Volume 5-Chapter 8

TRANSPORTATION IN THE REGIONAL COPPER-NICKEL STUDY AREA

Minnesota Environmental Quality Board
Regional Copper-Nickel Study
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REGIONAL COPPER-NICKEL STUDY REPORT OUTLINE
AND SCHEDULE OF CHAPTER AVAILABILITY FOR DRAFT REVIEW

A NOTE ABOUT UNITS

This report, which in total covers some 36 chapters in 5 volumes, is both international and interdisciplinary in scope. As a result, the problem of an appropriate and consistent choice of units of measure for use throughout the entire report proved insurmountable. Instead, most sections use the system of units judged most common in the science or profession under discussion. However, interdisciplinary tie-ins complicated this simple objective, and resulted in the use of a mix of units in many sections. A few specific comments will hopefully aid the reader in coping with the resulting melange (which is a reflection of the international multiplicity of measurement systems):

1) Where reasonable, an effort has been made to use the metric system (meters, kilograms, kilowatt-hours, etc.) of units which is widely used in the physical and biological sciences, and is slowly becoming accepted in the United States.

2) In several areas, notably engineering disucssions, the use of many English units (feet, pounds, BTU's, etc.) is retained in the belief that this will better serve most readers.

3) Notable among the units used to promote the metric system is the metric ton, which consists of 2205 pounds and is abbreviated as mt. The mertric ton (1000 kilograms) is roughly 10% larger (10.25%) than the common or short ton (st) of 2000 pounds. The metric ton is quite comparable to the long ton (2240 pounds) commonly used in the iron ore industry. (Strictly speaking, pounds and kilograms are totally different animals, but since this report is not concerned with mining in outer space away from the earth's surface, the distinction is purely academic and of no practical importance here).

4) The hectar is a unit of area in the metric system which will be encountered throughout this report. It represents the area of a square, 100 meters on a side (10000 m^2), and is roughly equivalent to 2½ acres (actually 2.4710 acres). Thus, one square mile, which consists of 640 acres, contains some 259 hectares.

The attached table includes conversion factors for some common units used in this report. Hopefully, with these aids and a bit of patience, the reader will succeed in mastering the transitions between measurement systems that a full reading of this report requires. Be comforted by the fact that measurements of time are the same in all systems, and that all economic units are expressed in terms of United States dollars, eliminating the need to convert from British Pounds, Rands, Yen, Kawachas, Rubles, and so forth!

<u>Conversions for Common Metric Units Used in the Copper-Nickel Reports</u>

1 meter	=	3.28 feet = 1.094 yards
1 centimeter	=	0.3937 inches
1 kilometer	=	0.621 miles
1 hectare	=	10,000 sq. meters = 2.471 acres
1 sq. meter	=	10.764 sq. feet = 1.196 sq. yards
1 sq. kilometer	=	100 hectares = 0.386 sq. miles
1 gram	=	0.037 oz. (avoir.) = 0.0322 Troy oz.
1 kilogram	=	2.205 pounds
1 metric ton	=	1000 kilograms = 0.984 long tons = 1.1025 short tons
1 m^3	=	1.308 yd^3 = 35.315 ft^3
1 liter	=	0.264 U.S. gallons
1 liter/minute	=	0.264 U.S. gallons/minute = 0.00117 acre-feet/day
1 kilometer/hour	=	0.621 miles/hour
degrees Celsius	=	(5/9)(degrees Fahrenheit -32)

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8.1 INTRODUCTION AND SUMMARY OF FINDINGS

The transportation system in the Regional Copper-Nickel Study Area (Study Area) provides service to both residential and commercial constituencies. Copper-nickel mining development would place increased demands on the transportation system both in terms of increased commercial mining travel and increased commuter and residential traffic. This chapter characterizes the transportation system serving the Study Area and examines the ability of this system to accommodate the growth in traffic resulting from copper-nickel development.

The commercial transportation network serving the Study Area is presently hauling taconite pellets from existing taconite mining operations. The taconite leaves the Study Area by rail and is taken to four ports on Lake Superior for transshipment. The increase in mining travel due to the copper-nickel industry would be small in volume relative to the shipment of taconite. All of the five railroads serving the Study Area are operating below their capacity and could handle increased tonnages depending on the amount and type of material. Two of these railroads are private carriers and as such cannot haul commodities for other companies. Three of the harbors on Lake Superior have facilities set up exclusively for taconite pellet shipment. The Duluth-Superior Harbor has facilities to handle several commodities and the present and projected use of the harbor is well below the estimated capacity. The inland waterway system is not currently involved in the transportation of mining products from the Study Area but has facilities which are capable of doing so. Projections of future use and capacity are not available so the amount of growth this mode could accommodate is not clear.

Transportation of copper-nickel concentrate produced at the processing stage would require special handling equipment such as covered rail cars, special loading and unloading equipment, and inside storage facilities. With a smelter at the mining operation, the quantity of metallic output produced is greatly reduced and the product form, ingots and matte, is easier to transport. A substantial amount of sulfuric acid, a by-product of smeltering, would also require transportation. Special procedures must be followed in transporting this material, and a spill during the loading, transporting, and unloading process could create hazardous conditions.

Residential growth associated with new mining development would increase the use of the highway system serving the Study Area. The traffic generated by copper-nickel development alone would exceed the capacity of several stretches of highway totalling approximately 70 miles. Traffic due to copper-nickel development in addition to traffic projected for the year 2000 would create capacity problems on several more stretches of road. The results of this analysis indicate that road upgrading and corresponding increased government cost would be a likely result of copper-nickel development.

8.2 METHODS OF STUDY

Use and capacity information was gathered from the Minnesota Department of Transportation (MnDOT) for the existing transportation system. Projections and analysis of the highway system were provided by the MnDOT Office of Transportation Analysis. Not all local roads were included in this analysis. Trunk highway traffic estimates were based on a combined analysis of 10-year historic traffic counts and a statewide travel model for the year 2000. Projections of traffic generated by future taconite expansion and potential copper-nickel development were based on the number and residential distribution of mine workers and families developed by the Regional Copper-Nickel Study (see Volume 5-Chapter 7, Residential Settlement). The MnDOT Office of Plan Development, provided future use and capacity information when available for the rail, barge, and Great Lakes waterway transportation systems.

8.3 CHARACTERIZATION

The characterization section of this chapter examines the location, use, and capacity of the highway, rail, barge, and Great Lakes transportation systems as they presently exist and may exist in the future without copper-nickel development. This information provides a baseline upon which assessment of impacts from copper-nickel mining can be made. The year 2000 was used for this baseline in order to assess impacts in a year of potential peak copper-nickel production.

8.3.1 Highway System

Five of the roads in the Study Area are part of the State Trunk Highway System. State Trunk Highways (TH) are administered and maintained by the state and in most cases are routes of statewide significance. The remaining roads are County State Aid Highways (CSAH), County Roads, or Forest Highways and are generally of local significance only (Figure 1). Approximately 22 percent of the land in the Study Area is directly accessed by or within one-quarter mile of a paved or unpaved public road. Seventy-three percent of the total Study Area is located within one mile of a public road. The areas that are not accessible by public roads include the Boundary Waters Canoe Area (BWCA), RARE II Roadless Areas, swamp lands, and mining areas along the Mesabi Iron Range (Figure 2). The mining areas are often accessed by private mining company routes rather than public roads.

