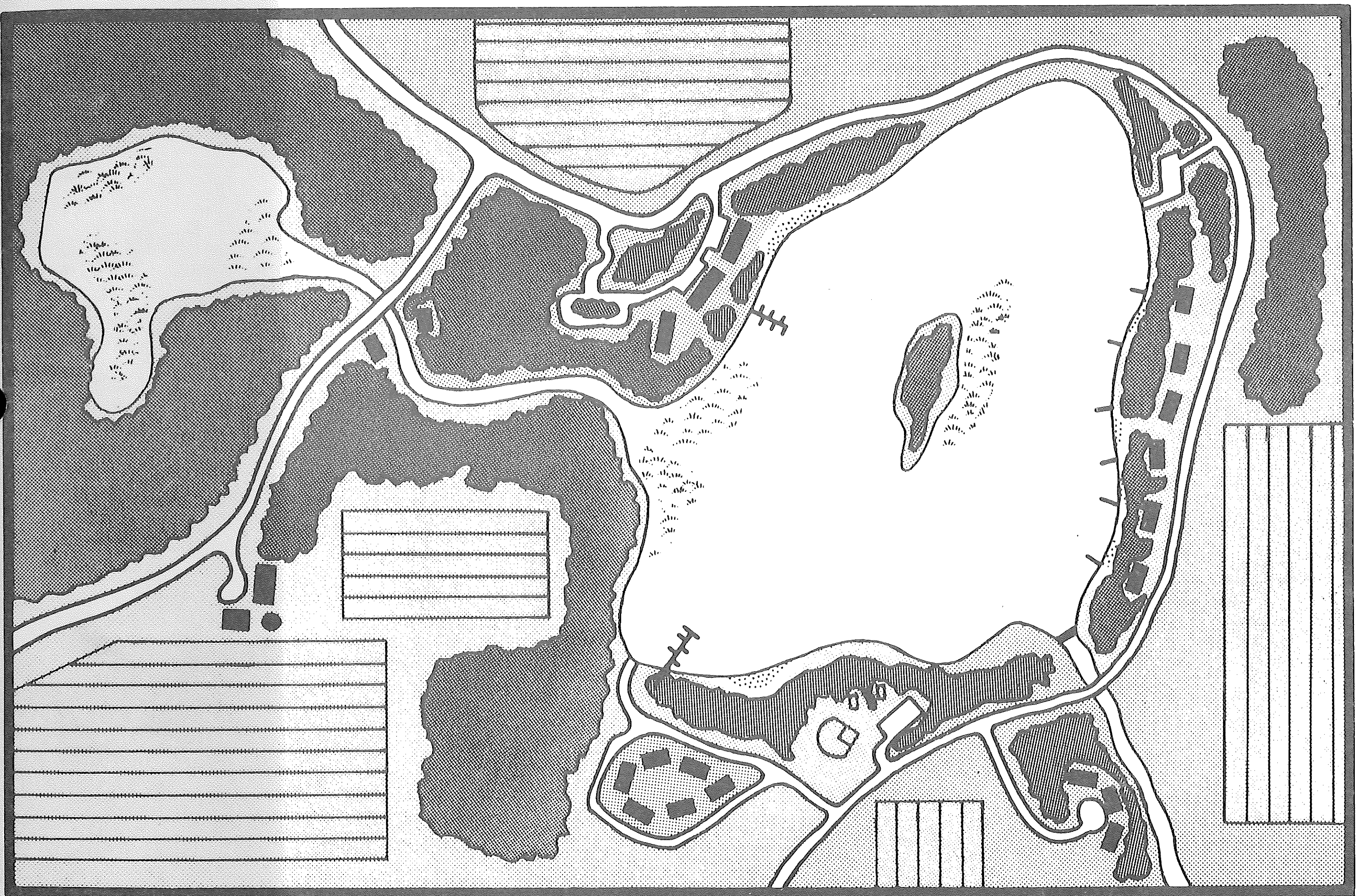
SHORELAND UPDATE

Report Number 4

SHORELAND DEVELOPMENT TRENDS



MINNESOTA
DEPARTMENT OF NATURAL RESOURCES
Division of Waters
FLOOD PLAIN/SHORELAND MANAGEMENT SECTION

1984

UPDATE PROJECT REPORTS

REPORT NUMBER	TITLE
1	Shoreland Management Effectiveness: A Questionnaire Survey of Shoreland Managers
2	Evaluation of Shoreland Management Based On Sample Counties and Townships
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SHORELAND UPDATE PROJECT

Report No.4

SHORELAND DEVELOPMENT TRENDS

by

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6-84:500

Minnesota Department of Natural Resources

Division of Waters

Flood Plain/Shoreland Management Section

ABSTRACT

Shoreland development has dramatically increased since the original lakeshore development inventory done in 1967. The amount, location, and type of new development provides important information about the pattern of shoreland development. The factors influencing shoreland development are numerous, and their interactions complex. However, it is possible to identify the relative importance of these factors. The most important factors include road and service center access, lake size, and amount of pre-existing development. Understanding the nature of these influences and how they interact is important if future management goals are to be achieved.

ACKNOWLEDGEMENTS

The collection, tabulation, and correction of data for the Shoreland Update Project involved many gruelling hours. Much of this labor was provided by student workers. What success this report can claim rests heavily on those individuals. So a very special thanks is extended to Sheila, Rachel, Julie, Greg, Dan, Brad, and others who spent countless hours pouring over county records, computer generated maps, and aerial photos. Special thanks must also be extended to Rick Gelbmann for his remarkable patience and special knack for always knowing what the machine was doing to the data.

Responsibility for the content and quality of this report rests squarely on the shoulders of the authors. But what success we achieved in communicating the information contained in this report is shared with a large number of people. We cannot overlook the essential contribution of the secretaries, Darcy Pepper and Jan Lassen, whose patience and perseverance are beyond our powers to adequately reward. The authors also extend a special thanks to Jim Zicopula for assistance in completing the graphics. And then there's Tim Kelly, who always asked the questions that were being overlooked or provided badly needed suggestions when the authors were not sure where to go next. We also extend our gratitude to the numerous individuals that provided editorial comments on the contents of this report, especially Ron Harnack and Steve Prestin.

Finally, we must also extend our gratitude toward the Legislative Committee on Minnesota Resources, without whose funding the Shoreland Update Project could not have been done, and whose resources provided employment for a few struggling students.

CONTENTS

I. SUMMARY

The large increases in shoreland* development which have occurred between 1967 and 1982 pose potentially severe resource problems for some of the most popular lakes in Minnesota. Numbers of lakehomes have increased 74% since the first census of shoreland development was taken in 1967. The largest increase has occurred in lakehomes used year round (100%) while seasonally used lakehomes have increased 63%.

Despite our wealth of shoreland resources (over 193,000 miles of shoreland on lakes and rivers), subsequent data will indicate that not all of it is conveniently located, desireable to shoreland residents, or useable as a recreational resource. As a result, most shoreland development is highly concentrated. Fifty lakes accounted for almost a third of the total increase in lakehomes between 1967 and 1982. Most of these same lakes had high development densities in 1967. As a result, the most densely developed lakes in 1967 reached even higher densities by 1982. On many of these lakes average frontage per dwelling is less than 100 feet. These lot widths are smaller than in many urban areas.

The location of shoreland resources has a significant impact on development pressures. Locations with the highest densities are shorelands within a quarter mile of a paved highway and within five miles of an urban service center. This pattern falls off sharply as distance from roads and service centers increases. Shoreland residents are also discriminating in their choice of shoreland resources. Typically, the most popular shoreland resources are found on lakes that support permanent game fish populations with forested shoreline containing sandy soils.

* The term shoreland, according to "Minn. Reg. Cons 70" refers to "land located within the following distances from public waters: (i) 1,000 feet from the normal high water mark of a lake, pond or flowage; and (ii) 300 feet from a river or stream, or the landward enxtent of a flood plain designated by ordinance on such a river or stream, whichever is greater. The practical limits of shorelands may be less than the statutory limits whenever the waters involved are bounded by natural topographic divides which extend landward from the waters for lesser distances when approved by the Commissioner [Department of Natural Resources].".

One must remember that shoreland management has reinforced patterns of increasing development concentration. By establishing less restrictive shoreland standards (lot size, width, setback, etc.) for the most popular lakes (GD or sometimes RD lakes), resource preferences are reinforced. But, while shoreland management standards have not substantially altered development patterns, that was their intent. Shoreland standards were designed to maintain the private market as the principal resource allocation mechanism while at the same time mitigating the adverse effects of uncontrolled development. This goal is reflected in regulations which establish minimum standards for development. The desirability of limiting the influence of shoreland management to this kind of influence is contingent upon shoreland management goals. If, for instance, the goal is to concentrate most shoreland development on a relatively small proportion of the total shoreland area, leaving a significant amount of the resource undeveloped for non-residential recreationists, and to allocate these resources through a market system, then continuing to encourage existing patterns makes sense. However, if these goals change (e.g., attempting to alter the current trends in shoreland development), then shoreland management strategies will likewise need to be modified.

Innovations in subdivision design along with new trends in housing choice and ownership arrangements have further contributed to high density trends. An increasing share of new subdivisions are planned unit developments and clusters (PUDs). Zoning standards allow higher densities for such designs. While these trends still constitute a small portion of total shoreland subdivision activity, they represent a growing number of new housing units in shoreland areas, which tend to be of the townhouse and condominium variety. Also, a new trend, timesharing-ownership, promises more intensive use of many high density areas.

Even though some prime shoreland resources appear to be developed to capacity, development densities will probably be even higher in the future. Second and third tier development is occuring in prime shoreland areas. However, some shoreland areas are being redeveloped, and depending on the particular case, variously raise or lower densities after older housing has been replaced. Also, there are still prime shoreland areas that are undeveloped and still in private ownership and many of these will be developed in years to come. These increasing densities raise the prospect that some of the more popular resource areas may face "over development".

There are substantial difficulties in determining the point at which a lake has become over developed. One reason is that judging an area as over-developed is heavily dependent upon perceptual factors. What some individuals judge to be relatively undeveloped others will judge as overly developed. For this and other reasons, shoreland managers have shied away from setting upper limits to development. While no statistics were gathered to identify a lake's development capacity, many shoreland managers have expressed concerns that safe development limits are being surpassed. Increasing frequency of user conflicts, declining fishing quality, increasing algal and weed growth, and contaminated ground water are signals that shoreland managers interpret as indicators of excessive development.* Finally, shoreland residents have also indicated concern about water surface crowding. A fourth of the shoreland residents contacted in a questionnaire** indicated that on occassion they have not used their lake because of the number of existing users.

As the amount of undeveloped space on popular resource areas has declined, the price for undeveloped shoreline has increased significantly. On some lakes in central Minnesota, the price of shoreland has more than doubled in the last decade. This high price along with the declining availability of developable sites on popular lakes, has led to increased development of less popular resource areas. In recent years small lakes and rivers have experienced rising development pressures.*** In 1982, dwellings on rivers and lakes smaller than 145 acres accounted for 15.45% of total shoreland development. Many of these less popular shoreland resource areas are more sensitive to heavy use than the larger, traditionally more popular lakes. Since shoreland zoning is more restrictive on the smaller lakes, some measure of protection is provided. Development of the less popular resource areas will continue to account for an increasingly large proportion of total shoreland development. In absolute numbers, however, most of the increase will actually occur on the more popular resource areas.

* See Report No. 1, <u>EFFECTIVENESS OF SHORELAND MANAGEMENT - QUESTIONNAIRE RESPONSE OF SHORELAND MANAGERS</u>, Shoreland Update Project, 1983.

**See Report No. 8, <u>SHORELAND RESIDENTS - A QUESTIONNARIE SURVEY</u>, Shoreland Update Project, 1983.

*** For more information on river shoreland development see Report No. 5, <u>A RIVER CLASSIFICATION SYSTEM</u>, Shoreland Update Project, 1983.

Data collected by the Shoreland Update Project also reveal that the most important influence on the rate and location of shoreland development is proximity to roads and service centers. It also appears the upgrading of existing roads encourages shoreland development. While road and service center proximity are important influences, it is still unclear how they interact with numerous other factors relating to shoreland development.

While numbers of shoreland residences have increased, the number of resorts have continued their long term decline. The reasons for this appear to be related to small returns on investment along with marginal management practices. Too many resort operators appear to approach management as part of a chosen lifestyle rather than as a business operation. The decline has some positive effects. Many resorts that cease operations are marginal facilities that do not meet shoreland standards. When they cease operation, often the buildings are either removed or brought into conformity with standards. Improvement in sewer systems also occurs.

II. CLASSIFICATION AND DISTRIBUTION OF SHORELAND RESOURCES

Shoreland management is based on a three-part classification of lakes and rivers which includes General Development, Recreational Development and Natural Environment. Classification is based on development densities, lake size and shape, and other physical criteria. Standards governing lot size, structure setback and elevation, and sewage treatment system requirements vary depending upon lake classification. General Development is the least restrictive category, Natural Environment the most restrictive.

This classification system forms the basis of shoreland management throughout the state. Some counties have modified the system to allow for a more refined classification. Recently, a growing awareness has emerged of the need for a more sophisticated approach. One concern is that the General Development class (GD) standards are not restrictive enough to protect many lakes. The amount of development that may occur within GD standards, especially as second and third tier lots are developed, may be detrimental to the lake resource. Crowding, decline in water quality, well contamination, and water surface use conflicts, are all concerns in high density situations. On many GD lakes, shoreland managers have observed that settlement patterns and related problems are more similar to urban than rural settings. Trespass, noise, and other nuisances have been growing concerns in high density areas.

Even if lakes and rivers have more restrictive standards, resource deterioration is possible. Certain resource areas such as trout streams and exceptionally clear lakes are especially fragile. Very little development or use may damage the characteristics that identify the resource as unique.

To assist resource managers, a more sophisticated classification system is being developed. This classification process is not yet completed since additional information is needed. It is based on ecological characteristics, density of development, and uniqueness of the resource.*

* The river classification process is described in Report No. 5, A RIVER CLASSIFICATION SYSTEM, Shoreland Update Project, 1983. The remainder of this report will focus primarily on shoreland development trends and problems more common to lakeshore areas, since these areas constitute the vast majority of shoreland development.

Lake characteristics are derived from the Division of Fisheries ecological classification of lakes. That classification considers lake size, depth, water chemistry, bottom conditions, management practices, etc. It is the basis for DNR fish management and is also a component of lake classification for shoreland management. It is a widely used and accepted approach based on careful measurement of the physical and biological characteristics of lakes.

The following ecological lake classification was used (higher class numbers reflect greater eutrophication):

1) trout - These are deep, rocky, infertile lakes most often found in the Arrowhead region and are well oxygenated. Tullibee and suckers are other important fish populations in these lakes. Examples include Mountain Lake and Clearwater Lake in Cook County.
2) soft water walleye - These are also medium to large sized lakes with natural walleye populations. However, these typically occur in northeastern Minnesota and are much less fertile and thus show fewer signs of eutrophication than hard water walleye lakes. Examples include Pike Lake in Cook County and Vermillion Lake in St. Louis County.
3) hard water walleye - These are medium to large lakes with well established, naturally occurring walleye populations. The most notable examples are Mille Lacs Lake and Lake Winnibigoshish.
4) centrarchid/walleye - These are medium to large sized lakes with diverse ecological conditions, such as bays, inlets, etc. Some parts of the lake are suitable for walleye, other areas are more suitable to panfish. Substantial populations of bullhead, and/or carp, and/or buffalo are not uncommon. Typical examples of this are Lake Minnetonka and Minnewaska Lake.
5) centrarchid - These lakes are generally medium to small sized hardwater lakes that are quite fertile (often displaying a weedy appearance). Large, open areas are uncommon, and the lakes may also contain substantial populations of carp, and/or buffalo, and/or bullheads. Typical examples are Gladstone Lake in Crow Wing County and Maple Lake in Douglas County.
6) roughfish/game fish - these are hardwater lakes generally found in southern and central Minnesota and characterized by roughfish such as carp, buffalo, sheepshead, and bullhead. Winter kill is not uncommon. Often roughfish removal and stocking of rescued fish are common management procedures. These includes lakes with occassional winter-kills and management aims at building up more desirable fish populations in as short a period of time as possible. Examples include Lake Tetonka in Le Suer County and Long Lake in Ramsey County.
7) bullheads - These are shallow lakes in which winter-kills promotes the dominance of bullheads. Examples include Christina, Star, and Bear Lakes.
8) game - This category generally refers to small shallow lakes that do not support a permanent fish population. Often, these are marshy areas.
9) lakes not otherwise classified.

Density of development, the second criterion used in classification, is a measure of the amount of development per mile of shoreline. Information on development density is supplemented by a classification of lakes according to the ratio of water surface acreage to amount of shoreline. This information is important because the size or irregularity of shoreline has a substantial impact on the amount of water surface acreage per shore mile. Differences in this ratio are significant because the amount of development can have dramatically different impacts depending on the amount of water surface space available to potential users residing in shoreland areas. The ratio of water surface acreage to shore length is also used to classify lakes for shoreland zoning. By studying the distribution of this ratio for lakes in Minnesota, three classes have been created. They are:

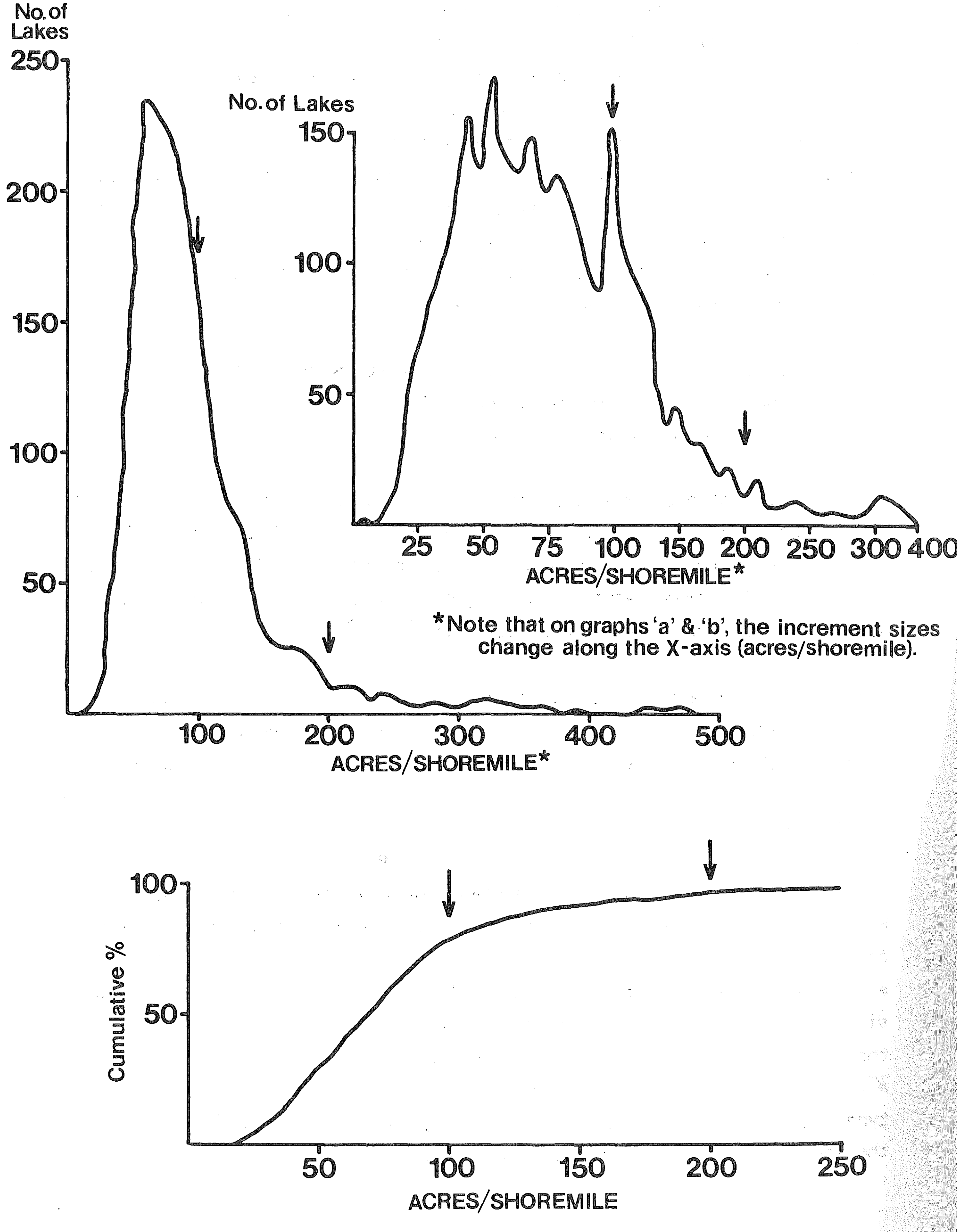
1) less than or equal to 100 acres of water/shore mile
2) 100 to 250 acres of water/shore mile
3) more than 250 acres/shore mile

These class distinctions are based on the distribution of the number of lakes by acres/mile of shoreline. As the graphs in figure 1 indicate, there is a significant change in distribution at approximately 100 acres of water per shoremile, with this category accounting for 77.6% of the lakes, while the second category accounts for another 17.6%.

Resource uniqueness, a third classification criteria, is determined by characteristics that pose special management needs. One of those characteristics is sensitivity to use or development. For example, trout lakes may be especially vulnerable to water quality degradation through development.

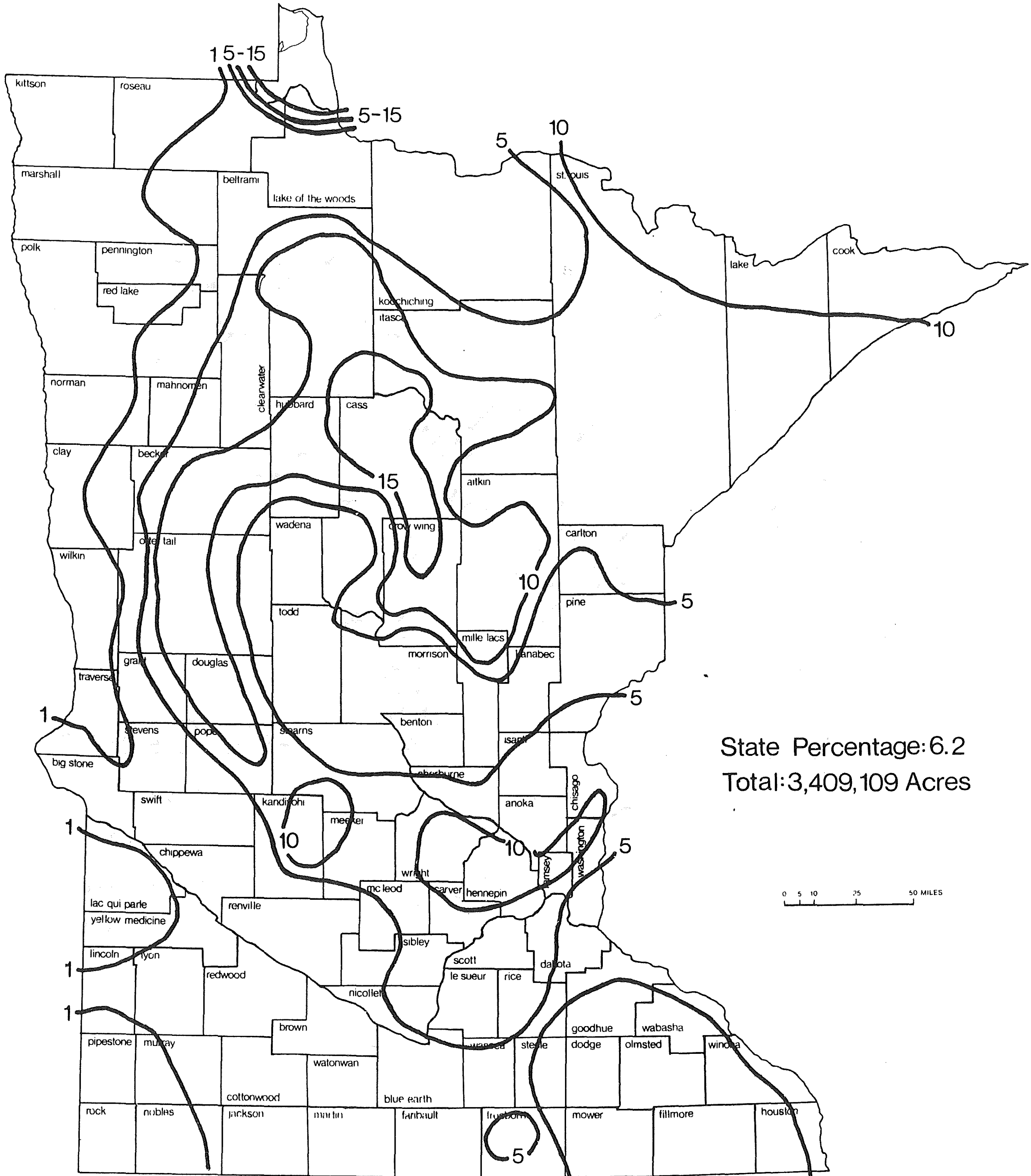
Another characteristic is the prevalence of a resource type within a region. For example, the lower number of lakes with game fish populations (walleye, centrarchid-walleye, and centrarchid lakes) in Southern Minnesota tends to add a measure of significance to the individual lake resources than would a similar lake in Northern Minnesota. Figures 2a and 2b graphically illustrate the wide range in water resources and lake types throughout the state. While a county may have significant lake resources, they may only be of one or two types, thus making certain of the lake types unique. For instance, most of the lakes in Stearns county are of the walleye or centrarchid variety, with

Figure 1: DISTRIBUTION OF LAKES BY ACRES/SHOREMILE



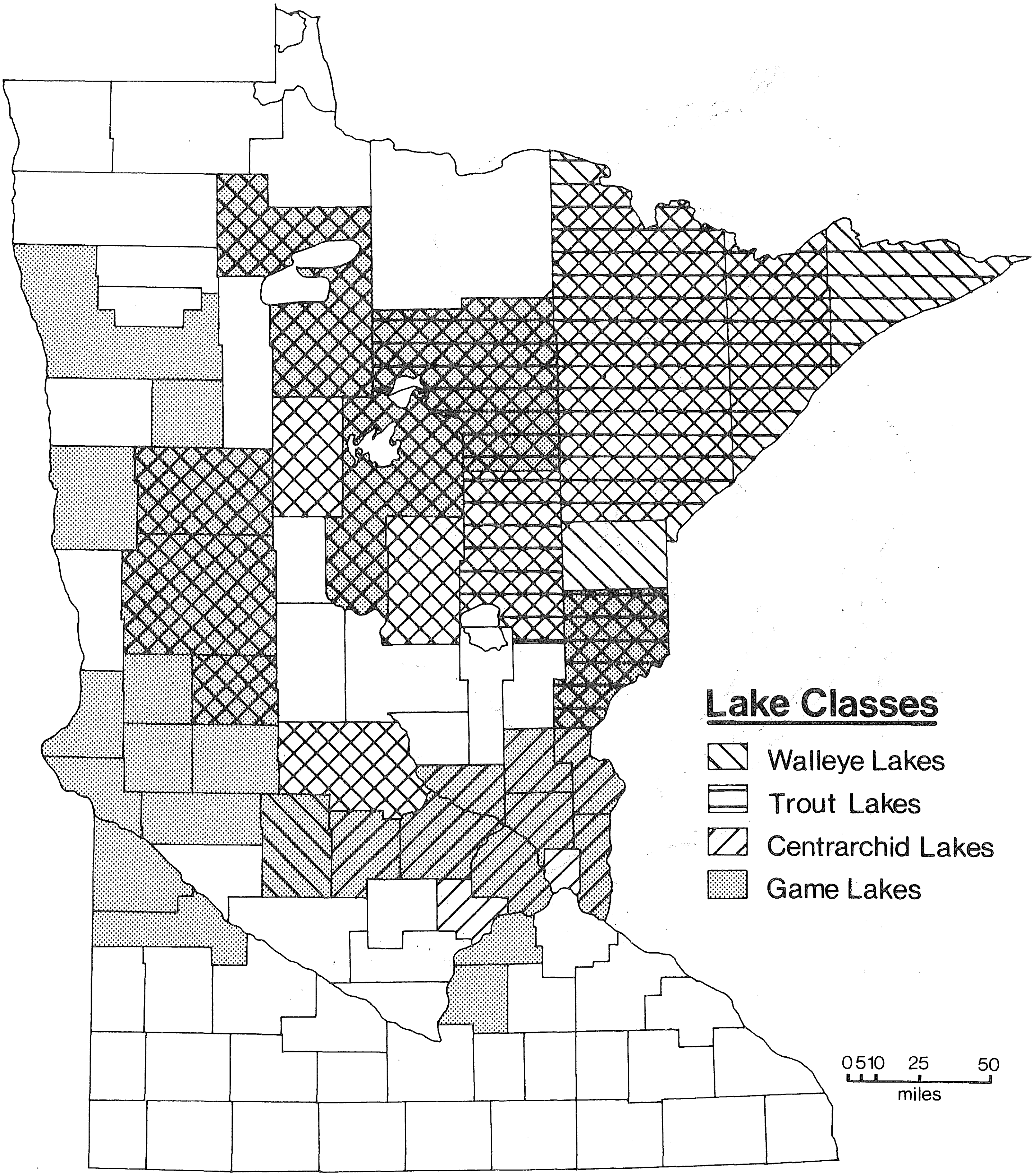
*Note that on graphs 'a' & 'b', the increment sizes change along the X-axis (acres/shoremile).

Figure 2a: PERCENT OF COUNTY AREA COVERED BY LAKE BASINS OF 10 ACRES OR LARGER



source: atlas of minnesota resources and settlement

Figure 2b: DOMINANT LAKE TYPES BY COUNTY



few trout or game lakes over 145 acres in size.* Although uniqueness within a region suggests potential for more intensive use or development, surprisingly, the data indicates this is not the case. Lakes in the same class, regardless of uniqueness within an area, have similar amounts of development pressure.

