The two routes follow existing rights-of-way for most of their length from Prairie Island to just north of downtown Red Wing, where they require separate, new rights-ofway to reach river crossing points.

North Red Wing 3 and 4 routes have in common segments 13, 3-4, and 4-10. They then diverge at Node 10 and continue separately to two river crossing, as did North Red Wing 1 and 2 routes. The primary difference in NRW 1 and 2 and NRW 3 and 4, other than separate river crossings, is the approach to Node 10 along different alignments. Segments 3-7-8-9-10 (NRW 1 and 2) is .33 miles longer than Segments 3-4-10 (NRW 3 and 4).

Overall the four North Red Wing routes are not significantly dissimilar. The differences between the two river crossing approaches (10-11 and 10-12) are perhaps most important in that each crossing requires new rights-of-way. In Minnesota, segment 10-11 crosses more undisturbed marshland than does 10-12, and provides less available access to the right-of-way. Impacts to wetland habitat would be greater along segment 10-11, which is longer (1.88 miles) than 10-12 (1.61 miles).

However, in Wisconsin, segments 10-12 has more potential impacts. Segment 10-12 extends a longer distance (5,500 feet) to reach a common point than 10-11 (500 feet). A single route in Wisconsin continues from this common point north along U.S. Highway 63. Segment 10-12 would be closer to more homes in the community of North Red Wing, Wisconsin and would require more new right-of-way.

South Red Wing (SRW) Routes 1-3

The three South Red Wing routes have their last segment in Minnesota, segment 16-17, in common. This segment follows an existing 69 kV line for its entire 6.44 mile length. It crosses the Mississippi River at the east end of Barnes Bluff and the City of Red Wing; and is described in the segment analysis section. Summarily, the segment has the following characteristics:

Crosses in Minnesota:

numerous steep, erodible slopes; Red Wing City Park with scenic overlooks; within 500 feet of Twin Bluffs Junior High School; 34 homes in right-of-way; 188 homes within 500 feet of right-of-way; near two large communication towers: TV and Cablevision; Isaak Walton League property and clubhouse; very near historic Carlson Limestone Kiln (on National Register); within view of numerous scenic overlooks in the Red Wing vicinity; and a cemetery.

Crosses in Wisconsin (near river):

Pierce County Island State Public Hunting Grounds; within 500 feet of the Prairie View Ellsworth Elementary School; and proposed glide slope of Red Wing Municipal Airport expansion.

The extensive impacts of this segment burdens each of the three South Red Wing because all three south Red Wing routes include the segment. Of the three routes, SRW 1 would have greater impact on agriculture operations. It is also longest of the three South Red Wing routes and longest of all routes beng considered (17.13 miles). SRW 2 and 3 are shorter, but between Nodes 1 and 16, they affect more residences than SRW 1.

Each of the three SRW routes follow existing rights-of-way, which was the original basis for their proposal.

Prescott Routes 1 and 2

Both Prescott routes emanate from the Prairie Island substation and cross the Mississippi River at Node 21 between Prescott and Hastings.

Prescott 1 route follows the CMSP&P railroad for most of its length. It would share approximately 60 feet of right-of-way, though access for construction would require extensive clearing and disturbance. The route's alignment through the Gores Wildlife Management Area may result in altered habitat quality and/or management, though this potential is reduced by placement of the line next to the railroad. The route includes segment 18-20 which requires .85 miles of new right-of-way across wooded wetlands. This route is within 500 feet of more homes than the Prescott 2 route (39 versus 14). If communications interference along the CMSP&P railroad occurs, mitigating measures will be required.
Prescott 1 route would cross a private air landing strip, requiring abandonment or relocation of the airstrip.

Prescott 2 route is an alternate to Prescott 1, and generally parallels it but at a distance of just over a mile to the southwest. It follows existing rights-of-way for its entire length of 15.11 miles. Of this total length, 13.82 miles will be parallel and adjacent to two existing single-circuit 345 kV lines. The proposed line will be very similar to the two existing lines, and result in three single circuit 345 kV lines in one right-of-way, which will be approximately 330 feet in total width. The total right-of-way will be wider for the intial segment of the route near the Prairie Island substation. Segment 1-13 is 2.27 miles long.

Agricultural impacts are an important consideration on the Prescott 2 route. The proposed line will cross 7.5 miles of cultivated fields with a diagonal alignment, as do the existing two lines. The resulting three lines will increase the difficulty of farming now experienced with the existing two lines. The additional line may further limit irrigation development, depending on final alignment.

The Prescott 2 route will result in impacts on the numerous wooded slopes crossed. Erosion potential is moderate to severe on these slopes. Wetlands crossed near Prescott will be affected by the overall disturbance of clearing and construction: the long-term impacts will be in addition to those of the existing lines.

Residences will not be directly crossed, but 14 homes are within 500 feet of the Prescott 2 route's reference centerline. These homes are concentrated near the Prairie Island substation and the community of Etter in Dakota County.

4.3.2.2 St. Croix River (King) Routes

Four complete routes have been accepted by the MEQB as alternatives which would cross the St. Croix River. The four routes have separate starting points, all within Washington County, and separate end points at the Minnesota-Wisconsin state boundary, which is the main channel of the St. Croix River. None of the four routes crosses or interconnects at any point. Each of the four complete routes has its alignment entirely along existing transmission line or highway rights-of-way. Each route was described as a segment (example: Route A is segment A1-A2) in Section 4.2.2.2.

Route A

Route A is the shortest of the four St. Croix routes: it is .8 miles in length. It also has the least overall impact in Minnesota in that the right-of-way would be predominantly on existing NSP property at the Allen S. King Generating Plant. Adjacent property that may be required for part of the proposed right-of-way is undeveloped lowland owned by the Andersen Window Corporation. The exact alignment and entry into the generating plant complex have not been determined, though any alignment will have very little overall impact. The route's reference centerline is presently along the existing 69/115 kV line on the south side of the plant. This alignment assumes a rebuilding of the existing line.

The nearest homes are along Point Road which is south of the King plant. The closest home will be 700 to 800 feet from to the proposed line.

The potential visual impact of Route A will be shared by both Minnesota and Wisconsin, through the presence of the existing King plant, substations, and west-south transmission lines already reduce visual quality in the vicinity. The proposed line wil be more intrusive than the existing line due to requirements for heavier structures and conductors. Vegetation clearing on the Minnesota side of the river will not be extensive. However, clearing on the Wisconsin slopes above the river can be a severe visual impact if not limited to absolutely necessary tree removal. The existing 69/115 kV right-of-way has stabilized very well since earlier construction and is relatively obscure at this time. The existing wood-pole structures which traverse the slopes are also relatively obscure when viewed from Minnesota. The potential visual impact on the slopes can be reduced if NSP uses wood-pole structures and limits tree cutting to only that essential for reliable and safe operations. The MEQB will have no authority over activity on the Wisconsin side of this route.

Route B

Route B generally follows U.S. Highway 12 from an existing substation adjacent to the highway to the U.S. 12/I-94 bridge at Hudson. The existing substation is presently under construction as a 115 kV substation. It is adjacent to the existing double-circuit 345 kV line, which goes south out of the King Plant, then west along the south side of U.S. 12, and turns directly south at the 115 kV substation site. The proposed line in this route would require expansion of the substation to accommodate a 345 kV tie-in. Existing NSP land ownership at the site will probably be adequate. Upon leaving the substation, the proposed routes reference centerline is separate to permit an alignment east and adjacent to the South side of U.S. 12 or adjacent to the south side of NSP's existing double-circuit 345 kV line. The alignment along U.S. 12 is not discussed further here because the alternative along the existing transmission line is a better alignment for the following reasons:

1. The U.S. 12 alignment would directly affect existing and proposed development along the highway;

2. The U.S. 12 alignment conflicts with planned upgrading of U.S. 12 to I-94;

3. The U.S. 12 alignment would separate the proposed line from the existing double-circuit line by a distance of approximately 500 feet;

4. The existing double-circuit line was originally located on its present alignment for the specific purpose of avoiding impacts along U.S. 12; and

5. The ability to share right-of-way along U.S. 12 is questionable whereas approximately 60 feet of existing right-of-way can be shared with the present double-circuit line.

The Route A reference centerline is parallel and adjacent on the south side of the existing transmission line for 1.70 miles, at which point the existing line angles north and across U.S. 12 to continue north. The proposed line follows the south side of U.S. 12 for 3.03 miles to cross the St. Croix River on the south side of the bridge.

A home recently constructed next to the existing double-circuit line in Section 6, Afton Township, will have to be removed if the proposed line is placed in this route. Along U.S. 12 and at the intersection of County Highway 21 (Point Douglas Road), five residences would probably be removed. The residences appear to be permanently occupied units of a small motel. More development is crossed near the U.S. 12/Minn. 95 interchange. A truck stop and at least two homes are adjacent to U.S. 12 on the south side. These would possibly be displaced depending on the design of the proposed line and clearance requirements. This development could be avoided if the final centerline angled east away from U.S. 12 to pass behind the development and returned to parallel U.S. 12 just past it. Three homes are adjacent to the south side of U.S. 12 between the U.S. 12/Minn. 95 interchange and the St. Croix River edge. It is unclear if these homes would be displaced, but if not, they would be very close to the right-of-way edge.

The crossing of the St. Croix River presents the most severe probable impact of Route B. Two types of aerial spans are feasible; each would be separate from and south of the two bridges. A single span would require very large steel structures on either side of the river. Multiple spans would place smaller structures in the river in addition to those on the river side approaches. In either case the visual impact would be severe. No aerial crossing other than the two bridges now exist. The proposed line crossing would be visible to much of Lakeland, Minnesota and Hudson, Wisconsin, travellers on U.S. 12 and Minn. 95, recreationists on the St. Croix River, and residents along the bluff line on both sides of the river.

The proposed route's alignment along U.S. 12 has elicited the following information from the Minnesota Department of Transportation (MDOT).

"A contract for the construction of the interchange between T.H. 95 and I-94, immediately adjacent to the west end of the bridges, is scheduled for letting in December of 1981. The scheduled interchange construction will dominate the remaining land in this area, which is hemmed in on the northwest by an extensive aggregate operation. Mn/DOT has had to work around this extensive mineral deposit to get the interchange into the area that is left, and any transmission line approach in this area would be extremely difficult. Accommodation of utilities on freeway rights-of-way is governed through Title 23 of the Code of Federal Regulations. Section 645, Subpart B, of Title 23 CFR requires conformance with the American Association of State Highway and Transportation Officials' (AASHTO) Policy on the Accommodation of Utilities on Freeway Rights of Way (attached). Basically, the AASHTO policy precludes the placement of new utility facilities on freeway right-of-way, except in cases where a hardship can be proven. The policy states that:

"There may be extreme cases where a utility may be permitted along a freeway on a new location under strictly controlled conditions. In each case there must be a showing that any other utility location is extremely difficult and unreasonably costly to the utility consumer, the installation on the freeway right-of-way will not adversely affect the design, construction, stability, traffic safety or operation of the freeway and the utility can be serviced without access from the through-traffic roadways or ramps.

"If an "extreme case" is proven by the utility, the utility placement must also conform to the twelve conditions outlined in Appendix A of Title 23 (pages 259-260 of Title 23). An additional limitation imposed by the AASHTO policy is that:

> "A new utility will not be permitted to be installed on a structure across a major valley river at and after the highway route is improved, except for extreme cases, in which cases the utility is to be located off the freeway right-of-way at both approaches to the structure.

"The above described limitations imposed upon utility accommodation on freeway right-of-way by the AASHTO policy have the full effect of law and severely limit the feasibility of the corridor/bridge sharing considerations discussed in this draft environmental impact statement.

"Recent attempts to provide greater flexibility within the AASHTO policy resulted in Section 113 of the Surface Transportation Assistance Act of 1978 which amended Section 109 of Title 23. The intent of the Surface Transportation Act's amendment of Title 23 was to require that impacts on agricultural lands be considered in utility routing decisions. Since the amendment does not delete or supercede any portion of the existing AASHTO policy, the precise nature of its impact on utility placement on freeway rights-of-way is uncertain at the present time. It is probable, however, that any new policy will be oriented toward potential overhang of freeway rights-of-way rather than toward actual placement of structures on freeway rights-of-way.

"While the amendment passed both Houses of Congress, its language did not fulfill the authors' intent and work was immediately begun on a technical amendment to alter the language. The problem presented by the amendment's language is that it renders the state or federal government liable for any accident which might occur involving any utility facility placed on the right-of-way, regardless of where it might be placed, and regardless of the probability of such an accident. The technical amendment proposed to correct the problem has passed the U.S. House and is presently in the U.S. Senate, which will hopefully pass it by fall of 1979.

"Once the technical amendment has passed Congress, it will result in a new rule making process. The policy being amended is a national policy, and will therefore require the involvement of every state in the rule-making process. Each state will be contacted for input and a preliminary draft of the new rules will be circulated to all state authorities and utilities for review. Review comments will be considered, and eventually new regulations regarding utilities accommodation will be promulgated. This rule making process is expected to take a minimum of one year to accomplish. Until this process is completed, the present AASHTO Policy on the Accommodation of Utilities on Freeway Right of Way will, of course, continue to have the effect of law."

Route C

Route C is four miles long. It begins at the point where two existing lines intersect a north-south double-circuit 345 kV line and an east-west 115 kV line: both are NSP lines. The crossing point of the two lines would require a new 345 kV substation at which the proposed 345 kV line would tie in with the existing 345 kV line. The substation site would require purchase of approximately seven acres in the center of section 30 of Afton Township. Land use at this site is presently agricultural.

The initial 1.5 miles of the route crosses rolling, cultivated lands. The remaining 2.5 miles become more hilly and residential as the route approaches the St. Croix River.

Two location options were discussed in the segment descriptions in Section 4.2.2.2. An alignment parallel, adjacent and south of the existing 115 kV line would place new structures in cultivated fields approximately 70 feet from the existing line. The existing line is on half section lines and thus predominantly on field edges. The new line in this alignment would affect farming efficiency near structures. The parallel alignment would also affect three homes which are near the existing 115 kV line. If minimum clearances do not require removal of the homes, the homes will be immediately adjacent to the proposed line.

The rebuild option would have lesser overall land use impact than the parallel design. However, the new line would probably be constructed while the existing one still operates, requiring new structures to be placed 20 to 50 feet into cultivated fields. This option would benefit landowners on the north side of the property line, because existing 115 kV structures would be removed. however, it would affect agricultural landowners on the south side who previously have had no structures to farm around. This reversal of impact is avoidable if the existing line were to be removed before constructing the new line so that the new line could be constructed on property lines (half section lines).

The crossing of the St. Croix River is a primary impact consideration on this route, as it is for all other route crossings. Rebuilding the existing 115 kV line to become a double-circuit 115/345 kV line will significantly increase visual impact. This will result from the much larger structures required and the vegetation clearing necessary for clearances. The existing 115 kV line crossing is unobtrusive compared to the changes necessary to replace it with a double-circuit 115/345 kV line. Homes on the slopes of both sides of the river will be affected. Numerous residences along River Road on the Minnesota side will have full exposure to the visual impact.

Route D

Route D is similar to Route C in that a new substation is required at its beginning point, the existing transmission line is along half section lines, agricultural land use predominates the western half of the route and the same two design options are available. Primary differences are that the existing line is an NSP single circuit 345 kV line and the eastern half of the route is predominately by public recreation lands.

The new substation in Section 6 of Denmark Township would require approximately seven acres of presently cultivated land in the center of the section. The existing line presently crosses about the same distance of cultivated fields as Route C, but has greater impact in that fields continue across the half section line, and structures thus are not along field edges. The rebuild option would not add significantly to this present impact. The parallel option on either side of the existing line would increase the cultivation difficulty, though matching structures would help limit this additional effect.

The route's impact on the Afton Alps Ski Area is difficult to project. The ski area presently is crossed by the existing 345 kV transmission line. The addition of another line would further diminish the aesthetic quality of the area. It appears to be very difficult to construct a second parallel line through the area without severe disturbance to present uses and facilities. Rebuilding to a double-circuit 345 kV line on single shaft steel poles is feasible and probably the only reasonable means of crossing the facility without major problems.

The Afton State Park is adjacent to the ski area and between the ski area and the St. Croix River. The present 345 kV line was constructed before the park land was acquired. The park has been recommended for classification as a natural state park, largely because it is a relatively unspoiled piece of land in a metropolitan area that has virtually no other public areas available for experiences in an uncrowded natural area. The park is yet undeveloped, but is scheduled for initial user facility construction in 1981. The proposed route and the existing route have an approximate one-half mile crossing at the center of the park. An additional line through the park whether its parallel to or a rebuild of the existing one, will impair the intent of the parks designation and limit the potential for natural experiences.

The route's crossing of the St. Croix River will require larger structures than are present for the existing single-circuit 345 kV line. Are built double-circuit 345 kV crossing would be slightly larger than the double-circuit 115/345 kV crossing proposed for Route C, though the additional visual impact would be less overall. The existing 345 kV structures and lines are dominant features of the bluffline and the river area.

4.4 RELATED STUDIES OF ROUTE IMPACTS

4.4.1 Visual Impacts

The visual impact of the proposed transmission line is a primary consideration in this review. All alternative routes cross either the Mississippi River or the St. Croix River. Both rivers are important water resources of Minnesota and Wisconsin. Designation of the Lower St. Croix as a National Scenic Riverway requires special consideration of the river's visual character, yet the portion of the Mississippi river being considered for crossing is visually unique in several areas.

The potential for visual impact is significant at all proposed crossings. A detailed assessment of the potential visual impact has been prepared by the staff of the MEQB under separate cover for review. The report is entitled "Visual Impact Analysis: Proposed Minnesota Routes for a 345 kV Transmission Line, Prairie Island/King-Eau Claire, Wisconsin." It is available at the libraries listed in Appendix C.

An earlier study performed for the MEQB Power Plant Siting Program, entitled "Visual Sensitivity of River Recreation to Power Plants," includes the following in its general discussion of transmission lines:

> A normal transmission line design criterion is to minimize grouping of many circuits on one right-of-way because of the greater potential loss of service that might result from a single catastrophic event, such as a tornado or aircraft crash, on the right-of-way. However, a reasonable grouping of circuits does minimize the visual impact on rivers that the lines must cross and should, therefore, be encouraged.

Some design criteria that should be used to reduce the visual effects of transmission lines on recreational rivers are as follows:

- Locate the power plant on the same side of the river as its main market, thus enabling the majority of the lines to be routed to their destinations without crossing the river.

- Rebuild existing crossings, accommodating the existing conductors on new, double circuit towers where possible.

- Use double circuit towers at crossings.

- Locate towers back from the river's banks and make them tall enough so that the conductors cross the banks sufficiently high that screening belts of trees can be retained there.

4.4.2 Agricultural Impacts

A detailed analysis of potential agricultural impacts has not been performed for this project in Minnesota, since the major issues have focused on the river crossings. However, 12 of the 16 alternative routes do cross one or more cultivated fields which will be potentially affected.

Several studies have been conducted which specifically assess potential agricultural impacts. The most recent report entitled "High Voltage Transmission Lines: Agricultural Issues and Impacts," (1979) was prepared by the Minnesota Department of Agriculture with partial financing from the MEQB Power Plant Siting Program. The report concluded:

> Fundamentally, this study found that the construction and existence of a high voltage transmission line on agricultural land does have significant impacts on the land and on farming operations. A litany of impacts was substantiated. These can be consequential to the individual farmer and, if allowed to occur as new lines are built in Minnesota, can affect the State's overall agricultural setting. This is not to say, however, that many of these impacts cannot be lessened through careful routing and planning. A basic revision is needed in thinking behind routing. No longer can it be accepted as a universal truth that the best routes for powerlines are over farmland. More deliberate and conscientious efforts must be made to utilize existing transportation right of ways for new power lines.

When farmland must be traversed, actions can be taken to mitigate the effects of high voltage transmission lines on agricultural land. These actions fall into three categories. First, there are recommendations to be considered during the planning and routing phase of the HVTL. Second, there are recommendations for mitigative measures which should be included in the conditions of the construction permit. And, third, there are recommended practices for safe farm operations under the line after its construction.

Routing. The careful and judicious routing of transmission lines over crop and pasture land is the single most important factor having the potential to mitigate long term impacts on agricultural land caused by HVTL's.

1. HVTL structures should be positioned on field, section, or property lines to every extent possible. Transmission lines should not be routed diagonally across fields.

2. Routing through wild rice operations should be avoided.

3. Areas of existing or potential irrigation should be avoided when less damaging alternatives are available.

Permitting. The Minnesota Environmental Quality Board, the agency responsible for administering the power plant siting program in the State, has the authority to grant construction permits to proposers of HVTL's. Conditions which should be included in the construction permit are:

4. The line must be constructed at a height which will assure a margin of safe clearance below it for the operation of aerial applicator planes, irrigation rigs, and other farm machinery and equipment.

5. Construction on cropland should be prohibited during conditions of high moisture and traffic should be restricted to as small an area as possible to minimize the extent of soil compaction. Use of existing roads should be required and excessive trips across fields avoided.

6. All farm machinery and other metal objects located or operated in the area of transmission line must be grounded to avoid the potential hazards of severe electrical shock.

7. To minimize impacts to specialty farm operations during construction or operation of HVTL's, the following measures should be taken:

   a. Beekeepers should be notified before the right-of-way is sprayed and application of herbicides timed to avoid blooming periods;

   b. Night construction near turkey ranges should be avoided;

   c. Sufficient distance must be maintained between the right-of-way area and mink shelters to eliminate the necessity of grounding;

   d. Unusual activity and noises around fur farms during breeding, whelping, and lactation should be avoided;

   e. Low-flying surveillance planes and helicopters used for line inspection should be routed away from fur and turkey farms.

Operations. Once a transmission line is constructed and operational, there are certain safety meausres which farmers should use to minimize impacts to their agricultural practices.

8. Vehicles should never be refueled within 50 feet of a transmission line.

9. Irrigation equipment should never be used directly under the power line. A safe distance must be maintained between irrigator nozzles and transmisison line conductors.

10. Fertilizers and pesticides should not be used in irrigation systems located along high voltage transmission lines.

11. Beehives should be covered and bees confined during herbicide spraying.

12. Equipment or people should not come closer than six feet to any energized conductor. No object which could be expected to make contact or near contact with the energized conductors should be lifted, elevated, built or passed under the transmission line.

The complete text of the above noted report can be requested from the MEQB Power Plant Siting Program or reviewed at the project library depositories listed in Appendix C.

4.4.3 Unique Natural Element Impacts

The presence in the two project study areas of extensive, undeveloped river bottoms and steep, wooded terrain indicated a diverse natural environment would have to be evaluated for this project. The MEQB Power Plant Siting Program contracted with the Minnesota Natural Heritage Program (joint program between The Nature Conservancy and the Minnesota Department of Natural Resources) to assess the potential for project impact on rare plants and animals, noteworthy geologic features, and proposed or designated natural areas. The assessment was conducted in May and June of 1980. The conclusions are presented here for inclusion in the project review. The full report is available for public review at the offices of the Power Plant Siting Program in St. Paul. Figure 4-1 exhibits the general relationship of proposed routes and the elements discussed in the following report summary.

Animal Occurrences

A total of 12 animal species that are of interest to the Minnesota Natural Heritage Program (MNHP) have been recorded within the study area associated with the potential transmission line corridors. The two bird species are considered with eight freshwater mussel species and two reptile species.

Depending upon the construction design utilized for river crossings (i.e., aboveground versus underground), the proposed power line could have the greatest impact, of the species considered here, on freshwater mussels. As a group, mussels are sensitive to substrate disturbance and water quality deterioration, both of which are potential by-products of the proposed construction. The presence of a federally endangered freshwater mussel, Lampsilis higginsi, within the study area makes it imperative to consider the effects of construction upon the mussel fauna.

Of the mussels of interest, the greatest concentration, both in terms of numbers of species and density, occurs in a seam located in the St. Croix River along the Minnesota border, from approximately the Hudson rail bridge downstream to U.S. Highway 12. Within this locale, three separate field surveys have found individuals of Lampsilis higginsi, including a gravid female which suggests the potential of reproduction at this site. Also at this site were six species of mussels which have been assigned to statewide status categories by the MNHP as follows: two species, in addition to Lampsilis higginsi, are considered Endangered; three species are considered Threatened; and one species is Rare.