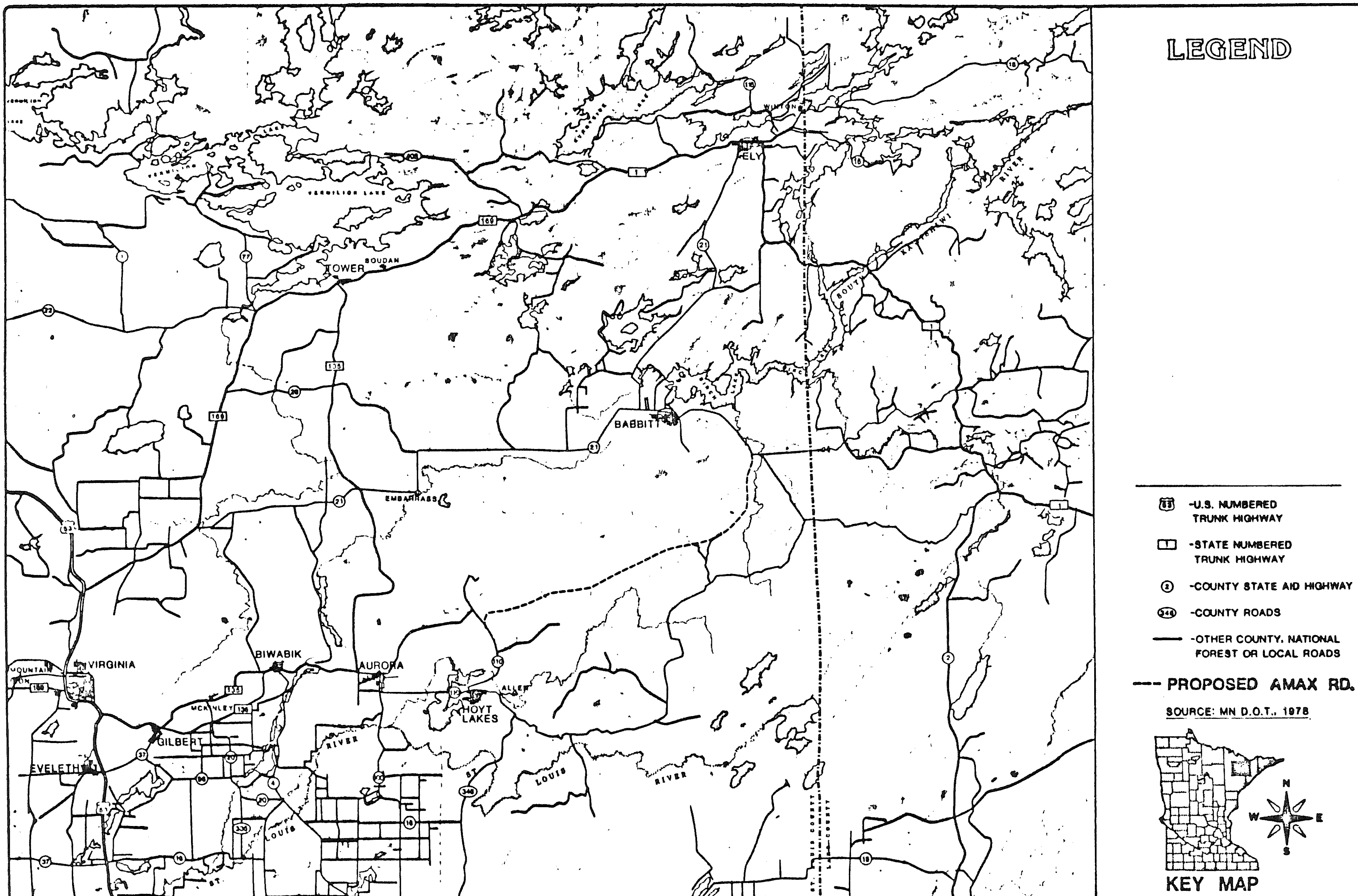


FIGURE 1

MEQB REGIONAL COPPER-NICKEL STUDY

PUBLIC ROADS

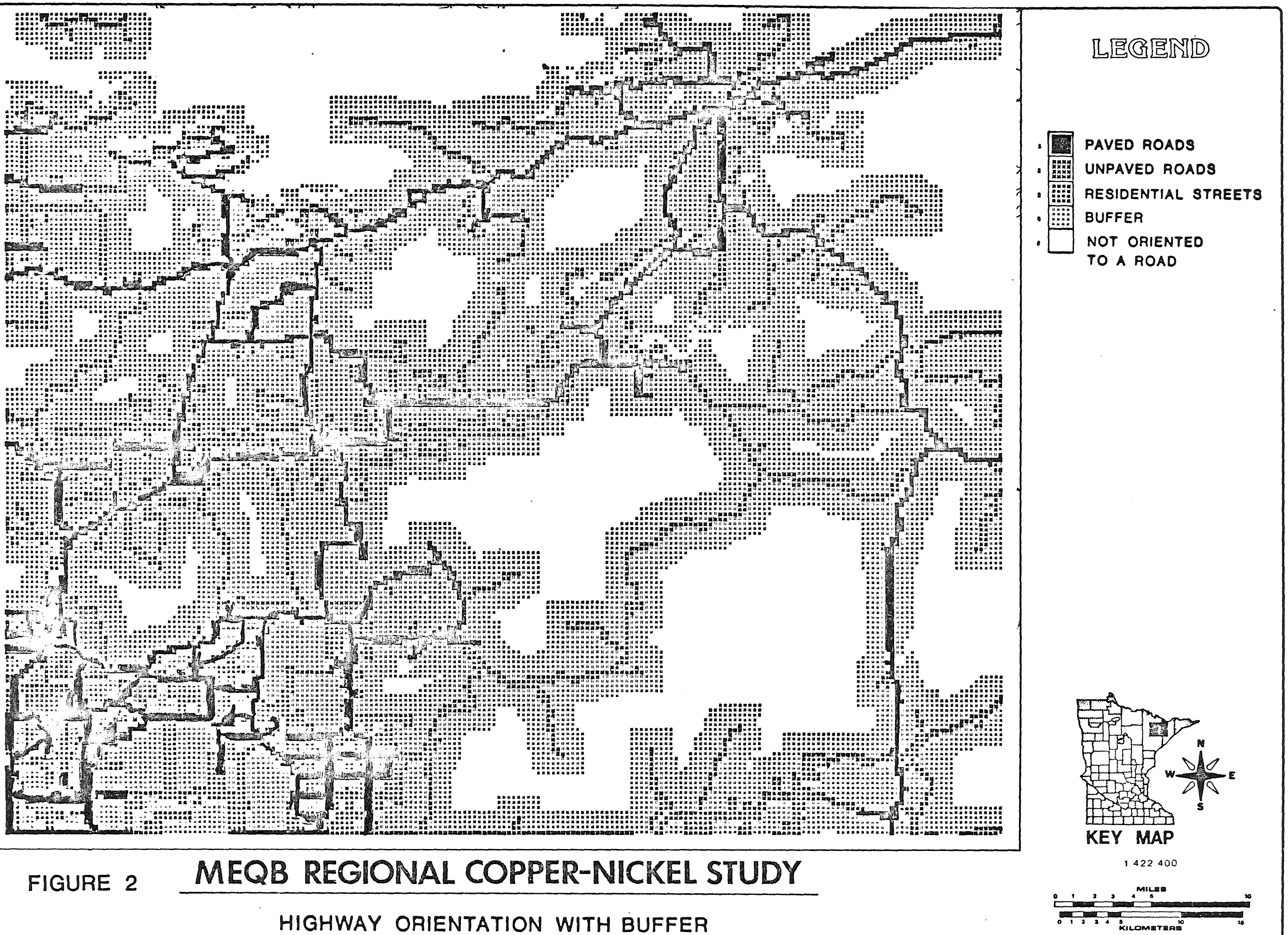


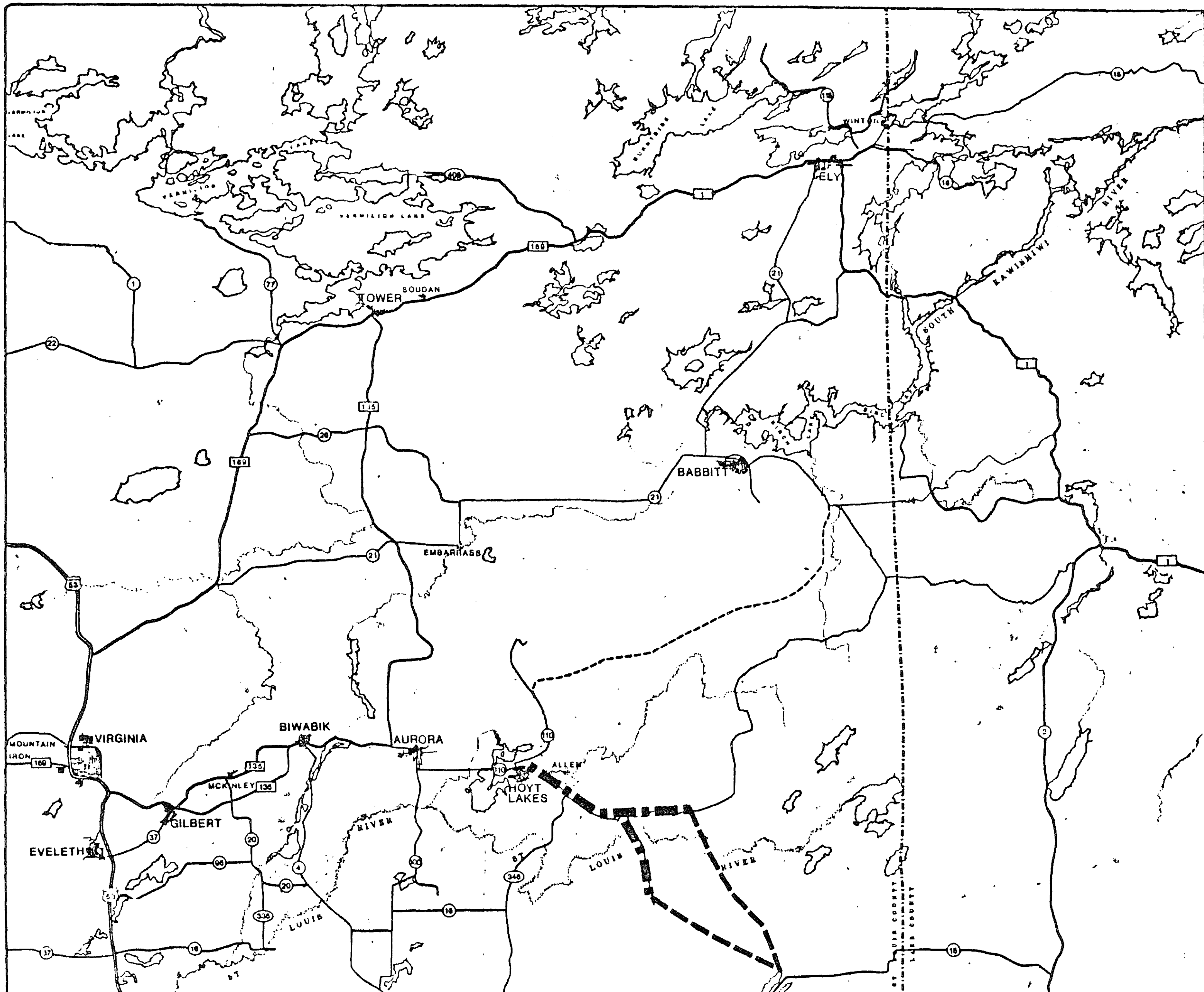
FIGURE 2 **MEQB REGIONAL COPPER-NICKEL STUDY**

HIGHWAY ORIENTATION WITH BUFFER

8.3.1.1 New Highway Proposals--Proposed Forest Highway 11 (F.H. 11) would connect Hoyt Lakes and Silver Bay. Several stretches would coincide with existing roads, leaving two major new segments to be constructed (Figure 3). In the Study Area a new stretch connecting Skibo to Cadotte Lake is under consideration. St. Louis County Highway Department is currently studying the project and if federal funding is available, they forsee the highway being built by 1985. Funding may be a problem as federal funds for forest highways are allocated on a priority basis. According to the USFS, Forest Highway 11 is a low priority road whose need has not been documented by traffic counts. Parts of County Road 16 with which F.H. 11 would coincide may be improved regardless of the status of the proposed highway.

8.3.1.2 Weight Restrictions--Most of the roads in the Study Area cannot accommodate the weight of heavy trucks. Some of the trunk highways have a 9-ton per axle weight restriction, but many have a less than 9-ton per axle weight restriction (Figure 4). Most mining related goods of the taconite industry are hauled by train rather than by truck. Some taconite mining equipment was trucked into the Study Area, but it was broken down to a size and weight that was compatible with weight restrictions.

8.3.1.3 Present and Projected Use of Highway Facilities--The use of highway facilities is calculated in terms of average daily traffic (ADT). ADT is the average number of vehicles traveling a stretch of road from either direction per day. Information on present and projected use of highways in the Study Area does not include all local roads (Figure 5). The roads in the southwestern portion of the Study Area are most heavily traveled, with Trunk Highway 53 showing the highest traffic count. Less than 10 percent of the traffic on Study Area roads is heavy truck or bus traffic (Table 1).



LEGEND

EXISTING SEGMENTS

PROPOSED SEGMENTS TO BE CONSTRUCTED

SOURCE: ST. LOUIS CTY. HWY. DEPT., 1977

-U.S. NUMBERED TRUNK HIGHWAY

-STATE NUMBERED TRUNK HIGHWAY

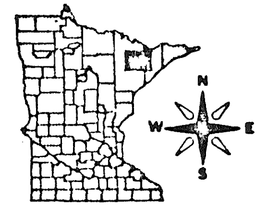
-COUNTY STATE AID HIGHWAY

-COUNTY ROADS

-OTHER COUNTY, NATIONAL FOREST OR LOCAL ROADS

--- PROPOSED AMAX RD.

SOURCE: MN D.O.T., 1978



KEY MAP

1:422,400

MILES

KILOMETERS

FIGURE 3

MEQB REGIONAL COPPER-NICKEL STUDY

PROPOSED FOREST HIGHWAY 11

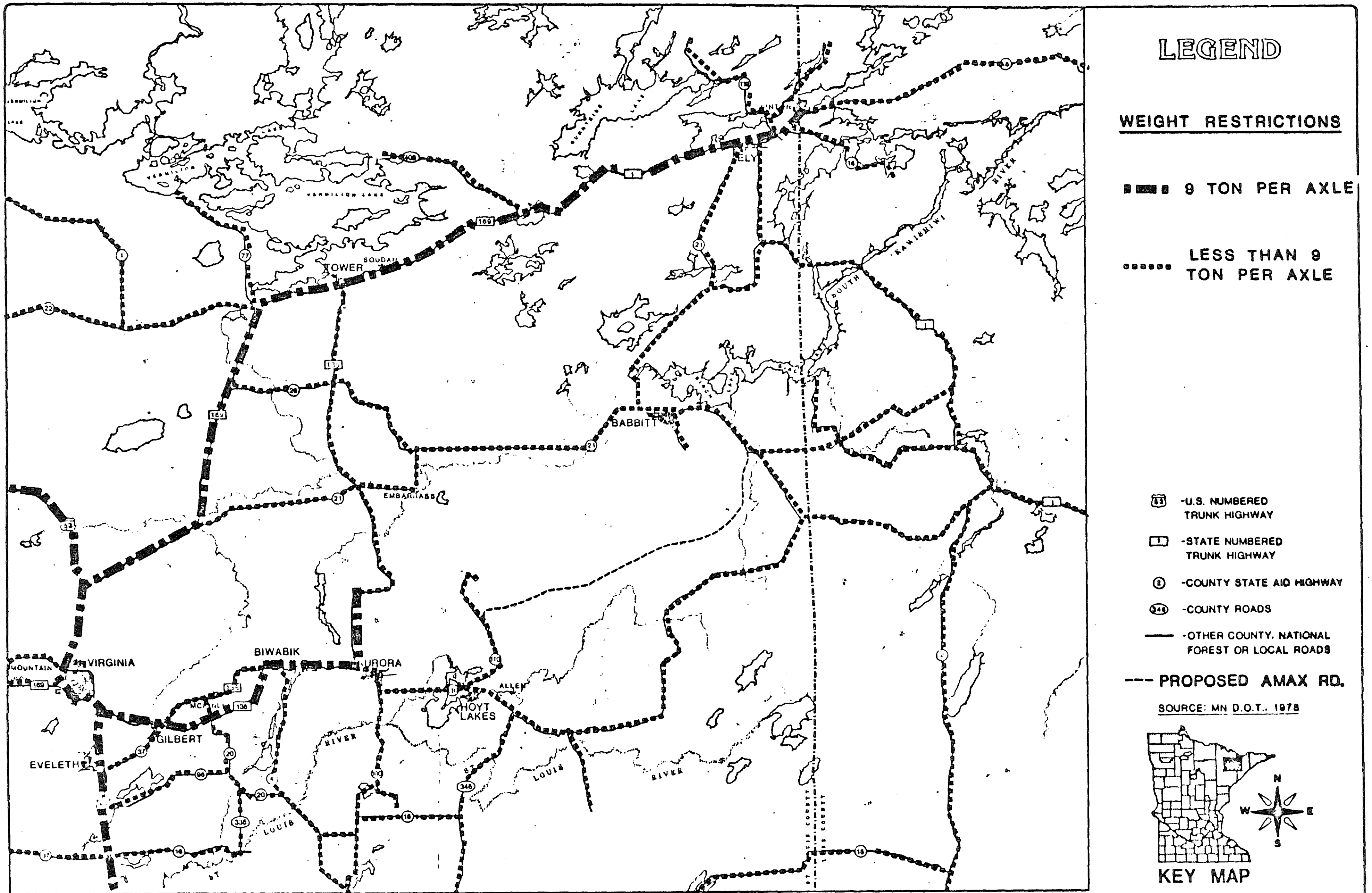


FIGURE 4

MEQB REGIONAL COPPER-NICKEL STUDY

HIGHWAY WEIGHT RESTRICTIONS

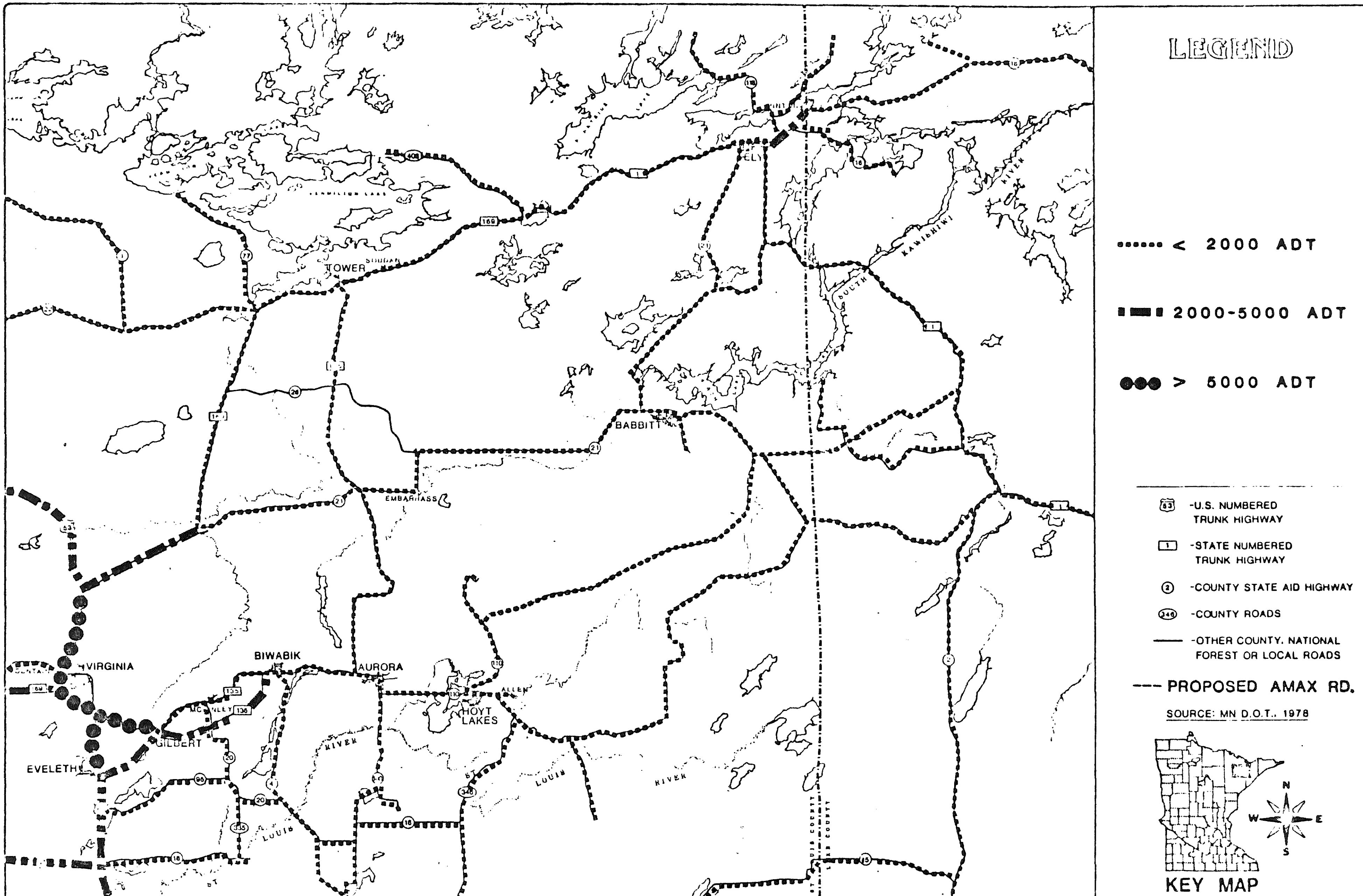


FIGURE 5

MEQB REGIONAL COPPER-NICKEL STUDY

AVERAGE DAILY TRAFFIC (ADT), 1976

Table 1. Typical traffic types for Study Area roads.

	TH 53	TH 1, TH 135, TH 169	LOCAL ROAD
Car	91.0%	94.0%	93.0%
Heavy Truck	8.5%	5.5%	6.6%
Bus	0.5%	0.5%	.1%

SOURCE: MnDOT 1978.

Traffic levels in the year 2000 for state and local roads in the Study Area were projected based on expected normal growth and future taconite expansion (MnDOT 1978)(Figure 6). Much of the growth in traffic occurs in the southwest quadrant of the Study Area. The ADT on most roads is projected to double and on some roads triple by the year 2000. This projection represents a maximum forecast in order to insure identification of capacity problem areas. No provisions were made in the projection for reductions in traffic due to energy constraints and the forecast may be high for this reason.

8.3.1.4 Capacity--Highway capacity is normally measured as the maximum number of vehicles that can pass a given point during a given period of time (usually a peak hour) at a given level of service. The level of service is important in assessing capacity because a greater number of cars may be carried by a section of road as the level of service is lowered. For the purposes of this analysis, the level of service was assumed to be movement at the speed for which the road was designed. Capacity in urban areas is controlled by intersections as well as the condition of the road.