A third measure of uniqueness are lake characteristics that suggest a need for unusual management practices. For example, lakes at the head of a large watershed require different management strategies than other lakes within a small watershed area. Also, lakes in western and southern Minnesota, where runoff is lower, usually have lower flushing rates and therefore require longer periods of time to recover from most types of pollution than lakes in the northeastern portion of the state.

While some parameters of lake classification have been identified, key aspects of the data inventory have yet to be computerized. Lake ecology class is still being computerized and there is still a need for more careful identification of lakes with special management practices. Consequently, the classes used to categorize data in this report should be viewed as transitional stages to a final classification system.

The following management classification system describes lake resources:

1) Habitat Management lakes are over 145 acres in size and do not have permanent gamefish populations. They often freeze out in the winter. Their appeal for shoreland development is limited. Nevertheless, they have value for wildlife management purposes.

2) Sensitive Resource lakes such as trout lakes have permanent game fish populations, but require unique management practices to protect the resource.

3) Unique resource lakes are game fish lakes (walleye, centrarchid-walleye and centrarchid) in counties that have less than 1% of the county area covered by water. Since there are few alternative resources available for use, these resources usually receive heavy development pressure. Uniqueness is measured by county because that is the jurisdictional level at which lakes are managed.

* This calculation can be refined so that within the lake region smaller areas with relatively few lakes can be identified. This can be accomplished by calculating water surface as a percent of land area within townships as well as by county.

4) Lakes with high density potential are those lakes with less than 100 acres of water per mile of shoreland and that have game fish populations. These tend to be very small but also include larger lakes such as Ossowinamakee, (in Crow Wing County) that have very irregular shorelines.

5) Baseline Management lakes are game fish lakes that are neither unique, sensitive, or pose special management constraints. This does not imply that management needs are not significant. Many of these are the more popular lakes in the state and have been developed to very high densities. They require careful management to ensure their popularity does not result in conditions harmful to the resource.

6) Non-classified lakes tend to be small lakes less than 145 acres which do not have permanent game fish populations. Their appeal for shoreland development is usually small if other, more popular resource types of lakes are available. These constitute the vast majority of lakes within the state.

Evaluation of shoreland development trends required this project to select the same lakes included in the 1970 Lakeshore Development Study. That study reported shoreland development information for 1,923 lakes in Minnesota. These were lakes larger than 145 acres that were not entirely surrounded by publicly owned land or within the Metro area. The studied lakes were the largest and generally the most popular lakes for shoreland residents. These lakes accounted for the vast majority of shoreland development in rural Minnesota.

To allow comparability, some lakes included in the 1970 study were deleted from this report. A major reason was data collection or coding errors in 1967 or 1982 that invalidated comparisons. Another factor was municipal annexation which biased development totals. What remains are 1,873 study lakes used for the body of this report. Table 1 indicates how these lakes are grouped in the lake classifications previously described. Also included for reference are the total of all lakes in the state. This study includes most of the significant lakes in the state (baseline management and other game fish lake categories).

A concept currently being explored for its potential in the evaulation of state owned lands is the Recreation Opportunity Spectrum*. An adaption of

* The Recreational Opportunity Spectrum was developed by the U.S. Forest Service. For more information, see the following sources: Roger N. Clark and George H. Stankey, "The Recreation Opportunity Spectrum: A Framework for Planning, Management, and Research," USDA Forest Service, General Technical Report PNW-98, December, 1979; USDA Forest Service, "ROS Users Guide," circa 1980.

Table 1: NUMBER OF LAKES BY LAKE CLASS

LAKE CLASS	SUBCLASS BASED ON LAKE ECOLOGY	NUMBER OF LAKES IN STATE	NUMBER OF LAKES IN STUDY
I. Habitat Management Lakes	Ia. Roughfish, gamefish, bullheads	1003	639
	Ib. Game	518	99
II. Sensitive Resource	IIa - IIb. Trout and Miscellaneous	171	97
III. Unique Resource Lakes*	IIIa. Centrarchid walleye	34	30
	IIIb. Centrarchid	196	54
IV. High Density Potential Lakes**	IVa. Hardwater walleye, softwater walleye	35	26
	IVb. Centrarchid walleye	163	45
	IVc. Centrarchid	367	114
V. Baseline Management Lakes	Va. Hardwater walleye, softwater walleye	203	165
	Vb. Centrarchid walleye	256	234
	Vc. Centrarchid	372	328
VI. Non-classified	None	12045	42
TOTAL		15363	1873

* Lakes in counties where water surface equals less than 1% of land area

** Lakes with less than 100 acres of water per shoreline this concept for specific application is the Minnesota Recreation Opportunity Spectrum (MNROS). MNROS is an effort to relate recreation activities and experiences to the natural character of the landscape. The approach has relevance for describing the lake resources of the state.

MNROS is determined by the land cover/land use of an area modified by the extent to which that area is accessible by roads. Although the concern of this report is only with the MNROS classification of shoreland areas, figure 3 indicates the distribution of MNROS for the entire state. To more adequately describe lake resources, the ROS concept has been further modified to include the general land use regions within which the MNROS class is located. This yields a measure of the extent to which the particular MNROS class may be unique within its region. Five ROS land use categories (ROSLU) have been designed for describing lake resources. They are:

Primitive/semi-primitive: This includes areas with poor road access and generally natural conditions. Forest cover, lakes, marshes and uncultivated open area conditions (forests, marshes, lakes and open uncultivated areas) fit into this category. These are located in the Northern part of the state and are generally near the Canadian border.

Natural in forest: This consists of the same natural land use/land cover conditions as the previous category except it has better road access. This category is generally located in the forested region of northern Minnesota.

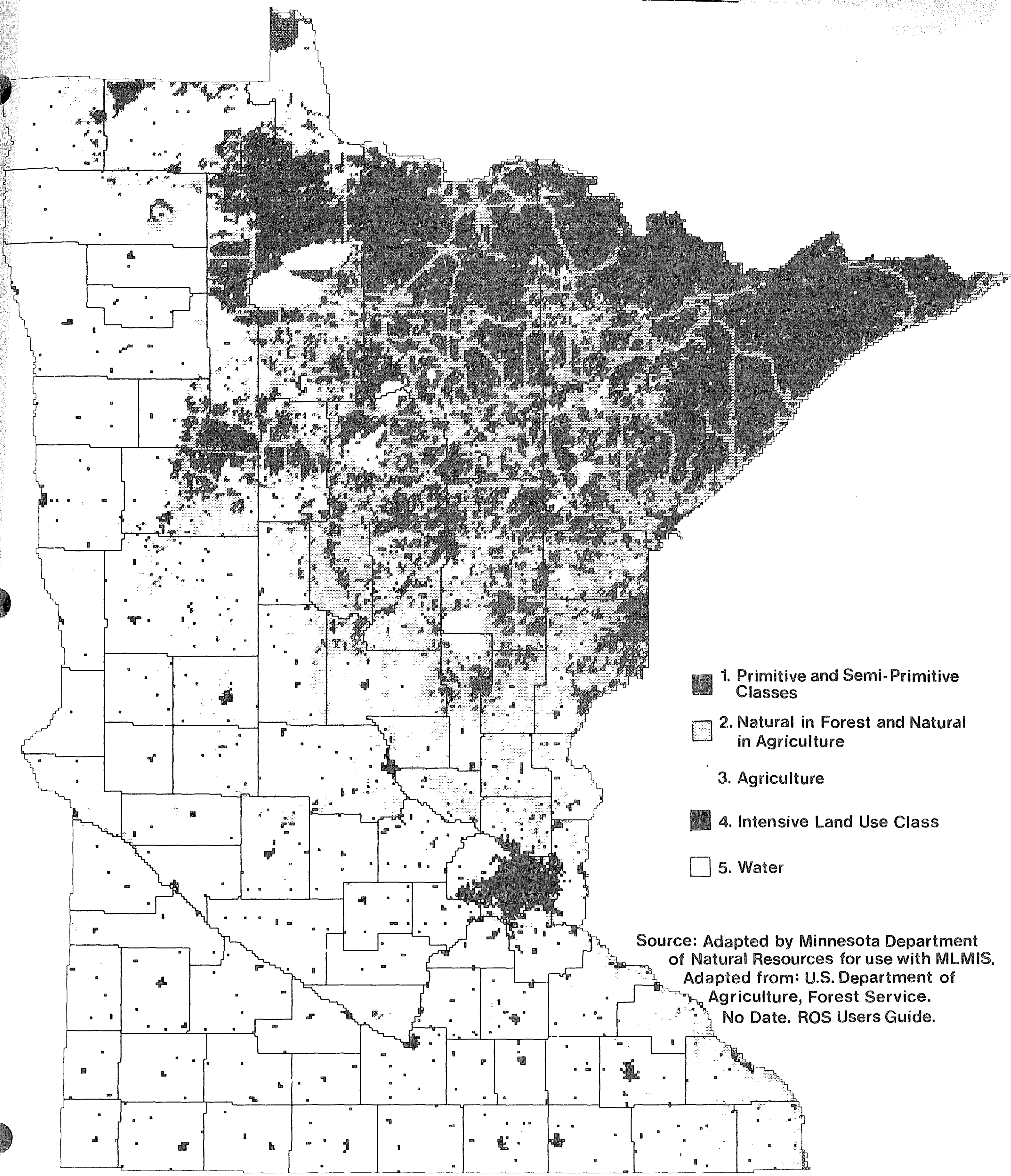
Natural in agricultural: This category is located outside of the major forested regions of the state. It is found in the predominantly agricultural part of Minnesota and in the transitional region that lies between the predominantly forested and agricultural areas. In this category, natural conditions represent an exception to the predominantly agricultural and open land uses. This lends a measure of uniqueness to the resource.

Agricultural: Agriculture and pasture or open conditions characterize the landscape, with few areas in a natural state.

Intensive: This category includes urban areas as well as the heavily altered Iron Range.

Table 2 provides the numerical distribution of lakes by lake class and ROSLU. About 40% of all lakes are in the Habitat Management class, one that holds low potential for shoreland development. About as many lakes are in the Baseline Management class, which holds the greatest attraction for shoreland development. Most of the Unique Resource lakes are in agricultural regions, and therefore may require special management strategies. Almost 20% of lakes

Figure 3: MINNESOTA RECREATION OPPORTUNITY SPECTRUM



are in the Primitive/Semi-primitive ROSLU class. Because of the isolation of these lakes, they may never receive heavy development pressure. As development pressure on other lakes continues, these will become increasingly important resources due to their lack of development and high resource quality. Although more than a third of the total study lakes are in the Agricultural ROSLU zone, most of these are the Habitat Management lakes which are less desirable for development purposes. This places greater pressure on the other lakes with fish populations in the agricultural zone. Some of the pressures being exerted on lake resources are examined in the following section.

Table 2: DISTRIBUTION OF LAKES BY LAKE CLASSIFICATION AND ROSLU

	RECREATION OPPORTUNITY SPECTRUM LAND USE CLASS (ROSLU)					
LAKE CLASSIFICATION	Primitive/ Semi-prim.	Natural FOREST	Natural in Agri. zone	Agri.	Intensive	Total Lakes
Habitat Management	90	85	98	421	16	710
Sensitive Resource	70	4	15	7	0	96
Unique Resource	0	12	20	40	12	84
High Density Potential	57	16	77	16	16	182
Baseline Management						
Walleye	41	13	75	26	8	163
Centrarchid/ Walleye	43	29	94	45	17	228
Centrarchid	69	40	115	88	14	326
Not Classified	16	3	8	8	1	36
Total lakes	386	202	502	651	84	1825*

* The total number of lakes in this chart is only 1,825 as compared to the 1,873 designated as study lakes in table 1. This is due to some lakes being deleted because the technique used to identify land parcels surrounding a lake was approximate; some lakes were subsequently lost. This approximation technique was dropped as the shoreland data files were completed. Now, every study lake can be assigned to a ROSLU class.

III. TRENDS AND INFLUENCES IN SHORELAND DEVELOPMENT

Minnesota patterns of resource use reflect similar national patterns and are heavily influenced by a myriad of individual choices and national policies and programs. Although Minnesota's capacity to alter these basic forces and policies is limited, to a degree, they can be directed and guided. To effectively manipulate or influence these patterns, we must develop an understanding of them.

A. Shoreland Development Trends

Minnesota has enough shoreland dwellings outside of the Twin Cities Metropolitan area to house the entire combined populations of Duluth, Rochester, St. Cloud and Mankato and still have room left over for a number of invited guests. With more than 100,000 miles of shoreland on lakes and over 93,000 miles on rivers, Minnesota still has enough undeveloped shoreland to house the entire Twin City Metropolitan area, should that be needed. In 1982, there were 112,624 shoreland dwellings in non-municipal areas (Table 3). But despite our wealth of shoreland resources, subsequent data will indicate that not all of it is conveniently located nor desireable to shoreland residents. As a result, much of the development is concentrated.

Since 1967 some subtle but important changes in development patterns have occurred. Resource areas that were popular in 1967 remain popular today. Although the increase in development densities is not surprising, the growing significance of permanent dwellings in comparison to seasonal is somewhat unexpected. Between 1967 and 1982, seasonal dwellings increased by 63%, permanent dwellings increased by 100% and total dwellings increased by 74%. These figures yield an average annual rate of 4.20% for seasonal, 6.67% for permanent, and 4.87% for total shoreland housing development. Compare these figures with the state average for increased housing, 2.46%, and it is clear that the rate of development in shoreland areas is quite high.* Much of that development occurred on lakes that were already considered heavily developed in 1967. Thus, development densities and the intensity of resource use have increased markedly despite the fact that development was subject to

* The state average is determined from the growth rate from 1970-1980, 24.6%, in 1980 Census of Population and Housing, U.S. Department of the Census.

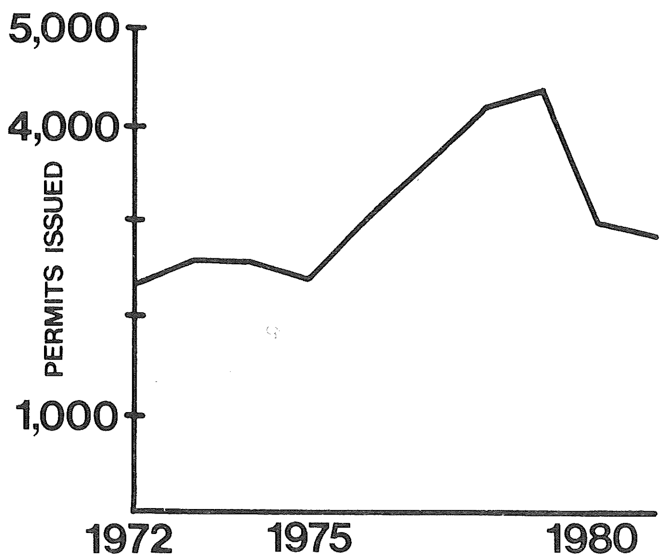
some government control. The shoreland program has not discouraged development growth - but then, it wasn't intended to.

The increase in shoreland dwellings has accounted for much of the increase in housing in many counties of the state. In some counties more than half of the housing stock added between 1970 and 1980 occurred in shoreland areas (see figure 10).

Table 3: TOTAL SHORELAND DEVELOPMENT, 1967-1982

	Lakes Larger than 150 acres		Lakes Smaller than 150 acres		Municipal Areas		Non-Munic.	
	Seasonal	Permanent	Seasonal	Permanent	Lakes	Rivers	Rivers	Total
1967	39016	17122	NA	NA	NA	NA	NA	56138
1982	64859	34492	4420	3017	18950	8350	8086	142174
% Change 1967-82	66.2	101.4	NA	NA	NA	NA	NA	NA

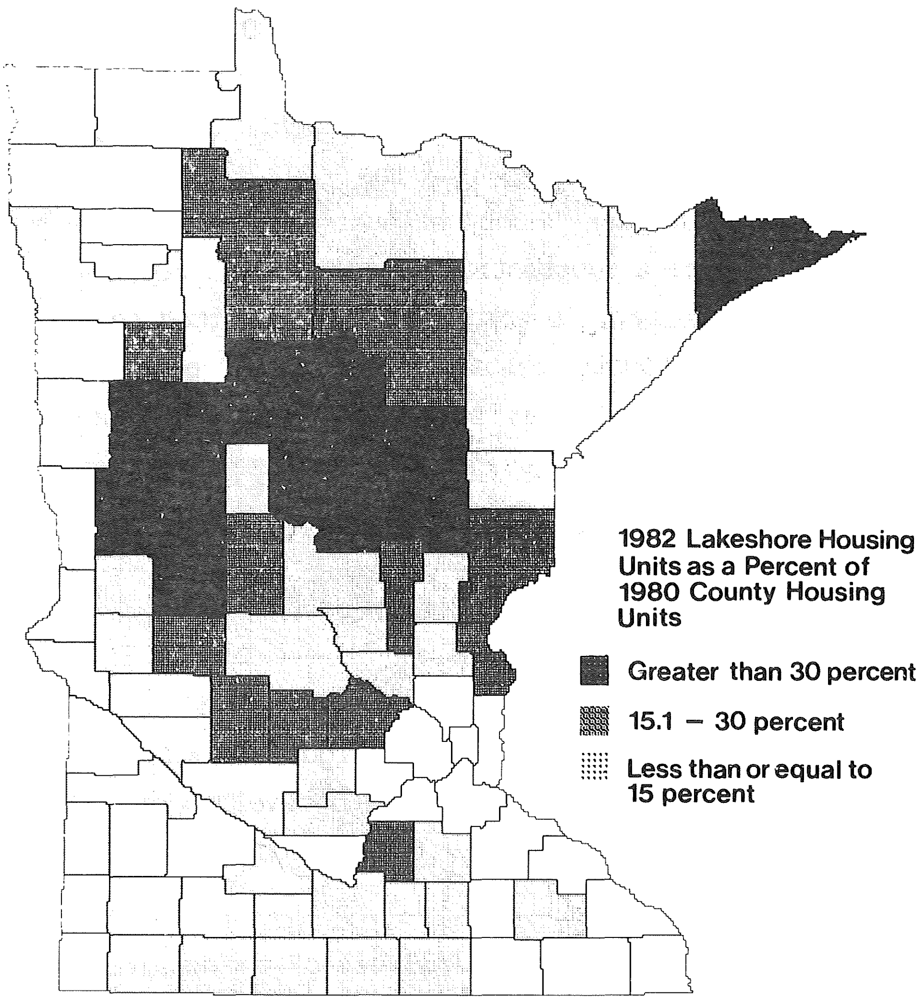
Figure 4: ANNUAL NUMBER OF SHORELAND BUILDING PERMITS ISSUED 1967-1982 (39 Counties in Sample)



The increase in development since 1967 has not been constant. Shoreland construction has varied considerably, usually reflecting general trends in the economy. A record of shoreland building permits in 39 sample counties indicates a decrease in development activity during the 1974 and 1980 economic downturns (Figure 4).* Building permit applications also made a sharp upturn in 1975. That upturn continued until the 1980 recession. Shoreland managers indicate that permit applications are on the upturn in 1983. If the rebound in building permits is as strong as the 1975 recovery, shoreland managers will be very busy during the next year or two.

One indication of the significance of shoreland development is the share of total county housing found in shoreland areas (Figure 5). In many counties,

Figure 5: PERCENT OF 1980 COUNTY HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES



* Although building permits are not an unambiguous measure of development activity, they do provide some sense of what development expectations and intentions are. For more information see, The Wright County Project on Land Use Change and Development Through Building Permits, by William J. Craig, Mpls.: Center for Urban and Regional Affairs, 1979.

more than half of the total housing units are located in shoreland areas. A shoreland residence opens new recreational opportunities. An example of this can be seen in the pattern of boat ownership. Statewide, shoreland residents own an average of more than two boats per residence. These facts underly the significance of shoreland residence as a part of a chosen lifestyle pattern.

Lost in the data is an appreciation of the enormous significance that shorelands hold for the economy and lifestyle of the state. In states less richly endowed in shoreland resources, it is not unusual for all privately owned shoreland to display multiple tier development.

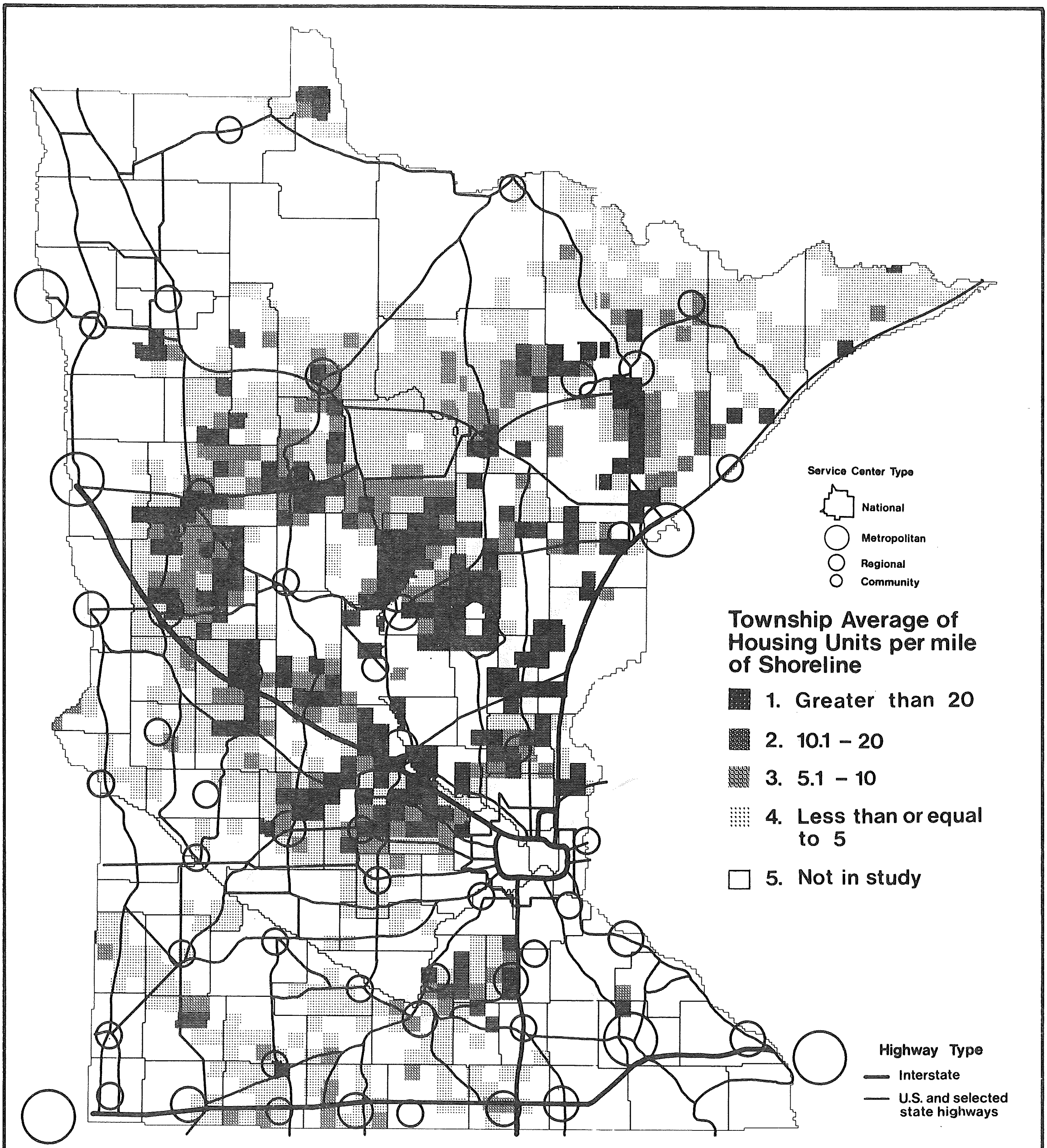
Shoreland development also represents an enormous contribution to the economy of many counties. Questionnaire returns indicate the average seasonal resident spends about $2,500 annually in the immediate area of the seasonal residence. In a county such as Cass, the 4,000 seasonal homes contribute approximately $10,000,000 to the local economy. Generally, each $25,000 of such expenditures accounts for one additional job. Ignoring the commonly used technique of applying multipliers to the calculation, seasonal shoreland resident expenditures in Cass County account for at least 400 jobs. Use of multipliers would produce a substantially larger contribution. In a recent study of the resort industry, Joseph Kreitzer determined that for every dollar taken in by an Itasca County resort, about $2.90 of income was generated within the county and as much as $4.50 including indirect expenses. Thus, almost $9 million may have been generated by resort shoreland activity. It is likely that similar multipliers are applicable to expenditures by shoreland residents.[*] The Department of Tourism estimates well over 100,000 jobs can be attributed to travel activity (both business and pleasure).[**]

The following maps (Figures 6a-8c) provide some useful insights into development patterns in shoreland areas. Figure 6a graphically demonstrates the influence of service centers on shoreland development. Important service centers (such as the Metro area, St. Cloud, and Brainerd) with significant

* Joseph L. Kreitzer, "An Econometric Analysis of the Resort Industry In Itasca County, Minnesota," Department of Economics, The College of St. Thomas, 1 October 1983. (Draft Report)

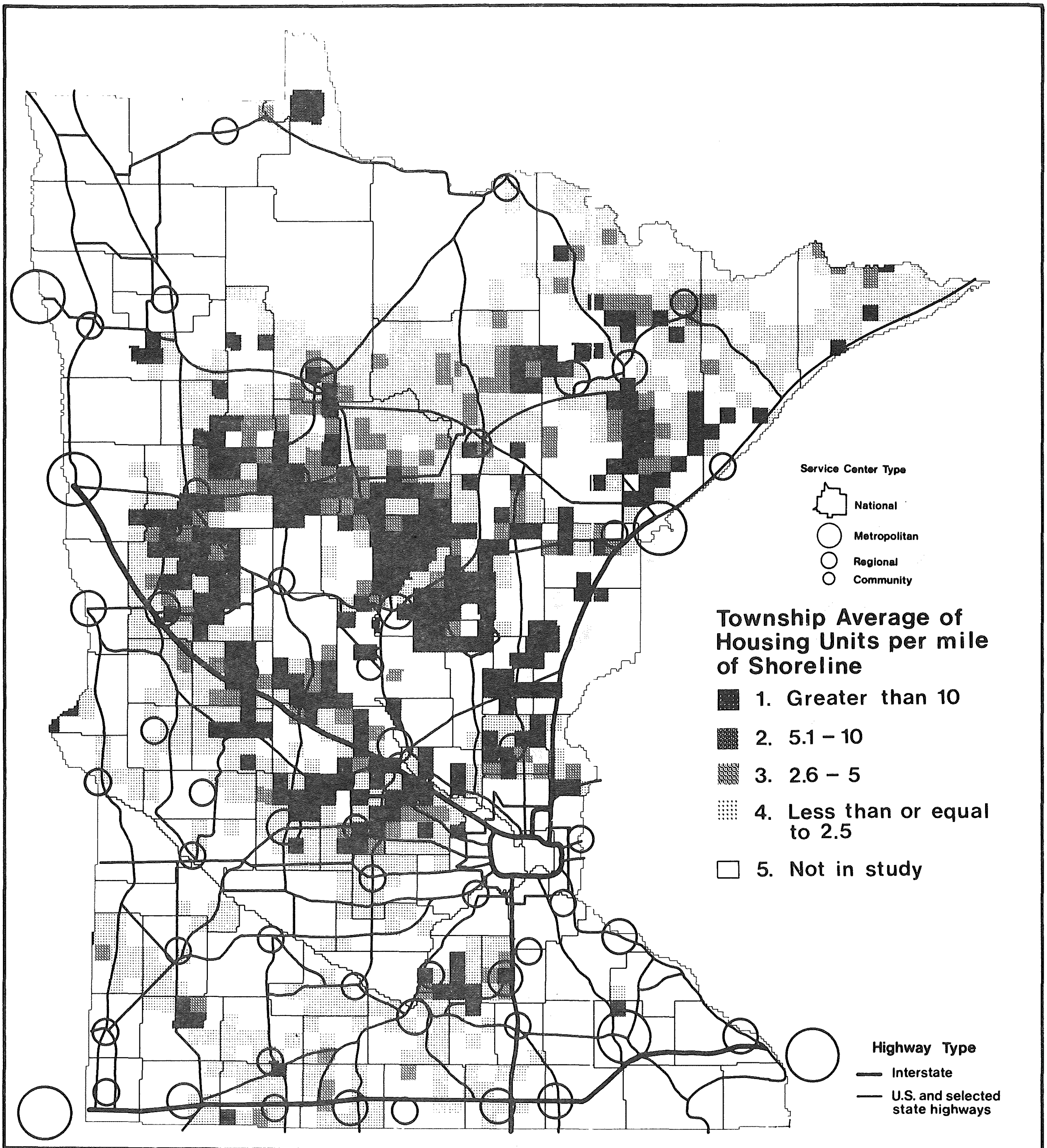
**Personal communication with Ing Sollin on 18 October 1983.