UNIQUE NATURAL ELEMENTS

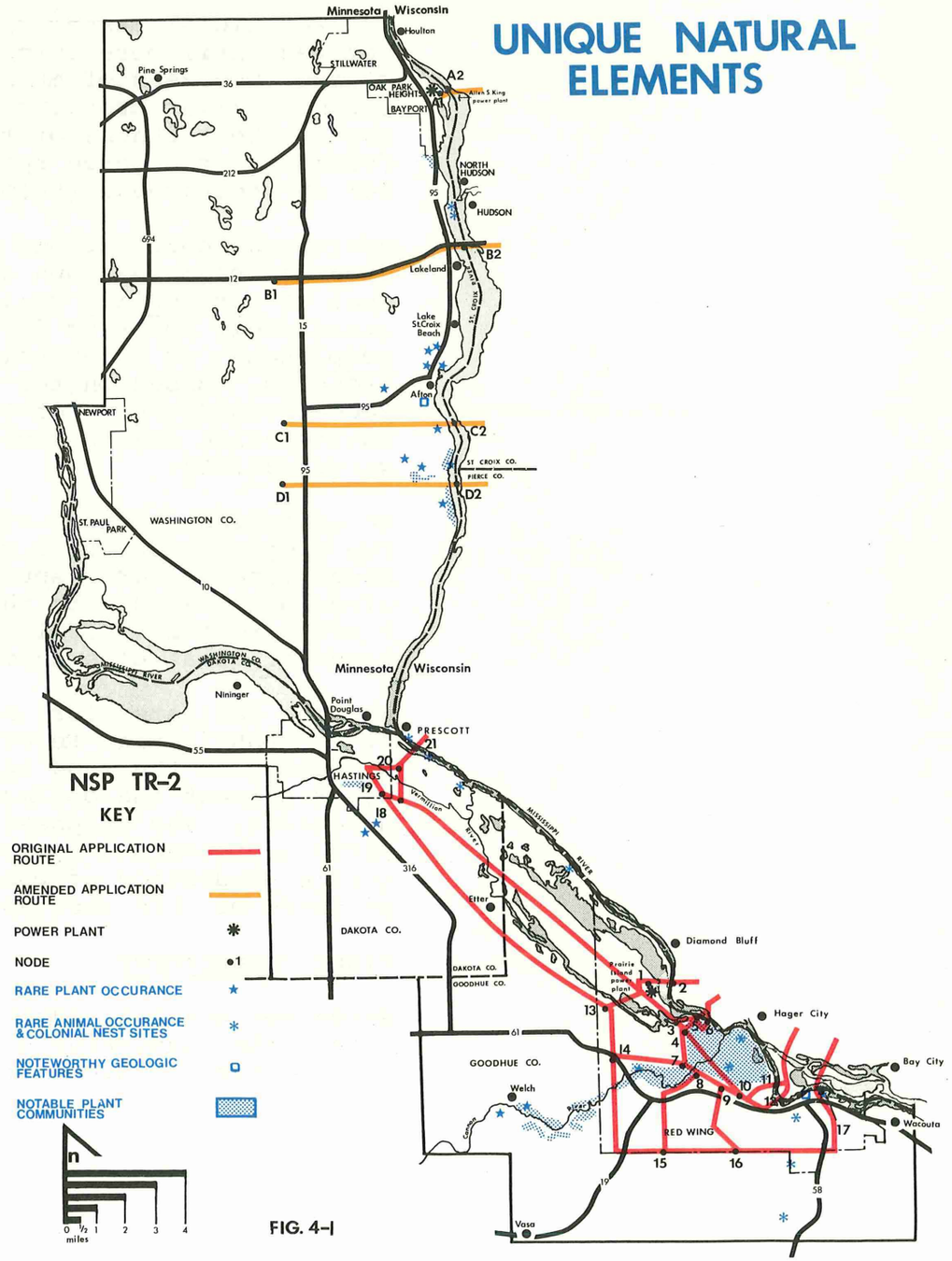


FIG. 4-1

One additional mussel species, classified as Undetermined Status, should be carefully watched until more information about its distribution and abundance can be determined. The seam of mussels described is adjacent to and immediately upstream from a proposed river crossing site (Route B) near the southern edge of Hudson, Wisconsin. Due to the richness of the mussel fauna at this site and the nearby presence of a federally endangered species, the MNHP advises against the use of proposed Route B for an underground (below river) crossing of the transmission line.

Additional observations of mussel species of interest occur near a proposed river crossing near the town of Prescott, Wisconsin on the Mississippi River. One individual of Actinonaias carinata, assigned a Threatened Status by MNHP, was observed immediately upstream from the proposed crossing while one specimen of Lasmigona complanata, of Undetermined Status, was observed immediately below the proposed crossing. Based on the evidence available, crossing the river at this site (Route Segment 20-21, part of Prescott 1 and 2 routes) would not be advocated unless the construction design caused little or no substrate disturbance and/or deterioration of water quality.

An additional element of interest to MNHP, a colonial nest site, is close enough to two proposed routes to warrant concern. It is conceivable that construction of the power line in early spring and summer could disrupt the breeding activities of the birds associated with the Devil's Lake Rookery if these routes were selected (Trenton 1 and 2 routes). Isolation apparently is an important component of the nesting locations of great blue herons and great egrets, the species nesting at this rookery.

An area nominated for inclusion within the Scientific and Natural Areas (SNA) Program of the DNR is near Redwing. The primary justification behind the nomination is the occurence of the wood turtle, Clemmys insculpta, in this area. This general locality may represent the optimal breeding habitat for the wood turtle, a rare species in Minnesota. The proposed SNA designation (portions of Sec. 13, 14, 15, 2024, T24N, R18W) is traversed by North Red Wing 3 and 4 routes. The potential effects on the turtle population of power line construction in the area is not understood but the presence of this rare species should be given consideration.

Plant Occurrences

Seventeen species, identified as rare statewide by the MNHP, are known to occur within the boundaries of the project study area. All of these 17 species are considered rare in Minnesota because they occur here at the western edge of their range.

Only two of these species are likely to be affected by transmission line construction. However, it is important to be aware of the location of all rare species within the study area for reference in planning access routes for construction and on-going maintenance of the transmission lines.

Liparis lilifolia is one rare plant species known to occur near Route C. Liparis lilifolia is an orchid of very limited occurrence. Orchids in Minnesota are under jurisdiction of the Department of Agriculture's MN Statute 17.23: Conservation of Certain Wild Flowers.

The habitat of this species is uncharacteristic of Minnesota orchids. Instead of cool, wet swamps, Liparis lilifolia requires warm, dry upland sites of the type that are typical of southeastern Minnesota. However, even where this habitat is common, Liparis lilifolia is rarely seen. In fact, this species is currenty known to exist at only two sites in Minnesota. It occurs as a small remnant population at a site in urban St. Paul and as a more viable colony near Afton. Historically, this species is known to have occurred in Dakota, Fillmore, Hennepin, Houston and Wabasha Counties. However, it has not been documented to occur in these counties since 1915. It is possible that Liparis lilifolia is extinct in one or more of these counties, but recent searches have failed to locate it. In the absence of recent confirmation, we must assume that this species has suffered a drastic decline in numbers. Additional declines can be expected as the St. Paul site comes under increasing pressure from urban development. The site near Afton may, in fact, be the best hope for the survival of the species in Minnesota. For these reasons it is recommended that every effort be made to preserve the occurrence of Liparis lilifolia located near Route C.

A second species, Carex muskingumensis is located very near the proposed route segment 16-17, part of South Red Wing 1, 2, and 3 routes, and may be adversely affected by construction activity. However, if disturbance relating to construction is limited to the corridor, and the wetland habitat adjacent to this population is not disturbed, damage to this species is unlikely.

Proposed or Designated Natural Areas

The study area and immediate vicinity have been examined for recognized natural areas including nominated, recommended, or designated Scientific and Natural Areas (SNAs) and other occurrences of notable plant communities that are known to the Heritage staff at this time. Plant communities which have been identified as being production priorities in the study area are: prairie, oak savanna, mature floodplain forest, and mature stands of "Big Woods" vegetation.

Occurrences within the project study area are:

Washington County

Name of Area: Sand Ridge Prairie

Description: This site two miles south of Bayport is reported to be a dry prairie on a "sand ridge." The present condition of this site is unknown.

Name of Area: Afton State Park

Description: Several "use-sensitive areas" designated as potential ecological protection zones in the park management plan (1979) lie within the power line corridor. These sites include oak savanna, dry prairie bluffs, and a wooded ravine.

Dakota County

Name of Area: Hastings SNA

Description: This 70-acre tract just southeast of Hastings is one of ten designated SNAs in the state. The property includes a fine example of the "Big Woods" (specifically a sugar maple-basswood-red oak forest) as well as a less mature floodplain forest. The Hastings SNA is subject to Environmental Quality Board rules on the routing of high voltage transmission lines over designated lands (6MCAR § 3.073 H2).

Goodhue County

Name of Area: Goat Prairie on Dolomite Outcrops

Description: A dry, hill prairie, presumed to be of good quality, occurs on south-facing dolomite bluffs above the Cannon River east of Welch. This site was recently nominated for SNA designation.

Name of Area: Maple-Basswood-Oak Forest

Description: The steep, north-facing slopes of the Cannon River Valley east of Welch contain remnants of "Big Woods" vegetation. This site was recently nominated for SNA designation.

Name of Area: Cannon River Floodplain/Towerview Area

Description: A good example of floodplain forest extends along the Cannon River from one mile west of the Highway 61 bridge to the Mississippi River. It includes the 337 acre Towerview Tract in Sec. 20, formerly a Nature Conservancy property that is now owned by the Red Wing School District.

Name of Area: Cannon River Flats

Description: An extensive floodplain forest at the confluence of the Mississippi and Cannon Rivers. The site includes breeding habitat for the wood turtle, Clemmys insculpta (see Animal Occurrences Section). The site has been nominated for SNA designation.

Name of Area: Barn Bluff

Description: This geologic site (see Geologic Features Section) has been nominated for SNA designation.

There are only two regions where proposed or designated natural areas might be impacted by construction in the proposed transmission line routes.

Proposed Route D crosses Afton State Park. The park management plan identified several potential ecological protection zones in and near the corridor. The "use-sensitive areas" designated as potential ecological protection zones in the park management plan of 1979 should be considered prior to construction of an additional transmission line in this corridor.

Several proposed transmission line routes (North Red Wing 1 and 2 routes, South Red Wing 1 route) traverse the Cannon River Flats area in the Mississippi River Valley near Red Wing and the Cannon River Floodplain/Towerview area; both areas contain good quality floodplain forest. Parts of the Cannon River Floodplain/Towerview area contain particularly fine stands of floodplain forest. However, due to the relatively narrow width of the Cannon River Valley, it appears that construction within the proposed route west of Highway 61 would have little impact on the floodplain forest (segment 14-15, part of South Red Wing 1 route).

The Cannon River Flats area was nominated as an SNA primarily as habitat for the wood turtle (see Animal Occurrences Section). In addition, the area is noted as an extensive floodplain forest. The information available on the forest is not complete. It is recommended that more information be obtained on the floodplain forest of this area before this area is seriously considered as a final route for the transmission line (North Red Wing 1 and 2).

Geologic Features

The project study area has been examined for unique and/or exemplary geologic features identified as priority for protection in the State of Minnesota. Two sites within the study area have been identified as being of particular concern: Barn Bluff at Red Wing, and the Graptolite Fossil Site near Afton.

Occurrences within the project study area:

Washington County

Name of Feature: Graptolite Fossil Site

Description: Graptolites are a primitive marine colonial organism known to be an excellent index fossil of the Paleozoic Era. This site, located just south of the town of Afton is believed to be the best occurrence of this index fossil in the state. The fossil bed of graptolites is in a soft siltstone of the St. Lawrence Formation, exposed at water level in a small creek. The site would be sensitive to any construction occurring either in the immediate vicinity or upstream of the fossil bed. However, the closest proposed corridor (Route C) is approximately one-half mile away so that adverse impact on this site is not anticipated.

Goodhue County

Name of Feature: Barn Bluff

Description: Barn Bluff is significant geologically for many reasons. It was once part of an island in the glacial Mississippi River. At least three geologic formations (Cambrian, Ordovician, and Pleistocene) and their contacts are exposed here. A large high-angle fault, the only exposed example in southern Minnesota, cuts through and displaces the rocks NW/SE. In addition, the site contains excellent trilobite fossils and other foliferous strata.

Barn Bluff has been nominated as an SNA (See Natural Areas Section). The proposed transmission routes do not directly cross Barn Bluff so destruction or degradation of the feature is not anticipated. The three South Red Wing routes do, however, pass very near the east end of Barn Bluff.

Summary/Evaluation

In the St. Croix River study area Rare, Threatened and/or Exemplary Elements are found either within or immediately adjacent to Routes B, C, and D (three of the four alternative routes).

Route B: A mussel bed, the location of the federally endangered Higgin's Eye Mussel and six other mussels considered by the MHNP to be of statewide significance, occurs just to the north of this proposed corridor crossing. Due to the richness of the mussel fauna at this site and the nearby presence of a federally endangered species, the MNHP advises against use of the proposed Route B for an underground crossing of the transmission line.

Route C: A rare orchid Liparis lilifolia occurs within the boundaries of this proposed route. This occurrence, one of two sites known in the state, is believed to be the most viable population of the species in the state. Liparis lilifolia as an orchid species, is under jurisdiction of the Department of Agriculture's MN Statute 17.23: Conservation of Certain Wild Flowers. For these reasons it is recommended that every effort be made to preserve the occurrence of this species located within the boundaries of the proposed Route C.

Route D: Proposed Route D crosses Afton State Park. The park management plan identified several potential ecological protection zones in and near the corridor. The "use-sensitive areas" designated as potential ecological protection zones in the park management plan of 1979 should be considered prior to construction of an additional transmission line in this corridor.

In the Mississippi River study area south of Hastings Rare, Threatened and or Exemplary Elements are found either within or immediately adjacent to 11 of the 12 alternative routes.

Prescott 1 and 2 routes: Two mussel species, one considered threatened by the MNHP and one designated as Status Undetermined have been observed immediately upstream and downstream of the proposed routes that cross the river near Prescott, Wisconsin. Based on the evidence available, crossing the river at this site would not be advocated unless the construction design caused little or no substrate disturbance and/or deterioration of water quality.

"Floodplain Routes": The "Floodplain" routes refer to those proposed routes that cross the floodplain forests to the north and west of the town of Red Wing (Trenton 1 and 2 routes, North Red Wing 3 and 4 routes).

Construction of a transmission line in early Spring and Summer could disrupt the breeding activities of the birds associated with the Devil's Lake Rookery if Trenton 1 and 2 were selected. Isolation is believed to be an important component of the nesting habits of great blue herons and great egrets, the two species nesting at this rookery.

North Red Wing 3 and 4 routes cross an area which represents the optimal breeding habitat for the wood turtle, a rare species in Minnesota, and an example of a mature floodplain forest, a Protection Priority of MNHP. This area has been nominated for potential effects on the turtle population and the floodplain forest are not understood, but the recognition this area has received as a potential natural area should be given consideration. A mature floodplain forest is located along the Cannon River west of Red Wing. This area has been recognized as a "good example" of a mature floodplain forest. As a MNHP Protection Priority, this area should be noted in the planning process. However, it appears that the impact of the route crossings (North Red Wing 1 and 2, South Red Wing 1) in this vicinity would be reduced due to the relative narrowness of the valley.

"East of Red Wing" Corridor: This corridor crosses a wetland area east of Red Wing near Colvill Bay. Carex muskingumensis (Muskingumensis Sedge) is located very near the proposed river crossing of South Red Wing 1, 2, and 3 routes. The wetland habitat of this species could be adversely affected by construction activity. However, if disturbance relating to construction is limited to the route boundaries, damage to this species is unlikely.

This discussion summarizes the information available at this time from the Minnesota Natural Heritage Program data-base. Proposed corridor routes not discussed in this final summary (Route A and Prairie Island routes) have no known occurrences located either within or adjacent ot the proposed corridor boundaries.

4.4.4 Underground Construction Impacts

An independent study has been performed for the Power Plant Siting Program which assesses feasibility and potential impact of installing the proposed transmission line under the Mississippi River or the St. Croix River. The study considered undergrounding only the alternative river crossings. In effect, all of the Prairie Island Routes and Route A at the King Plant were considered to be entirely underground: remaining route portions were assumed to be overhead. The study report, submitted in June, 1980, is extensive and thus not reproduced in this draft environmental impact statement in its entirety. However, it is summarized in Chapter 7, section 7.3 of this draft EIS. The complete report is available for public review at project library depositories listed in Appendix C, and at offices of the Power Plant Siting Program in St. Paul.

The report contains descriptions of environmental characteristics which complement this draft EIS. Several sections contain information which may assist interested persons in better understanding the nature of the two study areas and the specific issues associated with any type of river crossing. Though the report predominately covers underground construction and operation impacts, it provides several perspectives on comparative assessment of overhead and underground impacts.

TABLE 4-1
ENVIRONMENTAL INVENTORY FOR EACH ROUTE SEGMENT

Variable		Description	Source
1	Length	length between nodes	Air photos (1977), USGS
2	Fields Crossed	number of fields crossed	Air photos
3	Fields Crossed	length of cultivated land crossed	Air photos
4	Fields Bordered	length of line parallel to field boundaries	Air photos
5	Pasture	length of line crossing pasture or farmland with no apparent cultivation pattern	Air photos
6	Irrigated Pivot	number of center pivot irrigated fields crossed	Air photos, Minnesota Dept. of Agriculture
7	Irrigated Pivot	number of center pivot irrigated fields bordered	Air photos, Minnesota Dept. of Agriculture
8	Irrigated Traveling	number of traveling system irrigated fields crossed	Air photos, Minnesota Dept. of Agriculture
9	Irrigated Traveling	number of traveling system irrigated fields bordered	Air photos, Minnesota Dept. of Agriculture
10	Erosion Potential	length crossing soils with high erosion potential	Dakota County Soil Atlas Goodhue Co. Soil Atlas
11	Steep Slopes	number of steep slopes (25%) crossed	USGS Topographic maps

Variable	Description	Source
12 Upland Forest	acres cleared of mixed hardwoods 50% upland hardwoods (oak, maple, elm, birch, basswood, aspen	Air photos
13 Riparian Forest	acres cleared of bottomland hardwoods (cottonwood, willow, black ash)	Air photos
14 Savanna	acres of open-grown bur oaks, red cedar and shrubs	Air photos
15 Open Marsh	length through an area predominatly covered by open water 10 feet or less in depth with associated submergent and emergent aquatic vegetation	Air photos
16 Closed Marsh	length through an area predominantly covered by a wetland emergent vegetation type such as cattail or bullrush	Air photos
17 Wet Meadow	length through an area predominantly covered by a shallow wetland species such as sedges and reed grass; may be plowed and cultivated in dry years	Air photos
18 Streams Crossed	number of rivers and streams crossed	Air photos, USGS Topographic maps
19 Lakes	number of times open water is crossed	Air photos, USGS Topographic maps
20 Lakeshore	length of line within 1,000 feet of lake	Air photos, USGS Topographic maps
21 Wildlife Areas	length of line crossing State Wildlife Management Areas	Minnesota DNR
22 Wildlife Refuge	length of line crossing State Wildlife Refuges or Sanctuaries	Minnesota DNR

Variable	Description	Source
23 Park	number of existing parks crossed	USGS Topographic Maps SCORP Data Maps
24 Park	number of existing parks within 2,000 feet of likely centerline	USGS Topographic Maps SCORP Data Maps
25 Wayside	length of line crossing state wayside rests	SCORP Data Maps Minnesota Outdoor Atlas
26 Wayside	state wayside rests within 1,000 feet of likely centerline	SCORP Data Maps Minnesota Outdoor Atlas
27 Recrtn Facility	number of times recreation facilities are crossed	SCORP Data Maps Minnesota Outdoor Atlas
28 Recrtn Facility	number of recreation facilities within 1,000 feet of likely centerline	SCORP Data Maps Minnesota Outdoor Atlas
29 Scenic Road	number of scenic road crossings	SCORP Data Maps
30 Scenic Road	length of line parallel to scenic roads (1,000 feet)	SCORP Data Maps
31 Canoe Boating	number of crossings of canoe and boating rivers	Minnesota Outdoor Atlas
32 Canoe Boating	length of line parallel to canoe and boating river	Minnesota Outdoor Atlas
33 Proposed Park	length of line through proposed parks	Red Wing Comprehensive Plans, Minnesota DNR
34 Proposed Park	length of line within 1,000 feet of proposed parks	Red Wing Comprehensive Plans, Minnesota DNR
35 Scenic River	number of crossings of a designated wild, scenic, or recreational river	Minnesota DNR

Variable	Description	Source
36 Historic Site	number of historic sites within 1,000 feet of likely centerline	Minnesota Historical Society
37 Archeolo Site	number of archeological sites within 1,000 feet of likely centerline	Minnesota Historical Society
38 Trans Lines	length of line parallel to 345 kV transmission lines	USGS Topographic Maps NSP County Atlas
39 Trans Lines	length of line parallel to 161 kV transmission lines	USGS Topographic Maps NSP County Atlas
40 Trans Lines	length of line parallel to 115 kV transmission lines	USGS Topographic Maps NSP County Atlas
41 Trans Lines	length of line parallel to 69 kV transmission lines	USGS Topographic Maps NSP County Atlas
42 Railroad	length of line parallel to railroad	Air Photos USGS Topographic Maps
43 Paved 2 Lane	length of line parallel to two lane paved roads (1,000 feet)	Air Photos USGS Topographic Maps
44 Paved 4 Lane	length of line parallel to 4 lane paved roads (1,000 feet)	Air Photos USGS Topographic Maps
45 Unpaved Road	length of line parallel to unpaved roads (1,000 feet)	Air Photos USGS Topographic Maps
46 Property Lines	length parallel to property lines	Dakota County Atlas Goodhue County Atlas
47 Property Units	number of property units crossed	Dakota County Atlas Goodhue County Atlas
48 Diagonal Length	length not north-south, east-west or along property boundary	Dakota County Atlas Goodhue County Atlas

Variable	Description	Source
49 Homes taken	homes located within probable right-of-way	Air photos, USGS topographic maps
50 Homes 0-5	number of homes within 500 feet of likely centerline	Air photos, USGS topographic maps
51 Homes 5-10	number of homes 500-1,000 feet of likely centerline	Air photos, USGS topographic maps
52 Platts	length through platted property	Dakota County Atlas Goodhue County Atlas
53 Church Cemetary	churches or cemetaries crossed	Air photos, USGS topographic maps
54 Church Cemetary	number of churches or cemetaries within 1,000 feet of centerline	Air photos, USGS topographic maps
55 Zoned residence	length through areas zoned low-medium density residential dev.	Red Wing zoning map
56 Zoned residence	length through areas zoned for high density residential dev.	Red Wing zoning map

Table 4-2a Agriculture Impacts by Segment*

Variable	1	2	3	4	5	6	7	8	9	10
Segment	Length Miles	Fields Crossed Number	Fields Crossed Miles	Fields Bordered Miles	Pasture Miles	Irrigated Pivot Crossed Number	Irrigated Pivot Bordered Number	Irrigated Traveling Crossed Number	Irrigated Traveling Bordered Number	Erosion Potential Miles
1-2	.75	0	0	0	0	0	0	0	0	0
1-3	3.10	1	0.9	0	0	0	0	0	0	0
1-13	2.27	1	0.1	0	0	0	0	0	0	0.3
1-18	11.70	0	0	5.6	0.5	0	2	1	0	1.3
3-4	.49	0	0	0	0	0	0	0	0	0
3-5	1.30	0	0	0	0	0	0	0	0	0
3-7	1.25	0	0	0	0.2	0	0	0	0	0
4-6	1.82	0	0	0	0	0	0	0	0	0
4-10	2.35	0	0	0	0	0	0	0	0	0
7-8	.45	0	0	0	0	0	0	0	0	0.6
7-14	2.46	5	1.3	0.5	0.1	0	0	0	0	2.4
8-9	.81	0	0	0	0	0	0	0	0	0.1
8-15	3.52	5	0.9	0.2	0.2	0	0	0	0	0
9-10	.66	0	0	0	0	0	0	0	0	0
9-16	2.58	6	1.0	0.7	0	0	0	0	0	0.7
10-11	1.88	0	0	0	0	0	0	0	0	0
10-12	1.61	0	0	0	0.1	0	0	0	0	0
13-14	1.99	3	1.2	0.6	0.2	0	0	0	0	2.0
13-19	10.72	20	6.8	0.1	0.2	1	2	0	0	5.2
14-15	4.79	10	1.9	0.3	0.7	0	0	0	0	4.3
15-16	1.64	1	0.3	2.0	0.1	0	0	0	0	1.3
16-17	6.44	5	0.6	0.4	0.3	0	0	0	0	4.0
18-19	.87	0	0	0	0	0	0	0	0	0
18-20	.85	0	0	0	0	0	0	0	0	0
19-20	1.84	3	0	0.7	0	0	0	0	0	0
20-21	.28	0	0	0	0	0	0	0	0	0
TOTAL	68.42									

*prairie Island (Mississippi River) segments only: King (St. Croix River) segment data shown as complete routes in Table 4-3 a-e.