To determine the ability of the road to carry traffic, traffic volumes were compared to road capacities. The volume to capacity ratio (V/C) is the traffic

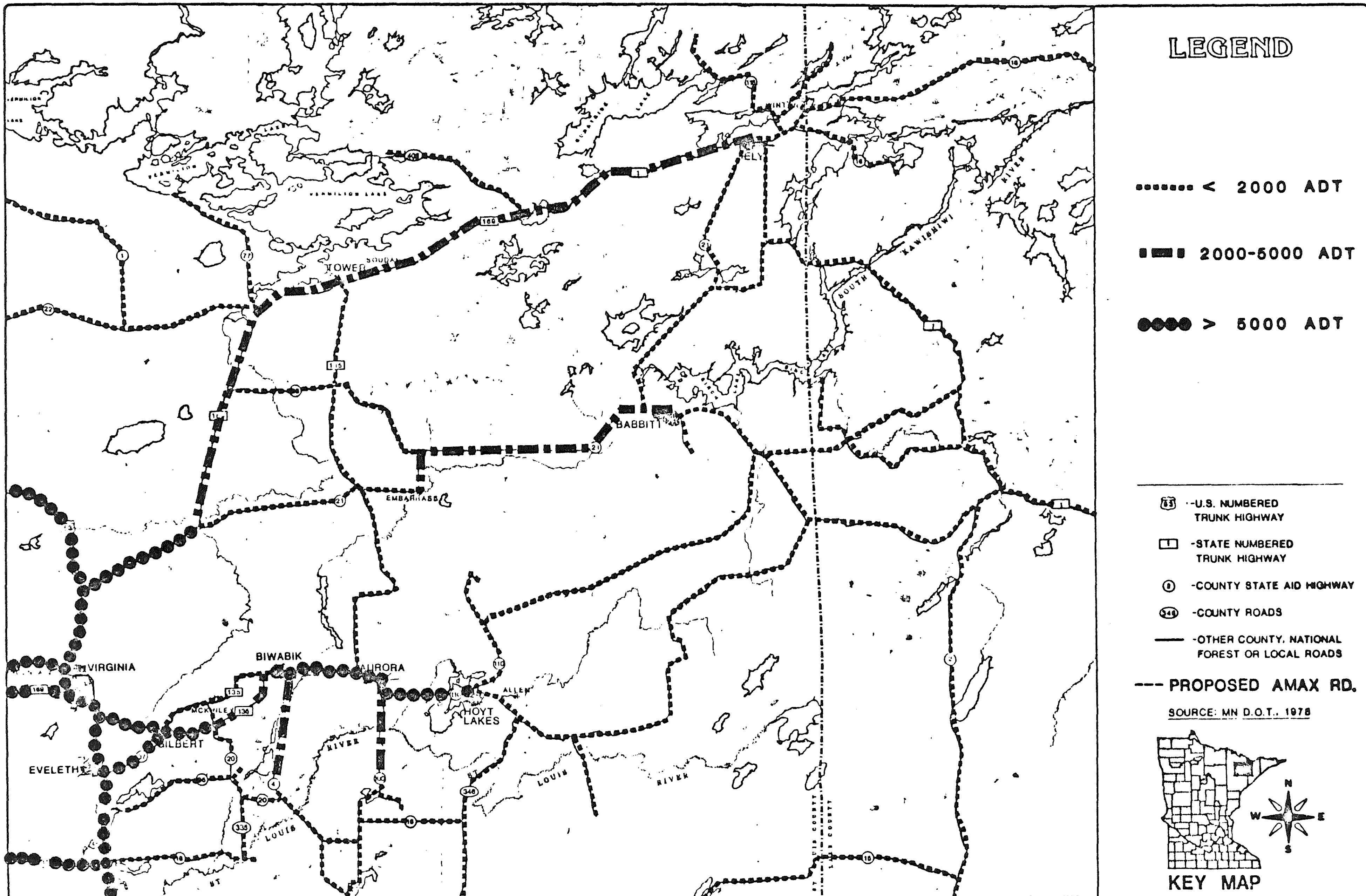


FIGURE 6 MEQB REGIONAL COPPER-NICKEL STUDY

PROJECTED AVERAGE DAILY TRAFFIC (ADT), YEAR 2000
WITHOUT COPPER-NICKEL DEVELOPMENT

volume of the road divided by the capacity of the road. A V/C ratio of 1.0 or greater indicates that the traffic volume exceeds the road's capacity. Following are operating characteristics for ranges of V/C ratios (MnDOT 1978).

0.0-0.7	Generally free flow, excellent service
0.7-1.0	Some congestion, but generally good service
1.0-1.3	Over capacity, traffic movement possible at lower level of service, poor service
1.3-over	Extreme congestion, stop and go driving, very poor service

Road segments on which traffic presently exceed capacity are found within the urban areas of the Study Area (Figure 7). By the year 2000, projected traffic on approximately 30 miles of rural roads could approach or exceed the capacity of the road. The remainder of the roads in the Study Area are projected to have traffic volumes well below the capacity of the road.

In order to maintain the level of service for which the roads were designed, some form of upgrading would be necessary on these capacity problem sections. Portions T.H. 53 and 135 and part of CSAH 110 are slated for study or improvement by 1985(MnDOT 1978)(Figure 8).

8.3.2 Rail System

Rail lines serving the Study Area are owned and operated by five different companies; Reserve Mining Company, Erie Mining Company, Duluth Mesabi and Iron Range Railway (DM&IR), Duluth Winnipeg and Pacific Railway (DW&P), and Burlington Northern, Inc. (BN)(Figure 9). Reserve and Erie Mining Company railroads are private carriers and haul exclusively taconite. As private carriers, they cannot haul commodities for other companies; therefore, it is

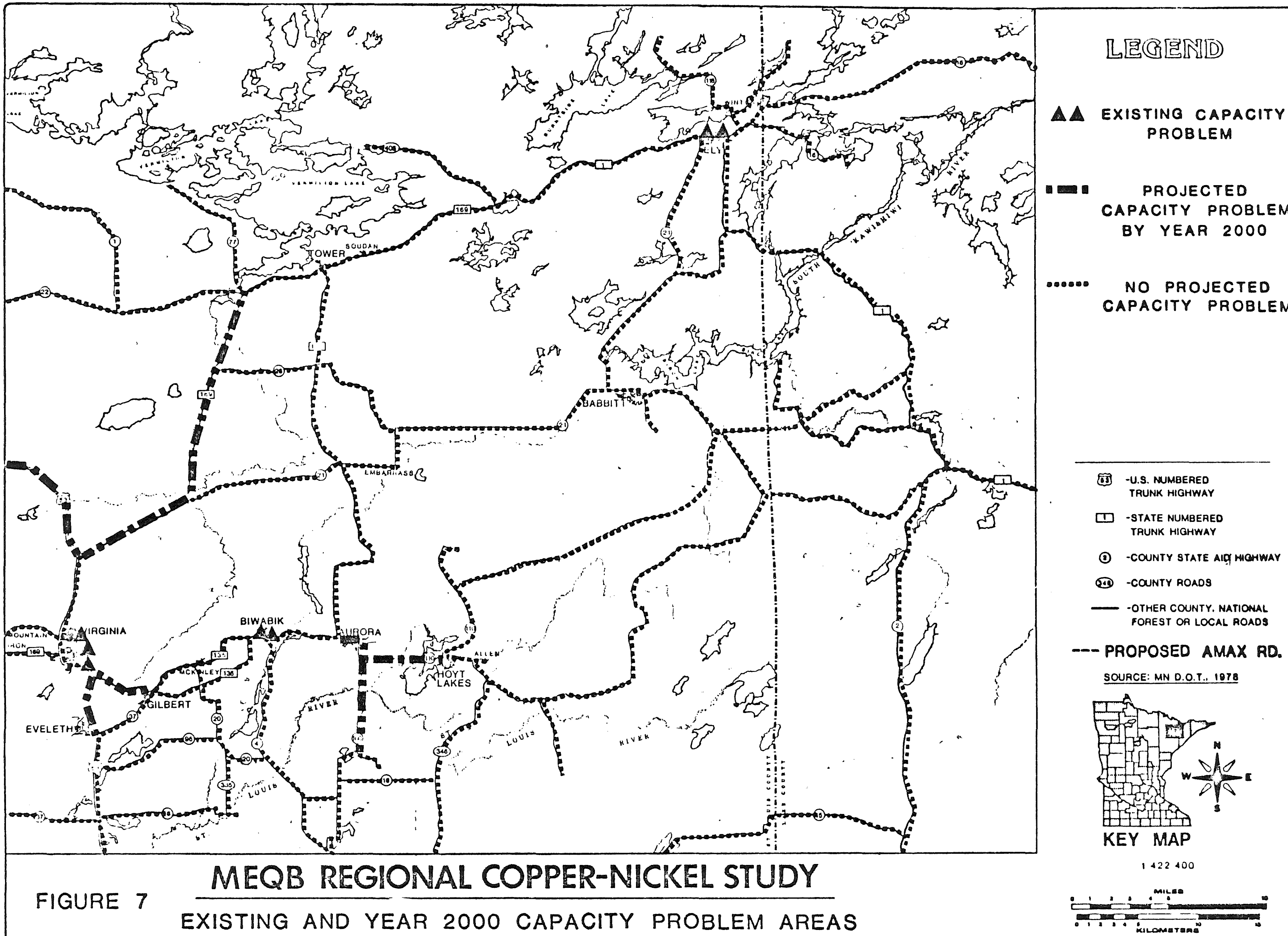


FIGURE 7

MEQB REGIONAL COPPER-NICKEL STUDY

EXISTING AND YEAR 2000 CAPACITY PROBLEM AREAS
(WITHOUT COPPER-NICKEL DEVELOPMENT)

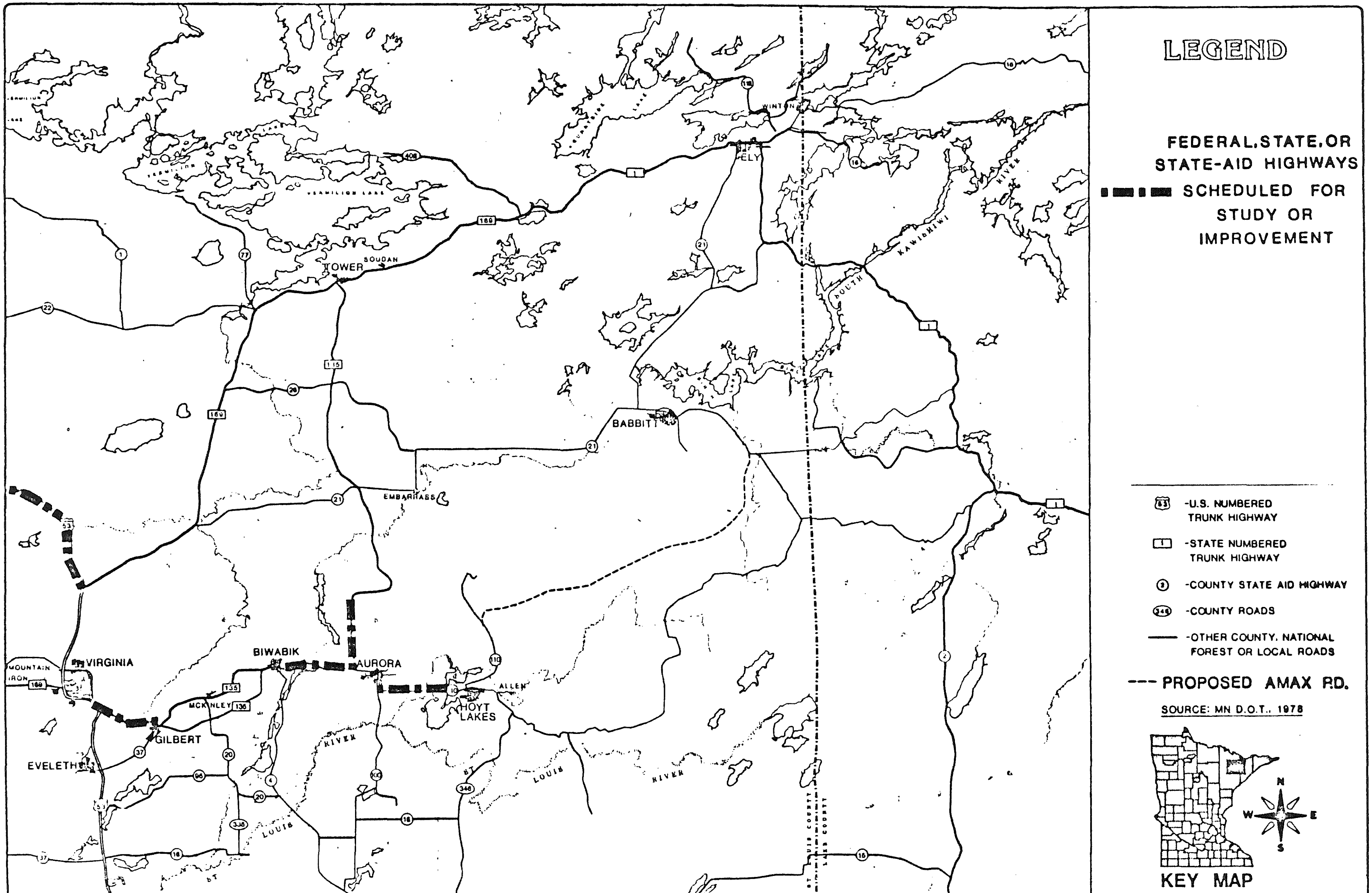
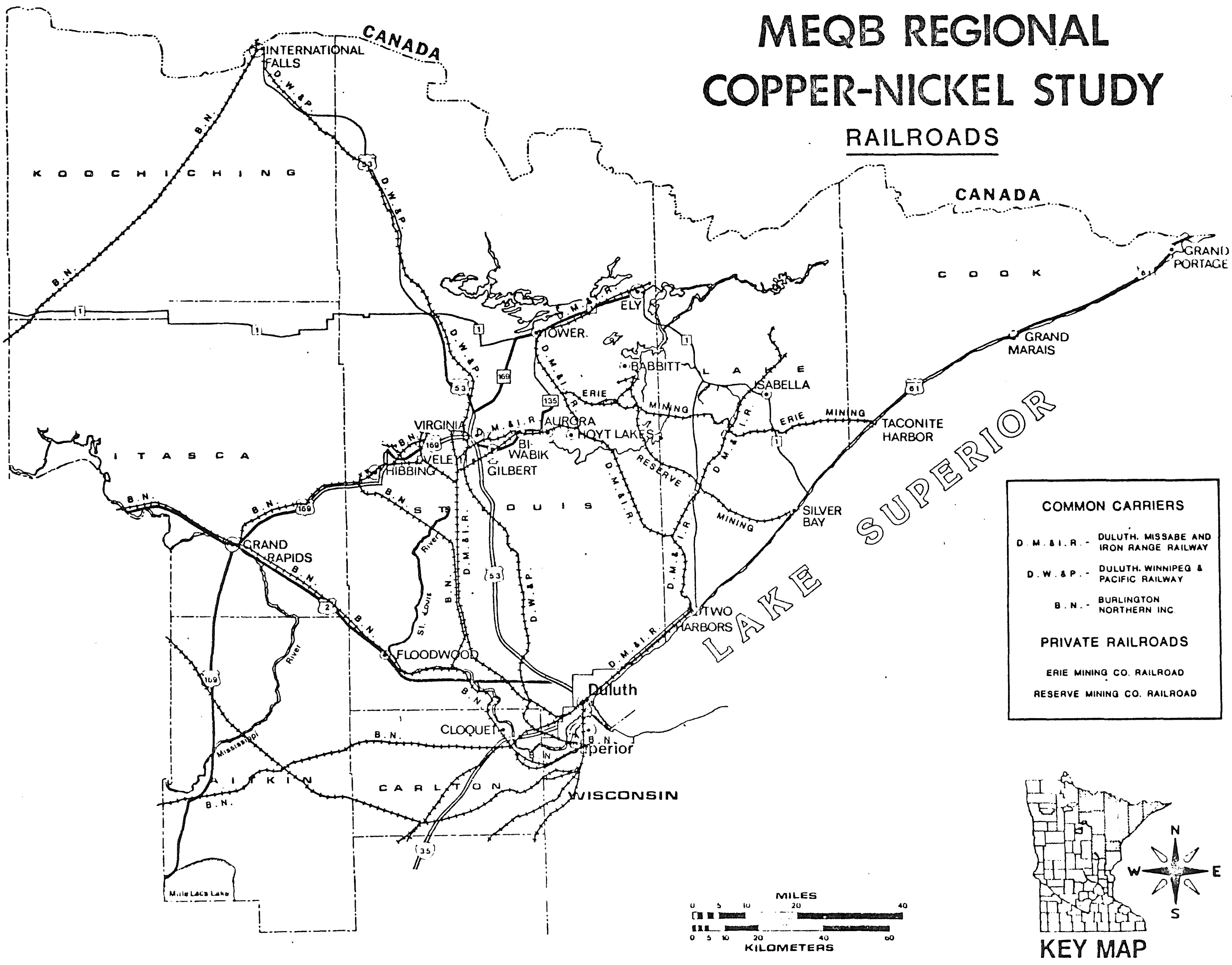