Figure 6a: DENSITY OF HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES, 1982



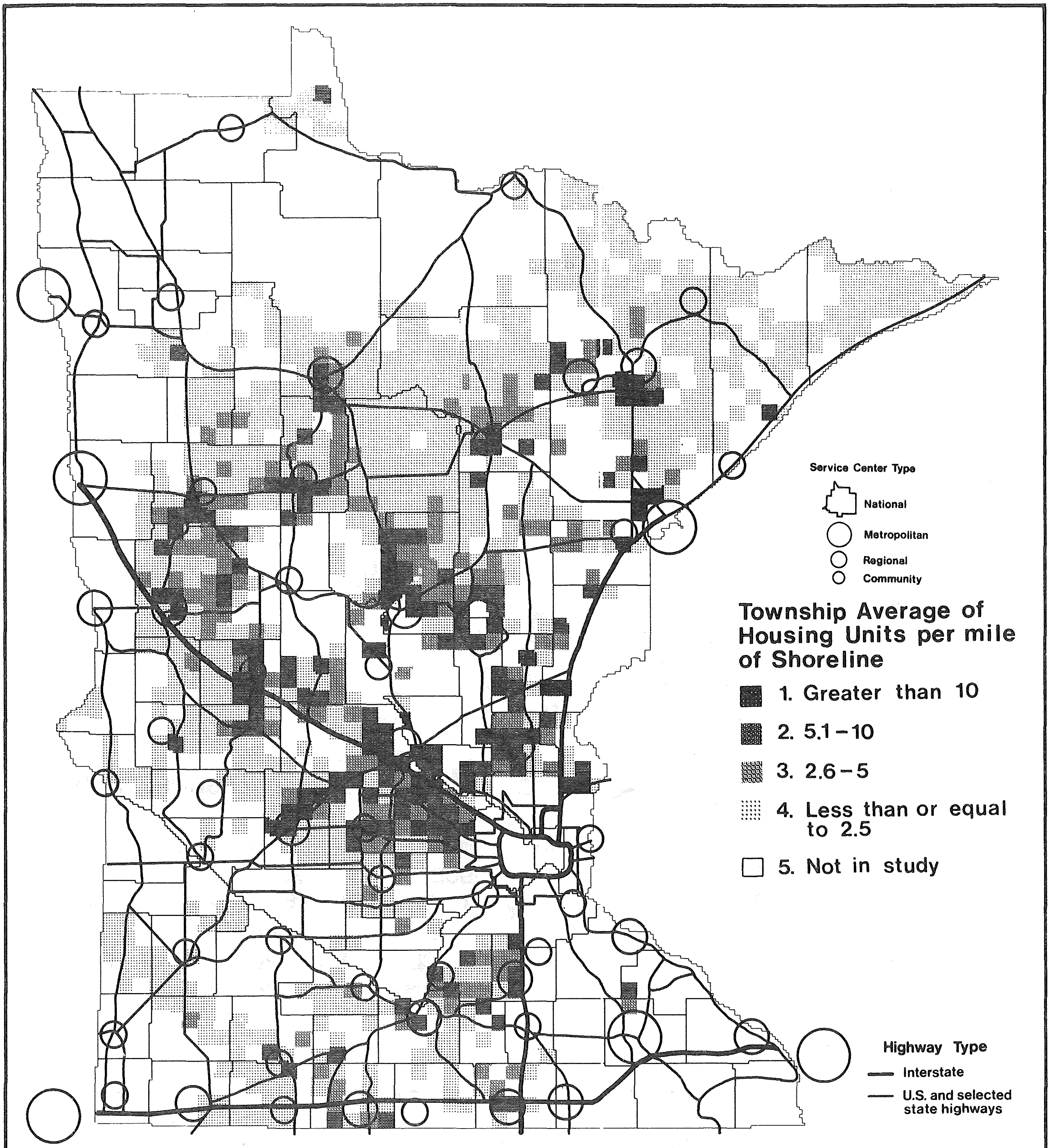
Source: Minnesota Department of Natural Resources

Figure 6b: SEASONAL HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES, 1982



Source: Minnesota Department of Natural Resources

Figure 6c: PERMANENT HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES, 1982



Source: Minnesota Department of Natural Resources

0 20 40 miles
0 20 40 60 km.

Figure 7: SERVICE CENTER ACCESS & CUMULATIVE %
of SHORELAND DEVELOPMENT

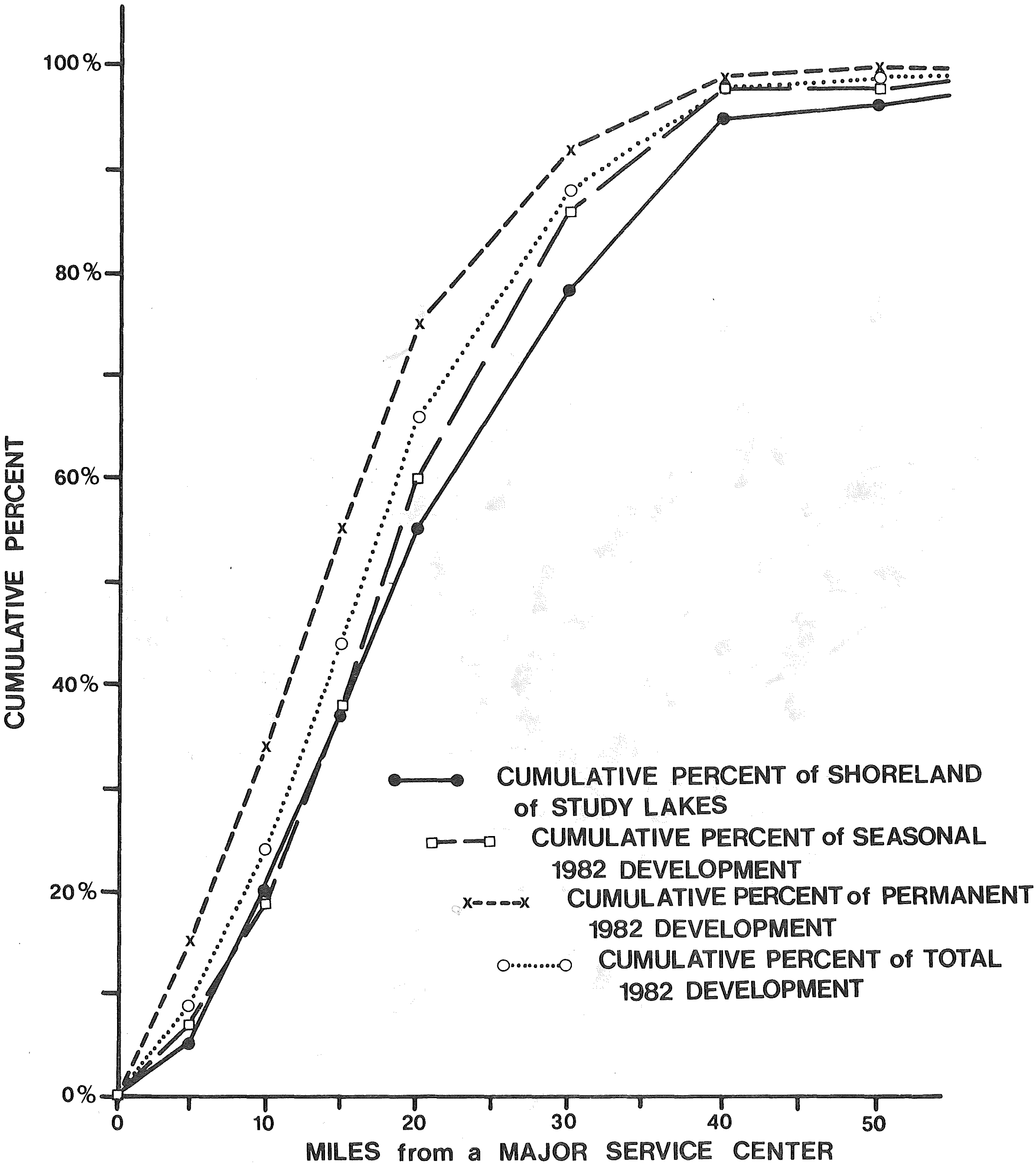
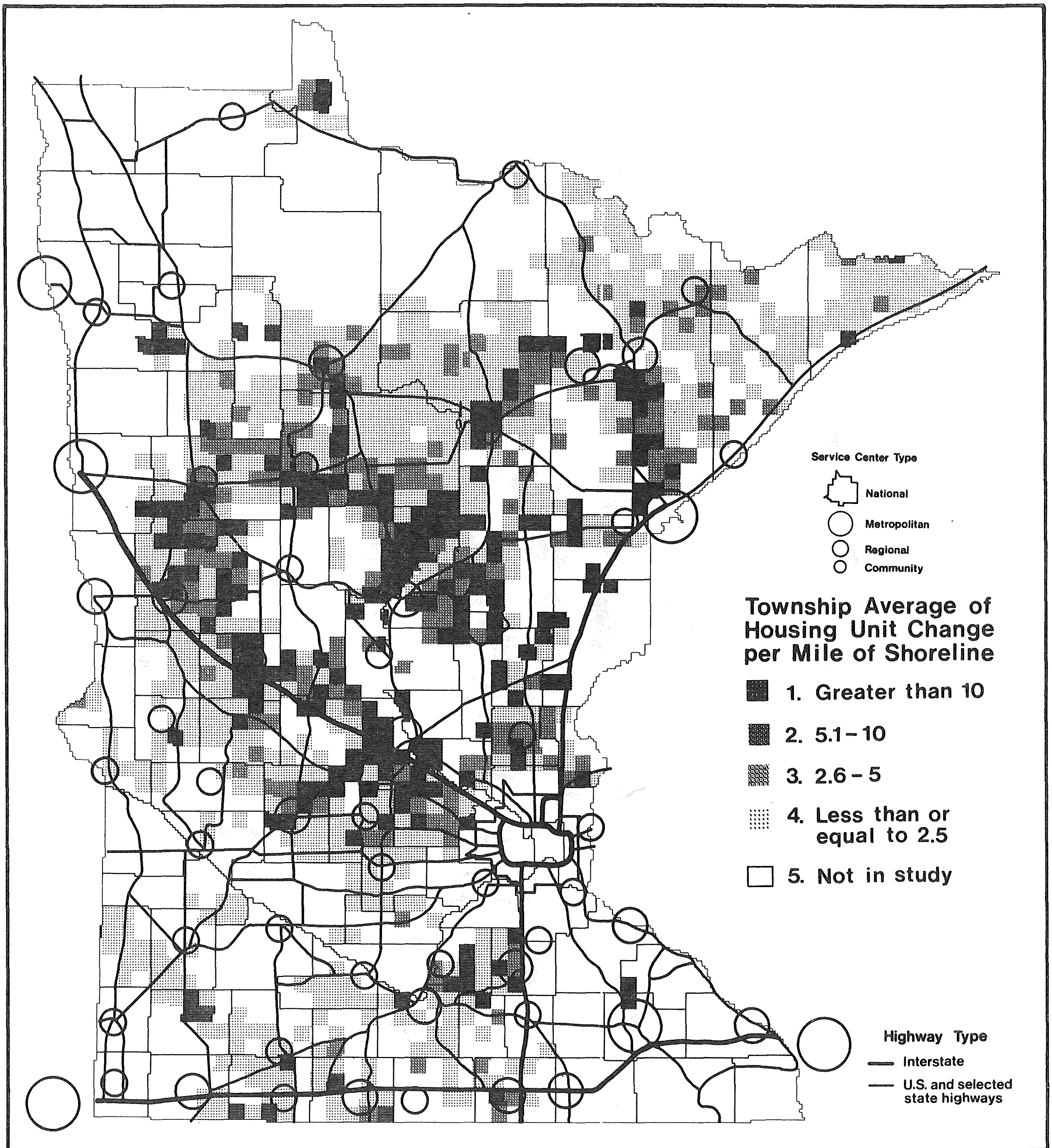


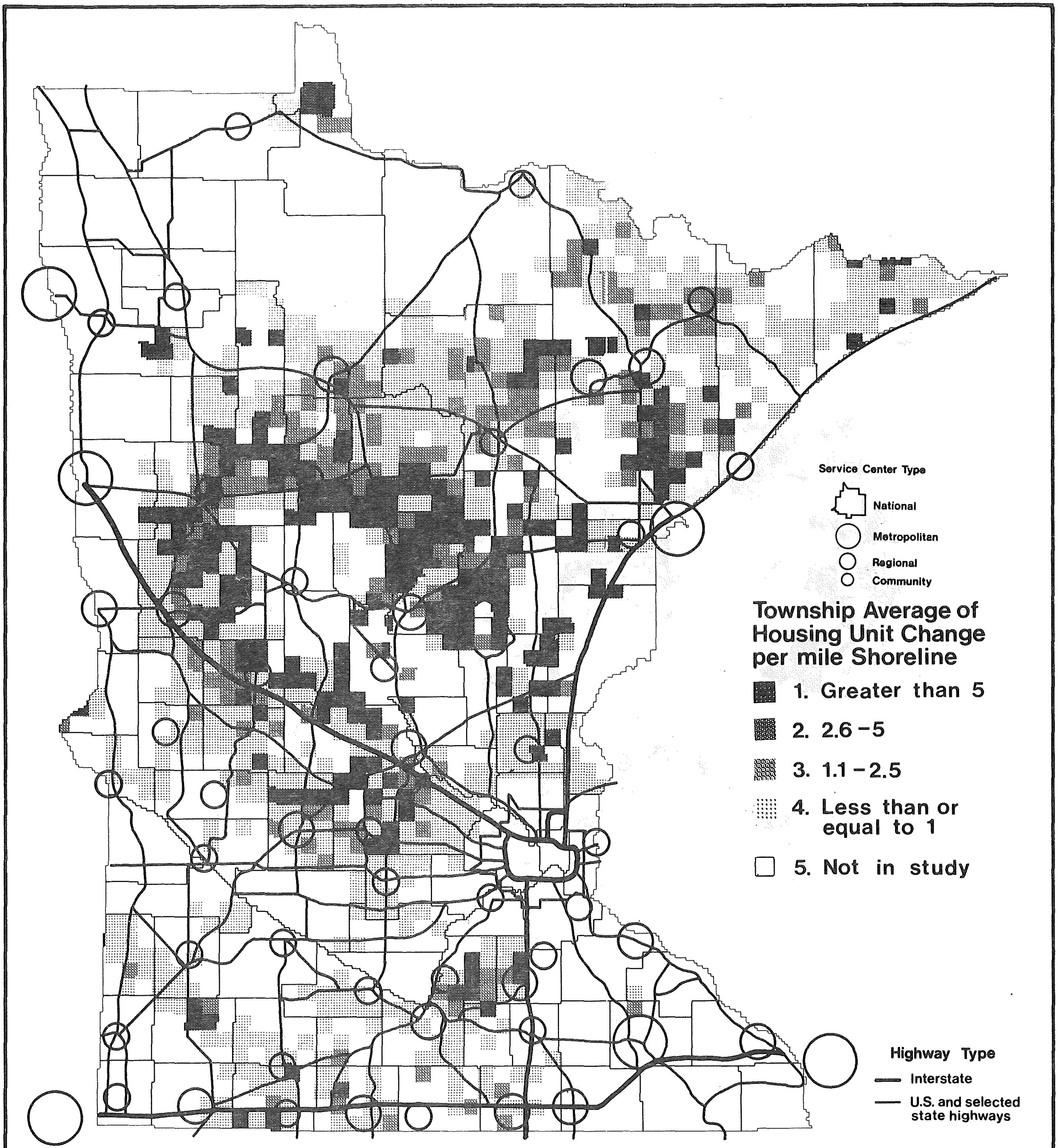
Figure 8a: CHANGE IN TOTAL HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES 1967-1982



Sources: 1982 shoreland data: Minnesota Department of Natural Resources.
1967 shoreland data: Borchert, J.R.; Orning, G.W.; Stinchfield, J.; and Maki, L. 1970 Minnesota's Lakeshore-Part I. University of Minnesota.

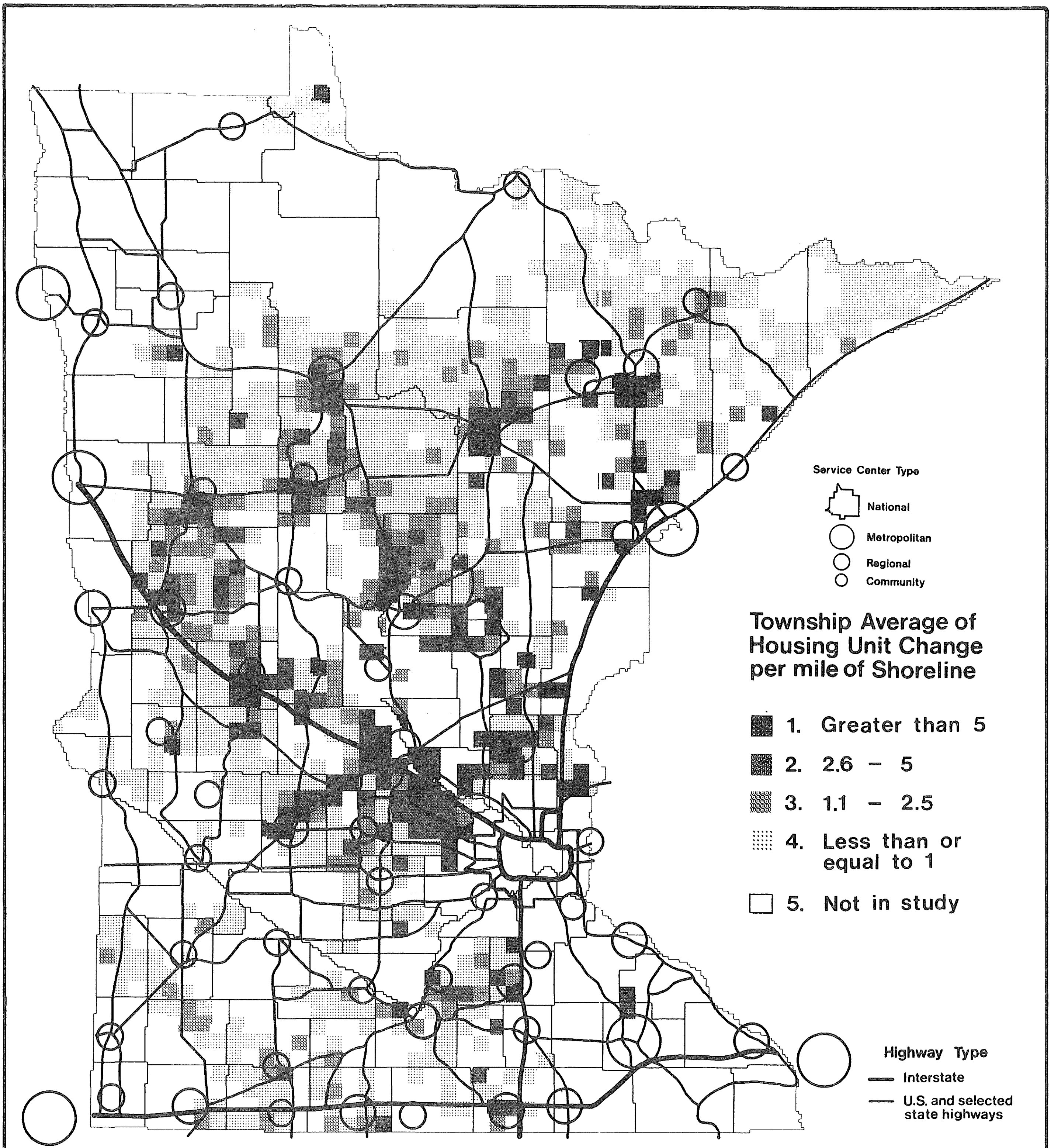
0 20 40 miles
0 20 40 60 km.

Figure 8b: CHANGE IN SEASONAL HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES 1967-1982

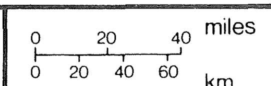


Sources: 1982 shoreland data: Minnesota Department of Natural Resources.
1967 shoreland data: Borchert, J.R.; Orning, G.W.; Stinchfield, J.; and Maki, L.
1970 Minnesota's Lakeshore – Part I. University of Minnesota.

Figure 8c: CHANGE IN PERMANENT HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES 1967-1982



Sources: 1982 shoreland data: Minnesota Department of Natural Resources.
1967 shoreland data: Borchert, J.R.; Orning, G.W.; Stinchfield, J.; and Maki, L. 1970 Minnesota's Lakeshore–Part I. University of Minnesota.



lake resources display the highest densities of shoreland development. But densities are also high near smaller regional centers such as Alexandria, Grand Rapids, Bemidji, and Park Rapids. It appears that around these centers a commuting zone has been established with the lake resources providing a significant portion of this base. A comparison of figures 6b and 6c also suggests that the distance from service center is more important for permanent than seasonal development. Figure 8 illustrates the importance of distance from a service center.* The graph indicates a higher share of total shoreland development occurs within close proximity to service centers than would be predicted based on availability of shoreland mileage. Almost 90% of all shoreland development occurs within thirty miles of a service center. Figures 8a-8c indicate this development pattern has not changed significantly since 1970. Despite the many socioeconomic changes, the pattern of development has, for the most part, undergone very little change.

This pattern also suggests that distinctions between urban and rural areas are fading. That observation, which is not unique to this report, is based on the following two observations. One is that the sharp demarcation that once existed between most urban areas and their rural environs is not as clear as it once was. 'Leapfrog development' has scattered housing far beyond municipal boundaries. Improved road systems allow extended commuting ranges, which appears to be a strong factor in much of the non-municipal population growth in Minnesota. That accounts for some of the growth of permanent dwellings in shoreland areas near the major urban areas. The second observation is that differences in the quality of services between urban and rural areas is decreasing. Thus, the non-municipal growth rates which have been larger than municipal growth rates can be seen as reflecting the extension of better service systems to the more rural hinterland. In this regard, it is no longer clear that municipal areas can be clearly differentiated from rural areas based upon growth rates.

* In figure 8 the shoreline is plotted in order to illustrate whether the variables are more or less concentrated nearer the service centers than the resource itself. If, for instance, the displayed variable is above the shoreline curve, the variable is more concentrated near the service centers than are the shoreland resources.

Another important trend in shoreland development is the increasing volume of offshore development.* Offshore development is occuring in many prime resource areas. To measure that trend, data was collected on numbers of residences in shoreland areas without actual frontage on the shoreline. Less than 10% of dwellings in shoreland areas do not have lake frontage (Table 4a). The relationship of this statistic to resource type is complex. On many marginal resource types, the percent of shoreland dwellings without frontage is higher than the state average. This does not, however, indicate significant offshore development. Many of these lakes are in agricultural areas. The development that exists is not oriented exclusively to the lake. Much of it is farmstead or simply incidental to the shoreland area. As a result, a smaller share of development in the shoreland area has been located because of the existence of the resource.

In other areas, very low rates of offshore development are an indication of resource remoteness. For example, much of the rock soil shorelands are located in poorly accessable locations. In these areas, there has been less

Table 4a: PERCENT OF 1982 DEVELOPMENT WITHOUT LAKE FRONTAGE

CLASSIFICATION	Total
Habitat Management	15
Sensitive Resource	4
Unique Resource	7
High Density Potential	7
Baseline Management	
Walleye	8
Centrarchid Walleye	9
Centrarchid	8
No Classification	22
Total	10

* Offshore development refers to lots within the 1,000 ft. shoreland area but without lakeshore frontage. In most subdivisions, such lots usually reflect second and third tier development.

development and lake frontage is more easily acquired. The most popular resource types have about the same share of total residences with frontage as the state average.

Table 4b indicates there is a strong relationship between second tier development and access to roads and service centers. In locations with the poorest road access, a higher percentage of shoreland dwellings have frontage. Thus, second tier development accounts for a smaller share of total dwellings. As road access improves, the share of total dwellings with frontage declines, indicating more dwellings in second tier development. The relationships between resource characteristics, access, and offshore development need further exploration for a clear understanding of the significance of this trend. The importance of road and service center access will be discussed in greater detail later in this report.

Table 4b: PERCENT OF 1982 DEVELOPMENT WITHOUT LAKE FRONTAGE

Service Center Proximity	ROAD ACCESS CLASS* 1	2	3	4	5	Total
0 - 5 Miles	24	22	8	13	13	22
5 - 15 Miles	11	11	6	4	0	10
15 - 30 Miles	9	6	4	3	1	7
Greater Than 30 Miles	12	8	3	2	0	7
Total	12	10	5	3	1	10

*To define the five road access classes, use the table below. For instance, road access class 4 is a mile or more from a paved road and a half mile or more from a gravel road.

*LEGEND: ROAD ACCESS CLASSES

PAVED ROAD ACCESS	GRAVEL ROAD ACCESS Oriented	0 and 1/2 mile	1/2 and 1 mile	1 mile
Oriented	1	1	1	1
0 and 1/2 mi	1	3	3	3
1/2 mi 1 mi	2	3	4	4
1 mi	2	4	5	5

One area in which shoreland development has decreased is in the number of resorts.* Resorts in shoreland areas have been in a decline for some time. Reasons for this decline are numerous. While patronage of resorts has remained fairly constant, the costs of running resorts have increased significantly. With marginal incomes and heavy investment in land and facilities, the return on investment has not been competitive with other opportunities. Many resort owners who remain in operation do so because of the lifestyle rather than viewing their resort as a business opportunity. Although there has been a substantial decline in the number of resorts, some new resorts are being constructed and additional units are often added to existing operations. Still, the prevailing trend is one of decline.

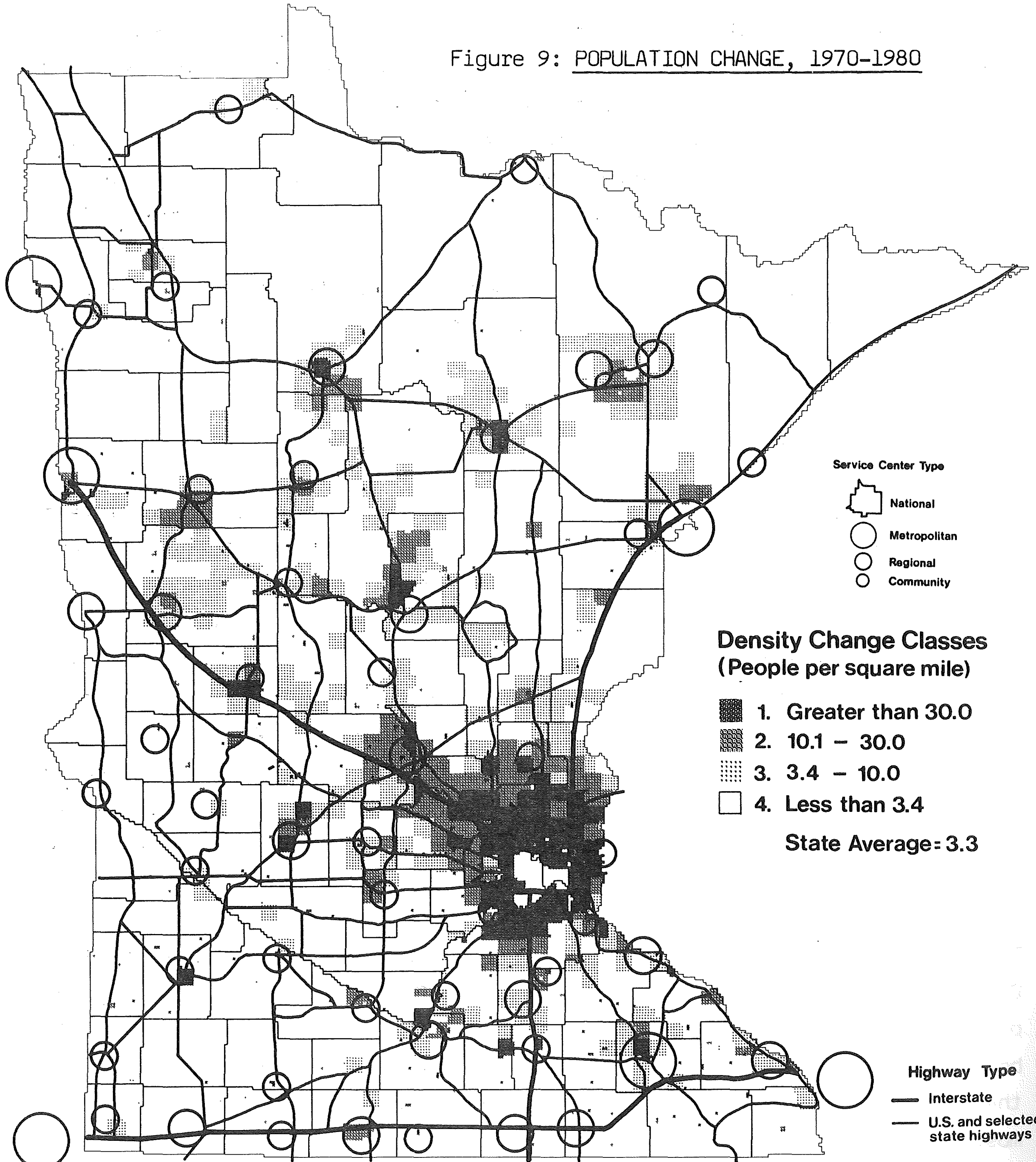
B. Patterns of Population Change

Throughout this nation's history, migration patterns have been toward metropolitan areas, especially the larger population centers. But in the late 1960s and 1970s, differences in population growth between metropolitan and non-metropolitan areas began to stabilize. The decade of the 70's saw a modest net out-migration from metropolitan areas. Similar patterns are occurring in Minnesota. Prior to the 1970 Census, population was becoming increasingly concentrated in the Twin Cities Metropolitan Area. Outside of the Twin Cites, population growth was sporadic, with large areas experiencing population loss. Even in some of the recreation regions, that area identified by heavy concentrations of forest cover and lakes, population growth was slow or declining.

That pattern changed during the 70's. The movement of people toward the Twin Cities Metro Area slowed to a near halt. Outside the Twin Cities region, population decline continued in the mostly agricultural counties but actually began to increase in recreational areas (Figure 9). A significant share of that growth was occurring in shoreland areas. Shoreland development was the most significant contributor to residential construction in Cook County and a core set of counties that follow a westward extending arc from southern Itasca and Cass counties and running through Otter Tail, Douglas, and Stearns Counties (Figure 10 - compare with Figure 5).

* For more detailed information about resorts in shoreland areas, see Report No. 7, RESORT TRENDS, Shoreland Update Project, 1983.

