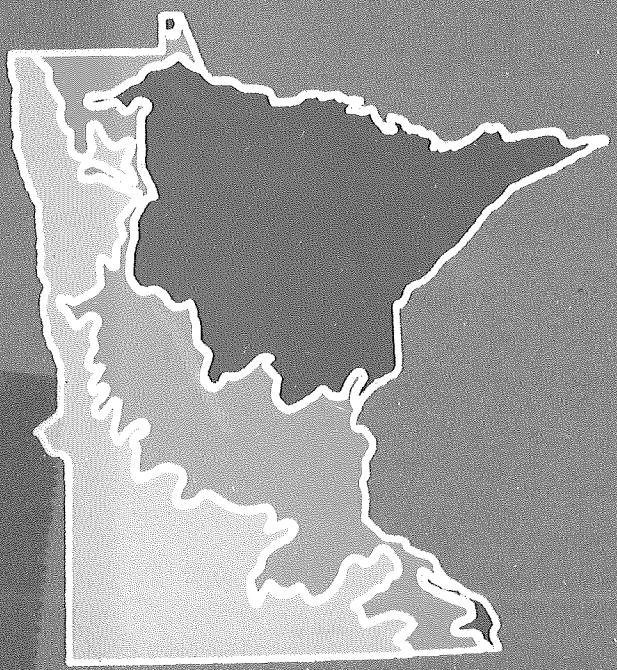
NOTEBOOK OF LAND USE PROJECTIONS



MINNESOTA STATE PLANNING A
ENVIRONMENTAL PLANNING DI

The Notebook...

This notebook contains projections of future land use demands in Minnesota.

These projections were developed by the Environmental Planning Division of the State Planning Agency from extensive interviews conducted with state and federal program managers. The projections have been reviewed by the State Agency Land Use Committee. Members of the committee include representatives from the Departments of Agriculture, Natural Resources, and Transportation; the Energy, Pollution Control, and State Planning Agencies; the Historical Society; and the Regional Development Commissions.

The land use projections reflect public needs and desired levels of services as determined by state and federal program administrators. The purpose of these projections is to increase the public's understanding of land use issues and to aid the coordination of government programs which affect the use of land.

Developing and maintaining the projections will hopefully be a continuous process. State agencies can play a major role in updating the projections as new data and trends are identified. Educational institutions and the private sector are also encouraged to contribute. A major objective of the State Planning Agency will be to provide periodic summaries and develop standard formats for making and presenting the projections.

The number of activities for which projections are made will be expanded. Categories will be taken from the Land Use Classification Manual published by the State Planning Agency. The State Agency Land Use Committee will review all projections for consistency with each other and with previously adopted standards and criteria. Once approved by the committee, new and revised projections, standards and criteria for making such projections, and periodic summaries of all projections will be sent to all notebook holders.

The notebooks will be distributed to many federal, state and local governments, regional development commissions, and to public and private interest groups. Notebooks will also be available at libraries for public review.

We hope that distributing this information will lead to a discussion of the status of state programs, land use trends, and conflicts and opportunities in resource use. Comments on the land use projections may be sent to:

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Notebook of Land Use Projections

Environmental Planning Division
State Planning Agency

June, 1978

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INTRODUCTION

Introduction

Since Minnesota's land and water resources are in limited supply, there is often competition among different users for the same piece of land. The allocation of these land and water resources has generally taken place through the private market system. Each entrepreneur relies on his ability to evaluate resources and interpret changing economic and social conditions. Over the years, this system has produced broadscale patterns of development which reflect advantageous locations for various activities.

The private market system has not always functioned perfectly. Due to a lack of information about the land, resource development has sometimes been based on trial and error. In other cases, resources were poorly managed or allocated with little concern for public interest. In Minnesota, these problems are illustrated by attempts to farm areas unsuitable for agriculture, massive clear cutting of the state's pine forests, urban development in flood prone areas, and a growing amount of urban sprawl. While the allocation of resources will continue to be made by the private market system, and rightfully so, there remains the need to make land use decisions that ensure the most beneficial and productive use of the state's resources.

In order to guide future land allocations, decision makers at the state and local level will need to know the potential of various resources and how they are currently being used. This will require an inventory of the state's land resources, including a ranking as to their suitability for producing crops, growing trees, managing wildlife, mining, supporting urban development, and other land use activities. Land use trends and potential resource conflicts must also be identified, monitored, and analyzed. The integration of this information will provide a basis for formulating standards and criteria to influence growth and development.

The purpose of this report is to aid the coordination of the many state and federal decisions that affect land use. This is accomplished by projecting future land use needs, providing an overview of land use trends and illustrating potential resource conflicts.

Land use demands in eight major land use categories were reviewed. These include agriculture, electrical energy, forestry, mining, recreation, transportation, urban land and wildlife management. In these categories, major land use change is expected to occur and data was readily available.

The potential demands on land resources were obtained by interviewing educators and state and federal administrators. Functional program managers at the state agency level were asked to quantify resource demand by determining how much product would be needed by 1990. When feasible, projections of future production (in bushels of corn, cords of timber, or miles of road, etc.) were translated into acres of land necessary to meet that production. Acres of land was chosen as the common denominator to facilitate comparison.

Land use demands are also likely to initiate a change in the way land is used or managed. This change may or may not be accompanied by a change in land ownership. Analysis of land use changes are complicated by multiple uses of the land, such as a highway also being used as a bike trail, or a wildlife management area that provides a hay crop during a drought year. In these cases, the primary land use which often reflects land ownership or management status, was used to simplify the analysis.

The information in this report is also derived from forecasting reports, approved acquisition plans, extrapolations of existing data and the departmental goals of state and federal agencies. These projections of change are not static. Public needs will be in constant fluctuation due to changing values, the availability of new information, legislative actions, the perceptions of program managers, and public opinion.

Several points should be kept in mind when reviewing these projections. First, the projected changes are represented by the number of acres, which does not always indicate the impact of the activity. For example, a mining operation on 100 acres of land may adversely affect the environment more than the loss of 2,000 acres of forest land to a recreational activity. Then, too, unless there is meaningful data with which to evaluate a loss of forest land in relation to some preceived need, the impact cannot be fully measured. In the absence of a process to review trade-offs, caution should be used when comparing acreage projections among different activities.

Second, it is possible that some plans may not be implemented or certain goals not be met. Although most projections have been approved by certain decision-makers, it does not necessarily mean they will be the final outcome. Projected needs should be reviewed by the public and revisions made when necessary.

While these estimates may or may not accurately represent the needs of the public, they are based on the best data available to identify current land use trends and provide an indication of future land use changes by 1990. It is hoped that this information will lead to a clearer definition of public needs and to a better way to meet them.

OVERVIEW

Overview

Land has always been one of Minnesota's most valuable resources. The success or failure of businesses, industries and individual livelihoods depends on an adequate and timely supply of products and jobs derived from our land base. In past decades, the state had adequate land resources to satisfy the needs of all types of activities. A growing population, increasing technology and higher standards of living have slowly but steadily changed that situation. Competition among land uses has grown intense.

In the years ahead, Minnesota will have increasing numbers of persons requiring more food, housing, energy, jobs and recreational opportunities. The state's human resources, as well as the nation's, will be strained to provide necessary public services and retain the lifestyle to which we are accustomed. This intense economic, social and physical activity will not occur, however, without constraints, disruptions and possible inconveniences. Great demands will be placed on our land resources and on those who allocate them.

Minnesota's physical resources are used in a variety of ways. In 1975, the state's 53.8 million acres consisted of 51 million acres of land and 2.8 million acres of water. The allocation of state land resources are illustrated in Table 1 and Figure 1.

The current pattern of land use in Minnesota has developed over a period of more than 125 years. This development pattern will continue to be modified over time. New land use activities will be determined by a variety of factors which Minnesota cannot directly control, such as population change, living styles,economic conditions, energy, technological advancements and national policy. Due to these uncertainties, Minnesota must maintain a flexible approach to changing conditions and problems.

Future land use changes will also vary in scope, intensity and location. In some cases, the changes will be compatible with the goals and values of a given locality. In other instances, they will be incompatible with existing patterns of growth and development or beliefs in how a particular area should develop. These conflicts will have to be addressed by existing local and state land use authorities. The following section describes Minnesota's current land use pattern, some of the potential problems that may occur in each land use zone, and major land use changes in various functional activities.

Table 1

ESTIMATES IN MINNESOTA LAND USE, 1975

LAND	IN (000) ACRES		PERCENT
CROPLAND[1]	23,750		44.1
PASTURE AND OPEN[2]	6,010		11.2
FOREST USES[3]	16,975		31.6
WILDLIFE MANAGEMENT[4]	1,450		2.7
TRANSPORTATION[5]	1,440		2.7
URBAN DEVELOPMENT[6]	1,260		2.3
EXTRACTIVE USES[7]	110		0.2
ENERGY FACILITIES[8]	36		--
		51,033	
WATER			
LAKES AND STREAMS[9]	2,770		5.0
		2,770	
		53,803	100.0

[1] From Minnesota Land Management Information System (MLMIS).

[2] From MLMIS.

[3] Forest Uses - refers to forested land used for watershed protection, private open space, recreation, timber production, etc. Acreage figure is a residual after subtracting other uses from state total.

[4] From Department of Natural Resources, Wildlife Section acreage figures and from U.S. Fish and Wildlife Service acquisition records.

[5] From Department of Transportation (DOT); Department of Highways and Department of Aeronautics; from 1975 Pocket Data Book. Includes acreage figures for roads, highways, railroads and airports based on assumed right-of-ways and mileage records.

[6] From MLMIS and Minnesota State Planning Agency.

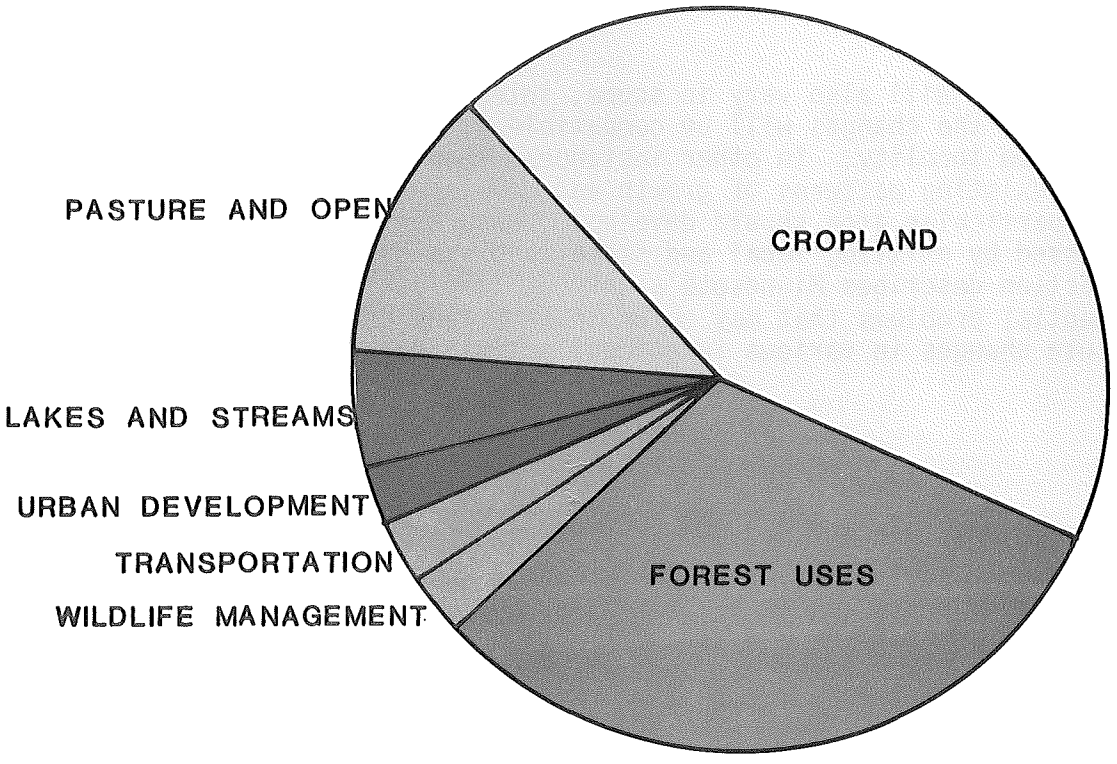
[7] From MLMIS and Land Cover in the Mesabi Iron Range 1969-1979, University of Minnesota, Center for Urban and Regional Affairs, 1976. Figures do not include smaller mining activities such as sand and gravel operations unless they are the dominant use on a forty.

[8] Calculated from existing transmission lines and generating plants in Minnesota as identified by Mid-Continent area power pool.

[9] From Minnesota State Comprehensive Outdoor Recreation Plan, 1975.

Figure 1

MINNESOTA LAND USE, 1975



Land Use Zones

Throughout the years, the private market system has been the major force in allocating Minnesota's land resources. This system, modified by an increasing degree of government intervention, has produced a distinct impact on the landscape. In general, the state can be divided into three major land use zones.[1] They include an area of intensive agriculture, a transitional zone and a forested region (Figure 2). These zones will be used to discuss potential land allocation problems and resource conflicts.

The agricultural zone comprises south-central and southwestern Minnesota and a narrow band of land along the Red River Valley. The zone consists of 15.7 million acres or 28 percent of the state and is characterized by extensive prairie plains with the most intensively cultivated and productive cropland in the state. Agriculture dominates this zone with 89.6 percent of the land being cultivated and an additional 6.7 percent used as pasture or open space. Remaining land uses account for less than 4 percent of the total area (see Table 2).

The transitional zone cuts across the state diagonally from the northwest to the southeast. This zone of mixed land uses contains 16.9 million acres or 32 percent of the state's land area. Generally, the area northwest of the Twin Cities is glacial moraine pocketed with numerous lakes, while the area to the southeast is largely stream-dissected land with steep slopes. The zone is characterized by interspersed areas of cultivated farmland, rolling hills, woodlands, and poor drainage. There are areas of quality farmland but also substantial acreage with limited potential for cultivation. Nearly half of the transitional zone is cultivated with 20 percent being open space and pasture and 16 percent forested. A dominant feature of the zone is the concentration of urban development. Approximately 70 percent of the state's urban development is located in this transitional area.

The forested zone dominates the northeastern one-third of the state. A heavy forest canopy covers 72 percent of the zone interrupted only by numerous lakes and isolated areas of open land. The landscape is diverse, typified by extensive areas of moraine, a considerable amount of ice-scoured land in the Arrowhead, and a large bog in the northwest. The zone is a prime area for many forest uses including timber production, seasonal homes, recreation, wildlife management, and open space preservation. This zone contains nearly all of the state's large-scale mining activity and about 60 percent of the state's inland surface water resources. The forested zone has the lowest percentage of agricultural land (4.5 percent) among the three zones. This limited agricultural potential is due to a short growing season and poor soils, although some specialty crops are grown.

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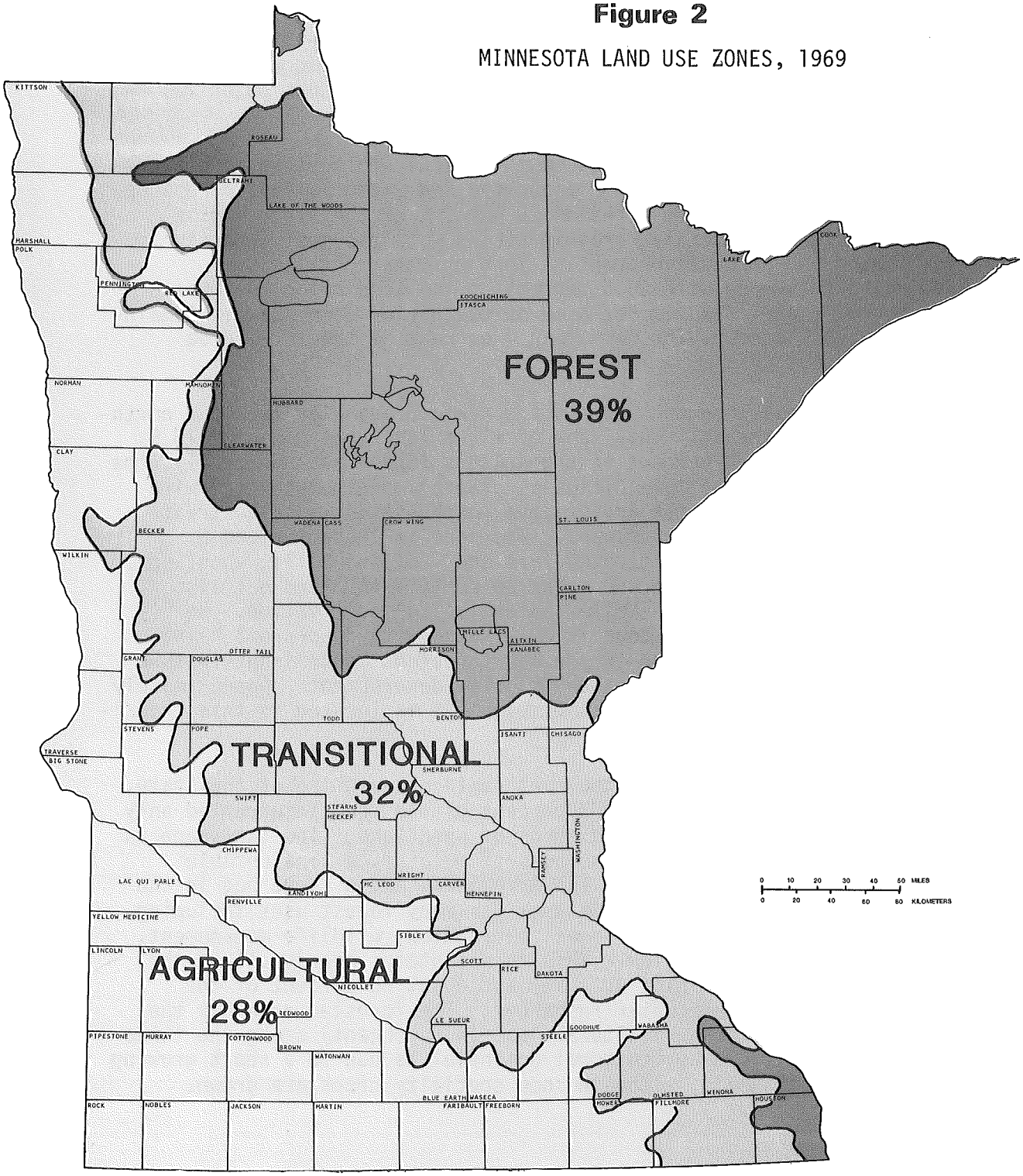
[1] John R. Borchert and Minnesota Land Management Information System Study, Perspective on Minnesota Land Use-1974, (St. Paul, MN.: Center for Urban and Regional Affairs, University of Minnesota, and Minnesota State Planning Agency, October, 1974), p. 17.

Figure 2

MINNESOTA LAND USE ZONES, 1969



DATA SOURCE: Perspective on Minnesota Land Use-1974
(John R. Borchert, MLMIS Staff)

Table 2

MINNESOTA LAND USE BY ZONES, 1969 (IN ACRES)

Major Land Use Zones	Cultivation	Forest	Open and Pasture	Marsh	Water	Urban	Extractive	Total Acreage by Zones
Cultivated Zone								
Acres	14,117,000	285,080	1,068,680	78,880	102,200	80,200	7,600	15,739,640
% of Zone	89.6	1.8	6.7	0.5	0.6	0.5	--	(28.8%)
% of Total	59.4	1.5	17.7	4.2	3.1	6.5	8.7	
Transitional Zone								
Acres	8,544,680	2,711,560	3,434,320	780,440	1,213,600	868,000	10,680	17,563,280
% of Zone	48.7	15.5	19.6	4.4	6.9	4.9	--	(32.2%)
% of Total	36.0	14.8	57.2	41.8	36.9	71.2	12.3	
Forest Zone								
Acres	1,077,960	15,374,760	1,498,200	1,007,720	1,973,880	270,280	68,880	21,271,680
% of Zone	5.0	72.2	7.0	4.7	9.2	1.2	0.3	(38.9%)
% of Total	4.5	83.6	24.9	53.9	60.0	22.1	79.0	
State Total	23,739,640 (43.5%)	18,371,400 (33.6%)	6,001,200 (1.1%)	1,867,040 (3.4%)	3,289,680 (6.0%)	1,218,480 (2.2%)	87,160 (0.1%)	54,574,600[1] (100.0%)

[1] The basic data shows dominant land use for each 40-acre parcel. Since some 40-acre parcels are only partially located in Minnesota, total state acreage is overstated by approximately 770,000 acres.

SOURCE: Minnesota Land Use, 1969, (Minnesota Land Management Information System), Center for Urban and Regional Affairs/University of Minnesota and the Minnesota State Planning Agency.

Agricultural Zone

Overall, little change is projected among land uses in the agricultural zone; the most noticeable feature is continued agricultural intensification. From 1969 to 1974, the amount of cultivated land was greatly increased in this zone. During this period, 36 counties accounted for an additional 1.8 million acres of harvested cropland, or an increase of 19 percent.[2] Much of this newly harvested cropland was released from "set-aside programs" because of favorable commodity prices and a federal policy of "full agricultural production." Agricultural land use will probably continue to intensify in the next 15 years although probably at a slower rate.

The increased intensification of agricultural land use is likely to heighten recent land use conflicts in this zone. A federal policy of "full agricultural production" is certain to conflict directly with the desire to preserve wetlands and uplands for wildlife management. In this zone, wildlife management programs will be more significant in taking land from agricultural use than urban development. In turn, a high demand for agricultural products will hasten the conversion of remaining wetland and sheltered areas to agricultural use. Controversies involving the drainage of wetlands and public land acquisition will remain foremost among land use problems.

Agricultural intensification will not occur without generating concern about long-term protection of the soil and the ability of local infrastructure to handle increasing agricultural production. Agricultural land demands indicate that the amount of harvested cropland is likely to remain high. This may result in the continued cultivation of lands not especially suitable for crops and the further elimination of protective erosion control measures, thus magnifying soil erosion problems. Measures will need to be taken to maintain the long-term productivity of Minnesota's soil and ensure a healthy agricultural future.

Demand projections for Minnesota crops also suggest possibilities of significant increases in commodity production. Such developments will require an analysis of the ability of the local infrastructure to handle additional grain storage and transportation. Potential adjustments and dislocations resulting from critical shortages of grain storage facilities or inadequacies in the transportation system would be costly not only to the farmer but the state as well. Urban growth is not expected to be a widespread problem, since only five percent of the state's urban land needs are projected to occur in this zone. Cropland losses that do occur are likely to be located around existing population centers. Local units of government will continue to face the challenge of handling this in a manner that allows the expansion of rural service centers and yet not conflict with local agricultural interests.

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[2]U.S. Department of Commerce, Bureau of the Census, 1974 Census of Agriculture, Minnesota State and County Data, (Volume 1 - Part 23, April, 1977).

Transitional Zone

The transitional zone is located between the state's major agricultural and forested areas. In this zone, neither use has become overwhelmingly dominant. Many land use activities take place in this zone including agriculture, forestry, recreation, wildlife management, transportation and major concentrations of urban development. The relative importance of these activities will vary as economic conditions change.

Projections indicate that approximately 80 percent or 165,000 acres of the state's urban land needs will occur in the transitional area. This urban development will be in constant competition and conflict with rural land uses. A growing population, an expanding industrial base and increasing irrigation will generate greater demands for electrical energy. Additional commitments of both land and water resources will be required to meet this production. The full impact of development in this zone will result in a direct withdrawal of land from both agricultural and forestry uses and a slow erosion of the viability of farming operations.

A growing amount of rural non-farm development may require the provision of urban types of services in rural areas. Eventually, the costs of these services may deteriorate farming conditions to the extent where marginally productive units will become economically obsolete. The potential conflicts between urban development and rural uses are likely to be a major factor in initiating land use change.

With a high demand for agricultural products, the private market system may offset the loss of agricultural land by bringing more land into production. Additional land could be developed through irrigation of non-crop land and through expansion in northwestern counties. However, future agricultural expansion will undergo stiff competition from other land uses. The extensive areas of sandy outwash river valleys and plains suitable for irrigation also serve as major transportation corridors. Since these areas are highly accessible, they will attract residential and commercial development which potentially would conflict with agricultural development. Agricultural expansion in the northwestern counties may result in renewed conflicts with wildlife management goals. Conversion of forested land to agricultural use would also hasten the reduction of the state's commercial forest land base.

In total, shifts in land use will take place between forestry, agriculture, recreation, wildlife management, energy facilities and urban land needs. Over the next fifteen years, land use fluctuation and change will be more evident in this zone than in the other two zones.

Forest Zone

While forest cover will remain dominant in this zone, competing uses are likely to steadily reduce the amount of commercial forest land. The forest zone is an area of limited growth, projected to account for

only 15 percent of the state's land needs by 1990. Despite the areas relatively low population increase, scattered residential development could conflict with effective timber management.

The majority of the urban land demand is projected to take place in two areas. The major growth area is located along the southwestern edge of the zone in the high amenity lake resort region. The four counties of Crow Wing, Cass, Hubbard and Beltrami will account for about 75 percent or 26,000 acres of the zone's urban land needs. The increased conversion of land to residential, industrial, commercial, and agricultural uses may slowly convert the edge of the forest zone into a transitional land use area.

The Iron Range is the other potential high growth area. Current taconite expansion and future copper-nickel development, if approved, could spur a resurgence of growth and development.

All of the state's large scale mining activities are located in the forest zone. Extensive land areas are projected to be used for mine waste disposal due to taconite development. Additional land commitments are possible for copper-nickel mining by 1990. Minnesota's growing energy demands might also facilitate development of peat resources.

Traditional land use conflicts between timber management, recreation, open space preservation, wildlife management, and watershed protection, will occur throughout the zone. Many of these conflicts center around the incompatibility of different forest uses. These conflicts will continue until land use plans can better identify the type, timing and location of different forest activities.

Table 3

PROJECTED LAND USE CHANGES/CONFLICTS BY LAND USE ZONE, 1975-1990

Agricultural Zone

Summary

1. Overall little change is projected among land uses, with agriculture remaining overwhelmingly dominant.

2. Agricultural land use will probably continue to intensify although at a slower rate.

3. Widespread urban growth is not expected to be a problem with only 5 percent of the state's urban land needs projected for this zone.

4. Urban growth that does occur in this zone is likely to be concentrated around major urban areas.

5. Land use problems and conflicts in agriculture are likely to include:

   a. storing and transporting increased agricultural products;

   b. long-term intensive cultivation resulting in increased soil erosion from wind and water; and

   c. heightened competition between policy of "full agricultural production" and desire to preserve wetlands and uplands for wildlife management.

Transitional Zone

Summary

1. The state's transitional zone between agricultural and forestry uses is projected to have the most significant change in land use activities.

2. The zone will see the most extensive conversion of land to urban development. It is projected that 80 percent (165,000 acres) of the state's urban land needs will occur in this transitional area. Outside of the metropolitan area, there are three high growth areas:

   a. The most rapid urban growth is expected to occur in the first ring of counties surrounding the metropolitan region. The six first ring counties would require 58,500 acres of land for urban development or slightly more than that of the entire metropolitan area.

   b. A second area of high urban land demand is the St. Cloud area, requiring approximately 17,900 acres for urban development.

   c. A third growth area includes counties in the high amenity resort region on the edge of the forest zone. These counties are projected to have an urban land demand of 36,500 acres.

3. The transitional zone is likely to show the most active agricultural change, with some economically marginal farm units going out of production but also new agricultural areas being developed.

4. The state contains approximately 2 million acres with good irrigation potential. Many of the best areas are located in the transitional zone along sandy outwash river valleys and plains.

5. Increasing urbanization may conflict with expanding agricultural irrigation. The area from St. Cloud to Anoka is characterized by geomorphic regions which are suitable for irrigation. Included in these regions are level, sandy outwash valleys which often have reliable groundwater

supplies. However, these valleys also contain several major transportation arteries which provide good accessibility to urban centers. As a result, the area is subject to considerable demands for residential, commercial and industrial activities. The growing amount of urban development may compete with agriculture for both land and water resources. Additional land use conflicts will result from the incompatibility between the two uses.

6. The transitional zone may see significant increases in energy demand from expanding irrigation and new residential, industrial and commercial development. Increasing controversies may develop over electrical power needs, site locations, and adequacy of water resources for power development.

7. Potential agricultural expansion is possible in the northwestern counties in the transitional area. There has been intense pressure in this area to release state (DNR) administered tax-forfeited lands for agricultural purposes.

8. Conflicts may arise from the need to provide services to an expanded rural non-farm population and to maintain economically viable farm units. Renewed conflicts may continue between wildlife management goals and agricultural development in the northwestern part of this zone.