FIGURE 8

MEQB REGIONAL COPPER-NICKEL STUDY

FEDERAL, STATE, OR STATE-AID HIGHWAYS SCHEDULED FOR STUDY OR IMPROVEMENT BY 1985

FIGURE 9


MEQB REGIONAL
COPPER-NICKEL STUDY
RAILROADS
CANADA
INTERNATIONAL FALLS
KOOCHICHING
ITASCA
COOK
LAKE
ST. LOUIS
AITKIN
CARLTON
WISCONSIN
LAKE SUPERIOR
ELY
TOWER
BABBITT
ISABELLA
GRAND PORTAGE
GRAND MARAIS
TACONITE HARBOR
SILVER BAY
TWO HARBORS
VIRGINIA
AURORA
HOYT LAKES
BIWABIK
GILBERT
EVELETH
HIBBING
GRAND RAPIDS
FLOODWOOD
CLOQUET
Duluth
Superior
Mille Lacs Lake
ERIE MINING
RESERVE MINING
COMMON CARRIERS
D.M.&I.R. - DULUTH, MISSABE AND IRON RANGE RAILWAY
D.W.&P. - DULUTH, WINNIPEG & PACIFIC RAILWAY
B.N. - BURLINGTON NORTHERN INC.
PRIVATE RAILROADS
ERIE MINING CO. RAILROAD
RESERVE MINING CO. RAILROAD
MILES
KILOMETERS
KEY MAP
N
S
E
W

unlikely that these lines would be shared with other mining companies. In order to haul commodities for other companies, they would have to apply to the Interstate Commerce Commission (ICC) to be licensed as a common or contract carrier. DM&IR, DW&P, and BN are common carriers licensed by the ICC. DM&IR operates 431 miles of track in Minnesota of which 300 miles are mainline and 131 miles are branchline. DW&P is primarily a connector-type service between Minnesota and Canada and operates 165 miles of track. Both DM&IR and DW&P provide service only in northeastern Minnesota, but connections are available with major railroads so that long haul routings are possible. BN operates 2,880 miles of track in Minnesota which is approximately 40 percent of the rail mileage in the state, and its lines extend outside of the state.

8.3.2.1 Abandonments--Several of the railroads serving the Study Area have branch lines that are subject to or proposed for abandonment (Figure 10). A 38-mile section of DM&IR rail from Penguilly to Alborn has been approved for abandonment and another section from Forest Center to Isabella is subject to abandonment in the future. If DW&P can share track with DM&IR from Virginia to Duluth, a 71-mile section of DW&P track is subject to abandonment by 1981.

8.3.2.2 Present and Projected Use--One measure of rail system use is the number of train movements per day on a particular line. The tonnages of cargo carried on a line can also be measured but can vary with the size of the train and the type of material hauled. Train movements per day vary in number from less than 2 to greater than 20 trains per day on rail lines serving the Study Area (Figure 11).

Erie and Reserve Mining companies haul exclusively taconite ore and pellets on their private rail lines. The remainder of the taconite pellets leaving the

FIGURE 10

MEQB REGIONAL COPPER-NICKEL STUDY

POTENTIAL RAILROAD ABANDONMENTS

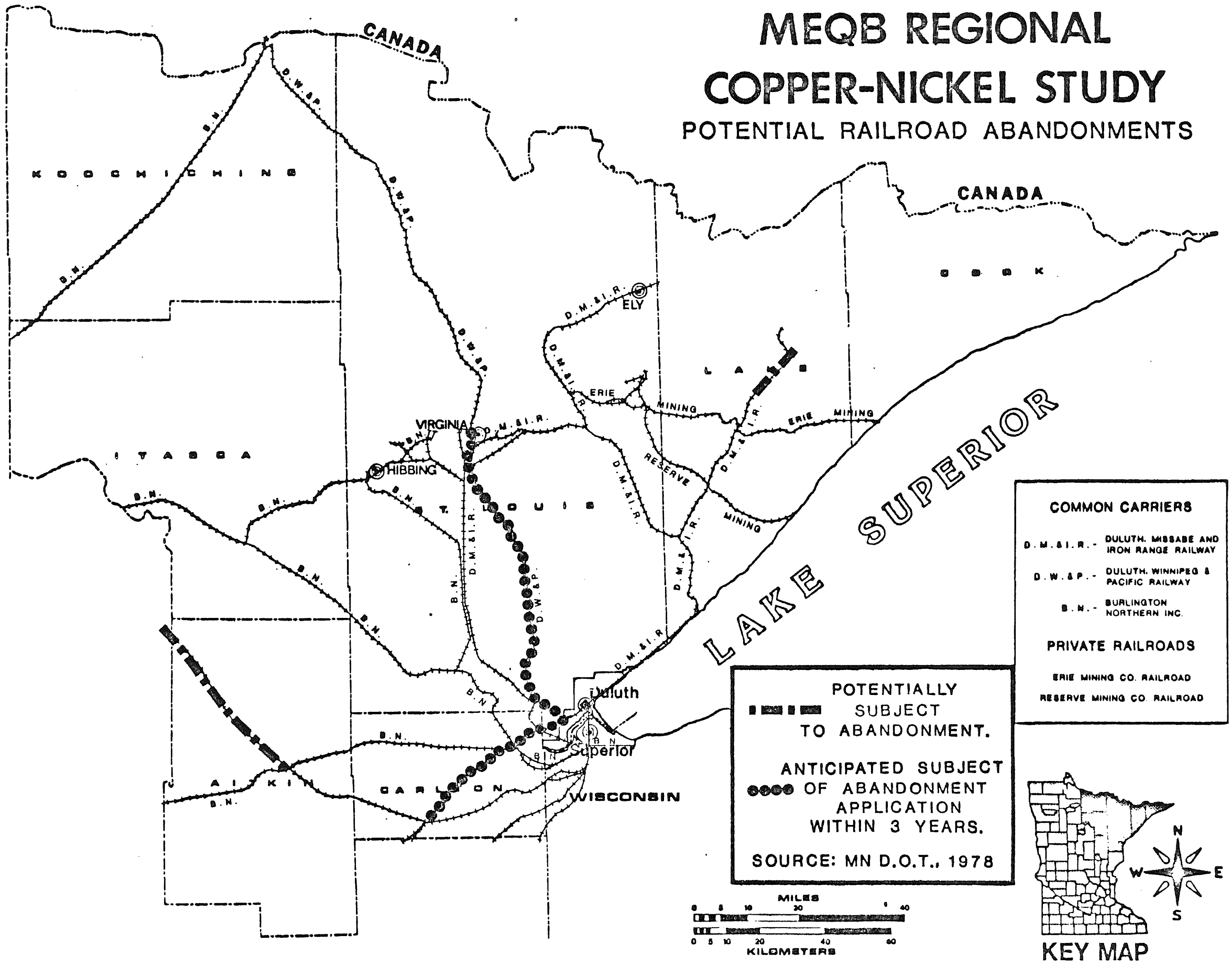
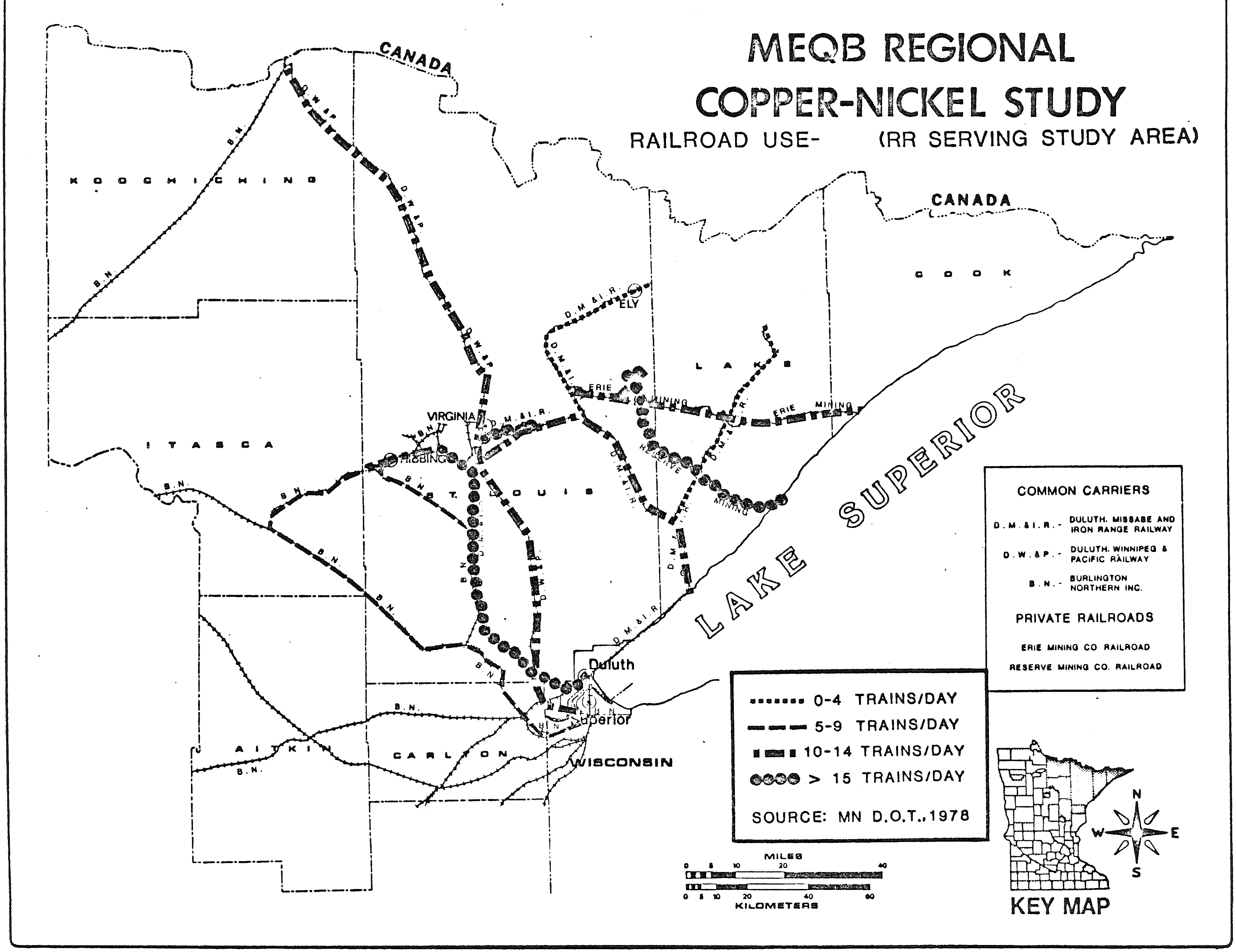


FIGURE 11


MEQB REGIONAL
COPPER-NICKEL STUDY
RAILROAD USE- (RR SERVING STUDY AREA)
CANADA
CANADA
K O O C H I C H I N G
I T A S C A
S T. L O U I S
L A K E
C O O K
A I T K I N
C A R L T O N
WISCONSIN
LAKE SUPERIOR
VIRGINIA
HIBBING
ELY
Duluth
Superior
B.N.
D.W.&P.
D.M.&I.R.
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B.N. - BURLINGTON NORTHERN INC.
PRIVATE RAILROADS
ERIE MINING CO RAILROAD
RESERVE MINING CO. RAILROAD
0-4 TRAINS/DAY
5-9 TRAINS/DAY
10-14 TRAINS/DAY
> 15 TRAINS/DAY
SOURCE: MN D.O.T., 1978
MILES
0 5 10 20 40
KILOMETERS
0 5 10 20 40 60
N
S
E
W
KEY MAP

Study Area are transported by DM&IR to Two Harbors or Duluth Superior and by BN. In 1976 DM&IR hauled 32 million tons of taconite pellets. This was approximately 95 percent of the total tonnage transported by this rail company. Pulpwood, lumber, coal, and other miscellaneous commodities comprise the remaining 5 percent of the freight hauled. Lumber, pulp, paper, and chemicals are the predominant commodities hauled by DW&P. No taconite materials are presently carried on this line. Coal, grains, metallic ores, and food are the primary commodities being shipped on BN's rail lines in Minnesota.

Projections for future use of the railroads were unavailable for DW&P and BN. Erie and Reserve would be expected to handle any increases from their own taconite operations. DM&IR is projecting a peak of 73 million tons per year with increased taconite production by 1985.

8.3.2.3 Capacity--The capacity of a railroad is a function of the physical ability of the rails to support the weight of the trains and the ability of the system to absorb a greater number of trains. All tracks in the Study Area could handle the weight of unit trains using 100-ton hopper cars. Unit trains are assembled trains, usually around 100 cars in size, that are loaded and unloaded without dismantling. They are most often used in large bulk commodity movements. DM&IR, Reserve, and Erie use unit trains for all their taconite movement.

The restrictive factor in the capacity of the rail system in the Study Area is its ability to handle an increased number of trains. According to the rail companies, all rail lines serving the Study Area are presently operating below capacity. The maximum number of train movements per day that the lines could accommodate with present facilities is shown on Table 2. Capacity could be increased by changing from single to double track or from a manual train order

Table 2. Rail system, present use and capacity (1977).

RAILROAD	PRESENT USE (trains/day)	CAPACITY (trains/day)
DM&IR		
Winton Jct. - Allen Jct.	1.5	6
Allen Jct. - Two Harbors	7	14
Iron Jct. - Allen	14	28
Iron Jct. - Duluth	24	30
DW&P	8-10	14
Erie	11	N.A.
Reserve	16	N.A.
BN	N.A.	N.A.

SOURCE: MnDOT 1978.

system to a Centralized Traffic Control System (CTC). A CTC system allows a greater number of trains to operate simultaneously and can almost double the capacity of the rail system.