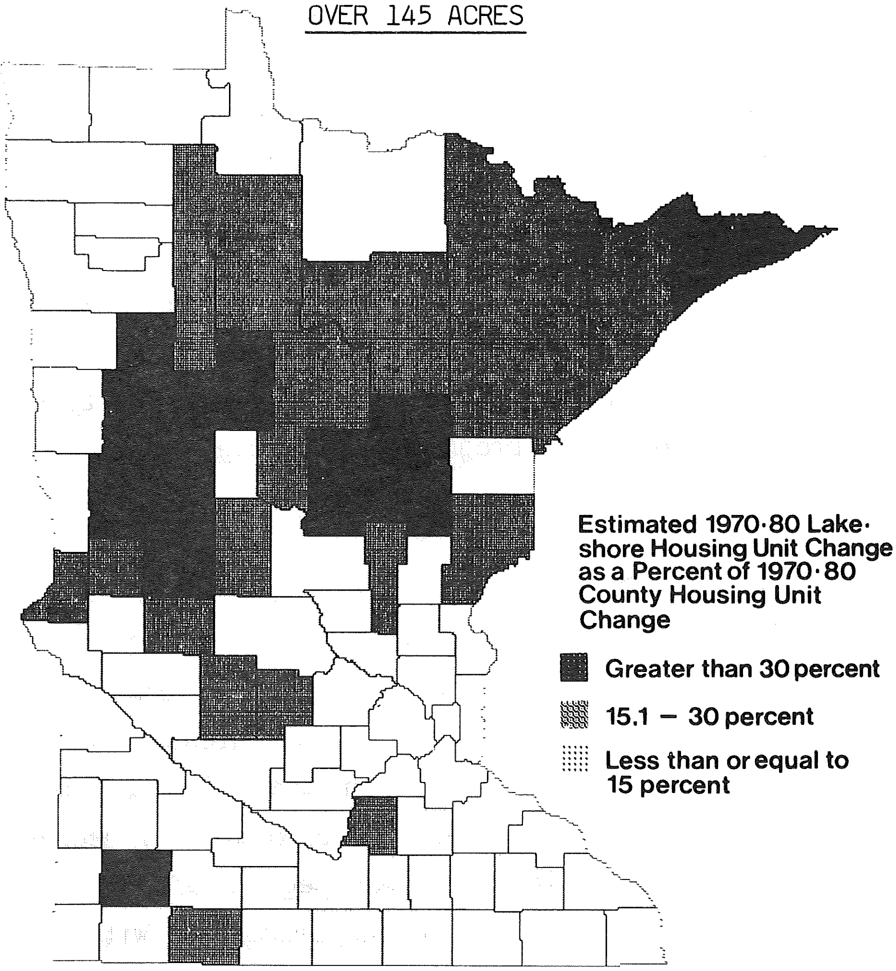
Figure 9: POPULATION CHANGE, 1970-1980



Source: U.S. Department of Commerce. Bureau of the Census. 1981. 1980 Census of Population and Housing.

Forces influencing patterns of rural migration are complex and vary considerably from region to region. Many demographers describe three significant dimensions of non-metropolitan migration. One of these is improved access to rural areas via a transportation network which has reduced the constraints to exurban housing locations. Second, is the dispersal of industry to rural areas, thus providing employment opportunities. Third, are lifestyle changes (i.e., early retirement, increased leisure orientation, and new sources of income for retirees which often leads to increased consumption, thus creating new employment opportunities where they are located).* Other demographers include amenity areas as a significant factor.**

Figure 10: PERCENT OF 70-80 CHANGE IN COUNTY HOUSING UNITS ON SELECTED LAKES OVER 145 ACRES



* This conclusion was drawn from a recent DNR survey of resort owners. For instance, few resort owners could relate such basic information such as occupancy rates, the source of their clientele, etc.

** Kevin F. McCarthy and Peter A. Morrison, The Changing Demographic and Economic Structure of Non Metropolitan Areas in the 1970's, The Rand Corporation, January, 1978. Page 5-6.

Other important sources of influence are lifestyle patterns associated with housing preferences. Americans have long held a strong desire for single family housing on large lots.* Despite the increasing popularity of townhouses and condominiums, prevailing market conditions continue to indicate the dominant preference is for detached single family housing.

In past years, the realities of rural locations conflicted with lifestyle aspirations. Not only were employment opportunities limited, but the level of services was often inadequate. Many were unwilling to sacrifice their desire for quality services such as education and health care, for the sake of rural lifestyles. Since the rural transportation network was inadequate, commuting to larger urban centers for employment or services was not feasible.

Impediments to rural lifestyles were reduced markedly during the 1950s and 1960s. The quality of services was upgraded (and in many areas are rated superior to urban service levels), rural transportation systems improved and employment opportunities increased. Within a short period of time, the lifestyle aspirations of many Americans took a more tangible form.

Also facilitating the movement to rural areas, were a large number of public policies and programs which encouraged and subsidized rural and suburban location. The income tax structure, public utility pricing, aid to education, transportation construction, and other programs underwrote much of the cost of rural location.

Minnesota, during the 1970s, reflected these national trends. State aid to education, construction of the interstate network, expansion of rural medical services, dispersal of many employment opportunities, and other forces have encouraged and facilitated population growth in rural areas. The result is the relatively large increase in population in the central lakes region between 1970 and 1980. With the exception of the economically depressed iron range area, all of the counties in the lake region of the state have experienced a net in-migration (Figure 11a: By comparing this with Figure 2a,

*Glenn V. Fuguitt, "Post 1970 Shifts in the Pattern of Populattion Change in the North Central Region", Patterns of Migration and Population Change in America's Heartland, Michigan State University, East Lansing Agricultural Experiment Station, April, 1978.

one can discern the overlap between net in-migration and the counties with significant amounts of shoreland resources).Retirement has also influenced these patterns. According to the 1980 Census of Population, most of the counties in the central lakes region experienced a net in-migration of persons aged 65 and older (Figure 11b). That trend is expected to continue. According to a 1982 questionnaire of shoreland homeowners, about one fourth of the seasonal residents plan to convert their dwelling to year-round use. They plan to do so, on the average, within eight years.

Figure 11a: NET MIGRATION RATES 1970-1980

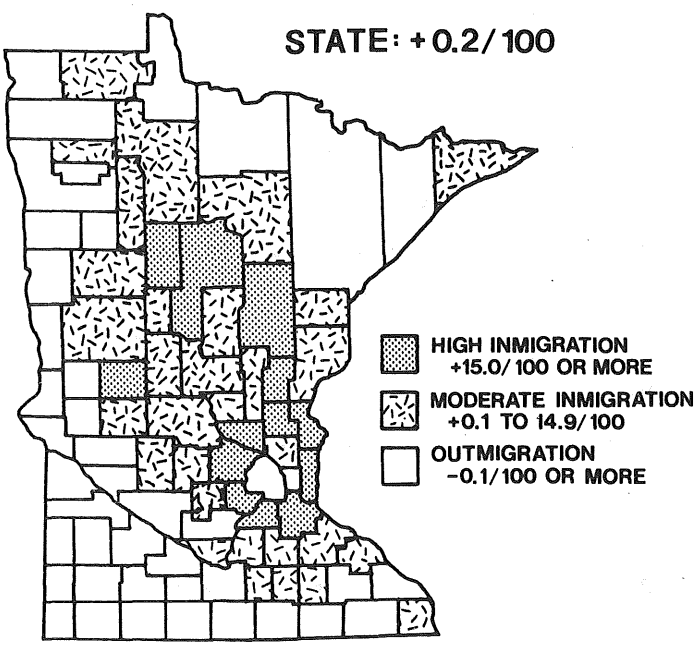
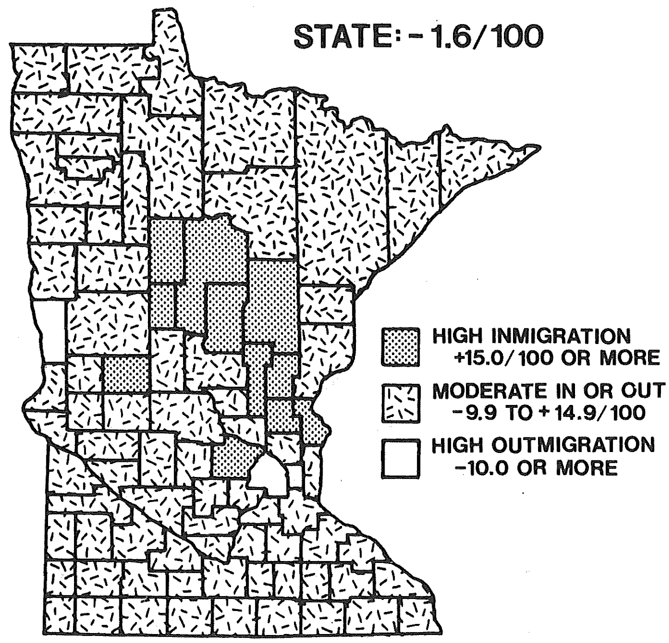


Figure 11b: MIGRATION RATES AGES 65-74



C. Shoreland Development and Recreational Activities

Recreation trends influence and reinforce many of the population patterns in Minnesota. In the "land of 10,000 lakes," (actually, there are over 15,000 lakes) recreation is oriented toward water related activities. The weekly 'up to the lake' migration is almost a summertime institution in Minnesota. The Friday afternoon exodus gives the appearance that everyone either owns a shoreland cabin or has friends and relatives that do (with many of those who don't, wishing they did).

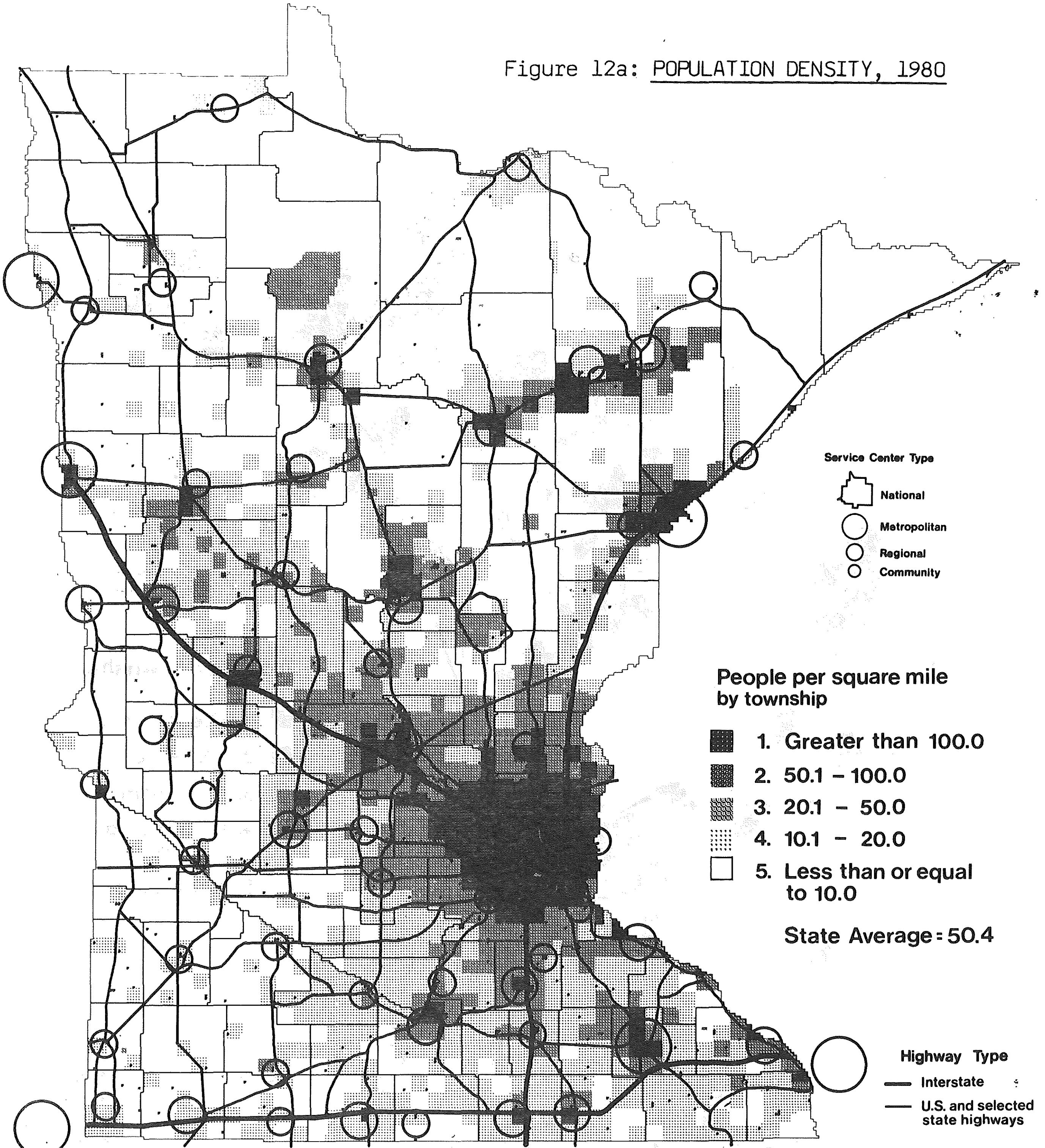
Affluence and greater amounts of leisure time have facilitated growth in recreation. Despite the recent recession, disposable income in Minnesota has risen. National studies have also indicated a gradual and steady increase in discretionary time. Popular wisdom buttressed by some studies indicate that recreational activity has been a beneficiary of some of this rising income and leisure time.

With water playing a pivotal role in Minnesota recreation experiences, it is not surprising that population pressure is focused on shoreland areas (compare Figures 12a and 12b)). What may be unexpected is the very high participation rates. About 40% of shoreland residents fish, swim, and sunbathe daily or often (Figure 13). The State Comprehensive Outdoor Recreation Plan (SCORP) indicates that there were over 52 million occurrances of water related recreational activities in Minnesota in 1978 (in order of popularity, these were swimming, fishing, boating, and canoeing).*

Projections from this study indicate there will be little change in participation rates for future years, with some exceptions due to cultural or technological innovations. If the rates do not change, the total number of recreational occurrances should continue to increase. Simple projections of recreation activities based on assuming no increase in participation rates conclude that between 1978 and 1995, activities common to shoreland residents will increase between 7.3% and 15.0%, depending on the particular activity (Figure 14).

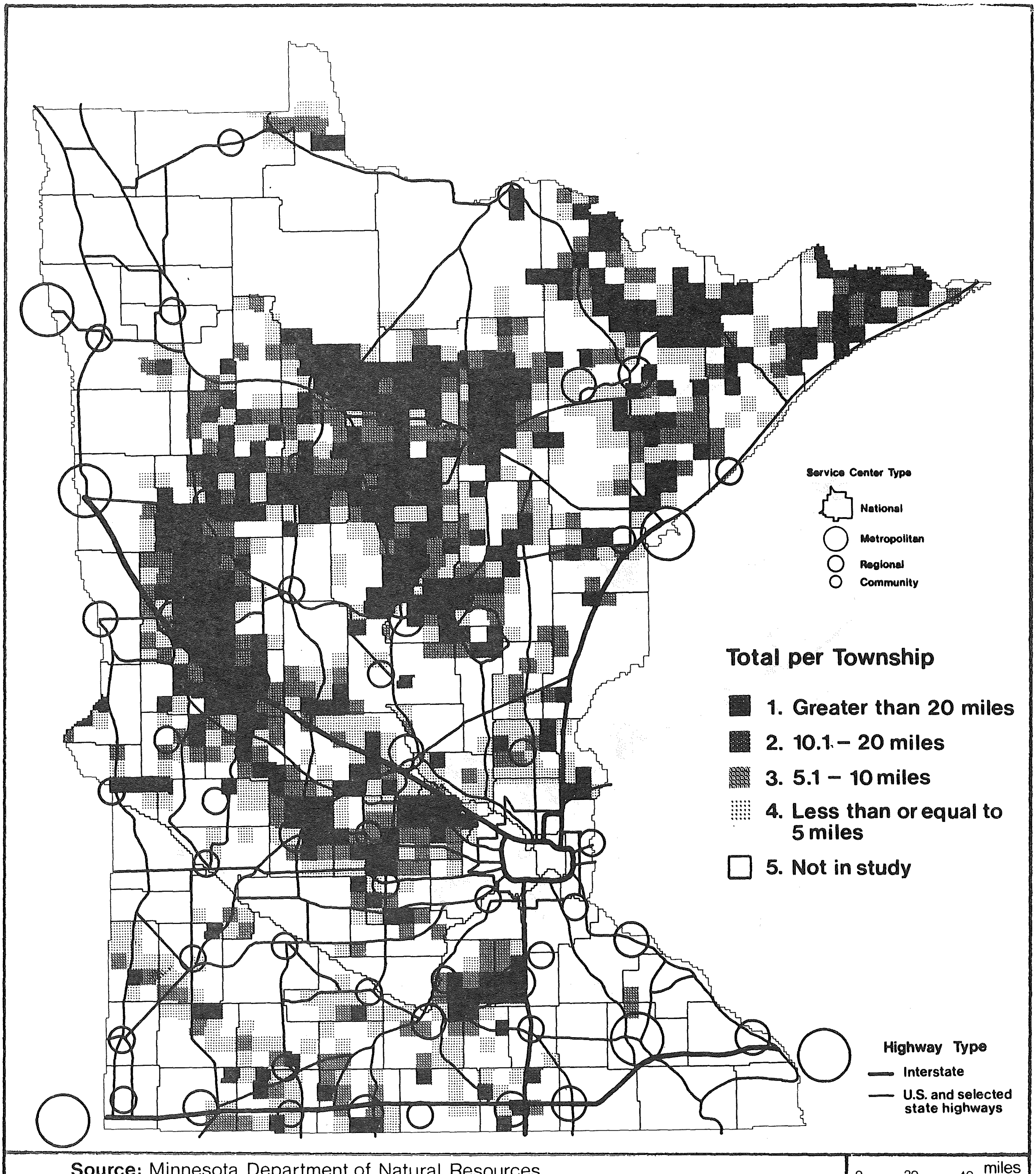
* A breakdown and analysis of this information can be found in the Minnesota State Comprehensive Outdoor Recreation Plan, 1979, Minnesota Department of Natural Resources, Office of Planning, Research and Policy Section (see esp. Chapter IV, "Recreation Demand").

Figure 12a: POPULATION DENSITY, 1980



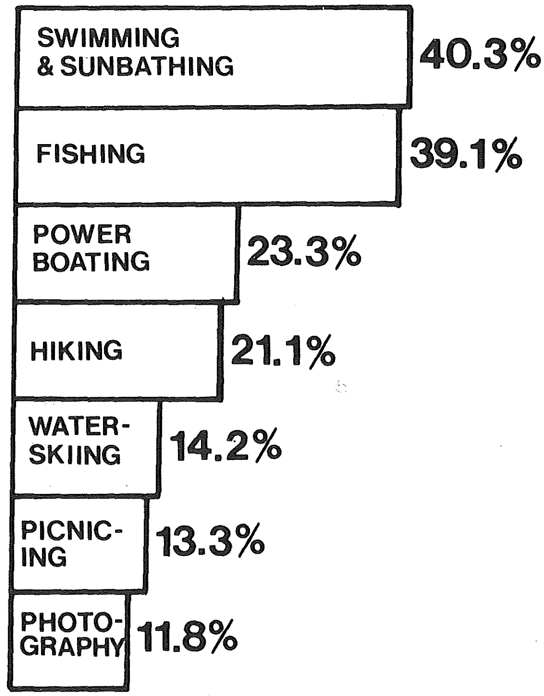
Source: U.S. Department of Commerce, Bureau of the Census. 1981. 1980 Census of Population and Housing.

Figure 12b: MILES OF SHORELINE ON SELECTED LAKES OVER 145 ACRES IN SIZE



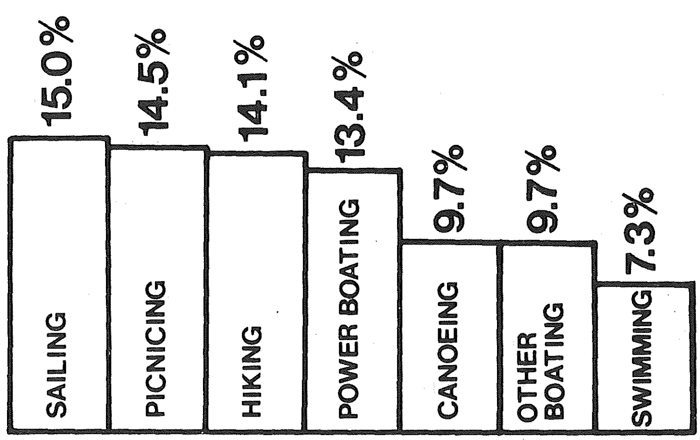
Source: Minnesota Department of Natural Resources

Figure 13: SHORELAND RESIDENTS PARTICIPATING DAILY OR OFTEN IN RECREATIONAL ACTIVITIES



Source: Shoreland Questionnaire, 1982

Figure 14: PROJECTED INCREASE IN POPULAR WATER AND RELATED LAND ACTIVITIES IN MINNESOTA, 1978-1995



Source: State Comprehensive Outdoor Recreation Plan, 1979

Even without future increases in shoreland development, these figures suggest resource use will increase. However, shoreland development is expected to likewise increase. These facts, in concert with the previous discussions, suggest that resource managers need to be concerned about the various implications of continued growth for effective shoreland management.

D. Locational Factors in Shoreland Development

"Virtually all of the development in this study is on only 14% of the lakes, and two thirds of the lakehomes occupy only 13% of the shoreline." This quote, from a 1970 report on shoreland development trends in Minnesota, is as accurate today as it was then. Although Minnesota has more than 15,000 lakes, virtually all of the non-urban shoreland development has occurred on the largest lakes (Table 5a).

The study lakes, although representing only 12% of total lake basins in the state, are the focus of the bulk of shoreland development activity. Even within this selection of lakes, development is highly concentrated. The top 50 lakes, in terms of total number of seasonal and permanent dwellings, account for almost a third of all shoreland dwellings in 1982.
Although subsequent data will indicate a slight downshifting in development pressure, the total increase in shoreland development occurring between 1967 and 1982 has also been highly concentrated. The fifty lakes that had the largest absolute increase in shoreland development also account for almost a third of the increase in shoreland development (Table 5b).

As a result, some shorelands have been developed to very high densities while others have been virtually ignored. The state is by no means in danger of 'running out' of shoreland areas. In 1982 there were more than 2,000 miles of shorelands with desirable resource characteristics in private ownership without any development. Desirable characteristics refers to lakes with permanent game fish populations that also have sandy or loamy shoreland soils. Not all of these have desirable access, nor are they located close to urban centers. Nevertheless, they do represent a reservoir of developable shorelands for future growth or protection, depending upon management objectives.

Although Minnesota is blessed with more than 15,000 lakes, not all of these are attractive to shoreland residents. Furthermore, there is an unequal

Table 5a: DEVELOPMENT ON TOP 50 LAKES RANKED BY TOTAL NUMBERS OF SEASONAL AND PERMANENT DWELLINGS PER LAKE

	1-10	11-20	21-30	31-40	41-50	1-50
Number of Dwellings	11,672	5680	4721	4007	3585	29,665
% of Total Dwellings in Study	11.7	5.7	4.8	4.0	3.6	29.4

Table 5b: DEVELOPMENT OF TOP 50 LAKES RANKED BY ABSOLUTE CHANGE IN TOTAL NUMBERS OF SEASONAL AND PERMANENT DWELLING BETWEEN 1967 AND 1982

	1-10	11-20	21-30	31-40	41-50	1-50
Increase in Number of Dwellings	5035	2283	1924	1631	1432	12,305
Percent of Total Increase of Dwellings in Study	11.9	5.4	4.6	3.9	3.3	29.1

distribution of the lakes that shoreland residents prefer. Large lakes with game fish populations, the types of lakes perferred by shoreland residents, tend to be geographically concentrated (refer back to Figure 12b).

These concentrations of popular lake resources are not all equally accessible to shoreland residents. Recent surveys indicate that 50% of seasonal homeowners travel less than 100 miles to their shoreland residence. Since most seek to minimize driving time as well as distance, the rural highway system plays an important role in focusing the development patterns. The freeway system is especially significant. An area of high shoreland development density generally exists along the paths of Interstate 35 north of the Twin City Metropolitan area and Interstate 94 northwest of the Twin City Metropolitan area.

Other roads are also significant. Highway 10, east of Moorhead, Highway 53 north of Duluth, and Highway 38 north of Grand Rapids, all seem to be the focus of minor but locally significant increases in shoreland development.

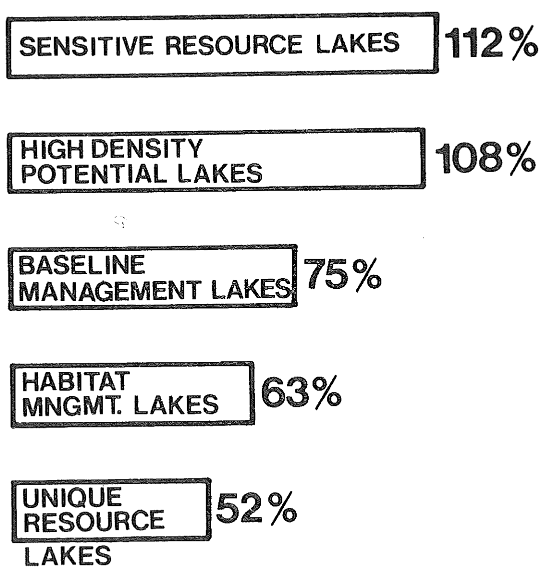
Although regional factors influence development patterns, local factors are more important. Three general categories of local factors are significant. They are differences in resource quality, access to roads and service centers and resource management.

E. Local Conditions Influencing Shoreland Development

The most important factors influencing shoreland development involve the particular features that characterize the setting in which shoreland resources are located. Site specific features such as resource quality, recreational opportunity, road access, and others, have a powerful influence on development pressure. Users of shoreland resources tend to have strong preferences for certain shoreland features. An analysis of where development occurs provides one means of defining some of those preferences. The shoreland soils/forest cover type and lake classification are among the most meaningful descriptors of resource quality. Also important are ROSLU, lake size, and water clarity.

Lake Classification: The highest development growth rates occurred on the Sensitive Resource Lakes (trout) and High Density Potential Lakes (Figure 15). For different reasons, each of these resource types is sensitive to

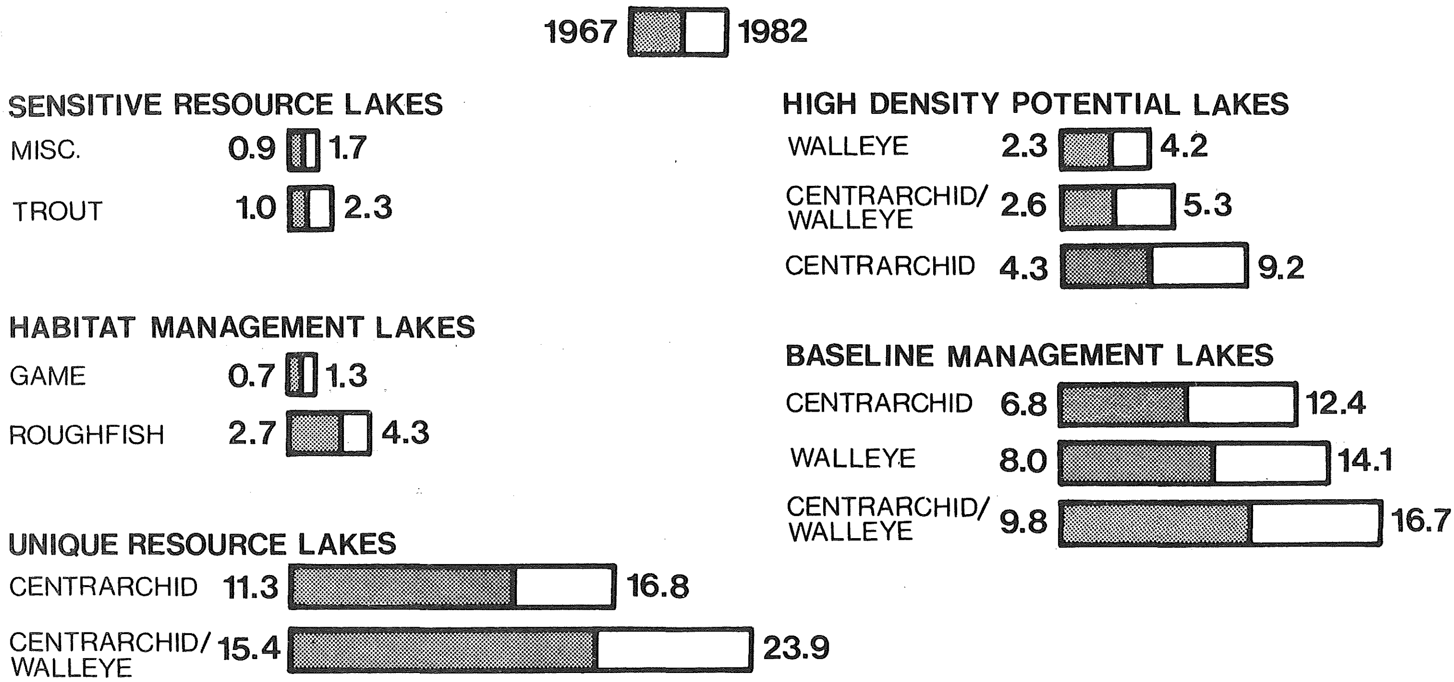
Figure 15: INCREASE IN SHORELAND DEVELOPMENT BY LAKE CLASSIFICATION, 1967-1982



shoreland development and resource use. Improperly planned high densities can lead to resource deterioration in each case. Presently each of these lake types have low average development densities (Figure 16), although there may be individual lakes within each class that are highly developed. The very remoteness of many lakes in these classes protects them from unwise development more effectively than management efforts might.

The lowest growth rates occurred in Habitat Management and Unique Resource lakes. Habitat Management lakes have characteristics that make them less

Figure 16: DWELLING UNITS PER SHOREMILE BY MANAGEMENT CLASSIFICATION, 1967-1982



popular for shoreland development so their low growth rate is no surprise. Unique Resource lakes, however, are popular to shoreland residents. They already had high development densities in 1967. However, their high densities indicate that a point of saturation is being reached, thus making them less attractive for future development and leading to reduced growth rates.