9. Provided a strong agricultural demand continues, the zone may see a reduction of commercial forest land in the northwest and in the sand-plain counties north of the metropolitan region.

Forestry Zone

Summary

1. The zone will continue to be dominated by forest cover although large-scale mining activities have the potential to affect extensive land areas.

2. Potential land use conflicts could arise between forestry and mine-waste disposal due to taconite extraction and potential copper-nickel development. While commitments to these land uses may be made within the next fifteen years, their full impacts may not be felt until after 1990.

3. Generally, the forest zone is an area of low urban growth, except for the Iron Range and the southern edge of the zone. Only 15 percent of the state's urban land needs will occur on this zone. New mining activities, if approved, could spur a resurgence of growth and development.

4. Traditional conflicts between recreation and other urban land uses and forestry are likely to continue until land use plans can be more specific in determining which uses should take place and when.

Land Use Activities

From 1975-1990, Minnesota will face major land allocation decisions. Based on present trends and goals, the state may experience land use shifts on more than one and a quarter million acres (Table 4). Government will play a major role in the majority of the land shifts either by initiating change or regulating land use activities.

The 1,291,000 acres of land use change is projected to take place in eight activities (Figure 3). Over 65 percent of the change will be the result of fee title acquisition for wildlife management areas. Urban land development represents the second largest change, 16.1 percent of the total. All other activities including airports, highways, energy facilities, mining operations, parks and trails account for only 18 percent of the total projected change.

The potential land use needs determined by program managers are as follows:

Wildlife Management

The largest projected need is in wildlife management with 832,000 acres desired for fee title acquisition. Easements are desired on an additional 457,000 acres. This would represent an 88 percent increase in managed acres (federal and state) and would bring the total area protected for wildlife to 2,744,000 acres by 1990.

Urban Land

Projections indicate the state will need an additional 205,000 to 238,000 acres of land within the next 15 years, or a 17 to 20 percent increase over the amount of urban land in 1969. During this period, Minnesota will probably lose less than .05% of the state's cropland base each year to the physical impacts of urban development. However, a growing amount of rural non-farm population and resulting land use conflicts (i.e. provision of urban services) may cause the idling of extensive agricultural land resources.

Electrical Energy Facilities

Roughly 36,000 acres were devoted to major electrical generating facilities and high voltage transmission lines in 1975. Projections indicate that by 1990, 78,500 additional acres will be affected by the production and transmission of the state's electrical energy needs, more than doubling existing land use for this activity. Transmission line rights-of-way will have varying effects on different land uses.

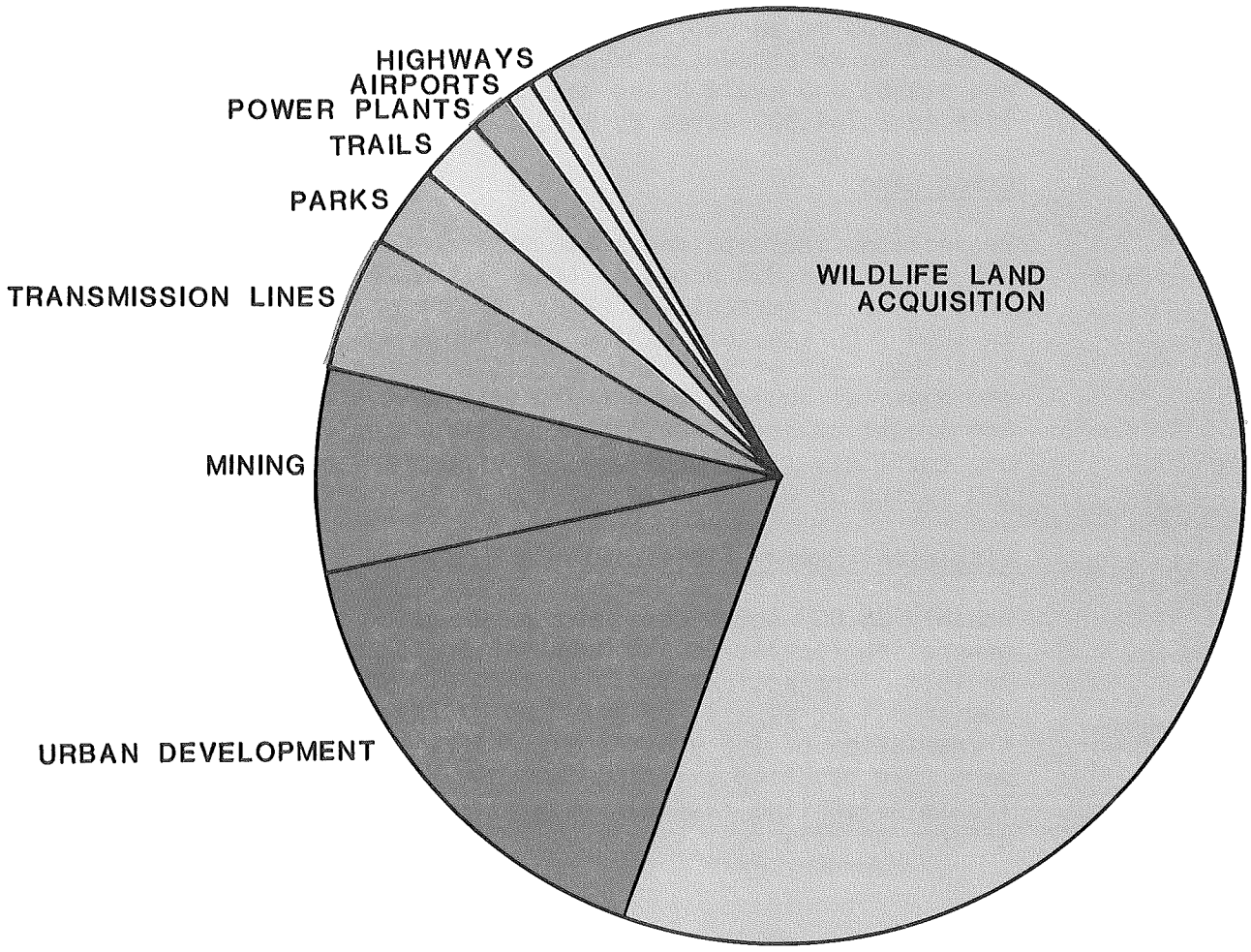
Table 4

PROJECTED LAND USE CHANGE, 1975-1990

LAND USE ACTIVITIES	ACRES	PERCENT
WILDLIFE LAND ACQUISITION	832,000	64.4
URBAN LAND	205,000	15.9
MINING	89,000	6.9
TRANSMISSION LINES	59,000	4.6
PARKS	36,700	2.8
TRAILS	28,000	2.2
POWER PLANTS	19,600	1.5
AIRPORTS	12,000	.9
HIGHWAYS	10,000	.8
TOTAL PROJECTED CHANGE	1,291,000	100%

Figure 3

PROJECTED LAND USE CHANGE, 1975-1990



Mining

Mining is another rapidly expanding industry. Major extractive uses accounted for only 110,000 acres in 1975, but an additional 79,000 acres would be committed to taconite mining by 1990. Copper-nickel mining, if approved, would use 2,600 to 10,000 acres. Combined, these activities represent approximately a 75 percent increase over existing extractive uses.

Recreation

With increasing use of state recreational areas, approximately 36,700 acres of land, chiefly from the forest base, will be acquired by the Department of Natural Resources by the end of this century. Completion of the state's proposed corridor trail system will require 28,600 acres of land from a variety of sources including public lands, private land easements and railroad abandonments.

Transportation

Transportation is not expected to use a great deal of land. Only 12,000 acres of land will be required for new and expanded airports and 10,000 acres for highway rights-of-way.

The changes in agricultural and forest uses are the most difficult to estimate because of fluctuations in market conditions and the inability to accurately measure changes in land use. Substantial land shifts may also occur between agriculture and forestry. In general, agricultural and forest uses are treated as residual categories with other land use requirements usually being withdrawn from these land bases. The possible effects of competing land uses on forestry and agriculture are summarized in Table 5 .

Agriculture

Competing land uses are projected to consume about 500,000 acres of agricultural land (land in farm units) in the next fifteen years, of which an estimated 65 percent may be cropland (Table 5).

By 1990, the annual demand for Minnesota crops could range from 914 million bushels under low demand assumptions to 1,180 million bushels under a high demand alternative. Given a high demand and a moderate crop yield, a reasonable alternative, a total harvested acreage of 22.6 million acres would be needed in 1990. This level of production would approach the limits of available cropland in the state.

The potential exists for adding a large number of acres to the state's cropland base. One notable trend in Minnesota is towards increased irrigation. Recent University of

Table 5

SUMMARY OF LAND USE DEMANDS AND ESTIMATED IMPACT ON AGRICULTURAL AND FORESTED LAND BASES

Competing Land Uses	Additional Land Needs 1975-1990	Assumptions About Land Acquisition (Easement and Fee Title)	Estimated Land Withdrawals from Agricultural and Forest Land Base	
	(in acres)		Agricultural Base	Forest Base
Airports	12,000	Only 800 acres of airport development are located in the forested region. These airports are assumed to use cleared land that has commercial forestry potential. The majority of airport development will be constructed in the transitional zone on previously cleared flat terrain most often in agricultural use. Assumption is made that 65% of agricultural land may be cropland.	11,200	800
Highways	10,000	Future land acquisitions are assumed to be proportionate to existing amount of agricultural use and forest cover, roughly 60% agriculture and 40% forested.	6,000	4,000
Electrical Energy				
Power Plants	19,600	Future power plant sites are assumed to affect equal amounts of agricultural land and forest land.	9,800	9,800
Transmission Lines	59,000	Transmission line right-of-ways will have varying impacts on different land uses. Urban development, forestry and sprinkler irrigation would be prohibited. Approximately 95% of the right-of-way could be used for other agricultural purposes, although the transmission lines may present some inconveniences.	1,450	29,500
Urban Land	205,000 - 238,000	Sixty percent of the land used for urban development is assumed to come from the state's agricultural base and 40% from the forested land base (roughly same proportion as existing use). Sixty percent of the development on agricultural land was assumed to be on cropland and 35% on pasture and woodlands.	123,000 - 142,800	82,000 - 95,200
Mining	81,600 - 89,000	Since all major mining activity is in the state's forested zone, it is assumed that the construction of tailings basins and mine facilities will primarily result in a loss of forested land.	--	81,600 - 89,000

Table 5 Cont.

Wildlife Management	809,000 (excludes lands under "other proposals")	State land acquisitions for wildlife consist of approximately 40% uplands and 60% wetlands, thus the 526,000 acres to be acquired would include roughly 210,400 acres of uplands and 315,600 acres of wetlands. The DNR indicated that agricultural land acquisitions consist of brush areas, woodlots and low grade farmland. The U.S. Fish and Wildlife Service acquisitions consist of approximately 60% uplands and 40% wetlands. The 283,000 acres to be acquired would include roughly 169,800 acres of upland and 113,200 acres of wetlands. According to state and federal policies, a total of 428,800 acres of wetland would be protected. A portion of the upland acquisition acquired by the state would be in the forested region as indicated by the DNR Long-Range Acquisition Plan.	345,200	35,000
Recreation				
State Parks and Recreational Units	36,000	The 36,000 acres acquired for state park and recreation units are assumed to come from the state's forest base.		36,000
Corridor Trails	28,600	Approximately 3,700 acres for corridor trails are desired from proposed railroad abandonments. The remaining acquisitions and easements are estimated to be derived 50% from agricultural and 50% forested land.	12,500	12,500
Agriculture	333,000	Speculative projections indicate 333,000 acres of non-cropland could be placed into agricultural production. It is possible that some areas of commercial forestry such as tree farms on sandy soil may be converted to agriculture. There are also indications other forested areas may be limited due to expanding agriculture. It is assumed that 333,000 acres of forest land may be converted, although OBERS' estimates of reductions of forest and woodland pasture range as high as 633,000 acres.	N/A	333,000
Forestry	--	The major effort to reserve commercial forest land has been in the Memorial Hardwood Forest where 8,720 acres were proposed for acquisition. On the other hand, substantial acreages will be withdrawn from the state's forested land base.	--	N/A
TOTAL LAND WITHDRAWALS	1,593,800 1,634,200	CONCLUSIONS: Total withdrawals of agricultural land may range in the neighborhood of 510-530,000 acres. However, there will be substantial conversions of other lands into agricultural production. These factors may offset each other and the total amount of agricultural land in the state will fluctuate with market conditions. Total withdrawals of forest land are likely to range from 625,000 to 650,000 acres. Commercial forest land resources may not be replaced.	509,000 - 528,950	624,000 - 644,800

Minnesota projections indicate that the state has at least 2 million acres that are potentially irrigable. Projections by the U.S.D.A. suggest that 333,000 acres of non-cropland may be placed into agricultural production by 1990. While estimates of the growth in irrigation are speculative, they do indicate the extent of potential land use changes.

The net result is that while some agricultural land is given over to competing uses, the market system can shift other lands into production to replace those losses. The total amount of land in agricultural use will fluctuate with changing market conditions and technological improvements. The major cause for concern is lack of a process to review trade-offs between the quality of cropland lost to competing uses and the environmental and economic costs of bringing new land into production. At present, land changes are not monitored and a new process does not exist for their evaluation.

Forestry

Forested land cover will probably continue to diminish as the result of competing uses. More than 625,000 acres of land may be withdrawn due to urban development, electric energy facilities, mining activities and through land conversion to agricultural uses (Table 5). State acquisitions for park and recreational units will account for only 6 percent of the land withdrawn from forestry. In most cases, the productivity of the land lost to competing uses is not monitored.

The losses of commercial forest land are unlikely to be replaced very quickly by the market system. Timber management involves a long-term production cycle, as long as 120 years to grow mature trees. In terms of realizing a quick economic return, timber management is not as competitive as many other land uses. Few private land owners are willing to maintain the long-term investment. Minnesota's wood demands, on the other hand, will increase 20 percent each decade from 1970 to 1990. If future demands are to be met, government may need to play a greater role. Emphasis should be placed on identifying highly productive forestry sites, encouraging intensive management where applicable and protecting these areas from unnecessary intrusions.

Examples of Interrelationships

Most land use conflicts will arise from the interaction among various land acquisitions and incompatibility of new uses. The inter-relationships can be illustrated by means of a short scenario.

Potentially, one of the largest land shifts could result from the acquisition of 832,000 acres of wildlife land. The combined acquisitions by federal and state government would be of approximately 50 percent

uplands and 50 percent wetlands. While vast acreages of wetlands are being preserved, approximately 345,000 acres of land would be taken out of farm units, of which a portion would be cropland. If the national and international demand for food remains high, the loss of potential cropland may have to be replaced to meet agricultural production needs. The amount of land to be replaced would depend on the productivity of the land converted to wildlife management.

Recognizing the need to provide food, farmers may (1) increase drainage of small wetlands not protected by government authorities and (2) clear brush land and woodlots for conversion to agriculture. The net result may be the loss of valuable wildlife habitat on private lands and land use shifts without consideration of the land's suitability for different uses.

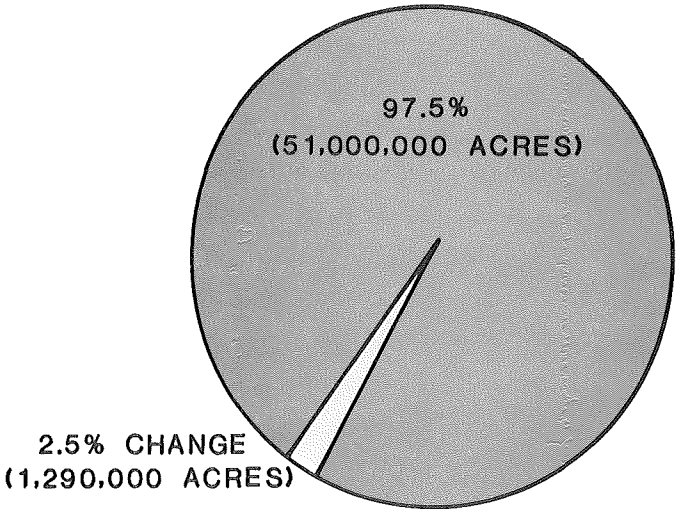
While wildlife land acquisition is necessary, the quality, quantity, and location of such acquisitions need to be reviewed in terms of their relationship to other land needs. Land acquisitions should be analyzed not only for potential wildlife production but also for crop production, water recharge areas, wood fiber production and other potential uses.

Government land acquisitions and regulatory policies are likely to continue to be an important force in land allocation decisions. Government decisions in one land use activity are often made without concern for the overall pattern of development supporting public goals. In part, this may be due to a lack of clear definition of public needs and desires.

In conclusion, the 1,290,000 acres of projected change will be withdrawn from the state's agricultural and forested land base. While these land use changes represent only 2.5% of the state's land area (Figure 4), they are likely to have profound effects on land management practices, settlement patterns, energy consumption, and environmental quality. In most cases, these activities will produce intense conflicts over how the state's land resources should be used. Government will need to identify, monitor and evaluate land use trends with respect to public goals.

Figure 4

LAND USE CHANGE AS PERCENT OF TOTAL STATE LAND



ANALYSIS

ANALYSIS

NOTE: This section will be completed at a later date. The analysis of the projections may include a review and discussion of land use activities with respect to type of impact, change in land ownership, irreversible changes or constraints placed on the future use of the land.

AGRICULTURE

SECTION 1

Agriculture

Minnesota farms contain about 23,743,000 acres of cropland. In 1974, 60 percent of the harvested cropland was devoted to feed grains, 17 percent for food crops and 23 percent for other crops. Minnesota farms also contain substantial amounts of forested land, lakeshore, range land and other areas not used for agricultural production, bringing the total land in farm units to 30,600,000 acres. Originally, farmers retained these lands because of their continuity to the farm, conservation and aesthetic qualities and because there was relatively little economic incentive to do otherwise. However, trends of the past 25 years indicate a change in the use of farmland.

Decreasing rural population during the 50's and 60's left fewer people to pay for expanding community services. Agricultural land values rose, followed by higher property tax increases. The tight money situation in the 70's challenged farmers to find alternative sources of capital for necessary farm investments and to eliminate holdings that were not economical. Farmers abandoned less productive lands, primarily transitional areas between the agricultural and forested zones, and sold lakeshore, wetlands and woodlands not essential for crop production. As a result, from 1950 to 1972, total Minnesota farmland acreage was reduced by 2,700,000 acres.

During this period agriculture became more mechanized and capital intensive. Farms were consolidated to take advantage of economies of scale. Through 1972, Minnesota farms grew larger in size and fewer in number.

The reduction of the number of farms in Minnesota, at least temporarily, has slowed. In 1935, Minnesota had an estimated 203,000 farms. By 1973, the number of farms had declined to 117,000 and has remained at that level for four years before decreasing to 116,000 in 1977.

The experience from 1972 to 1977 also shows a leveling off of the decline of acreage in farms that occurred during the 50's and 60's. Since 1972, farmland acreage has stabilized at 30,600,000. This may be due in part to the growth in export demand, economic actions of the agricultural community, and government policies that increased farm prices and net income to higher levels, thus alleviating economic pressures which presumably forced farmers off land or cause them to sell land. Also, recent increases in off-farm employment may make farm operators increasingly independent of the agricultural market place. Together these conditions provide capital to allow more farms to remain economically viable.

It appears that a good year on the farm may slow the trend to dispose of land holdings. In 1973, the average Minnesota farm experienced a 58 percent increase in gross income and 162 percent in net income. This was also the first year since 1964 that total land in farms did not decrease. The five years previous to 1973 had seen an average

annual increase of $653 in net farm income while the 1972-1973 increase in net farm income was $12,617.[1] Farmers had more cash available to make necessary purchases of farm machinery and equipment and domestic needs, repay loans, and take care of deferred maintenance on the farmstead. Farm prices have been much lower in recent years as compared to 1973-1974. Time will tell if a lower farm income will cause a decrease of land holdings in farm units.

It is not certain these alternatives will be available to cope with financial problems in agriculture. Eventually, farm units may run out of aesthetic land holdings to sell, foreign exports may decline because importing nations became self-sufficient, or part-time jobs may not be available. Hence, the short-term capital constraints could be a real obstacle to the continuance of family farming operatings. Government and agricultural interests must actively explore new ways of coping with these problems, ways that are compatible with desired agricultural land use patterns.

Projections

Numerous studies of future cropland needs have been developed by public agencies and private organizations. A recent analysis has been developed by the Economic Research Service (United States Department of Agriculture) for the United States Water Resources Council. These long-term projections, called OBERS, indicate that Minnesota farmers are likely to convert more land to crop production, abandon marginal farmland and decrease farmland holdings unnecessary for crop production (Table 1). Total land in farm use is projected to decline to 28,216,000 acres in 1990 and to 27,948,800 acres by the year 2000.

Despite continued decreases in total farmland over the next 25 years, the amount of harvested cropland is projected to increase to 20,924,000 acres by 1990 and over 22,000,000 acres by the year 2000. Forest and woodland on farms will decrease from approximately 2,884,200 acres in 1969 to 2,251,000 acres in 1990, as farmers continue to eliminate non-essential lakeshore and woodlands. Assuming historical trends persist, the number of Minnesota farms will continue to decrease while the average farm will probably increase in size.

Since these projections were released in 1975, Minnesota has seen a record amount of 21,941,100 acres of harvested cropland, nearly surpassing OBERS' projections for the year 2000. The question remains: How much cropland will Minnesota need to meet future agricultural demands?

The OBERS' analysis is based on many assumptions about future conditions affecting agriculture and should not be accepted as the only alternative projection. A review of the OBERS material showed several

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[1] Crop and Livestock Reporting Service, U.S. Department of Agriculture and Minnesota Department of Agriculture, Minnesota Agricultural Statistics, (August, 1975), p. 74.

Table 1

MINNESOTA FARM LAND USE, SELECTED HISTORICAL, ESTIMATED AND PROJECTED YEARS, 1964-2020[1]

	1964	1969	1980	1985	1990[2]	2000	2020
				(Thousand Acres)			
Cropland Harvested[3]	17,514.8	15,649.1	19,477.2	20,371.0	20,924.0	22,030.2	22,283.0
Feed Crops[4]	12,778.1	11,308.0[5]	12,258.4	12,575.0	12,282.0	13,496.9	13,747.1
Food Crops[6]	1,405.5	1,230.0[5]	1,601.5	1,616.2	1,647.0	1,708.2	1,787.1
Other Crops[7]	3,401.6	3,107.9[5]	5,760.7	6,329.7	6,548.0	6,987.2	6,901.7
Cropland Not Harvested[8]	4,728.6	6,611.0	2,967.8	2,143.7	1,651.0	668.5	594.7
TOTAL CROPLAND	22,243.4	22,260.5	22,445.0	22,514.7	22,577.0	22,698.6	22,877.7
FOREST AND WOODLAND PASTURE	3,863.7	2,884.2	2,503.6	2,377.7	2,251.0	1,999.9	1,652.6
PASTURE, RANGE AND OTHER LAND[9]	4,697.8	3,689.5	3,528.3	3,458.8	3,388.0	3,250.2	2,844.0
TOTAL LAND IN FARMS	30,805.0	28,785.2	28,477.0	28,351.2	28,216.0	27,948.8	27,362.2

[1] Due to the inability to survey every farm unit, the U.S. Census of Agriculture estimates relating to land in farms are lower than those given by the Federal-State Crop Livestock Reporting Service in Minnesota Agricultural Statistics, 1975. Projections through the Year 2000 should be used to indicate trends rather than exact losses/gains in various farm use categories.

[2] Interpolated from 1985 and 2000 projections.

[3] Total acreage for feed crops, food crops, and other crops may exceed cropland harvested because of double cropping.

[4] Includes corn, grain sorghum, oats, barley, hay and silage.

[5] Figures represent estimates of harvested acres in given category.

[6] Includes wheat, rye, rice, citrus and non-citrus fruits, vegetables, sugar cane, sugarbeets, irish potatoes, sweet potatoes, dry beans and dry peas.

[7] Includes soybeans, peanuts, flaxseed, cotton, tobacco, and other miscellaneous crops; projected values for other miscellaneous crops may include some major crops too limited to be reported by statistical reporting service, U.S.D.A.

[8] Cropland used only for pasture or grazing; cropland in clover crops, legumes and soil improvement grasses, and cropland on which all crops failed; cropland in cultivated summer fallow; and idle cropland

[9] Includes land occupied by houses or other buildings, lanes, roads, ditches, land in ponds, and waste land.

SOURCE: OBERS E' Projections, Minnesota Agricultural Statistics, 1975; 1969 Census of Agriculture, Minnesota Summary; State Planning Agency

assumptions were not applicable to agricultural conditions in Minnesota. To test the reliability of such projections, a scenario was developed using modified assumptions to reflect current agricultural trends. The complete scenario is found at the end of this section.

Since agriculture inputs are subject to extreme fluctuations, the scenario was designed to illustrate various levels of future cropland demand in Minnesota. Projections of the harvested acreage required in Minnesota to meet future agricultural needs vary depending on the demand for crop production and per acre yields. The combined annual harvest of Minnesota's major crops averaged nearly 775 million bushels during the period 1972-1974 (estimates exclude corn for silage). The scenario indicates that the yearly demand for Minnesota crops could range from 914 million bushels under low demand assumptions to 1,180 million bushels in 1990 under a high demand alternative. These estimates assume Minnesota will maintain its share of national production.

Using the two "extreme" examples, total harvested acreage could vary from 15.9 million acres under high yield and low demand assumptions to 28.4 million acres with low yield and a high demand. Eliminating the two extreme cases, required cropland would range from 17.2 million acres to 23.1 million acres.

The amount of land used for agriculture production depends on the availability and price of a number of agricultural inputs including capital, energy, fertilizer, pesticides, water and land. In past years, U.S. agriculture has relied heavily on increased applications of the fertilizer and pesticides to increase output. However, because of decreasing effectiveness of additional amounts of fertilizer and potential environmental restraints on some pesticides, these inputs may not continue to account for large increases in agricultural production. Harvesting more cropland, despite its marginal qualities, may become an increasingly feasible alternative to increase agricultural production in the future.

Given a high demand and a moderate crop yield, a reasonable alternative in 1975, the scenario indicates a total harvested acreage of 22.6 million acres would be needed in 1990. This level of production would approach current limits of available cropland in the state. The scenario suggests the OBERS projections of harvested cropland are with reasonable limits of future agricultural demands estimated for Minnesota given stated assumptions. That is, record acreages of cropland may continue to be harvested in Minnesota if the conditions of high demand alternative are met.

The intensification of cultivated cropland is illustrated in Figure 1. From 1969 to 1974, harvested cropland in Minnesota increased by 2,247,400 acres.[2] The largest percentage increases were located in counties in

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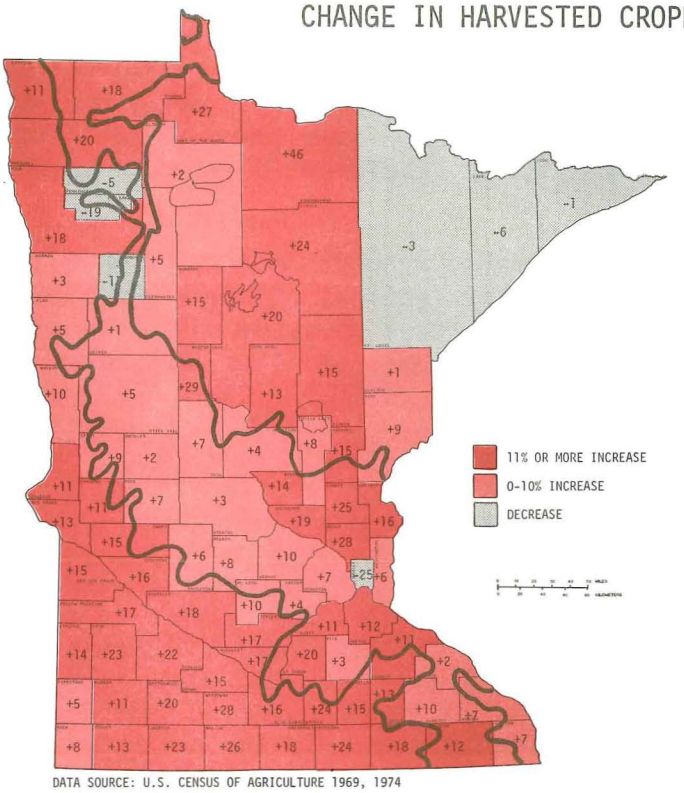
[2]U.S. Census of Agriculture, 1974, Minnesota State and County Data, Vol.1, part 23, April, 1977.

Figure 1

CHANGE IN HARVESTED CROPLAND, 1969-1974



DATA SOURCE: U.S. CENSUS OF AGRICULTURE 1969, 1974

the southern part of the state's main agricultural zone. Most counties in the transitional zone did not show a similar increase. The large percent increases in harvested cropland in the forest zone were due to a small base of cropland.