Table 4-2b Vegetation and Wildlife Impacts by Segment

Variable	11	12	13	14	15	16	17	18	19	20	21	22
Segment	Steep Slopes Number	Upland Forest Miles	Riparian Forest Miles	Savanna Miles	Open Marsh Miles	Closed Marsh Miles	Wet Meadow Miles	Streams Crossed Number	Lakes Number	Lakeshore Miles	Wildlife Area Miles	Wildlife Refuge
1-2	0	0	0.1	0	0	0						
1-3	0	0.4	0.3	0.1	0	0.1	0	1	1	0	0	0.4
1-13	1	0.4	0.3	0.1	0	0	0	2	0	0.7	0	0.2
1-18	1	0.1	1.6	0.1	0.3	1.8	0	3	1	0	0	0
3-4	0	0	0.1	0	0	0.4	1	2	2	0	0.3	0.4
3-5	0	0	0.7	0	0	0.5	0	0	0	0	0	0
3-7	0	0	0.2	0	0.1	0.2	0	2	0	0	0	0
4-6	0	0	1.0	0	0	0.8	0.5	1	0	0	0	0
4-10	0	0	2.7	0	0	1.3	0	2	0	0	0	0
7-8	0	0	0.5	0	0	0	0	2	0	0	0	0
7-14	9	0.8	0	0	0	0	0.1	3	0	0	0	0
8-9	0	0	0.2	0	0	0.1	0	2	0	0	0	0
8-15	4	0.4	0.9	0	0	0.2	0	0	0	0	0	0
9-10	0	0	1.0	0	0	0	0	1	0	0	0	0
9-16	8	0.7	0	0	0	0	0	0	0	0	0	0
10-11	0	0	0.9	0	0	1.1	0	0	0	0	0	0
10-12	0	0	0.9	0	0	1.3	0	4	1	0.1	0	0
13-14	2	0.3	0	0	0	0	0	2	0	0	0	0
13-19	22	2.1	1.4	0	0	0.1	0	0	0	0	0	0
14-15	10	1.1	0.2	0	0	0	0	13	0	0	0	0
15-16	9	1.3	0	0	0	0	0	5	0	0	0	0
16-17	17	2.8	0.1	0	0	0.2	0	3	0	0	0	0
18-19	1	0.1	0.4	0	0	0	0	5	0	0	0	0
18-20	0	0	0.6	0	0	0	0	0	0	0	0	0
19-20	0	0.4	0.6	0	0	0	0	1	0	0	0	0
20-21	0	0	0.1	0	0	0	0	3	0	0	0	0
							0	2	0	0	0	0.2

Table 4-2c Recreation & Cultural Impacts by Segment

Variable	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
Segment	Park Number	Park Number	Wayside Miles	Wayside Number	Recreation Facility Number	Recreation Facility Number	Scenic Road Number	Scenic Road Miles	Canoe Boating Number	Canoe Boating Miles	Proposed Park Miles	Proposed Park Miles	Scenic River	Historic Site Number	Archaeologic Site Number
1-2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
1-3	0	0	0	0	1	2	0	0	0	0	0	0	0	0	2
1-13	0	0	0	1	0	2	0	0	0	0	0	0	0	0	0
1-18	0	0	0	0	0	3	0	0	0	0	0	0	0	0	2
3-4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-5	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
3-7	0	0	0	0	0	0	0	0	0	0	0	0	0	0	3
4-6	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0
4-10	0	0	0	0	0	0	0	0	1	0	0	0	0	0	0
7-8	0	0	0	0	0	0	0	0	1	0	0	0	0	0	1
7-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	3
8-9	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8-15	0	1	0	1	0	0	1	0	0	1.6	0	0	0	0	3
9-10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
9-16	0	2	0	0	0	0	1	0	0	0	0	0	0	0	5
10-11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10-12	0	0	0	0	0	0	0	0.5	0	0	0.6	0	0	1	2
13-14	0	0	0	0	0	0	1	0	0	0	0	0	0	0	0
13-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1
14-15	0	0	0	0	0	0	0	0	2	0	0	0	0	1	1
15-16	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
16-17	2	1	0	1	0	0	1	0	0	0	0.4	0	0	1	3
18-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18-19	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
19-20	0	0	0	0	0	0	0	0	0	0	0	0	0	0	2
20-21	0	0	0	0	0	1	0	0	0	0	0	0	0	0	0

Table 4-2d Right-of-Way Sharing by Segment

Variables	38	39	40	41	42	43	44	45	46	47	48
Segment	Transmission Line 345 kV Miles	Transmission Line 161 kV Miles	Transmission Line 115 kV Miles	Transmission Line 69 kV Miles	Railroad Miles	Paved 2 Lane Miles	Paved 4 Lane Miles	Unpaved Road Miles	Property Lines Miles	Property Units Number	Diagonal Length Miles
1-2	0	0	0	0	0						
1-3	1.2	2.7	0	0	1.6	0	0	0	0	1	0.4
1-13	2.3	1.1	0	0	10.51	1.3	0	1.4	0.2	9	1.7
1-18	1.1	1.1	0	0	0	1.3	0	0	0	6	1.1
3-4	0	0	0	0	1.4	2.7	0	1.0	9.6	29	1.3
3-5	0	0	0	0	0	0	0	0	0.2	2	0.4
3-7	0	1.25	0	0	0	0	0	0	0	3	1.2
4-6	0	0	0	0	0	0	0	0.9	0.5	4	0
4-10	0	0	0	0	0	0	0	0	0	5	1.7
7-8	0	1.45	0	0	0	0	0	0.2	0.1	6	1.4
7-14	0	2.46	0	0	0	0	0	0.1	0.1	3	0.7
8-9	0	.81	0	1.1	0.6	0	0	1.1	0.9	9	1.6
8-15	0	0	0	3.52	1.5	0	0	0.1	0.5	3	0.6
9-10	0	0	0	1.66	1.9	0.2	0	0	0.9	9	0.7
9-16	0	0	0	2.58	0	0	0	0.2	0	1	0.1
10-11	0	0	0	0	0	0.2	0	0	0.2	6	1.8
10-12	0	0	0	1.6	1.6	0	0	0	0	3	1.3
13-14	1.99	0	0	0	0	0.2	0	0.4	0	0	0
13-19	10.72	0	0	0	0	0	0	0.2	0.3	6	0.4
14-15	3.1	0	0	1.6	0	0	0	0	9.1	39	0.9
15-16	0	0	0	1.64	0	0	0	0.2	1.6	12	0
16-17	0	0	0	6.44	1.2	0	0	0	1.8	4	0
18-20	0	0	0	0	0	2.4	0	0	3.8	30	0
18-19	0	0	0	0	1.87	0	0	0	0.6	5	0
19-20	0.83	0	0	1.01	0	0	0	0.9	0.4	2	0.2
20-21	0	0	0	1.28	0	0	0	0.3	0.4	4	0.7
						0	0	0	0	2	0

Table 4-2e Settlement Impacts by Segment

Variable	49	50	51	52	53	54	55	56
Segment	Homes in ROW (Number)	Homes 0-500' (Number)	Homes 500-1,000' (Number)	Platted Property (Miles)	Church or Cemetary Crossed (Number)	Church or Cemetary Within 1000' (Number)	Zoned Low-Medium Residential (Miles)	Zoned High Density Residential (Miles)
1-2	0	0	0	0	0	0	0	0
1-3	3	1	5	0	0	0	0	0
1-13	0	0	4	0	0	0	0	0
1-18	0	30	15	0	0	0	0	0
3-4	0	0	0	0	0	0	0	0
3-5	0	1	0	0	0	0	0	0
3-7	0	1	2	0	0	0	0	0
4-6	0	0	0	0	0	0	0	0
4-10	0	13	14	1.2	0	0	0	0
7-8	0	0	0	0	0	0	0	0
7-14	0	3	4	0	0	0	0	0
8-9	0	0	0	0	0	0	0	0
8-15	7	34	49	0	0	0	0	3.4
9-10	0	13	14	0.8	0	0	0	0
9-16	4	26	46	0.6	0	0	2.5	0.2
10-11	0	0	0	0.2	0	0	0	0
10-12	0	1	0	1.3	0	1	0	0
13-14	0	2	3	0	0	1	0	0
13-19	0	14	7	0	0	1	0	0
14-15	0	5	3	0	0	0	1.6	0
15-16	0	0	0	0	0	0	2.0	0
16-17	34	188	244	3.7	1	1	4.7	0.2
18-20	0	0	0	0	0	0	0	0
18-19	0	3	1	0	0	0	0	0
19-20	0	0	1	0	0	0	0	0
20-21	0	0	0	0	0	0	0	0

Table 4-3a Agriculture Impacts by Route

Variable	1	2	3	4	5	6	7	8	9	10
	Length (Miles)	Fields Crossed Number	Fields Crossed Miles	Fields Bordered Miles	Pasture Miles	Irrigated Pivot Crossed Number	Irrigated Pivot Bordered Number	Irrigated Traveling Crossed Numberd	Irrigated Traveling Bordered Number	Erosion Potential Miles
Mississippi River Routes										
Prairie Island	.75	0	0	0	0	0	0	0	0	0
Trenton 1	5.41	1	0.1	0	0	0	0	0	0	1.3
2	4.40	1	0.1	0	0	0	0	0	0	0
N Red Wing 1	8.15	1	0.1	0	0.2	0	0	0	0	0.7
2	7.88	1	0.1	0	0.3	0	0	0	0	0.7
3	7.82	1	0.1	0	0	0	0	0	0	0
4	7.55	0	0.1	0	0.1	0	0	0	0	0
S Red Wing 1	17.13	20	4.1	3.3	1.3	0	0	0	0	11.9
2	16.40	12	2.7	2.6	0.8	0	0	0	0	5.9
3	14.63	12	2.5	1.1	0.5	0	0	0	0	5.3
Prescott 1	12.85	0	0	5.6	0.5	0	0	0	0	1.3
2	15.11	25	7.5	0.1	0.9	1	2	0	0	5.5
St. Croix River Routes										
A	0.8	0	0	0	0.2	0	0	0	0	0
B	4.4	3	0.4	0.7	1.6	0	0	0	0	0
C	4.0	2	0.2	2.2	0.4	0	0	0	0	.5
D	4.1	6	1.4	0.5	0.2	0	0	0	0	1.5

Table 4-3b Vegetation and Wildlife Impact by Route

Variable	11	12	13	14	15	16	17	18	19	20	21	22
Mississippi River Routes	Steep Slopes Number	Upland Forest Miles	Riparian Forest Miles	Savanna Miles	Open Marsh Miles	Closed Marsh Miles	Wet Meadow Miles	Streams Crossed Number	Lakes Number	Lakeshore Miles	Wildlife Management Area Miles	Wildlife Refuge Miles
Prairie Island	0	0	0.1	0	0	0	0	1	1	0	0	0.4
Trenton 1	0	0.4	1.4	0.1	0	1.3	0	4	0	0.7	0	0.2
2	0	0.4	1.0	0.1	0	0.6	0	4	0	0.7	0	0.2
N Red Wing 1	0	0.4	3.1	0.1	0.1	1.5	0.6	10	1	0.8	0	0.2
2	0	0.4	2.2	0.1	0.1	1.7	0.6	8	0	0.7	0	0.2
3	0	0.4	0.4	0.1	0	2.9	0	8	1	0.8	0	0.2
4	0	0.4	4.0	0.1	0	3.1	0	6	0	0	0	0
S Red Wing 1	39	5.9	0.6	0.1	0	0.2	0	16	1	0	0	0
2	30	4.9	2.0	0.1	0.1	0.7	0.6	15	0	0.7	0	0.2
3	25	3.9	1.3	0.1	0.1	0.6	0.6	11	0	0.7	0	0.2
Prescott 1	1	0.1	2.3	0.1	0.3	1.8	0.1	5	2	0	0.3	0.6
2	23	2.9	2.4	0.1	0	0.1	0	21	1	0	0	0.2
St. Croix River Routes												
A	0	0	0	0	0	.1	0	1	0	0	0	0
B	0	.2	0	0	0	0	0	1	0	0	0	0
C	.5	.6	.1	0	0	0	0	1	0	0	0	0
D	1.2	.3	.1	0	0	0	0	1	0	0	0	0

Table 4-3c Recreation and Cultural Impacts by Route

Variable	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37
	Park Number	Park Number	Wayside Miles	Wayside Number	Recreation Facility Number	Recreation Facility Number	Scenic Road Number	Scenic Road Miles	Canoe Boating Number	Canoe Boating Miles	Proposed Park Miles	Proposed Park Miles	Scenic River	Historic Site Number	Archaeologic Site Number
Mississippi River Routes															
Prairie Island	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Trenton 1	0	0	0	0	1	2	0	0	0	0	0	0	0	0	2
2	0	0	0	0	1	2	0	0	0	0	0	0	0	0	2
N Red Wing 1	0	0	0	0	1	2	0	0	1	0	0	0	0	0	6
2	0	0	0	0	1	2	0	0.5	1	0	0.6	0	0	1	8
3	0	0	0	0	1	2	0	0	1	0	0	0	0	0	2
4	0	0	0	0	1	2	0	0.5	0	0	0.6	0	0	2	4
S Red Wing 1	2	1	0	2	0	2	2	0	2	0	0.4	0	0	2	4
2	2	2	0	2	0	0	2	0	1	1.6	0.4	0	0	1	7
3	2	3	0	1	1	2	2	0	1	0	0.4	0	0	1	14
Prescott 1	0	0	0	0	0	4	0	0	0	0	0	0	0	0	2
2	0	0	0	0	1	3	0	0	0	0	0	0	0	0	3
St. Croix River Routes															
A	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
B	0	1	0	0	0	0	0	0	1	0	0	0	1	1	1
C	0	0	0	0	0	0	0	0	1	0	0	0	1	0	0
D	1	0	0	0	1	0	0	0	1	0	0	0	1	0	0

Table 4-3d Right-of-Way Sharing by Route

Variable	38	39	40	41	42	43	44	45	46	47	48
	Transmission Line 345 kV Miles	Transmission Line 161 kV Miles	Transmission Line 115 kV Miles	Transmission Line 69 kV Miles	Railroad Miles	Paved 2 Lane Miles	Paved 4 lane Miles	Unpaved Road Miles	Property Lines Miles	Property Units Number	Diagonal Length Miles
Mississippi River Routes											
Prairie Island	0	0	0	0	0	0	0	0	0	1	0.4
Trenton 1	1.2	2.7	0	0	2.0	1.3	0	1.4	0.4	16	3.5
2	1.2	2.7	0	0	1.6	1.3	0	1.4	0.2	12	1.9
N Red Wing 1	1.2	5.1	0	1.0	3.1	1.3	0	2.7	1.3	32	4.5
2	1.2	5.1	0	1.6	3.7	1.5	0	3.1	1.3	29	3.2
3	1.2	2.7	0	0	2.0	1.3	0	1.6	0.5	20	4.8
4	1.2	2.7	0	0.6	0.6	1.5	0	2.0	0.5	17	3.5
S Red Wing 1	7.3	1.1	0	10.0	0.2	3.7	0	0.4	7.5	58	1.5
2	1.2	4.5	0	12.2	3.2	3.9	0	2.4	7.3	62	3.1
3	1.2	5.1	0	9.2	2.4	3.9	0	2.5	5.3	64	4.9
Prescott 1	1.1	1.1	0	0.4	10.5	2.7	0	1.0	10.2	36	1.3
2	14.3	1.1	0	1.5	0	1.3	0	0.3	9.5	51	2.7
St Croix River Routes											
A	0	0	.8	.8	0	0	0	0	.2	1	0
B	1.8	0	0	0	0	0	2.6	0	2.6	13(1)	.2
C	0	0	4.0	0	0	0	0	1.2	4.0	45	0
D	4.1	0	0	0	0	0	0	2.0	2.0	15	0

(1) Does not include lots in Lakeland.

Table 4-3e Settlement Impacts by Route

Variable	49	50	51	52	53	54	55	56
	Homes in Row (Number)	Homes 0-500' (Number)	Homes 500-1000' (Number)	Platted Property (Miles)	Church or Cemetary Crossed (Number)	Church or Cemetary Within 1000' (Number)	Zoned Low-Medium Residential (Miles)	Zoned High Density Residential (Miles)
Mississippi River Routes								
Prairie Island	0	0	0	0	0			
						0	0	0
Trenton 1	3	1	5	0	0			
2	3	2	5	0	0	0	0	0
						0	0	0
N Red Wing 1	3	15	21	1.0	0			
2	3	16	21	2.1	0	0	0	0
3	3	14	19	1.4	0	1	0	0
4	3	15	19	2.5	0	0	0	0
						1	0	0
S Red Wing 1	34	195	254	3.7	1			
2	39	224	300	3.7	1	2	8.3	0.2
3	41	216	297	4.3	1	1	10.1	0.2
						1	7.2	0.4
Prescott 1	0	39	15	0	0			
2	0	14	12	0	0	1	0	0
						0	0	0
St. Croix River Routes								
A	0	0	3	0	0	0	0	0
B	1	31	36	.6	0	0	N.D.*	N.D.
C	3	24	15	1.0	0	0	N.D.	N.D.
D	1	0	6	.5	0	0	N.D.	N.D.

*N.D. - No Data.

chapter 5

SUMMARY ANALYSIS OF PROJECT IMPACTS

CHAPTER 5
SUMMARY ANALYSIS OF ROUTE IMPACTS

5.1 DIRECT AND INDIRECT EFFECTS WHICH CANNOT BE AVOIDED

5.1.1 Adverse Effects of the Proposed Transmission Line

Construction and operation of the proposed 345 kV transmission line will have unavoidable adverse effects on the environment. Three major areas of concern are agriculture, human settlements, and the natural environment.

Adverse effects on farmland and to farm operations may be unavoidable. In general, the following effects on agricultural land use can be anticipated:

a. Crop damage will occur within the right of way where construction equipment crosses fields.

b. Compaction of soils occurs when the land is traversed by the heavy equipment used for construction.

c. Normal water flow in subsurface drainage systems can be disrupted by construction activities.

d. Erosion and siltation may result where soil disturbance occurs, particularly on slopes.

e. In those instances where cultivated fields must be crossed during the growing season, some modification of crop patterns may be necessary during construction.

f. Following construction, tower structures which are located in cultivated fields will remain as permanent obstructions to farming. This may require some changes in equipment handling and alterations in crop patterns.

g. Aerial spraying, dusting or seeding may be more difficult, more costly, and more dangerous.

h. Placement of the HVTL along field edges, property boundaries, and along roads or highways may influence future plans for consolidation or subdivision of the land for either agricultural or residential uses.

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The direct and indirect effects on human habitation within the study area may include the following.

a. Dwellings and other structures may be removed from the right-of-way. The presence of the transmission line will prevent future construction of buildings within the right-of-way.

b. In general, the presence of the transmission line creates linear constraints upon future development and consequent land use opportunities are altered or lost.

c. The sale of an easement for a right-of-way will change and possibly decrease the real estate value of the property.

d. The operation of the HVTL may create a variety of public health and safety problems which may be minimized, but not entirely eliminated.

e. Historical and archaeological sites may be damaged, especially during the construction period, unless special care is taken during the siting process. Salvage archaeology may be necessary.

f. Electrical effects from a HVTL may impair the operation of telephone, radio, television, and other electronic equipment.

g. A HVTL creates an unavoidable adverse impact on the visual landscape. The proposed line will cross either the St. Croix River or the Mississippi River and will result in a visual intrusion in either case.

The direct and indirect effects upon the natural environment include the following impacts.

a. Trees and shrubs in the right-of-way will be cleared. Tall growing plants will be permanently suppressed.

b. Right-of-way clearing will alter natural habitats and, in some cases, provide easier access for hunters and other outdoor recreationists.

c. Both plants and animals in the vicinity of the right-of-way may be affected by the long term use of herbicides.

d. Wetlands, stream banks and other natural features will be altered during the construction period.

e. Construction activities may encourage soil erosion and cause mixing of top soils with subsoils.

f. Birds, especially migrating waterfowl and raptors, may collide with the new tower structures.

Although proper design and planning can reduce their impact, these effects are unavoidable. Although significant for the entire project, the impacts are a series of relatively small disturbances along the entire length of the right-of-way. Proper and efficient engineering, construction and maintenance in conjunction with sound routing procedures will limit the overall environmental impact.

5.1.2 Mitigative Measures

The following description of mitigative measures is based upon specifications provided by NSP in its application to the MEQB for a construction permit. The construction permit issued by the MEQB will include required mitigative measures.

Agricultural

In cultivated areas, the structures will be self-supporting, rather than guyed to minimize the amount of land affected. The transmission line and structures will be located along legal survey lines, land lines, ditches or field borders to the extent practicable. Access to construction areas will be gained along land lines and on existing farm roads where feasible.

Care will be taken to minimize disruption of crops during construction. Owners will be compensated by NSP for all damages incurred during construction as well as any damage resulting from emergency maintenance.

Any irrigation system operated near a transmission line should be inspected to make sure it is properly grounded and the operator is informed of proper safety procedures.

Human Settlement

Transmission lines have a variety of potential impacts on human settlement and land use. Impacts may occur not only on land uses within and adjacent to the right-of-way but, to a limited extent, on land uses at some distance from a transmission line.

Usually the disruption amounts to little more than limited visual impact. However, the disruption could result in a discontinuation of the present land use. Right-of-way sharing is considered to be a measure which mitigates the adverse impacts of a transmission line interfering with other land uses. The amount of additional land required for a new line's right-of-way is less when it is adjacent to a previously existing right-of-way.

The proposed project mitigates impacts on human settlement for the most part by avoiding populated areas. NSP construction practices are designed to minimize some of the effects of construction on human settlement, although some noise, traffic and dust, associated with any construction project, will occur.

The best method of reducing impact on recreational or historic land uses is to avoid those areas. Where this is not possible vegetative screens will be developed, as appropriate. Where consistent with safety considerations, original vegetation will be left uncut. Should historical or archaeological sites be discovered during surveying, clearing or line construction, such work will be stopped and the Minnesota Historical Society will be advised.

In addition to avoiding major sensitive areas, many features of NSP's right-of-way management plan will soften visual impacts. The plan includes vegetative screening at road, stream and river crossings and keeping the width of the cleared right-of-way to a minimum consistent with safety requirements.

Natural Environment

While sensitive vegetative and wildlife areas are avoided wherever possible, some impact may still occur. Vegetative management aims to control revegetation to favor indigenous flora and fauna. The growing season and soils along the routes encourage quick revegetation.

The normal process of plant succession allows plant communities which originally occupied a site to grow over disturbed areas. For safety reasons, the right-of-way management program has been designed to prevent the establishment of tall-growing species, which could interfere with operation of the line.

Elm trees affected by Dutch elm disease may be encountered on the right-of-way selected. All elm wood, whether diseased or not, will be removed in accordance with Minnesota Department of Agriculture Plant Quarantine #78-1.

In wooded areas in the Mississippi River Valley potential waterfowl collision will be minimized by using low profile construction. By using H-frame structures and short spans, conductors will be kept at or near tree top level, thus minimizing the likelihood of collision.

To minimize impacts where aquatic systems and surface hydrology are concerned, necessary fording operations will be coordinated with the local Minnesota Department of Natural Resources managers and their recommendations will be followed. Where the situation dictates, seeding of desirable grass-cover mixtures on both sides of a water crossing will be accomplished.

Surface runoff will be controlled by selective cutting within an appropriate distance from the water's edge. In employing selective cutting, as much riparian vegetation will be left as possible. This minimizes the possibilities for impact on aquatic wildlife caused by sedimentation, increased turbidity and increased water temperature.