8.3.3 Great Lakes Waterway System

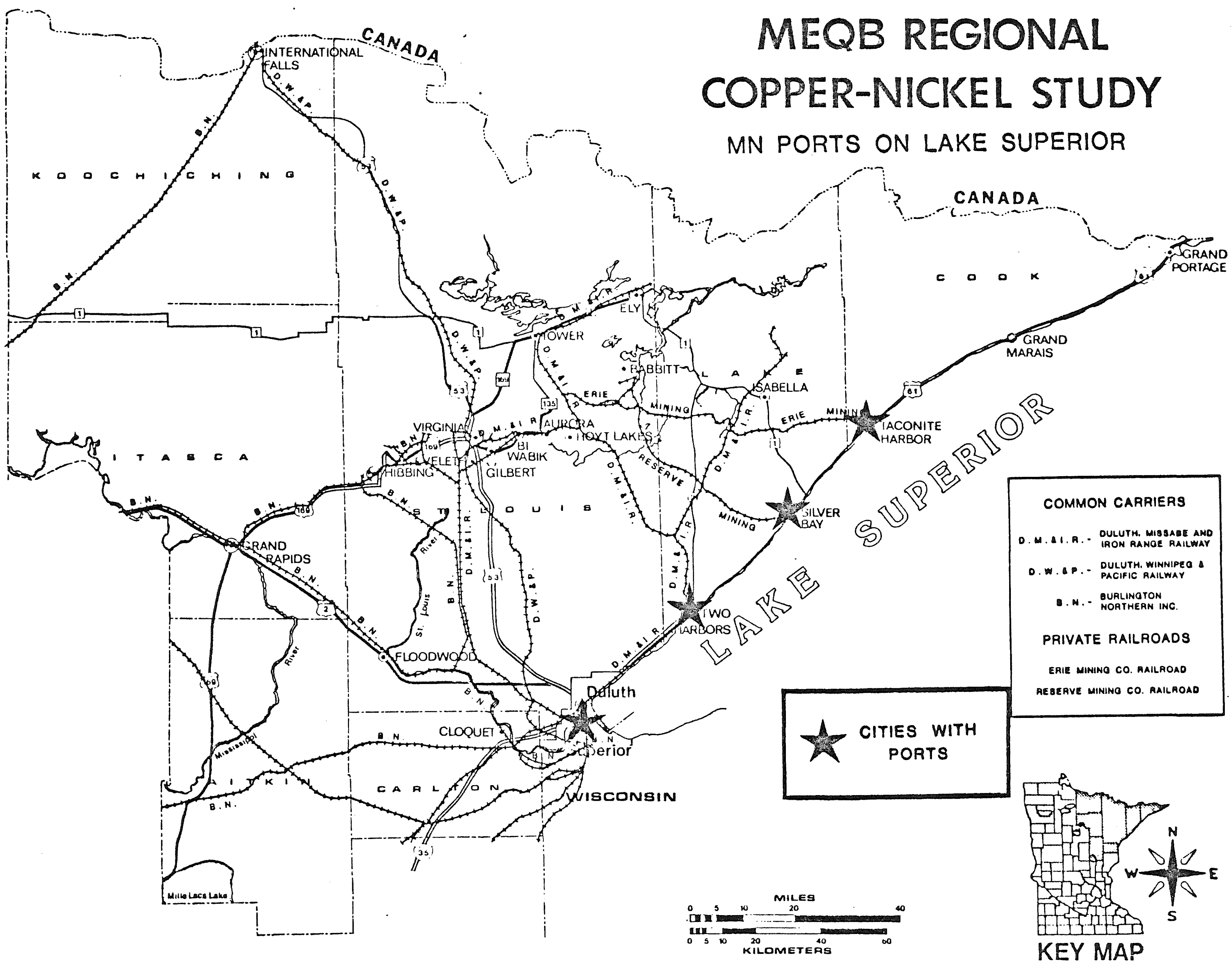
Bulk commodities can be transported to four ports on Lake Superior for transshipment to the Great Lakes Waterway System (Figure 12). The docking facilities at the ports of Taconite Harbor, Silver Bay, and Two Harbors are set up exclusively for taconite pellet shipment. Taconite Harbor is Erie Mining Company's private port, and Silver Bay's port facilities are owned and operated by Reserve Mining Company. Both Taconite Harbor and Silver Bay are accessed only by Erie and Reserve's private railroads, and for this reason it is unlikely that other mining operations would use these ports. The DM&IR operates and provides rail access to the port of Two Harbors. The Duluth-Superior Harbor consists of nearly forty docking facilities at which several different bulk commodities are shipped. Six major railroads provide access to the harbor including DM&IR, BN, and DW&P coming from the Study Area.

8.3.3.1 Present and Projected Use--Annual cargo tonnages are the most appropriate measure of harbor use and capacity. The alternative is to use number of vessels using the harbor, but this varies greatly as vessel size and capacity changes over time.

Presently 11.8 million tons of taconite pellets are shipped out of Two Harbors annually. Taconite is the only commodity shipped from this port. A maximum of 14.4 million tons per year is expected with peak taconite production.

Iron ore, taconite pellets and grain have in the past been the dominant types of bulk cargo shipped in the Duluth-Superior Harbor. With the completion of the

FIGURE 12


MEQB REGIONAL
COPPER-NICKEL STUDY
MN PORTS ON LAKE SUPERIOR
CANADA
INTERNATIONAL FALLS
KOOCHICHING
ITASCA
ST. LOUIS
LAKE
COOK
CARLTON
AITKIN
WISCONSIN
LAKE SUPERIOR
GRAND PORTAGE
GRAND MARAIS
TACONITE HARBOR
SILVER BAY
TWO HARBORS
Duluth
Superior
CLOQUET
FLOODWOOD
GRAND RAPIDS
HIBBING
EVELETH
VIRGINIA
GILBERT
BIWABIK
AURORA
HOYT LAKES
TOWER
ELY
BABBITT
ISABELLA
Mille Lacs Lake
COMMON CARRIERS
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CITIES WITH PORTS
MILES
KILOMETERS
KEY MAP
N
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Superior Coal Transshipment Facility (ORTRAN), western coal has also become an important bulk commodity. General cargo (e.g. manufactured goods that are not considered bulk) accounts for very little of the harbor's present shipping activity.

Several forecasts predict an increase in tonnages shipped from the Duluth-Superior Harbor, but the magnitude of the increase varies among forecasts. The A.T. Kearney forecast was highest for most commodities and included western coal trade in its estimate (Table 3).

8.3.3.2 Capacity--Estimates of facility capacity at the Duluth-Superior Harbor were prepared for the Corps of Engineers by Architectural Resources, Inc. (Table 3). According to these estimates, the forecasted cargo increases can be accommodated by the existing facilities. A new coal shipping facility may be necessary since coal shipping is expected to reach approximately 70 percent of its theoretical capacity. Although Two Harbors is presently operating below its capacity, another taconite pellet docking facility is planned by DM&IR at this location.

The capacity estimates for the Duluth-Superior Harbor were made on the assumption that vessels using the harbor would be operating at close to peak efficiency. There are several problem areas, such as narrow and shallow channels and seasonality, which could restrict the capacity of the harbor.

A major restriction in the Duluth-Superior Harbor is channel depth. A large portion of the harbor is served by a shallow 23-foot deep channel. Existing docks on this channel cannot load ships to their full capacity. Extension of the 27 ft channel through the entire harbor is being studied and would be necessary in order for all docks to function at capacity.

Table 3. Use and capacity of the Duluth-Superior Harbor (tonnages of cargo).

CARGO	PRESENT USE (1976 shipments)	PROJECTED USE (2000) A.T. Kearney	CAPACITY
General Cargo	84,925	783,000	1,520,000
Coal	2,305,360	17,527,000	25,000,000
Grain	4,250,468	9,368,000	15,050,000
Iron Ore & Taconite Pellets	22,618,499	37,468,000	80,000,000
Other Bulk Commodities	581,794	725,000	-----
TOTAL	29,841,046	65,146,000	121,570,000

SOURCES: U.S. Army Corps of Engineers 1976; Metropolitan Interstate Committee 1977.

For the harbor to accommodate increased tonnages and for shipping operations to maintain economic feasibility, more longer ships (over 800 ft) will have to use the harbor (Metropolitan Interstate Committee 1977). The Corps of Engineers has proposed to widen the Superior front channel by 300 ft to increase vessel maneuverability and safety.

Two of the five bridges crossing the harbor also pose navigational problems (Arrowhead Bridge, and the BN St. Louis Bay Bridge). Both present maneuverability problems for the larger ships and cause traffic delays for ships and the trains or cars moving over the bridges. The proposed Arrowhead bridge will eliminate the maneuverability and congestion problems. No action has been taken to improve the BN bridge.

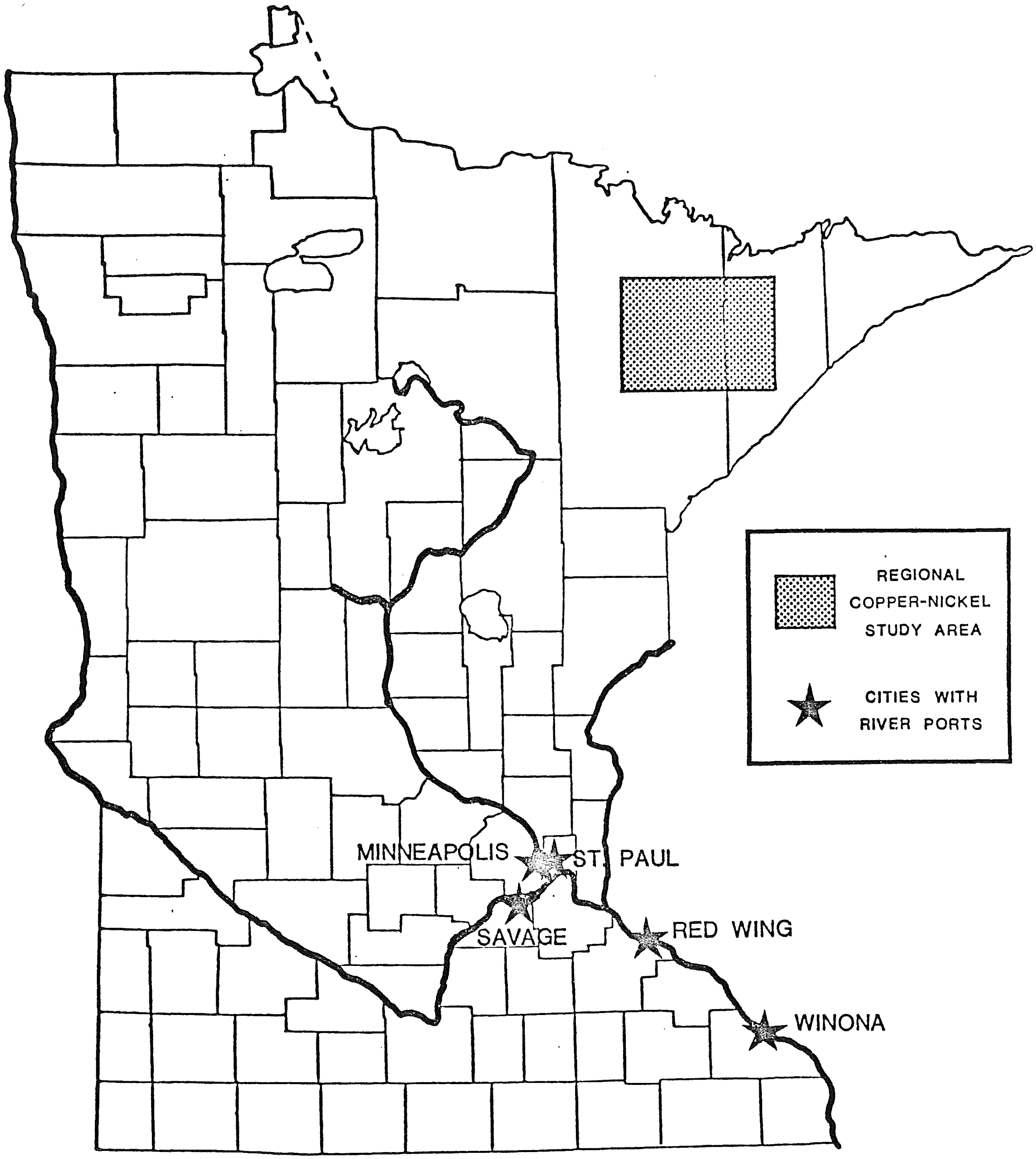
Currently, the Duluth-Superior Harbor is open for shipping only 8 to 10 months of the year. Studies are being conducted by the Corps of Engineers to extend the shipping season, such as the use of bubblers to reduce ice thickness. If extension programs are successful, the capacity of the harbor would be increased for all commodities.

8.3.4 Inland Waterway System

The Study Area is connected by rail to five ports on the Minnesota river system. The ports of Minneapolis, St. Paul, Redwing, and Winona are found on the Mississippi River, and the port of Savage is located on the Minnesota River (Figure 13). There are 71 active barge terminals on the Minnesota River System. Currently, there are no terminals that handle the movement of taconite from the Study Area, but some have the potential for transporting bulk mining products.

8.3.4.1 Present and Projected Use--Grains, coal, and sand are the dominant commodities moving out of Minnesota on the river system (Table 4). Projections of

FIGURE 13



LOCATION OF MINNESOTA PORTS ON THE INLAND WATERWAY SYSTEM

Table 4. Present use of the Minnesota river system.

COMMODITY	OUTGOING TONNAGE (1975)	INCOMING TONNAGE (1975)
Grain	5,009,725	30,159
Coal	2,360,600	2,887,355
Sand	1,176,725	267,658
Fuels	972,378	1,522,258
Other Agricultural Products	422,652	612,179
Other Miscellaneous Products	546,254	2,083,932
TOTAL	10,488,344	7,403,541

SOURCE: U.S. Army Corps of Engineers 1975.

future commodity movements are not available at the present time. In the past, the growth rate of movement on the river system has been less than five percent per year with little variation. If this growth continues through the year 2000, total movement out of Minnesota on the river system would be approximately 35.5 million tons per year at that time.

8.3.4.2 Capacity--Total capacity of the river system is a function of the ability of the dock facilities to store and load the tonnages of commodities and the ability of the river system (e.g. locks) to efficiently accommodate the barge traffic. No capacity estimates are available at the present time, but some problem areas such as fleeting areas and traffic congestion at locks have been identified.

Fleeting areas are parking places for barges when tows are broken up for individual barge movement. With increases in commercial shipping, the number of available fleeting spaces may become a problem in the Twin Cities ports.

The major bottleneck in the waterway system is Lock and Dam 26 at Alton, Illinois. The maximum capacity of the lock and dam is 55 million tons per year. In 1975, 52.9 million tons passed through the locks, and by 1985 tonnages are projected to be at capacity. By year 2000, tonnages are projected to be 68.1 million tons per year, or 13.1 million tons over capacity (MnDOT Plan 1978). Congress has authorized the construction of new locks at Alton, which would alleviate traffic congestion problems there.

The shipping season on the Minnesota river system begins in March or April and ends in November. A year-round season would greatly increase the capacity of the system, but no plans have been developed for accomplishing this task.

8.4 IMPACTS OF COPPER NICKEL DEVELOPMENT ON THE TRANSPORTATION NETWORK

Impacts to the transportation network would be generated by the transportation needs of the copper-nickel industry and residential growth associated with new mining development. This section assesses the ability of the transportation system in the Study Area to accommodate the increases in mining and residential travel due to copper-nickel activities and the implications of accommodating these demands on land use, air quality, and noise.

8.4.1 Commercial Transportation Demands of Copper-Nickel Industry--A transportation corridor will be required for the movement of input and output materials associated with copper-nickel mining activities. North American copper-nickel industries rely almost entirely on rail haulage for transportation outside the mine (CRU report, 1977). For distances typically less than 25 miles, truck haulage may be used to transport materials from the mine to the nearest railhead. In situations where the smelter or refinery are separated from the mine by great distances, a water transportation system (Great Lakes or Inland Waterway System) in combination with a rail system may be utilized.

8.4.1.1 Construction Stage--Construction equipment and materials would be delivered to the mine site by rail or truck depending on the origin of the materials and the cost of each mode. The equipment would be broken down to a size that is consistent with weight regulations and restrictions of the transportation industry or government. The heavier equipment may also be transported during winter months when road beds are frozen and can carry greater weights. This type of movement would be temporary and would not require modifications of the existing transportation system.

8.4.1.2 Operating Stage--The number and size of mining operations and the stage of processing will determine the volume and type of materials to be transported during the operating phase. Because recoverable metal makes up less than 1 percent of average grade ore, it is prohibitively expensive to transport ore long distances. For this reason, concentrators or processors are located near the mine. The copper-nickel concentrate produced at this stage is more economically feasible to transport. The smelter and refinery may be located at the mine or hundreds to thousands of miles away.