The possibilities of increased agricultural production pose several significant environmental and resource management problems. In 1975, 67 percent of the total land in farms was harvested, as compared to only 56 percent in 1964. By 1990, assuming a high demand and moderate yields, over 80 percent of the total land in farms could be harvested. Concerning the intensification of cultivated land, the following points should be made:

1. In general, farmers have eliminated many of the non-productive lands from their farms thus reducing the total acreage of land in farms. The remaining cultivated land is probably the "better" quality land.

2. Future conversions of cropland to other uses may become increasingly significant. Greater amounts of other agricultural inputs such as energy, fertilizer, chemicals and land would have to be used to replace lost production.

3. Non-irrigated land coming into agricultural production will probably be of marginal quality and less productive.

Perhaps the biggest unknown in agriculture is the extent to which land will be developed in the future. OBERS projections indicate that through irrigation, 333,000 acres may be added to the state's cropland base within the period 1975-1990. This means irrigating land that has not been previously cropped. Some sources feel this is a conservative figure. This projection developed in 1973 was based on past irrigation trends.

In recent years, sporadic drought conditions throughout the state have increased interest in irrigation. Current estimates indicate that Minnesota has 8 million acres of sandy soil. These areas contain about 1 million acres of light soils and 1 million acres of heavier soils that could be irrigated.[3] However, little information is known about the extent of groundwater available or the environmental problems of extensive irrigation in Minnesota. Studies are underway to address these problems. No doubt a high degree of risk will remain for both the individual farmer and the environment until more data is available.

Minnesota's soil is becoming more exposed to wind and water erosion. Varying amounts of cropland are usually held in reserve for pasture or grazing cover crops and soil improvement grasses, cultivated summer fallow and as idle cropland. In 1969, there were approximately 6.7 million acres of this land in Minnesota. Approximately 3.3 million acres of land have been placed into agricultural production since 1969. If all of this land is assumed to come from the 6.7 million acres of "reserve" land, approximately 3.4 million acres of such land would remain. When reserve cropland is placed into production, it is often at the expense of grass waterways, windbreaks, shelter belts and pasture lands that are essential for soil conservation.

Many of these areas are withheld from production because of hazards to the soil and water resources. The State Conservation Needs Inventory Committee recommends that four percent of the State's cropland in 1967 should be phased out of crop production and converted to pasture, forest, or wildlife use.[4] If long-term forecasts of land use on farms hold true, more land with potential erosion problems could be placed into production and fewer acres of "conservation land" will remain to prevent soil erosion.

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[3]Bruce Pankonin, "The Potential for Irrigation in Minnesota," The Farmer, Vol. 95 II, (January 15, 1977), p. 10.

[4]Minnesota Conservation Needs Committee, Minnesota Soil and Water Conservation Needs Inventory (St. Paul, MN.: Soil Conservation Service, 1971), p. 157.

Continued "fence to fence and shore to shore production" could prove disastrous to the state's soil resources. The Soil Conservation Service estimated that Minnesota lost 33 to 35 million tons of topsoil to wind and water erosion in 1974. The most severe soil losses occurred on marginal croplands (marginal relative to local conditions) that have been removed from conservation reserves. Newly converted lands are estimated to have lost over 4.1 million tons of topsoil in 1974, or nearly 12 percent of the state's total soil loss. Yet, converted acreage accounted for less than 4 percent of Minnesota's planted acreage.

Wind and water erosion control measures are also needed for existing agricultural lands. The Soil Conservation Service estimates that only 31 percent of the land in Minnesota is adequately protected against erosion and other soil problems. Soil scientists recommend that more than 12 million acres of Minnesota farmland should employ minimum tillage practices. However, in 1974 there were only 1.6 million acres under minimum tillage and 1.7 million acres in 1975.

Natural processes take roughly 300 to 400 years to produce one inch of productive topsoil. Consequently, a potential cost which must be considered in the conversion of land to crops is a decline in its availability to future generations. Efforts should be made to identify areas susceptible to severe erosion and the maximum land area that can be placed into production under sound conservation practices without endangering the soil. Eventually, the desirable amount of cropland may be a constraint on production, but a necessary one if we are to ensure adequate soil resources.

Cropland Demands

Introduction

The resource demand in agriculture can be viewed in terms of how much land will be required to produce desired quantities of agricultural products. This involves projecting the demand for agricultural products, the availability of land and the constraints on production.

Harvested cropland acreage is a function of both domestic and foreign demand. Domestic demand depends both on population change and the per capita consumption of agricultural products. The amount of food consumed per person is based on considerations such as income, income elasticity for products, product substitution and social programs. Foreign demand is a function of world population, per capita income levels, crop production, cultural preferences and currency rates in importing nations and U.S. government policies.

Agricultural output depends on the availability of land and its productivity. Crop yields are influenced by technology, climate, the availability of chemicals, fertilizers, and fuels, and the amount of irrigated acreage. Land may become available for production based on its physical suitability, available capital for investment, product prices, and required conservation practices. In turn, some productive croplands will be lost to other competing land uses.

Projections

Baseline estimates of future production, harvested acres, and land used for farming have been developed in the OBERS E' Agricultural projections.[5] These projections derived for the United States Water Resources Council represent levels of production, consumption, exports and resource use that could occur given certain assumptions.

The OBERS E' assumptions have been reviewed and modified to reflect more accurately conditions and trends in Minnesota agriculture.[6] These projections are presented as an initial review of possible levels of future crop demand. They can also serve as a base from which alternative future policies and programs can be evaluated. The agricultural community is encouraged to further modify, expand and improve the baseline projections.

The purpose here is to estimate the potential range of cropland under varying circumstances. Three alternative projections have been developed using high, medium and low demands for agricultural products (Table 2).

High demand assumes United States population will reach 258 million by 1990 with foreign exports continuing at the high level seen since 1972.

Baseline or medium demand assumes a United States population of 245 million persons in 1990 with continued foreign exports although they are constrained by higher prices and big importing nations becoming more self-sufficient.

Low demand based on United States population of 236 million in 1990 with foreign exports not exceeding the levels of 1969 to 1971.

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[5]United States Water Resources Council, 1972 OBERS Projections, Regional Economic Activity in the United States, Series E' Population Supplement Vol.I, III and IV, (Washington D.C. Government Printing Office, 1975), p. 139.

[6]Division of Planning and Development, Minnesota Department of Agriculture, Alternative Futures for Agriculture in the State of Minnesota: 1990, (St. Paul, Minnesota, 1976) (Unpublished Paper).

To estimate potential cropland requirements, three levels of future crop yields were used. The alternative per acre yields were developed with the following assumptions:

High yield which assumes crop yields will increase at the same rate as experienced in the last 25 years.

Moderate yield which was lowered from OBERS estimates to account for an 8-10 percent reduction in the use of chemicals and fertilizers and anticipated fuel cost increases.

Low yield which held crop yields constant at 1972 to 1974 levels.

Demand for Major Crops

Alternative demand levels of Minnesota's major crops are illustrated in Figure 2. Future production requirements range from a low projection of 914.4 million bushels to a high projection of 1,180.3 million bushels. These projections represent the level of crop production needed in Minnesota to maintain the state's share of national production. The national demand for agricultural products was calculated from the data in Table 2.

Figure 2

TOTAL MINNESOTA CROP PRODUCTION - 1990 ALTERNATIVE FUTURES

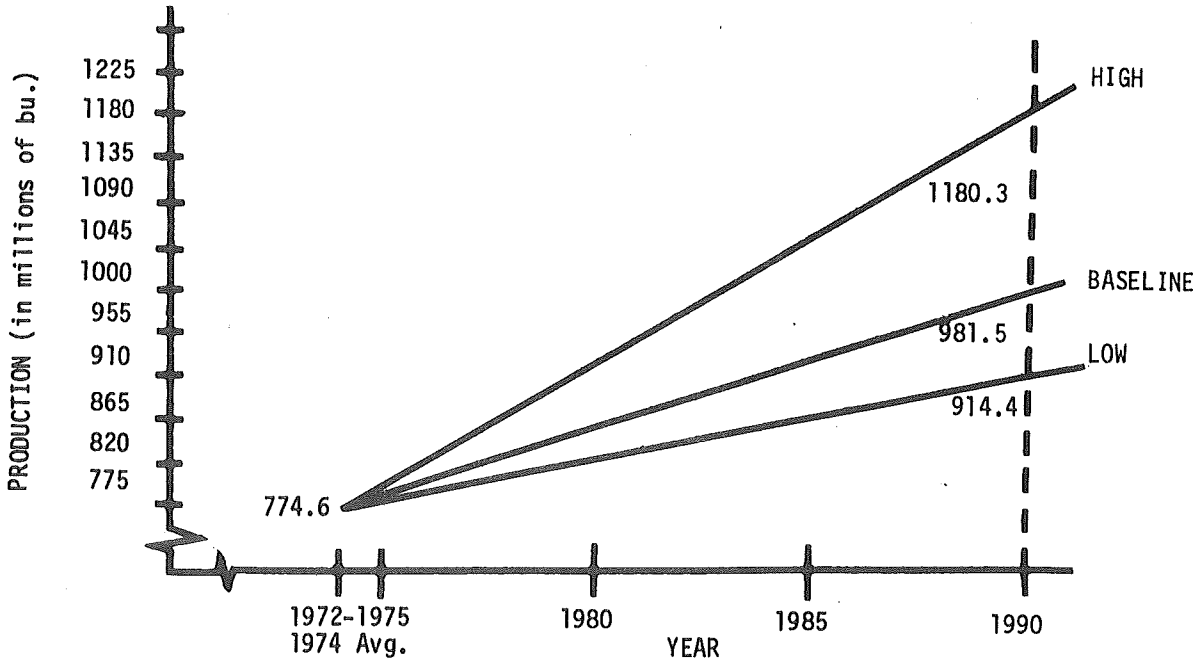

Table 2

Alternative Futures For Agricultural Production Factors, 1990

CROP	NATIONAL POPULATION [1] (millions)			CONSUMPTION (bushels per year) [2]	FOREIGN EXPORTS [3] (millions)			YIELD PER ACRE [4]		
	High	Moderate	Low		High	Moderate	Low	High	Moderate	Low
Corn				23.9	121.8	62.8	53.6	113.8	103.7	82.3
Soybeans				4.7	77.5	45.6	35.5	31.1	30.7	26.0
Wheat [5]				4.3	59.6	29.4	25.1	53.8	43.5	33.6
Oats				2.4	90.7	58.7	47.6	67.2	64.4 [6]	51.7
Barley				1.9	12.9	8.9	5.1	50.5	46.7 [7]	42.0
Flax				0.1	1.4 [9]	0.7	0.5	16.0	14.0	12.2
Hay				0.6 [8]	0	0	0	4.1 [8]	3.3 [8]	2.6 [8]
Totals	258	245	236							

[1] National population estimates based on U.S. Bureau of the Census projections. The low estimate represents Series F; the moderate, Series E; and the high, Series D.

[2] Consumptions based on crop produced for domestic use divided by total population using estimated of LeRoy Quance, "Demand Projections -- A Commodity Outlook and Economic Situation Update," Paper presented to American Seed Trades Association Farm Seed Conference, Kansas City, Missouri, November 5, 1974.

[3] Estimates of Minnesota exports only. Low estimates represent return to pre-1972 averages. Moderate estimates represent increase over pre-1972 trends to account for periodic interventions into market by Soviet Union and China. High estimates assume continuation at 1973 to 1975 export levels.

[4] Yield per acre estimates based on Minnesota. Low estimates represents no increase over 1972-74 average; moderate estimates represent OBERS projection adjusted for reductions in fertilizer usage and for Minnesota yields; and high estimates represent Minnesota trend line projections.

[5] Include rye, another food grain.

[6] Fertilizer adjustments not available. Reduction is 8 percent of OBERS estimate.

[7] Because of anomoly which arises historical trend and OBERS results inverted. Reduction for fertilizer adjustment is 8 percent.

[8] In tons.

[9] Flax estimate based on regression data. Alternative method yields unrealistic estimate.

Original estimates of domestic consumption and per acre crop yields were provided by the Economic Research Service, United States Department of Agriculture. The projected domestic consumption of oats and barley were significantly higher than present rates of consumption. The production of oats and barley in the United States in recent years has been declining, while exports as a percent of total production have increased. An adjustment in the opposite direction was necessary for wheat. The export demand trend based on 1972 and subsequent years has jumped dramatically and can be expected to remain relatively high. Subsequently, adjustments were made for three crops. The domestic consumption of oats and barley were reduced to reflect lower production and higher exports while the low and moderate assumptions for wheat production were adjusted upwards because of increased export demand.

Future alternatives for individual crop production are shown in Table 3 (estimates do not include corn for silage). These alternative demand levels are compared to the 1972-1974 average levels of production in Table 4. From 1972-1974, the state's major crops - corn, soybeans, wheat, oats, barley, flax and hay accounted for approximately 96 percent of harvested acres in Minnesota. Corn is the leading crop, based on 1972-1974 averages, in both acres harvested and production. Oats are second in production and third in acres harvested, while soybeans are second in harvested acreage and third in bushels of production. Wheat, barley, and flax follow in both production and the number of harvested acres. The state's hay crop, measured in tons, accounted for an average 3.1 million harvested acres from 1972-1974. The 1990 projections are further summarized as follows:

1. The high demand future estimates the need for about 52 percent greater production of major crops (excluding hay) than occurred using the 1972-1974 average. Three crops would require approximately 65 percent increases -- soybeans, oats and barley. Corn for grain would require an increased production of about 44 percent, although this production level would be only 25 percent higher than the previous record high year for corn production.

2. The baseline demand future also requires a significant increase in production over the 1972 to 1974 average for major crops (excluding hay). The estimated necessary increase is about 27 percent. Three crops show at least a 30 percent increase under this alternative and corn is estimated to increase by nearly 25 percent. Estimated corn production of 552.9 million bushels would be only about 8 percent above 1973 production. Wheat estimates show only a small increase, but this could be significantly higher if relative prices for wheat are high in future years.

3. Under the low demand alternative, production would still be required to increase by about 18 percent over the 1972 to 1974 average. The level of corn production under this alternative would be only about 12 million bushels higher than in 1973.

Table 3

ALTERNATIVE FUTURES ESTIMATES FOR MINNESOTA CROPS--1990

CROP	HIGH DEMAND				BASELINE DEMAND				LOW DEMAND			
	PRODUCTION 1/	Acres (millions)			PRODUCTION 1/	Acres (millions)			PRODUCTION 1/	Acres (millions)		
		High Yield	Mod. Yield	Low Yield		High Yield	Mod. Yield	Low Yield		High Yield	Mod. Yield	Low Yield
Corn (for grain)	637.9	5.6	6.2	7.8	552.9	4.9	5.3	6.7	525.7	4.6	5.1	6.4
Soybeans	168.1	5.4	5.5	6.5	131.6	4.2	4.3	5.1	118.4	3.8	3.9	4.6
Wheat 2/	106.5	2.0	2.4	3.2	74.0	1.4	1.7	2.2	68.0	1.3	1.6	2.0
Oats	204.6	3.0	3.2	4.3	166.9	2.5	2.6	3.2	151.8	2.3	2.4	2.9
Barley	57.0	1.1	1.2	1.4	50.8	1.0	1.1	1.2	45.6	0.9	1.0	1.1
Flax	6.2	0.4	0.4	0.5	5.3	0.3	0.4	0.4	4.9	0.3	0.4	0.4
Subtotal	1180.3	17.5	18.9	23.7	981.5	14.3	15.4	18.8	914.4	13.2	14.4	17.4
Hay, all	9.4 3/	2.3	2.8	3.6	8.9 3/	2.2	2.7	3.4	8.6 3/	2.1	2.6	3.3
Total		19.8	21.7	27.3		16.5	18.1	22.2		15.3	17.0	20.7

1/ Production represents Minnesota production. Computation is of the form, number of persons times consumption times percent Minnesota production is of natural production plus exports.

2/ Includes rye, another food grain.

3/ In tons.

Table 4

DEMAND ALTERNATIVES COMPARED TO 1972-74 AVERAGES (in millions)

CROP	1972-74 August Production	High Demand		Baseline Demand		Low Demand	
		Total	Percent Increase	Total	Percent Increase	Total	Percent Increase
Corn (for grain)	443.0	637.9	44.0	552.9	24.8	525.7	18.7
Soybeans	100.8	168.1	66.8	131.6	30.6	118.4	17.5
Wheat 1/	72.1	106.5	47.7	74.0	2.6	68.0	-5.7
Oats	121.4	204.6	68.7	166.9	37.5	151.8	25.0
Barley	34.6	57.0	64.7	50.8	46.8	45.6	31.8
Flax	2.7	6.2	129.6	5.3	96.3	4.9	81.4
Subtotal	774.6	1180.3	52.4	981.5	26.7	914.4	18.0
Hay 2/	7.9	9.4	19.0	8.9	12.7	8.6	8.0

1/ Includes rye, another foodgrain.

2/ In tons. All other estimates in millions of bushels.

The 1990 demand projections show no change in relative positions of production or harvested acreage for major crops. Corn will continue to be the largest volume crop under all projections. Flax will show the largest percentage increase with production nearly doubling by 1990 under the baseline alternative although total acreage remains relatively minor.

It is possible that in certain years changes in rank could occur because relative prices change or because short-term weather conditions are unfavorable. For instance, OBERS forecasted large increases in soybean production; however, imports of Malaysian palm oil and other factors have reduced the domestic price of soybeans and slowed expansion in this area. Recent concerns about drought conditions may result in additional acreage planted in crops, such as wheat, that require less water throughout the growing season. However, there is no sure prediction of what the long-term weather cycle will be, and normal weather is held as a reasonable expectation over the long run. Barring short-term fluctuations, Minnesota's leading crops are likely to retain their positions.

Harvested Acreage

The harvested acreage required in Minnesota to meet 1990 agricultural production under varying yields and demands is shown in Table 5 (estimates do not include corn for silage).

Three yield assumptions and demand levels are used, resulting in nine possible alternatives. Since a high demand for any one crop will not necessarily result in a high demand for all other crops, numerous levels of potential production are possible. Table 5 illustrates the extreme ranges of production based on previously stated assumptions. Using the two "extreme" examples, total harvested acreage could vary from 15.9 million acres under high yield and low demand assumptions to 28.4 million acres with low yield and a high demand. It is unlikely that either of these cases will occur. However, if a cropland demand of 28.4 million acres existed, it would be greater than the OBERS projection of the total amount of land in farms for 1990.

The baseline demand projections encompass all but two of the alternatives. Eliminating the two extreme cases, required cropland would range from 17.2 million acres to 23.1 million acres. Under the baseline demand and moderate yield assumptions, total harvested cropland required in Minnesota would be about 18.9 million acres in 1990.

High demand for agricultural products, especially from foreign markets, and environmental, and energy constraints, may continue to increase harvested acreage on Minnesota farms. This may be the result of the increased cost of non-land inputs, such as the diminishing returns from crucial inputs such as fertilizer. According to a report by the Urban Institute, even at lower prices that prevailed for fertilizer in the past, this diminished productivity makes continued massive substitution of fertilizer for land impractical.[7] Furthermore, concern over potential environmental problems may limit the use of certain pesticides. The report concludes that it may be somewhat risky to assume that in the future agricultural production can be sustained or improved by substituting other inputs for good quality farmland.

The total state harvest of all crops included 20.5 million acres in 1975, 21.5 million acres in 1976 and 21.9 million acres in 1977. Given a high demand and a moderate crop yield, currently a reasonable alternative, a total harvested acreage of 22.6 million acres would be needed in 1990. This level of production would begin to approach the limits of available cropland in the state.

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[7] George E. Peterson and Harvey Yompolsky, Urban Development and the Protection of Metropolitan Farmland (Washington, D.C.: Urban Institute, 1975), p. 15.

Table 5

HARVESTED ACRES -- ALTERNATIVE FUTURES AND 1972 TO 1974 AVERAGES COMPARED

CROP	1972 to 1974 Avg. Acres	HIGH DEMAND						BASELINE DEMAND						LOW DEMAND					
		High Yield	% Chan.	Mod. Yield	% Chan.	Low Yield	% Chan.	High Yield	% Chan.	Mod. Yield	% Chan.	Low Yield	% Chan.	High Yield	% Chan.	Mod. Yield	% Chan.	Low Yield	% Chan.
Corn (for grain)	5.4	5.6	3.6	6.2	14.8	7.8	44.4	4.9	-9.3	5.3	-1.9	6.7	24.1	4.6	-14.8	5.1	-5.6	6.4	18.5
Soybeans	3.9	5.4	38.5	5.5	41.0	6.5	66.7	4.2	7.7	4.3	10.3	5.1	30.8	3.8	-2.6	3.9	0.0	4.6	17.9
Wheat 1/	2.2	2.0	-9.1	2.4	9.1	3.2	45.5	1.4	-50.0	1.7	-22.7	2.2	0.0	1.3	-40.9	1.6	-27.3	2.0	-9.1
Oats	2.3	3.0	30.4	3.2	39.1	4.3	87.0	2.5	8.7	2.6	13.0	3.2	39.1	2.3	0.0	2.4	4.3	2.9	26.1
Barley	0.8	1.1	37.5	1.2	50.0	1.4	75.0	1.0	25.0	1.1	37.5	1.2	50.0	0.9	12.5	1.0	25.0	1.1	37.5
Flax	0.2	0.4	100.0	0.4	100.0	0.5	150.0	0.3	50.0	0.4	100.0	0.4	100.0	0.3	50.0	0.4	100.0	0.4	100.0
SUBTOTAL	14.8	17.5	18.2	18.9	27.7	23.7	60.1	14.3	-3.4	15.4	4.1	18.8	27.0	13.2	-10.8	14.4	-2.7	17.4	17.6
Hay	3.1	2.3	-25.8	2.8	-9.7	3.6	16.1	2.2	-29.0	2.7	-12.9	3.4	9.7	2.1	-32.3	2.6	-16.1	3.3	6.4
SUBTOTAL	17.9	19.8	10.6	21.7	21.2	27.3	52.5	16.5	-7.8	18.1	1.1	22.2	24.0	15.3	-14.5	17.0	-1.0	20.7	15.6
Other 2/	0.7	0.8	14.3	0.9	28.6	1.1	57.2	0.7	0.0	0.8	14.3	0.9	28.6	0.6	-14.3	0.7	0.0	0.9	28.6
TOTAL	18.6	20.6	10.8	22.6	21.5	28.4	52.7	17.2	-7.5	18.9	1.6	23.1	24.2	15.9	-14.5	17.7	-4.8	21.6	16.1

1/ Includes rye, another food grain

2/ Does not include corn for silage.

CONSERVANCY

SECTION 2

CONSERVANCY

NOTE: The section on conservancy will be completed at a later date.

EXTRACTIVE

SECTION 3

Extractive

Iron Ore

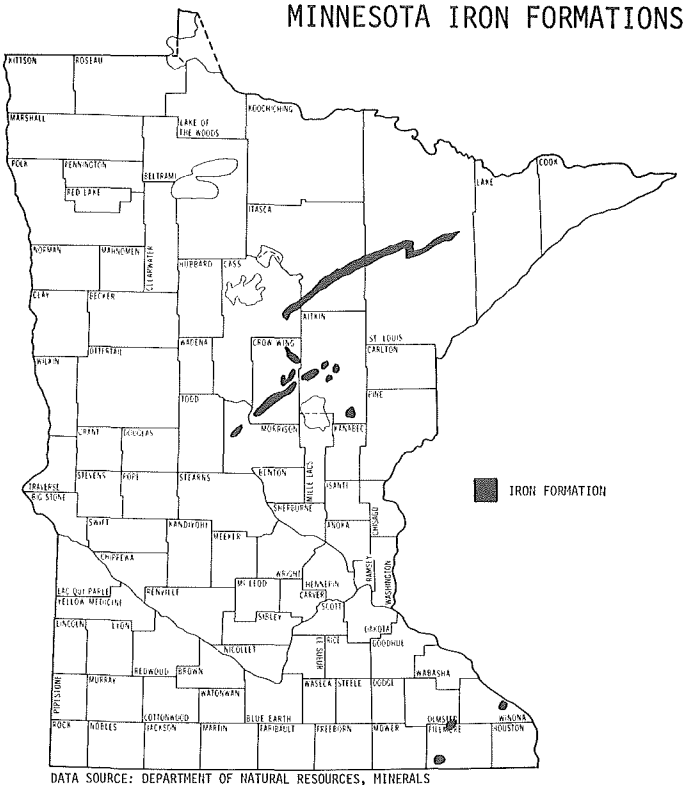
Minnesota contains three major iron bearing formations: the Mesabi Range, the Vermillion Range and the Cuyuna Range (Figure 1). Over the past 85 years these mining districts have produced over 3 1/4 billion tons of ore. Today the main supplier of ore is the Mesabi Range. The Vermillion has not been mined since 1967 and the Cuyuna presently yields only a small amount of ore from one mine.

The ore that has been mined in Minnesota can be divided into two main types: (1) natural iron ore and (2) taconite ore. Natural ores were formed by geologic processes that concentrated the iron minerals within the rock formation. Taconite, on the other hand, is the virgin rock of the formation which in most cases has remained unaltered and is not concentrated like the natural ores. Taconite occurs in two main forms: (1) magnetic taconite and (2) non-magnetic taconite.

Prior to 1955, only natural ore was mined in Minnesota. In 1955, however, full scale mining of magnetic taconite was initiated on the Mesabi Range. Since that time, natural ore has represented a declining percentage of the ore shipments because of the near depletion of this resource and the rapid growth of magnetic taconite production. Future mining operations will continue the trend toward the lower-grade taconite ores.

Figure 1.

MINNESOTA IRON FORMATIONS



DATA SOURCE: DEPARTMENT OF NATURAL RESOURCES, MINERALS

To date only the magnetic taconites have been mined. The technology for processing this material was developed over a thirty-year period between the 1920s and the mid-1950s. The use of non-magnetic material has been investigated to some extent, but present technology is apparently not adequate or is too costly to make mining attractive. Recent research indicates that a particular type of non-magnetic taconite, semi-taconite, has the best potential for becoming economically mineable within the near future. Eventually, it is probable that non-magnetic ores will take the place of magnetic taconite. However, for the next several decades magnetic taconite will be the backbone of Minnesota's iron mining industry.

Minnesota's low-grade iron ore deposits (magnetic taconite, nonmagnetic taconite and semi-magnetic taconite) are vast. In 1962, the Department of Natural Resources conservatively estimated the State's open-pit magnetic taconite reserves at 45 billion tons. When processed, this resource will yield approximately 15 billion tons of iron concentrate, which is over four times the amount of all iron ore shipments to date. It appears that magnetic taconite reserves are sufficient to support open-pit taconite mining in the state for at least 200 years.

Because it is not yet economical, nonmagnetic taconite has not been thoroughly explored and estimates of the extent of the resource have not been made. In an effort to fill this gap the Department of Natural Resources has initiated a program in which an estimate of all Minnesota's iron resources will be made, hopefully providing more knowledge about the quality and quantity of the resources.

As mentioned earlier, magnetic taconite production has experienced rapid growth over the past 20 years, and this trend is expected to continue over the next 20 years. In 1975, six Minnesota mining companies produced 38,130,266 tons of magnetic taconite concentrate. By 1990, speculative projections indicate that nine companies could be producing 71,900,000 to 77,400,000 tons of concentrate annually. This represents a doubling of taconite production over the next fifteen years. These forecasts include known plant expansions through 1980 plus projections of potential mining operations which could reach an operational stage by the late 1980's.

The land use impacts associated with future mining will be unprecedented. The shifting from natural ore to taconite has resulted in the mining of up to three times more iron-bearing rock (taconite ore) in order to produce a concentrate containing the same amount of iron. In addition, the costs of building taconite processing plants have increased so drastically that only large capacity plants can remain economical. The result of these two factors is that large areas of land will be consumed by the taconite mines, and even greater areas will be covered with the by-product wastes.

Through 1975, taconite mining and processing operations consumed 26,427 acres of land (42.3 square miles). By the early part of the next century, additional taconite production is expected to require

approximately 79,000 acres or 123 square miles (Table 1). The area directly affected by taconite operations would be approximately three times as great as existing land commitments.

The land requirements of existing taconite operations shown in Table 1 are estimated needs based on current knowledge about plant capacity and ore supply. The time frame for such land consumption varies depending on production rates, with the ore supply of existing plants estimated to last between 40 and 100 years per operation. Additional mining facilities, future exploration, and changes in technology will undoubtedly allow new ore reserves to be used, increasing the ultimate land needed for mining.

