DOUGLAS COUNTY LAKE AND RIVER CLASSIFICATION PLAN

INTRODUCTION

Local units of government in Wisconsin are charged with regulating land uses to protect the public health, safety and general welfare, and they are encouraged to formulate policies and plans toward that end in advance. In carrying out this responsibility a major emphasis is usually placed on resource protection--fostering the wise use of waters, agricultural and forest lands, minerals and other natural resources. Oftentimes the strength of such resource--based land use programs, particularly when challenged in a court of law, can be traced rather directly to the degree to which the locality has linked its resource policies, plans and regulations to available natural resource data.

The following sketches one way land use programs may be grounded to the statistical information which exists for Wisconsin's water resources at the local level. The same method of regulating according to prior resource classification can be applied using different data sources in the case of other natural resources such as agricultural, forest and mineral-bearing lands. Three general ingredients comprise the method: 1) a rationale, 2) a classification scheme, and 3) a regulatory program.

This plan will focus solely on classifying the surface water resource. Similar detailed data for streams and rivers does exist and can be built into local land use programs in basically the same way.

The regulatory program discussed later will pertain directly to the local zoning power on shorelands. A full-blown carrying-capacity approach could utilize the resource classification scheme for local surface water use regulations as well.

Once the classification system has been devised it can be used for various purposes, zoning and non-zoning (e.g., surface water use regulations) alike. Also, the system can provide a basis for dealing not only with routine and typical development proposals, but with such a typical and non-routine matters as PUDs, conditional uses, rezonings, back-lot developments, resort conversions, etc.

DOUGLAS COUNTY PROFILE
LAKES AND IMPOUNDMENTS

Natural Lakes			**Impoundments**		**Total**	
Acreage classes	Number	Total acreage	Number	Total acreage	Number	Total acreage
0.1 - 9.9	264	660.8	19	46.3	283	707.1
10.0 - 49.9	97	2,307.6	5	106.7	102	**2,414.3**
50.0 - 99.9	22	1,569.2	2	117.3	24	**1,686.5**
100 - 199.9	10	1,429.4			10	**1,429.4**
200-499.9	6	2,098.1	1	346.0	7	**2,444.1**
500 - 999.9	4	3,417.5			4	**3,417.5**
1,000			1	1,912.7	1	**1,912.7**
Total	**139**	**10,822**	**9**	**2483**	**148**	**13,305**

70% of natural lakes 10 - 50 acres
23% of natural lakes 50 - 200 acres
All of the spring ponds of Douglas County can be found in either the St. Croix or Bois Brule River watersheds. A total of 26 soft water drainage lakes have an average size of 232.1 acres. This is the largest average size for the various lake categories. Hardwater seepage lakes, averaging 1.5 acres per lake, have the smallest average size for lakes in the county.

STREAMS AND RIVERS

Mean width - Entire stream	Number	Area acres	Length miles
Less than 10 feet	64	130.8	177.8
10 - 19 feet	23	310.6	252.1
20 - 39 feet	9	414.2	139.5
40 or more feet	5	7,298.0	136.0
Total	101	8,153.6	705.4

The Rationale.

There are two major reasons for utilizing this approach. First, lakes constitute important environmental and economic (recreation) resources in Wisconsin. And, second, with a reasonable amount of time and effort, it is possible to devise a local program more sensitive to an individual lake resource than is the minimum statewide standard in Wisconsin.

On the first reason, water resource importance, ten counties of northwest Wisconsin house approximately four percent of the state population, but contain almost twenty-five percent (more than 400 square miles) of the states's inland water acreage. This includes nearly 6,000 lakes which are unevenly distributed according to basic indicators such as size, shape and geography. For instance, more than two-thirds of the lakes are small, less than 25 acres in size, and about fifty lakes are 600 or more acres. Similarly, the breakdown for lake shape shows that while about half the lakes are fairly regular("round") and the other half are less regular ("long") more than three hundred fifty lakes are highly irregular ("spider"). And, geographically, although one county has only one hundred fifty lakes, several have close to one thousand and most northern counties have between three and five hundred lakes.

Recent trends in permanent and transient population movement, such as the so-called rural residency turnaround (in-migration) and changing recreational travel patterns, also affect localities throughout the North differently and unevenly. But, in general, these trends have resulted in substantial pressures for lake-related development, and have contributed to the need for more systematic management and growth studies such as this carrying-capacity plan.