Both the location of the smelter and refinery in relation to the mining operation and the markets for copper and nickel products determine the length and destination of the haul. The major domestic markets for copper refinery products are in Chicago and the New York-Connecticut region. For nickel products, Chicago and Pittsburgh are the primary market places (CRU report, 1977).

The transportation requirements of hypothetical mining development with and without an onsite smelter were examined (Table 5). The hypothetical development consists of one mine and one processing plant in each of zones 2, 4, and 7 (Figure 14). The effects of a smelter located in zone 4 on transportation requirements were also examined. Each of the three processing plants would produce 635,000 mtpy of copper-nickel concentrate totaling approximately 1,900,000 mtpy. Without an on-site smelter, the concentrate would be shipped out of the Study Area for further processing. This represents the maximum volume of material to be transported for the hypothetical development. With a smelter in zone 4, the amount of metal products to be shipped would be greatly reduced, but a large amount of sulfuric acid, a by-product of smelting, also requires transportation. Smelting on site results in only a 12 percent reduction (by weight) of material to be shipped.

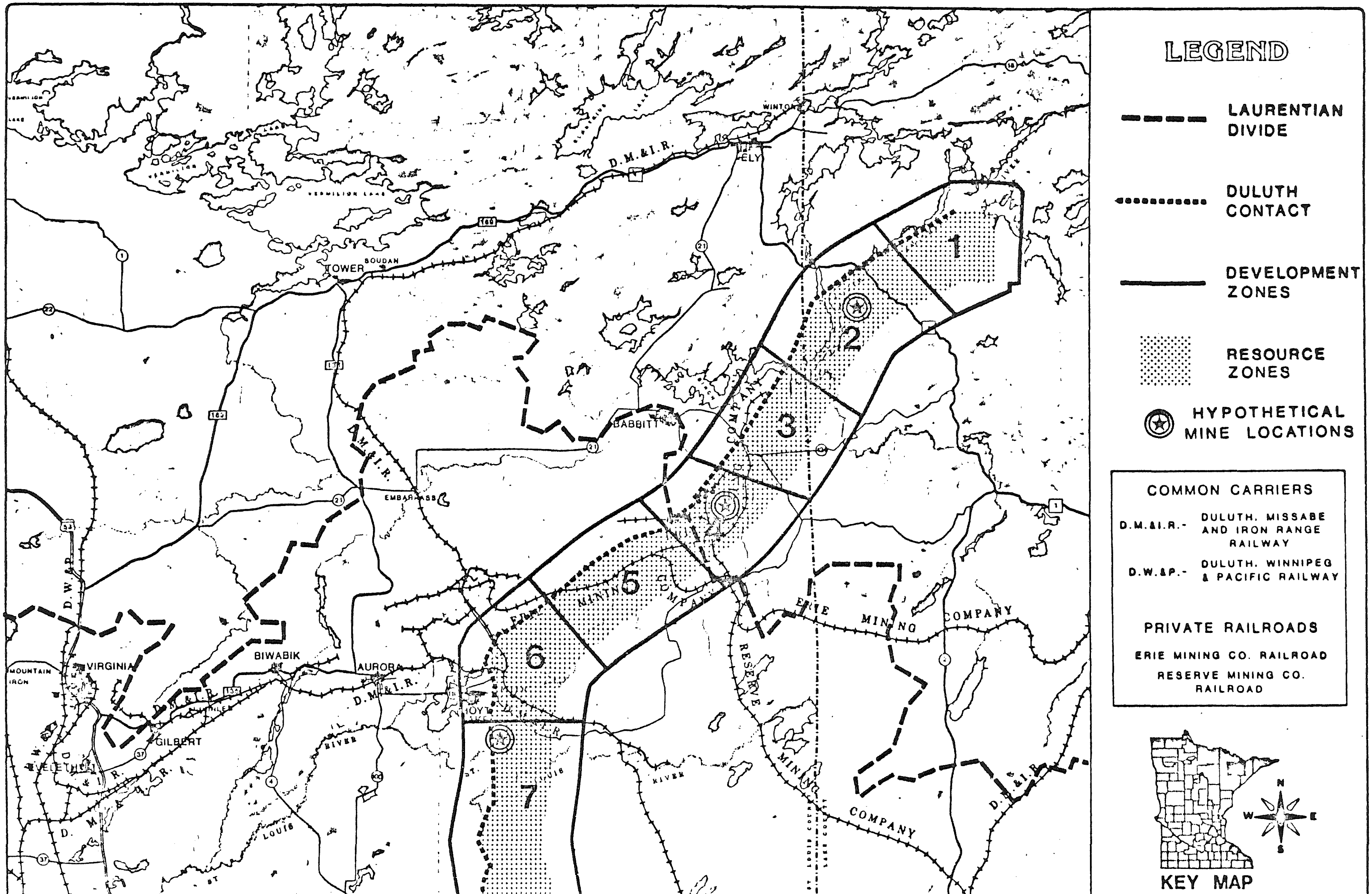
TABLE 5

TRANSPORTATION REQUIREMENTS OF HYPOTHETICAL COPPER-NICKEL DEVELOPMENT

(WITH AND WITHOUT AN ON-SITE SMELTER)

		ZONE 1 & 2		ZONE 4		ZONE 6 & 7	
		12.35 MILLION MTPY UNDERGROUND		16.68 MILLION MTPY OPEN PIT/UNDERGROUND		20.0 MILLION MTPY OPEN PIT	
	DESCRIPTION	AMOUNT	POSSIBLE TRANSPORT MODE	AMOUNT	POSSIBLE TRANSPORT MODE	AMOUNT	POSSIBLE TRANSPORT MODE
WITHOUT AN ON-SITE SMELTER	COPPER-NICKEL CONCENTRATE (FINE POWDER)	635,000 MTPY	RAIL AND GREAT LAKES OR BARGE	635,000 MTPY	RAIL AND GREAT LAKES OR BARGE	635,000 MTPY	RAIL AND GREAT LAKES OR BARGE
WITH A SMELTER IN ZONES 4 & 7	COPPER-NICKEL CONCENTRATE (FINE POWDER)	635,000 MTPY	RAIL AND GREAT LAKES OR BARGE				
	COPPER ANNODE (INGOTS-34"X24"X1")			67,200 MTPY	RAIL AND GREAT LAKES OR BARGE	67,200 MTPY	RAIL AND GREAT LAKES OR BARGE
	NICKEL-COPPER MATTE 1. CRUSHED AGGERGATE ($<\frac{1}{4}$") 2. FINE POWDER 3. INGOTS (34"X24"X2")			41,200 MTPY	RAIL AND GREAT LAKES OR BARGE	41,200 MTPY	RAIL AND GREAT LAKES OR BARGE
	SULFURIC ACID (LIQUID)			452,000 MTPY (70×10^6 GALLONS)	RAIL	452,000 MTPY (70×10^6 GALLONS)	RAIL

SOURCE: REGIONAL COPPER-NICKEL STUDY, TECHNICAL ASSESSMENT TEAM.



MEQB REGIONAL COPPER-NICKEL STUDY

FIGURE 14

MN CU-NI DEVELOPMENT AND RESOURCE ZONES

In addition to the transportation of output products various input materials for the smelters must be transported to the mining operation (Table 6). A transportation system capable of handling the quantities of output products would have ample capacity to handle the relatively small quantities of input materials.

8.4.2 Ability of Rail System to Accommodate Demands

Mining companies would probably utilize the existing rail system due to the low volume of copper-nickel products and the high cost of rail construction (approximately $900,000 per mile). Of the common carriers serving the Study Area, DM&IR rail lines are located closest to the copper-nickel development zones (Figure 14). One line runs north of the development zones through Ely, and the other crosses the southern end of the Study Area through zone 6. It would be necessary to construct a rail spur connecting the mine with one of the DM&IR lines, or utilize truck haulage to transport the material to the railhead. If copper-nickel development occurs at several locations along the resource area, then a new railroad system similar to the one serving the iron range would likely be established in this area. Such a transportation network could easily involve 15 to 50 miles of track occupying 90 to 300 acres of land. Once the material is on DM&IR's line it can be transported by this railroad to Two Harbors or the Duluth-Superior Harbor for transshipment. DM&IR also has connections with other major railroads so that longer haul routings are possible.

The tonnages of copper-nickel products to be transported are very low in comparison with the amount of taconite traveling on the rail lines in the Study Area. Each hypothetical mine producing 635,000 mtpy of copper-nickel concentrate would require approximately 1 unit train movement (100 car unit train) every 5 or 6 days to transport the material out of the Study Area. If all the

Table 6. Typical ranges of major materials required for a modern smelter/refinery complex.

Basis: 100,000 mtpy metal production.

MATERIAL	RANGE
Coal	30,000 - 50,000 mtpy
Limestone	11,250 - 30,000 mtpy
Silica Flux & Lime	125,000 -175,000 mtpy

SOURCE: Technical Assessment Team, Regional Copper-Nickel Study, 1978.

concentrate produced by 3 mines (1.9 million mtpy) was transported on the same rail route, this would result in an increase of approximately 1 train movement (100 car unit train) every other day. This estimate represents the maximum number of trains needed to haul copper-nickel products resulting from this hypothetical development. All the rail lines serving the Study Area would be capable of transporting this volume of material if modifications were made to haul the types of materials produced (MnDOT, 1978). Larger unit trains of 100 to 150 cars could be utilized, which would reduce the number of trains necessary for the transportation of copper-nickel products.

The fine powder consistency of copper-nickel concentrate makes it susceptible to dusting and spillage so that covered rail cars, special loading and unloading equipment and indoor storage facilities are necessary.

With an on-site smelter, the rail system would have no problem transporting the copper annode and nickel-copper matte. As a hazardous material, sulfuric acid would require special handling to prevent accidents and spills. The Interstate Commerce Commission (ICC) requires that there be 6 buffer cars at both ends of the train, between the tanker cars filled with acid and the engine and caboose. Because of the volume of acid to be transported some size of unit train could be utilized. Depending upon the size of the unit train (25 cars to 100 cars) one train every 3rd to 10th day would be required to transport the acid out of the Study Area. There are no major acid-consuming markets in Minnesota at present, so acid shipments would cover long distances, increasing accident potentials.

8.4.3 Ability of Great Lakes Waterway System to Accommodate Demands

If copper-nickel products were to be transported over long distances, a waterway system could be utilized in conjunction with the rail system. Of the 4 ports on

Lake Superior, the Duluth-Superior Harbor and Two Harbors would be available to copper-nickel mining companies. Gross capacity is not a central concern for either harbor but modifications of transshipment facilities would be necessary to handle the types of copper-nickel products.

The capacity of the Duluth-Superior Harbor is much greater than the projected use of the harbor. Relative to the harbors capacity, the volume of copper-nickel products is very low and could be accomodated by the harbor's existing facilities with some adjustment to handle the product form.

Two Harbors has sufficient docking space to transport the volume of copper-nickel products and is owned and accessed by DM&IR Railway (Bennett, 1977). Existing facilities are set up for the shipment of taconite pellets, and modifications would be necessary to ship copper-nickel concentrate or ingots.

Mining companies would probably lease existing facilities and make the necessary modifications, rather than bare the cost of new facility construction due to the low volume of copper-nickel products. In order to ship copper-nickel concentrate the existing loading facilities would have to be modified and indoor storage facilities would be required for transshipment of concentrate and ingots. At the Duluth-Superior Harbor, the one dock with existing indoor storage facilities is located on the 23 ft. deep channel. Ships cannot be loaded to their full capacity on this channel, unless the channel is deepened sometime in the future.

8.4.4 Ability of Inland Waterways System to Accommodate Demands

Copper-nickel mining products could be transported by rail to the Twin Cities for transshipment to the Inland Waterway System. The capacity of the river system is dependent upon the capacity of the docking facilities and the capacity of the locks and dams to handle the barge traffic. The existing facilities would have the capacity to handle the increased tonnages from copper-nickel mining but would require modifications in order to accommodate the type of copper-nickel products. Traffic congestion at the locks and dams could be a problem in the future even without copper-nickel. This will depend partially on the amount of coal being transported by this mode in the future. Several techniques could be used to reduce barge passage time through the locks, which could alleviate some or all of the congestion without replacement of the locks.

At the Port of Minneapolis, existing docking facilities could be modified to accommodate the shipment of copper-nickel concentrate. Shipping concentrate would require special loading and unloading equipment and the construction of inside storage areas. The port has the necessary room for rail car unloading so that rail car congestion would not be a problem. In St. Paul there may be a shortage of space for new storage facilities and a problem with rail car congestion.

The shipment of smeltered products, Ni-Cu matte and copper annode for further processing would pose few problems for this mode as compared to the shipment of concentrate. The volume and types of materials would require less modification. Both the matte and annode, approximately 100,000 mtpy, could be transported in 9 to 10 barge tows per year. Sulfuric acid would not be transported by this mode (MnDOT 1978).

8.4.5 Residential Transportation Demands Due To Copper-Nickel Development

Residential growth associated with new copper-nickel mining development would place demands on the highway system serving the Study Area both in terms of new commuter work trips and increased general travel. Future traffic levels were projected for each of the 3 hypothetical mines (MnDOT 1978) (Figures 15-18). The projections were based on the number of mine and service workers associated with each hypothetical mine and the distribution of their residences (see Volume 5-Chapter 7, Residential Settlement). Generally, those roads leading to the mine locations received large increases in use. Assuming that all three mines would be operating in year 2000, the traffic generated by copper-nickel development was added to a base case projection of traffic in the year 2000 (Figure 19). This represents a maximum forecast of traffic in order to insure identification of capacity problem areas.

8.4.6 Ability of the Highway System to Accomodate Demands

To determine the ability of the roads in the Study Area to accomodate traffic increases, traffic volumns were compared to road capacities. A volumn to capacity ratio of 1.0 or greater indicates that the traffic volumn exceeds the roads capacity. The traffic on approximately 70 miles of roads in the Study Area is projected to exceed capacity by the year 2000 due to copper-nickel development (Figure 20). These roads are generally those leading to the hypothetical mine locations, which previously had little use. Traffic generated by copper-nickel activities in addition to projected traffic in the year 2000 exceeds the capacity on several more stretches of road in the Study Area totaling roughly 180 miles (Figure 21). Of the capacity problem areas, 51 percent are state highways, 44 percent are CSAH, and 5 percent are forest highways.