The need to develop a long-term land use plan cannot be overstated. Minnesota's first century of mining has seen many land use decisions that prevented development of the mineral resource. As a result, it was necessary to relocate or abandon entire towns and move highways and railroads in order to continue mining.[2] The placement of waste or lean materials encountered or generated during the development process has been equally uncoordinated and has resulted in unnecessary pollution, sporadic revegetation, safety hazards and, in a number of cases, the need for relocation of disposal areas.

By the year 2020, three times as much land may be disturbed by mining activities. In addition, thousands of acres will be needed for homes, industries, roads, transmission lines, and recreational areas. Illustrations of existing tailing basins and potential land requirements are shown in Figures 2 and 3. Land use decisions will be complicated by the lack of knowledge about the future location and intensity of mining operations. Decision-makers must decide where to channel growth, build roads, transmission lines, pipelines, railroads and public facilities, and how to protect highly productive forest land.

In order to aid these decisions, an overall mining plan must be developed for the Iron Range. The first phase would locate, classify and estimate tonnage of iron resources and wastes to be generated. The Department of Natural Resources is developing such information in a "regional iron resource estimate." This effort is part of the DNR's total mineland reclamation program, which includes the development and implementation of an Iron Range Plan, and a permit-to-mine program which will apply this range-wide plan in reviewing requests to mine.

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[2]Division of Minerals, Minnesota Department of Natural Resources, Regional Iron Resources Estimate for Use in Mineland Reclamation Planning (January 23, 1976), pp. 1-6.

Table 1

EXISTING AND PROJECTED MINNESOTA TACONITE PRODUCTION AND ASSOCIATED MINING AND PROCESSING LAND REQUIREMENTS

	1975 Production (Long Tons)	Projected 1990 Production (Long Tons)	Extraction Pit		Tailings Basin		Stock Pile	
			Existing (Acres)	Planned (Acres)	Existing (Acres)	Planned (Acres)	Existing (Acres)	Planned (Acres)
U.S. Steel	12,011,657	18,500,000 (possible +5,500,000)	1,619	NA	2,797	14,080	557	NA
Erie	10,113,808	10,700,000	5,242	NA	2,682	9,024	1,869	NA
Reserve	8,971,236	9,500,000	3,322	NA	--	3,187-7,898	1,165	NA
Inland Steel	--	2,600,000	--	755	--	2,810	--	1,523
Hibbing Taconite	--	8,100,000	--	2,298	--	7,424	--	NA
Eleveth Taconite	2,139,241	6,000,000	1,139	1,280	781	3,277	1,197	1,747
Jones & Laughlin	--	4,500,000	--	1,677	--	4,608	--	NA
Hana (National & Butler)	4,894,324	12,000,000	627	NA	2,880	20,864	550	NA
TOTAL	38,130,266	71,900,000-77,400,000	11,949	6,010	9,140	65,274-69,985	5,338	3,270

SOURCE: Minerals Division, Department of Natural Resources and Draft Environmental Impact Statement for Reserve Mining Company's proposed On-Land Tailings disposal plan, Department of Natural Resources and Pollution Control Agency.

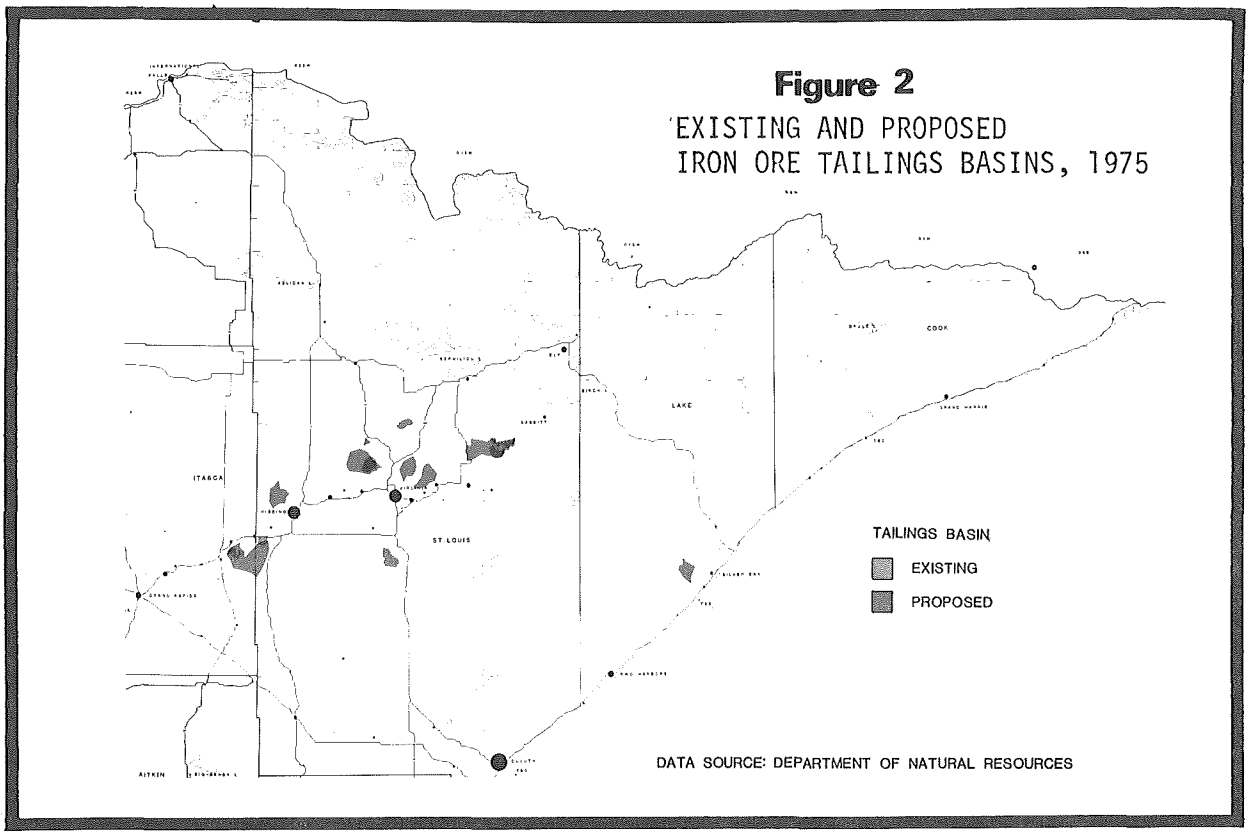


Figure 2

EXISTING AND PROPOSED
IRON ORE TAILINGS BASINS, 1975

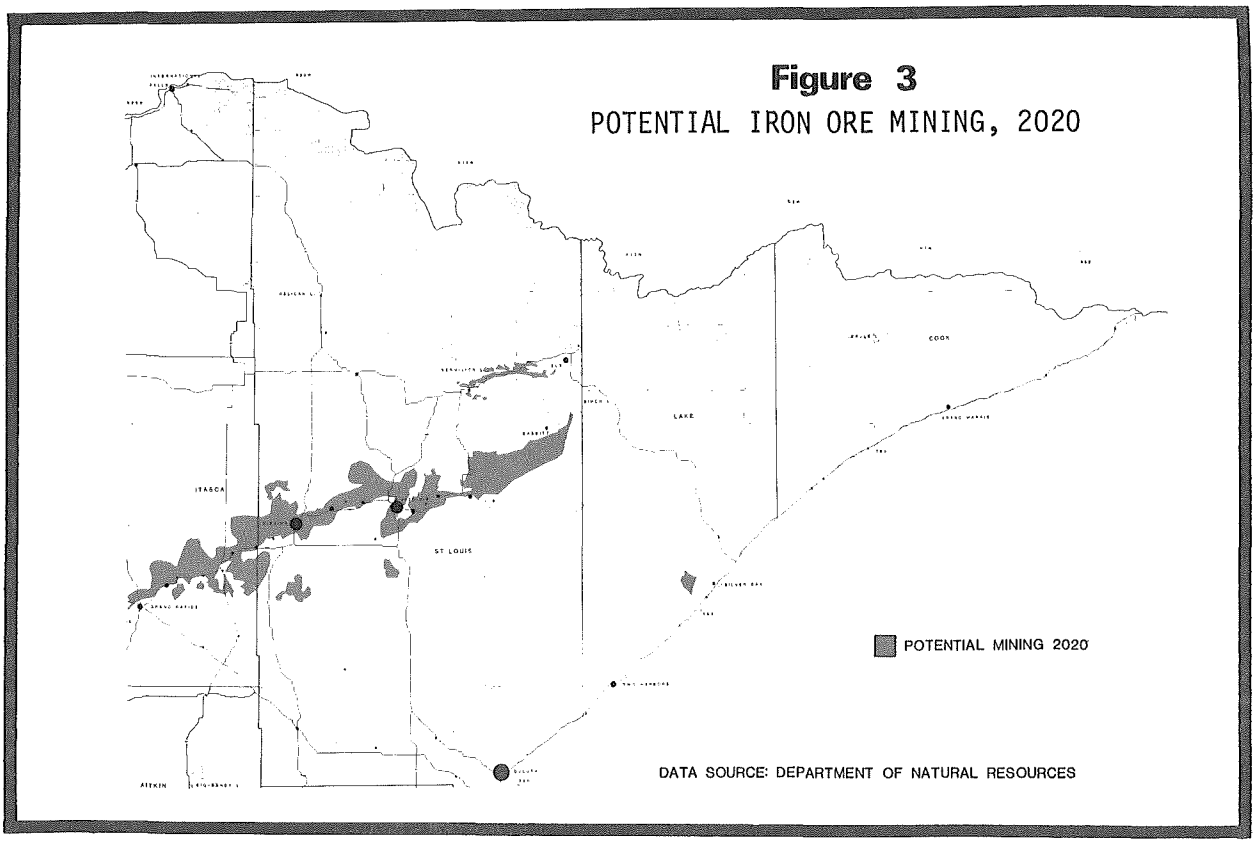


Figure 3

POTENTIAL IRON ORE MINING, 2020

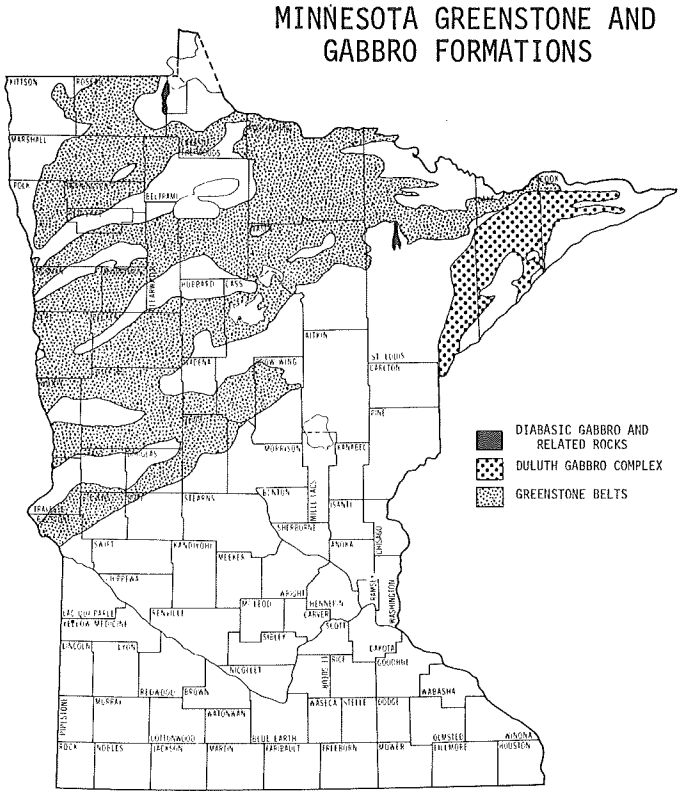
Copper-Nickel

Two other Minnesota rock formations have drawn the attention of prospectors and miners. These formations are the Greenstone belts and the Duluth Gabbro (Figure 4).

The Greenstones are a series of volcanic and metamorphic[1] rocks which extend across the northern part of the state. This rock series is part of a larger system located in Wisconsin, Michigan and Canada. Prospecting and exploration of Minnesota's Greenstones have been limited due to the thick surface covering much of the potentially mineralized rock. In Canada, however, where vast areas of the Greenstone are exposed, several dozen mining ventures are producing a wide variety of metals including lead, silver, gold, zinc and copper (commonly referred to as base metals). To date, there have been no discoveries of commercial significance within Minnesota's Greenstones although exploration continues.

Figure 4

MINNESOTA GREENSTONE AND GABBRO FORMATIONS



DATA SOURCE: DEPARTMENT OF NATURAL RESOURCES, MINERALS

[1] Alteration of an igneous or sedimentary rock by extreme pressure, heat or chemical action.

The Duluth Gabbro is a large igneous[2] rock formation located in the northeastern part of the state. The sulfide mineralization, mainly of copper and some nickel within this rock unit, is located at the extreme western contact of the formation. Geological data to date indicate that the best mineral potential along this contact is located between Hoyt Lakes and the Boundary Waters Canoe Area. Exploration along this portion of the contact has been intense over the past twenty years. To date, two proposals which go beyond the prospecting stage have been made. The American Metals Climax Company (AMAX) requested and received approval from the state to proceed with an underground exploration shaft near Babbitt, and International Nickel Company (INCO) proposed the development of an open pit mine near Ely. Although INCO has terminated its Minnesota activities, the interest in Minnesota's copper-nickel resource remains very keen.

The AMAX and INCO proposals as well as explorations by other mining companies indicate that large low grade ore deposits with commercial potential probably exist within the Gabbro. As a result of recent company mining activities, the state is conducting environmental and economic studies for the legislature which will determine how or if development should proceed. The decision to mine Gabbro ore depends on its economic feasibility, the availability of capital, state approval through regional and site-specific environmental impact studies, and compliance with the terms of several state permits. Meeting these criteria, the earliest possible development of copper-nickel would take place by 1983 or 1985. Predictions of future copper-nickel development are extremely tenuous; however, assuming state approval, it is possible that from one to perhaps three copper-nickel mines could be operational by 1990.

An interagency task force[3] estimated the land requirements for underground and open-pit mining of the Gabbro. These estimates have been modified by the Department of Natural Resources to reflect the type of alternate mining systems which would be employed (Table 2). The land requirements are based on a 20,000 ton/day production of 25 percent copper concentrate and a 25-year mine life. It is assumed that low-grade ores would be used that contain an average of .8% copper and .2% nickel.

According to the DNR's Gabbro mine model, land requirements for one mining operation would vary from 695 to 5,840 acres. An underground mine with two-thirds of the tailings and waste rock left below surface would have the least impact. An open-pit mine with surface disposal would require the most land area. Using alternative levels of copper-

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[2]Formed through solidification from a molten state by volcanic action or intense heat.

[3]Minnesota Department of Natural Resources, Interagency Task Force Report on Base Metal Mining Impacts, (January, 1973), p. 6-15.

Table 2

LAND REQUIREMENTS FOR COPPER/NICKEL MINING
(GABBRO MINE)

Type of Mining Operations	Production	Probable 1990 Situation (1 Mine[1]) Minimum	Maximum	Possible 1990 Situation (3 Mines[1]) Minimum	Maximum
		acres			acres
Underground Mine-2/3 of Tailings and Waste Rock are Disposed of Underground	20,000 tons/day	695 1.1 square miles	2,410 3.8 square miles	2,085 3.26	7,230 11.30
		acres			acres
Underground Mine - No Underground Disposal of Tailings or Waste Rock	20,000 tons/day	1,980 2.8 square miles	5,220 8.2 square miles	5,940 9.28	15,660 24.47
		acres			acres
Open Pit	20,000 tons/day	2,610 4.1 square miles	5,840 9.1 square miles	7,830 12.23	17,520 27.38

[1] Assumptions necessary for construction - (1) large low grade deposits; (2) large tonnage operation; (3) could require extraction facility; (4) pyrometallurgy only presently feasible method; (5) minimum size extraction facility -- 300,000 tons per year; (6) grade of concentrate - 25% Cu; (7) grade of ore - 1% combined Cu-Ni (.8% Cu and .2% Ni).

SOURCE: Draft Environmental Impact Statement - Reserve Mining Company's Proposal on Land Tailings Disposal Plan, prepared by DNR and PCA, October 1975. Interview with Bob Poppe, Executive Director, Copper-Nickel Regional Impact Study, February 2, 1976.

nickel development, by 1990 land use commitments could range from 695 to 17,520 acres. The most likely prospect, however, is that a 2,600-10,000 acre land commitment will be made. While not all this land will be in use by 1990, the land will have been committed at that time. The problem is to determine which land should be committed and what the long-term impacts on the surrounding area will be.

At the present time, it is impossible to make predictions on the Greenstone formation. Not enough is known about its geology to make projections on the size, location or type of mining which could result.

Peat

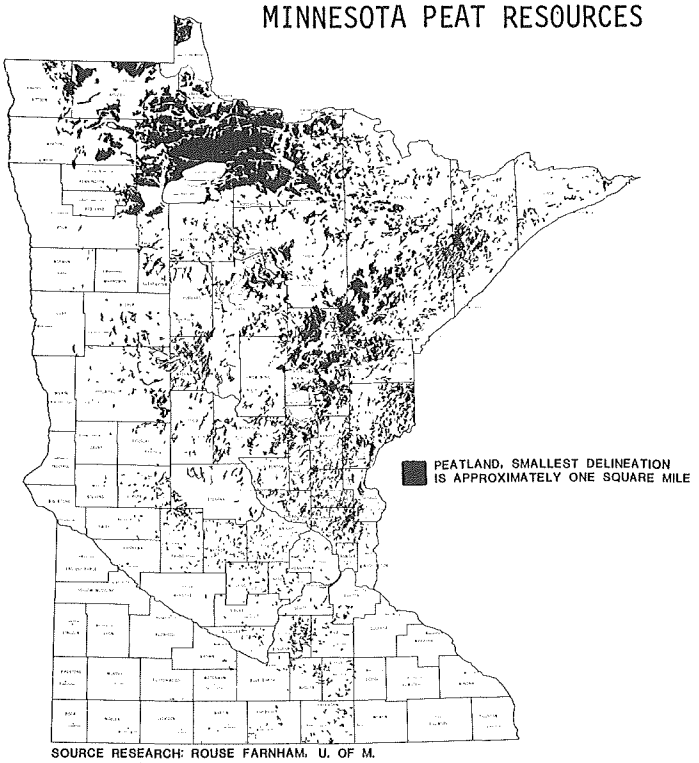
The peat deposits of Minnesota are a largely undeveloped resource which is significant for several reasons. First, Minnesota contains an estimated 7.5 million acres of peatland, the largest total in any other state except Alaska (Figure 5). Second, the state owns or administers an estimated 90 percent of the peatlands and is thereby in a position to strongly influence any development. Third, the peat resource has a multitude of potential uses including energy, chemicals, horticulture, agriculture, forestry, and natural preservation.

The present uses of peatlands in Minnesota are the following:

1. Horticulture - Seven small operations are currently producing horticultural peat in the state. Their land requirements and impact on the social and natural environment are small. Some of these operations lease peatlands from the state, removing peat under surface leases.

Figure 5

GENERALIZED MAP OF
MINNESOTA PEAT RESOURCES



SOURCE RESEARCH: ROUSE FARNHAM, U. OF M.
FUNDING: MINNEGASCO

2. Agriculture - Approximately 200,000 acres of peatland are currently in production statewide. Crops produced include wild rice, vegetables, forage, and sod. Much of the vegetable and sod production occurs in peatlands near Minneapolis-St. Paul, while wild rice is produced in northern Minnesota.

3. Natural Areas - Two large bogs in northern Minnesota have been designated as National Natural Landmarks by the U.S. Park Service. They are the Lake Agassiz Peatlands Natural Area, which encompass 22,000 acres some 30 miles south of International Falls, and the Upper Red Lake Peatland, containing 137,920 acres in Beltrami County. The Lake Agassiz Peatlands are also being considered for status as a Natural and Scientific Area by the state, an action which would then preclude any development.

4. Forestry - The acreage of peatland used for forestry-related activities is difficult to estimate. It is estimated that some 5 million acres of Minnesota peatlands are forested with pulp materials. Christmas trees are also produced on some northern Minnesota peatlands.

Possible future uses of peatlands may be for energy and/or chemical production; however, neither use has yet been developed on an economically commercial basis in the United States.

The Department of Natural Resources has received an application by the Minnesota Gas Company for a surface lease on some 200,000 acres of state land immediately north of Upper Red Lake. The firm proposes a gasification plant using peat as a feedstock which would produce 250 million cubic feet (mcf) of synthetic natural gas (SNG) each day. The peat in the proposed lease area would last approximately 20 years based on an 18 million ton per year extraction rate. The proposal represents the largest single commitment of state peatland to date. The Department of Natural Resources will not act on the lease application until studies are completed, legislative policy direction provided, and appropriate rules and regulations promulgated.

Several technological problems have to be overcome before peat can be used as an energy source. Conventional methods of drying and harvesting peat are not adequate to produce sufficient quantities of the resource in an environmentally or economically sound way. An abnormally large labor force would have to be amassed on short notice during a sporadic harvesting schedule. Although labor intensive peat harvesting has been used in Europe, similar methods would not be feasible in the United States. Furthermore, in many cases, foreign energy facilities using peat are uneconomical, usually relying on subsidies or government intervention to maintain stable operating conditions. New methods of harvesting and drying peat must be perfected before large-scale operations can commence in the United States.

The technology used in gasifying the peat has not been fully developed. Many methods are still in an experimental stage. If all research continues as planned, it would be possible to have an operational energy facility by 1990.

To meet future requirements, emphasis should be placed on determining the location of peat deposits that are best suited for each desired use. Analysis may include a review of agricultural suitability, energy value, forest cover, land use, ownership, and accessibility. These variables can be combined to create suitability maps that indicate the most prudent use of the resource.

An initial peat inventory is being conducted through the Minnesota Land Management Information System. This study identifies the major concentration of peatlands in Koochiching County by ownership. A more detailed inventory is currently underway under the direction of the Department of Natural Resources. This inventory includes sampling of peat to determine its quality, quantity, and location. Further, the peat will be classified according to its possible use. This analysis is an important step in making the economic and environmental decisions about one of Minnesota's most extensive resources.

SECTION 4

FOREST PRODUCTION

Forest Production

Minnesota's forest land makes valuable contributions to both the economy and environment of the state. Approximately one-third or 18.4 million acres of Minnesota's total land area is forested. The commercial timber harvest from this land supplies the majority of wood required for Minnesota's forest industries, the third largest industry in the state. Our forests also provide numerous recreational, wildlife management and aesthetic benefits for all Minnesotans.

Considering the multiple benefits of our forest land, responsible and conscientious management is necessary to meet growing resource demands. Yet, there are several serious obstacles to a progressive forest management program in Minnesota. These include a lack of specific goals for program direction, unclear management policies, difficulties in relating resource information to policy decisions, conflicts resulting from competing or incompatible land uses, and the inability to effectively monitor programs.

Clear objectives stating when a particular forested parcel is going to be managed, how, and for what purposes do not exist. Minnesota's public forest lands are to be managed under the principle of multiple use and sustained yield; however, there is no agreement on what multiple use means. Some envision the concept to mean that all possible forest uses should be carried out simultaneously on every acre, which is a physical impossibility. Others view multiple use as more than one activity taking place on forest land, but not on every acre. Still others view it as multiple use of a given acre over time, with one use dominating at one time and another use dominating at another time. There is also disagreement as to whether multiple use can exist without a timber harvest. As a result, efficient resource management is difficult to achieve.

Forest management is complicated by intermingled federal, state, and private land ownership. Over 56 percent of the state's commercial forest land is under public control, with 20 percent managed by the State of Minnesota, 20 percent managed by county and municipal government, and 16 percent managed by the federal government. The remainder of the forested land is under private ownership. Just under 1 million acres (5 percent of Minnesota's forest land) are owned by the forest industries.

Little is known about the goals of private landowners concerning their forested land holdings. As forest land passes from one private owner to the next, individual management goals change. The amount of land managed for timber production versus other uses fluctuates and a determination of future output levels is difficult. Public land managers indicate that with the increasing emphasis on non-timber uses such as recreation, wildlife management and conservation for publicly held forest land, the timber industries will have to depend heavily on private lands. Yet, present estimates of future timber harvest from these lands are generally unreliable.

Factors such as the availability of privately owned timber resources and the accessibility of timber on public lands create a gap between volume estimates of growing stock and the timber which can be realistically harvested. One alternative approach to meeting timber needs is increasing the level of land management. In theory, it has been suggested that 5-8 million acres of the state's most productive forest land, intensely managed, could meet Minnesota's wood fiber needs in the future. Under intensive management, fewer acres could be used to produce more annual timber growth, thus freeing land for other forest uses. However, intensive timber management implies substantial investment which may be difficult to justify. A major need is to create a process by which trade-offs among various approaches can be identified and evaluated.

While present timber management programs tend to disperse funds without much regard for the productive capacity of forest land, public monies could be spent on areas where natural conditions would result in more annual timber growth. In part, this could be accomplished by analyzing suitability of lands managed for forestry and altering the management of these lands.

In the long run, public forest management plans could be reinforced by local planning and zoning controls. Minnesota counties and municipalities own 43.5% of all of the forest land owned by counties and municipalities in the nation. The state may wish to consider programs to help identify the most highly productive sites and encourage intensive management on these lands. Again, the intensity of management for any given area would depend on the potential costs and benefits involved in relation to achieving forest management goals.

In the future, Minnesota forest land managers will need to designate forest lands according to their suitability for timber production, recreation areas, watershed protection, wildlife management conservation, and aesthetic uses. The location of these designated areas will change over time as the forest matures, as timber is pruned, thinned and harvested and as replanting occurs. Some forest uses will be compatible. Others will require special harvest methods and techniques or may be totally incompatible on a given parcel of land (Table 1). The specific location of these forest uses must be incorporated into management plans and reflect overall management goals.

Unfortunately, Minnesota does not have a set of goals that can be used by federal, state, and local government to manage forest activities. Since many different management philosophies and desired uses of our forest land exist, trade-offs among different approaches are difficult to identify. The end result is that management efforts are often conflicting and counterproductive.

A good example of a framework for long-term planning has been provided by Congress in the Forest and Rangeland Renewable Resources Planning

Table 1

DEGREE OF PHYSICAL COMPATIBILITY OF SECONDARY WITH PRIMARY FOREST USES

Primary Use	Secondary Use: Attractive Environment	Recreation Opportunity	Wilderness	Wildlife	Natural Watershed	General Conservation	Wood Production and Harvest
Maintain attractive environment		Moderately compatible; may limit intensity of use	Not inimical to wilderness but does not insure	Compatible to most wildlife, less so to a few	Fully compatible	Fully compatible	Limited compatibility; often affects amount of harvest
Provide recreation opportunity	Moderately compatible unless use intensity excessive		Incompatible; would destroy wilderness character	Incompatible for some kinds; others can tolerate	Moderately compatible; depends on intensity of recreation use	Moderately compatible; incompatible if use too heavy	Limited compatibility depends on harvest timing and intensity; roads provide access
Wilderness	Fully compatible	Completely incompatible, can't tolerate heavy		Highly compatible to much wildlife, less so for others	Fully compatible	Fully compatible	Completely incompatible, precludes all harvest
Wildlife	Generally compatible	Limited compatibility; use intensity must be limited	Mostly compatible though some wildlife require vegetative manipulation		Generally fully compatible	Generally fully compatible	Generally compatible but may require limiting volume or conditions of harvest
Natural watershed	Fully compatible	Moderate compatibility; may require limitation on intensity	Not inimical to wilderness but does not insure	Generally compatible		Fully compatible	Moderate compatibility; restricts harvest methods but does not prevent timber harvest
General Conservation	Fully compatible	Moderately compatible; if use not excessive	Not inimical to wilderness but does not insure	Generally compatible	Fully compatible		Compatible but requires modifications in methods of timber harvest
Wood production and harvest	Compatible if harvest methods strictly controlled	Moderately compatible	Completely incompatible; would destroy wilderness	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	Compatible if harvest methods fully controlled	

SOURCE: Marion Clawson, "Forests for Whom and for What?"

Act of 1974, more commonly called the Resources Planning Act (RPA).[1] The act provides for the identification of issues involving natural resources, the collection of information for decision-making and assessment of resources including projections of future supplies and demands.

The strength of the act is in the organization and description of alternative courses of action, their trade-offs and future impacts. This is accomplished by identification of different potential goals for each area of program responsibility (i.e., recreation, timber supply, wildlife, etc.). These goals are evaluated and structured into possible action alternatives. Finally, the Resources Planning Act "establishes a management process that assures coordination among long-term goals, action programs designed to achieve specific goals, budgets tailored to necessary programs, and annual evaluation of accomplishments."

There is no easy, short-term solution to solving Minnesota's forestry related problems. But the development of a structure to evaluate policy alternatives is fundamental to a sound forestry program.