As a class, Baseline Management lakes have the second highest development densities. Their growth rates are close to the state average. But because there are so many lakes in this class, they accounted for the largest share of

Table 6: SHORELAND DEVELOPMENT BY MANAGEMENT CLASSIFICATION 1967-1982

Baseline Management	
Walleye	29.5%
Centrarchid/Walleye	26.1%
Centrarchid	16.4%
Habitat Management	10.7%
High Density Potential	8.9%
Unique Resource	6.6%
Sensitive Resource	1.6%
Not classified	0.2%
	100.0%

new development occurring during the study period. Between 1967 and 1982, more than 70% of the increase in shoreland development occurred on Baseline Management lakes (Table 6).

Shoreland Soils/Forest Cover Type: As discussed earlier, the character of the shoreland area continues to be one of the most important factors influencing development densities. Shoreland residents show a strong preference for forested shoreland on walleye, centrarchid/walleye, or centrarchid lake types which generally have sand or loam soils. Table 7 indicates that sandy soils typically contain the highest densities of development. In fact, over 40% of shoreland development occurs on sandy soil types.

Although this preference cuts across tree-types, the lack of forest cover has a significant impact on the amount of development. Table 7 also adds weight to the conclusion that walleye, centrarchid/walleye, and centrarchid lakes are far and away the most popular lakes of shoreland residents. One outcome of this preference is that high densities for less desirable soils (wet) are often higer than for sand or loam soils on other lake categories. Although Table 7 only indicates the density of development for 1982, the figures for 1967 would reveal lower density figures, but the proportions would be virtually unchanged. This suggests that apparent preferences in resource types are not simply the result of some idiosyncracy in the data. Rather, shoreland residents appear to have a fairly clear idea of what they are

Table 7: TOTAL UNITS/SHOREMILE, 1982
(miles of shoreline)

LAKE TYPE

Shore/Physical Combination Trees/Soils)		Roughfish Gamefish Bullheads	Game	Trout	Walleye (hard & soft water)	Centrachid Walleye	Centrachid	Special Resource	Row* Marginals
Coniferous	wet	1.2	0	0	15.3	5.5	3.2	.8	5.0
		(17)	(1)	(.5)	(10)	(15)	(12)	(5)	(61)
	loam	8.6	3.0	3.9	11.4	8.7	4.6	2.8	7.3
		(18)	(2)	(4)	(13)	(33)	(26)	(5)	(102)
	sand	5.0		1.7	23.7	15.6	18.0	9.1	17.8
		(14)		(1)	(56)	(59)	(55)	(2)	(187)
	bedrock	10.4		0	1.0	1.0		0	.9
		(.5)		(1)	(17)	(3)		(1)	(22)
Deciduous	wet	3.9	.7	10.3	18.7	13.3	10.5	4.1	8.5
		(383)	(54)	(1)	(99)	(182)	(173)	(9)	(901)
	loam	4.7	1.2	1.0	14.5	14.2	9.1	2.9	9.1
		(508)	(49)	(4)	(185)	(348)	(365)	(18)	(1478)
	sand	8.9	3.6	2.4	24.1	22.5	19.0	12.7	19.2
		(187)	(10)	(3)	(210)	(377)	(345)	(7)	(1138)
	bedrock	9.7		1.9	.4	10.0	0	0	2.8
		(5)		(1)	(44)	(12)	(.5)	(3)	(64)
No trees	wet	1.8	.9	0	5.2	6.3	6.0	1.6	3.7
		(466)	(73)	(1)	(124)	(186)	(180)	(15)	(1045)
	loam	2.1	.6		7.3	8.8	5.3	.3	4.7
		(152)	(16)		(16)	(97)	(56)	(6)	(343)
	sand	5.6	1.8		12.1	13.5	10.3	0	9.8
		(80)	(5)		(62)	(57)	(80)	(1)	(285)
	bedrock	1.0			6.7	.6	4.0		3.6
		(5)			(4)	(2)	(14)		(24)
Column* Marginals		4.1	1.1	2.8	15.2	14.6	11.6	3.3	9.9
		(1835)	(211)	(15)	(839)	(1371)	(1307)	(71)	(565)

* - each figure rounded off independently, so marginals don't quite add up. Data excludes Otter Tail County.

looking for in a shoreland setting.* Still, the highest development growth rates and the greatest absolute increase occurs on lakes with predominantly sandy shoreland soils in deciduous forests (Table 8).** This may be partly due to sandy soils providing superior material for swimming beaches, the most popular activity of shoreland residents. As a result, densities on lakes in this category increased sharply in absolute numbers. Between 1967 and 1982, lake homes per shore mile increased from 11.0 to 19.1 on lakes with sandy soils and deciduous forest cover. This places such shorelands among the most densely settled in the state.

Table 8: LAKEHOMES CONSTRUCTED BY FOREST/SOILS LAKE CLASS, 1967-1982

Lake Class	Total Construction	Study Lakes in Class
Sandy Soils Deciduous Forest	35.9%	20.1%
Loam Soils Deciduous Forest	20.9%	26.2%
Wet Soils All Forest Types	11.2%	17.0%
Sand Soils, Coniferous Forest and Treeless	5.6%	8.4%
Loam Soils, Coniferous Forest and Treeless	2.9%	7.9%
Other Soils and Forests Types and no data	23.5%	20.4%
Total	100.0%	100.0%

*For further information about resident expectations and preferences for shoreland resources, see Report No. 8, SHORELAND RESIDENTS - A QUESTIONNAIRE SURVEY, Shoreland Update Project, 1983.

**Table 8 should be interpreted with some caution because generalizations were made at the lake level. For instance, an individual lake is classified as being a particular forest/soil type, even though there may be substantial amounts of other types present. The validity to this kind of approach is that it provides a broad, generalized sketch of what preferred lake characterisitics tend to be. One should not use this kind of information to draw specific conclusions about individual lakes. The resolution of the data is inappropriate for that kind of analysis.

Least popular shore soils/forest cover types are lakes with predominantly wet or rocky soils. Rocky soils pose severe limitations to building construction, water supply, and functioning of on-site sewage treatment systems. Also, they are most often located in the extreme northern part of the state in areas that are inaccessible and mostly in public ownership. Densities in these areas would be low even if the soils/forest cover were more suitable to development. Wet soils also pose limitations to construction and to functioning of on-site sewage treatment systems. Low densities on such lakes are no surprise. Despite new technical innovations which allow construction of structures and sewer systems on soils with severe constraints, it is likely that most development pressure will continue to be focused on lakes with more suitable soils.

Lake Size: Growth rates varied according to lake size between 1967 and 1982 (Table 9). The largest lakes experienced the greatest amount of growth. Lakes between 1,000-4,999 acres accounted for almost 1/3 of all development. Although lakes greater than 5,000 acres only accounted for slightly more than 1/6 of development, this lake size class only represents 11.3% of the total shoreline. This significance of size is further substantiated by the development density data. The 1982 density of lakehomes per shoremile increases substantially with increasing lake size (Table 9) as does the absolute increase in development per mile of shore. Between 1967 and 1982 the number of dwellings per shoremile increased by 6.0 on lakes larger than 5,000 acres and by only 2.9 on lakes smaller than 300 acres. These increases are partly explained by shoreland management. Development on smaller lakes (most of which are classified as NE) probably occurred on lots

Table 9: SHORELAND DEVELOPMENT BY LAKE SIZE

Lake Size (acres)	% of Shoreline	Total Development	Dwellings/Shoremile 1967	Dwellings/Shoremile 1982
145-299	25.6%	17.0%	3.5	6.4
300-499	17.3%	13.8%	4.4	7.7
500-999	20.2%	21.8%	5.7	10.4
1000-4999	25.6%	30.6%	6.9	11.5
greater than 5000	11.3%	16.8%	8.3	14.3

created during the period compliant with shoreland standards, whereas much of the development on larger lakes occurred on pre-existing substandard lots of record. Even if most of the development occurred on standard lots, the lots would be smaller for the larger lakes (which are generally classified as GD or RD), causing higher densities than are possible for smaller, NE lakes.

Recreation Opportunity Spectrum Land Use (ROSLU): The highest growth rates in shoreland development have been occurring in the least developed ROSLU lake classes. In terms of sheer quantity, however, most development is still occurring on lakes with the highest densities. As Figures 17a and 17b illustrate, the highest growth rates (112%) occurred on lakes in the Primitive/Semi-Primitive class. This class had the lowest density of lakehomes/shoremile in both 1967 and 1982. This would seem to cast doubt on the earlier claim of road access influence on shoreland development. However, one must keep in mind that this class has the lowest development densities, and therefore, a rather small number of new dwelling units will yield large growth rates on these lakes when compared with lakes that already have greater amounts of development. At the same time, the number of developable sites may be diminishing significantly on lakes that already have high development densities. For instance, the Intensive ROSLU class had the highest density in both 1967 and 1982, but experienced the lowest growth rate (56%) during the study period. Despite this low growth rate, the absolute increase in numbers of lakehomes per shoremile was largest in the Intensive ROSLU class. Between 1967 and 1982, 8.1 additional dwellings/shoremile were added on lakes in the intensive class but only 1.7 on lakes in the primitive class. Although an additional 1.7 units/shoremile is small, its impact may be dramatic because of the the characteristics of lakes in the primitive/semi-primitive land use class. Whether or not this is the case requires further research and analysis. Although the more developed lakes are still receiving most of the development pressure, their is a discernible trend toward more remote lakes (Table 10, and refer back to Figure 17). Whether this is due to reaching thresholds of some sort in more accessible lake classes, changes in lifestyle, aesthetic tastes, or other reasons, is not clear and requires further study.

A fact often over-looked, but apparent in the data, is that the majority of shoreland development (64.9%) occurs in areas with some agricultural activity. This suggests that the relationship between agricultural activities and recreational development in shoreland areas may be more significant than

Figure 17a: INCREASE IN SHORELAND DEVELOPMENT BY ROSLU CLASSES 1967-1982

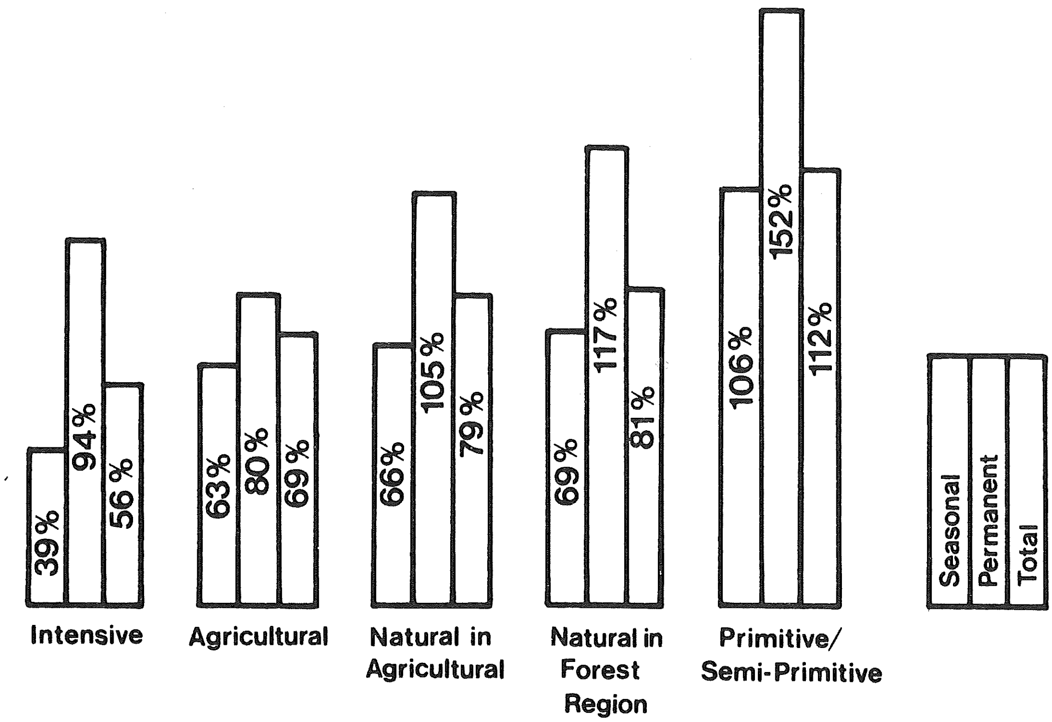
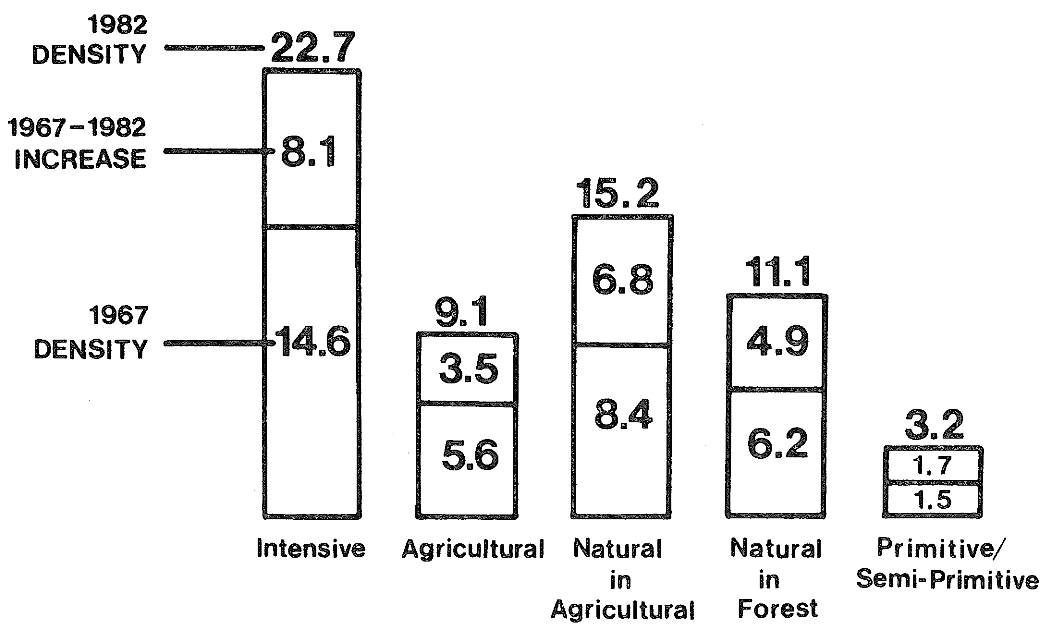


Figure 17b: DWELLINGS/SHOREMILE BY ROSLU CLASSES 1967-1982



has generally been assumed.*

Secchi disk: Shoreland residents cite algae blooms as a major source of concern. They also cite a number of other water quality and general environmental degradation problems. Many shoreland dwellers use water clarity as a perceptual measure of the quality of lake water conditions. Possibly Figure 18 reflects a preferrence since it indicates the clearest lakes experienced the largest percent increase in shoreland development between 1967 and 1982. Water clarity, however, is closely related to location within the state and to lake ecology. It is possible the relationships reflected in Figure 18 are a function of other lake resource preferences.

Table 10: SHORELAND DEVELOPMENT BY ROSLU CLASS

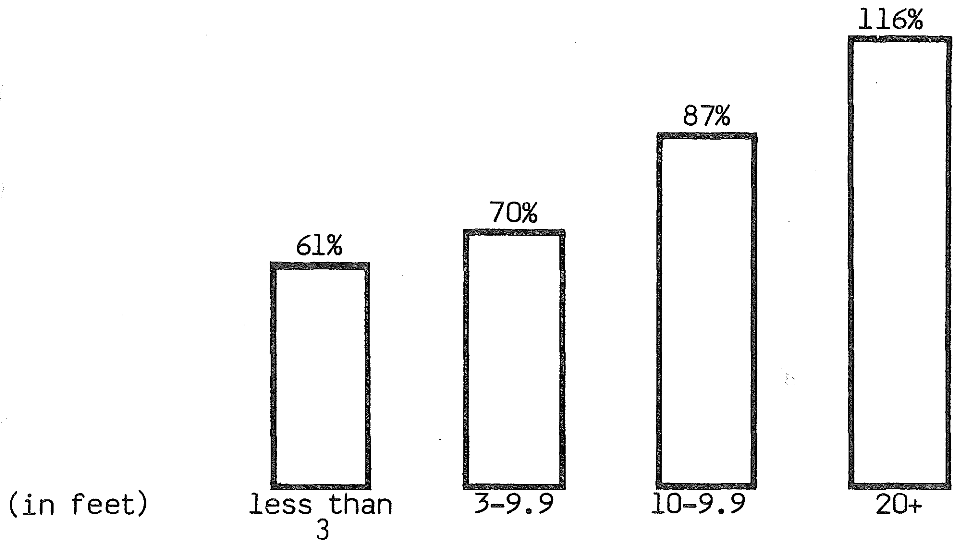
ROSLU LAKE CLASS	PERCENT OF DEVELOPMENT SINCE 1967	PERCENT OF TOTAL DEVELOPMENT	AMOUNT OF DEVELOPMENT
Primitive/Semi-primitive	8.2%	6.5%	6,439
Natural in Forest	39.7%	17.0%	16,926
Natural in Agricultural	17.8%	64.9%	63,841
Agricultural	24.8%	11.3%	11,116
Intensive	9.5%	less than 0.5%*	17*
Total	100%	100%	98,339

* These figures are extremely small because this data set includes only lakes 145 acres or larger and excludes most urban areas.

It is ironic that the very condition which attracts shoreland residents may be seriously damaged by excessive or poorly planned development. Water clarity is affected when sewage treatment systems function poorly and allow nutrients to enter surface waters. Water clarity may also be affected by run-off from fertilized lawns. Many shoreland residents perceive that their lakes have become progressively greener over the years. The concern suggests the need for special standards to protect water clarity on lakes that are especially clear.

* This appears to be the case given that current shoreland management does not directly address agricultural activity in shorelands. The level of shoreland development occuring in agricultural regions helps explain why, in Report No. 8: SHORELAND RESIDENTS - A QUESTIONNAIRE SURVEY, Shoreland Update Project, 1983, agricultural activity was identified as a major source of many lake problems.

Figure 18: INCREASE IN SHORELAND DEVELOPMENT BY SECCHI DISK CLASS, 1967-1982



Access: In a highly mobile society, ready access to goods, services and employment are significant determinants of land use patterns. In shoreland areas, access to roads and service centers are the single most significant factors in the amount of development that has occurred and the amount of development pressure one can expect. The consumption habits and service needs of shoreland residents, whether seasonal or year round, make road access and service center proximity very important. As mentioned earlier, the average seasonal homeowner will spend about $2,500 annually for supplies and services while at a shoreland residence. Permanent shoreland residents will look to urban areas not just for goods and services, but also for employment.

Small urban areas probably do not offer enough variety in goods and services to be a significant factor in shoreland trends. The smallest urban center likely to be a significant influence is the community service center described by Gustafson.* This report created a heirarchy of urban areas based on the services they provide (Figure 19). To be ranked a community service center, the urban area must provide such services as a high school, doctor, bank, weekly newspaper, new car dealership, and others. Most such centers have a population of at least 3,000. Figure 20 shows community service centers in

*Gustafson, Neil C., Donald M. Moe, Susan K. Johnson, and Dwight F. Forsberg, 1973. Recent Trends/Future Prospects: A Look at Upper Midwest Population Changes, Minneapolis, Minnesota: Upper Midwest Council.

Minnesota. A comparison of this map with earlier maps displaying shoreland densities quickly reveals there is a strong coincidence in the amount of permanent shoreland development and the location of community service centers.

Access to urban areas is provided by the rural road network. Both seasonal and permanent home ownership are dependent upon close proximity to roads. Very little shoreland development is located more than one mile from either a paved or gravel road. An analysis of shoreland development densities (Table 11a and Figures 21a and 21b) supports the claim of a strong relationship between the development location and road access and major service center proximity.

By comparing development densities using the two variables (access to roads and proximity to service centers), the significance of relative location is demonstrated. Ignoring other measures of resource quality, the density of permanent lakehomes per mile of privately owned shoreline is strongly correlated with proximity to service centers and good access to roads. Densities of permanent lakehomes per shoremile are five times higher on lakes within 6 miles of a service center than on lakes that are more than 30 miles distant. Differences in densities by various classes of road access are even higher (Table 11a).

Figure 19: TYPES OF SERVICE CENTERS
(Taken from Gustafson, 1973)

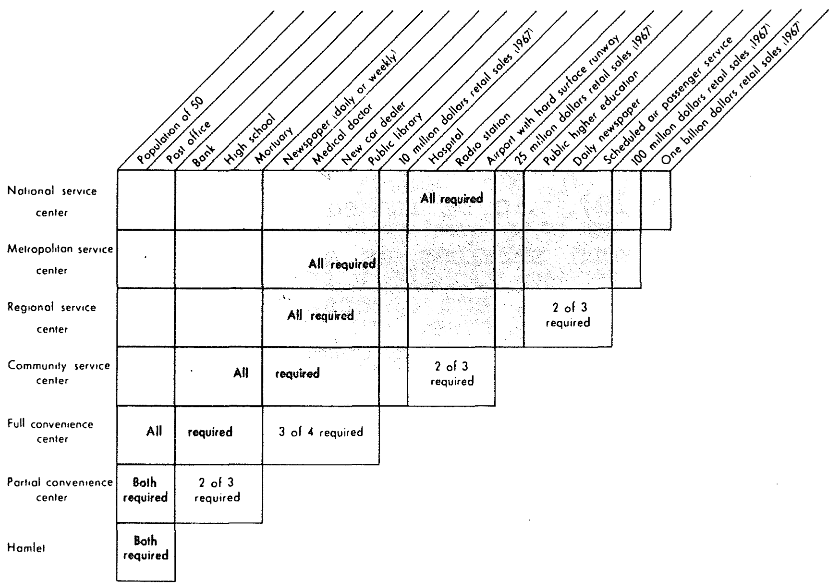


Table 11a: SERVICE CENTER AND ROAD ACCESS: DEVELOPMENT DENSITY
LAKES GREATER THAN 145 ACRES, 1982

MAJOR SERVICE CENTER ACCESS	ROAD ACCESS CLASS high 1	2	3	4	low 5	TOTAL
1 (within) (5 mi)	28.4 16.2 12.3 207	14.4 4.7 9.8 27	10.7 6.5 4.2 258	4.0 1.9 2.1 53	2.6 1.3 1.3 15	16.6 9.4 7.2 560
2 (6-15 mi)	18.9 8.4 10.6 877	11.8 3.6 8.1 396	6.5 2.7 3.8 1195	3.0 .9 2.1 323	1.0 .1 1.0 61	10.6 4.3 6.2 2852
3 (16-30 mi)	19.0 6.6 12.4 874	12.9 3.1 9.8 524	8.1 2.5 5.6 1161	4.5 .8 3.7 602	2.0 .1 1.9 321	10.4 3.1 7.3 3482
4 (30 mi)	20.8 5.7 15.1 231	13.4 2.5 10.8 206	7.8 1.6 6.1 345	4.1 .5 3.5 258	1.1 .1 1.0 303	8.7 1.9 6.8 1343
TOTAL	20.1 8.1 11.9 2189	12.6 3.2 9.4 1153	7.6 2.8 4.8 2959	4.0 .8 3.2 1236	1.6 .1 1.4 700	10.6 3.8 6.8 8237

KEY
(units/private shoremile)
- Total
- Permanent
- Seasonal
- Shoremiles

LEGEND: ROAD ACCESS CLASS DESCRIPTION

PAVED ROAD ACCESS	GRAVEL ROAD ACCESS Adjacent	0 and 1/2 mile	1/2 and 1 mile	1 mile
Adjacent	1	1	1	1
0 and 1/2 mi	1	3	3	3
1/2 mi 1 mi	2	3	4	4
1 mi	2	4	5	5

Table 11b: SERVICE CENTER AND ROAD ACCESS: CHANGE IN DEVELOPMENT DENSITY LAKES GREATER THAN 145 ACRES, 1967-1982

MAJOR SERVICE CENTER ACCESS	ROAD ACCESS CLASS high 1	2	3	4	low 5	TOTAL
1 (within) (5 miles)	10.7 7.8 2.8	6.0 2.5 3.5	4.7 3.5 1.2	2.5 1.0 1.4	1.1 .8 .3	6.6 4.7 1.9
2 (6-15 mi)	7.6 4.6 3.0	5.7 1.9 3.8	3.0 1.5 1.5	1.6 .2 1.3	.7 ** .7	4.6 2.4 2.2
3 (16-30 mi)	7.8 3.5 4.3	5.5 1.5 4.0	3.7 1.3 2.4	2.2 .3 1.9	.9 .1 .8	4.5 1.6 2.9
4 (30 mi)	7.3 2.2 5.1	5.5 1.0 4.5	4.1 .6 3.5	2.4 .2 2.2	.4 * .4	3.7 .7 3.0
TOTAL	7.9 4.2 3.7	5.6 1.6 4.0	3.6 1.5 2.1	2.1 .3 1.8	.7 .1 .6	4.5 1.9 2.6

KEY
(change in
(units/private shoremile
-Total
-Permanent
-Seasonal

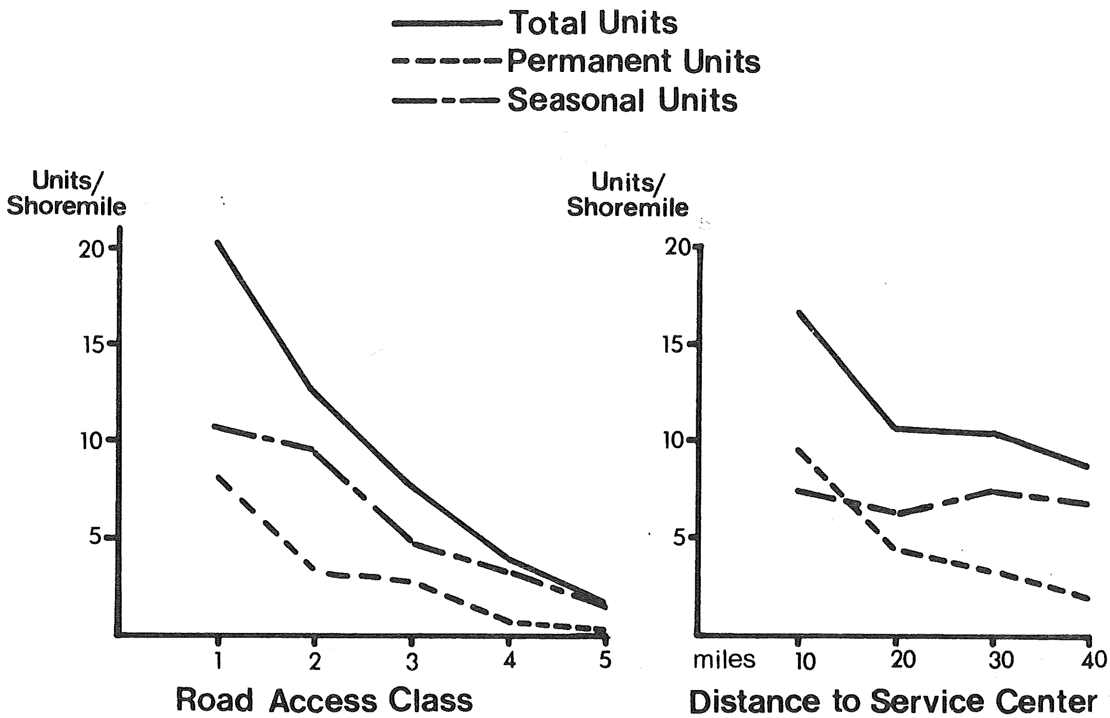
* designates positive number less than .05
** designates negative number smaller than -.05

LEGEND: ROAD ACCESS CLASS DESCRIPTION

		GRAVEL ROAD ACCESS		
PAVED ROAD ACCESS	Adjacent	0 and 1/2 mile	1/2 and 1 mile	1 mile
Adjacent	1	1	1	1
0 and 1/2 mi	1	3	3	3
1/2 mi 1 mi	2	3	4	4
1 mi	2	4	5	5

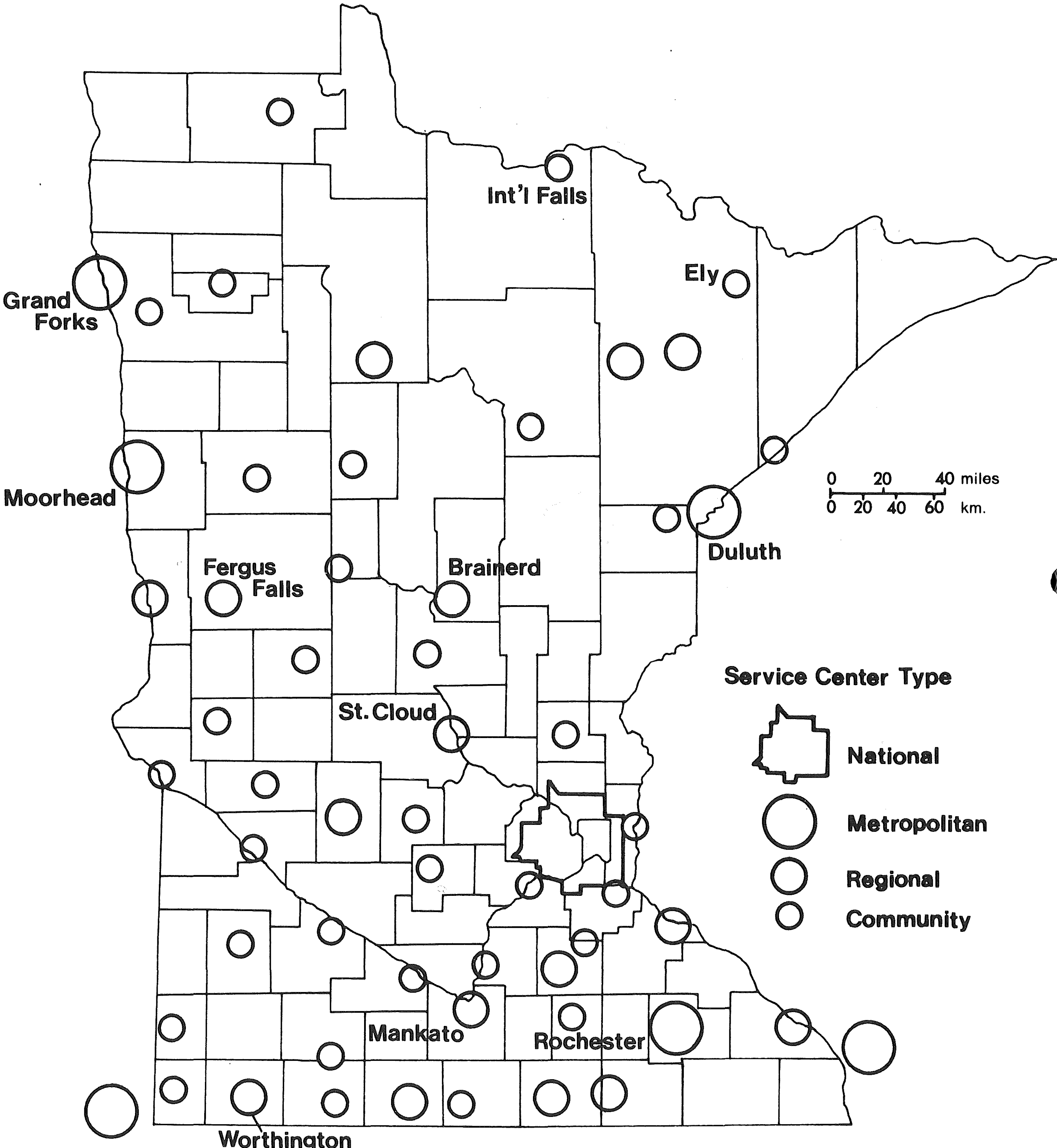
Figure 21a: SHORELAND DENSITY AND ROAD ACCESS

Figure 21b: SHORELAND DENSITY AND DISTANCE TO SERVICE CENTER



Density patterns of seasonal homes per shoremile vary from those of permanent homes. Seasonal home densities show the same dependance on road access but are much less dependent on proximity to service centers. In fact, at a 30 mile distance from service centers the densities of seasonal lakehomes per shoremile are actually larger than densities within six miles of the service center. Also, permanent residential increases were greatest in zones near service centers that have the best road access while seasonal density change increases with distance from service centers (Table 11b and Figure 21b). Changes in total seasonal units are also significantly more skewed toward poorer access classes than permanent development. This suggests that the locational requirements of seasonal homes are not as rigorous as those of permanent homes.