Electrocution of large raptors is generally only a problem with lower voltage lines, where phase-to-phase or phase-to-ground wire spacing may be less than a bird's wing span. The design of the proposed transmission line should preclude electrocution of raptors.

5.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

The construction of a high voltage transmission line requires a substantial amount of natural and human resources. These resources, by the nature of such a project, are irreversibly and irretrievably committed on a comparatively permanent basis. Examples include: (1) the irreversible socio-economic commitment of labor, financial resources, and technical expertise for the construction and maintenance of the project; (2) the irretrievable use of raw materials, both renewable and non-renewable; (3) the comparatively permanent commitment of natural resources by the clearing of forested rights-of-way; and (4) the loss of present and future alternative land use opportunities caused by the need to modify agricultural practices or by the loss of scenic values.

Commitment of resources will vary in both degree and the stage at which it occurs during implementation of the project. Engineering and routing methods will be utilized to the fullest possible extent to reduce resource requirements while minimizing other environmental impacts.

Irretrievable commitments include labor, gas and other energy used during the construction phase and any brush or other wood burned in clearing a right-of-way.

Long term commitments of nonrenewable resources include the use of aluminum and steel in meeting structural requirements of the line. Table 5-1 lists structural material requirements per mile of 345 kV line for several different structure systems. All the materials will be recycled when the line is abandoned, with the exception of the concrete used in footings for the structures.

Relatively little modification of land use need occur because of the presence of the line. While some modifications occur in maintenance of proper clearances for rights-of-way, the only commitment of land itself occurs directly beneath structure footings and guy wires. This commitment extends for the life of the line.

Table 5-1 Steel and Aluminum Requirements for Structure Systems.

Steel Towers and Steel Twin Poles

Steel	100,000 lbs/mile
Aluminum	29,000 lbs/mile

Wood K Frame Structures

Steel	15,000 lbs/mile
Aluminum	29,000 lbs/mile

5.3 SHORT AND LONG TERM USE OF THE ENVIRONMENT AS IT RELATES TO PRODUCTIVITY

The project's short term consequences include the disruption of land use and land cover during the construction process and the adjustment period for the natural landscape, e.g., shifts in wildlife habitats immediately after the construction of the line. Other disruptions include land cleared of vegetation for the line, the existence and maintenance of access roads, the maintenance of rights-of-way, cutting of trees, brush burning, and the general nuisances of construction activities such as dust, noise and fumes. While short lived, these activities may disturb nearby residents and wildlife.

The expected average operating life of 345 kV transmission line facilities is between 40 and 50 years. Experience indicates that, in most cases, transmission rights-of-way and corridors are the areas most likely to be upgraded to higher capacities in response to energy demands and technological advancements. Since the locations of generating facilities and load centers are not expected to shift significantly, the right-of-way will continue to be the best available route for transmitting electricity in the area. Therefore, the right-of-way represents a long term use of the environment.

The most significant long term impact on the environment and productivity of the proposed transmission line and associated facilities is its general contribution to the Applicant's electrical power distribution system in Wisconsin and its ability to provide an adequate and reliable power supply.

chapter 6

REGULATORY REQUIREMENTS

CHAPTER 6
REGULATORY REQUIREMENTS

6.1 FEDERAL PERMITS

The proposed 345 kV transmission line is subject to a number of federal laws and regulations. Failure to comply with any of these laws and regulations could result in the delay, modification or ultimate cancellation of the project.

The United States Army Corps of Engineers requires permits under Section 404 of the Federal Water Pollution Control Act of 1974 whenever wetlands are filled. In addition, the Corps of Engineers will require a permit under Section 10 of the River and Harbor Act of 1899 for the crossing of either the St. Croix or Mississippi Rivers.

Under Section 7 of the Endangered Species Act, the United States Fish and Wildlife Service (FWS) requires that an examination of critical natural habitats within the study area be carried out in order to determine whether or not any species protected under the Endangered Species Act of 1973 would be harmed. In addition, the FWS will review the proposed project with regard to any potential adverse impacts on other wildlife in the area.

The transmission line must meet height limitations for structures near airports established by the Federal Aviation Administration and the Minnesota Department of Transportation. In addition, safety markers will be required on conductors which cross major rivers.

Proposed routes which cross the Prairie Island Indian Reservation will require a formal right-of-way grant from the Secretary of the Interior. Bureau of Indian Affairs regulation 25 CFR 161, Rights of Way Over Indian Lands, provides that in rights-of-way, the Secretary, as provided by Congress, grants the right-of-way with the consent of the Indian landowner, as provided in the enabling legislation.

Federal regulations (Title 23, part 645.206 (e)) presently prohibit transmission lines on or overhanging freeway rights-of-way. Transmission lines may cross freeways but towers generally are not allowed within the right-of-way of controlled access roads.

The Federal Surface Transportation Act of 1978 included a provision which permits the use of Federal Aid highway right-of-way by utilities to reduce adverse impacts on

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abutting agricultural land. However, the Act also states that such usage can only take place when the location of utility facilities will not affect highway user safety. To date, this provision has been interpreted to mean that the state and federal governments would be legally liable for any accidents involving any utility facilities located on the highway's right-of-way.

A technical amendment to the Act has been proposed which more clearly defines the "safety" language of the 1978 Act. The federal and state governments are presently involved in the development of regulations which will guide the implementation of the 1978 Act. These regulations should be completed in the latter part of 1980; the existing regulations guiding the use of Federal Aid highway right-of-way will remain in effect until the new regulations are adopted.

6.2 MINNESOTA PERMITS

In addition to the Minnesota Environmental Quality Board routing and construction permit process, permits will be required for water crossings from the Minnesota Department of Natural Resources. A permit to cross public land may also be required depending on the route chosen. Permits for crossing highways are required by the Minnesota Department of Transportation.

6.3 WISCONSIN PERMITS

The Wisconsin Public Service Commission (WPSC) grants a Certificate of Public Convenience and Necessity (CPCN) in accordance with Wis. Stats. 196, for individual construction projects.

Before approving a CPCN, the WPSC must comply with the Wisconsin Environmental Policy Act (WEPA), Wis. Stats. 1.11. This law requires that each state agency consider the environmental implications of major actions significantly affecting the quality of the human environment. The WPSC is required to prepare an environmental impact statement describing the effects of such projects. This is circulated to other state agencies and the public for comment. In granting a CPCN, the WPSC must determine that the proposed project is: (1) in compliance with the most recent Advance Plan; (2) necessary to satisfy the reasonable needs of the public for an adequate supply of electrical energy; (3) design and location is in the public interest considering alternative sources of supply, alternative location of routes, individual hardships, engineering, economic, safety, reliability, and environmental factors; (4) will not have undue adverse impact on other environmental values such as, but not limited to, ecological balance, public health and welfare, historic sites, geological formations,

the aesthetics of land and water and recreational use; and (5) will not unreasonably interfere with orderly land use and development plans for the area involved.

In accordance with Chapter 196.491 of the Wisconsin Statutes utilities are required to file biennial advance plans with the WPSC. These plans must identify long range electric need projections and utility plans to meet these needs, including planned power plant and transmission line additions.

Once the utilities have submitted their advance plans, the plans are made available to the public and is distributed to various governmental agencies for comment. The WPSC prepares and distributes an environmental assessment of the advance plans. Following a review and comment period, hearings are held. The WPSC then approves or rejects the plans based on comments and testimony by the public and governmental agencies, and on the WPSC assessment.

The Wisconsin Department of Transportation (DOT) requires permits for transmission line crossings of state highways or construction along state highways. An interstate highway is the most sensitive of all state highways in terms of new construction, and thus will require careful scrutiny by the Wisconsin DOT. The Wisconsin DOT submits proposals involving interstate highways to the federal government for approval.

The Wisconsin Department of Natural Resources (DNR) requires permits for structures constructed over rivers. Structures constructed in floodplains are subject to compliance with NR 115 and NR 116 floodplain zoning. Permits would be required to cross any Wisconsin DNR land. If the line would cross the Willow River State Park, a permit from the Wisconsin DNR and approval from the U.S. Heritage Conservation and Recreation Service would be required.

6.4 MULTI-STATE RESPONSIBILITIES

Any final route chosen for this project will have to cross portions of Minnesota and Wisconsin. Though each state has its own regulatory review process for transmission line permitting, special efforts have been made to coordinate project review between states. The obvious dilemma of each state designating separate routes which do not meet at the state boundary is possible under existing state laws. However, efforts to avoid incompatible routes are being made through synchronized review processes and open communication between state and federal agencies, NSP, and the general public.

The two states did not formally agree on a common point for a state boundary crossing. This was due primarily to the sequence of project events which expanded the number of possible end points in Minnesota. Minnesota's Power Plant Siting Act of 1973, as Amended (Minn. Stat. § 116C.51 et seq. 1977), states in Subd. 3:

> "If a route is proposed in two or more states, the board (MEQB) shall attempt to reach agreement with affected states on the entry and exit points prior to authorizing the construction of the route. The board, in discharge of its duties...may make joint investigations, hold joint hearings within or without the state, and issue joint or concurrent orders in conjunction or concurrence with any official or agency of any state or of the United States."

The staffs of the two states' regulatory agencies have planned joint information meetings and public hearings for this project. This is intended to provide a common forum for public review and comment on the project, and a common basis on which to agree on a state boundary crossing point.

Minnesota-Wisconsin Boundary Area Commission

The Minnesota-Wisconsin Boundary Area Commission is a public agency sponsored by the states of Minnesota and Wisconsin. It is authorized to make recommendations to proper governmental agencies concerned with the boundary portion of the St. Croix River with regard to land and water use, including property laws, administration roles, ordinances, or other regulations. Its membership is comprised of an appointed representative from the National Park Service, State of Minnesota Department of Natural Resources and State of Wisconsin Department of Natural Resources. The Commission's objectives, as stated in the cooperative agreement creating the Commission are as follows:

A. To provide a regular forum for discussion of mutual problems, activities and programs associated with the Lower St. Croix National Scenic Riverway.

B. To coordinate programs and plans of the parties to avoid duplication and conflict with agreements, and State and Federal legislation.

C. To promote and ensure coordination with local units of government and other interests.

D. To monitor implementation of plans and programs for the Lower St. Croix River consistent with the National Wild and Scenic River Act as Amended.

E. To formulate uniform policies insofar as possible among the parties.

Though the Minnesota-Wisconsin Boundary Area Commission has no specific route approval responsibility or authority, it will be active in the review process.

chapter 7

ALTERNATIVES TO THE PROPOSED ACTION

CHAPTER 7
ALTERNATIVES TO THE PROPOSED ACTION

7.1 UPGRADE EXISTING LINES

The Wisconsin Public Service Commission has conducted a review of the alternative of reconductoring the existing 115 kV Red Rock-Crystal Cave transmission line. The line runs from the south of St. Paul to near Eau Claire and is the existing right-of-way which proposed alternative Route C would share. This alternative is a short term solution to the undervoltage and over current problems in west central Wisconsin, and does not eliminate the need for larger, additional transmission by 1987.

Reconductoring involves replacing the existing conductors with larger conductors, and also replacing some of the existing structures. A reconductored 115 kV line would still operate but would be able to carry greater amounts of power. Since the Minnesota portion of the line has been rebuilt more recently than the Wisconsin side, few structures in Minnesota would have to be replaced. The crossings at the St. Croix River would have to be rebuilt on both sides of the river, and would require larger structures. The addition of capacitors would be associated with the reconductoring alternative.

NSP does not favor the reconductoring alternative, in that reconductoring postpones the 345 kV line project at an inflated cost for future construction. Additional discussion on the reconductoring alternative is provided in the WPSC Final Environmental Impact Statement. In the absence of a need review by the Minnesota Energy Agency (MEA), there is no authority in Minnesota by the MEA or the MEQB to require or deny implementation of this alternative.

7.2 NO ACTION

The alternative of "no action" or "no build" is not considered in this EIS. It is not within the statutory authority of the MEQB to deny a construction permit to NSP on the basis of such a determination. State Environmental Impact Statements for high voltage transmission lines routes are specifically exempted from considering the need of a project (6MCAR § 3.025 6.2.(3)). The Wisconsin Public Service Commission staff has reviewed the issue of need for the proposed line, and presented information on the subject in their final EIS.

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7.3 UNDERGROUND TRANSMISSION

The alternative of placing an equal capacity transmission line underground is several times more costly than overhead construction, except in central business districts. Typically, the excessive cost precludes serious consideration of undergrounding, except in special circumstances where short lengths of the line would be in unique environmental areas.

On this project, the MEQB determined that alternative crossings of the Mississippi River and the St. Croix River should be studied in detail for consideration of placing the final route crossing beneath the riverbed. In response the MEQB order, the Power Plant Siting Program contracted with an independent engineering consulting firm to perform an evaluation of the available undergrounding technology, its costs to install, and the potential environmental impacts of its construction, operation and maintenance. The study was performed in May and June, 1980 and is available for review in its entirety at the offices of the MEQB Power Plant Siting Program, St. Paul and at project library depositories listed in Appendix C. A summary is provided here.

SUMMARY REPORT OF UNDERGROUND ALTERNATIVE

Six river crossing points were ordered for study by the MEQB (see Figure 7-1). From one to three undergrounding techniques were studied at each crossing, resulting in eleven total options which are presented in this report. The river crossings are identified as:

SCR A - St. Croix River Route A
SCR B - St. Croix River Route B
SCR C - St. Croix River Route C
SCR D - St. Croix River Route D
MR 1-2 - Mississippi River Segment 1-2 (Prairie Island Route)
MR 3-5/4-6 - Mississippi River Segments 3-5 and 4-6 combined (Trenton 1 & 2 routes)

Cable Types

Three underground cable types were considered, which represent the commercially proven technology for 345 kV ac power transmission. The following sections describe each cable type. Cross sections of typical underground installations are shown in Figure 7-2. The operational characteristics of the cables, that is, reliability, accidents and chemicals, noise, heat, electric and magnetic effects, are discussed in the consultant's report, but is not included here due to its length. The procurement time for each cable type is approximately one year.

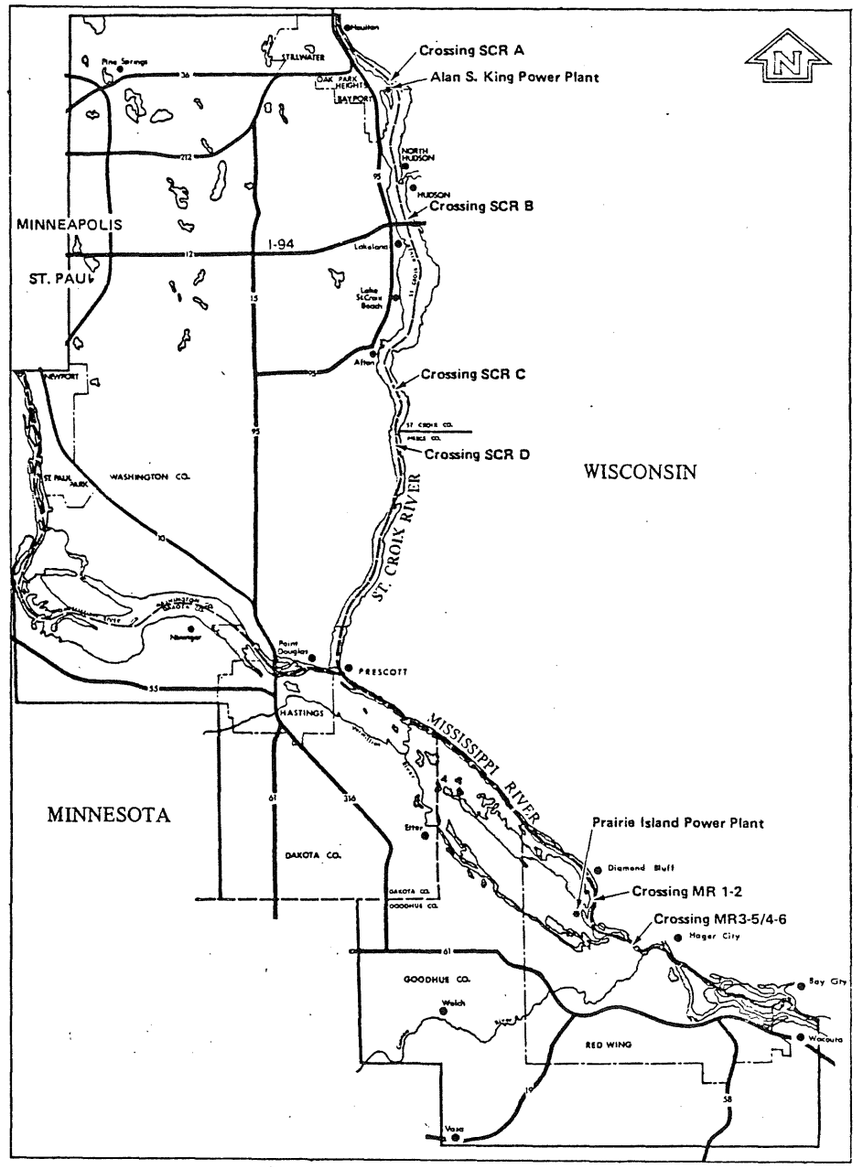
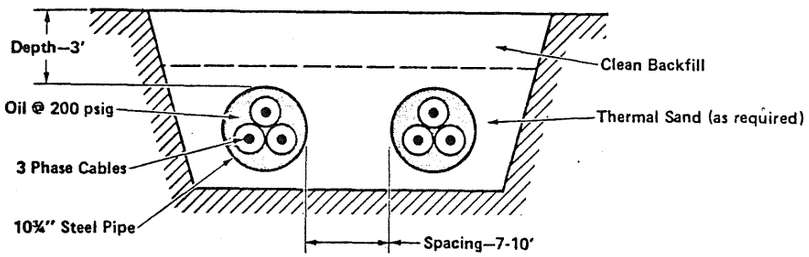
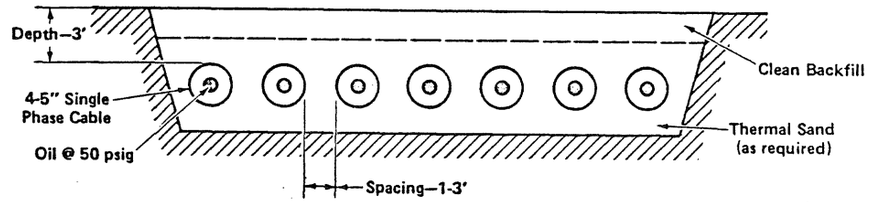


FIGURE 7-1
LOCATION MAP

HPOF (high pressure oil filled)



SCOF (self contained oil filled)



GITL (gas insulated transmission line)

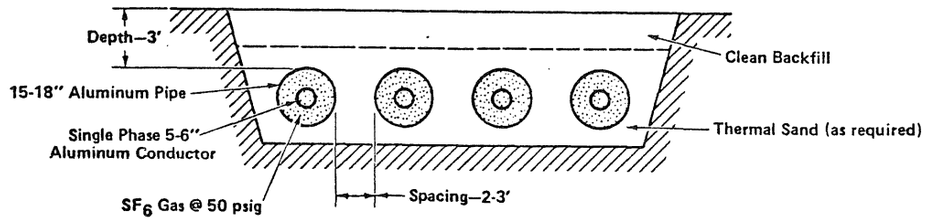


FIGURE 7-2
CABLE AND INSTALLATION CROSS SECTIONS

(1) HPOF (High Pressure Oil Filled) Pipe Type Cable

This system consists of a steel pipeline, into which three insulated phase conductors are pulled. The pipeline is installed in 60 foot sections, and welded. For distances greater than about 3,000 feet, manholes are installed and the conductors are pulled in from manhole to manhole and spliced end-to-end. The pipe line is pressurized to 200 pounds per square inch gauge (psig) with a dielectric fluid (napthenic mineral oil). A 345 kV HPOF cable with a transmission capacity up to 600 million-volt-amperes (MVA) typically has an outer pipe diameter of 10 3/4", and an oil capacity of about 2.3 gallons/foot. The power can be increased 50% by force-cooling the cable, i.e., pumping the oil through the pipe from a refrigerator at the terminal station. Since the NSP application assumes a capacity of 1200 MVA, two pipe type circuits are required, with a possible third line for contingency.

Accessory equipment for an HPOF system includes:

- Pressurization equipment (to maintain pipeline pressure) - a small pump (less than 5 HP) and an oil reservoir of 300-1500 gallons, for the lines in this study. A 10 HP pump and reservoir of 1500 gallons or more would be used for the force cooling application in this study.

- Shunt reactor (to compensate for capacitance in this type of cable system) - a device of the same approximate site and visual impact as a transformer. A reactor with open air bushings may be 30 feet high. Reactors are not required for the short length applications in this study and have not been included in the cost analysis. However, they could be installed to increase the operating efficiency of the line. Consequently, they are assumed in order to include "worst case" conditions in the environmental assessment.

- Termination (to connect the underground cable to an overhead line or to substation equipment) - normally a procelain bushing, standing 20 to 30 feet high.

- Circuit breakers and switches (to isolate the line and/or switch in the spare cable during contingencies) - a cell with bushings 20 feet high. For a short underground section of a long transmission line, such as at dips for crossing rivers or overhead lines, breakers are not necessary. The underground section may be protected by differential relays, which activate the line breakers at the substation by remote control. Relays rather than breakers were included in the cost analysis.

- o Refrigerator (oil-to-air heat exchangers for force-cooling applications) - dry-fin units the size of a house trailer with 8 foot fans may be installed fully enclosed, and sound baffled.

- o Manholes (to access the line and to splice cable sections) - these are about 6 feet by 8 feet by 25 feet for a single circuit.

The accessories are located at terminal stations within the right-of-way. Depending on how much of the support equipment is needed and how many circuits there are, the stations will occupy an area of about ¼ to 1 acre or more.

(2) SCOF (Self Contained Oil Filled) Cable

The SCOF cable is an isolated phase system, i.e., three separate phase cables per circuit. Each phase is a flexible cable 4 to 5 inches in diameter, consisting of an insulated hollow conductor, and pressurized with oil at about 50 psig. The outer diameter of underwater cable may be wrapped with a steel wire armor. The cable is installed from reels in lengths of several thousand feet. The capacity of a 345 kV circuit depends on the cable design, and can range from 400 MVA up to 1000 MVA. In this study we consider a cable of 600 MVA capacity, so that the NSP application would have a double circuit plus a spare, or seven phase cables.

Accessories for an SCOF system are the same as for HPOF, although the oil support equipment is less elaborate. Since the oil volume is smaller (about 0.2 gallon per circuit foot) reservoirs need only be 50-100 gallons, and gravity feed may be substituted for pumps if the reservoirs are elevated on poles at high points on the line. The SCOF installations considered in this study are not force-cooled. Manholes are not necessary since any splices may be buried.

(3) GITL (Gas Insulated Transmission Line)

The GITL is an isolated phase system, each phase of which consists of two concentric aluminum tubes, the inner one being the conductor, and pressurized to 50 psig with SF_6, an inert gas. The tubes may be either rigid (60 ft. smooth section) or flexible (300 ft. corrugated lengths on a reel). The outer diameter of each phase if 15-18 inches. The capacity of a 345 kV circuit ranges from 1200-1800 MA. Thus a single circuit would meet the NSP requirement; with a spare phase for contingency, there would be four phase cables.

The GITL system is self-sufficient in that the requirement for accessory equipment for the GITL system is minimal. No reactors or pressurizers are normally required. Because of its ideal heat dissipation characteristics, the termination riser section can be installed to tower height, and connect directly with overhead lines. In this way the area required for a termination station can be limited to an area as small as the tower itself.

Crossing Options

The selection of cable types and methods of installation was made on the basis of recommendations by the consultant, and in consultation with the MEQB project manager. For each of the designainstallation or terminal locations were selected for engineering and environmental analysis. Following is a documentation of these options. For the crossing routes in this study, suitable HPOF, SCOF or GITL installations could be engineered. That is, crossing conditions at the routes ordered for this study do not of themselves favor or preclude any of the cable types, and in this sense, the selection of cable types at each of the crossings may be considered arbitrary. It is worth noting that the GITL technology is relatively recent and as yet there are no GITL systems installed underwater. A bridge crossing was considered the best option for th GITL. A recent advance in pipe laying technology is that of directional drilling, so an HPOF installation by this method was selected at one route. Additional considerations in the selection of cables are discussed in the following sections. An attempt was made to provide a good basis for comparison by selecting more than one cable type for each type of geographical setting.