With the development of copper-nickel mining, a new access road (proposed AMAX road) may be necessary along the Duluth Contact connecting Hoyt Lakes with Babbitt. Construction of this road would facilitate workers commuting from East Range

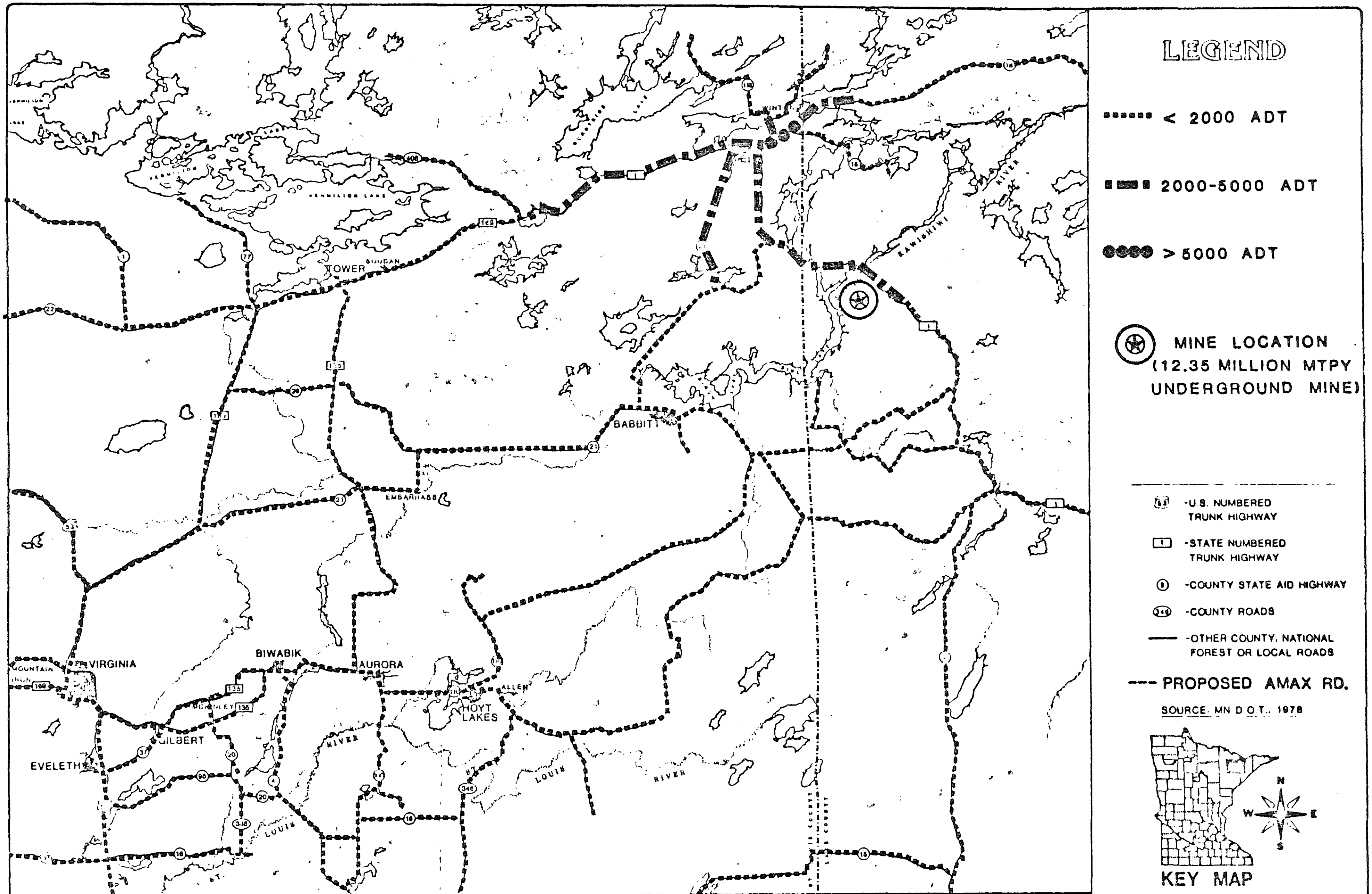


FIGURE 15

MEQB REGIONAL COPPER-NICKEL STUDY

PROJECTED AVERAGE DAILY TRAFFIC (ADT)
- DUE TO CU-NI MINE IN ZONE 2

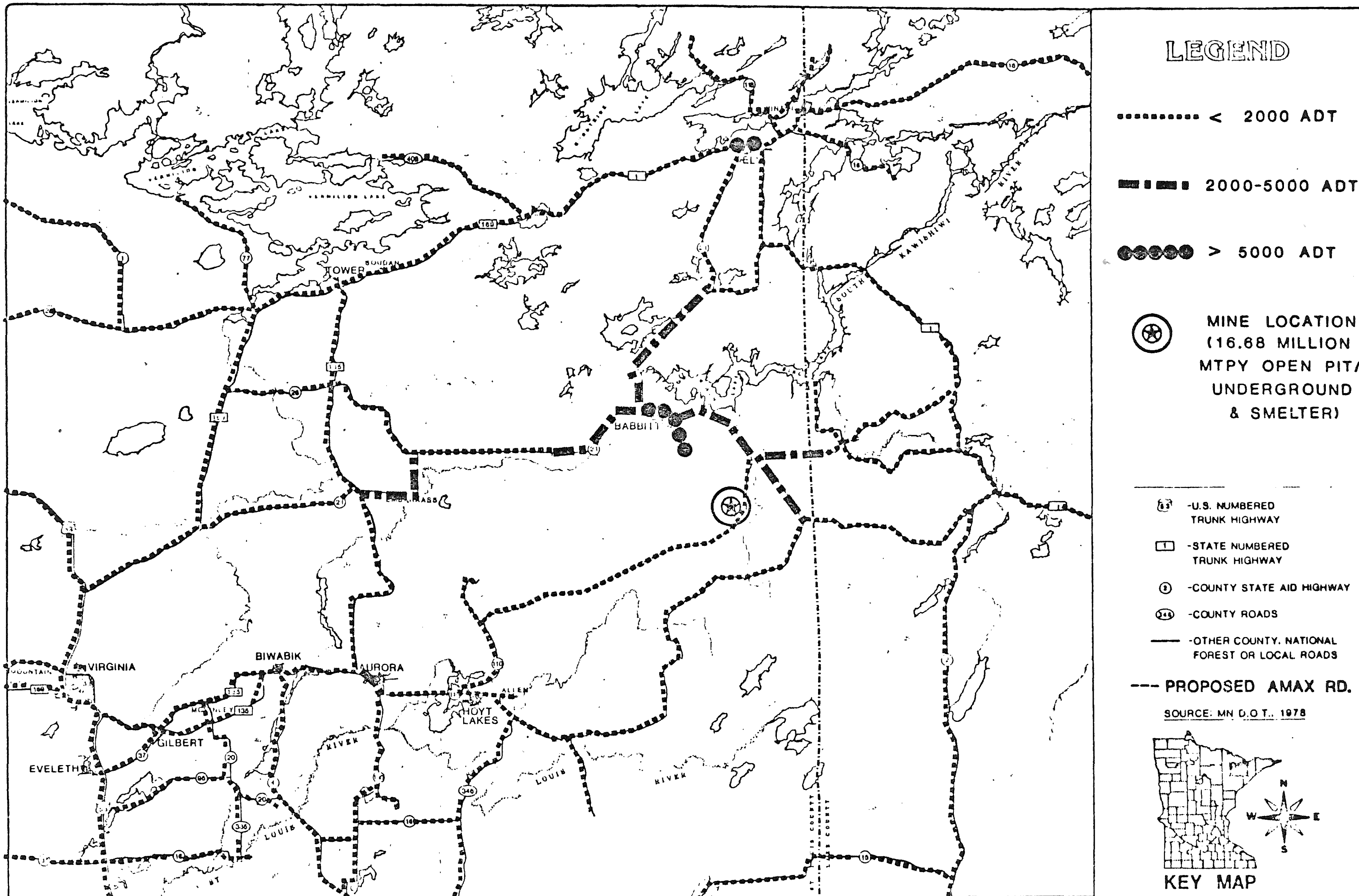


FIGURE 16

MEQB REGIONAL COPPER-NICKEL STUDY

PROJECTED AVERAGE DAILY TRAFFIC (ADT)-
DUE TO CU-NI MINE IN ZONE 4

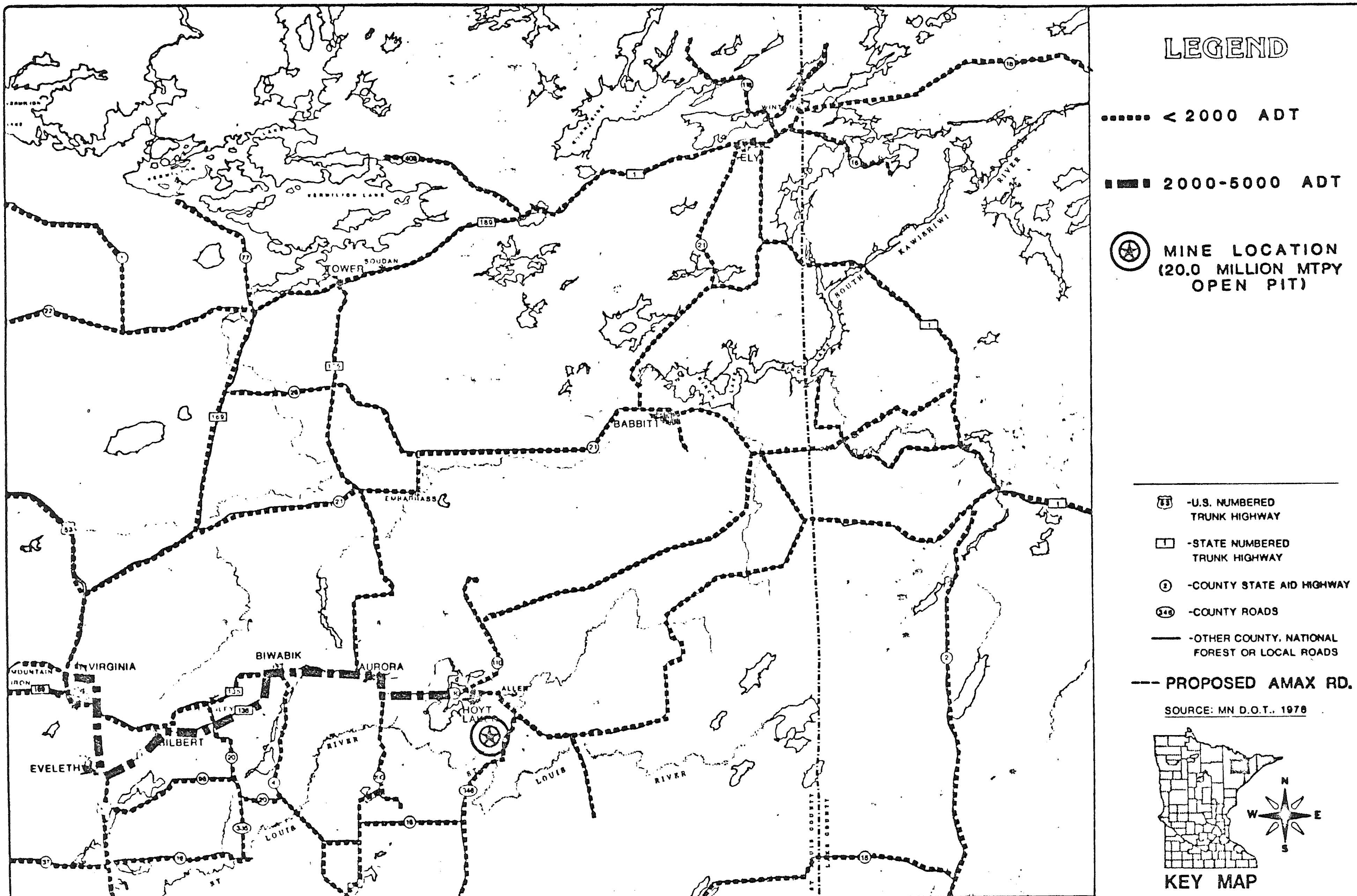


FIGURE 17 MEQB REGIONAL COPPER-NICKEL STUDY

PROJECTED AVERAGE DAILY TRAFFIC (ADT) - DUE TO CU-NI MINE IN ZONE 7

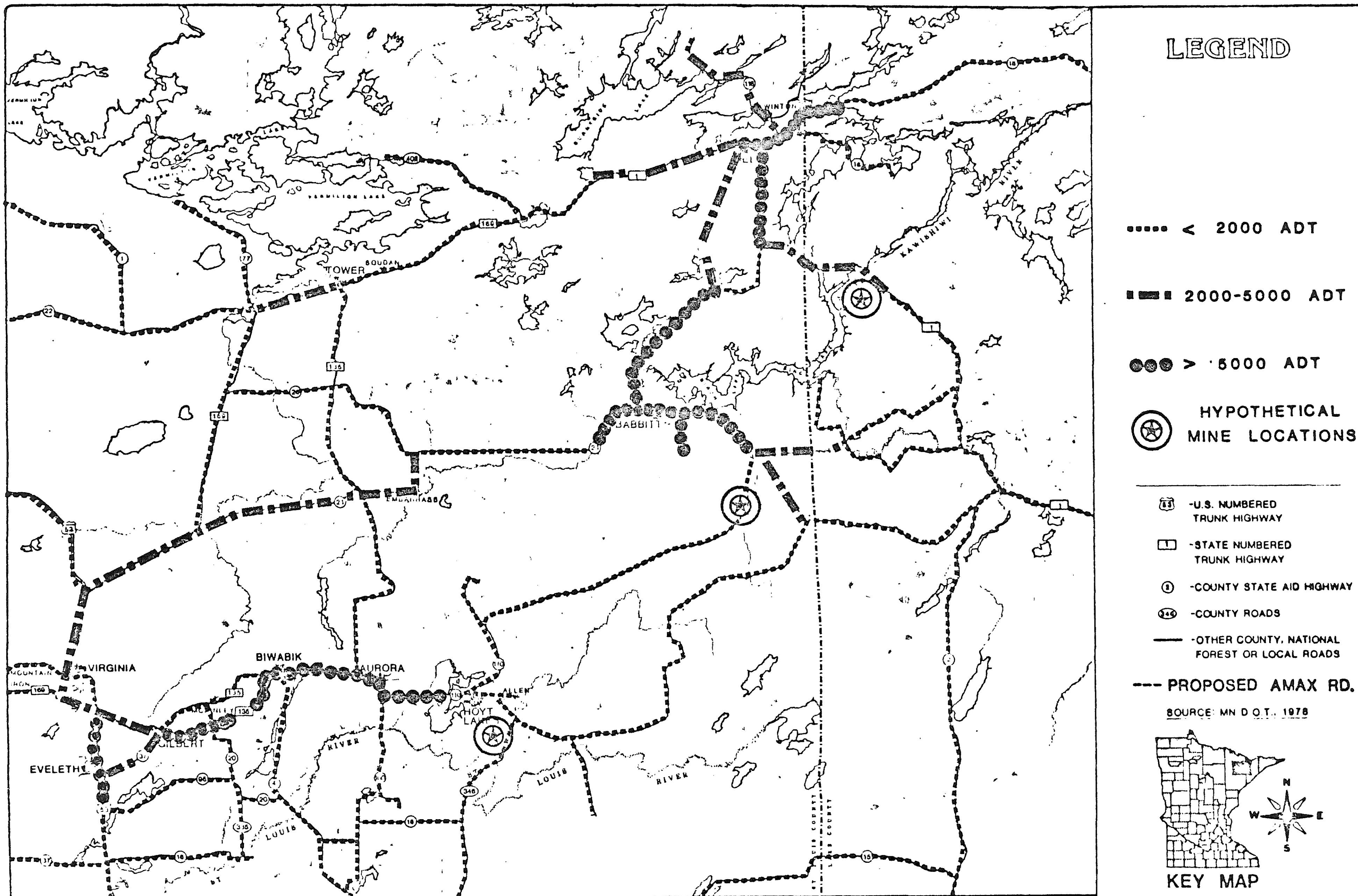
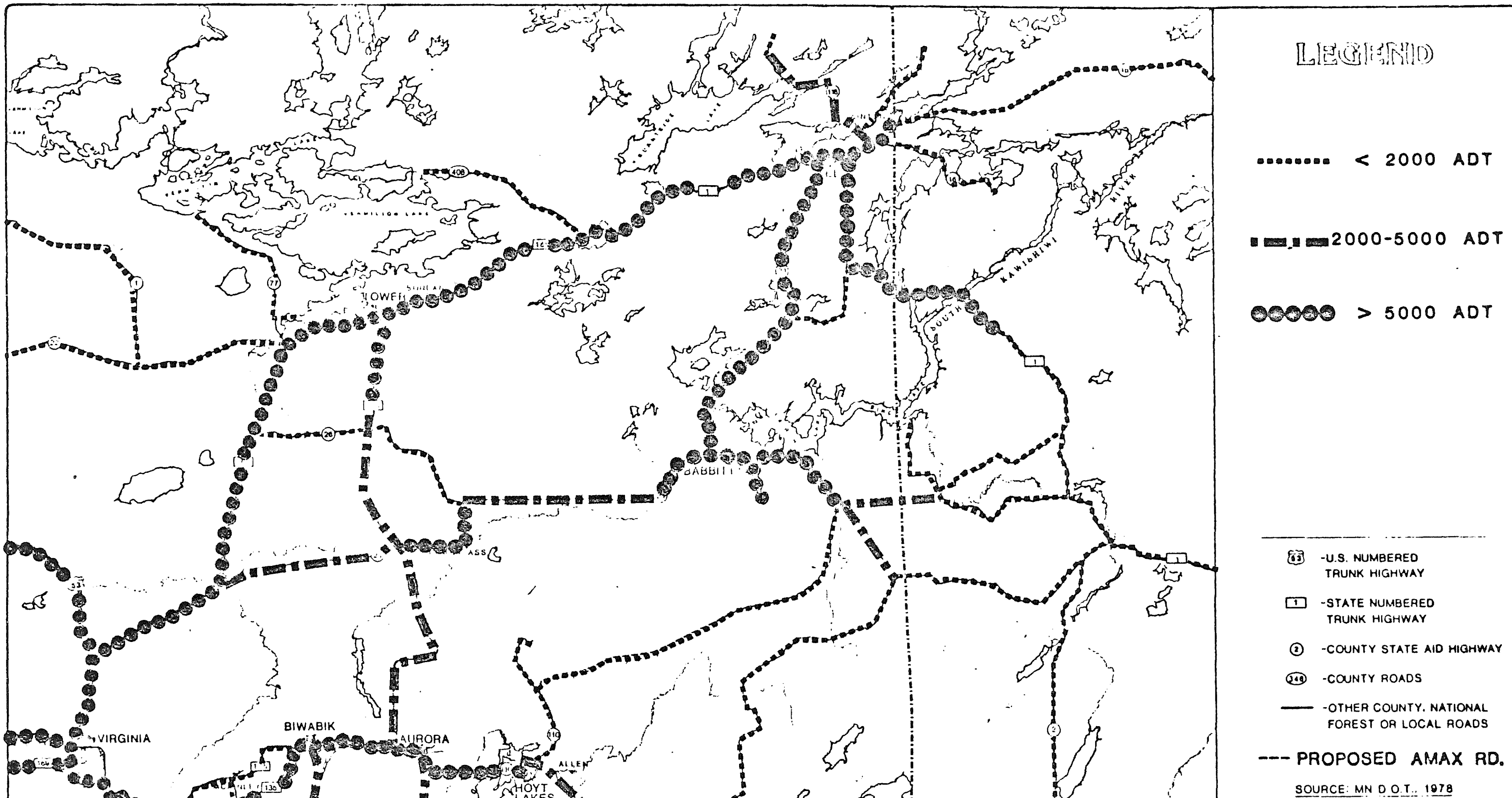