Figure 21c: MAJOR URBAN SERVICE CENTERS



Source: Guftafson, 1973. Recent Trends/Future Prospects: A Look at Upper Midwest Population Changes.

F. Municipal Shoreland Development

An estimated 27,300 shoreland dwellings are located within municipal areas of the state. This includes just the first tier of development and does not include all units in multiple dwellings. About 30% of the municipal shoreland dwellings are on rivers, the rest on lakes.

Municipal areas account for a significant share of total shoreland development. In 1982 about 15% of the total shoreland development on lakes larger than 150 acres outside of the seven county Twin City area occurred in municipal areas. No municipal shorelands development data was collected in 1967 so that growth rates in municipal areas could not be estimated. Given that population change was relatively small in municipal areas, it is also likely that increase in shoreland development has also been relatively small.

Municipal shoreland development differs from that in rural areas. Municipal shoreland dwellings are not always resource oriented. On river frontage in particular, dwellings appear to be in shoreland areas more by coincidence than because of the shoreland resources. Also, second tier municipal shoreland development may use the resource less than second tier shoreland development in rural areas.

First tier municipal shoreland development does appear to be oriented toward the use of shoreland resources, and therefore raises important issues for proper resource management. Most lake oriented municipal development is located on resources with high recreational use potential. Less than 15% of total municipal shoreland development is on lakes smaller than 150 acres (Table 12a). A fourth is located on lakes larger than 5,000 acres. Municipal use adds to the crowding potential of shoreland areas. Finally, about 85% of lake-oriented municipal development is located on GD lakes (Table 12b). This is generally the result of the shoreland management program's classification criteria. When lakes were originally classified, any lake with a portion of its shoreline within a municipal area was classified as GD.

Municipal shoreland development which tends to be concentrated on the most popular resource areas enhances the potential for resource problems

Table 12a: MUNICIPAL SHORELAND DEVELOPMENT

Lake Size	Est. Total Shoreland Dwellings	Percent of Total
1-149	2615	13.8
150-299	1876	9.9
300-499	2464	13.0
500-999	5154	27.2
1000-4999	1800	9.5
5000+	5021	26.5
Total Lakes	18950	99.9
Rivers	8350	N/A
Total Lakes and Rivers	27300	N/A

Table 12b: MUNICIPAL SHORELAND DEVELOPMENT BY ZONING CLASS

Zoning Class	Est. Total Units	% of Total*
NE	25	0.1
RD	2666	14.1
GD	16259	85.8
Total	18950	100.0

* It is likely the sample procedures underestimated the number of shoreland dwelling units for NE lakes. No error estimate for the sample was established. However, the distribution of the sampled forties used for this table was large (462) to determine the relative distributions with some degree of confidence.

stemming from overdevelopment. The possibility that many of these lakes are reaching development limits is increased by the presence of a municipality. However this problem is somewhat ameliorated because most municipal areas are sewered, thus reducing one source of concern. However, only about a third of municipal development is located in jurisdictions which have passed shoreland zoning standards. This lack of management may be a significant concern.*

* The issues raised by development of shorelands in municipal areas is addressed in greater detail in other reports of the Shoreland Update Project. For further information see Report No. 2: EVALUATION OF SHORELAND MANAGEMENT BASED ON SAMPLE COUNTIES AND TOWNSHIPS, and Report No. 3: LOCAL OFFICIAL RECOMMENDATIONS FOR SHORELAND PROGRAM IMPROVEMENTS, Shoreland Update Project, 1983.

G. Factors Influencing Shoreland Development - Summary

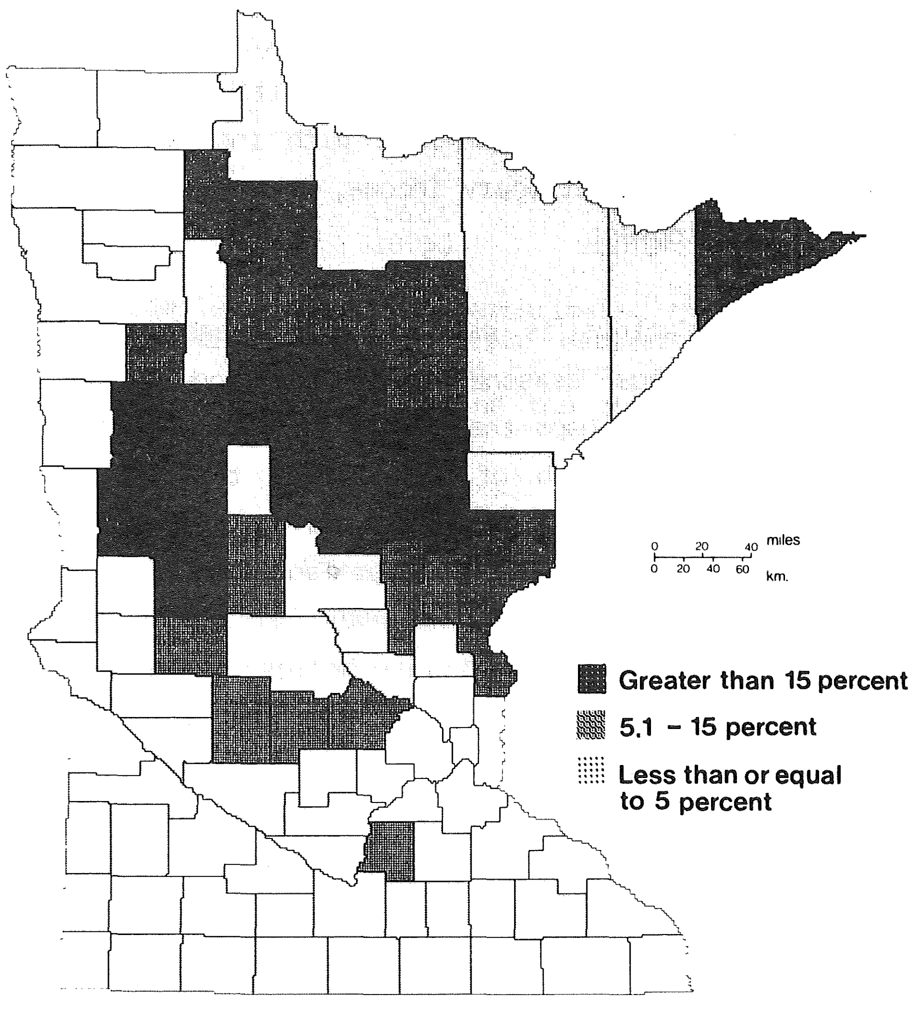
The preceding sections have provided some useful conclusions about the character of shoreland development. The most obvious conclusion is that shoreland development and recreational resource use have increased markedly in the 15 years since the original Lakeshore Development Study. These increases have generally concentrated on large lakes with already significant numbers of dwellings. Since 1967, shoreland development has tended to reflect prevailing national trends related to the state of the economy and population movements. For instance, the economic downturns in 1974 and again in 1980 are reflected in the number of applications for building permits in shoreland areas (refer back to Figure 4).

More importantly, these patterns of resource use and development reflect a general shift in migration patterns from urban centers to more rural areas. This is due partly to improvement in the quality of services in rural areas. Shoreland development seems to reflect a lifestyle preference that is made possible by improvements in transportation networks, utilities, medical care, employment opportunities, and other services traditionally restricted to largely urban areas. Combine this improvement with increased leisure time, earlier retirement, and more discretionary income, and one has the conditions for continued shoreland development.

The significance of these factors is especially noticeable in the growing importance of permanent versus seasonal dwellings and their respective proximity to service centers. Perhaps the most significant shift in shoreland development has been the proportion of development that is permanent as opposed to seasonal. According to the Shoreland Residents Questionnaire, seasonal homeowners intend to convert their shoreland dwellings to permanent residential use. Each time a seasonal homeonwer retires to the shoreland cabin, the number of seasonal homes on that lake decreases while the number of permanent lakehomes increases. Yet, no actual change in dwelling counts occurs. This conversion process contributes to the larger increase in permanent homes on GD lakes and the lower than average increase in seasonal homes mentioned later in this report. The trend toward permanent residential use has important social, economic, and environmental implications. One can expect that with conversion will come changes in the pattern and intensity of resource use. Conversion use may also have important economic implications for local units of government. While seasonal dwellings pay higher real estate taxes than comparably valued permanent dwellings because they do not qualify for homestead credit, conversion is usually accompanied by increased investment and value for dwelling units, and thus, an increase in total taxes payed. However, seasonal users typically demand lower levels of service (such as schools and road maintenance). So conversions imply increased service demands along with changes in the tax base. Whether tax revenues can keep pace with increased service requirements needs careful study and consideration.

Earlier in this report it was noted that shoreland development constitutes an important economic force in its own right. A significant share of the growth occurring in non-urban areas is directly related to shoreland areas. As Figure 22 clearly indicates, significant proportions of the

Figure 22: PERCENT OF 1980 COUNTY POPULATION ON LAKES OVER 145 ACRES



population in important lake counties reside in shoreland areas. Because the trend toward permanent residency signals an important departure from past development trends, there are many questions and problems that may need careful study and consideration.

Aside from the move toward permanent residency, development trends in shoreland areas have remained fairly stable and reflect a continuation of past patterns. Lakes that were important targets of development pressure in the past remain so and will likely continue to be in the forseeable future. However, there are important features of this pattern that need to be kept in mind. Earlier in the report it was noted that the bulk of shoreland development is concentrated on large lakes that already contained significant amounts of development (Figure 23b). However, Figure 23a reveals that almost 80% of new development occurs in areas with 10 or fewer dwelling units/shoremile. This means that development on large lakes tends to occur along stretches of shoreline that are relatively undeveloped. Development is thus gradually filling in undeveloped stretches of shoreline on lakes that already contain large numbers of dwellings. Furthermore, there was an 8% drop in the amount of less developed shoreline (less than 10 units/shoremile) between 1967 and 1982 (Figure 23a). This is a sizable chunk of shoreland when one considers that total shoreline of the study lakes alone exceeds 12,000 miles.

The shoreland management program has itself been an important influence on development patterns. One of the major objectives of this program has been establishment of minimum standards for development. To implement those standards, lakes were divided into three zoning classes. The least restrictive standards, and hence the highest densities, are allowed on General Development (GD) lakes. The most restrictive standards are applied to Natural Environment (NE) lakes. A variety of factors, including existing density and the ratio of shoreline to surface water area, were the basis for the zoning classification. Generally, the highest densities already existed on GD lakes, suggesting that these were the most attractive resource areas for shoreland residents. NE lakes, being smaller and often without permanent fish populations, were less attractive and had very low development densities. Recreation Development (RD) lakes fell in-between these extremes.

By allowing higher density on lakes that are more attractive to shoreland residents, the shoreland standards have reinforced existing patterns.

Figure 23a: LARGE LAKE DEVELOPMENT DENSITY, 1967 AND 1982

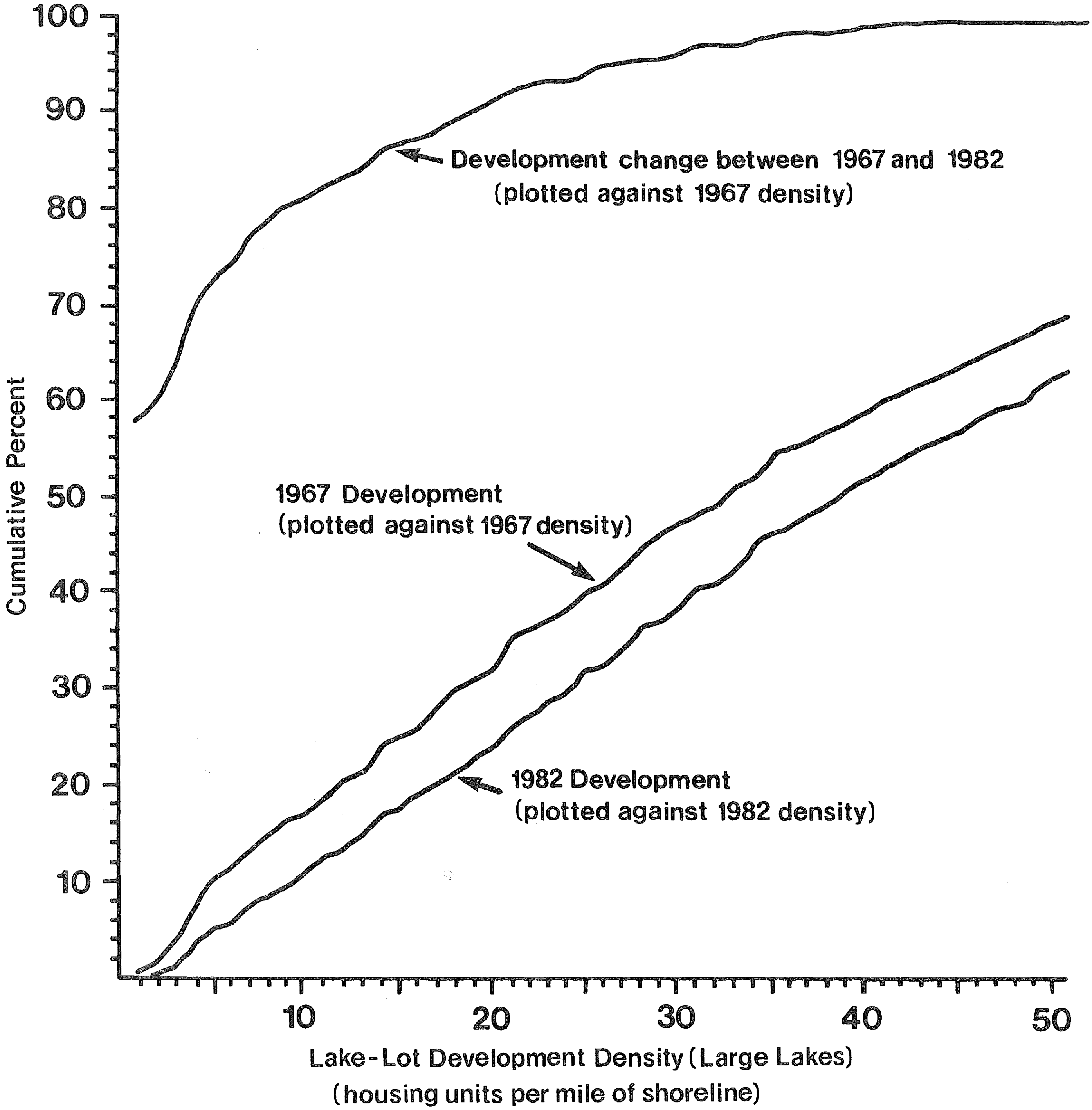
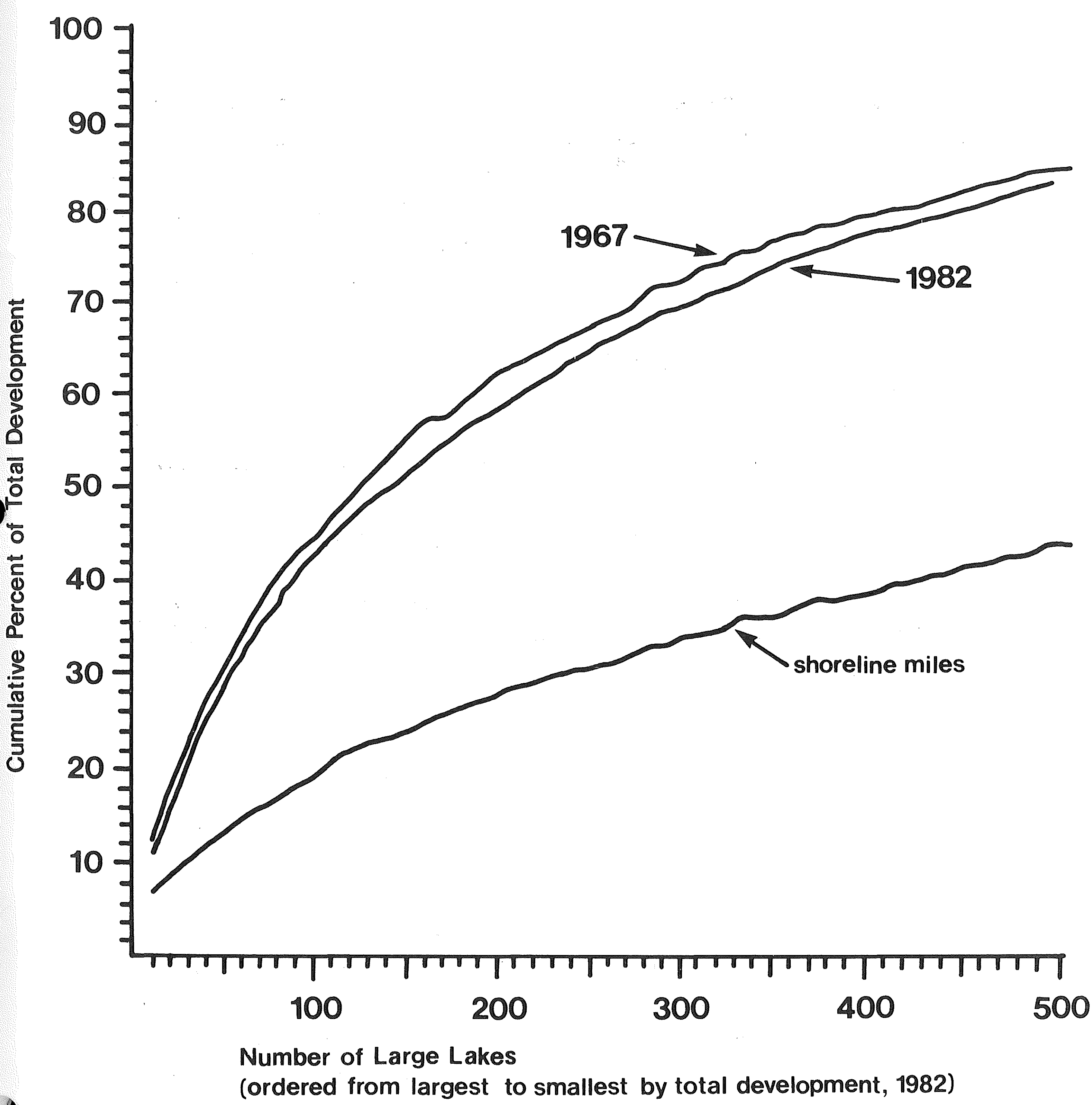


Figure 23b: PERCENTAGE OF LAKESHORE DEVELOPMENT ON LARGE LAKES 1967 AND 1982



Therefore, it comes as no surprise that the highest densities continue to be on the GD lakes (21.2 lakehomes/shoremile), and the lowest on NE lakes (1.6 lakehomes/shoremile - Table 13). Even though there is substantially more developable space on NE lakes, their lower desireability coupled with stricter standards have resulted in a density increase far below that of more developed lakes. Unless shoreland standards change, one can expect these trends to continue.

By reinforcing existing preferences of shoreland residents, the standards may be encouraging development densities harmful to the resource. Despite densities approaching those of some urban areas, the popularity of GD lakes suggest that even higher densities are forthcoming (especially with the possibility of second and third tiers). Currently, 95% of all development is almost evenly split between GD and RD lakes. This raises questions about the capacity of certain lakes to absorb more development. Some of those questions will be addressed later in this report.

The relative change in the importance of seasonal and permanent lakehomes is very noticeable when examining the data for lake zoning classes (Table 13).

Table 13: INCREASE IN SHORELAND DEVELOPMENT 1967-1982

Zoning Class	Increase in Seasonal	Increase in Permanent	Total	Dwellings/ Shoremile, 1967	Dwellings/ Shoremile, 1982
GD	48.2%	101.2%	63.1%	11.7	21.2
RD	76.3%	117.3%	87.5%	4.7	9.9
NE	137.8%	37.8%	63.7%	0.6	1.6
Total	63.0%	99.5%	74.1%	5.6	9.8

Decline in farm numbers may be an important factor in explaining changes on NE lakes. On many NE lakes, the only form of development in 1967 were farmsteads. Because farm numbers have declined since 1967, many NE lakes experienced an absolute decrease in the number of permanent (farmstead) dwellings in shoreland areas. This may account for the smaller than average increase in permanent lakehomes on NE lakes.

The actual locational and physical characteristics of lakes also has an influence upon where development occurs. From earlier analyses (see sections on "Locational Factors in Shoreland Development" and "Resource Quality") it appears the ideal combination of characteristics attracting the highest densities would be a walleye lake with sandy soils within five miles of a service center and adjacent to a paved road. Lakes meeting this description often have an average density of 59 units/shoremile. This density translates into less than 90 feet of frontage per lakehome and surpasses densities found in many urban areas. Since the figure 59 units/shoremile represents only an average, some lakes have densities considerably higher than this.

Although the majority of development occurs in a narrowly defined range of resource characteristics, there are still significant amounts of undeveloped shoreline with desirable characteristics (Table 14). As a result, not all shorelands will eventually develop to the same degree as those currently found in desirable resource areas. If low desirability does not restrain high densities, shoreland zoning will. Recreation Development, and especially Natural Environment zoning classes, are too restrictive to allow the high densities occurring in prime resource areas. Most of these areas are either General Development lakes or were developed to a high density at the time shoreland zoning was instituted.

Still another factor that could significantly influence shoreland development trends are economic factors such as rising interest rates, property taxes, land prices, construction, and all of the components that influence housing costs. The increase in many of these costs since 1967 means that many families are having to pay a higher share of their total income for housing than in the past. This reduces discretionary spending and makes the affordability of a shoreland residence impractical for a large share of the population. Although comparitive statistics have not been developed, it is likely that a smaller share of today's population can afford a second seasonal or a permanent shoreland home than was the case in previous years.

A more tangible way of looking at the interactions of shoreland development with the factors mentioned thus far is to observe the change in shoreland development for specific lakes or in a specific area. Figures 24a-h are computer-generated maps of a portion of Itasca County (Figure 24a) that

Table 14: MILES OF UNDEVELOPED LAKESHORE IN PRIVATE OWNERSHIP, 1982

Service Center Proximity	Road Access Class**	Sand Soils Lake Ecology#					Loam Soils Lake Ecology					Wet and Rock Soils Lake Ecology					Totals
Within		1	2	3	4	T	1	2	3	4	T	1	2	3	4	T	
5 miles	1	2	5	3	3	13	-	2	3	5	10	1	*	1	7	10	33
of a	2	4	5	5	9	23	-	2	7	20	29	4	2	9	24	39	91
Service	3	-	*	*	1	2	-	0	0	3	3	0	0	*	3	3	8
Center	4	1	0	*	1	2	-	*	1	3	4	2	0	*	6	8	14
	Total	7	10	9	14	40	-	4	11	31	46	8	2	10	40	60	146
5 miles	1	41	50	51	55	197	30	29	38	99	196	58	37	39	119	253	646
or more	2	64	73	95	109	341	55	72	103	282	512	120	89	85	378	672	1525
from a	3	20	23	18	24	85	21	27	25	76	149	18	22	27	92	159	393
Service	4	63	24	38	30	155	65	67	71	105	308	316	70	54	179	619	1082
Center	Total	188	170	202	218	778	171	195	237	562	1165	512	218	205	768	1703	3646
	Total	195	180	211	232	818	171	199	248	593	1211	520	220	215	808	1763	3792

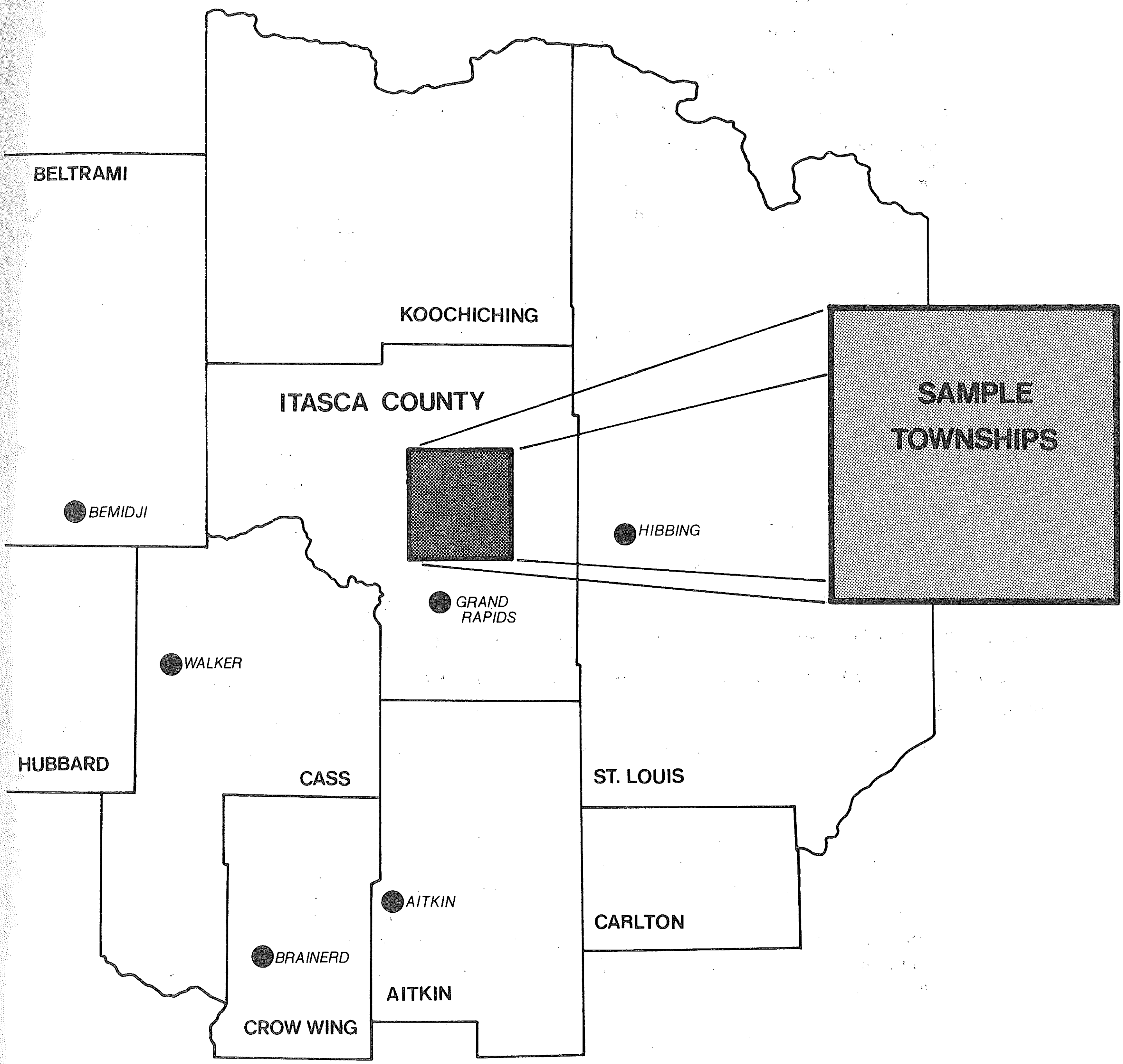
#The Lake ecology categories are as follows: 1) soft and hardwater walleyes and trout lakes; 2) centrarchid/walleye lakes; 3) centrarchid lakes; and 4) bullhead lakes.

* Refers to mileage totals less than a half a mile.

** Refers to the Road Access Classes as defined in Table 4b, page 29.

- Refers to incomplete data.