St. Croix River Crossing-Route A (SCR A)

This route parallels an existing double-circuit 69/115 kV overhead line.

Option 1

Two or three HPOF pipe circuits installed by trench from shore to shore. HPOF cable is selected for assessment at this crossing because it is the most widely used underground cable in the U.S. Oil pressurization equipment and reactors are located at the termination station on the King Plant side. Breakers and relays, switches and surge arrestors may be installed at both terminations. The connection on the Wisconsin side is to low profile overhead lines to a point beyond the bluff where high towers for long spans would be out of sight from the river.

Option 2

Two or three HPOF pipe circuits installed by trench from the King Plant shore to the point beyond the bluff. In this case, the right-of-way on the Wisconsin side is cleared of trees and maintained with low vegetation. Station equipment is the same as above.

St. Croix River Crossing-Route B (SCR B)

This route parallels the U.S. 12/Interstate Highway 94 bridge across the St. Croix River.

Option 1

One GITL circuit (4 phase cables) installed by trench between points beyond the bluffs on both sides of the river. Flexible GITL is installed underground on either side of the river. The river crosing itself is achieved by hanging the cables under the I-94 bridge deck. The GITL is desirable because of its lighter weight and self-sufficiency. Because of the joint use with the I-94 right-of-way, minimal tree clearing would be required. Station equipment at each of the line consists only of terminations, breakers and switches.

Option 2

Two or three HPOF circuits, installed by the same method as Option 1 between the same points. The HPOF system was considered for purposes of a cost comparison and because of the question of the bridge vibration. Whether vibration would affect the useful life of the aluminum (GITL) or the insulation (HPOF) has not been determined. Pressurizing pumps, an oil reservoir and perhaps shunt reactors are installed at one end station.

St. Croix River Crossing-Route C (SCR C)

This route parallels an existing 115 kV overhead line.

Option 1

Two or three HPOF circuis installed by trench from shore to shore. Contours are altered at the shore to accommodate a station area of about ¼ acre on one shore and ½ acre or more on the other. Low overhead lines connect the terminations to high towers out of sight behind the bluffs. Accessory equipment at the end stations is the same as stated above.

Option 2

Two or three HPOF circuits installed by trench between termination stations located at the towers beyond the bluffs. This involves clearing the right-of-way of trees on the river banks. Station equipment is as above.

Option 3

Two or three HPOF circuits installed by trench from stations beyond the bluffs to points near the crest of the bluff. Directional drilling and pipe pulling methods are used to reach the edges of the river, at which point manholes may or may not be installed. The directional drilling method employs a reamer which is guided by remote control. A 3 inch pilot reamer will be used to establish the line. The final hole will be made by an 18 inch reamer. A steel pipe casing would be attached to this reamer and pulled through the hole. This option avoids tree clearing on the slopes. Installation underwater is by trench. Because of the depth of the drilled sections, the cables would be force cooled. Accordingly, pumps and refrigerators are installed at one end station and additional 5 inch pipes are installed alongside the cables for oil return flow.

St. Croix River Crossing-Route D (SCR D)

This route parallels an existing 345 kV overhead transmission line.

Option 1

Two SCOF circuits (7 phase cables) installed by trench from shore to shore. Stations are located at the shore and overhead connection is made via low profile lines to high towers beyond the bluffs. Accessory equipment and station areas are similar to those for the HPOF system. Since crossings SCR C and SCR D are geographically very similar, the HPOF system for SCR C and the SCOF system for SCR D were selected to provide an engineering, cost, and environmental comparison.

Option 2

Two SCOF circuits (7 phase cables) installed by trench between termination stations located at the high towers behind the bluffs. The route on the Minnesota side deviates from the existing overhead route in order to terminate on high ground far enough behind the bluff to keep the high tower out of sight from the river. The right-of-way is cleared of trees on the river banks. Station equipment is as above.

Mississippi River Crossing-Route 1-2 (MR 1-2)

Option 1

Two SCOF circuits (7 phase cables) installed by trench from the shore at Prairie Island to a wooded area beyond the wetlands in Wisconsin. Trees along the cable route are cleared and low vegetation is maintained. Overhead connection is made to a high tower near the Wisconsin termination. The overhead lines are outside of the waterfowl flyway, defined by the bottom wetlands. Shunt reactors and oil support equipment would be located at the Prairie Island termination near the power plant.

Mississippi River Crossing-Route 3-5/4-6 (MR 3-5/4-6)

Option 1

Two or three HPOF pipe circuits installed by trench between upland wooded areas beyond the wetlands on both sides of the river, spanning the waterfowl flyway. The right-of-way is cleared of trees and maintained with low vegetation. Oil pumps and reservoirs, as well as reactors, are installed at one end station. Only one underground crossing route was considered here, instead of the two overhead "Trenton" routes, because the two would be very similar.

Cost Assessment

Construction cost estimates were determined for each of the crossing options. The installation of underground systems includes equipment and work by the utility, by manufacturers and suppliers, and by one or more construction contractors. Operation and maintenance and repair costs are not included in the study.

Construction Cost Estimates

Costs considered and included in the assessment were as follows:

I. Furnished by Power Company (at cost)

1. Equipment: pipe (including corrosion protection) cable, oil or gas
2. R-O-W (based on the following assumptions: $2,000-$3,000 per acre; $100/ft. river frontage)
3. Surveys, explorations, test borings ($40,000/mile)

II. Installation by Contractor

1. Access, clearing, restorations
2. Trenching
3. Weld & install pipe (HPOF, GITL)/install cables (SCOF)
4. Trench backfill
5. Pull cables (HPOF)
6. Oil fill & pressure test (HPOF, SCOF)/gas fill & pressure test (GITL)
7. Manholes (HPOF)
8. Splices (HPOF, SCOF)
9. Terminals (potheads/bushings, risers, switches, differential relays)
10. Oil pressue system static or force cooled (HPOF, SCOF)
11. General job expenses
12. Company overhead & profit (20% of items 1 through 11)

III. Engineering & Contingencies by Utility and/or Contractor

1. Engineering: planning and design (5% of I and II given above)
2. Contingencies (10% of I and II given above)

The cable equipment is the largest single line item, and that the largest construction expenses are associated with the trench, i.e., excavation and backfill. There are discussed in the following two sections.

Equipment Costs

The equipment associated with each cable system was described in the previous section. The predominant cost for all crossings is the cable equipment (line item I-1, Table 7).

Cable equipment costs for the various underground cable types are as follows:

Cable Type	Cost/L.F.	No. of Circuits
HPOF	$194	2
HPOF	$291	3
SCOF	$383	2 (+1 spare phase)
GITL	$690	1 (+1 spare phase)

The HPOF and SCOF cable costs above represent 1/3 to 1/2 of the total project cost per linear foot (L.F.). The GITL cable cost, however, represents 84% of the project cost per L.F. In principal, GITL systems are more competitive at short distances and high power levels because their capacity per circuit is much greater and because HPOF and SCOF accessories at the terminations become a more significant fraction of the cost. The high costs of GITL equipment result in an excessive total for SCR B Option 1 because of the very long length of the line.

Trench Costs - Excavation and Backfill

The largest construction costs are for excavation and backfill of the trench containing the cables, for all crossing options except SCR B, where the river crossing is by bridge intead of trench. Trench costs in general depend on the location, terrain, and trench size. The trench sizes may differ depending on the size and number of cables to be installed, and the spacing between adjacent cable. Cable spacing is determined by such competing factors as provision for heat dissipation, allowance for sufficient space for repair activities in the event of an accident or fault, and right-of-way costs. In the absence of soil profiles, and a thermal model of each installation, a conservative spacing was assumed in order to minimize interaction between cables, possibly compromising capacity. Further, a five foot cut is assumed in all cases. In addition, it is assumed that the trench spoils will have sufficient thermal conductivity to warrant treating on-site and returning as backfill. This conservative assumption means that an additional cost is to be incurred to import a "thermal sand" in which the cable is embedded, thereby reducing the heat flux density in the cable environment. It is possible that the spacing and the backfill requirements will be necessary with the GITL, because of its low flux density, and that reduced spacing as well as trench depths (and therefore backfill volumes) will suffice for the SCOF. Accordingly, both these costs are conservative.

The direct costs (i.e., excluding overhead & profit of "trenching and trench backfill" are dependent on working conditions in various terrain: moderate terrain, steep terrain, wetlands, and underwater at 14 to 55 ft. water depth. Typical unit direct costs per L.F. are:

	Trenching (per L.F.)	Trench Backfill (per L.F.)
Moderate Terrain	$11 - $16	$19 - $29
Steep Terrain (Bluffs)	$22 - $38	$24 - $41
Wetlands	$69 - $139	$24 - $41
Underwater	$95 - $141	$92 - $109

If local borrow material with sufficient thermal conductivity, such as silty sand, is available, the backfill costs will be minimized, resulting in a 3% overall project cost reduction.

Moderate Terrain

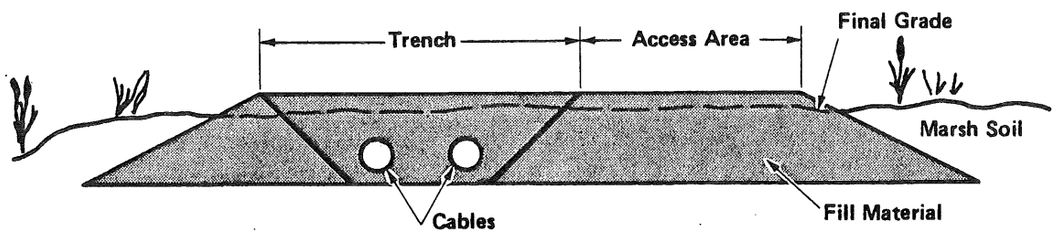
Trenching on moderate terran is normally done with a 1 cu. yd. backhoe.

Steep Terrain

Trenching on steep terrain reduces the output by 1/3 to 1/2 of the normal rate achieved on moderate terrain.

Wetlands

Wetlands, consisting of 0 to 2 ft. of water, are traversed at the two Mississippi River crossing sites. Fill material is brought into the wetland to constructe a road 30 to 40 feet wide and one foot above waterline. This fill material is placed directly on the marsh soils, and compacted. The marsh soils are displaced with excavation. The trench for the cables is then cut in this workable access road. After the pipes or cables are placed, the trench is backfilled and the original surface elevation is restored. If local borrow material can be used for the road, this would save 3% and 7% of the total project costs for MR 1-2 and MR 3-5/4-6, respectively. Further, if this material were thermally acceptable, it would save 6% and 10%, of the total project costs, respectively.



One alternative to the surface trenching methods described above is the directional drilling method. It is used in SCR C, Option 3. Directional drilling is used at the east and west bluffs. The 10-3/4" HPOF pipe is then pulled through a slurry or drilling mud. Because of the depth, a force-cooled oil pressure system is installed to remove the heat generated by power transmission.

Another alternative to surface trenching is utilized in SCR B, Options 1 and 2. Approximately 2,600 feet of route is installed by suspending pipes, GITL or HPOF, under the existing steel bridge on eastbound Highway I-94. If terminations to overhead lines were to be located adjacent ot I-94 at the water's edge, the short span would influence the cost comparison of the GITL and HPOF options.

The trench backfill consisting of "imported" thermal sand, and a three-foot depth of cover are assumed for all the options considered. The total quantity depends on the cross section, i.e., land cuts with steep 1:1 slopes or underwater river cuts with flat 5:1 slopes. It is likely that the bottom material from the St. Croix River is thermally acceptable and can be used in the trench. This would reduce the total project cost by 3% and avoid the logistical problems of a large-scale soil "exchange."

Cost Summary

The underground transmission system was based on 345 kV, delivering 1200 MW. After visiting the sites, cost estimates were prepared for four river crossing routes on the St. Croix River and two routes across the Mississippi River.

Each crossing was generally 2,000 feet wide with depths of water ranging from 14 to 55 feet. The total length of each crossing, including the land and river portions, ranged from 2,000 to 12,000 feet. The longer crossings were from bluff to bluff (SCR) or across wetlands (MR). The cost per linear foot (L.F.) depended on terrain and the type of cable selected. The lengths of the crossing options are summarized in Table 7-1.

Project costs ranged from approximately $447 per L.F. to $1,309 per L.F. (Equipment costs of the power line only ranged from approximately $235 to $707 per L.F.) Total project costs per site ranged from approximately $2.0 million to $10.1 million--dpending mainly on the length of the crossing. A cost summary of crossing options is given in Table 7-2. The five cost categories given in Table 7-2 summarize line items listed earlier. The categories are:

- Planning and Design - includes line items I-3 and III-1.
- Right-of-Way Acquisition - includes line item I-2.
- Material and Equipment - includes line items I-1, II-7, II-9, and II-10.
- Construction - includes line items II-1, II-2, II-3, II-4, II-5, II-6, II-8, II-11, and II-12.
- Contingencies - includes line item III-12.

In Table 7-2, the HPOF options include the cost of two HPOF circuits. If a third HPOF circuit were included to provide a "spare" pipe cable for contingency, the total project cost for each HPOF option would increase 45%.

The SCOF options costs in Table 7-2 include two circuits, plus a spare phase cable for contingency. The GITL option includes one circuit plus a spare phase cable for contingency.

The most expensive cable equipment is the GITL, although it has greater capacity and minimal accessory equipment. SCOF cable is costlier than HPOF, although it can be designed for higher capacity. The use of the bridge at crossing SCR B is less expensive than trenching.

The terminal for the underground cables at crossings SCR A, C, and D (Options 2 and 3) and at crossings SCR B (Option 1 and 2) are located relatively far back from the edge of the river in order that the high towers be out of sight from the river. If a low visibility overhead approach to the river were allowed at crossing SCR B, their terminals could be constructed on the river banks and the distance of the bridged and buried cable reduced to 4,000 feet. This would considerably reduce the cost of this crossing (by over $6,000,000 for Option 1, for example).

The possible cost of an easement for use of the I-94 bridge, if required, has not been included in the estimates in this report.

The reader is cautioned that the cost estimates given here are useful for comparative purposes, but would not necessarily hold up under a competitive bidding process. The line items may vary considerable once construction specifications, delivery and completions schedules, and the competitive field are determined.

Environmental Assessment

A detailed assessment of the potential environmental impacts which may result from undergrounding the proposed 345 kV HVTL is included in the consultant's report, but due to its length, is not presented here. The full report is available from the Power Plant Siting Program staff, Minnesota Environmental Quality Board, St. Paul, Minnesota, and can be reviewed in libraries listed in Appendix C.

TABLE 7-1

LENGTHS OF CROSSING OPTIONS

Location	SCR A*		SCR B*		SCR C*			SCR D*		MR 1-2**	MR 3-5/4-6**
Option	1	2	1	2	1	2	3	1	2	1	1
Cable Type	HPOF	HPOF	GITL	HPOF	HPOF	HPOF	HPOF	SCOF	SCOF	SCOF	HPOF
Length in feet											
Steep Terrain	-	800	-	-	-	900	1,600	-	600	-	100
Moderate Terrain	400	2,100	8,000	8,000	200	3,300	2,600	200	1,500	1,600	8,100
Wetland	-	-	-	-	-	-	-	-	-	5,500	3,000
Underwater	1,800	2,300	-	-	2,300	2,300	2,300	1,800	1,800	1,600	800
Bridge	-	-	2,600	2,600	-	-	-	-	-	-	-
TOTAL LENGTH	2,200	5,200	10,600	10,600	2,500	6,500	6,500	2,000	8,700	9,700	12,000

* St. Croix River

** Mississippi River

TABLE 7-2

COST SUMMARY OF CROSSING OPTIONS

(in June 1980 dollars)

Location	SCR A		SCR B		SCR C			SCR D		MR 1-2	MR 3-5/ 4-6
Option	1	2	1	2	1	2	3	1	2	1	1
Cable Type	HPOF	HPOF	GITL	HPOF	HPOF	HPOF	HPOF	SCOF	SCOF	SCOF	HPOF
Planning & Design	104,900	103,000	513,700	255,800	85,200	224,400	278,700	129,800	192,700	366,200	329,700
Right-of-Way Aquisition	10,000	8,500	29,200	62,200	10,000	12,000	12,000	12,000	17,000	31,800	35,000
Material & Equipment	886,300	1,477,500	7,491,000	2,563,800	934,400	1,749,400	2,149,400	1,277,800	1,944,300	3,602,700	2,820,000
Construction	866,200	1,346,300	1,152,900	1,442,500	1,160,900	1,719,200	2,403,600	970,100	1,303,900	2,341,800	1,807,200
Contingencies	177,800	287,200	874,900	411,800	210,300	352,900	461,300	227,600	329,300	604,100	475,400
TOTAL PROJECT COST	2,045,200	3,303,100	10,061,700	4,736,100	2,418,800	4,057,900	5,305,000	2,617,300	3,787,200	6,946,600	5,467,300

appendix

APPENDIX A
Report on Recreation Use of the St. Croix River

The following information was presented to the King Citizens Route Evaluation Committee at one of their regular meetings by Steven Johnson, Associate Director of the Minnesota-Wisconsin Boundary Area Commission. Recreation data is only available in detail for the St. Croix River portion of the study project area.

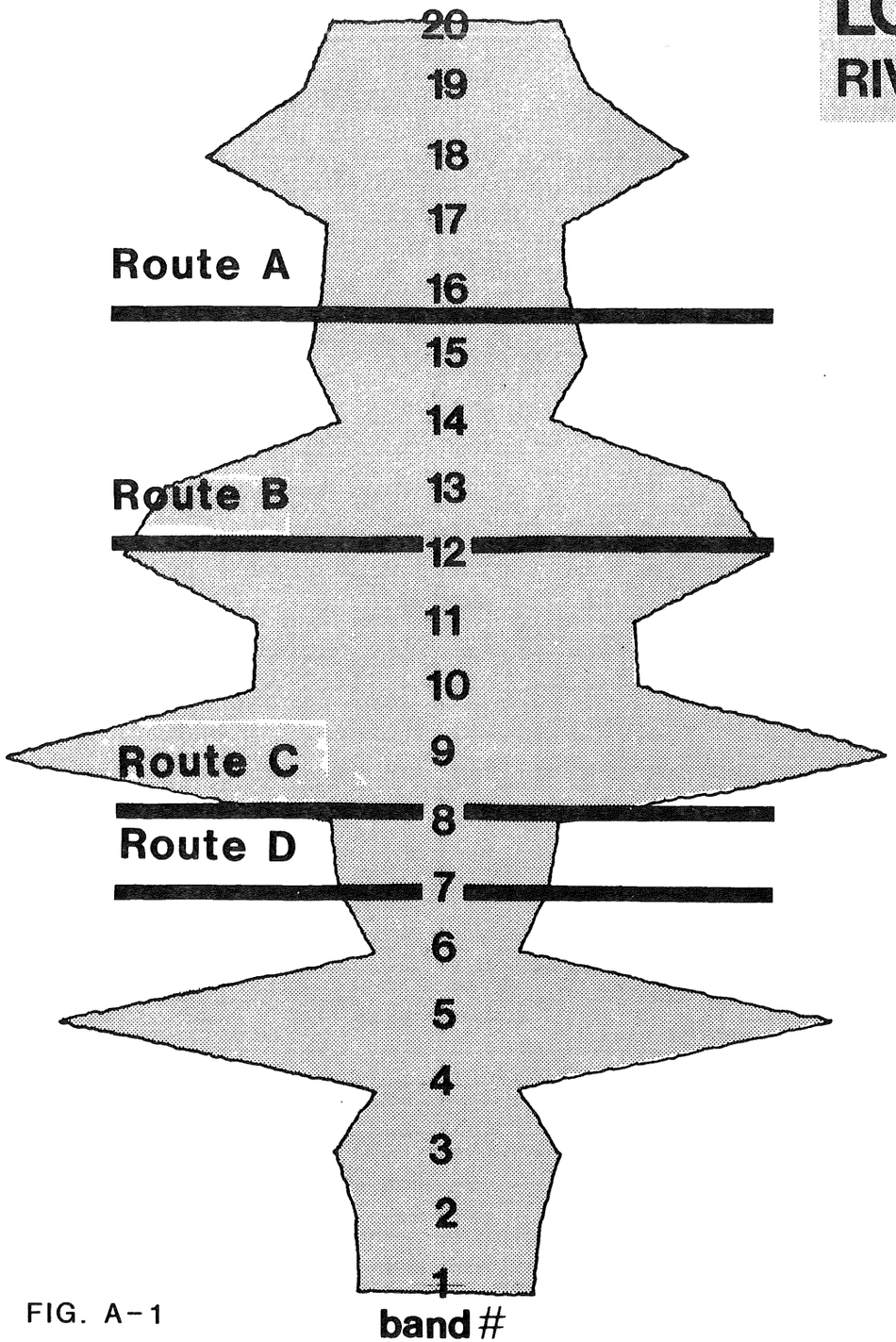
The 52-mile Lower St. Croix National Scenic Riverway has been divided arbitrarily into 34 equal-sized chunks, called "bands." The Arcola Sandbar (River Mile 31.0) restricts power boating above that point, so that motorboat recreation occurs primarily south of that point, in Bands 1-20. The 21 miles of river north of that point gets 19 percent of the total river's use, while 81 percent of the use occurs on the southerly 31 miles. Figures reported here deal exclusively with that southerly segment.

Following are percentages of river use that occur in the southerly 20 bands, based on aerial photography conducted in 1977 and 1978. River use percentages correspond to Figure A-1.

Band #	Percent	Transmission line route visible from each band	Geographic feature
1	2.5		Prescott
2	2.6		
3	3.2		
4	2.0		
5	11.4	D	Kinnickinnic State Park
6	2.0	D	Corridor D
7	3.0	C,D	Afton State Park
8	3.3	C,D	Corridor C
9	13.0	C	Catfish Bar, Afton
10	5.7	B	
11	5.6	B	
12	9.5	B	Hudson, Hudson Islands, Corridor B
13	8.3	A,B	Hudson, Hudson Islands
14	3.0	A	North Hudson
15	4.0	A	Bayport, King Plant, Corridor A
16	3.5	A	Stillwater
17	3.4		Houlton
18	7.0		Boomsite Historic Wayside Park
19	4.2		
20	3.4		Arcola High Bridge

Appendix

LOWER ST. CROIX: RIVER'S SHAPE BY USE



Arcola High Bridge 20

Boomsite Wayside 18

Stillwater 17

Bayport 15

Lakeland 11

Afton 9

Afton State Park 7

17 Houlton

14 North Hudson

13 Hudson Islands

12 Hudson Islands

9 Catfish Bar

5 Kinnickinnic State Park

1 Prescott

FIG. A-1

The heaviest use area on the lower segment of the river is the Hudson Islands area (Bands 12-13), which gets 17.8 percent of the use. Second is the islands/narrow channel area north of Stillwater (Bands 18, 19, and 20), which gets 14.6 percent of the use. Third is Catfish Bar (Band 9), where 13.0 percent of the use occurs. Fourth is the sand delta in Kinnickinnic State Park (Band 5), where 11.5 percent of the use occurs.

Drawn from the figures on the previous page are the following use percentages for those bands that are within sight of each of the four transmission line corridors:

	Percent
Route A	18.8
Route B	29.1
Route C	19.3
Route D	19.7

The river segment below the Arcola Sandbar will have 1,366.6 boats on it at 2 p.m. on a typical good-weather weekend day in the summer. On a typical summer weekday at 2 p.m., there will be 149.6 boats in use on the river.

The following table indicates the amount of boating recreation that will occur within sight of each transmission line route at 2 p.m. on typical days:

	Typical summer weekend day		Typical summer weekday	
	Number of Boats	Number of People	Number of Boats	Number of People
Route A	257	771	28	84
Route B	398	1,193	44	131
Route C	264	791	29	87
Route D	269	807	29	88

The following table demonstrates the percentage of boats that will be either beached or moving in the channel within sight of each transmission line corridor.

	Percent moving in channel	Percent beached
Route A	51.4	48.6
Route B	50.4	49.6
Route C	43.3	56.7
Route D	43.9	56.1

Only craft considered to be in active recreation use are counted as part of the airphoto studies. Boats docked in marinas or at residences, as well as boats seasonally beached at residences, are not counted. Interviews with river users have told us that most boaters spend part of each recreation day beached. About 60 percent of the craft in active use at any time are beached.