In addition to the demands for timber resources, management goals also must address increased needs for wildlife protection, wilderness preservation, recreation and conservation. However, this section will focus on the projected wood fiber needs from 1970 to 1990; other "multiple uses" are addressed in the sections on recreation and wildlife management.

Forest Demands

A recent attempt to incorporate an overview of timber demand has been completed in a timber-based sector analysis by the University of Minnesota College of Forestry.[2] The following assessment of resource demand will rely on the initial application of the sector analysis. The analysis projects what is "most likely" to occur in 1980 and 1990 using current state trends in production, trade, forest management and harvesting, income, population, and national trends in consumption and relative prices. These results are tentative in that new forecasts will be produced as additional information is obtained and analyzed.

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[1] U.S. Department of Agriculture, Forest Service, RPA-Summary, A Summary of a Renewable Resource Assessment and a Recommended Renewable Resource Program (February, 1976), p. 3.

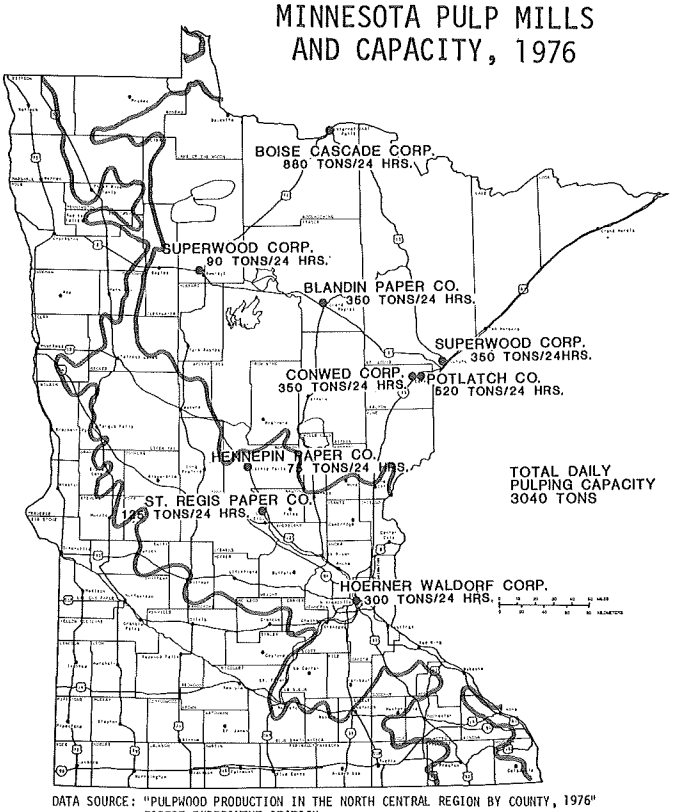
[2] Robert Denee and Hans M. Gregerson, Minnesota Timber Based Sector, Analysis: A Methodology and Preliminary Application (St. Paul, MN.: College of Forestry, University of Minnesota), August, 1975.

The sector analysis indicates, based on per capita consumption estimates, that Minnesota is and will continue to be a major wood consuming state. In 1970, Minnesota ranked among the top twenty states in total wood consumption, with nearly 300 million cubic feet (RWE)[3] consumed. Assuming state population rises nearly 10 percent per decade, future consumption of state wood-using industries would likely exceed 360 million cubic feet (RWE) in 1980 and 430 million cubic feet (RWE) in 1990. This represents a 20 percent increase in wood fiber consumption in each decade from 1970-1990.

The pulp and paper industry generates the major demand on Minnesota's wood fiber resources, consuming about 80 percent of the state forest production. In 1976, the state harvested 1,578,000 cords of woodpulp which supported nine Minnesota mills having a combined pulping capacity of 3,040 tons per 24 hours (Figure 1). State woodpulp mills operated at 95-100 percent of capacity in 1974 and consumed 1,174,720 cords of woodpulp. In addition, Minnesota exported 260,000 cords to Wisconsin Mills with smaller amounts being shipped to Canada or used internally for other purposes. The sector analysis projects that the demand for woodpulp will increase by 73 percent from 1970-1990 and by 143 percent for other pulp (includes recycled paper) over the same period.

Figure 1

MINNESOTA PULP MILLS
AND CAPACITY, 1976



DATA SOURCE: "PULPWOOD PRODUCTION IN THE NORTH CENTRAL REGION BY COUNTY, 1976" FOREST EXPERIMENT STATION

[3]RWE, roundwood equivalent volume, is the volume of wood raw material required in the processing of consumed forest products.

According to the sector analysis, the largest increases in per capita demand from 1970-1990 will be in the particleboard, plywood, and paper and paperboard (woodpulp) categories with a smaller increase in the demand for Christmas trees. All other segments of the forest industry will show decreased per capita demands by 1990. Overall lumber consumption will show only a moderate increase as per capita use declines because of the trend toward composite rather than solid wood products. The per capita demand for softwood lumber is expected to rise during the 70s but will slacken by 1990 because of declining availability of sawlogs and the resulting higher prices for lumber.

Matchwood and hardwood lumber are expected to have continually declining per capita demands through 1990, while per capita demands for cooperage, piling, poles, posts and other nonprocessed wood will begin to decline during the 1980's. However, state consumption will show small decreases in only a few product categories because of an assumed increase in state population to 4.7 million persons in 1990.

Fuelwood was expected to have a declining per capita demand. After these projections were made, rising energy prices have generated great interest in home wood burning stoves, thus increasing the demand for fuelwood. Such trends illustrate the need to continually update and revise demand projections. The sector analysis can then be used to analyze possible impacts or trade-offs of changing conditions.

As stated earlier, these forecasts are based on historical data and new trends could cause per capita demands to change rapidly. For example, recent impacts of the energy crisis have made nonrenewable fuels more expensive and less available. The Forest Industries Information Committee indicates that several technological and economic changes suggest the feasibility of using woodchips as an alternative fuel source. Possibilities exist that low quality hardwood chips could be shipped from the port of Duluth to national and international markets providing a new market for Minnesota wood resources. The U.S. Forest Service indicates softwood demand now exceeds domestic supply and hardwood demand will probably exceed available domestic supplies shortly after the year 2000. As national timber shortages occur, Minnesota's timber resources, especially its hardwood surplus, could receive national attention and demands on Minnesota's wood resources could increase significantly.

Based on historical trends, future Minnesota timber-based industrial production is expected to increase at a slower rate than state consumption and national production. Industrial production in 1970 was 142 million cubic feet (RWE), with over 57 percent of the production accountable to the pulp and paper industry. By 1980, production will increase 15 percent to 163 million cubic feet (RWE), and an additional 5 percent to 171 million cubic feet by 1990. These relatively smaller forecasted increases in manufacturing output tend to follow recent trends in Minnesota where forest industries have been losing ground overall in relation to national wood production manufacturing in the past few decades.

Substantial capital investment must be made in Minnesota's forest industries to meet projected production levels. According to the sector analysis, completed or planned expansions will make the state's forest industries fully capable of producing at projected 1980 output levels. The 1970-1980 period will require an expected $193 million capital investment with almost 80 percent of the new investment in paper and board manufacturing. A subsequent investment of $356 million will be needed to meet production, trade, and harvest forecasts in the 1980-1990 projection period.

Value Added in Manufacture for primary forest industries of Minnesota is estimated to have been $184.4 million in 1970. The largest contributor is the pulp, paper, and board group with over 90 percent of value added. Nearly half of this is attributable to labor payments and capital investment, the remainder being the sum of taxes and income accruals. The forest sector analysis indicates value added in manufacture for the primary forest industries is estimated to surpass $270 million by 1980 and $375 million by 1990 (1970 constant dollars). The largest contributor throughout the forecast period is likely to continue to the pulp, paper and board group, if forecasted expansions hold.

On a net volume basis, the state's commercial forest land base currently supplies more wood resource materials than are used by Minnesota forest industries. In 1970, timber removals from Minnesota forests were estimated at 15.1 million cubic feet,exceeding instate demand by 9 million cubic feet. Thus, Minnesota is a net exporter of timber, providing wood products such as matchwood, paper and paper board, and Christmas trees to other areas of the nation and Canada. Not all wood requirements for Minnesota industries are met by state harvested timber. Each forest industry has specific requirements regarding species, size, and quality of needed wood resources. A shortage of softwoods, long-fibered species such as spruce, red, white and jack pine and balsam fir are expected to continue through 1990. According to the Minnesota Department of Natural Resources, the level of softwood deficiency cannot be determined until a forestry inventory is completed. However, Minnesota pulp mills imported 5 million cubic feet of pulpwood (primarily softwood) in 1970. The state also imported nearly 86 percent of softwood lumber needs, and almost 98 percent of total plywood and veneer consumption, All substantial consumption of particleboard, plywood and lumber product categories is expected to increase Minnesota's dependence on timber imports (Tables 2 and 3). As a result, Minnesota's net timber exports are expected to be reduced to 8 million cubic feet in 1980 and to 6 million cubic feet in 1990.

Supply data about Minnesota's forest resources are relatively outdated. Based on 1962 data, the Minnesota Department of Natural Resources indicates the state's hardwood supply in terms of annual growth is more than double annual harvest and the demand for softwoods will probably surpass supply within ten years. The Department of Natural Resources indicated the number of acres for each tree species is known for state-owned lands, but data on the volume of timber is considered unreliable. Even less is known about supply availability on private timber lands. Long-fibered softwoods are recognized to be the major deficiency, although

Table 2

MINNESOTA CONSUMPTION OF WOOD RESOURCES, HISTORICAL AND PROJECTED, 1970-1990

	(In Thousands) 1970	1980	1990
Lumber	734,400 board feet	814,100 board feet	860,100 board feet
Plywood and Veneer	331,000 square feet	492,700 square feet	601,600 square feet
Particleboard	64,700 square feet	150,300 square feet	220,900 square feet
Matchwood	.4 cords	.3 cords	.2 cords
	2,000 square feet	1,700 square feet	1,400 square feet
Woodpulp	800 tons	1,181 tons	1,523 tons
Other pulp	220 tons	353 tons	535 tons
Cooperage	3,988 board feet	4,800 board feet	3,850 board feet
Piling	537 linear feet	640 linear feet	520 linear feet
Poles	99 pieces	120 pieces	90 pieces
Posts	1,815 pieces	2,180 pieces	1,760 pieces
Other Industrial	4,288 cubic feet	5,160 cubic feet	4,160 cubic feet
Fuelwood	296.8 cords	290 cords	300 cords
Paper and Paper Board	1,079 tons	1,522 tons	2,139 tons
Resins, Gums, Distillates	8 tons	8 tons	8 tons
Christmas Trees	700 pieces	800 pieces	900 pieces
TOTAL ROUNDWOOD EQUIVALENT VOLUME IN CUBIC FEET	300 Million feet^3	360 Million feet^3	430 Million feet^3

SOURCE: Minnesota Timber-Based Sector Analysis, College of Forestry, University of Minnesota.

Table 3

CHANGE IN MINNESOTA FOREST PRODUCTS PRODUCTION, TRADE AND CONSUMPTION, 1970-1990

	Per Capita Demand	State Consumption	Net Imports	Net Exports	Production
Sawnwood (Lumber)	Down 5%	Up 17%	Up 20%	--	Up 9%
Plywood & Veneer	Up 47%	Up 82%	Up 83%	--	Down 12%
Particleboard	Up 176%	Up 241%	Up 137%	--	Up 408%
Matchwood	Down 44%	Down 30%	--	Down 44%	Down 44%
Woodpulp	Up 40%	Up 73%	Up 245%		Up 31%
Other pulp	Up 97%	Up 143%	--	--	Up 143%
Cooperage	Down 22%	Down 3%	Down 3%	--	Down 4%
Piling	Down 21%	Down 3%	Down 4%	--	Steady
Poles	Down 23%	Down 9%	Down 17%	--	Down 8%
Posts	Down 22%	Down 3%	Down 17%	--	Up 2%
Other Industrial Wood	Down 22%	Down 3%	Up 3%	--	Down 4%
Fuelwood	Down 19%	Up 1%	Up 4%	--	Steady
Paper & Paper Board	Up 60%	Up 98%	1/	1/	Up 82%
Resins, Gums, Dist.	Down 20%	Steady	Steady	Steady	Steady
Christmas Trees	Up 6%	Up 29%	--	Down 11%	Steady

1/ Paper and Paperboard category changes from 83 net exports to 19 net imports

SOURCE: Minnesota Timber-Based Sector Analysis, College of Forestry, University of Minnesota.

the exact shortfall will not be known until completion of the forest survey in 1978. Until then, the question "Can Minnesota commercial forest lands meet future wood fiber demands that increase 20 percent in each decade from 1970-1990?" will remain unanswered.

Potentially, Minnesota's commercial forestland is capable of meeting the state's future wood fiber needs and could play an increasingly important role at the national level. However, to realize this potential, numerous policy decisions regarding future management practices are necessary. The state's commercial forestlands have widely varying physical characteristics which make certain sites more productive and better suited for intensive forest management. If high and medium-quality sites were identified and properly managed, there would be an increase in annual timber growth at a lower cost. At present, only a very limited portion of commercial forestland in the state is under any form of intensive timber management.

OUTDOOR RECREATION

SECTION 5

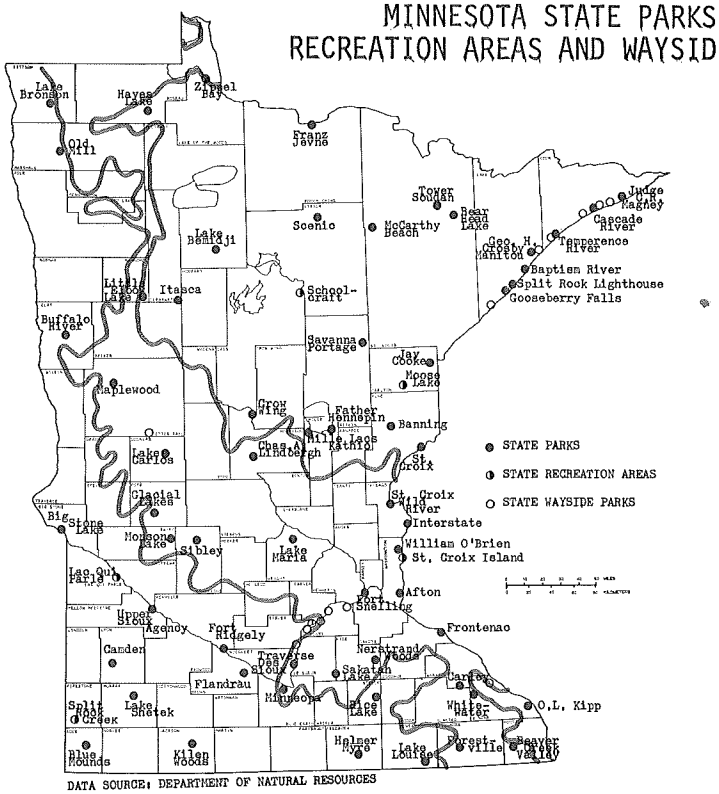
Outdoor Recreation

Minnesota's State Park and Recreation System has helped to preserve many unique and scenic high amenity areas for public use. These resources are facing the recreational demands of a younger and more active state population with increasing leisure time. Consequently, the need to identify recreational trends, improve existing facilities, and develop new facilities is essential to maintain quality recreational opportunities. This section reviews the present status of Minnesota's park and recreation system and identifies scheduled and potential land commitments for recreation at the state level.

Minnesota has 87 major units in its state park and recreation system consisting of 214,633 authorized acres. The system includes 60 state parks, 6 recreation areas, 11 state waysides, 1 memorial state wayside and 9 state monuments (Figure 1). In addition, the system contains 12 state trails, 5 scientific and natural areas, 18 canoe and boating route rivers, 1 national and 3 state wild and scenic rivers and 75 forest recreation areas. Currently, the size, physical characteristics and facilities within park and recreational units are being reviewed, and they may be reclassified to reflect more accurately their primary function.

Figure 1

MINNESOTA STATE PARKS,
RECREATION AREAS AND WAYSIDES, 1977



DATA SOURCE: DEPARTMENT OF NATURAL RESOURCES

The present emphasis of the Parks and Recreation Division of the Minnesota Department of Natural Resources is to complete acquisition within existing park and recreation units. Land acquisition has been a slow and tedious process due to limited funding and the reluctance of many private owners to sell their land. In 1975, approximately 36,700 acres of private land had yet to be acquired. The Minnesota Legislature, recognizing the need to improve the quality of the state park system,approved a three phase acquisition program to purchase remaining private land holdings. In the first phase, the 1975-1977 biennium, approximately 12,108 acres are to be purchased. The remaining 24,621 acres would be acquired during the second and third phases of the program which are recommended to follow in succeeding bienniums.

Upon completion of land acquisition in existing units, new park and recreation areas may be created. In 1969, the Legislature authorized and funded "Project 80 - A Study of the Total Environment." The primary purpose of the study was the preparation of a document to help guide the legislative review of appropriation requests involving state land acquisition, development and maintenance for recreation.

Project 80 recommended that 21,224 acres be considered for possible expansion of existing park and recreation units.[1] In addition, more than 115,000 acres possessing outstanding scenic, historic or natural value were identified. These sites may be included in future public acquisition plans depending on the demand for recreational facilities, an analysis of existing sites, and future legislative actions. Scheduled and potential recreational land commitments are summarized in Table 1.

Land use and facility needs for recreational activities are identified in the State Comprehensive Outdoor Recreation Plan (SCORP). This plan, completed in 1974 by the Minnesota Department of Natural Resources, inventoried public and private recreational facilities as well as estimated future recreational activity levels in each of the state's economic development regions. Projected recreational activity levels were then converted into rough spatial estimates of developed acres and undeveloped buffer areas required for each activity. These recreation open space estimates are shown by region in Table 2.

New population projections, better recreation trend data, and improved inventory procedures make revision of the 1974 SCORP highly desirable. The last statewide survey of recreational participation rates was completed in 1967 and does not accurately reflect present recreational participation patterns. In addition, forecasted population shifts to some Minnesota rural areas may cause resident outstate recreational facility needs to increase somewhat in relative magnitude to metropolitan area needs. Since February, 1976, the Department of Natural Resources

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[1] Minnesota Department of Natural Resources, Bureau of Planning and Minnesota State Planning Agency, Environmental Planning Division, Minnesota Resource Potentials in State Outdoor Recreation, Project 80 Staff Report No.1, July, 1971, p. 9.

Table 1

POTENTIAL AND SCHEDULED LAND ACQUISITIONS FOR PARKS AND RECREATION (IN ACRES)

REGION	PROJECT 80 PROPOSED UNITS[1]	+	PROJECT 80 RECOMMENDED EXPANSIONS OF EXISTING UNITS[1]	+	1975-1990 PROPOSED CORRIDOR TRAIL ACQUISITION[2]	+	RESOURCE 2000 ACQUISITION IN AUTHORIZED UNITS	=	TOTAL POTENTIAL LAND ACQUISITION
1	3,320		2,900		1,572		1,609		9,401
2	1,620		0		2,724		441		4,785
3	33,455		4,240		8,004		10,363		56,062
4	17,890		2,435		2,724		4,009		27,058
5	16,560		0		2,604		802		19,966
6E	17,659		250		1,896		1,753		21,558
6W	0		160		888		315		1,363
7E	2,630		700		264		6,521		10,115
7W	12,510		960		912		222		14,604
8	0		950		252		1,646		2,848
9	2,480		600		1,332		513		4,925
10	6,520		8,029		4,404		7,309		26,262
11	160		0		924		1,146		2,230
State Total	114,804		21,224		28,500		36,649		201,177

[1]These recreation areas may or may not be acquired. There is no time table for acquisition.

[2]Trail acquisitions are based on projected state corridor trail needs of approximately 2,800 miles of which 415 miles were acquired by 1975. Acreage figures for regions are calculated from 1975 DNR map of proposed corridor trails; actual acreage in each region will depend on the alignment of the trails.

Sources: Minnesota Resource Potentials in State Outdoor Recreation, Project 80, Staff Report Number 1; Resource 2000 - Department of Natural Resources; Trails Section, Department of Natural Resources; Parks and Recreation Division, Department of Natural Resources.

Table 2

PROJECTED ACREAGE DEFICIENCIES FOR OUTDOOR RECREATION BY 1990[1]

	Swimming	Camping	Picnicking	Water Accesses[2]	Snow Trails[2]	Hiking Trails[2]	Athletic Fields	Tennis Courts	Golf[2]	Total Acreage Deficiencies
Region 1	-32	-180	-19	-40	-1,528	-256	-21	-8		-2,084
Region 2		-232		-390				-8		-630
Region 3		-1,381	-176	-550	-1,096		-346	-74		-3,623
Region 4		-692	-65	-950	-2,204			-36		-3,947
Region 5		-659	-109	-500	-2,348					-3,616
Region 6		-303	-58	-360	-2,172	-432	-9	-18		-3,352
Region 7	-637	-1,266	-455	-300	-3,956	-80	-453	-188	-792	-8,127
Region 8	-29	-216	-32	-100	-884	-336	-61			-1,658
Region 9	-196	-420	-156	-235	-2,184	-636	-169	-18	-16	-4030
Region 10	-538	-529	-225	-50	-3,272	-884	-730	-192		-6,420
Region 11	-582	-1,388	-895	-235	-9,864	-7,496	-6,829	-1,232	-224	-28,745
State Total	-2,014	-7,266	-2,190	-3,710	-29,508[3]	-10,120[3]	-8,618	-1,774	-1,032	-66,232

[1]Figures are based on a projected state population of 4.6 million in 1990.

[2]Land needs projected to 1975 only.

[3]Trail mileage may be subject to duplication.

SOURCE: STATE COMPREHENSIVE OUTDOOR RECREATION PLAN, REVISED BY DNR PLANNING, AUGUST 18, 1976

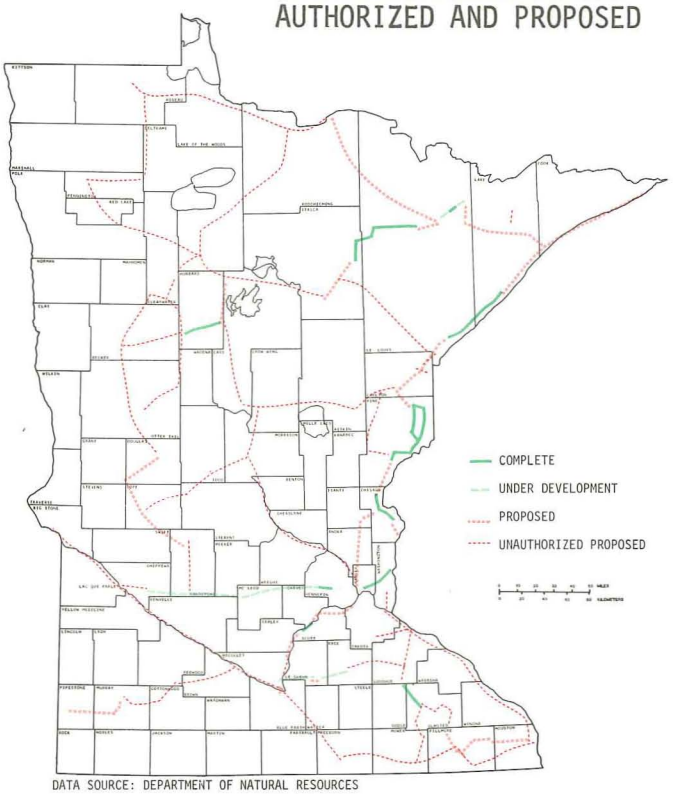
has been involved in developing a new survey design to update projections of recreational participation and facility needs for the 1979 State Outdoor Recreation Plan.

Corridor trails potentially represent a significant land consuming activity at the state level. The state's 12 corridor trails will be multi-purpose and serve to link counties and recreation areas throughout the state. In 1975, 415 miles of corridor trail have been acquired out of 1,400 authorized miles. The Department of Natural Resources expects an additional 1,400 miles of corridor trails to be needed by 1990. As of July 1, 1975, approximately 4,980 acres of land have been acquired for corridor trail development. By 1990, a projected 28,620 additional acres would be needed. Approximately 315 miles of trail right-of-way are sought from proposed railroad abandonments. The remaining land acquisitions would involve both public and private lands. Authorized and proposed corridor trails are shown in Figure 2.

Trail acquisition is difficult since many landowners may be involved. To date, most successful corridor trail acquisitions have involved abandoned railroad lines or significant areas of public land. If future rail abandonments are not forthcoming, private land purchases or easements would be necessary. The Department of Natural Resources is currently working on a "State Trail Plan" to determine the optimum location and type of future trail development.

Figure 2

STATE CORRIDOR TRAILS
AUTHORIZED AND PROPOSED



DATA SOURCE: DEPARTMENT OF NATURAL RESOURCES

SECTION 6

PUBLIC UTILITIES

Public Utilities

Electrical Energy

Minnesota is largely dependent on other states and foreign countries for its energy. In 1973, the state consumed 1,143,700 billion BTUs[1] of energy. Petroleum products accounted for 44.4 percent of the supply, natural gas 31.1 percent, coal 16.2 percent and hydropower and nuclear power 7.5 percent.[2] Virtually all of the state's energy is imported or produced from imported fuels.

Minnesota's lack of domestic energy sources results in relatively limited land allocations for energy production, with the exception of electrical generating facilities. Coal, oil, and gas fuels may require land for loading facilities, storage areas, refining plants, and distribution systems. Since these fuels are often refined or processed out of state and shipped as finished products, little additional land in Minnesota is required for manufacturing, processing, and distribution.

The most significant land use requirements are likely to result from electrical generating facilities and transmission lines. Projections of future electrical energy facilities are fairly reliable for about 7 to 10 years because of the necessary lead time for plant construction. Beyond this period, numerous factors including government policies and resource supply will affect the demand for electrical energy. Natural gas reserves at the national level are declining and oil imports from Canada are scheduled to be substantially reduced. This may result in the need to substitute electrical energy for less available fuel resources. However, the extent of future substitution is unknown.

Despite the uncertainties of fuel substitution, the demand for electrical energy in Minnesota is expected to increase significantly. The Minnesota Energy Agency indicates that several land activities have shown dramatic increases in energy use. In 1974, mining companies purchased more than four times as much power as in 1965. Minnesota Power and Light (MP&L), which supplies over 90 percent of the electricity sold to the mining industry, expects these sales to more than triple by 1980. Between 1965 and 1975, the amount of electricity used in irrigation increased 25 times. Since less than 4 percent of Minnesota's agricultural land is irrigated, the potential exists for irrigation to become a significant part of Minnesota's summer electrical demand.[3]

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[1] BTU British thermal unit is the quantity of heat required to raise the temperature of one pound of water one degree Fahrenheit.

[2] Minnesota Energy Agency, Minnesota Energy Use Trends, 1957-1973, St. Paul, Minnesota, February, 1975.

[3] Minnesota Energy Agency, Minnesota's Energy Situation, A Biennial Report to the Governor and the Legislature, St. Paul, Minnesota, January, 1976.

Future demands for electricity have been estimated by the Minnesota utilities on the basis of historical load data.[4] Energy conservation, large-scale energy users, residential growth patterns and energy substitution were also considered when data were available. In 1975, the state had an electrical generating capacity of 5,758 megawatts (mw). The electrical utilities' fifteen year forecast indicates a projected peak summer demand of 15,213 mw of electrical power in Minnesota by 1990. This means that the state's generating capacity would almost double every ten years.

From 1975 to 1990, utility companies estimate they will have to build energy facilities to produce an additional 9,816 mw of electrical power and construct approximately 3,260 miles of transmission lines (Table 1). Projections of future generating capacity indicate the Minnesota Environmental Quality Board (EQB), upon receiving a certificate of need from the Minnesota Energy Agency, may have to locate major sites for both nuclear and coal-fired energy facilities (Table 2). Since 1975, 1,088 miles of transmission line have been routed and scheduled for construction. The EQB will also route an additional 1,502 miles of 230 kilovolt (kV) transmission lines, 295.5 miles of 345 kV lines and 375 miles of 500 kV lines by 1990.

Table 1

FUTURE POWER GENERATION AND TRANSMISSION LINE REQUIREMENTS 1975-1990

Electric Power Generation

Committed and Proposed Additions to 1980	807
Committed and Proposed Additions to 1985	3009
Projected Additions to 1990	6000
Total new generating capacity	9816 mw

Transmission Lines[1]

	Miles 230 kV	Miles 250 kV (dc)	Miles 345 kV (dc)	Miles 400 kV (dc)	Miles 500 kV	Total Miles
Routed - yet to be constructed (1975-1978)	417	205	154	172	140	1,088
Future Routings (1979-1990)	1,502	---	295.5	---	375	2,172.5
	1,919	205	449.5	172	515	3,260.5

[1]Distances are estimates on straight line basis.