Figure 24a: Relative Location of Sample Townships in Itasca County



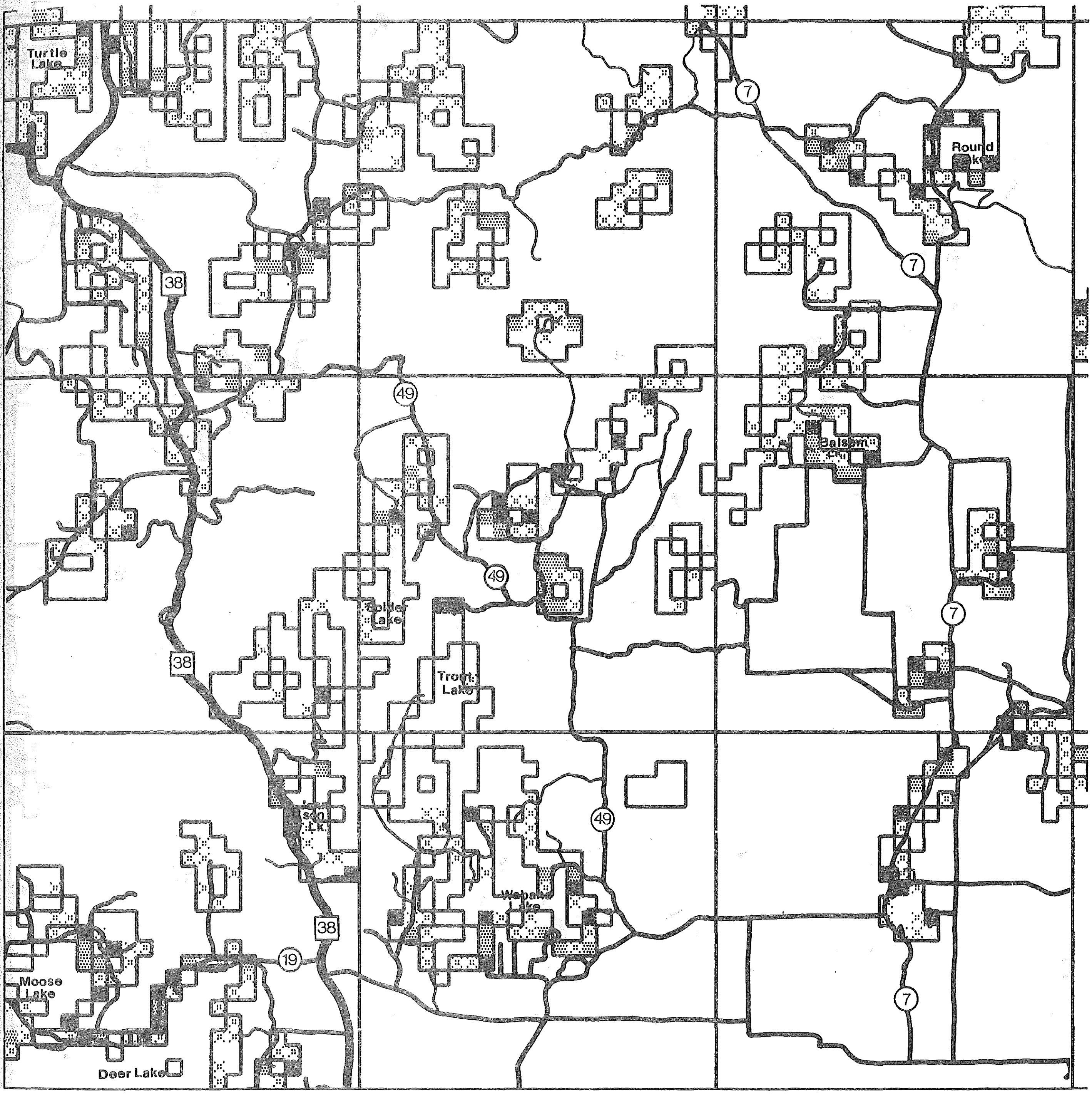
include nine townships.* This area was chosen because it illustrates many of the factors already identified as influencing shoreland development patterns.

Figure 24b illustrates development in this region according to density classes, while Figure 24c reflects development changes since 1967. A comparison of these two maps shows that the majority of new development tends to occur on forties adjacent to previously developed forties (greater than 10 units/shoremile). The exceptions to this pattern are those lakes without development of any kind in 1967 (these are primarily in the southeast and northwest corners of the maps). Further analysis of development increase since 1967 (Figures 24d-f) indicate that the 1967 density class of 1-10 units/shoremile accounted for the largest portion of the forties experiencing increased development. This conclusion reflects the conclusions drawn from the information represented in Figure 23a.

Figure 24c also shows that portions of lakes that were undeveloped in 1967 tended to remain undeveloped in 1982. The opposite appears true for portions of a lake showing some development in 1967, regardless of the density of such development. So while undeveloped areas tend to remain undeveloped, sparsely developed forties tend to develop rapidly. This suggests that already existing development is a better indicator of the likelihood of future development than is development density. However, since most new development occurs in sparsely developed forties (1-10 units/shoremile), development density may be a fair indicator of the rate at which a forty develops. If one

* When interpreting these computer-generated maps, it is important to keep in mind the data are broken into 40 acre parcels (generally referred to as forties) that contain shoreland frontage. Thus, these maps do not display the outline of lakes, but rather, the outline of forties adjacent to the lakes. To get an idea of how this kind of map generates boundaries, it might be useful to compare the road network overlayed on the maps with the computer-generated map of road access, Figure 24g. It is also worth noting these maps represent crude "snapshots" of changes in shoreland development over a period of time. I mention this because these maps represent preliminary steps toward the possible development of models that can generate scenarios of possible consequences given certain kinds of social and physical constraints. The data collected by the Shoreland Update Project and other data available at LMIC represent a reservoir of data that could be employed for modeling purposes. This modeling, if pursued, could represent an important new aid to the development of new planning and management strategies that could be employed at both the state and local level.

Figure 24b: SHORELAND DEVELOPMENT IN DENSITY CLASSES, 1982

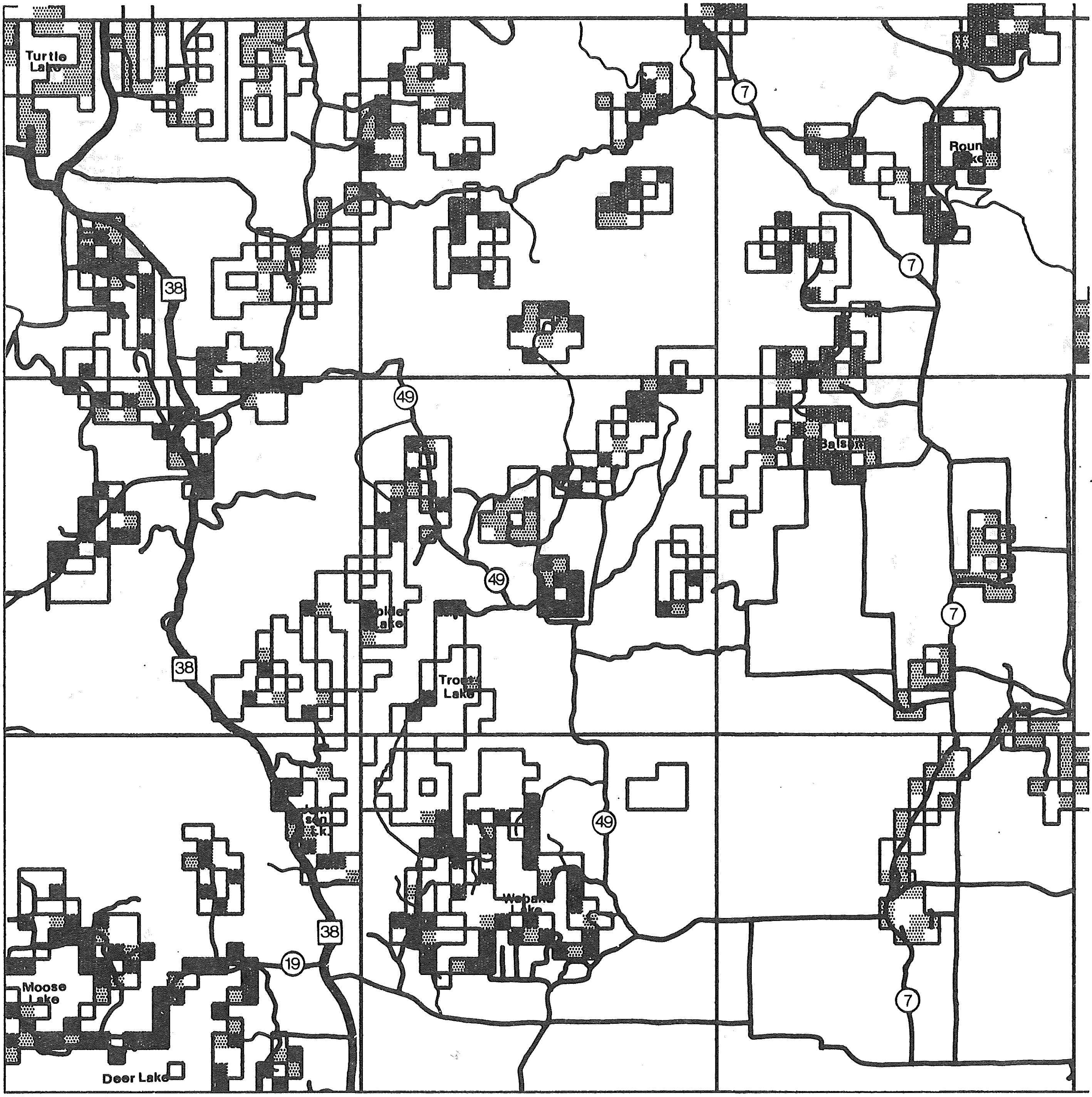


In shoreland units/shoremile

	Count	Percent	Acres	Density Classes
	4867	91.3	194680	No development
	320	6.0	12800	Fewer than or equal to 10 units/shoremile
	77	1.4	3080	11-20 units/shoremile
	65	1.2	2600	Greater than 20 units/shoremile

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

Figure 24c: SHORELAND DEVELOPMENT IN AREAS UNDEVELOPED IN 1967

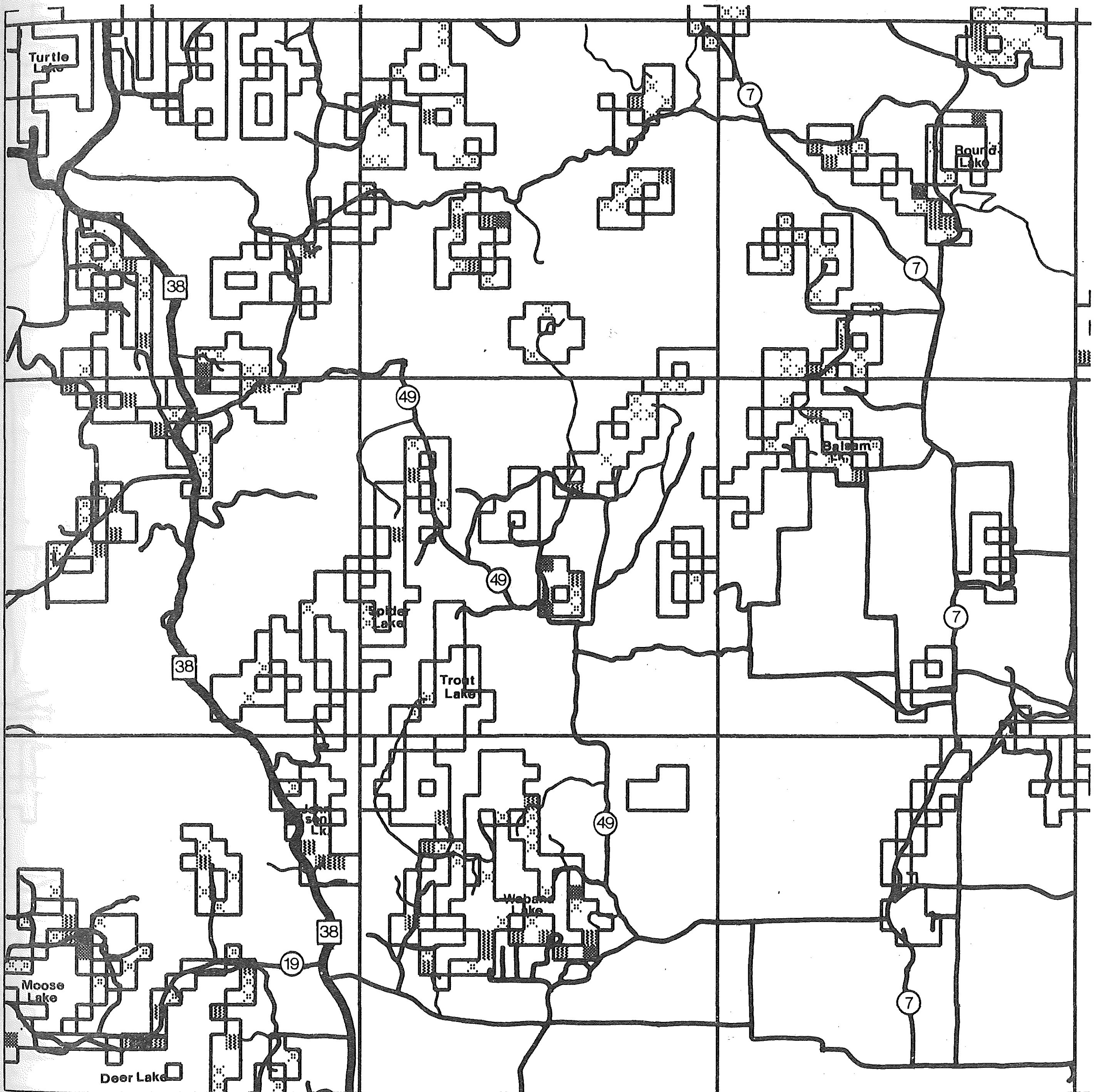


In shoreland units/shoremile

	Count	Percent	Acres	Description
	498	9.3	19920	Shoreland forties without development in 1967 or 1982.
(light stipple)	213	4.0	8520	Shoreland forties without development in 1967 but with development in 1982.
(dark pattern)	294	5.5	11760	Shoreland forties with development in 1967 which show further development in 1982.

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

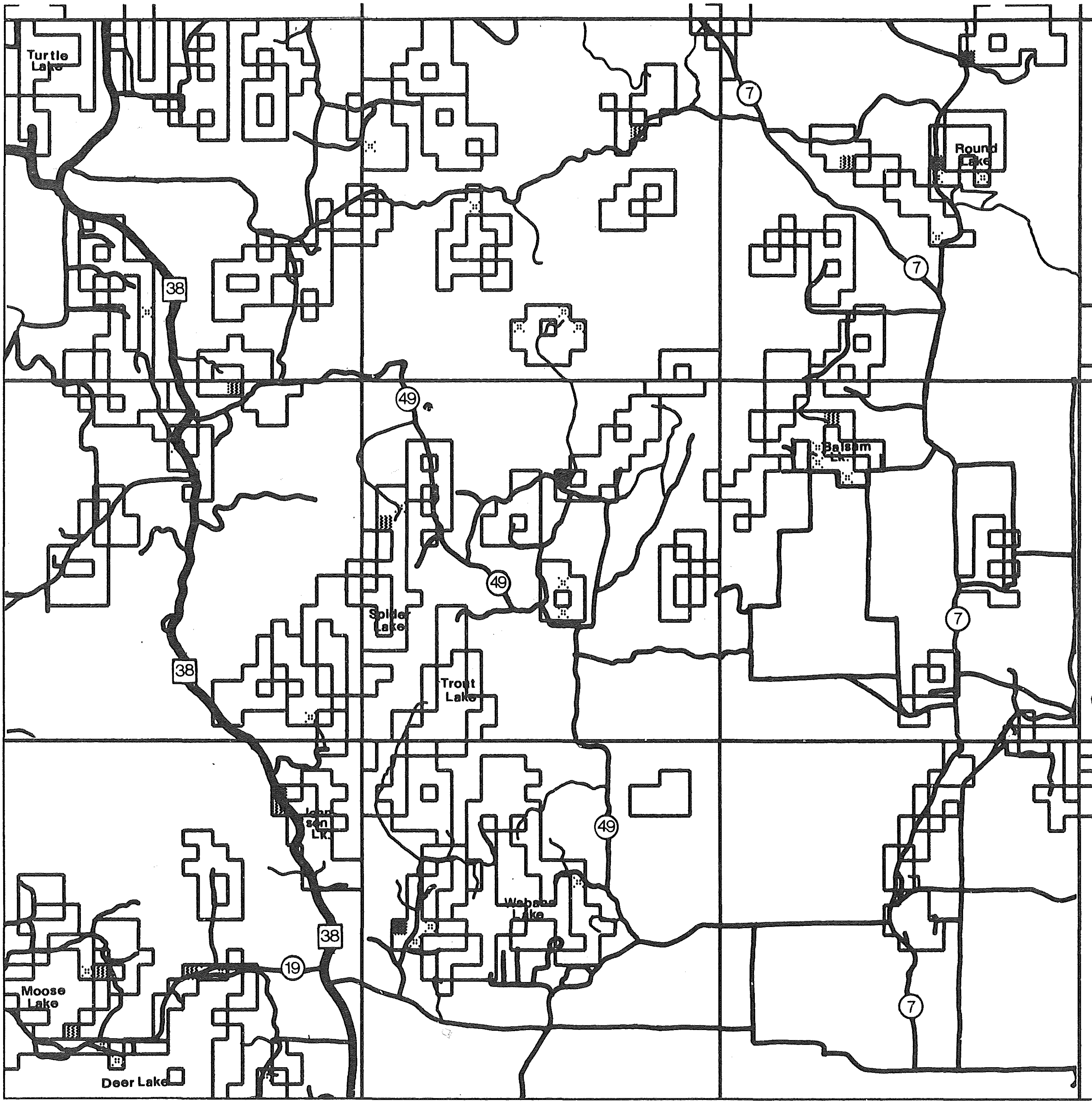
Figure 24d: DEVELOPMENT INCREASE (1967-1982) IN SHORELAND AREAS WITH A 1967 DENSITY OF 1-10 UNITS/SHOREMILE



	Count	Percent	Acres	Density Classes
	779	14.6	31160	Shoreland density not equal to 1-10 units/shoremile in 1967.
(dotted)	153	2.9	6120	Increase less than 1 unit/shoremile.
(hatched)	59	1.1	2360	Increase 1-10 units/shoremile.
(dark)	9	0.2	360	Increase 11-20 units/shoremile.
	5	0.1	200	Increase greater than 20 units/ shoremile.

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

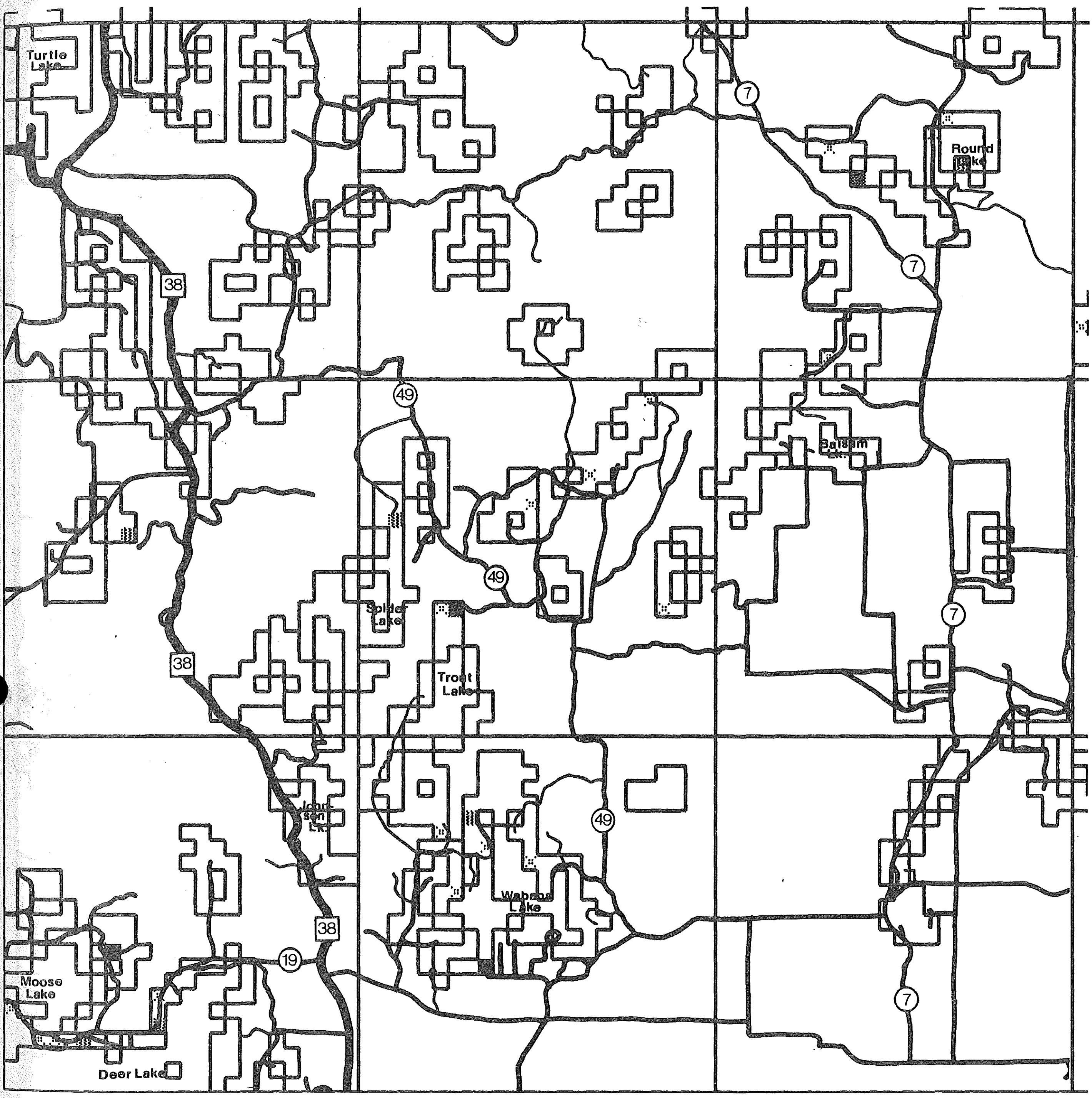
Figure 24e: DEVELOPMENT INCREASE (1967-1982) IN SHORELAND AREAS WITH A 1967 DENSITY OF 11-20 UNITS/SHOREMILE



	Count	Percent	Acres	Density Classes
	965	18.1	38600	Shoreland density not equal to 11-20 units/shoremile in 1967.
	26	0.5	1040	Increase less than 1 unit/shoremile.
	9	0.2	360	Increase 1-10 units/shoremile.
	4	0.1	160	Increase 11-20 units/shoremile.
	1	0.0	40	Increase greater than 20 units/ shoremile.

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

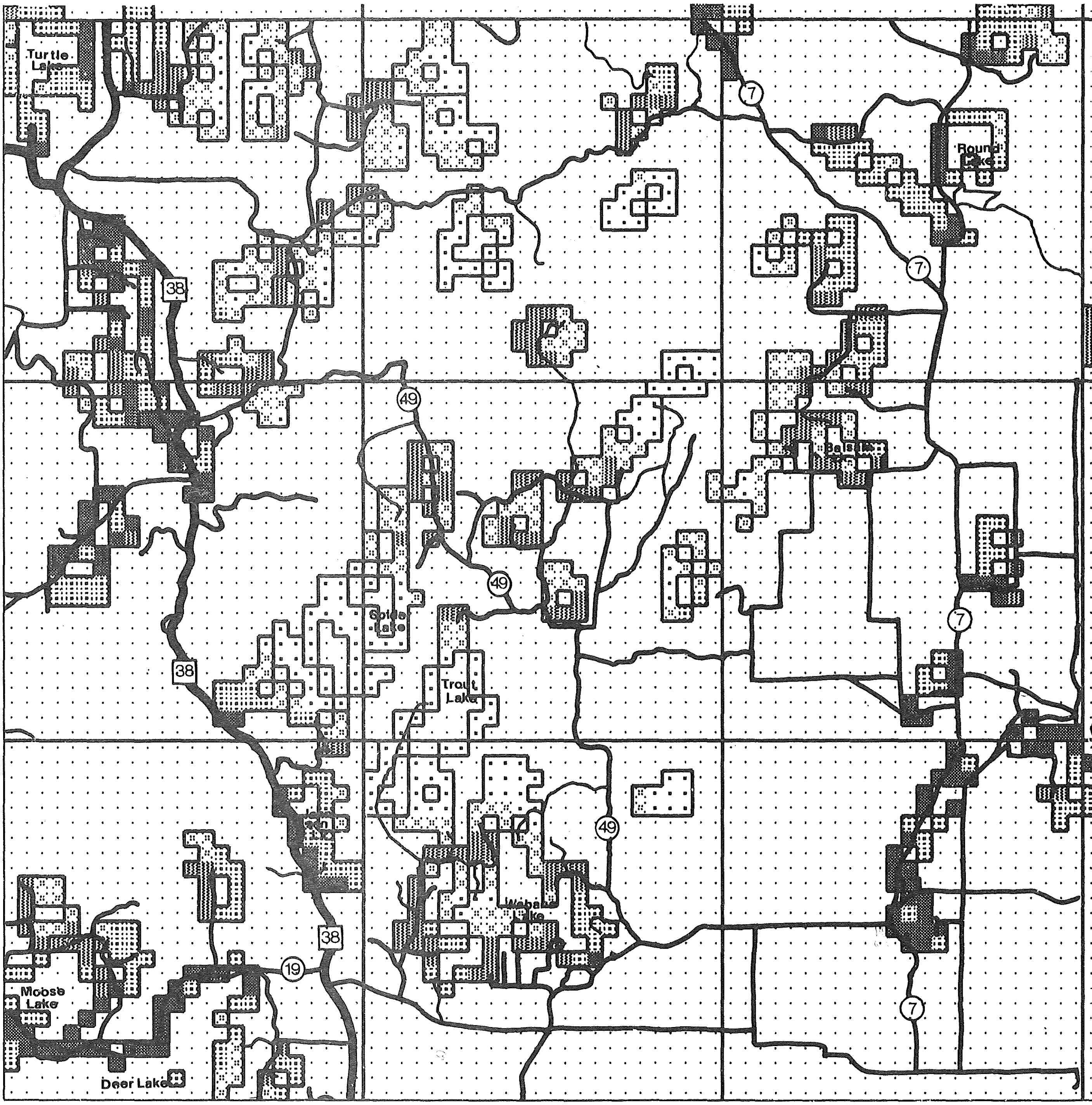
Figure 24f: DEVELOPMENT INCREASE (1967-1982) IN SHORELAND AREAS WITH A 1967 DENSITY OF OVER 20 UNITS/SHOREMILE



	Count	Percent	Acres	Density Classes
	977	18.3	39080	Shoreland density less than 20 units/shoremile in 1967.
	18	0.3	720	Increase less than 1 unit/shoremile.
	6	0.1	240	Increase 1-10 units/shoremile.
	2	0.0	80	Increase 11-20 units/shoremile.
	2	0.0	80	Increase greater than 20 units/shoremile.

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

Figure 24g: CLASSIFICATION OF SHORELAND FORTIES BY ROAD ACCESS CLASS

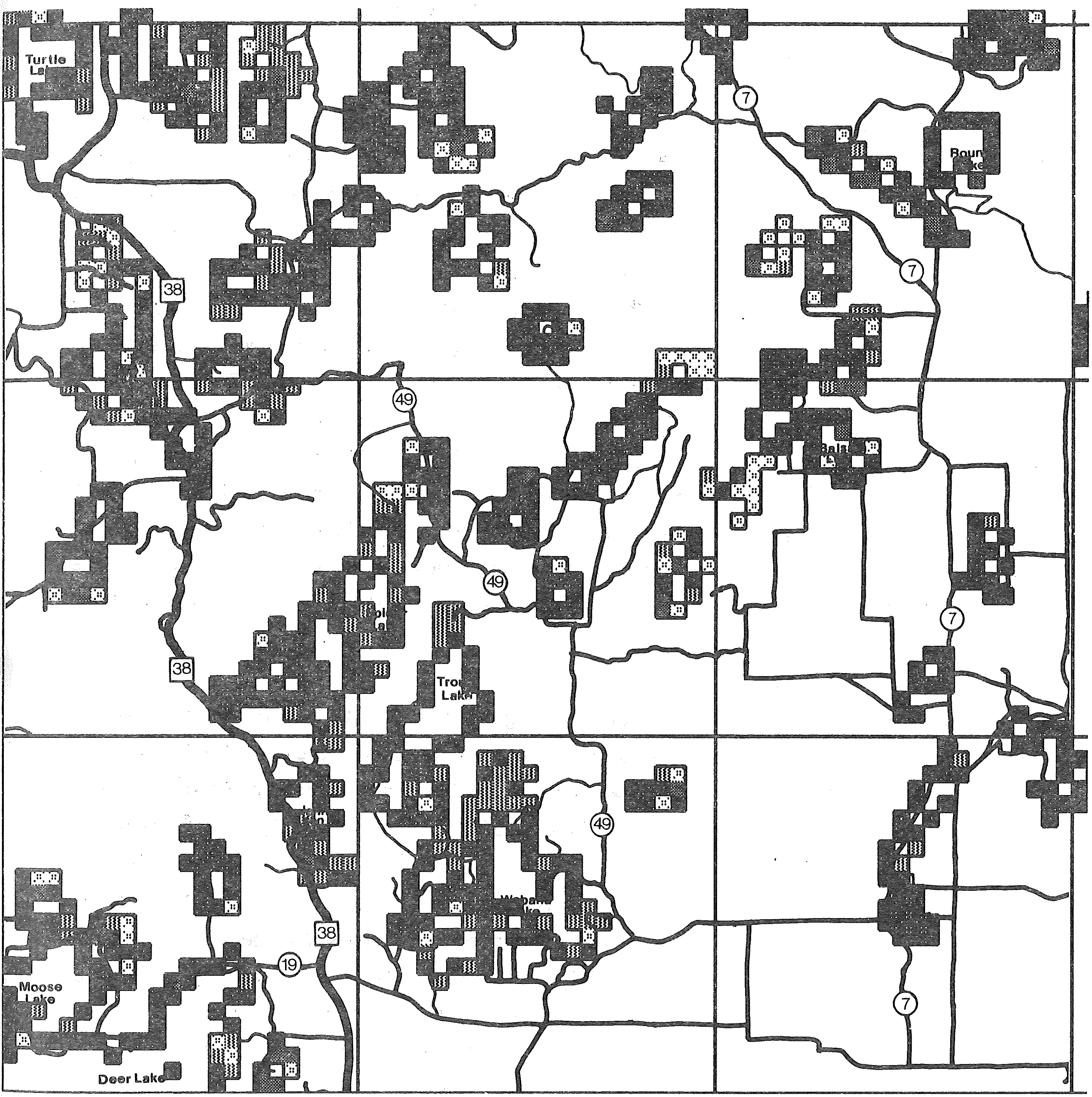


	Count	Percent	Acres	Road Access*
	4324	81.1	172960	Forties not in shoreland area.
	148	2.8	5920	CLASS 1
	172	3.2	6880	CLASS 2
	225	4.2	9000	CLASS 3
	272	5.1	10880	CLASS 4
	188	3.5	7520	CLASS 5

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

* For description of classes, see Table 4b, page 30.