The river segment below Arcola will be used by 2,051 different watercraft on a typical summer weekend day, or about 6,153 people (about the same as the present population of Hudson). That amounts to 36,918 person-hours of boating recreation each summer weekend day or holiday. The segment of the river below Arcola will be used by 224 different boats on a typical summer weekday, or 672 people. That amounts to 4,032 person-hours of boating recreation each summer weekday.



In the river segment below the Arcola Sandbar in a typical summer season in the late 1970s, there will be use by 82,915 watercraft, or 248,745 people; that's 1,492,470 person-hours of boating recreation. (These figures do not take into account recreation not asssociated with boats, such as hiking, sunbathing, swimming, shore fishing, etc., where the people go to the river by some means other than a boat.)

The following table describes recreation activity within sight of each transmission line corridor for an entire typical summer season in the late 1970s:

Route	Boats	People	Person-hours of recreation
A	15,588	46,764	280,584
B	24,128	72,385	434,309
C	16,003	48,008	288,047
D	16,334	49,003	294,017

The figures are based on "instant count" airphotos from 1977 and 1978, and do not take into account through traffic to and from recreation sites and launch ramps/marinas. Actual figures would be higher. For example, the above methods would show total seasonal activity in Band 1 (Prescott) is 2,073 boats. Actual traffic observations conducted as part of a study at Prescott in 1979 yielded a seasonal traffic estimate for Band 1 of 51,024 boats. Of those boats passing on or off the Mississippi, the same study in 1979 determined that 22,502 watercraft would have passed under Route D; 18,471 would have passed under Route C; 10,511 would have passed under Route B; and 5,501 would have passed under Route A. To put this another way, in 1979 there were 5,051 boat trips past the King Plant by watercraft that originated at marinas and launch ramps on the Mississippi in the Prescott-Hastings area.

Several questionnaires were administered in 1977 to boaters as they came off the river at the end of their recreation day. One of those asked a question about transmission lines:

19. The following items describe man-made conditions along the river. Please circle the number which best describes your feelings about the section of the river which you visited TODAY:

Electric transmission lines

disturbing	1	8.4%
	2	12.6
	3	24.0
not disturbing	4	55.0

Note that the question asked boaters only about the section of the river they had just visited; some of the respondents who said transmission lines were "not disturbing" probably did not see any transmission lines on that boating day. There was no follow-up question, so there is no way to determine how many did or did not see any lines.

Question 19 also asked about 15 other man-made elements. The "disturbing" response ranged from 2.9 percent (bridges) to 25.6 percent (litter). The "not disturbing" end of the scale ranged from 26.2 percent (litter) to 65.0 percent (bridges). There were 669 respondents to the questionnaire that included question 19.

Another questionnaire administered in 1977 was sent to all the riparian landowners in the Riverway. Response was fairly low--only 325 completed questionnaires were returned. This questionnaire also included a 15-element question:

21. What is the most annoying part of your residence.

power lines 5.5 percent

The lowest was sailboats at 0.3 percent; the highest was noise at 31.2 percent.

APPENDIX B

Comments/Positions on the Potential for Waterfowl Collisions with Proposed Mississippi River Route Crossings

As noted in the main body of this Draft EIS, the potential for waterfowl mortality resulting from collisions with the proposed transmission line is a controversial issue. Potential collisions are only a concern on proposed routes which cross the Mississippi River. Very little use of the St. Croix River by waterfowl exists in the project study area.

Individuals and agencies which are concerned with the collision issue generally agree that collisions will occur, but are not in agreement about the probable number of collisions.

The following comments and positions have been submitted to the MEQB.

Information provided by Northern States Power:

Report: Fall Waterfowl Populations in the Prairie Island Area - Fall, 1979
Prepared By: Karl K. Karrow, Research Assistant
James A. Cooper, Associate Professor
Department of Entomology, Fisheries, and Wildlife
University of Minnesota
St. Paul, Minnesota 55108
Dated: January, 1980

Northern States Power Company has proposed construction of a 345 kV electrical transmission line in the Prairie Island area, near Red Wing, Minnesota. This line would cross the Mississippi River and adjacent wetlands between NSP's Prairie Island Nuclear Generating Plant (PINGP) and Wisconsin. Because ducks, geese and swans are known to die from collisions with powerlines, questions have been voiced concerning the magnitude of this potential impact (Northern States Power Company, 1979).

Objectives of this study were to: 1) determine composition of waterfowl species using the Prairie Island area in fall, 2) measure abundance and distribution of these birds, and 3) measure the magnitude of waterfowl travel through the proposed Mississippi crossing site. This data should aid in evaluating the probable impact of the crossing on waterfowl.

appendix

Study Area

The area surveyed included portions of the Mississippi, Vermillion, and Cannon Rivers and associated bottomlands located between Prescott, Wisconsin and Red Wing, Minnesota. This area, bound by steep river bluffs, is located in Goodhue and Dakota Counties, Minnesota and Pierce County, Wisconsin, and is dotted with numerous ponds, lakes, sloughs and backwaters. Hardwood forest covers the bluffs and other moderate to well drained soils, while cattails and other marsh vegetation dominate the wetlands. Agricultural use of the area is limited to the terrace between the Mississippi and Vermillion River channels; corn, beans, and pasture are important crops.

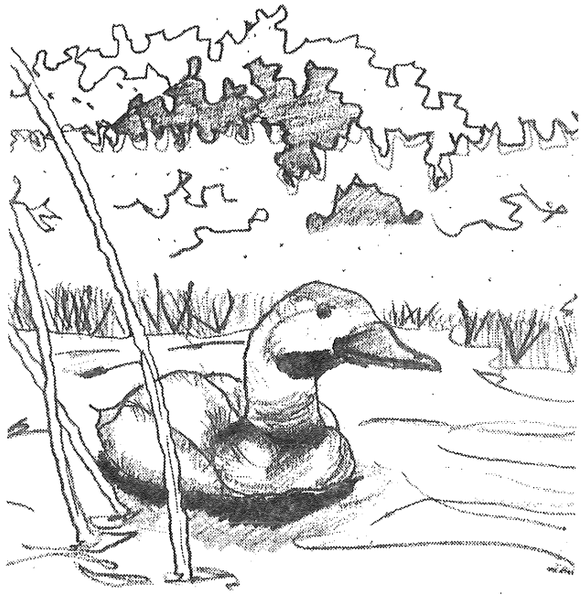
Several important man-made structures were present and potentially influence waterfowl use of the area. The Prairie Island Nuclear Generating Plant (PINGP) is a two-unit nuclear-fueled plant located on Prairie Island adjacent to Sturgeon Lake about 12 km above Red Wing. Cooling water discharge from PINGP generally exceeds river water temperatures by three to five degrees Fahrenheit (Eberley 1978:1, 2-3). The influx of warm water resulted in ice-free conditions in the PINGP discharge canal and adjacent portions of Sturgeon Lake during this study.

Located 10 km upstream from Red Wing is Lock and Dam 3 (Great River Environmental Action Team 1979a). This structure is operated by the U.S. Army Corps of Engineers and is part of the 9-foot Channel Navigation Project initiated in 1930. The upstream water levels by 2.4 meters (m) at the dam site and forms a 7180 hectares (ha) pool extending 29.3 km upstream. The main channel of the Mississippi River is maintained for commercial river traffic by the Corps of Engineers. Waterfowl impacts of the 9-foot Channel Navigation Project are described by the Great River Environmental Action Team (1979a, b, c).

Much of the study area is under public ownership and is open to public recreation. The Mississippi River backwaters, northwest of the North Lake boat access, are managed by the Minnesota Department of Natural Resources as Gores Pool Number 3 Wildlife Management Area. Virtually all of Burnside Township (T. 113N., R 15 W.), including Goose, Jones, and Wildcat Lakes and the Cannon River bottoms, are within the city limits of Red Wing. Parts of section 31 and 32, T. 114 N., R. 15 W. and section 6, T. 113N, R. 15 W. compose Prairie Island Indian Reservation. The Cannon River bottoms, west of Red Wing, and Gantenbien marshes east of PINGP, are privately owned and managed for waterfowl hunting. No hunting is allowed in the North Lake State Wildlife Refuge (NLSWR) located in sections 24, 25, and 30, T.114N., 5.16W.

Table B-1. Aerial survey blocks used in the Prairie Island area waterfowl census.

Block	Name	Description
1	Mississippi Channel	This block included the main channel and a few minor backwaters immediately adjacent to the channel.
2	Mississippi Backwaters	This block consisted of backwaters of the Mississippi River, most of which are influenced by Lock and Dam 3. Important backwaters are: Brewer Lake, Mud Hen Lake, North Lake, Sharp Muskrat Lake, Sturgeon Lake, and Twin Lakes.
3	Vermillion Backwaters	This block included the Vermillion River and its backwaters. Principal backwaters are: Birch Lake, Clear and Upper Clear Lake, Jones Lake, Larsen Lake, Rattling Springs, and Wildcat Lake.
4	Private Marshes	This block included two marshes privately owned and managed for sport hunting. The Red Wing Wildlife Protection League controlled Cannon River bottoms northwest of Red Wing, and Gantenbien Lake and adjoining sloughs are located on the Wisconsin side of the Mississippi River.



Methods

Waterfowl occurring in the study area were surveyed from the air, motordriven canoe, and car. Individuals with a knowledge of waterfowl numbers in the area during the past 10 years were interviewed to determine the representativeness of the study findings. In addition, observations of waterfowl traversing the proposed Mississippi River crossing were made to estimate correlation between population size and potential collisions.

Aerial surveys were conducted at approximately weekly intervals from just prior to the opening of the Minnesota waterfowl hunting season (29 September, 1979) until most of the water areas froze (14 November). An additional survey was flown on 17 December to ascertain the winter population. All censuses, except the last, were made from a Cessna 172 fixed-wind aircraft.

The study area was divided into four blocks for aerial census (Table B-1). These four blocks were distinct and easily defined aerial survey units. Surveys were flown at 50 to 80 m altitude and at minimum airspeed under existing conditions. This altitude allowed species identification under good visibility conditions and usually did not flush resting waterfowl. Waterfowl numbers were estimated, and location and species recorded. Flights were made at midday, when waterfowl movements were minimal. Weather and logistics permitting, flights were made on Wednesdays in order to allow waterfowl to resume normal patterns after weekend disturbances, and allow two weekdays to make up a flight.

Due to the high concentrations of waterfowl and large size of the Gantenbien marshes only half of the marshes were surveyed from the air. Estimates were increased, after modification by the ground/air correction, by a factor of two.

Two ground counts were made at areas of high waterfowl concentrations on the same day as aerial surveys were flown. These data were subsequently used to derive ground/air composition. Ground counts were made from the George Larson farm (NW¼, section 25, T. 114 N., R. 16 W.) west of North Lake and from a bluff above the Gantenbien marshes (NE¼, section 30, T. 25. N., R. 18 W.). Counts were made with a 30X spotting scope with a window mount from a parked vehicle, and were completed within 3 hours following the aerial survey.

TABLE B-2 Species observed during ground counts at NLSWR and Gantenbien marshes, fall 1979.

Species	Survey Date: 3 October NLSWR	3 October G.[1]	10 October NLSWR	10 October G.	24 October NLSWR	24 October G.	2 November NLSWR	2 November G.	7 November NLSWR	7 November G.	14 November NLSWR	14 November G.[3]	Total
Canada Goose (Branta canadensis)	39	0	0	0	64	0	40	0	41	0	54	0	248
Snow Goose (Anser caerulescens)	3	0	0	0	46	0	46	0	46	0	53	0	194
Mallard (Anas platyrhynchos)	0	4	0	9	215	19	520	21	840	460	1180	0	3268
American Wigeon (A. americana)	0	15	0	3	2	2	0	0	0	0	0	0	22
Gadwall (A. stepena)	0	4	0	0	2	3	0	0	0	0	0	0	9
Northern Pintail (A. acuta)	1	0	0	0	0	0	0	0	0	0	0	0	1
Northern Shoveler (A. clypeata)	0	0	0	0	0	9	0	0	0	0	0	0	9
Blue-winged Teal (A. discors)	0	13	2	2	0	0	0	0	0	0	0	0	17
Green-winged Teal (A. crecca)	0	0	0	2	0	0	0	0	0	0	0	0	2
Redhead (Aythya americana)	0	3	0	2	2	0	6	0	0	0	0	0	11
Canvasback (A. valisineria)	0	0	0	0	16	7	17	33	12	10	0	0	95
Ring-necked Duck (Aythya collaris)	0	18	0	2	7	95	280[2]	89	160[2]	180	350[2]	0	1181
Lesser Scaup (A. affinis)	0	0	4	5	0	0	0	12	0	0	0	0	21
Bufflehead (Bucephela albeola)	5	0	0	0	0	0	0	3	0	1	0	0	9
Wood Duck (Aix sponsa)	0	0	0	0	0	11	0	8	0	3	0	0	22
Ruddy Duck (Oxyuna vamaicensis)	5	0	0	0	0	0	0	0	0	0	0	0	5
American Coot (Fulica americana)	25	750	176	870	49	166	83	45	75	34	0	0	2273
Grebes (Podicipedidae)	0	3	0	0	0	0	0	0	0	0	0	0	3
Total	78	810	182	895	401	318	486	211	1174	688	1647	0	7390

[1]Gantenbien marshes

[2]Lesser Scaup and Ring-necked Duck combined; these two species were sometimes impossible to distinguish in the field.

[3]Gantenbien marshes were frozen and no waterfowl were observed there.

TABLE B-3 Estimate of waterfowl numbers in the Prairie Island area, fall 1979.

Date	Waterfowl type	Block 1: Mississippi Channel	Block 2: North Lake SWR[1]	Block 2: Other Areas	Block 3: Vermillion River	Block 4: Canon River	Block 4: Gantenbien Marshes[1]	Total
26 Sept	Anserinae	0	0	0	0	0	0	0
	Anatinae	0	0	200	25	125	700	1050
	Am. Coot	0	0	610	0	300	1200	2110
3 Oct	Anserinae	0	60	0	0	0	0	60
	Anatinae	0	5	25	50	80	180	340
	Am. Coot	20	400	250	0	0	2320	2990
10 Oct	Anserinae	0	60	0	0	0	0	60
	Anatinae	0	20	10	0	0	1020	1055
	Am. Coot	0	100	265	75	1800	7100	9340
24 Oct	Anserinae	0	100	0	0	0	0	100
	Anatinae	5	240	45	5	55	670	1020
	Am. Coot	20	50	25	5	1200	720	2020
2 Nov	Anserinae	0	86	0	0	0	0	86
	Anatinae	0	815	5	10	0	430	1260
	Am. Coot	0	80	30	0	310	25	445
7 Nov	Anserinae	0	87	1[2]	0	0	40[2]	128
	Anatinae	10	1010	0	25	0	17160	18205
	Am. Coot	0	75	0	5	0	0	80
14 Nov	Anserinae	0	117	0	0	0	0	117
	Anatinae	15	1530	50	0	0	250	1845
	Am. Coot	0	0	0	0	0	0	0
17 Dec	Anserinae	0	0	0	0	0	0	0
	Anatinae	70	0	60	0	0	0	130
	Am. Coot	0	0	0	0	0	0	0
Total	Anserinae	0	510	1[2]	0	0	40[2]	
	Anatinae	100	3620	395	120	260	20410	
	Am. Coot	40	705	1180	85	3610	11365	

[1]Estimates modified as described in text.

[2]Whistling Swans (Cygnus columbianus)

Canoe transects were run on the Vermillion River and its principal backwaters at mid-day on the day immediately after or before the aerial survey. Transects started at Birch Lake and proceeded through the Vermillion River and into its principal backwaters as far as Upper Clear Lake. A 17-foot square stern canoe equipped with a three or six hp outboard motor was used in these transects. Transects were approximately 17 km long, and took, depending on conditions, three to four hours to complete. The canoe was motored slowly along the Vermillion River and into the backwaters far enough to observe waterfowl present; waterfowl observed were identified and their location recorded.

Interviews with John Langenfeld, Annette Crocker, and employees of the NSP Environmental Laboratory were used to assess the magnitude of the waterfowl migration and use of the area relative to other years. Annette Crocker, manager of the Gantenbien Marshes, is familiar with waterfowl use of that area. John Langenfeld has kept hunting records of the North Lake area for about ten years.

Weekly morning or evening counts were made from 27 September through 15 November of waterfowl movements through the Mississippi River crossing area. Counts were made from the public boat landing located on Sturgeon Lake about 150 m northwest of PINGP. Species identification and counts were made with 7X35 binoculars or a 30X spotting scope. Counts were made from sunrise to one hour after sunrise and, on alternate weeks, from one hour before sunset to sunset.

Results

Data from ground counts at North Lake and Gantenbien Slough are presented in Table B-2. These data were used to determine species composition and to modify aerial survey estimates.

During the first three weeks of the survey, waterfowl in North Lake were widely scattered and aerial counts probably represent the most realistic estimate of waterfowl numbers. Later in the study, arrival of new migrants and concentration of waterfowl in NLSWR made waterfowl numbers difficult to estimate from the air. Ground counts were considered to be the most accurate estimates for the North Lake area from 24 October through the end of the study. The estimates for NLSWR, presented in Table B-3, are from aerial surveys for 26 September to 10 October and from ground counts from 24 October through the end of the study.

Ground counts of the Gantenbien marshes were used to modify aerial estimates of waterfowl in that area. Ground counts and aerial estimates were made of the same portion of marsh located just below the bluff in the NE¼, section 30, T. 25 N., R. 18 W. Ground counts generally exceeded aerial estimates and were considered to more

accurately estimate the number of waterfowl present. Aerial estimates for the Gantenbien marshes were modified weekly by a ratio of ground air estimates. Access to the Gantenbien marshes was denied for the 26 September survey. Ground counts for 3 and 10 October correlated so highly with aerial estimates that no correction was made for those surveys. The ground:air ratio was highly variable from flight to flight. Several factors might account for this variation: 1. change in observers' experience, 2. estimate accuracy may be a function of waterfowl density, 3. changes in marsh vegetation influence ability to observe waterfowl from the air, and 4. changes in weather and visibility conditions for aerial surveys.

Time and logistics did not allow ground counts at other locations. As smaller waterfowl concentrations are probably easier to estimate accurately from the air, and no real basis was available to determine a correction factor, unmodified aerial estimates were used for all other areas surveyed.

Aerial Survey

Aerial estimates for weekly surveys are presented in blocks in Table B-3. These data were categorized as Anserinae (geese and swans), Anatinae (ducks), and American Coot. In cases where ducks and coots could not be distinguished from the air, ground count data were used to determine relative numbers. No flight was conducted the week of 14-21 October due to inclement weather conditions.

At no time were great numbers of waterfowl observed in blocks 1 and 3. Waterfowl numbers in the main channel of the Mississippi were negligible until the 17 December survey when Mergansers (Mergus ssp.) and Common Goldeneye (Bucephela clangula) were observed. With the exception of a few scattered holes, the river was frozen during the December survey.

Few waterfowl were found on the Vermillion River and its backwaters. Canoe transect results (Table B-4) support aerial survey observations for block 3.

Block 2 wetlands, other than the NLSWR, had fair numbers of waterfowl before the 29 September opening of the Minnesota waterfowl hunting season. After the season opened most birds were within the boundaries of NLSWR (Table 3). This buildup was concentrated along th west shore of North Lake near the George Larson farm (section 25, T. 114 N., R. 16 W.). All of block 2 was frozen, except parts of the North and Sturgeon Lakes, before the 14 November census. Sixty ducks, mostly mallards, were observed in the ice-free area near the PINGP discharge canal on Sturgeon Lake during the 17 December survey.

Table B-4. Waterfowl observed in the Vermillion River and its backwaters on canoe transects.

Date	Location	Number	Species
5 Oct	Birch Lake	1	Wood Duck
	Rattling Springs	6	Wood Duck
	Clear Lake	1	Mallard
11 Oct	Larson Lake	1	Blue-winged Teal
	Rattling Springs	13	American Coot
	Clear Lake	2	Mallard
		1	Ruddy Duck
25 Oct	Indian Slough	4	Mallard
	Larson Lake	5	Mallard
	Rattling Springs	15	Lesser Scaup
		12	American Coot
		3	Wood Duck
31 Oct	Indian Slough	1	Mallard
8 Nov	Wildcat Lake	4	Mallard
	Indian Slough	5	Mallard
	Larson Lake	2	Mallard
	Rattling Springs	7	Mallard
		1	Wood Duck
		13	Mallard
		6	Mallard
15 Nov	Wildcat Lake	2	Hooded Merganser
	Rattling Springs	4	Unidentified

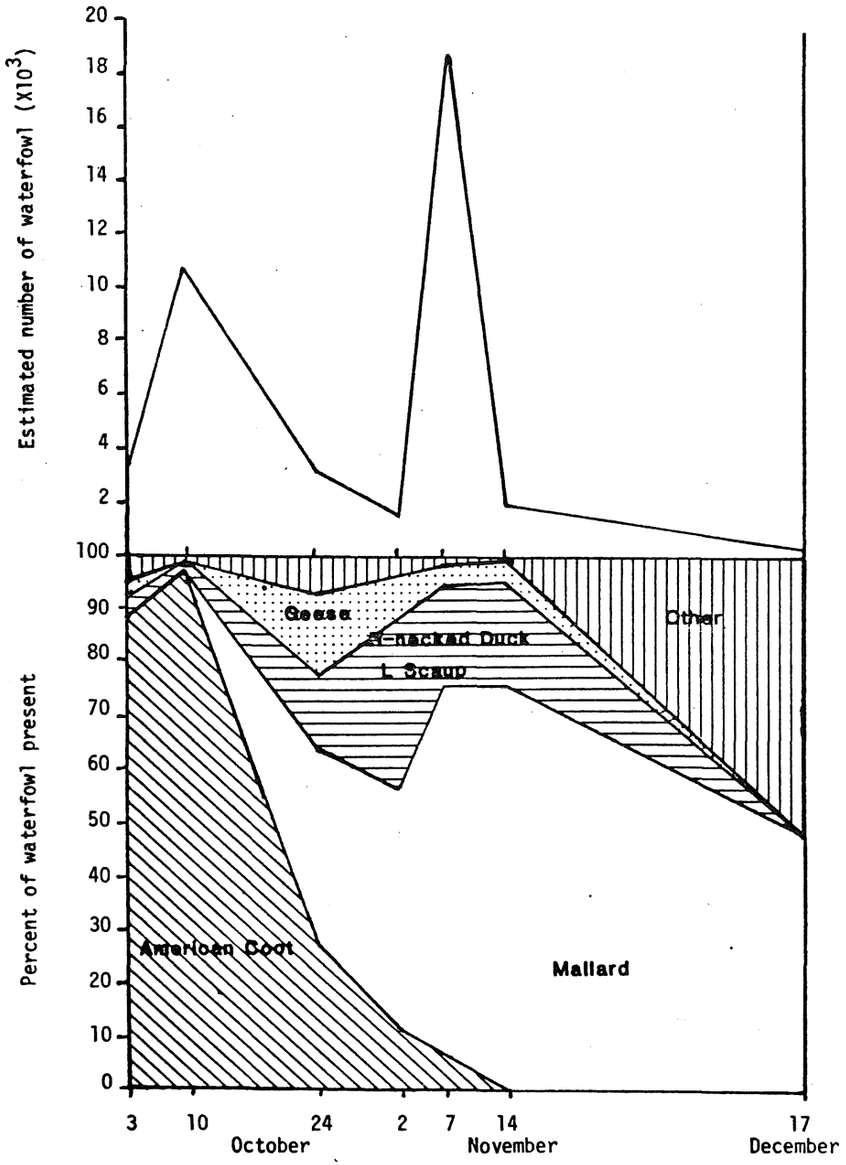


Figure B-1 Estimated total number (aerial survey estimates) and species composition (ground counts) of waterfowl in the Prairie Island area, fall 1979.

Largest waterfowl concentrations observed in the study area were in block 4. The Cannon River bottoms had highly variable numbers of waterfowl throughout the study. The Cannon River bottoms were frozen by 14 November. The Gantenbien marshes had high numbers of waterfowl during the study period. Although the marshes were frozen by 14 November an estimated 250 mallards were found resting on the ice of Gantenbien Lake.

Waterfowl Numbers and Species Composition

Total waterfowl numbers increased from 26 September to a maximum on 7 November (Table 3). Waterfowl numbers declined rapidly after 7 November, probably due to freeze-up of many of the water areas. Few waterfowl were present by 17 December.