[4] Minnesota-Wisconsin Power Supplies Group, Advance Forecasting Report to the Minnesota Environmental Quality Board, St. Paul, Minnesota, July, 1976.

Table 2

ADDITIONAL COMMITTED AND PROJECTED GENERATING CAPACITY IN MINNESOTA, 1976-1990

System	Unit Name	Location	Type	Summer Rating (mw)	In-Service Date	Water Source	Water Demand Max. Rate (GPM)[1]	Water Demand Yearly Volume (MG)[2]
Committed and Proposed Generating Capacity								
NSP	Sherburne Co. 2	Becker	Fossil	680	5-1-77	Mississippi River	8,500	3,155
UPA	Peaking 1+2+3	Minnesota	Gas	63/69	5-1-78	None		
CPA	Peaking 1	Benson	Gas	21/29	5-1-78	None		
CPA	Peaking 1	Jackson	Gas	21/29	5-1-78	None		
MP&L	Boswell 4	Cohasset	Fossil	500	5-1-80	Mississippi River	6,500	2,600
NSP	Sherburne Co. 3	Becker	Fossil	780	5-1-81	Mississippi River	10,000	7,700
LSDP	Sherburne Co. 3	Becker	Fossil	20	5-1-81	(Included above)		
NSP	Sherburne Co. 4	Becker	Fossil	780	5-1-83	Mississippi River	10,000	7,700
CPA	1983 Peaking	Mayer	Gas	49/60	11-1-83	None		
MP&L	1985 Fossil	Brookston-Floodwood Area	Fossil	500	11-1-85	St. Louis River	9,200	3,800
	1984 Fossil	Brookston Floodwood Area	Fossil	300	11-1-84	(Included above)		
CPA	1984 Peaking	Mayer	Gas	49	11-1-84	None		
Projected Facilities								
M/W PSG	---	Unknown	Coal	800	---	Unknown	10,000	7,700
M/W PSG	---	Unknown	Coal	800	---	Unknown	10,000	7,770
M/W PSG	---	Unknown	Coal	800	---	Unknown	10,000	7,770
M/W PSG	---	Unknown	Coal	800	---	Unknown	10,000	7,770
M/W PSG	---	Unknown	Nuclear	1,100	---	Unknown	18,900	6,200
M/W PSG	---	Unknown	Nuclear	1,100	---	Unknown	18,900	6,200
M/W PSG	---	Unknown	Peaking	600	---	---	---	---
TOTAL GENERATING CAPACITY/ESTIMATED WATER DEMAND				9,783-9,816 mw[3]			112,000	60,455

[1] Gallons Per Minute
[2] Millions of Gallons
[3] Possibility exists that some generating plants could be built outside Minnesota.

SOURCE: 1976 Advance Forecasting Report to the Minnesota Environmental Quality Council

From 1975 to 1990, power plants and transmission lines may affect approximately 78,600 acres of land in Minnesota (Table 3). Because of the need for water reservoirs, future power plants will require approximately 2,000 acres of land per 1000/mw. Projected increases in generating capacity would necessitate the use of roughly 19,630 acres for new power plants. Committed and proposed facilities are shown in Figure 1. These projections assume that no major shifts to electric power will arise from the energy crisis.

Transmission lines, assuming an average right-of-way for each voltage of lines, would directly affect about 59,000 acres. The proposed location of these lines is shown in Figure 2. The structures of 345 kV and 500 kV lines will displace less than one-half acre of land per mile. Only one-tenth of an acre per mile would be required for 230 kV and 250 kV lines. With proper routing, as much as 97 percent of the transmission line right-of-way can be used for agricultural purposes.

Electrical energy production will represent a growing consumption of land in Minnesota's future. Location of future generating facilities is the responsibility of the Environmental Quality Board. To aid in the site selection process, the EQB has developed a list of potential power plant candidate areas. Over 40 sites were identified which include 1,329,264 acres primarily located in north central and northeastern Minnesota. Less than 2 percent of the combined candidate areas will be used by 1990. The list of potential power plant candidate areas is being studied further and will be revised. Potential transmission corridors will be reviewed as soon as energy facilities and market destinations can be identified.

Table 3

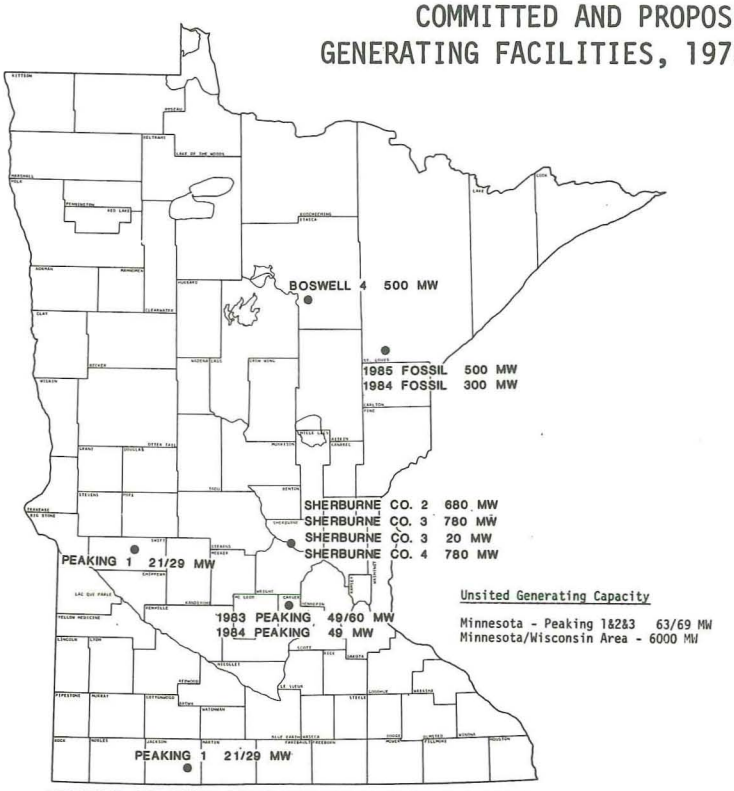
FUTURE POWER PLANT AND TRANSMISSION LINE REQUIREMENTS 1975-1990

Facility	Typical Land Use Requirements	Projected Demand	Land Requirements
Power Plants	2,000 acres/1000MW	9,816/1000MW	19,632 acres
Transmission Lines			
230 kV	130' right-of-way	1,919 miles	30,238 acres
250 kV (dc)	120' right-of-way	205 miles	2,981 acres
345 kV	160' right-of-way	449.5 miles	8,716 acres
400 kV (dc)	160' right-of-way	172 miles	3,335 acres
500 kV	220' right-of-way	515 miles	13,733 acres
			78,635 acres

SOURCE: 1976 Advance Forecasting Report to the Minnesota Environmental Quality Board.

Figure 1

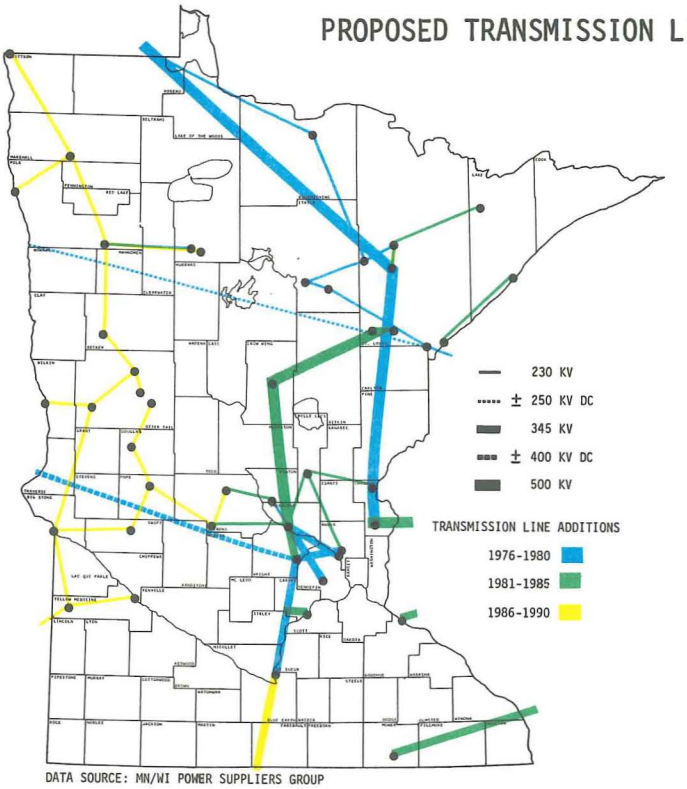
COMMITTED AND PROPOSED
GENERATING FACILITIES, 1975-1990



DATA SOURCE: 1976 ADVANCE FORECASTING REPORT TO THE MINNESOTA ENVIRONMENTAL QUALITY COUNCIL

Figure 2

PROPOSED TRANSMISSION LINES, 1975-1990



DATA SOURCE: MN/WI POWER SUPPLIERS GROUP

SECTION 7

TRANSPORTATION

Transportation

Airports

Minnesota's aviation system includes 140 airports which use an estimated 43,000 acres of land. While an airport has relatively small land requirements, its site selection is instrumental in shaping community growth. Airports not only provide transportation links to other cities, they also play a crucial role in where commercial, industrial, and residential development takes place.

The state's publicly-owned airports are classified as key airports, intermediate airports, or landing strips depending on their size and function (Appendix A). In the last twenty-five years the number of publicly-owned airports has nearly doubled. In 1950, public airports totaled 78. By 1975, the state aviation system had expanded to 19 key airports, 57 intermediate airports and 64 landing strips (Table 1). Complementing this system are 254 restricted or private fields and 25 privately-owned fields open to the public within the state.

Minnesota's 1990 aviation system is expected to have a total of 145 airports with control over an estimated 56,700 acres of land (Table 2). Out-state expansion would upgrade existing facilities, resulting in five additional key airports and 23 additional intermediate airports (Figure 1). Landing strips would be reduced in number by 23. Only 11 new sites would be needed for airports in outstate Minnesota. Recommended expansion in the metropolitan area, based on a 1972 study, includes new sites for two key airports and three intermediate airports. These aeronautical needs are currently being reviewed by the Metropolitan Council and are subject to revision.

Table 1

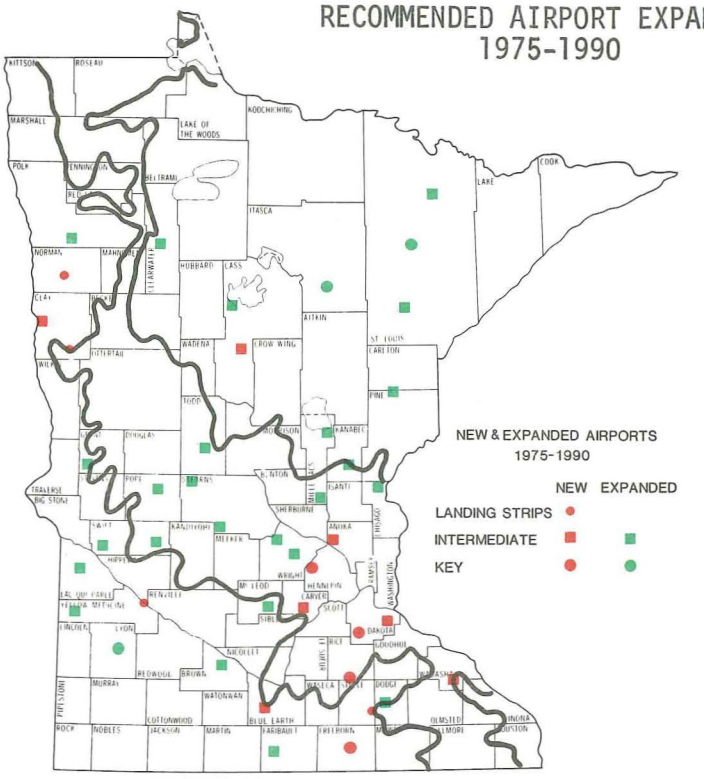
MINNESOTA AVIATION SYSTEM, 1975

Classification	Number	Typical Acreage	Total Acreage
Key Airports (Additional acreage at MSP)	19	570	10,830
Intermediate Airports	57	285	3,000
Landing Strips	64	200	16,245
Restricted Use Fields	254	6	1,524
Privately-Owned Public and Commercial	25	12	300
			44,699

SOURCE: Minnesota Aviation System Plan Summary Report

Figure 1

RECOMMENDED AIRPORT EXPANSION,
1975-1990



Future airport expansion emphasizes improving and upgrading existing landing strips and intermediate airports. New construction will not require much land. Projections show an additional 12,000 acres would be needed for airport development by 1990 (Table 3). The most concentrated development would be in the metropolitan area where 7,200 acres of land are needed or nearly 60% of the state total. These projections assume the average size of a key airport to be 570 acres, an intermediate airport 285 acres, and a landing strip 200 acres. Not all of the acreage is used by the landing surface. As much as 40 to 50 percent in the buffer zone may be leased for agricultural purposes.

Future airport planning will involve coordinating public and private airport expansions to develop an effective system to serve public needs. In some cases, landing strips may be consolidated to provide better facilities, freeing land for other uses. Such land use decisions will continue to be important in guiding local growth and development.

Table 2

MINNESOTA AVIATION SYSTEM, 1990

Classification	Number	Typical Acreage	Total Acreage
Key Airports[1]	24	570	13,680
(1975 additional acreage at MSP)			3,000
Intermediate Airports	80	285	22,800
Landing Strips[2]	41	200	8,200
Metropolitan Airports (2 new key, 3 new intermediate)			7,200
Restricted Use Fields	254	6	1,524
Privately-Owned Public and Commercial	25	12	300
			56,704

[1] Excludes new metropolitan airports.

[2] Includes the Rushford landing strip which is not recommended for expansion in the 1987 system.

SOURCE: Minnesota Aviation System Plan Summary Report

Table 3

ESTIMATED LAND REQUIREMENTS FOR AIRPORT CONSTRUCTION, 1975-1990

Region	Net Change in Key Airports (570 Acres)[1]	Net Change in Intermediate Airports (285 Acres)[1]	Net Change in Landing Strips (200 Acres)[1]	Estimated Additional Acreage
1	--	+1	--	285
2	--	+1	-1	85
3	+2	--	-2	740
4	--	+3	-1	655
5	--	+3	-4	55
6E	--	+1	-1	85
6W	--	+4	-3	540
7E	--	+4	-4	340
7W	--	+5	-5	425
8	+1	-1	--	285
9	--	+3	-2	455
10	+2	-1	--	855
Metro (11)	-- [2]	-- [2]	-- [2]	7,200
TOTAL	+5	+23	-23	12,005

[1] Figures denote typical acreage needed for each airport classification.

[2] See Appendix - Region 11.

SOURCE: Minnesota Aviation System Plan Summary Report

Highways

In 1975, the right-of-way for Minnesota roads and highways used 1,224,201 acres of land. Approximately 50,150 acres have been acquired in the past fifteen years (see Table 4). Since the interstate highway system has been virtually completed, future highway expansions will be limited. To the extent possible, new highway improvements will emphasize upgrading and maintaining existing transportation routes within the existing right-of-way.

The interstate freeway system has increased mobility, made more land accessible for development and shifted settlement patterns. In spite of its profound impact, the interstate system has consumed comparatively little land. Presently, the system in Minnesota stretches 762 miles over 27,709 acres of land, comprising only 2.3 percent of the total land in highways, but represents 55 percent of all highway construction since 1960. The major land consuming highways are those in county and township control, containing 72 percent of all land in highways. Trunk highways account for another 16.4 percent of highway land, city streets and municipal-aid streets 7.4 percent, and other roads 1.6 percent.

By 1990, Minnesota roads and highways are expected to increase by 1,535 miles and use an additional 17,056 acres of land (Table 5). Completion of the interstate highway system will require an additional 5,600 acres; however, much of this right-of-way has already been acquired. Most road building in Minnesota will take place under the jurisdiction of county and township government. These rural highways and roads will account for 57 percent of the future land requirements and, if the interstate system is not included, they would represent 84 percent of the future land needs. Municipal streets including state-aid streets are expected to use an additional 1,493 acres, with new trunk highways using 193 acres and other roads accounting for 200 acres.

According to the Minnesota State Highway Department's preliminary major highway improvement program, 870 miles of trunk highway will be upgraded from 1975 to 1990 (Figure 2). Since the lead time for highway construction is eight to ten years, right-of-way for many 1975 to 1980 projects has already been obtained. Additional right-of-way still remains to be acquired for projects from 1981 to 1990. Land required to improve existing highways has not yet been determined, although a rough estimate would indicate 3,000 to 4,000 acres.

It is likely that highway developments from 1975-1990 will be relatively limited in terms of land requirements. Assuming that existing Interstate acquisitions offset the land needed to improve existing highways and present levels of highway expenditures continue, approximately 17,056 new acres of land will be required for highway development by 1990. The significance of this land consumption is in its secondary impact; particularly in those land areas that are made more accessible and could attract growth and development.

Table 4

MINNESOTA'S HIGHWAY SYSTEM, HISTORICAL, PRESENT AND PROJECTED, 1960-1990

1960 System

	1960 Mileage	Assumed Average Right-of-Way	No. Acres Per Mile	1960 Acreage
Interstate Highways	30	300'	36.36	1,091
Trunk Highways	11,811	145'	17.52	206,929
County-State-Aid Highways	29,098	87'	10.55	306,984
County Roads	15,961	60'	8.00	127,688
Municipal State-Aid Highways	854	60'	7.44	6,354
Municipal Streets	9,124	60'	7.27	66,331
Township Roads	54,919	66'	8.00	439,352
State and/or National Forest, Park Refuge and Institutional Roads	2,415	66'	8.00	19,320
TOTAL	124,212			1,174,049

1975 System

	1975 Mileage	Assumed Average Right-of-Way	No. Acres Per Mile	1975 Acreage
Interstate Highways	762	300'	36.36	27,709
Trunk Highways	11,435	145'	17.50	200,343
County-State-Aid Highways	29,785	87'	10.55	314,096
County Roads	15,172	66'	8.00	121,376
Municipal State-Aid Highways	1,500	60'	7.44	11,165
Municipal Streets	10,867	60'	7.27	79,032
Township Roads	56,299	66'	8.00	450,368
State and/or National Forest, Park, Refuge and Institutional Roads	2,514	66'	8.00	20,112
TOTAL	128,334			1,224,201

1990 System

	1990 Mileage	Assumed Average Right-of-Way	No. Acres Per Mile	1990 Acreage
Interstate Highways	916	300'	36.36	33,306
Trunk Highways	11,446	145'	17.52	200,534
County-State-Aid Highways	29,904	87'	10.55	315,487
County Roads	15,333	66'	8.00	122,664
Municipal-State-Aid Highways	1,523	60'	7.44	11,336
Municipal Streets	11,039	60'	7.27	80,254
Township Roads	57,168	66'	8.00	457,344
State and/or National Forest Park, Refuge and Institutional Roads	2,540	66'	8.00	20,332
TOTAL	129,869			1,241,257

SOURCE: MINNESOTA DEPARTMENT OF TRANSPORTATION

Table 5

LAND REQUIREMENTS FOR HIGHWAYS, 1975-1990

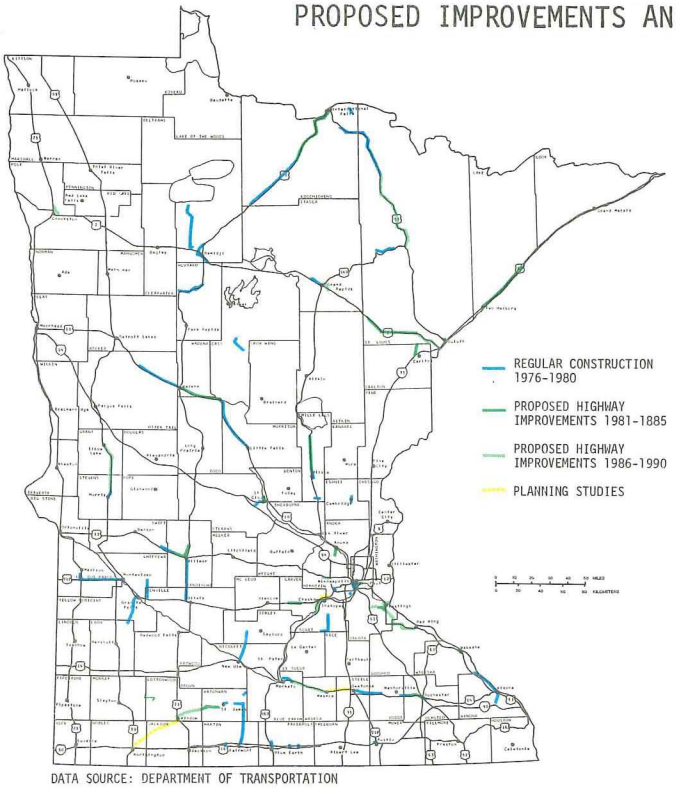
Highway	Approximate 1975-1990 Additional Mileage	Acres[1] Per Mile	Additional Acres Required	Percent of Total
Interstate Highway	154	36.36	5,597	33
Trunk Highway	11	17.52	191	1
County-State-Aid	119	10.55	1,391	8
County Roads	161	8.00	1,288	8
Municipal-State-Aid	23	7.27	171	1
Municipal Streets	172	7.27	1,222	7
Township Roads	869	8.00	6,976	41
State and/or National Forest, Park, Refuge and Institutional Roads	26	8.00	220	1
	1,535		17,056	100

1 Acreage may vary slightly depending upon local conditions.

SOURCE: Office of Program Planning, Minnesota Department of Highways; State Planning Agency

Figure 2

MINNESOTA HIGHWAY CONSTRUCTION
PROPOSED IMPROVEMENTS AND STUDIES, 1976-1990



DATA SOURCE: DEPARTMENT OF TRANSPORTATION

Railroads

The projected changes in the use of land for railroads are quite different than for most other activities. While other activities are acquiring more land to satisfy their needs, the railroad industry is in the process of abandoning trackage.

Abandoned railroad lines, their rights-of-way and other properties, are a valuable resource to the State of Minnesota. It is expensive and disruptive to continue to assemble rights-of-way for different facilities. A railroad right-of-way is an established use; its re-use as a trail, transmission line, highway or pipeline is less damaging to existing land use and social patterns than constructing a new right-of-way.

Railroad abandonments must be approved by the Interstate Commerce Commission (ICC). In most cases, if the railroad can demonstrate that the line is unprofitable to operate, the ICC will approve the abandonment. This action allows railroads to suspend service as of the date the order is effective, remove the rails and dispose of the property after a six month period.

In 1975, Minnesota's railroad system consisted of approximately 7,851 miles of main and branch rail lines and 3,828 miles of spur lines, yard tracks and passing tracks. From January 1, 1975 to July 1, 1977, 337 miles of line have been abandoned and applications for abandonment are pending before the ICC for another 38 miles of line (Table 6).

Railroads have sold approximately 55 percent of the rights-of-way abandoned between 1970 and 1976. Most of the land has been used for agricultural purposes or recreational trails. Other potential re-uses include land banking for future rail use; highway, transmission line, and pipeline corridors; wildlife management; conservation and urban development.

Table 6

RAILROAD ABANDONMENTS, 1975-1990

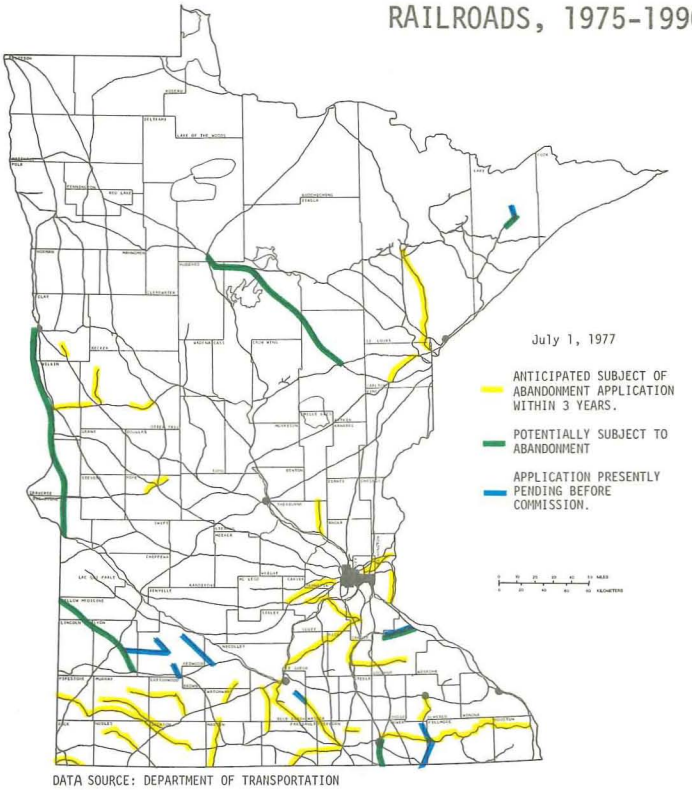
Time Schedule	Status	Mileage	Acres/Mile of 100' R-O-W	Potential Acreage for Re-use
1975-1977	Abandoned	337	12.12	4,084
1977	Application Pending	38	12.12	460
1977-1980	Anticipated Abandonment	863	12.12	10,460
1980	Potential Abandonment	240	12.12	2,909
	TOTALS	1,478		17,913

Starting May 1, 1977, the ICC has required railroads to prepare a "system diagram map" which shows the status of each line in that railroad's system (Figure 3). This allows the state an opportunity to assess the impacts of rail abandonment and to plan for the reuse of rail property. According to the plan filed with the ICC, 862 miles of railroad are anticipated to be subject to abandonment with three years; another 240 miles of railroad have been identified as potentially subject to abandonment. If approved, railroad abandonments would total 1,477 miles from 1975 to 1990. This represents approximately 17,900 acres of land likely to be sold by the railroads (Table 6).

The State Planning Agency is conducting a study to determine the potential reuses of abandoned rail lines and to suggest a state program of orderly reuse. The abandoned properties would be evaluated for their suitability for transportation, communication, recreation, conservation, wildlife management and agriculture reuses in a manner that considers long-term needs, safety, environmental compatibility, social implications and economic realities.

Figure 3

ABANDONED AND POTENTIALLY ABANDONED RAILROADS, 1975-1990



DATA SOURCE: DEPARTMENT OF TRANSPORTATION

CLARIFICATION

Slightly more than 17,000 acres is projected for future highway needs (Table 5, page 7-6). This projection was made in 1975 and is based, in part, on the now defunct Backbone System Plan. The new DOT Plan emphasizes a planning process rather than a long range plan. As such, many decisions remain to be made regarding individual projects.

In the overview section (Figure 3, page 14), the projection of 17,000 acres for highways is reduced to 10,000 acres to avoid double counting and reflect a decrease in the number of highway improvement projects. In the first case, the urban land category will include access provided by municipal streets, therefore, already accounting for a portion of the land use change. In the second case, a decrease in highway funding has resulted in a major emphasis on highway maintenance and bridge repair. As a result, less land will be acquired for upgrading existing highways.

In general, the conclusions remain the same. Highways are projected to use little land compared to other land use activities. Most future acquisition is likely to be for township and county roads.

URBAN LAND

SECTION 8

Urban Land

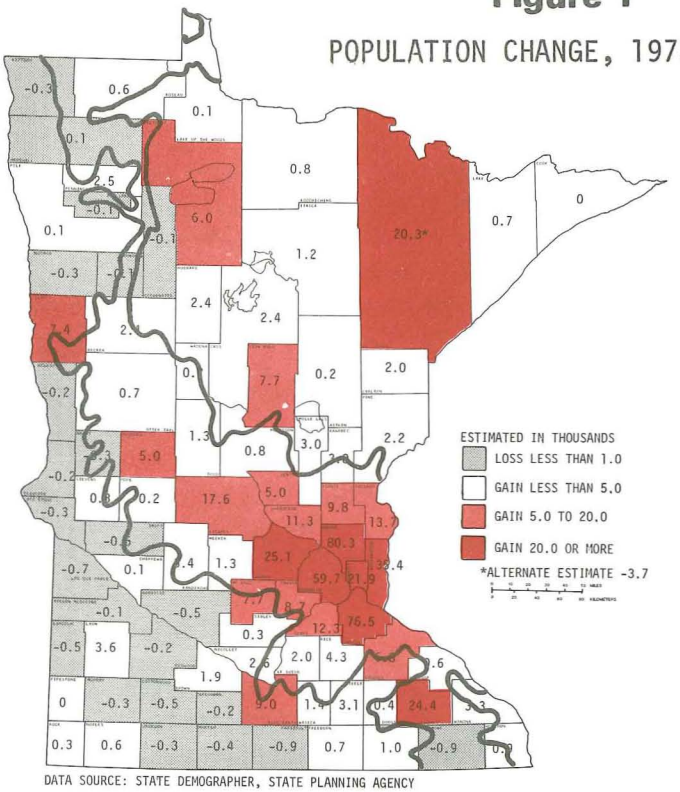
The state demographer's population projections for the next fifteen years indicate changes in the rate and distribution of Minnesota's growth. The projections confirmed that the state's growth rate is not as rapid as in recent years. This is due mainly to a lower fertility rate. On the average, women are having fewer children. However, the age structure of the state's population may continue to make urban growth a problem. Since there are more young people leaving their parents' home, the state will be entering a period of rapid household formation. The need for new housing units and related urban facilities will mean a greater demand for urban land.