FIGURE 18 **MEQB REGIONAL COPPER-NICKEL STUDY**

PROJECTED AVERAGE DAILY TRAFFIC (ADT) - TOTAL DUE TO CU-NI MINES IN ZONES 2, 4, & 7



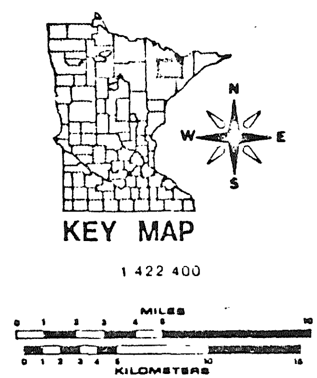


FIGURE 19 **MEQB REGIONAL COPPER-NICKEL STUDY**

PROJECTED AVERAGE DAILY TRAFFIC (ADT), YEAR 2000
WITH COPPER-NICKEL DEVELOPMENT

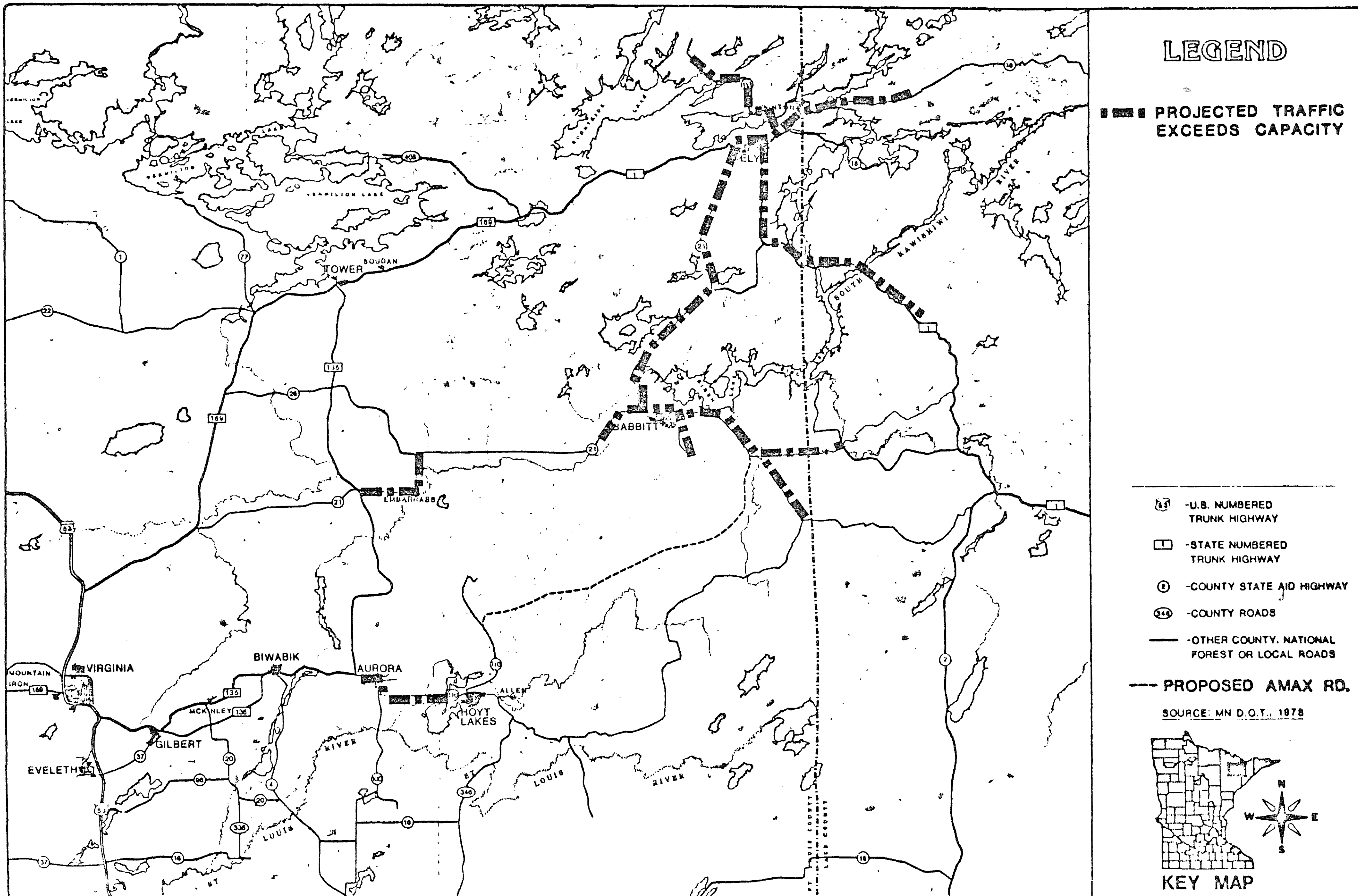
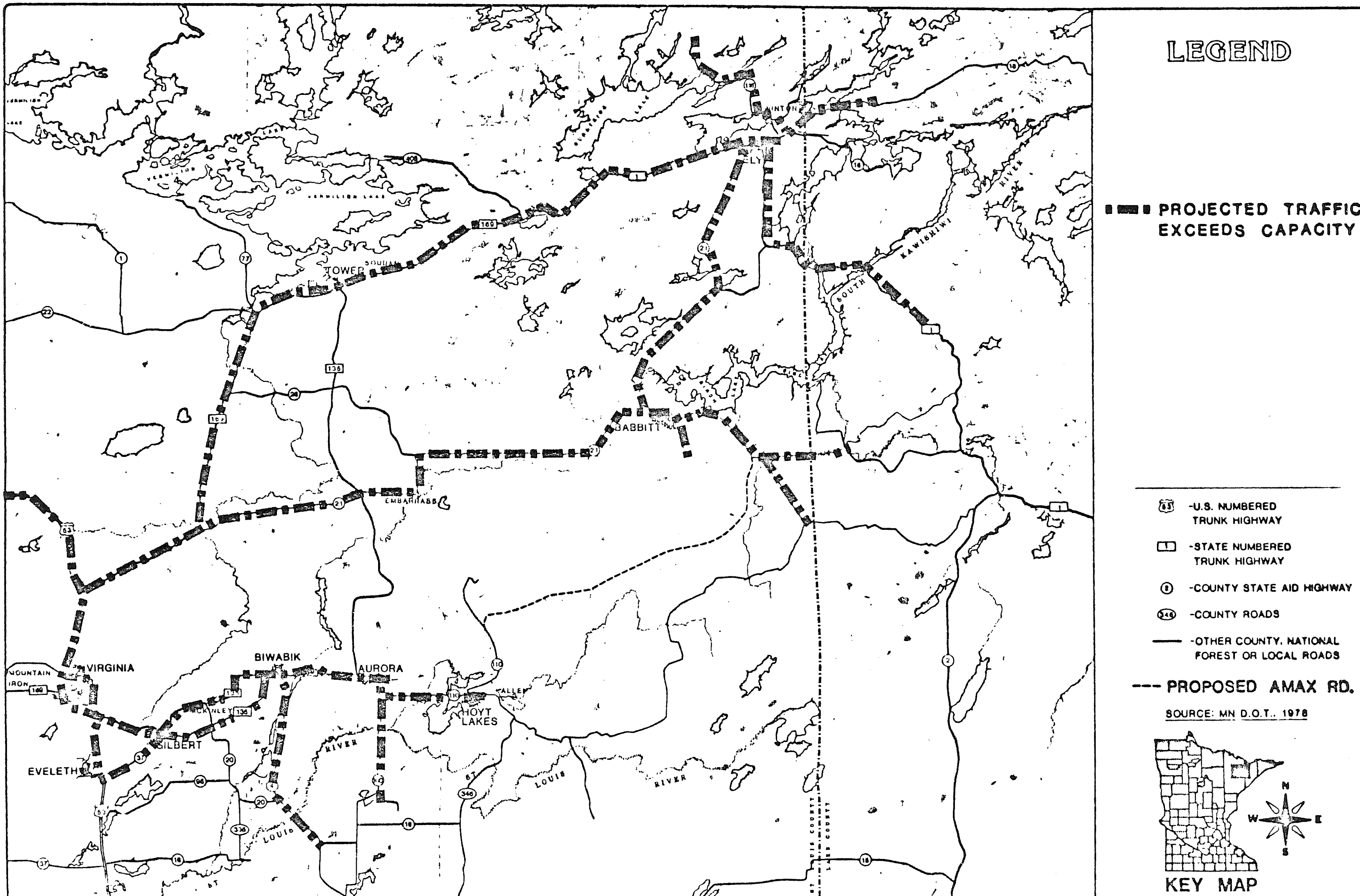


FIGURE 20 MEQB REGIONAL COPPER-NICKEL STUDY

CAPACITY PROBLEM AREAS - DUE TO TRAFFIC GENERATED BY COPPER-NICKEL DEVELOPMENT



MEQB REGIONAL COPPER-NICKEL STUDY

FIGURE 21

CAPACITY PROBLEM AREAS, YEAR 2000-TOTAL WITH COPPER-NICKEL DEVELOPMENT communities and rural areas to mine developments in zones 3, 4, or 5. This could potentially alleviate some of the traffic congestion in Babbitt while adding to congestion in Hoyt Lakes. Construction costs for a 2-lane paved road with no previoius roadbed would be approximately $500,000 per mile (MnDOT 1978). A new access road along the contact could involve the construction of 10 to 15 miles of new road at a cost of roughly $5 to $7.5 million. The sources of funding for such a road are not determined.

8.4.6.1 Upgrading--When traffic volume exceeds capacity the level of service is lowered, which translates into travel at lower speeds and greater congestion. As traffic exceeds capacity by larger amounts, the level of service continues to drop until there is extreme congestion and stop and go driving. In order to maintain a good level of service, the roads in the Study Area with capacity problems may warrant some form of upgrading. A determination of the specific extent of upgrading required to maintain present service levels is beyond the scope of this study. The level of government that administers the road would be responsible for the capacity improvements, and the results of this analysis indicate that road upgrading and corresponding increased government cost will be likely as a result of copper-nickel development.

Costs of upgrading for some general road types are shown on Table 7. The improvements would be funded by various sources depending upon the type of road to be upgraded and the particular need for improvement. State trunk highways that are on the federal primary or secondary system would receive some federal funding along with state funding for upgrading costs. Upgrading on county-state-aid roads would be funded by a combination of county, state and possibly federal funds. On county roads, upgrading costs would generally be met with purely local funds. Upgrading on these roads in the Study Area would benefit

Table 7. Upgrading costs for general road types.

FORM OF UPGRADING	COST (1977 dollars)
2 lane gravel to a 2 lane paved	$70,000/mile
Resurface a 2 lane highway	$50,000/mile
Widen a 2 lane highway	$160,000/mile
2 lane to a 4 lane	$680,000/mile

SOURCE: MnDOT, 1978.

not only those involved in copper-nickel mining, but other users in the region would also benefit from the improved service.

8.4.7 Implications of Accommodating Demands

8.4.7.1 Land Use--A transportation corridor, similar to the one serving the iron range would likely be constructed to connect the mine with the nearest rail head, if development occurred at several locations along the contact. In zones 4, 5, 6 and 7, the rail line could connect with the DM&IR line crossing through zone 6. In development zones, 1, 2, and 3, the corridor could either continue down along the Duluth contact connecting with the southern DM&IR line, or could extend northward to connect with the DM&IR through Ely. A transportation corridor of this type could involve 15 to 50 miles of track occupying from 90 to 300 acres of land.

Pressures on the highway system due to copper-nickel development may result in a small increase in the amount of land used for transportation. Some forms of upgrading such as widening roads or increasing from a 2 lane to a 4 lane road would increase the amount of land used for transportation. Construction of a new public access road along the contact would involve approximately 10 to 15 miles of new road.

8.4.7.2 Noise--The increased number of trains necessary to transport copper-nickel products would be another source of noise in the Study Area. The increase in trains would vary from 1 to 4 trains per week on different rail lines. Most of the railroads in the Study Area already have from 1.5 to 24 trains per day moving on their lines. Increases in traffic due to copper-nickel development would also increase the noise generated in the Study Area (see Volume 3-Chapter 5, Noise).

8.4.7.3 Air Quality--The changes in the air quality of the region due to increases in traffic would be insignificant. The traffic levels projected for the year 2000 fall well below the thresholds at which the standards for carbon monoxide, lead, nitrogen oxides (NOX) and hydrocarbons would be exceeded (MnDOT, 1978).

8.4.7.4 Accident-Spills--An accident or spill while transporting either copper-nickel concentrate or sulfuric acid would create a potentially hazardous situation. A spill of either would result in a concentration of potentially toxic chemicals which would be substantially higher than would normally exist in an area. The chemicals would be subject to leaching through precipitation or runoff into the surface and groundwater system. The amount of damage would depend on the size of the spill, the specific location of the spill, and the extent of the clean-up operations. A spill of sulfuric acid would also be potentially dangerous to human life (see Volume 4-Chapter 1, Aquatic Biology).

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