In early fall, American Coot was the predominate waterfowl species in the study area (Fig. 1), composing more than 95 percent of the waterfowl present on 10 October. The mallard rapidly became the most abundant species after 10 October, and by 14 November, it made up about 75 percent of all waterfowl in the area. Ring-necked Duck and Lesser Scaup increased after 10 October and represented about 30 percent of the birds present on 2 November. Although geese numbers remained fairly constant, their percent contribution changed due to fluctuations in total waterfowl numbers. All other species of waterfowl combined did not represent more than 10 percent of the waterfowl present until 17 December. On 17 December, low waterfowl numbers and the presence of mergansers and goldeneye in the mainchannel, resulted in "other species" representing over 50 percent of all waterfowl in the area.

Canoe Transects

Few waterfowl were observed on the Vermillion River and its backwaters during canoe transects (Table B-4). This corroborated low aerial count data for those areas. Personal observations from the air, canoe transects, and the ground suggest that intense hunting pressure prevented waterfowl from making greater use of the Vermillion backwaters. Mallard, wood duck, and American Coot were the species most frequently observed on canoe transects; only one occasion were diving ducks observed in the Vermillion backwaters.

Interviews

Annette Crocker, manager of the Gantenbien marshes, felt waterfowl numbers in these marshes during the first two weeks of October to be lower than in previous years. She noted that waterfowl numbers for the remainder of the season were as high or higher than she had ever observed in the area. John Langenfeld who has kept hunting records for the North Lake area for about ten years, also felt that waterfowl numbers were high during the 1979 season. Casual inquiries of hunters during canoe transects and at public boat landings generally resulted in comments that waterfowl numbers were "up" from previous years.

Mississippi River Crossing Observations

Numbers of waterfowl flying through the crossing area were highly variable (Table B-5). Low clouds and precipitation limited visibility for the 7 and 14 November counts. Most of the waterfowl observed were estimated to be flying higher than 100 m above the ground; ducks were often barely discernible due to haze. Most waterfowl movement appeared to be between North Lake and Gantenbien marshes.

Discussion

The estimates presented in Table B-3 probably underestimate total waterfowl numbers in the area. Individuals and small groups of waterfowl that are widely dispersed are easily overlooked during aerial surveys. In addition, the study area contains many small wetlands that ate inaccessible by land or boat and visibility from the air is limited by surrounding woods. These wetlands may have contained waterfowl that are not represented in the estimates. The Cannon River bottoms contain a large area of flooded willow (*Salix* spp.) that greatly reduces visibility and waterfowl numbers were probably underestimated for that area.

Canoe transects of the Vermillion River and its backwaters may underrepresent waterfowl use of those backwaters. Birds could have been flushed by the sound of the approaching canoe, and not all backwaters were deep enough to allow boat passage. Many of these backwaters were deep enough to allow boat passage. Many of these backwaters contained extensive stands of emergent vegetation that could have hidden resting waterfowl.

Table B-5. Dawn and dusk observations of waterfowl traveling through the proposed Mississippi River crossing site, fall 1979.

Date	Time of Day[1]	Official Sunrise/ Sunset*	Number	Species
5 October	18:10-18:47	(18:47)	0	
10 October	7:22-8:22	7:22	1	Mallard
17 October	17:25-18:25	(18:25)	35	Mallard
			1	Gadwall
			77	Unidentified
25 October	17:12-18:12	(18:12)	15	Mallard
			28	Unidentified
1 November	6:51-7:51	6:51	7	Mallard
			60	Unidentified
7 November	15:55-16:30[2]	(16:54)	0	
15 November	7:10-8:10	7:10	24	Unidentified

[1]Central Daylight Savings Time until 31 October; Central Standard Time for the remainder of the Study.

[2]Terminated early due to storm conditions and poor visibility.

*Sunset in parentheses.

Observations at the Mississippi River crossing site were extremely limited in duration. While the observations provide an indication of numbers of waterfowl passing through the area, the data base is so limited that valid conclusions are difficult to make. However, there is no apparent correlation between the number of waterfowl in the area and the number observed passing through the proposed crossing.

The estimates in Table 3 are representative of the number of waterfowl using major wetlands within the area. Most waterfowl in the area concentrated on large bodies of water in large flocks that were easy to locate and survey.

Commercial and recreational use of the river may have influenced patterns of waterfowl use. Commercial river taffic is confined to the main channel of the Mississippi and may adversely affect waterfowl use of the channel. The last commercial traffic in 1979 passed through Lock and Dam 3 on 4 December (U.S. Army Corps of Engineers). Recreational uses, other than hunting, decline rapidly in the fall and are probably not very important to the waterfowl during the study period.

Probably the most important factor affecting waterfowl distribution in the Prairie Island area is hunting. The Great River Action Team (1979c) projected waterfowl hunter use of pool 3, alone, to exceed 1200 annual activity occasions for the period 1975-1980. Significant numbers of waterfowl were not observed in wetlands open to public hunting after waterfowl season opened. Waterfowl concentrated in NLSWR, the Gantenbien marshes, and the Cannon River bottoms. The Gantenbien marshes are hunted by twelve members on a rotation schedule in which no area is hunted two days consecutively. In addition, the entire marsh is "rested" at least one day a week during the season (Annette Crocker). The Cannon bottoms are hunted by members of the Red Wing Wild Life Protection League. This is a fairly large organization that does not limit member hunting (Tom Zibble). American Coot, not considered a desirable game species by many hunters, was the predominant waterfowl species in the Cannon bottoms.

Personal observations while flying aerial surveys, conducting canoe transects, and traveling in the study area indicated that intense hunting pressure prevents waterfowl from using many wetlands. Easy vehicle and boat access and large areas of public land, combined with a large population center nearby (Minneapolis-St. Paul is less than 100 km away) make this area very attractive and accessible to a large number of hunters. Waterfowl were observed to concentrate in areas having limited or no hunting pressure.

Summary

Waterfowl in the Prairie Island area were censused by aerial survey, ground counts, and canoe transects in the fall of 1979. Interviews indicated that waterfowl numbers in the area were higher (during the study) than in previous years. The Mississippi River crossing site was monitored to determine waterfowl movements through the area. Large waterfowl concentrations were observed in NLSWR and Gantenbien marshes. Peak waterfowl numbers occurred in early November. American Coot and Mallard were the most abundant species in the Prairie Island Area.

It is felt that hunting is the primary factor influencing waterfowl distributions. Major concentration areas were those areas with reduced hunting pressure. Few waterfowl were observed passing through the proposed Mississippi River crossing site, but the data base was too small to formulate conclusions.

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NSP Memorandum: WATERFOWL FLIGHT PATTERNS AND BALD EAGLE USE OF THE BOTTOM LANDS NEAR THE PRAIRIE ISLAND PLANT IN RELATION TO CROSSINGS OF THE TYRONE TRANSMISSION LINE

Prepared By: E. A. Hibbard, NSP Associate Environmental Biologist

Dated: November 9, 1976

Introduction

A meeting was held on the afternoon of October 28, 1976 on the campus of the University of Wisconsin, River Falls. In attendance were personnel from the Minnesota and Wisconsin DNRs and NSP biologists and consultants. Service were unable to attend but results of the meeting were discussed with John Wolfin of the USFWS on November 8, 1976. The chief topic of the meeting was waterfowl flight patterns in the area from North Lake through Sturgeon Lake and Gantenbien Lake to the Red Wing area. Used as aids in this discussion were black and white aerial photo projections of infrared transparencies and geological quadrangle maps.

Points of Consideration

Species of Waterfowl Using the Area

Two major groups of ducks use the area: (a) Migrant ducks - largely diving duck species, including a few redheads and canvasbacks but mainly bluebills (lesser scaup) with fewer number of migrant "puddler" ducks. The bulk of the redhead and canvasback stop-over, however, occurs further south in the Lake Pepin area. (b) Local "puddler" species (mallard, teal, wood duck, etc.) that breed in the area and reside there largely from spring (April) through midfall (October). (c) Other "water" birds including swans, cormorants, herons, gulls, geese, and coots, etc. These latter species are mainly migrants, although there is a large rookery of breeding herons on Devils Lake (approximately two miles southeast of Lock and Dam 3).

Season of Use

Migrant species probably utilize the local lakes most heavily for 2-3 weeks in the spring. Normally the first major migration would occur in early April, but it may begin earlier or later, depending upon the season. Fall use of local lakes by migrants, especially diving ducks, varies but is heaviest for two weeks or more in October. This year, for instance, 800-1000 ducks (largely mallards and diving ducks) were utilizing Sturgeon Lake the morning of October 25, 1976. This was a typical resting "stopover" after being "pushed out" of more northerly areas by an early freeze-up.

Height of Flight

There was some discussion at the October 28 meeting that migrant diving ducks flying over open water areas (i.e., Sturgeon or North Lakes) might normally fly high enough to clear transmission lines. However, contradictory information and observations made in the Sturgeon Lake area on October 29 indicate that this is only partly true. During inclement weather, small groups of ducks and most larger flocks generally tend to be low flyers and often fly at a height sufficiently low to intercept transmission lines. Larger flocks, on the other hand, often flew high enough to clear any tower or transmission lines present.

Hunter Recreational Use

Hunting pressure is heaviest on mallards, wood ducks, and other puddler species (largely raised locally) early in the season and then shifts to migrant puddler and diving ducks (largely "bluebill") later in the season. This pressure can be quite heavy; for example, on the opening weekend of the 1976 waterfowl season, approximately 150 or more cars were parked in the North Lake public access area. Hunter recreational use along the river is of two types: the "public" lakes such as North, Sturgeon and lakes in the Red Wing vicinity; and private hunting "preserves" such as found in the Gantenbien marshes and lake complex.

Participants at the meeting generally agreed that most waterfowl flights are parallel to the Mississippi River and associated lakes and marshes. This is especially true of migrant diver species which may move upstream and downstream from lake to lake. Local puddler species (e.g., mallards) often use this flight pattern also but may move from marsh to marsh in a random direction in relation to the river (especially true of wood ducks).

There are court cases on record which indicate that transmission lines over lakes and marshes may disrupt normal duck and goose flights up to one quarter of a mile on each side of the lines. This is mainly because waterfowl tend to "rise up" over transmission lines and hence may be too high for hunters to shoot.

While the heaviest use of the area by migrant ducks only covers a period of 5-6 weeks during the year, bald eagles may utilize the river for seven months of the year. Use of the river during winter months (mid-November through February) has been documented by Craig Fannes (Prairie Island Annual Report, 1975). On November 18, 1975 Fannes found only four eagles utilizing the Mississippi River Study Area, all at Lock and Dam 3.

Comparable data from 1976 indicate that eagles were already utilizing the Prairie Island area in late October. For instance, on October 29, an eagle was perched in a trees adjacent to the Prairie Island Plant for much of the morning. On November 5, 1976 nine eagles were sighted just below the lock and dam, largely within a distance of one-quarter or one-half mile.

Discussion

The general consensus of the October 28 meeting was that heavy duck use occurs in the North Lake Sturgeon Lake - Gantenbien Lake area during both spring and fall. Spring was considered the season of heaviest waterfowl use, chiefly because less disturbance by humans allowed longer stopovers, however, fall was also an important time for waterfowl use.

Hunter recreational use tended to be heaviest in the public areas but also was an important consideration in areas such as the Gantenbien private hunting area. This privately-owned marsh and lake complex has been developed and managed especially for "quality" hunting (i.e., duck food plantings, impoundments, etc.). Individual ponds and marshes of this reserve are open for hunting on a rotating basis. This makes them especially attractive to waterfowl because on many days much of the marsh is a virtual refuge.

The usual waterfowl flight pattern is southeastward over North and Sturgeon Lake (opposite the Prairie Island Generating Plant and at the NSP "preferred" transmission crossing) and then over into the Gantenbien preserve area opposite Lock and Dam 3. Flights in the reverse direction also occur. Waterfowl moving southward from the Gantenbien area tend to fly high over the river bottom forest because there are few water areas attractive to ducks (especially migrant divers) between Gantenbien and the lakes near Red Wing.

On the Minnesota side there is considerable duck habitat northwest of Red Wing in the flood plain lakes near the mouth of the Canon River (Cannone Lake, Round Lake, etc.) This is largely wood duck - puddler duck habitat, however, and movement in this area would tend to be largely local rather than migratory.

The area from Red Wing to Lock and Dam 3 was also reviewed for wterfowl habitat in relation to other possible transmission line crossings. The general opinion was that there was less duck use of the bottomlands between Gantenbien lake and upper and lower lakes near Red Wing (excepting for Cannon Lake and associated marshes as mentioned above). There appear to be several benefits to waterfowl of routing the line southeastward, either below Gantenbien Lake or to Red Wing. Possible benefits include: (1) paralleling the river would tend to reduce hazards to waterfowl, especially if the perpendicular crossing were in areas of marginal duck habitat, and (2) reduced danger to migrant divers through reducing the acreage of over-water crossings.

Alternative Route Discussion 1.

1. Below are comments on a possible route south along Wisconsin Highway 53 to Red Wing and north and west along the railroad tracks (North Red Wing routes). Although there may be engineering and economic problems (developed areas, grain elevators, etc.) with this route, it would appear to be better for waterfowl than the preferred or alternate routes. The concentrations of street lights, etc. in this area may deflect waterfowl from a crossing near Red Wing and hence reduce the kill. There may, however, be problems with crossing the marsh area just above Red Wing.

2. Listed below are comments on a route just south of Gantenbein Lake, crossing into Minnesota north of Diamond Island and then west and northwest across the river bottoms and along the west edge of the railroad tracks to opposite the Prairie Island Plant (Trenton routes).

Benefits

It is thought that ducks tend to leave high out of Gantenbein when flying south because of adjacent forested areas lacking in suitable duck habitat. Crossing here would miss most of the flights between Gantenbien and the Trenton Slough area of Wisconsin. There may be the usual problem of killing migrant non-game birds which follow the Mississippi River through this wooded area, but this problem would not be unique to this area.

Portions of this possible route lying adjacent to the Mississippi River in Wisconsin and Minnesota were reviewed on foot and by boat on November 5, 1976. The only large trees in this area fringe the river for approximately 200 yards on each side of the river in Wisconsin and Minnesota (south of Gantenbien Lake and west north west of Diamond Island). Species include large cottonwoods, silver maple, American elm and green ash. A short distance away from the Mississippi River below Gantenbein Lake, the forest is in an early successional stage of 6" - 8" cottonwood, elm. etc. with brushy openings which would require less right-of-way clearing.

On the Minnesota side beyond the fringe of tall trees adjacent to the river there is a considerable expanse of open vegetation with low bush species, willows, and tall herbacious vegetation. This open, bottomland habitat is owned, at least in part, by the Red Wing Wild Life Protective League. Some duck habitat is present along the meandering channels associated with the Cannon and Vermillion Rivers, but these areas could be largely avoided by routing the line more northwesterly after crossing the river. Further west this route has some negative attributes.

This possible alternative route was recommended for investigation at this meeting. After a further review and on-site consideration with NSP Prairie Island biologists, I feel that this route should be strongly considered as a viable alternative to previously suggested routes.

In sum, there was strong desire by attendees at this meeting to avoid a long over-water crossing in the area at or above Lock and Dam 3.

NSP Testimony: Potential Impacts of an Overhead Crossing on Waterfowl

Presented By: Richard L. Prestin and Robert Grosshans before the Atomic Safety and Licensing Board, U. S. Nuclear Regulatory Commission

Dated: June 6, 1977

B-18

The major impact on waterfowl of an overhead crossing of the Mississippi River is considered to be the potential for bird mortality due to collisions with the transmission lines. Based on the personal observations of Mr. Prestin and other local biologists, it is known that generally the birds will be able to see the transmission lines and will fly well over them. The greatest potential for collision occurs during inclement weather, fog and darkness (1). NSP conducted a literature search to learn more about the potential for waterfowl mortality due to transmission line impacts. In addition, for the last three years, NSP has employed Dr. Steve Goddard of the University of Wisconsin-River Falls to conduct an empirical study of bird mortality due to collisions with transmission lines near the Prairie Island plant. Dr. Goddard's report of his three-year study is not yet completed. However, the preliminary results of his study, as set forth in a draft summary, indicated that over a three-year period nine ducks and eight coots were found dead due to collisions over a 2.8 mile right-of-way along a 345 kV transmission line (2).

The results of the literature review found that 50 percent of all waterfowl die each year; of the total waterfowl deaths, 50 percent are killed by hunters and the other 50 percent die as a result of all other causes (3).

The majority of all non-hunting waterfowl mortality is due to disease (4). The only significant empirical data available on non-hunting waterfowl mortality is collected in a master's thesis by I.J. Stout (5). Stout calculated that all collisions account for 0.14 percent of non-hunting duck mortality. He found that one-half (0.07 percent) of these kills was due to "wires."

A calculation of the potential for waterfowl mortality at a transmission line crossing at Prairie Island was made using Stout's empirical results and using the following assumptions: (1) that 20 percent (or 370,00) of the mean number of waterfowl listed in Table 2.2 of the Final Environmental Statement pass over the section of Mississippi River Valley near Prairie Island, and (2) that 10 percent of those killed by all wires in the above sample were killed by transmission line across the Mississippi River at Prairie Island (6). Of the 370,000 waterfowl, 185,000 will die. Hunters will kill 92,500 birds and a like number will die due to all other causes. According to Stout, 0.07 percent (or 64.75 birds) would be expected to be killed by all wires. If 10 percent of the birds killed by all wires along the entire migratory route were killed by the transmission line at Prairie Island, the number of birds killed would be 6.5 birds each year.

While this analysis employs a series of assumptions, the resultant 6.5 birds is of the same order of magnitude as the 17 ducks and coots observed by Dr. Goddard to have been killed over a three-year period at Prairie Island. Even if it is assumed that 50 percent of the expected number of birds killed due to wires in this sampling of birds migrating over great distances were killed at the Prairie Island crossing, the total would be 32 birds (7). A number in the range of 6 to 100 waterfowl killed per year is a rough approximation of the potential waterfowl mortality due to collisions with a transmission line across the Mississippi River Valley (8).

References Cited

(1) I.J. Stout Non-hunting Mortality (M.S. thesis, Virginia Polytechnic Institute) (1967).

(2) The study involved searching an 80 meter wide area along the transmission line right of way 3 times each year during peak bird migration. The objective was to obtain a rough approximation of the species and numbers of birds killed. Note that the study involved transmission lines over land and not over water. However, the 2.8 mile line is 80 percent longer than the proposed Prairie Island crossing (1.6 mile).

(3) F. Bellrose, Ducks, Geese and Swans of North America, 64 (1976). According to Bellrose, hunter "harvest" and crippling kill an average 20 million waterfowl each year.

(4) Stout supra note 9.

(5) Id.

(6) These both appear to be conservative assumptions. The avian flyway corridor is considered to be 50 to 100 miles wide. Although waterfowl tend to follow the Mississippi River, 20 percent probably is an overestimation of how many waterfowl would pass directly over Prairie Island. Considering all of the other "wires" throughout the entire length of the flyway, 10 percent is probably a conservative estimate of the portion of the sampling killed by all wires that would be killed at the transmission line crossing of the Mississippi River at Prairie Island.

(7) Even if it were assumed that the entire mean number of waterfowl in Table 2.2 of the FES flew over Prairie Island, the total number of birds killed due to all wires, using Stout's findings, would be estimated to be 323 birds.

(8) Staff requested that NSP investigate the effects of the existing 345 kV transmission lines at Prairie Island on local wildlife populations. Dr. Goddard stated that it was difficult to define the impact of the transmission lines on wildlife populations because of the overall change in the Prairie Island site. Where before the site had been in agricultural production, now the area around the transmission lines has been allowed to develop natural low-growing vegetation. This change in habitat has favored the wildlife by providing for more cover, nesting areas and food. Any detrimental effects of the lines have been offset by the positive effects of the change in habitat.

Information provided by the U.S. Fish and Wildlife Service

U.S. Fish and Wildlife Service Concerns Regarding an Aerial Transmission Line Crossing in the Vicinity of the Prairie Island Nuclear Power Plant

Presented To: Prairie Island Citizens Route Evaluation Committee

Dated: November, 1978

The proposal to construct a high voltage transmission line across the Mississippi River must be viewed with particular environmental concern because of the potential impacts this line could have on migrating and breeding birds in this area.

For large numbers of waterfowl and other birds, the Mississippi River Valley is a key migrational corridor. Birds use prominent features of the landscape to aid in their migrational orientation. A variety of bird species also use the numerous lakes, marshes, and bottomland forests associated with the river for breeding habitat. Available information indicates that heavy waterfowl and eagle use occurs seasonally in the vicinity of the proposed and alternative routings of this transmission line.

The vulnerability of certain bird species to overhead wires is influenced by their flight characteristics. The high speed, low altitude flights of diving ducks, in particular, increase their susceptibility to overhead wires. Thus, power lines across major flight lanes used by low flying birds may result in substantial impact. Birds such as ducks, geese, swans, and particularly eagles, cormorants, herons, egrets, grebes and coot involved in local movements along the Mississippi River corridor would also be vulnerable to power lines constructed perpendicular to their flight path.

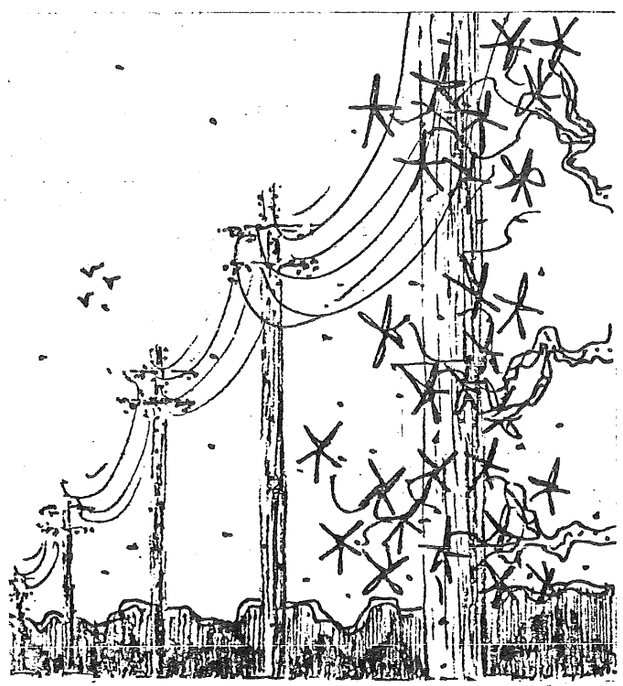
Major daily waterfowl migrations usually occur during the first few hours after sundown. Many birds collide with transmission lines at night or during periods of low visibility and inclement weather. However, no information is currently available that adequately describes the impacts of overhead transmission lines on waterfowl during these critical periods.

The magnitude and significance of the loss of North American birds to collisions with power lines is poorly understood. We are concerned about the impact on bird populations that may occur with the widespread proliferation of power lines. It has been estimated that the number of transmission lines will double in the next decade. Although little is known about the impact of these lines on birds, it is anticipated that their impact will increase markedly.

Available literature indicates that waterfowl casualties tend to be isolated events; however, spectacular losses of migrating passerines have been reported. Although birds strikes with wires commonly occur, many incidences are unnoticed and unreported. Limited human activity in areas where strikes are most frequent and the concealment of dead birds lying beneath wires in marsh or upland cover precludes awareness of most wire strikes. In addition, predators and scavengers remove most injured and dead birds from these areas which further reduces the apparent magnitude of this loss. Poor light conditions and inclement weather, particularly wind and fog, accentuate wire strikes. Previous assessments of the impacts of power lines on birds have been inadequate principally because they have been limited to diurnal observations of bird movements. Numerous researchers have demonstrated the importance of the nocturnal period in avian migration.

Another major concern associated with an aerial high voltage transmission line constructed across this extremely important migration corridor is its potential for altering waterfowl and other bird flight patterns in this area. The route selected should be in a location that will minimize this impact to the extent possible.

The U.S. Fish and Wildlife Service has been involved in the planning efforts to select an environmentally acceptable transmission line route across the Mississippi River to the Prairie Island Generating Plant since October 1, 1976. At a meeting held at River Falls, Wisconsin on May 18, 1977, with representatives of Northern States Power Company (NSP) and the concerned state conservation agencies, However, we agreed that from the information presented regarding general waterfowl flight patterns and eagle use areas, it may be possible to select an overhead crossing that would have the least environmental impact on these species. However we expressed concern that using this criterion would not necessarily guarantee the environmental acceptability of any selected route because the potential incidence of all bird strikes would not be known nor would potential impact on flight patterns be evaluated.