Changes were also noted in the geographic distribution of rapid population increases. In previous years, Hennepin and Ramsey Counties were forerunners in the percentage of population increase. They are no longer expected to be the fastest growing counties. Rapid growth areas now include scenic, high amenity counties, especially those surrounding the metropolitan area. Several counties which are generally rural in nature seem to be facing the challenge of accommodating future growth.

Minnesota's population is projected to increase by approximately 500,000 persons within the next fifteen years (Figure 1).

Figure 1

POPULATION CHANGE, 1975-1990



DATA SOURCE: STATE DEMOGRAPHER, STATE PLANNING AGENCY

These population increases will not have the same influence or impact on the land in each county or region of the state. Settlement patterns are historically more land consumptive in certain areas. Land values, physical characteristics, recreational resources, transportation corridors and existing development patterns will influence land use decisions. Consequently, changes in the distribution of population growth will result in different patterns of land use.

This analysis attempts to look at recent state population projections in terms of their land use implications. In other words, if the persons making up the population increase of the next fifteen years adopt present living styles and recreational habits, what would be the impact on land use patterns? How much land might be converted to urban development and where? How will agricultural land be affected? What will be the implications for recreation land resources?

Methodology

Projections of urban land needs are based on the acres of urban land used per capita. Urban land is defined as a 40-acre parcel containing five or more residential structures or an institutional or commercial development. The projections represent the number of 40-acre parcels that will be converted to industrial, residential and commercial development in the next fifteen years if historical trends continue. Primary data sources include the state demographer's population projections and the amount of urban land as identified by the Minnesota Land Management Information System (MLMIS).[1]

The amount of urban land used per capita was calculated for the state, economic development regions and counties by dividing the 40-acre parcels of developed land within these areas by an estimate of the corresponding urban population (See Table 1 for regional example). Land use planning staff determined that the U.S. Census Bureau's urban population, the population of incorporated cities under 2,500 and permanent lakeshore population would best approximate the number of persons residing in urban forties identified by MLMIS. Since the population data may vary in its correspondence with identified urban parcels in a given area, density estimates for larger geographical areas (the state and economic development regions) are considered more reliable than county based projections. However, all methods may be disaggregated or aggregated for comparison. The assumptions used in developing the urban land projections and the detailed procedure for determining per capita land use ratios are included in Appendix B.

Three separate projections of urban land were developed and will be referred to as series 1, series 2 and series 3. The first series is

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[1]The MLMIS is a computerized method of storing information by geographically definable areas called "data cells" and a computerized system to analyze resource data.

based on the statewide ratio of .4 acres of urban land per capita. This ratio was calculated by dividing the total amount of urban land in the state by the total estimated urban population. The urban land demand is derived by multiplying the ratio by the projected increase in state population from 1975-1990. Only those counties showing population increases were used to calculate the population growth since a declining population will not result in a decrease of existing urban development. The statewide total of urban land is distributed proportionately by using the ratios determined in the regional and county projections.

The second series of urban land projections is based on the amount of urban land that is used per capita in each economic development region. The per capita ratio is multiplied by the projected increase in regional population from 1975 to 1990 (Appendix B, Table 1). The regional urban land needs are distributed proportionately to the counties by using the percentages determined in the county projections.

The third series of projections is based on the acres of urban land used per capita in each county. The county urban land per capita ratio was multiplied by the increase in county population in the same manner as were the other projections. The resulting county urban land projections were aggregated into regional and state totals. The calculation of three series are shown in Appendix B.

In all cases, the amount of urban land allocated to the Twin Cities Metropolitan Region was 57,600 acres. This figure was determined by the regional method (series 2) and is comparable to the urban land demands estimated by the Metropolitan Council, if based on the same population increase (See Appendix B).

The urban land projections were developed to illustrate areas of greatest land consumption. The three projections of urban land demand compare favorably at the state level and in most cases even within similar geographical areas (Table 2). Since projections are developed from past trends, increased residential lot sizes or major new development could alter the land use estimates within local areas. Projections by regions are less susceptible to change due to the larger data base. For purposes of illustration, series 1 projections will be used to summarize future urban land patterns.

Urban Land Projections

In 1969, 1,194,000 acres or 2.2 percent of Minnesota's total land area was devoted to urban development. Urban land projections indicate the state will need an additional 205,000 to 238,000 acres of land within the next fifteen years, or a 17-20 percent increase over the amount of urban land in 1969. This estimate represents the number of 40-acre parcels that would be converted from primarily agricultural and forest use to urban needs if present trends persist.

Although the development of 205,000 to 238,000 acres seems relatively small for a fifteen year period, the distribution of these parcels will

Table 1

ACRES OF URBAN LAND PER CAPITA BY REGION, 1970

REGION	Step 1 URBAN RESIDENTIAL FORTIES[1]	Step 2 URBAN MIXED FORTIES[1]	Step 3 TOTAL URBAN FORTIES[1]	Step 4 =1+2+3 TOTAL URBAN ACRES	Step 5 1970 URBAN POPULATION[2]	Step 6 INCORPORATED CITIES UNDER 2,500[2]	Step 7 ESTIMATED UNINCORPORATED LAKESHORE POPULATION[3]	Step 8 =5+6+7 TOTAL 1970 "URBAN" POPULATION	Step 9 = 4 ÷ 8 ACRES OF URBAN LAND PER CAPITA
1	335	443	778	31,120	27,089	25,395	224	52,708	.590
2	760	176	936	37,440	14,181	8,314	2,716	25,211	1.485
3	3,116	1,731	4,847	193,880	189,298	32,527	8,764	230,589	.841
4	1,502	890	2,392	95,680	69,389	34,102	13,356	116,847	.819
5	1,978	613	2,591	103,640	26,431	27,157	9,800	63,388	1.635
6E	371	558	929	37,160	32,932	21,817	3,836	58,585	.634
6W	129	469	598	23,920	15,035	17,670	420	33,125	.722
7E	605	455	1,060	42,400	8,580	20,184	3,724	32,488	1.305
7W	1,053	602	1,655	66,200	54,591	38,963	5,376	98,930	.669
8	260	913	1,173	46,920	44,534	36,739	812	82,085	.572
9	496	1,083	1,579	63,160	98,604	45,894	2,156	146,654	.431
10	1,005	1,609	2,614	104,560	194,875	61,823	1,820	258,518	.405
11	4,491	4,210	8,701	348,040	1,751,652	31,721	--	1,783,373	.195
TOTAL	16,101	13,752	29,853	1,194,120	2,527,191	402,306	53,004	2,982,501	.400

[1] Minnesota Land Management Information System.
[2] U.S. Census, 1970.
[3] Minnesota's Lakeshore - Resources, Development, Policy Needs Part I, Minnesota Lakeshore Development Study, University of Minnesota.

Table 2

1990 URBAN LAND DEMANDS - SUMMARY BY SERIES (IN ACRES)[1]

	Series 1 State Projections	Series 2 Regional Projections	Series 3 County Projections
Region 1			
Kittson			
Marshall			
Norman			
Pennington	1,107	1,295	858
Polk	82	96	64
Red Lake			
Roseau	424	497	329
Sub-total	1,615	1,888	1,251
Region 2			
Beltrami	4,836	5,630	6,138
Clearwater			
Hubbard	5,873	6,836	7,454
Lake of the Woods	132	155	169
Mahnomen			
Sub-total	10,843	12,623	13,761
Region 3			
Aitkin	582	678	756
Carlton	1,466	1,708	1,906
Cook			
Itasca	1,671	1,946	2,172
Koochiching	502	588	653
Lake	765	891	995
St. Louis	1,293	1,507	1,700[2]
Sub-total	6,281	7,317	8,128
Region 4			
Becker	3,697	4,303	4,118
Clay	1,966	2,288	2,190
Douglas	4,556	5,303	5,075
Grant			
Ottertail	709	826	791
Pope	203	236	226
Stevens	124	144	139
Traverse			
Wilkin			
Sub-total	11,258	13,104	12,539
Region 5			
Cass	6,301	7,333	8,765
Crow Wing	9,555	11,120	13,290
Morrison	659	766	916
Todd	810	943	1,127
Wadena	92	107	130
Sub-total	17,421	20,274	24,228
Region 6E			
Kandiyohi	2,600	3,026	2,696
McLeod	3,185	3,707	3,303
Meeker	969	1,127	1,005
Renville			
Sub-total	6,755	7,862	7,004
Region 6W			
Big Stone			
Chippewa	59	72	60
Lac Qui Parle			
Swift			
Yellow Medicine			
Sub-total	59	72	60
Region 7E			
Chisago	13,642	15,877	15,029
Isanti	11,824	13,761	13,024
Kanabec	3,281	3,819	3,615
Mille Lacs	3,625	4,219	3,996
Pine	3,051	3,551	3,364
Sub-total	35,434	41,238	39,028
Region 7W			
Benton	1,783	2,076	2,620
Sherburne	8,074	9,398	11,864
Stearns	6,168	7,180	9,064
Wright	17,938	20,880	26,355
Sub-total	33,967	39,538	49,904
Region 8			
Cottonwood			
Jackson			
Lincoln			
Lyon	1,729	2,014	1,638
Murray			
Nobles	314	366	298
Pipestone			
Redwood			
Rock	166	193	157
Sub-total	2,207	2,574	2,093
Region 9			
Blue Earth	2,840	3,252	2,997
Brown	640	733	676
Faribault			
Le Sueur	1,453	1,664	1,534
Martin			
Nicollet	779	892	822
Sibley	170	195	180
Waseca	589	675	622
Watonwan			
Sub-total	6,473	7,413	6,831
Region 10			
Dodge	220	256	227
Fillmore			
Freeborn	310	361	321
Goodhue	3,933	4,581	4,060
Houston	492	573	509
Mower	372	433	385
Olmstead	6,196	7,216	6,393
Rice	1,699	1,979	1,754
Steele	1,174	1,367	1,212
Wabasha	358	416	369
Winona	1,062	1,237	1,096
Sub-total	15,821	18,428	16,325
Region 11			
Seven County Area	57,506	57,506	57,506
Sub-total	57,506	57,506	57,506
STATE TOTAL	205,640	229,837	238,712

[1] Figures may not total indicated number because of rounding.

[2] The population projections for St. Louis County do not show an overall increase. A special adjustment was made in this series to reflect short-term growth on the Iron-Range (See Appendix). If copper-nickel mining becomes operational the long term land needs in St. Louis County could substantially increase.

SOURCE: State Planning Agency

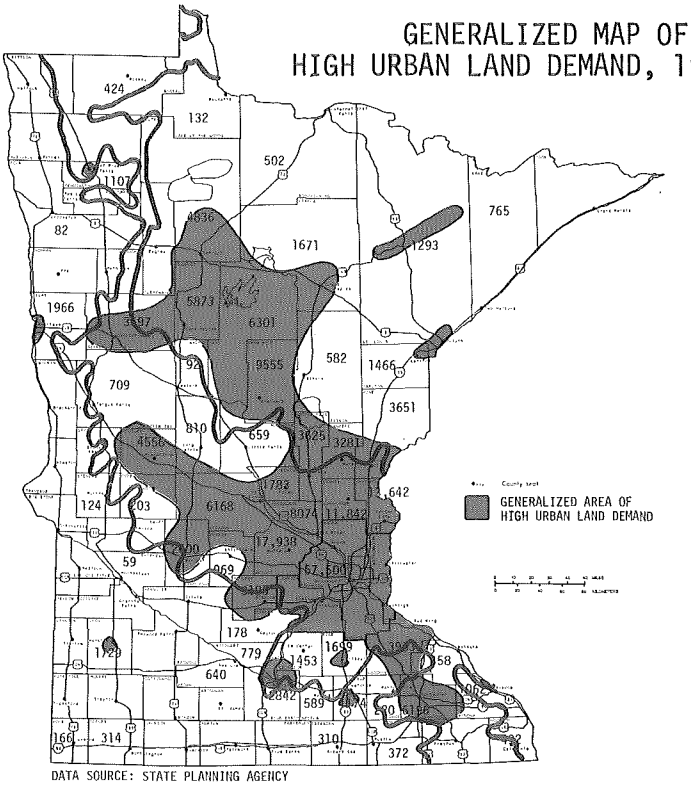
be significant. Growth that results in a checkerboard pattern of alternating developed and undeveloped parcels may have widespread social, energy and economic implications for local units of government when providing educational, health, fire, police and utility services. On the other hand, parcels that are developed in a contiguous well-planned manner should result in substantial cost savings to both the local community and the state.

Major areas of projected land consumption extend south of the Twin Cities Metropolitan Region through Goodhue and Olmstead Counties, to the north along Interstate 94 and 35E, and through the high amenity resort region of central Minnesota (Figure 2). The urban land projections reinforce basic spatial patterns of population growth. However, several rapid population growth areas are magnified even further because of high per capita land use trends. The regional urban land ratios range from .195 acres per capita in the metropolitan region to 1.635 acres in Region 5 (Refer to Table 1).

From 1975-1990, the metropolitan region will require an additional 57,600 acres of land for urban development. This estimate is based on a population increase of 294,000 projected by the state demographer and a per capita urban land ratio of .195. If more growth were channeled or guided into the metropolitan region, a larger population could be absorbed with less impact on land resources. Ideally, the most desirable area to increase population and urban investment would be in the core cities of Minneapolis and St. Paul.

Figure 2

GENERALIZED MAP OF
HIGH URBAN LAND DEMAND, 1975-1990

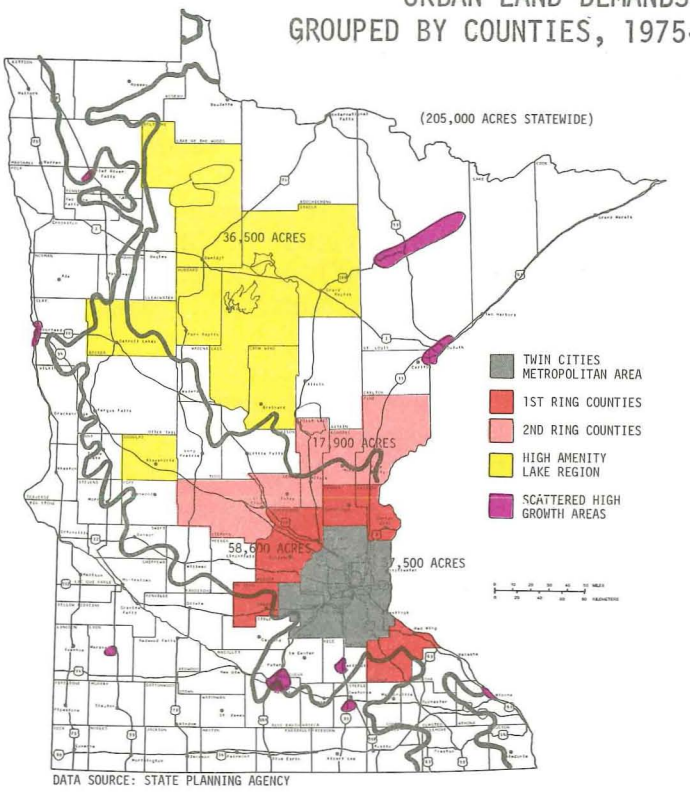


DATA SOURCE: STATE PLANNING AGENCY

ACRES OF LAND TO BE CONVERTED TO RESIDENTIAL, INDUSTRIAL, AND COMMERCIAL GROWTH

Figure 3

URBAN LAND DEMANDS
GROUPED BY COUNTIES, 1975-1990



A possible implication of metropolitan growth policies may be to force development into adjacent counties. Projections indicate extensive urban land requirements in several first ring counties surrounding the metropolitan area (Figure 3). To the north of the metropolitan area, Wright, Sherburne, Isanti and Chisago Counties have high per capita land use ratios, ranging from 1.05 to 1.33 acres per capita. Goodhue County to the south and McLeod to the west have lower per capita urban land ratios, .4 to .6 acres, but expect larger increases in population. These six counties are projected to have a total population increase of 74,500 from 1975 to 1990. Provided past trends continue, the six first ring counties would require 58,000 acres of land for urban development, or slightly more than the metropolitan area. Increasing urban development is also projected for several second ring counties surrounding the metropolitan region. The counties likely to experience growth pressures from the Twin Cities Metropolitan Area and the St. Cloud urbanized area are Kanabec, Mille Lacs, Benton and Stearns and the southern portion of Pine County. Projections indicate that the population within these counties will increase by 30,800 and 17,900 acres of land will be converted to urban development by 1990. In this group, Stearns County is projected to have the most land converted to urban development.

A third major growth area consists of counties in the high amenity lake resort region. Rapid growth counties include Crow Wing, Cass, Hubbard, Beltrami, Douglas and Becker. The population of these counties is expected to increase by 27,100 and roughly 36,500 acres of land would be needed for urban uses. The resort region would be characterized by low density seasonal homes or recreational development, with considerable pressure to develop lakeshore.

The remaining isolated pockets of rapid growth are located in and around existing urban population centers. Urban land would probably be required for growth areas surrounding Rochester, Mankato, the Iron-Range communities, Duluth, Moorhead, Marshall, Thief River Falls, Faribault, Owatonna and Willmar.

Urban land projections for economic development regions indicates that 7E and 7W are projected to have the largest urban land demands. Due to low density development and a population increase of 31,600 persons, Region 7E would require 35,400 acres of urban land to satisfy the pressures of urban development by 1990. A larger population increase is expected in Region 7W, but the region's urban character suggests an urban land need of 33,960 acres during the fifteen year projection period. If current land use trends continue, more land may be converted by 1990 to urban development in Regions 7E and 7W than in the metropolitan region.

Regions 2, 4, 5, and 10 show a significant growth with each requiring between 10,800-17,400 acres of land for future development. High rates of land consumption for Regions 2, 4, and 5 are due primarily to recreational and seasonal home and resort development from persons living outside of the region, while the land demand in Region 10 is attributable to a larger population increase.

Three Regions (3, 6E and 9) show a moderate demand for land, ranging from 6,300 to 6,700 acres over the 1975-1990 projection period. Regions 1, 6W and 8 show limited population growth and an urban land demand of less than 2,500 acres per region.

Region 3 is somewhat of an anomaly in that it is presently going through a construction boom related to taconite processing facilities. Due to a large temporary labor force, the area has seen rapid population growth with extreme pressure on existing community facilities and infrastructure. The long term effect of this expansion has yet to be clearly identified and permanent population growth is difficult to ascertain. The county-based urban land projections for Region 3 have been adjusted to reflect the growth associated with peak demand during the construction boom period from 1976-1980. According to the Arrowhead Regional Development Commission, approximately 3,400 housing units would be needed to satisfy needs within Region 3. Using a density of .5 acres per dwelling unit, 1,700 acres of land would be needed to handle short-term growth. Numerous factors relating to the future development of copper-nickel mining and the level of permanent population growth reveal uncertainty about the long term needs of this area.

The Loss of Agricultural Land

Within the next fifteen years, the state's agricultural land base does not seem to be seriously threatened by the "physical" loss of land to urban development. Federal and state projections indicate that Minnesota is likely to lose less than 10,000 acres of cropland annually or less than .05 of 1 percent of the state's cropland base each year. Using series 1 projections, 13,666 acres of land in Minnesota will be converted to urban development each year. Assuming that 50-60 percent of the land used for urban purposes originates from our agricultural base, the state's agricultural land base would be reduced by 6,600 to 8,000 acres annually and only a portion of that loss may be "prime cropland." Using series 3 projections, 15,866 acres would be required annually for urban development. Under this projection, the loss of agricultural land to urban development would range from 7,900 to 9,500 acres a year. Agricultural land is used as a generic term which could include pasture land and other non cropland categories.

These projections compare favorably to recent estimates of cropland reduction from competing land uses by the Economic Research Service (ERS) of the United States Department of Agriculture. The ERS estimated Minnesota will lose 170,900 acres of cropland from 1969-1980 and 136,700 acres from 1980-2000. Calculating the cropland losses from 1975-1990. Minnesota's cropland base would be reduced by approximately 9,735 acres annually. The ERS estimates are based on a slightly broader definition of urban land.

Past projections have grossly overestimated the "physical" amount of land to be consumed by urban development. Often, these projections referred to the loss of agricultural land due to other reasons such as economic obsolescence. While there may be a close association between economic obsolence and low density urban development in rural areas, the fiscal or economic impact of this development is more detrimental to the future of farming than the "physical" loss of agricultural land.

The future growth of the state will cause some agricultural land to be lost to urban development. In order to protect the agricultural capacity of the state, it is desirable that these losses be of lesser quality for agricultural production and that our best agricultural land be left in production. This can be accomplished by determining the potential agricultural productivity of the land through analysis of its soil characteristics, topography, market accessibility and climate. Such information is presently being computerized as part of the Minnesota Land Management Information System. Once areas of greatest agricultural value are identified, appropriate policies to ensure their protection can be developed.

Low Density Development

In 1970, approximately 335,000 persons, 8.8 percent of Minnesota's population, have settled in areas that were non-farm, unincorporated, and non-lakeshore. The majority of this population is settled at a very low density. Potentially, such settlement patterns are a serious threat to the farming economy in that they may contribute to idling

more acres of agricultural land than that consumed by residential, industrial, institutional and commercial development.

Low-density development whether located on low grade cropland, pasture-land, marshland or forestland represents a disproportionate cost to all levels of government that must provide necessary community services. In the long run, the costs of rural sprawl are usually proportioned to the entire taxing district. Marginal farm units may become economically unsound as the result of higher land values and increased taxes. As such, the farms remain idle for a number of years before being converted to other uses. Ironically, because of the problems with obtaining credit, the only alternative for some farmers is to sell land for recreational development or for non-farm homes in order to cope with higher land values and increased taxes, thus perpetuating the very situation that causes their problems.

The increasing number of rural subdivisions is heightened by speculation in the land market. The result is a growing rural non-farm population that requires different needs and services which may be incompatible with a healthy agricultural economy.

Little is known about the effects of rural non-farm sprawl especially as it relates to environmental impact, how much of this type of development can be tolerated, and how the financial burdens associated with the development should be allocated. Substantial research remains to be done on this topic. While rural sprawl consumes more land per capita than growth in incorporated areas, the environmental and economic impact of rural sprawl on the agricultural and forested land base may be even more significant.

Effect on Recreational Resources

Urban land demands are likely to affect both the quality of recreation and the amount of high amenity lands available for recreational use. The amount of land converted to urban uses in the forest zone will range from 82,000 to 119,000 acres, less than 1 percent of the state's commercial forest base. While urban land projections do not pinpoint specific losses of high value recreation land, they can indicate generalized areas of potential conflict.

The recreational resources in Economic Development Regions 5 and 7E will probably undergo substantial pressure to develop. More than 50,000 acres of land will be converted to urban use in these regions, suggesting continued intense development of lakeshore and attractive woodland area. Comparatively, Regions 5 and 7E have an abundance of natural resources for recreational use, but overcrowding, pollution, and incompatible land uses are threats to the quality of recreation in those areas.

WILDLIFE PRODUCTION

SECTION 9

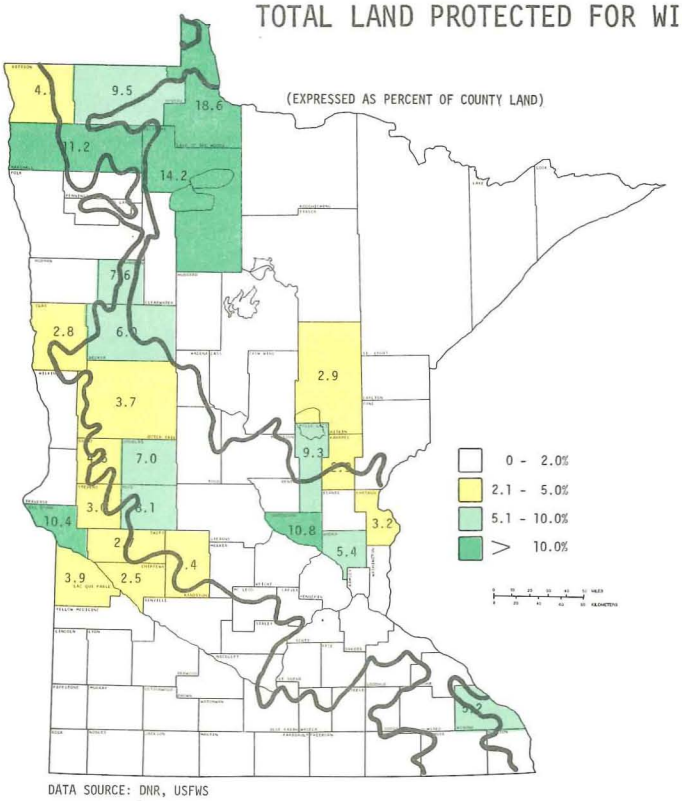
Wildlife Production

Maintaining adequate habitat is essential to protect the state's wildlife. The total land to be acquired by public agencies will need to take into account the species of wildlife to be protected, the desired level of wildlife populations, hunting demands, the intensification land management, long-term climatic conditions and the amount of habitat that is altered in Minnesota, the United States and Canada. Some factors cannot be directly controlled. Other trends may be extremely difficult to forecast. Nevertheless, assumptions must be made regarding these factors if a rational program for wildlife land acquisition is to be developed.

In 1975, Minnesota had more than 1,454,000 acres protected for wildlife through a variety of state and federal programs. These programs protected wetlands and a significant amount of upland through fee title acquisition or by obtaining an easement on development rights. Most of the land managed for wildlife is located in three generalized areas, namely, northwestern, west central and east central Minnesota (Figure 1). Thirteen counties have five percent or more of their land protected for wildlife. Five counties have more than ten percent protected for wildlife.

Figure 1

TOTAL LAND PROTECTED FOR WILDLIFE, 1975



DATA SOURCE: DNR, USFWS

Land is acquired and managed under the auspices of several programs. About 251,000 acres (17.3 percent) are controlled by the state in small wildlife management areas and another 199,000 acres (13.7 percent) in Major Wildlife Units. The federal government controls another 238,000 acres (16.4 percent) in waterfowl production areas through direct purchase and easement and more than 185,000 acres (12.7 percent) in National Wildlife Refuges (Table 1). In addition, there is an 81,700 acre (5.6 percent) coordination area on the Red Lake Management Area which consists of small scattered parcels owned by the Federal Government, but managed by the Minnesota Department of Natural Resources. Within the Red Lake preserve, more than 406,000 acres (27.9 percent) of state owned lands are managed primarily for wildlife. Over 92,000 acres (6.3 percent) of other Department of Natural Resources land and federal lands are managed for wildlife through cooperative agreements.

Wildlife habitat is acquired from willing sellers, although condemnation can be used with legislative approval. Before the state can purchase private lands for wildlife management purposes, the acquisition proposal must be approved by resolution passed by the county board. Some county boards fear the economic implications of having land removed from the tax rolls and therefore are hesitant to approve additional acquisitions. The state contributes an average annual payment of $.63 per acre for private land eliminated from the county tax base. Tax revenues generated from private ownership are usually greater than state compensation.

Federal land acquisitions are approved in two ways. National Wildlife Refuges are created through congressional legislation. The U.S. Fish and Wildlife Service is authorized to acquire small wetlands in Minnesota as a result of a procedural agreement with the Department of Natural Resources approved by the State Land Exchange Board. In deciding the extent of future acquisitions, the Land Exchange Board considers county board resolutions relating to the matter. The Land Exchange Board does not set guidelines as to what type of lands can or cannot be acquired.

Future wildlife management land acquisitions are shown in Table 2. If state goals are met, approximately 526,000 acres of fee title would be acquired for state wildlife programs.[1] Most land, 414,714 acres, will be acquired in small wildlife management areas. The remainder of state acquisitions would be within the existing boundaries of the nine major wildlife management units. The Department of Natural Resources believes most land acquisitions be acquired within the next ten years while lands are still available for purchase.

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[1]Wildlife Management Area Long-Range Acquisition Plan, Minnesota Department of Natural Resources, 1975.