Figure 24h: CLASSIFICATION OF SHORELAND FORTIES BY FOREST AND SOIL COVER



Count	Percent	Acres	Soil/forest Cover Class
760	14.3	30400	Sand-loam soils with trees.
38	0.7	1520	Sand-loam soils without trees.
130	2.4	5200	Other soils with trees.
77	1.4	3080	No data and other soils without trees.

Bituminous Road
Gravel or Stone
Graded & Unimproved Road

reasons that there are a variety of factors that limit development density (zoning restrictions, site suitability, aesthetics, etc.), then it makes sense that less densely developed forties tend to develop more rapidly.

Given this information, one can easily imagine, as one looks at Figures 24b through f, a series of "time-lapsed" maps of this region, with new development gradually filling in and occupying sparsely developed forties. With each new iteration, another set of forties that previously had just a few development units, quickly increases in density. At the same time, an occassional forty that was previously undeveloped has one or two units built upon it. This forty, at a later time becomes the object of intensive development pressure. One can also envision the gradual formation and expansion of development corridors. On Wabana Lake (in the south central portion of the map), for instance, it becomes readily apparent that in almost every instance, new development since 1967 occurred in areas that either already had development in 1967 or on forties immediately adjacent to such forties. At the same time, one can also see the outlines of a distinctive development corridor along the southern boundary of Wabana Lake. Another lake displaying a similar pattern is Deer Lake (in the southwest corner).

The maps also show how new development, regardless of its density, is strongly associated with road access. This relationship is dramatically illustrated on all the development maps. Areas with poor or no road access generally do not contain old or new development. Corridors of shoreland development form along the road network that traverses this region. Sections of highways 7, 19, 38, and 49 form corridors of development on lakes to which they provide access. This pattern does not change, whether or not one compares the development with the roads displayed on the individual maps or if one compares them with map 24g, which classifies shoreland forties according to the road access classes used earlier in this report (see Table 4b on page 30). It should also be noted that the southern boundary of this region is within 10 miles of an important service center, Grand Rapids.

Finally, a comparison of Figures 24b and 24h suggest a relationship between shoreland development and forest-soil cover. While there is a high degree of overlap between developed forties and sand-loam soils with trees, the degree of overlap tends to deteriorate on those portions of lakes that have the highest densities of development. For instance, while the sandy-loam soils with trees predominate on the southern half of Wabana Lake, much of the new development occurs on forties with other types of forest-soil cover (compare Figures 24b and 24h). Additionally, there is only one forty with a development density greater than 20 units/shoremile that is also classified as treeless. Since one would expect those forties with the highest densities to have been developed for the longest period of time, one is drawn toward the conclusion that while certain physical characteristics may be preferred by shoreland residents, the force or impact of this preference decays with increasing amounts of shoreland development.*

This snapshot view of shoreland development within a small area of Itasca County helps highlight that the most important factors influencing shoreland development on a statewide basis appear to be road access, and secondarily, distance to service center. Earlier, it was noted that development densities drop off quickly with increasing distance from roads or service centers (refer back to Table 11a and 11b and Figures 21a and 21b). These two factors, road access and distance to service center, are the most important determinants in the location of shoreland development. This conclusion is further supported by a two-way analysis of variance with road and service center access as independent variables.**

These results indicate that while road access and distance to service center (to a lesser degree) are good explainers of shoreland development, they are very poor predictors. The importance of these two factors are not surprising since the needs and wants associated with shoreland residence demand both an adequate transportation network and certain services. There is an ongoing and complex interrelationship between road access, service center access, and shoreland densities. As shoreland densities increase, the likelihood of increased road access and growth of a service center correspondingly increase. Given these results, one might be tempted to attribute causative characteristics to these variables, and therefore use them to predict shoreland development trends and patterns. However, the analysis to date is

* The relationship of physical characteristics to the location of new shoreland development is developed further in the following summary discussion of the importance of road and service center access.

** For a more detailed interpretation of this analysis, see Appendix II.

inadequate for distinguishing whether or not roads are constructed in response to development pressure, or vice-versa. At the same time, the data is not adequate for determining the impact of upgrading of roads as opposed to new road construction. There is some evidence to indicate that the upgrading of a road from unpaved to paved may have significantly more impact upon development pressure than simply constructing a new road in an area that does not currently have one.* Thus, one can imagine, for instance, an historical scenario in which development of shoreland areas was initially attracted by particular landscape characteristics of the lake and adjacent lands.** But as development density increased, and as prime resource areas were occurpied, factors such as road and service center access increase in importance. In this type of scenario, roads are both a response to and a cause of increased shoreland development.*** This prospect is raised to emphasize that while the current analysis can be said to reliably identify the important factors influencing shoreland development, the nature and character of that influence is a more complex undertaking and is still open to considerable debate and speculation.

As noted earlier, distance to service center is more influential in determining permanent shoreland development than seasonal. This probably reflects the development of a commuting zone around centers with significant amounts of shoreland resources. Road access, on the other hand, is a more important determinant of seasonal development. The importance of these two factors has significant implications for shoreland planning. However, the administration of shoreland management at the local level rarely addresses the development, upgrading, or maintenance of road access as an important component of their program. Typically, the development or upgrading of roads is only constrained by questions of land ownership, construction

* This conclusion was indicated by a further, more detailed analysis of variance. Unfortunately, this data was not ready at the time this report was being published.

** Such a scenario would help explain the high correlation between shoreland development and forested sandy-loam soils noted in the earlier discussion of figures 24a and 24g. While natural resource characteristics such as soil and forest type may be an impetus to development, they need not be the cause or major influence of continued development.

*** It would be very useful for purposes of planning and management, to engage in further analysis of the relationship between access and shoreland development.

problems due to the physical characteristics of the land, and the funding necessary to maintain roadways. Thus one finds that shoreland management has not adequately addressed one of the most important influences in the continuing development and use of shoreland resources. Because access appears to be an important influence, the absence or poor quality of roads is a significant deterrent toward higher density development. At the same time, the lack of roads in undeveloped areas encourages continued expansion onto shorelands that are roaded despite their present high densities. The question of how to integrate the influence of road access and distance to service center into a shoreland management program is one that needs further consideration and more careful study.

IV. INNOVATIONS IN SHORELAND DEVELOPMENT

Most of the development which occurred during the study period followed patterns identified in 1967. Even so, there have been some innovative additions to shoreland development, though they still parallel past trends. Some of these innovations will undoubtedly pose problems for shoreland managers during the coming years.

One change from the 1967 study is the development of areas that were, until recently, largely ignored (small lakes, rivers and marginal resource areas). Since data was not collected on small lakes and rivers in the 1967 study, no time series comparison is possible. But there is consensus among shoreland managers throughout the state that there have been increasing numbers of development proposals for these areas.

While reasons for these shifts have not been probed, it is almost certain that increasing densities on the prime resource areas account for the change. Prime resource areas now sell for as much as $800 per frontage foot. The price of a new lakehome with modest dimensions can easily reach $150,000 or more. This represents a significant investment, even if the lakehome is to be a permanent residence. Frontage on smaller lakes and rivers is more affordale, placing the lakehome within reach of a larger portion of the population. It is also possible, however, that resource preferences are beginning to change. Although there are no data to verify this supposition, many persons may actually prefer the less crowded conditions of rivers and small lakes. The Natural Environment zoning in most of these areas should be sufficient to keep the resource from reaching the high densities of the other prime resource areas.

Development of rivers and small lakes is also occurring in areas that traditionally were not viewed as preferred resource areas. Throughout southeastern Minnesota, for instance, development of river shorelands is more pronounced due to the unusual quality of the river resources and because there are few lakes to compete for attention.

For similar reasons, development has shifted not only to the more marginal resource areas, but also to off-shore locations.* As shorelands in prime resource areas have increased in value and become heavily developed, many people have chosen not to locate on small lakes or rivers. The attractiveness of some of these resource areas is sufficient that many users are willing to accept the less expensive areas adjacent to shore lots. Currently, offshore development is becoming much more pervasive in the state's densely developed central lake counties such as Aitkin, Becker, Crow Wing, Hubbard, etc. Although such developments do not have riparian rights, use of the resource is available via public and private accesses.

Some of the earliest shoreland subdivisions in rural areas had back lots. In most areas, however, subdivisions provided just a single tier. If there were back lots, these were seldom developed. Although comparative data are not available from 1967, visual comparisons of shoreland trends support the conclusion that backlot development is far more pronounced today than in years past.

Earlier, it was noted (refer back to Tables 4a and 4b) that the percent of total shoreland development that does not have frontage is generally small. The information indicates the average density of non-frontage residences per shoremile is still low. However, concentrations are highest in regions where frontage densities are also very high. This trend was not anticipated in earlier shoreland research. Current information and research does not adequately address the question of how multi-tier development effects resource quality.

The 1970's have witnessed a flowering of new development and ownership approaches for shoreland areas. The more traditional forms of lot and block subdivisions for sale of single family lots are still dominant. But for a variety of reasons, alternative approaches are becoming more attractive options. The higher densities, declining availability of developable space on prime lakes, increasing costs of development, and even the shoreland standards themselves, have encouraged experimentation with new approaches to serve traditional demands.

* Multi-tier development is also discussed earlier in this report in the section titled "Shoreland Development Trends."

Time-share developments, which have become increasingly popular in vacation spots around the world, have also made their way into Minnesota shoreland areas. This concept allows a buyer to purchase a divided ownership in a shoreland residence. Each owner is allotted a certain period of time during the year when they may occupy the lakehome. Usually the time period is in blocks of a week or more. The buyer has use of the resource without associated maintenance problems. Although the price per week of use is high, it is very competitive with the costs of owning a shoreland lot and building a residence. A major concern with this approach is that resource use is greatly intensified. Each unit of residence is used for a larger share of the year than most seasonal lakehomes. It is probably safe to assume that the average use per day is also much higher. Shoreland managers have been concerned about the possible implications of this innovation. Needless to say, since the scope of potential problems are uncertain, there are no specific standards to govern time-share developments on shoreland areas.

Another relatively new approach to ownership is the condominium development. With this approach, the buyer has title to a residence and an undivided ownership in common space and recreation facilities accessory to the residence. A management firm performs the details of maintenance, leaving the resident with greater time to use and enjoy the resource. Again, this type of development probably implies a much more intensive use of the resource.

Planned unit developments and cluster developments are a relatively new approach to subdividing land in shoreland areas. This approach was not unknown when the shoreland standards were developed. They had been around for some time but were rarely applied to shoreland subdivisions. Shoreland standards were structured to encourage such approaches. Higher densities are allowed for PUD and cluster designs. The philosophy has been that the higher densities are justified by the opportunities to develop common facilities such as community sewage treatment systems and designing open space areas in keeping with the aesthetics of shoreland areas. Generally, this approach has won growing acceptance. In some areas, almost all new development proposals are some variety of cluster or PUD design.

With the increasing popularity of these approaches, there may be a need to reconsider the trade-offs they imply. These approaches definitely have the potential for reducing sewage treatment system contamination of lakes, protecting sensitive shoreland areas, improving the visual quality of shoreland development, and reducing the costs of shoreland acquisition to buyers. The possible side affects, however, may be a less than desirable increase in density, especially in terms of water surface use. That increase may conceivably cause deterioration in other aspects of the shoreland resource.*

The PUD (Planned Unit Development) or Cluster development approach is one of many approaches for converting former resorts to new uses. Although this approach takes many forms, the common occurrance involves cabins of resorts being sold individually to new owners with the lodge remaining in group ownership for use as a clubhouse. As with so many of these new developments, there are both positive and negative benefits to them. On a positive note, an often deteriorating facility is salvaged and improved. Although comparative data are not available, it is possible that the total use of a PUD may be lower than that experienced when the facility functioned as a resort. This would then actually reduce pressures on the resource. One problem with this trend is that the approach is sometimes used to cirumvent shoreland standards that would be applied if the resort were converted to other uses. Many resorts have densities that are higher than allowed by the standards and have structures that are located too close to the shoreline. By avoiding the necessity of bringing the facility into conformity, a sub-standard condition is extended indefinitely into the future.

These new trends in ownership and subdivision are still in an early developmental stage. New forms and approaches are constantly emerging, presenting shoreland managers with new dilemnas. Each new proposal demands a unique evaluation and application of the standards. Often, there is disagreement regarding how the standards should be applied, especially with respect to density provisions. Constant monitoring will be needed to ensure the standards are adequate for managing the situation.

Data has not been collected to indicate or measure the strength of these new trends. Traditional data sources such as courthouse assessment records, do not provide sufficient information. DNR shoreland management records,

* Recommendations for addressing these and other problems can be found in Report No. 2: EVALUATION OF SHORELAND MANAGEMENT BASED ON SAMPLE COUNTIES AND TOWNSHIPS, and "Report No. 3: LOCAL OFFICIAL RECOMMENDATIONS FOR SHORELAND PROGRAM IMPROVEMENTS, Shoreland Update Project, 1983.

however, do indicate the general location of most of the new developments (Figure 25). More detailed monitoring of these trends is needed.

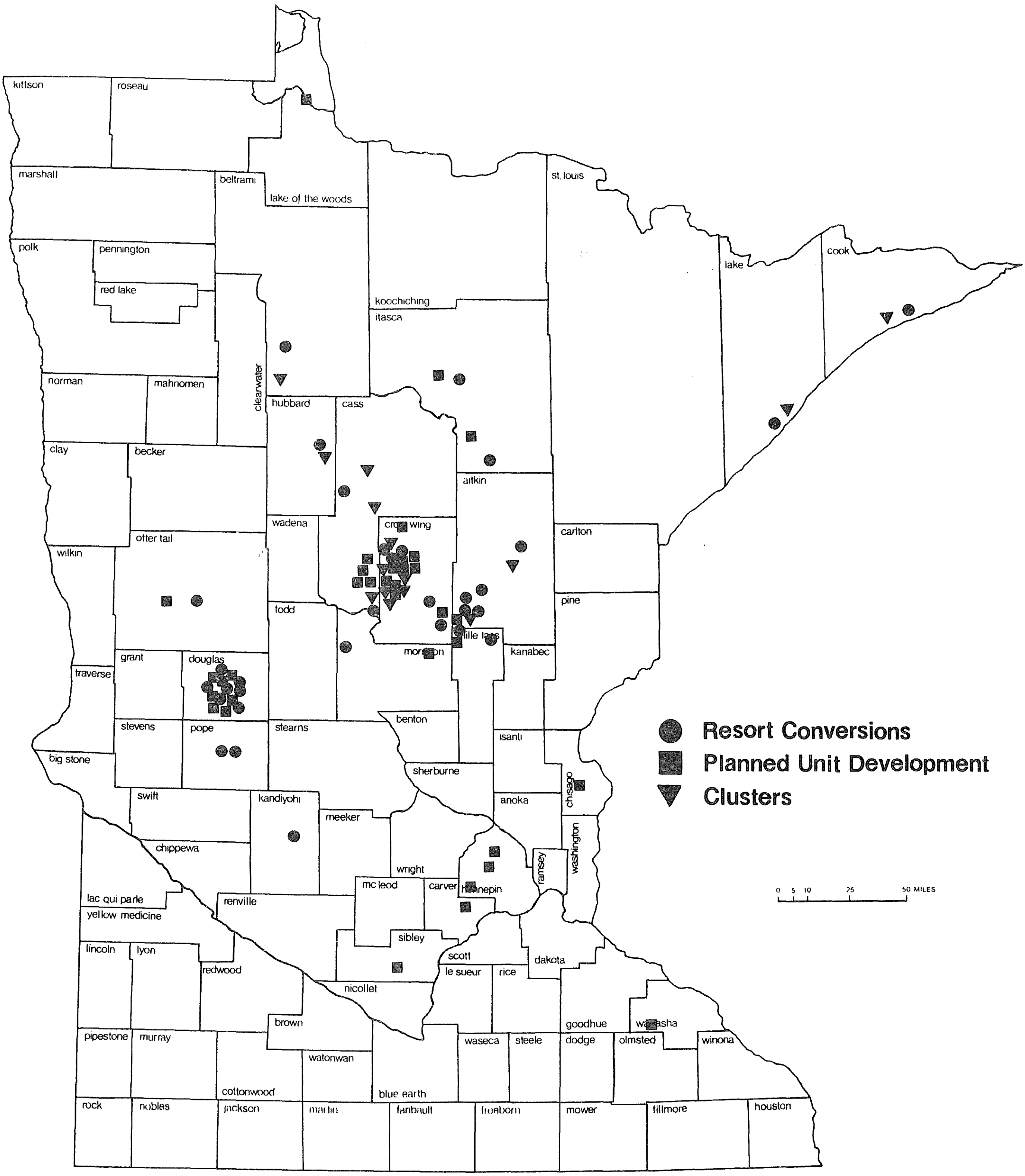
Redevelopment of shorelands is also emerging as a significant new force with the potential to substantially correct some of the worst planning errors of the past. Usually, when redevelopment does occur, it is because a developer has purchased blocks of currently developed shoreland property that has a relatively low marketplace value. Usually the relatively low value is due to the sub-standard conditions of structures and lot sizes. Often the property is a resort that has ceased operating. Occassionally, redevelopment is comprehensive, with all the structures being leveled and new buildings erected. In other cases, there is substantial restoration of old structures. In some cases, however, the remodeling is simply an attempt to circumvent permit requirements and shoreland standards.

Often, the result of redevelopment is a shoreland area that bears little resemblance to its prior state. Densities are often lower but not always, since the PUD and cluster approaches are most often used and these allow for higher development densities than traditional lot and block approaches. Even where higher densities result, centralized sewage treatment systems and more aesthetic structures do much to soften the sting of the impact on the resource.

Finally there has been a shift toward greater public involvement in lake and river management in the form of lake associations and watershed districts. These groups are often organized in an attempt to halt development or as a strategy to improve resource quality.

Ideally, the DNR should seek to coordinate and guide citizen resource management efforts. The DNR could even promote proliferation of lake associations as an approach to improving resource management. Such an opportunity holds considerable potential for expanding public awareness of resource concerns and developing public pressures for improvement of critical problem areas such as malfunctioning on-site sewage treatment systems. Despite the golden opportunity presented by this option, the DNR lacks the resources for such an intiative. DNR shoreland management staff has all it can handle with existing problems and opportunities. Eventually, the DNR may

Figure 25: DISTRIBUTION OF PUDs, CLUSTERS, AND RESORT CONVERSIONS



wish to explore this further to determine potential avenues for greater public/private coordination in lake management.

This report has attempted to provide a broad analysis of shoreland development trends within the state. Current indications are that these trends have, for the most part, followed paths previously anticipated. Although there have been some unexpected changes, most notably conversion from seasonal to year-round use, these still represent a small portion of total development. Perhaps the most significant outcome is that continued growth and development may begin to reach certain thresholds that may have deleterious impacts upon shoreland resources. Analysis of trends suggest that modifications in the current shoreland program may be adivsable, with special consideration given to strategies that help identify possible use 'thresholds' for shoreland resources and that provide greater versatility for tailoring shoreland standards to individual lakes.

Appendix I: SUMMARY OF COUNTY SHORELAND DEVELOPMENT, 1982

	SEASONAL DWELLINGS				PERMANENT DWELLINGS				TOTAL DWELLINGS			
County(# & name)	Large Lake	Small Lake	River	Percent	Large Lake	Small Lake	River	Percent	Large Lake	Small Lake	River	Total
1) Aitkin	4518	119	89	79.2	1121	25	109	20.8	5639	144	198	6118
3) Becker	4059	27	0	67.2	1938	57	0	32.8	5997	84	0	6083
4) Beltrami	1008	22	7	47.9	1045	24	48	52.1	2053	46	55	2165
5) Benton	114	0	25	27.6	147	0	217	72.4	261	0	242	503
6) Big Stone	5	2	0	12.3	17	27	0	87.7	22	29	0	57
7) Blue Earth	149	0	1	31.8	155	7	159	68.2	304	7	160	471
8) Brown	0	0	0	0.0	46	0	0	100.0	46	0	0	46
9) Carlton	460	104	0	59.8	264	85	30	40.2	724	189	30	983
11) Cass	3930	376	61	72.1	1474	150	62	27.9	5404	526	123	6053
12) Chippewa	0	0	0	0.0	3	0	5	100.0	3	0	5	8
13) Chisago	736	4	2	43.4	838	32	24	56.6	1574	36	26	1743
14) Clay	26	13	0	15.8	2	7	199	84.2	28	20	199	247
15) Clearwater	274	27	0	73.2	67	43	0	26.8	341	70	0	411
16) Cook	1030	21	0	89.5	114	10	0	10.5	1144	31	0	1184
17) Cottonwood	20	0	0	16.9	98	0	0	83.1	118	0	0	118
18) Crow Wing	7832	437	36	67.9	3594	229	87	32.1	11426	666	123	12364
20) Dodge	0	0	1	2.2	0	0	44	97.8	0	0	45	45
21) Douglas	2041	51	0	48.4	2174	42	0	51.6	4215	93	0	4440
22) Faribault	55	0	0	61.1	35	0	0	38.9	90	0	0	90
23) Fillmore	0	0	7	12.1	0	0	51	87.9	0	0	58	58
24) Freeborn	42	0	0	10.7	280	45	26	89.3	322	45	26	393
25) Goodhue	0	4	1	10.2	0	1	92	89.8	0	5	93	118
26) Grant	185	1	0	56.2	142	3	0	43.8	327	4	0	331
28) Houston	0	0	12	14.5	0	0	71	85.5	0	0	83	83
29) Hubbard	2729	107	0	67.1	1286	97	0	32.9	4015	204	0	4357
30) Isanti	455	11	6	45.8	421	78	62	54.2	876	89	68	1041

County(# & name)	SEASONAL DWELLINGS Large Lake	Small Lake	River	Percent	PERMANENT DWELLINGS Large Lake	Small Lake	River	Percent	TOTAL DWELLINGS Large Lake	Small Lake	River	Total
31) Itasca	2613	369	69	54.4	1968	280	309	45.6	4581	649	378	5610
32) Jackson	161	2	1	55.2	105	0	28	44.8	266	2	29	297
33) Kanabec	514	22	52	65.8	272	17	32	34.2	786	39	84	1105
34) Kandiyohi	1616	34	0	56.8	1153	76	0	43.2	2769	110	0	3099
35) Kittson	0	0	0	96.0	0	0	0	4.0	0	0	0	25
36) Koochiching	0	6	9	18.8	0	0	65	81.3	0	6	74	80
37) LacQui Parle	0	0	0	27.3	0	0	8	72.7	0	0	8	11
38) Lake	602	60	18	64.8	185	8	30	35.2	787	68	48	1498
39) Lk. of Woods	294	0	113	61.9	52	0	198	38.1	346	0	311	657
40) Lesueur	1069	12	2	62.8	612	19	9	37.2	1681	31	11	1725
41) Lincoln	72	0	0	62.6	43	0	0	37.4	115	0	0	115
42) Lyon	0	0	2	2.2	59	0	22	97.8	59	0	24	92
43) McCleod	7	0	0	2.5	159	10	47	97.5	166	10	47	280
44) Mahnomen	443	0	0	78.7	120	0	0	21.3	563	0	0	563
46) Martin	78	0	0	25.4	229	0	0	74.6	307	0	0	307
47) Meeker	859	31	0	56.0	646	35	15	44.0	1505	66	15	1588
48) Mille Lacs	899	0	4	59.6	581	0	42	40.4	1480	0	46	1643
49) Morrison	643	91	2	73.9	231	22	7	26.1	874	113	9	996
50) Mower	0	0	4	0.8	0	0	483	99.2	0	0	487	487
51) Murray	368	0	0	81.1	86	0	0	18.9	454	0	0	454
52) Nicollet	0	0	0	0.0	0	0	50	100.0	0	0	50	50
53) Nobles	2	0	0	5.7	33	0	0	94.3	35	0	0	35
54) Norman	0	0	4	57.1	0	0	3	42.9	0	0	7	7
55) Olmsted	38	0	11	24.4	27	0	240	75.6	65	0	251	401
56) Otter Tail	8077	1	0	71.3	3238	15	0	28.7	11315	16	0	11331
57) Pennington	0	0	0	0.0	0	0	164	100.0	0	0	164	164
58) Pine	1261	167	125	68.0	576	63	66	32.0	1837	230	191	2459
60) Polk	539	12	0	87.3	74	6	0	12.7	613	18	0	631

County(# & name)	SEASONAL DWELLINGS				PERMANENT DWELLINGS				TOTAL DWELLINGS			
	Large Lake	Small Lake	River	Percent	Large Lake	Small Lake	River	Percent	Large Lake	Small Lake	River	Total
61) Pope	819	0	0	67.0	404	0	0	33.0	1223	0	0	1225
63) Red Lake	0	0	0	0.0	0	0	194	100.0	0	0	194	194
65) Renville	5	0	0	13.9	31	0	0	86.1	36	0	0	36
66) Rice	501	8	0	43.2	537	20	70	56.8	1038	28	70	1179
68) Roseau	33	0	0	53.2	9	0	20	46.8	42	0	20	62
69) St. Louis	7588	1744	65	72.9	2793	449	114	27.1	10381	2193	179	12970
71) Sherburne	562	59	20	38.0	600	132	305	62.0	1162	191	325	1691
72) Sibley	0	0	0	0.0	64	0	0	100.0	64	0	0	64
73) Stearns	1930	190	30	49.2	1449	355	500	50.8	3379	545	530	4784
74) Steele	0	0	0	42.3	2	0	99	57.7	2	0	99	189
75) Stevens	22	0	0	25.9	63	0	0	74.1	85	0	0	85
76) Swift	9	0	1	10.3	32	13	42	89.7	41	13	43	97
77) Todd	1052	51	6	64.1	564	40	8	35.9	1616	91	14	1736
78) Traverse	114	0	0	80.3	28	0	0	19.7	142	0	0	142
79) Wabasha	21	9	10	36.6	59	1	51	63.4	80	10	61	677
80) Wadena	141	20	21	56.5	85	46	22	43.5	226	66	43	352
81) Waseca	68	37	0	35.7	172	17	0	64.3	240	54	0	294
83) Watonwan	27	0	0	30.3	62	0	0	69.7	89	0	0	89
84) Wilkin	0	0	1	14.3	0	0	1	85.7	0	0	2	14
85) Winona	0	0	12	42.9	0	0	16	57.1	0	0	28	28
86) Wright	2144	169	2	46.0	1817	431	458	54.0	3961	600	460	5036
87) Yell. Med.	0	0	0	0.0	11	0	0	100.0	11	0	0	11

Appendix II: TWO-WAY ANALYSIS OF VARIANCE AND LINEAR REGRESSION, Road Access Class and Distance to Service Center

The results are displayed in the table below. The combination of high F ratios and very small significance of F figures show that road access and service center access are good explainers of shoreland development. Road access is particularly good. Although there is some interaction effect between these two variables, the difference in F figures suggests that there is less explanatory power in the interaction of these two factors than in the independent variables alone. While road access seems to be a good explainer of variation in shoreland development, it clearly is insufficient as a predictor. This is initially suggested by the very large size of the sum of squares for the residuals in comparison with the independent variables. One interpretation of this is that shoreland development is subject to a large assemblage of influences, of which, road and service center access are two important elements. This conclusion is further augmented by the multiple R squared figure, which indicates that only about 5% of development can be reliably predicted by these two independent variables.*

Two-Way Analysis of Variance
Road and Service Center Access

Source	Sum of Squares	Degrees of Freedom	Mean Squares	F Ratio	Significance of F
Main Effects	71813.928	7	10259.133	271.348	.001
Road Access	63421.708	4	15855.427	419.366	.001
Service Center	4779.697	3	1593.232	42.140	.001
2-Way Interactions					
Road & Center	839.703	10	83.970	2.221	.015
Explained	72653.631	17	4273.743	113.038	.015
Residual	1408425.886	37252	37.808		
Total	1481079.517	37269	39.740		

Variable and Category	Unadjusted Deviation	ETA	Adjusted Deviation	BETA
Road Access Classes				
1	1.29		1.26	
2	.64		.70	
3	-.25		-.29	
4	-1.70		-1.64	
5	-2.34		-2.31	
		.21		.21
Distance to Service Center				
0 - 5 miles	-.23		-1.10	
6 - 15 miles	1.85		1.47	
16 - 30 miles	.28		-.14	
greater than 30 miles	-.18		-.07	
		.08		.06

Multiple R^2 .048
Multiple R .220

* It should be noted that the multiple R squared figure represents the results of a best fit linear regression. There is good reason to expect a distance decay influence by the road and service center access variables, and therefore, the likelihood of a nonlinear relationship. Although there was insufficient time to conduct a nonlinear regression, analysis to date suggests that even such an analysis would lead to similar results concerning the predicitve powers of these two variables.