At the May 18 meeting we stressed the need for a detailed study to determine the degree of impact these overhead high voltage transmission lines would have on the waterfowl, eagles, and other birds that migrate through this area each spring and fall. We also described a promising method for obtaining this type of data by using a mobile radar unit recommended by Dr. David Trauger of our Northern Prairie Wildlife Research Center. We informed NSP that we were exploring the feasibility of using this equipment to evaluate various alternative transmission line corridors across the Mississippi River.

Our review of the supplemental testimony which Northern States Power Company compiled for the Tyrone Environmental Hearings clearly indicated that no detailed study had been made to determine the magnitude of impacts that the alternative overhead crossings would have on the birds in these areas. For this reason, the Service disagreed with the statement made by NSP on page 28 of the testimony that "the considerable data compiled in evaluating the possible crossing of the Mississippi River is sufficient to make a determination of the environmental acceptability of the various routes and in fact shows that all five crossings are environmentally acceptable."

The Nuclear Regulatory Commission (NRC) in their comments on the final environmental impact statement regarding this transmission line crossing stated that it "feels strongly that the Mississippi River waterfowl and eagle resource is of significant environmental importance that feasible alternatives for any proposed power line through the Mississippi River bottoms should be carefully evaluated." The NRC further stated that "the applicant should collect and analyze these data in consultation with the appropriate State and Federal authorities." We believe that this detailed environmental data has not yet been obtained and have repeatedly expressed these concerns to both the applicant and the NRC.

The Service also questions the final determination made by the Nuclear Regulatory Commission regarding the environmental acceptibility of some of the alternative routes. This is particularly true of the Prairie Island crossing which is the proposed and preferred route of NSP. Information obtained at the meetings in River Falls based on general waterfowl flight patterns alone indicates that of the various routes being considered the Prairie Island crossing appeared to have the greatest potential for generating adverse impacts on waterfowl. This is primarily due to the concentrations and movements of waterfowl in the Sturgeon Lake-Gantenbein Marsh area during the spring and fall migration periods which would be bisected by this proposed line. The Service also has reservations about the environmental acceptibility of the Trenton crossing particularly in the vicinity of the Mississippi River channel and in two other open marsh areas which would also be spanned by this route. Discussions at the May 18 meeting in River Falls indicated that a considerable number of wood ducks may be impacted by overhead lines constructed across these open marsh areas. In the Service's opinion, the remaining portions of the Trenton route through the wooded areas would appear to be environmentally acceptable provided that low towers are used and the wires are strung as close to, or preferrably below, the tree top level. The potential impact of the wires on passerine bird species through these wooded areas has not been determined.

Based on the general waterfowl flight patterns and other limited information obtained to date on the various transmission line routes presently being considered across the Mississippi River in this area, the Service believes the North Red Wing #1 and #2 crossings would create the least potential adverse impacts on waterfowl. Although the North Red Wing #1 Route would still span a portion of a fairly extensive marsh area, local waterfowl experts have indicated that impacts to waterfowl would be less than at the preferred (Prairie Island) crossing. In our opinion, both of the North Red Wing Routes would be more desirable from an environmental standpoint since they would parallel other features of human disturbance such as existing highways, railroads and tranmission lines. In the Final Environmental Statement the NRC stated that "A North Red Wing Route leading from some point on the proposed route in Wisconsin to a river crossing at the Highway 63-65 bridge affords the opportunity for the lines to parallel several areas of human disturbance and thus to potentially minimize environmental impacts. Economic costs for this line, however, would be greater than for the proposed crossing, although the costs would not appear to be prohibitive. The extra costs result from the additional length of line required and the fact that more potential commercial, residential, and agricultural land would be affected." The Service agrees that the North Red Wing Routes would result in more economic impacts, however, we believe the potential for significant waterfowl and other migratory bird impacts as well as the disturbance to important avian flyway areas would not be nearly as great as in the Prairie Island and Trenton crossing locations.

In our letter dated August 12, 1976 to the Nuclear Regulatory Commission we expressed many of the above concerns regarding this proposed Mississippi River crossing and also provided a Scope of Work for a detailed 4-year study that the Service recommended be undertaken at Prairie Island. A cooperative agreement has now been made between NSP, FWS, NASA and the University of Colorado to conduct such a study. We believe this study will help to more adequately determine the degree of impact a high voltage transmission line constructed across the Mississippi River perpendicular to waterfowl migration and flight paths will have on these and other bird species that utilize this river corridor.

Based on the above concerns, the U.S. Fish and Wildlife Service recommends that the following actions be taken by the Minnesota Environmental Quality Board and the Wisconsin Public Service Commission during this power line routing process:

1. Coordination efforts with the Service and the concerned state conservation agencies be maintained to ensure that an environmentally acceptable route is ultimately selected;

2. All additional information obtained within the next year from the radar study relative to the anticipated environmental impacts of an overhead transmission line constructed across this major river corridor be adequately evaluated and considered in the route selection process; and,

3. The environmental concerns and potential environmental impacts on waterfowl, eagles, and other birds be given equal consideration to the social and economic issues associated with this major river crossing.

Position: U.S. Fish and Wildlife Service

Presented In: Comments to the Wisconsin PSC on the WPSC Draft EIS

Dated: October, 1979

In our opinion, the Prairie Island-Eau Claire system alternate should be dropped from further consideration because of its potential for creating significant adverse impacts on waterfowl and other avian species that pass through this major migrational river corridor each spring and fall. The Draft EIS documents the inferiority of this system alternative to both the King-Eau Claire and Red Rock-Eau Claire system alternatives. If the Prairie Island-Eau Claire system alternative cannot be deleted, then in our opinion only the North Red Wing II, North Red Wing I, State Trunk Highway 63, and Prescott Crossings merit further consideration in the Final EIS.

Report: Progress Report, An Evaluation of the Impacts of a Proposed Transmission Line Across the Mississippi River on Bird Movements.

Prepared By: Northern Prairie Wildlife Research Center, Jamestown, North Dakota for the U.S. Fish and Wildlife Service

Dated: 1979

This progress report covers the 1979 spring migration radar study at the Prairie Island Nuclear Generating Plant near Red Wing, Minnesota. Preparation for the spring migration started about the first of January 1979.

During the fall of 1978 a site was chosen and cleared of trees and brush for the Red Wing radar study.

This location offers a good radar view of the main channel and Sturgeon Lake upstream of the site. It is very close to the proposed Prairie Island route that would cross over Sturgeon Lake. Because the site is located in a controlled access area, entry of unauthorized people is minimized.

Actual radar operations began April 3rd and were halted temporarily on June 13th due to recording equipment failure. It is not felt that this temporary halt had any serious effect on the radar study. Data that were collected prior to the failure already indicated a marked decrease in bird activity. In fact, data collecting efforts had already been decreased and operations were being continued primarily to determine resident bird movement.

Two objectives were established for the first field season of this project.

1. To determine the feasibility of using radar to document flights of birds at low elevations.

2. To observe the extent and chronology of migration of birds along the Mississippi River near NSPs Prairie Island Nuclear Generating Plant near Red Wing, Minnesota.

Although normal radar operation is the scan mode with the antenna rotating, the high density of bird movement in the area made manual plotting of this movement from the radar scope virutally impossible. Thus, we chose to operate with the antenna in a fixed position.

To establish the sensitivity of the radar to detect birds we locked the antenna in a fixed position and simultaneously observed the air space across the river and radar output onto the paper chart recorder during daylight hours. Birds were detected at the farthest extent of the range gate without any difficulty. Normal ground clutter prevented the detection of targets flying in close proximity (100 meters) to the radar antenna. Birds flying only a few inches above the water were detected as well as those flying higher. Based on the 24° vertical beam width we estimate that at the furthest range birds could be detected at an approximate altitude of 250 meters. Individual birds, the size of swallows, were reliably detected by the radar at the furthest range.

We next tried to correlate bird numbers with spikes on the paper chart. We recorded bird movements for ten minute periods by combining the observations of two observers, one on each side of the river. Observations on species, numbers, altitude, and range were combined by simultaneously recording observations using cassette tape recorders and two-way radios. Two things were learned very quickly. It was obvious that the radar could detect bird targets being detected.

The radar was operated continuously for long periods of time, 12 to 48 hours, to evaluate daily movements and activity peaks.

Ten minute sample periods provided a subjective indication of the species that are migrating during the daylight hours. Upon arrival at the study area on March 21st the river was ice-covered except for a few open water pockets. A few waterfowl and gulls were the only birds present. As the season progressed the passerines began to migrate through. Earliest passerines were redwinged blackbird, followed by grackles, swallows and warblers.

We were interested primarily in the flights of birds within the radar sampling area; however, notable high altitude migration was recorded. On April 10th several thousand whistling swans were observed flying northward above the river valley. Bald eagles were seen on several occasions, slowly moving northward at tree top height. Three eagles were seen on April 11th.

Generally the northward migration of passerines, visually observed during daylight hours, was at altitudes less than 250 meters.

Data collected for 10-minute time periods, which consisted of 720 time intervals. We then tallied the number of intervals in which birds were detected. A percentage (intensity of bird movement) was obtained based on the tallied intervals versus total Number of intervals in the 10-minute period. Data on 6 10-minute periods were combined to give hourly averages which could be conveniently plotted (Figure 3).

Note: The above described radar study was scheduled for completion in early 1980. The final report has not yet been received from the USF&WS.

Information provided by the Wisconsin Department of Natural Resources.

Position: Wisconsin Department of Natural Resouces

Dated: November 1, 1979

Some of the problems posed (e.g., how many birds collide with man-made objects?) would perhaps require several years of research. However, our knowledge of this area indicated to us early in our review of the Tyrone Energy Park EIS that the Prairie Island crossings would have unavoidable and relatively more severe adverse effects on waterfowl than other alternatives. Of all the identified Mississippi River crossings, these corridors at Prairie Island were worse because of their infringement into major waterfowl flight patterns to and from Gantenbein Lake. Thus, we anticipated higher waterfowl mortality in this area.

A short time ago, our Public Service Commission identified a more environmentally acceptable crossing called the Eau Claire-King route. We feel that this corridor is environmentally preferable to the Prairie Island crossings, even though it would cross the St. Croix River.

Information provided by Concerned Wildlife Groups.

Comment: Audubon Chapter of Minneapolis

Dated: January 11, 1980

Any crossing which is already in use would have the least effect. Therefore, Red Wing #1 or 2 would be preferable to the Prairie Island or Trenton crossings. Both of these cross very heavily used flyways and would be disruptive. If the birds stay away from the line because of the noises, this could change whole flight patterns, with the possibility of them leaving the area altogether. We would prefer not to make any statements on which route we feel is preferable until after the King-Eau Claire route hearings are concluded.

Avian mortality problems should be of great concern. In the long run, bird survival is directly tied to other environmental and social issues especially those things that affect the habitat. It is as simple as that - no habitat no birds. We are rapidly losing our heritage of wild life and wild places. If these are all lost our country will have suffered an irreplaceable loss and our quality of life will be that much poorer. I hope that the E.Q.B. will give every consideration possible to the problems of Avian mortality as another tool to help preserve this very valuable portion of the river in its purity.

The text of this letter was approved by the executive Board of the Minneapolis Chapter at its January 9th meeting.

Comment: Audubon Chapter of Minneapolis
Dated: December 28, 1977

Because any or all of the four routes proposed by NSP will cross such things as heron rookeries, and bald eagle wintering sites and would intersect a major waterfowl flyway, we don't feel that any of the propsoed routes would be environmentally sound. We feel with the U.S. Fish and Wildlife Service that "the environmental concerns and potential impacts on waterfowl, eagles, and other birds should be given equal consideration with the social and economic issues associated with this major river crossing."

In making decsions on the location of this line we hope that the Minnesota Environmental Rights Act (Minn. Stat. CH 116B) is being considered. It "prevents the state from permitting any conduct which will pollute, impair, or destroy the environment if a prudent and feasible alternative exists." There are alternative routes and we hope that they will be explored fully and the decision made to use existing corridors.

B-29

If, however, one of NSP's four proposed routes has to be used, we hope that no decision on which one will be made till next summer to give the U.S. Fish and Wildlife Service time to complete their radar studies of bird flight patterns in the area through at least the spring migration. This should yield valuable data as an aid to choosing the least damaging route.

Comment/Position: St. Paul Audubon Society

Dated: December 7, 1978

The St. Paul Chapter of the National Audubon Society has been carefully studying NSP's construction permit application for the Prairie Island-Tyrone-Eau Claire 345 kV transmission line. After attending several of the Citizen's Route Evaluation Committee meetings held in Red Wing, Minnesota during November and December 1978, concerns and opinions have been developed by our chapter members regarding the four proposed power line crossings on the Mississippi River between Red Wing and Prairie Island.

B-30

Our concerns are:

1. lack of adequate studies regarding the effect of the proposed power line crossings on migrating birds, wintering Bald Eagles and other wildlife,

2. that NSP, when discussing the value of various crossings, generally talks in construction dollars rather than numbers of wildlife affected and the degree those wildlife are affected; a complete balance of the various types of costs must be evaluated by considering the non-compensable impacts of the power line,

3. that the four proposed power line crossings between Red Wing and Prairie Island are so close together that they provide no real alternative sites to evaluate,

4. that the Citizens Route Evaluation Committee is not maintaining minutes of the meetings for review prior to a final decision and for public distribution.

Based on the four concerns presented in this letter our chapter feels that discussion regarding the proposed power line crossings between Red Wing and Prairie Island should be postponed until further studies, including the U.S. Fish and Wildlife Service's radar studies, are completed. If a decision cannot be postponed then we recommend no power line crossings over the Mississippi River between Red Wing and Prairie Island because of the potential for extreme wildlife depredation. The Mississippi River corridor is a major migratory flyway which may be destroyed by too many or misplaced high voltage power lines.

Report: Impacts of Transmission Lines on Waterfowl

Prepared By: St. Paul Audubon Society, for the Prairie Island Citizens Route Evaluation Committee

Dated: September 11, 1979

The conservation committee of the St. Paul Audubon Society is vitally concerned with the impacts of the proposed Prairie Island-Eau Claire transmission line on the Mississippi River bottoms migrating waterfowl and eco-system. In order to assess that impact, we have examined available literature regarding transmission lines and waterfowl and, when possible, have consulted with knowledgeable people of the area regarding the wildlife. The following statement is a result of this research.

In recent years, many scientists have expressed concern about the impact of the expected proliferation of high voltage transmission lines on birds, particularly waterfowl and raptors.

The most consistent victims of collisions with transmission lines are large migratory waterfowl such as; Whistling Swans, Canada Geese, Canvasback, Redhead ducks, Wood ducks, Teals, and Widgeons. Wire strikes of water birds are the most frequent where lines cross water areas or grain fields used by birds or where powerlines separate feeding and roosting areas. Species, whose flocking behavior brings large numbers of birds together in dense flocks in small wetlands, are the most vulnerable. Field-feeding puddle ducks are especially susceptible to collisions with overhead wires due to the high speed and low altitude of their flights.

There is strong disapproval voiced over lines which run perpendicular to waterfowl flight paths. "Wires are particularly lethal when they run across channels or rivers, or pass close to sites holding large concentrations of birds." "Powerlines running across the Mississippi River at right angles to waterfowl flight patterns, coupled with the timber-marsh funneling effect would cause serious waterfowl losses."

Wire strikes appear to be most frequent at night and during windstorms, snowstorms, periods of heavy fog or meteorological phenomena which reduce visibility and/or cause bird to fly lower. Considerably more birds migrate at night, which means their low take-off and landing flight patterns would jeopardize them where a line is in the vicinity.

Many researchers feel that the number of birds killed by powerlines has not been accurately gaged. The studies conducted in this matter are inconclusive and unreliable for predicting future waterfowl losses. Bird collisions with powerlines are inadequately reported. Certain species of birds, because of their habits or small numbers, are more vulnerable to powerline losses than others and some species are more biologically sensitive at specific places and seasons. "The extent of our knowledge today is such that we may not be able to perceive or measure changes in carrying capacity attributable to wire strikes even if they are sizable and long term.

Most dramatic bird kills are often catastrophic, irregular in time and thus unpredictable. "A given stretch of line may result in neglible bird mortality for many years, then suddenly - during the chance juxtaposition of a certain flock of birds with certain adverse weather conditions and a certain disturbance - cause dramatic kills of hundreds of birds overnight." Studies of bird losses cannot be accurately quantified except over possibly decades of data gathering.

Migration Factors

In lieu of these concerns and uncertainties, the conservation committee of the St. Paul Audubon Society agrees with various authorities in the necessity of following suggested ways of mitigating the impact of transmission lines on waterfowl. These mitigating factors must be given serious consideration regarding the four primary Prairie Island-Eau Claire routes because between 1.4 and 2.4 million waterfowl fly past the Prairie Island area every year.

1. Routing lines to avoid wetlands is desirable and that the location of these habitats warrants special attention in any plan for power line siting.

2. Corridors between two bodies of water or marshes and those that intersect known flight paths of waterfowl should be avoided.

3. Line placement should be parallel rather than perpendicular to predominant lines of flight.

4. Clustering lines, or sharing the same right of way with several types of lines, may be preferable because the network of wires is more visible and confined to a smaller area.

5. Avoiding areas of frequent and heavy fog can reduce the probability of wire strikes.

6. Where it is necessry to cross a natural flyway, the lines should be masked by structures such as a bridge.

7. Corridor sharing should be exhaustively reviewed before any new corridors across rivers are considered.

The preceding information is presented in order to act as guidelines for the consideration of the proposed Prairie Island-Eau Claire transmission line.

Specific Routes

NSP's preferred river crossing is designated as the Prairie Island route. This line would bisect the Sturgeon Lake-Gantenbein marsh area which has been identified as a valuable waterfowl habitat area and is within the low altitude waterfowl flight lines. This area is noted for its large concentrations and movements of waterfowl during spring and fall migrations. This route crosses Sturgeon Lake and would need two hundred foot towers which would be a severe collision hazard for waterfowl. The Gantenbein wetlands are a third of a mile south of this route but major waterfowl flight lanes connect these marshes and would pass over the line so that collisions with the line in this area could present serious problems. The main channel of the river between these areas is an important gathering area for migrating waterfowl, mostly divers. These divers include Canvasback and Redhead which are not hunted this year because of their low numbers. Due to the importance of this corridor to these species, we believe it is imperative to avoid crossing this area. Dr. Edmund A. Hibbard thinks that "considering waterfowl use of this area, I would consider avoidance areas to be from Lock and Dam #3 through Sturgeon Lake, i.e., considering eagle use, I would add the area from 3/4 mile or one mile below Lock and Dam #3 as avoidance areas.

Less than two miles south of Prairie Island is Trenton I & II. The U.S. Fish and Wildlife Service has expressed reservations about the environmental acceptability of this crossing particularly in the vicinity of the Mississippi river channel and in two open marsh areas. This area is considered to have greater land use impacts and natural system impacts than the Prairie Island route but poses a greater threat to waterfowl than the Red Wing routes.

The Red Wing routes which are south of Trenton by two miles are within a half a mile of each other. Red Wing I spans extensive marsh areas and Red Wing II crosses near Upper Mud Lake which is a valuable waterfowl habitat area and is used by herons and egrets as a migratory staging area. The U.S. Fish and Wildlife Service feels that these crossings have the least potential impacts on waterfowl, especially when compared to the Praririe Island route. The main drawbacks of these routes is their land use impacts. These routes would affect the greatest amount of habitat in the river valley and would necessitate the clearing of extensive riparian forests. The Red Wing Wildlife Protection League feels that these routes, especially #1, would ruin the greatest amount of habitat of the four primary routes.

This area is also a prime duck hunting area in the fall which brings up a topic not previously mentioned. According to available literature, hunting severely declines in the vicinity of transmission lines. "Immediately over the line there is an almost 100% absence of ducks and that effect reaches out as far as one-quarter mile on either side of the line." Others feel that effect might extend as much as one-half mile on either side of the line. Another consideration is that even though wire strikes may not effect ultimate population size, they may reduce the harvestable surplus of waterfowl available to hunters. Two recent court decisions have found that transmission lines have some adverse effect on waterfowl behavior to the detriment of waterfowl hunting near the line. One Illinois hunting club was awarded one hundred thousand dollars in damages for decreased hunting opportunities attributed to the line.

From the information presented, a knowledge of seasonal weather conditions and a study of the routes on maps, it is apparent that NSP's four primary routes pose serious environmental questions. The seven methods of mitigating transmission lines' effect on migrating waterfowl seem to have been totally ignored, especially in the case of the Prairie Island and Trenton routes. Even the Nuclear Regulatory Commission felt that "the Mississippi River waterfowl and eagle resource is of significant environmental importance that feasible alternatives for any proposed powerline through the Mississippi River bottoms should be carefully evaluated.

The Conservation Committee of the St. Paul Audubon Society feels that, because of the severe threat to waterfowl and other environmental consequences, the Prairie Island, Trenton I&II, and North Red Wing I&II routes should be rejected. Viable alternatives exist which would make use of existing corridors, equate energy use with the impacts of its production or possibly make large transmission lines in the area unnecessary in the future. In line with the PEER decision, these alternatives cannot be discounted. We believe that the uniqueness of the river bottoms in the Prairie Island-Red Wing area makes it a valuable natural resource which must be maintained in its present state for the benefit of the surrounding communities and future generations.

Position: Red Wing Wildlife Protection League

Dated: December 13, 1978

The Board of Directors for the Red Wing Wildlife Protective League wish to go on record as disagreeing with the U.S. Fish & Wildlife Service stand on the proposed high voltage transmission line crossing the Mississippi River. The Red Wing Wildlife Protective League owns 2,500 acres at the confluence of the Cannon River, Vermillion River, Spring Creek, and Hay Creek and the Mississippi River. The league has tried to keep the property in its natural state and presently we have one of the largest heron rookerys in the upper Mississippi Valley. The Leagues' over 900 members use the property for canoeing, camping, bird watching, snowmobiling, trapping, swimming, cross country skiing and hunting. This year we were voted by the Minnesota Conservation Federation 1978 Conservation Club of The Year.

B-35

We believe that the map drawn at the May 18, 1977 meeting at River Falls, Wisconsin doesn't show the true low level flight patterns. We have drawn in what we consider the missing flight patterns. These flight patterns were agreed upon by people who have lived and observed ducks in this area for up to 40 years.

The reason we disagree with the U.S. Fish and Wildlife Service on their statement that the North Red Wing route #1 would create the least potential adverse impact on waterfowl is that it would ruin the greatest amount of wetland habitat of all four proposed routes. Habitat is the most critical element in the continuation of waterfowl. The North Red Wing route #1 has the best wetlands for waterfoul nesting and muskrat production. This is the prime duck hunting area in the fall. The proposed transmission line and the road to service it would ruin over half of our property. We would vigorously contest such a route if the Minnesota Environmental Quality Board designated this route. The impact of birds flying into the transmission lines has to be considered, but at a lower level than habitat. The birds that use our Mississippi bottoms are generally local puddler ducks and migrants that tend to stay for two to six weeks. These birds would get used to a transmission line, but we could never replace the habitat.

We feel the proposed transmission line should cross the Mississippi via the Prairie Island route with our second choice being the Trenton route amended to cross up River of Diamond Island. The Trenton route as proposed passes very close to our public beach and would have high visual impact at this popular recreation spot. The Trenton route would then follow the Vermillion River to the existing 161 KVA Line. This is a forested area that the line could be strung at tree top level to avoid bird collisions and visual impact.

APPENDIX C

PROJECT LIBRARIES

Materials specific to this project, and those materials noted in this Draft EIS, can be reviewed at the following public libraries.

Valley Branch Library
15876 South Afton Boulevard
Afton, Minnesota 55001

Bayport Library
260 North 3rd Street
Bayport, Minnesota 55003

Stillwater Public Library
223 North 4th Street
Stillwater, Minnesota 55082

Hudson Public Library
304 Locust
Hudson, Wisconsin 54016

Hastings Public Library
830 Vermillion
Hastings, Minnesota 55033

Red Wing Public Library
225 Broadway
Red Wing, Minnesota 55066

Washington County Library
Park Grove Branch
7520 80th Street South
Cottage Grove, Minnesota 55016

St. Paul Public Library
90 West 4th Street
St. Paul, Minnesota 55102

Minneapolis Public Library
300 Nicollet Mall
Minneapolis, Minnesota 55401

Prescott Public Library
235 North Broad
Prescott, Wisconsin

appendix C