Table 1

FEDERAL AND STATE ACREAGE MANAGED FOR WILDLIFE IN MINNESOTA
September 1, 1975

Region	State Wildlife Management Areas[1]	Major State Units[1]	Production Areas (Fee Title)	Federal Waterfowl Production Areas (Easement)	Major National Wildlife Refuges	Other State and Federal Areas[2]	Total Land Under Management
1	82,924	82,497	6,813	3,146	61,090	113,308	349,778
2	14,887	289	4,027	13,759	--	403,435[2]	436,397
3	19,927	--	--	--	16,515	33,802	70,244
4	29,976	2,283	62,881	84,402	35,196	4,383	219,121
5	14,703	--	--	--	--	17,418	32,121
6E	5,880	--	8,800	10,059	--	140[3]	24,879
6W	17,183	26,637	16,274	17,283	10,540[4]	748	88,665
7E	10,336	44,976	--	--	--	2,896	58,208
7W	6,939	--	6,774	1,232	28,858	--	43,803
8	28,449	3,279	2,882	--	--	121	34,721
9	11,223	--	--	--	--	120	11,343
10	5,878	24,841	--	--	33,004	3,883	67,506
11	2,949	14,223	--	--	123	240	17,535
TOTAL	251,254	199,025	108,451	129,881	185,326	580,494	1,454,134

[1]Includes land obtained by purchase, option or transfer.

[2]Includes other U.S. License and Department of Natural Resources lands managed for wildlife.

[3]Includes 140 acre federal fish hatchery.

[4]Recently acquired Big Stone - Whetstone National Wildlife Refuge.

SOURCE: DNR, U.S. FISH AND WILDLIFE SERVICE

Table 2

FUTURE INCREASE IN FEDERAL AND STATE LAND PROTECTED FOR WILDLIFE MANAGEMENT (IN ACRES)

Region	State Wildlife Management Areas	Major State Wildlife Units	Federal Waterfowl Production Areas[3] (Fee Title)	Federal Waterfowl Production Areas[1] (Easement)	National Wildlife Refuges	Other Proposals	Total Future Acquisition
1	211,470	73,557	32,287	63,214	--	--	380.528
2	5,896	15,521	9,973	24,491	--	--	55,881
3	22,095	--	--	--	724	--	22,819
4	16,775	1,095	115,719	186,158	113	7,600[2]	327,460
5	38,486	--	15,880	12,700	--	--	67,066
6E	15,864	--	34,820	47,394	--	--	98,078
6W	29,123	5,852	21,063	66,537	--	--	122,575
7E	3,914	2,730	--	--	--	--	6,644
7W	5,973	--	29,266	39,093	720	--	75,052
8	27,792	532	2,268	--	--	--	30,592
9	21,862	--	21,760	18,092	--	--	61,714
10	11,608	12,796	--	--	--	--	24,404
11	3,856	--	--			13,540[3]	17,396
TOTAL	414,714	112,083	283,036	457,679	1,557	21,140	1,290,209

[1]Proposed Hamden Slough, Becker County, U.S. Fish and Wildlife Service.

[2]Proposed Minnesota Valley National Wildlife Recreation Area-joint control 9,540 acres federal; 4,000 acres state; and 3,960 acres local. Figure includes only areas under federal and state control.

[3]Includes revised goals under 1977 procedural agreement between the DNR and the U.S. Fish and Wildlife Service.

SOURCE: DNR, U.S. FISH AND WILDLIFE SERVICE

The Federal Waterfowl Production Program had 22,676 acres of fee title and 203,449 acres of easements yet to be acquired in 1975. After some initial success in acquiring easements to prevent draining, filling and burning of wetlands, the program has been slowed in reaching its original goal of 333,000 acres. Many private landowners are unwilling to have restrictions placed on marginal lands that may be cultivated in the future thus reducing the number of easements that could be acquired.

In May of 1977, the U.S. Fish and Wildlife Service submitted a revised list of acquisition goals to the State Land Exchange Board. According to the procedural agreement, the U.S. Fish and Wildlife Service "...found that an adjustment in county fee and easement goal acres is needed to realistically accomplish the goals and assure maximum effort to preserve the remaining waterfowl habitat..."[2] As a result, authorized fee title land acquisition in the Waterfowl Production Program was increased by 260,360 acres and authorized land easements were increased by 254,230 acres. Total amount of land scheduled for acquisition after July 1, 1975, amounts to 283,000 acres of fee title and 457,679 acres of easements.

The U.S. Fish and Wildlife Service expects existing National Wildlife Refuges will probably have only minor land additions, although several proposals for new refuges have been made, including the Minnesota Valley National Wildlife Recreation Area (17,500 acres); Hamden Slough in Becker County (7,600 acres); and Heron Lake in Nobles County.

The proposed increases in federal and state land to be protected for wildlife management total 1,209,209 acres. Approximately 832,500 acres would be acquired in fee title and 457,700 acres in easements. If acquisition goals are met by 1990, the amount of land protected primarily for wildlife would increase to over 2,744,000 acres (Figure 2). Most of the proposed land acquisition is located in counties along the southern and western edge of the transitional zone. The number of counties having five percent or more of their land protected would increase to 27. Counties with 10 percent or more of their land protected for wildlife would increase to 19.

Proposed fee title acquisition totals 832,000[2] acres and is shown as a percent of county land in Figure 3. It is uncertain whether all of the land will be acquired by 1990. Obviously, some landowners may drain desired wetlands before acquisition can occur and some landowners may be unwilling to sell. On the other hand, the procedural agreement does not restrict the substitution of upland for wetland in meeting goals or redefining lands that are significant for waterfowl production. While the precise rate of fee title acquisition cannot be determined, it seems reasonable to assume that public agencies will acquire extensive land areas for the protection of wildlife.

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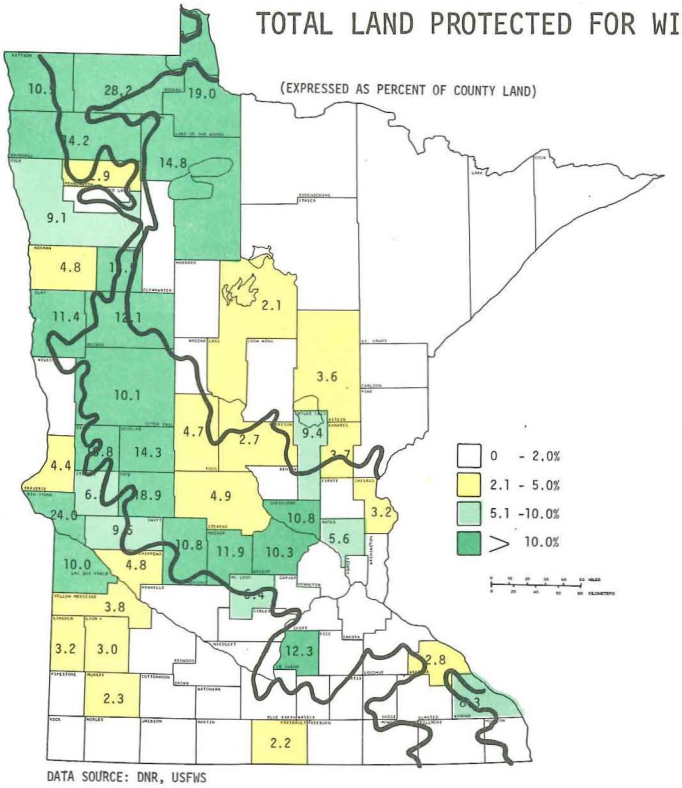
[2]Amendment to Procedural Agreement Between the Minnesota Department of Natural Resources and the U.S. Fish and Wildlife Services, May 10, 1977.

Figure 2

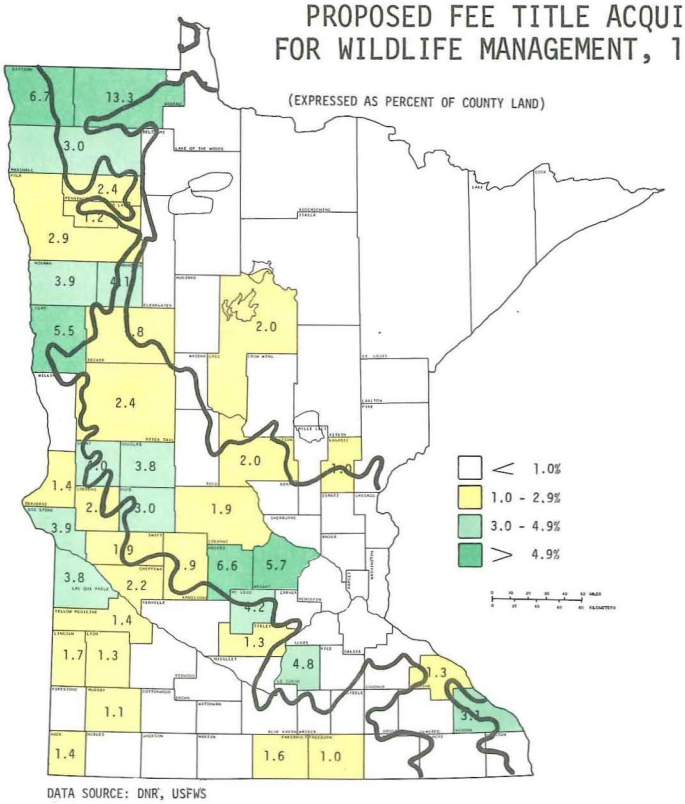
TOTAL LAND PROTECTED FOR WILDLIFE, 1990



DATA SOURCE: DNR, USFWS

Figure 3

PROPOSED FEE TITLE ACQUISITION
FOR WILDLIFE MANAGEMENT, 1975-1990



DATA SOURCE: DNR, USFWS

The acquisition of land for wildlife management often results in conflicts among private landowners, county governments and state government. If there is a high demand for agricultural products, farmers are likely to place more land into crop production. A considerable amount of the newly converted cropland may be at the expense of shelter belts, fence, woodlots and wetlands. These land use conflicts are likely to become more intense.

In recognition of these trends, land acquisition programs have been stepped up to protect remaining habitat areas. Approximately 40 percent of state wildlife acquisitions and 60 percent of federal acquisitions are upland. Substantial upland requirements necessary to provide nesting areas and for cover during inclement weather could conflict with future agricultural interests. For example, there has been extreme pressure on the Department of Natural Resources to sell state administered tax-forfeited land to agricultural interests in northwestern Minnesota counties. This is the same area where extensive land acquisitions are desired.

In addition to the lands managed primarily for wildlife, the Department of Natural Resources manages 4,251,000 acres of state-owned land which provides beneficial habitat for wildlife. Substantial acreages are also protected for wildlife by local governments, environmental groups, and sportsmens' clubs. Although large land areas are already under public control, the amount of wildlife habitat in Minnesota continues to decline because of habitat alteration on private lands.

Virtually all land use needs described in this report will affect the quantity and quality of wildlife habitat. Public agencies cannot acquire enough habitat to maintain unspecified levels of wildlife population without intensifying land use conflicts. The amount of land necessary for public acquisition will remain unknown until there is a public discussion of wildlife management goals. This discussion should focus on the desired levels of wildlife population, the location of habitat ranges, intensified management of existing lands versus continued land acquisition, a review of conflicting land uses, implications of the loss of tax base for local government units and an analysis of how secondary benefits of land acquisition can be maximized.

APPENDICES

Appendix A - Definitions

AGRICULTURAL LAND - refers to all land within a farm unit including the farmstead and other buildings, lanes, roads, land in ponds, wood lots and wastelands and land use for pasture or grazing, cover crops, fallow, soil improvement grasses and idle land, as well as cropland.

AIRPORTS - publicly-owned airports in the State are identified by the following system descriptions:

Key System - Airports having a paved and lighted runway over 5,000 feet in length, capable of accommodating heavy, multi-engine aircraft as well as most of the corporate jet fleet.

Intermediate System - Airports having a paved and lighted runway less than 5,000 feet in length, capable of accommodating all single-engine and most twin-engine aircraft as well as some light jet aircraft.

Landing Strip System - Airports with turf runways capable of accommodating single-engine and light twin-engine aircraft.

COMMERCIAL FOREST LAND - land which is both available and suitable for growing continuous crops of saw logs or other industrial timber products. Areas qualifying as commercial timberland have the capability of producing in excess of 20 cubic feet per acre per year of industrial wood in natural stands. Land that is not forested may be classified as commercial forest land.

CROPLAND - land which has recently been tilled or harvested mechanically.

FARMLAND - a generic term used in the same contect as agricultural land.

FORESTED LAND - generally used to indicate forest cover; a MLMIS forested parcel is a forty in which the dominant land use consists of trees. To be considered forested a forty must contain a scattering of trees whose crowns cover at least 10 per cent of the land area.

URBAN LAND - a forty containing five or more residential dwellings and no commercial buildings; and forties containing at least one commercial, industrial, or institutional development which may or may not contain residential development.

Appendix B - Urban Land Projections

MAJOR ASSUMPTIONS USED IN MAKING LAND USE PROJECTIONS

1. Although living styles and recreational trends are changing, data is not available to accurately quantify the direction or magnitude of these changes. Therefore, it is assumed that living styles and recreational patterns will continue as in the past and that the amount of urban land consumed per capita will remain constant.

2. It is assumed that the ratio between the number of permanent residents in a region and the amount of land used in the region for recreation or seasonal home development by persons living outside the region remains constant.

3. It is assumed that the population growth from 1975-1990 will locate in similar densities as in the past.

4. Due to the MLMIS definition of urban land, the dominant land use on a forty acre parcel may not always give a visual impression of being urban. Also, some forties with a dominant visual urban cover may not be classified as urban. It is assumed that these factors will tend to cancel each other.

5. The MLMIS definition of urban land is different than that of the U.S. Census Bureau. Therefore, urban population was undercounted in many areas of lakeshore development as indicated on the 1969 Land Use Map and an adjustment in urban population was made from the Lakeshore Study Data. A discrepancy arises because some of the permanent lakeshore homes identified by the study are not located on urban forties and therefore, should not be included. However, permanent homes on lakes of less than 150 acres were not inventoried. It is assumed that these factors will tend to cancel each other.

6. It was assumed that a decrease in a county's population would not result in decrease of acres of existing urban development. Therefore, regional population growth was adjusted to include only those counties showing population increases from 1975-1990.

7. It was assumed that the large population decrease in St. Louis County was due primarily to population loss in Duluth. Therefore, growth may take place elsewhere in the county although related population increases may not be perceptable at the county level. A special adjustment was made for expected residential and commercial growth on the Iron Range that is related to construction boom for taconite processing facilities.

Table 1

1990 URBAN LAND NEEDS DETERMINED BY STATE, REGIONAL AND COUNTY METHODS

REGION	Step 1 1975 POPULATION[1]	Step 2 1990 POPULATION[1]	Step 3 1975-1990 POPULATION INCREASE[1]	Step 4 ADJUSTED REGIONAL POPULATION INCREASES[2]	Step 5 ACRES OF URBAN LAND PER CAPITA[3]	1990 Urban Land Demands (Acres) Series 1 CONTROLLED TO STATE TOTAL	Series 2 CALCULATED BY REGIONAL METHOD	Series 3 CALCULATED BY BY COUNTY
1	96,600	99,000	2,400	3,200	.590	1,614	1,888	1,251
2	58,500	66,900	8,400	8,500	1.485	10,843	12,623	13,761
3	331,100	332,400	1,300	8,700	.841	6,281	7,317	8,182
4	191,100	206,800	15,700	16,000	.819	11,258	13,104	12,539
5	119,400	131,800	12,400	12,400	1.635	17,421	20,274	24,228
6E	100,900	113,000	12,100	12,400	.634	6,755	7,862	7,004
6W	61,400	59,900	-1,500	100	.722	59	72	60
7E	85,300	116,900	31,600	31,600	1.305	35,434	41,238	39,028
7W	189,300	248,400	59,100	59,100	.669	33,967	39,538	49,904
8	141,000	143,600	2,600	4,500	.572	2,207	2,574	2,093
9	223,200	238,900	15,700	17,200	.431	6,370	7,413	6,556
10	396,900	441,500	44,600	45,500	.405	15,865	18,428	16,276
11	1,927,600	2,222,500	294,900	294,900	.195	57,506	57,506	57,506
	3,923,000	4,421,500	498,500	514,100	.400	205,640	229,837	238,388

[1] State Planning Agency Population Projections.
[2] Includes only those counties that have projected population increases by the State Demographer.
[3] From Table 1 Acres of Land Per Capita By Regions.

Table 2

PROCEDURE FOR DETERMINING STATE AND REGIONAL LAND DEMANDS

Step 1 1975 Population Estimates by the State Planning Agency.

Step 2 1990 Population projections by the State Planning Agency.

Step 3 Determine 1975-1990 population increase. Subtract 1975 population (Step 1) from 1990 population (Step 2).

Step 4 Adjust Regional Population growth to include only those counties that have projected population increases.

Step 5 Determine acres of urban land used per capita from Table 1.

Table 3

CALCULATION OF URBAN LAND DEMANDS

Series 1 Determined by multiplying the statewide urban land per capita ratio (.4 acres - Step 5) by the adjusted regional population increases from 1975 to 1990. After allocating 57,500 acres to the metropolitan region,[1] the remaining acres are distributed to the regions proportionately, based on the acres of urban land per capita in Step 5.

Series 2 Determined by multiplying 1975-1990 regional population increase (Step 4) times the acres of urban land used per capita (Step 5).

Series 3 Figures represent regional and state urban land needs aggregated from county projections (see Table 5). The Metropolitan land allocation was held constant at 57,500 acres.[1]

[1]See Metropolitan Council Projections of Urban Land.

Table 4

METROPOLITAN COUNCIL PROJECTIONS OF URBAN LAND DEMAND

To determine the demand for urban land within each sector of the metropolitan area in 1980, 1985, and 1990, communities were divided into inner ring, developing ring, and outlying communities. Dwelling unit forecasts were made for the rings, and residential densities were then assumed based upon past utilization of land and the current availability of land for urban purposes. After the residential land demand was forecasted, the land needs for commercial, industrial, and other land uses were made using employment forecasts. The Metropolitan Council estimated the total urban land needs for Region 11 to be 173 square miles or 110,720 acres for the period 1973-1990.

There are two important differences between the calculations of the Metropolitan Council and those projected for Region 11 in Table 2. First, the Council's projections are for a 17 year period (1973-1990), whereas, SPA projections are for 15 years (1975-1990). Secondly, the council based its projections on population figures that include 337,000 more persons in the Metro Area in 1990 than the projections made by the State Planning Agency.

The two estimates of urban land needs can be compared, however, by using the amount of urban land used per capita. The Council's population estimate for the Metropolitan Area in 1973 was 2,004,575. Its projection for 1990 is 2,556,000. This is an increase of 555,425 persons over 17 years. If the urban land demand between 1973-1990 is divided by the population increase for the same period, a per capita urban land increase of .199 acres results. This compares very favorably to the per capita ratio of .195 that was determined with MLMIS data.

Metropolitan Urban Land Needs Using SPA Population Projections

	Acres of Urban Land Per Capita	1975-1990[1] Metro Area Population Increase	Urban Land Demand 1975-1990
Metro Council	.199	294,900[1]	58,685 acres
SPA	.195	294,900[1]	57,505 acres

Consequently, if the per capita land demands are multiplied by the same population increase, in this case using SPA projections, the urban land demands are similar.

[1] State Planning Agency Population Projections

1975-1990 URBAN LAND DEMAND PROJECTED BY COUNTY (SERIES 3)

Counties by Development Region	1970 Urban Population	Population of Incorporated Cities Under 2,500	Estimated Unincorporated Lakeshore Population	Total "Urban" Population	Total Urban Acres	Acres of Urban Land Per Capita	1975-1990 County Population Increase	County Land Needed in Acres
REGION 1								
Kittson	--	3,789	--	3,789	3,040	.802	-300	--
Marshall	--	5,684	--	5,684	3,440	.605	-100	--
Norman	--	4,655	--	4,655	3,080	.662	-300	--
Pennington	8,618	481	--	9,099	3,120	.343	2,500	858
Polk	15,919	5,727	224	21,870	14,000	.640	100	64
Red Lake	--	2,724	--	2,724	1,760	.646	-100	--
Roseau	2,552	2,335	--	4,887	2,680	.548	600	329
TOTAL	27,089	25,395	224	52,708	31,120	.590	2,400	1,251
REGION 2								
Beltrami	11,409	1,306	1,260	13,975	14,320	1.023	6,000	6,138
Clearwater	--	2,496	140	2,636	3,240	1.229	-100	--
Hubbard	2,772	930	896	4,598	14,280	3.106	2,400	7,454
Lake of the Woods	--	1,767	84	1,851	3,120	1.686	100	169
Mahnomen	--	1,815	336	2,151	2,480	1.153	-100	--
TOTAL	14,181	8,314	2,716	25,211	37,440	1.485	8,300	13,761
REGION 3								
Aitkin	--	2,560	2,128	4,688	17,720	3.780	200	756
Carlton	8,699	4,590	392	13,681	13,040	.953	2,000	1,906
Cook	--	1,301	112	1,413	7,080	5.01	--	--
Itasca	7,247	8,854	2,436	18,537	33,560	1.810	1,200	2,172
Koochiching	6,439	4,242	--	10,681	8,720	.816	800	653
Lake	7,941	362	112	8,415	11,960	1.421	700	995
St. Louis	158,972	10,618	3,584	173,174	101,800	.588	-3,700	--
TOTAL	189,298	32,527	8,764	230,589	193,880	.841	1,200	6,482 1,700 8,182 [1]
REGION 4								
Becker	5,797	2,497	3,360	11,654	20,000	1.716	2,400	4,118
Clay	32,026	5,332	--	37,358	11,040	.296	7,400	2,190
Douglas	6,973	3,652	3,248	13,873	14,080	1.015	5,000	5,075
Grant	--	3,871	364	4,781	3,640	.761	-300	--
Otter tail	12,443	9,924	5,376	27,743	31,360	1.130	700	791
Pope	2,584	2,346	812	5,742	6,480	1.129	200	226
Stevens	5,366	1,653	140	7,159	3,320	.464	300	139
Traverse	--	3,306	56	3,362	2,400	.714	-200	--
Wilkin	4,200	1,521	--	5,721	3,360	.587	-200	--
TOTAL	69,389	34,102	13,356	116,847	95,680	.819	15,300	12,539
REGION 5								
Cass	--	6,266	2,912	9,178	33,520	3.652	2,400	8,765
Crow Wing	11,667	8,077	5,096	24,840	42,880	1.726	7,700	13,290
Morrison	7,467	3,808	532	11,807	13,520	1.145	800	916
Todd	2,657	6,784	1,120	10,561	9,160	.867	1,300	1,127
Wadena	4,640	2,222	140	7,002	4,560	.651	200	130
TOTAL	26,431	27,157	9,800	63,388	103,640	1.635	12,400	24,228
REGION 6E								
Kandiyohi	12,869	4,541	2,016	19,426	15,400	.793	3,400	2,696
McLeod	12,248	4,884	504	17,636	7,560	.429	7,700	3,303
Meeker	5,262	4,111	1,232	10,605	8,200	.773	1,300	1,005
Renville	2,553	8,281	84	10,918	6,000	.550	-500	--
TOTAL	32,932	21,817	3,836	58,585	37,160	.634	11,900	7,004
REGION 6W								
Big Stone	2,665	2,103	280	5,048	5,160	1.022	-300	--
Chippewa	6,304	2,601	28	8,933	5,360	.600	100	60
Lac Qui Parle	--	4,980	--	4,980	3,720	.747	-700	--
Swift	3,484	3,412	84	6,980	4,840	.693	-600	--
Yellow Medicine	2,582	4,574	28	7,184	4,840	.674	-100	--
TOTAL	15,035	17,670	420	33,125	23,920	.722	-1,600	60

[1] Includes 1700 acres for residential, commercial and industrial growth (excludes mining) on the iron range.
Urban land adjustment calculated by multiplying 3400 housing units peak demand x .5 acres per unit.

Table 5

1975-1990 URBAN LAND DEMAND PROJECTED BY COUNTY (SERIES 3) cont.

Counties by Development Region	1970 Urban Population	Population of Incorporated Cities Under 2,500	Estimated Unincorporated Lakeshore Population	Total "Urban" Population	Total Urban Acres	Acres of Urban Land Per Capita	1975-1990 County Population Increase	County Land Needed in Acres
REGION 7E								
Chisago	--	7,156	1,120	8,276	9,080	1.097	13,700	15,029
Isanti	3,467	1,423	588	5,478	7,280	1.329	9,800	13,024
Kanabec	2,582	630	308	3,520	4,240	1.205	3,000	3,615
Mille Lacs	2,531	3,934	980	7,445	9,920	1.332	3,000	3,996
Pine	--	7,041	728	7,769	11,880	1.529	2,200	3,364
TOTAL	8,580	20.184	3,724	32,488	42,400	1.305	31,700	39,028
REGION 7W								
Benton	9,231	3,130	168	12,529	6,560	.524	5,000	2,620
Sherburne	3,918	3,912	1,120	8,950	9,400	1.050	11,300	11,865
Stearns	38,167	18,650	1,316	58,133	29,960	.515	17,600	9,064
Wright	3,275	13,271	2,772	19,318	20,280	1.050	25,100	26,355
TOTAL	54,591	38,963	5,376	98,930	66,200	.669	59,000	49,904
REGION 8								
Cottonwood	3,952	4,515	196	8,663	5,360	.619	-500	--
Jackson	3,550	3,145	224	6,919	4,400	.636	-300	--
Lincoln	--	3,399	56	3,455	3,320	.961	-500	--
Lyon	12,402	4,183	84	16,669	7,600	.455	3,600	1,638
Murray	--	5,328	140	5,468	4,480	.819	-300	--
Nobles	9,825	4,551	112	14,488	7,200	.497	600	298
Pipestone	5,328	3,095	--	8,423	4,160	.494	--	--
Redwood	4,774	6,176	--	10,950	6,720	.614	-200	--
Rock	4,703	2,347	--	7,050	3,680	.522	300	157
TOTAL	44,534	36,739	812	82,085	46,920	.572	2,500	2,093
REGION 9								
Blue Earth	30,895	7,701	308	38,904	12,960	.333	9,000	2,997
Brown	19,042	1,206	112	20,360	7,240	.356	1,900	676
Faribault	6,756	5,665	84	12,505	7,200	.575	-900	--
Le Sueur	4,694	7,633	560	12,887	9,880	.767	2,000	1,534
Martin	10,751	5,348	420	16,519	7,880	.477	-400	--
Nicollet	15,686	1,416	--	17,102	5,400	.316	2,600	822
Sibley	--	7,178	168	7,346	4,400	.599	300	180
Waseca	6,789	2,955	336	10,080	4,480	.444	1,400	622
Watonwan	4,027	3,902	168	8,097	3,720	.459	-200	--
TOTAL	98,640	43,004	2,156	143,800	63,160	.439	15,700	6,831
REGION 10								
Dodge	--	6,142	--	6,142	3,480	.567	400	227
Fillmore	2,572	9,271	--	11,843	7,560	.638	-900	--
Freeborn	19,418	4,447	476	24,341	11,160	.458	700	321
Goodhue	10,441	8,690	364	19,495	11,640	.597	6,800	4,060
Houston	5,761	3,702	--	9,463	5,360	.566	900	509
Mower	25,074	5,291	--	30,365	11,680	.385	1,000	385
Olmsted	59,406	4,828	280	64,514	16,920	.262	24,400	6,393
Rice	26,830	2,175	700	29,705	12,120	.408	4,300	1,754
Steele	15,341	3,063	--	18,404	7,200	.391	3,100	1,212
Wabasha	3,594	6,745	--	10,339	6,360	.615	600	369
Winona	26,438	6,969	--	33,407	11,080	.332	3,300	1,096
TOTAL	194,875	61,323	1,820	258,018	104,560	.405	44,600	16,325

Table 6

CALCULATION OF ESTIMATED PERMANENT LAKESHORE POPULATION

REGION	NUMBER OF PERMANENT HOMES	AVERAGE FAMILY SIZE	ESTIMATED LAKESHORE POPULATION
1	80	2.8	224
2	970	2.8	2,716
3	3,130	2.8	8,764
4	4,770	2.8	13,356
5	3,550	2.8	9,800
6E	1,370	2.8	3,836
6W	150	2.8	420
7E	1,330	2.8	3,724
7W	1,920	2.8	5,376
8	290	2.8	812
9	770	2.8	2,156
10	650	2.8	1,820

SOURCE: Minnesota's Lakeshore: Resources, Development, Policy Needs, Part I, 1970.

NOTE:

1. Urban population as defined by the Minnesota Land Management Information System was undercounted because many areas of lakeshore development are not incorporated. Therefore, an adjustment was made for permanent lakeshore homes.

2. Permanent homes on lakes of less than 150 acres were not inventoried in the lakeshore study, nor was development along Lake Superior.

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