A brief look at two simple and fundamental lake characteristics, size and shape, provides an orientation to a problem with Wisconsin's minimum state standard approach for land uses in shorelands. The left diagram shows two lakes of identical shape, but different size, super imposed on each other. Little Round Lake covers 50 water surface acres, while Big Round Lake encompasses 200 acres,. If we were to measure the shoreline length we would discover that, although Big Round has four times the surface water acreage, its shoreline is only twice the length of Little Round. The right diagram on the other hand, shows two lakes of identical size (50 water surface acres, like Little Round), but different shapes--Long Lake and Round Lake. In spite of the fact that they have the same water surface area, Long Lake has sixty percent more shoreline length. It is,therefore, potentially subject to much greater development and recreation user pressure, per water surface acre, than is Round Lake.

Table 1 shows how much the water surface area per developed shoreline lot would vary from lake to lake, if we assume that all the lakes in Map 2 could be fully developed at the state minimum standard of 100 feet per lot at the waterline. To the extent that we can agree that more water surface per lot generally translates into an increased capacity to carry or absorb the "shocks" (pollution, aesthetic degradation, etc.) which development imposes on the lake resource, we can conclude that large, regularly-shaped lakes (Big Round) have a greater absorptive capacity than do small, irregularly shaped lakes (Long Lake). And we can see that the use of a state standard (or any across-the-board standard of any dimension) ignores the existence of such variations. What we are not sure of, however, is precisely whether this is done at the expense of the most sensitive lakes (not protective enough), the least sensitive lakes (overly protective), or all lakes regardless of sensitivity (not protective enough or too protective).

Table 1: Full Development Potential at Wisconsin Minimum Lot Width

Lake Name	Number Lots	WSA/lot
Long Lake (50 acres)	85	.59
Round and Little Round (50 acres)	53	.96
Big Round Lake (200 acres)	106	1.92

The Classification Scheme

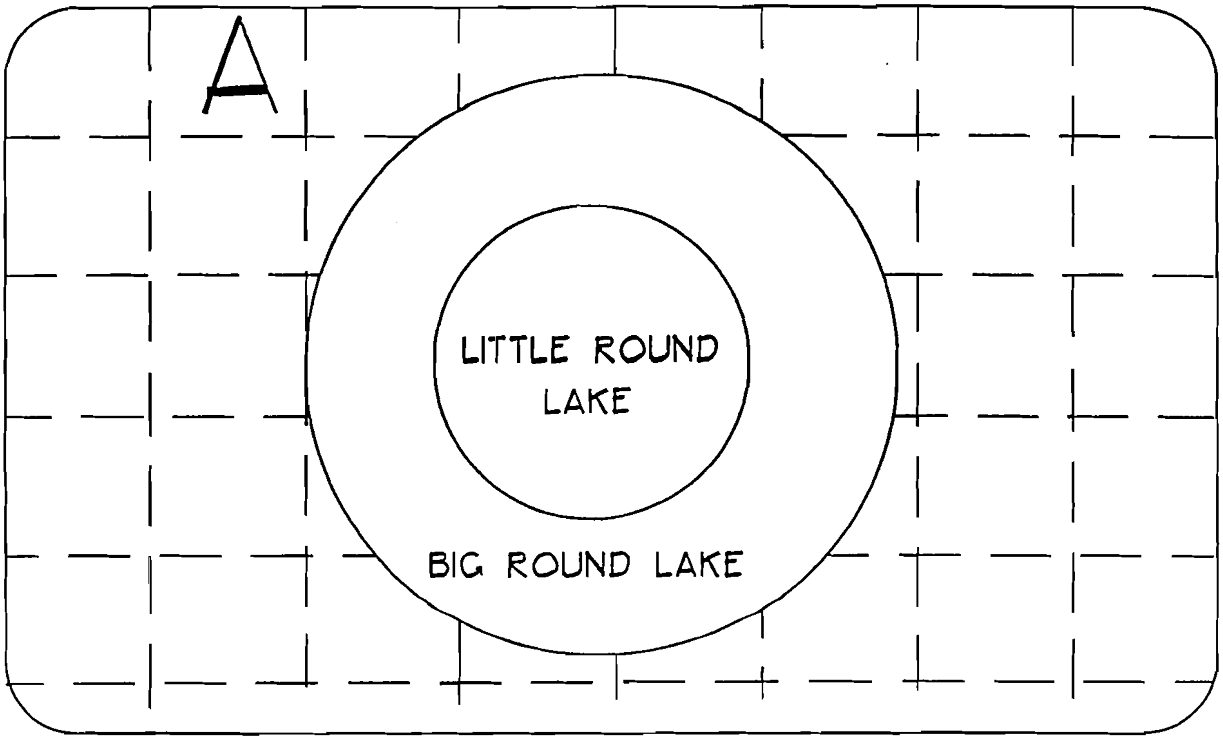
Resource classification schemes range from very simple sortings into several groups based on one or two distinctive characteristics to highly complex divisions derived from interrelating many variables. In the case of lake resources, an extremely simple sort is often suggested in the names of the lakes--Clear Lake vs Mud Lake, Bass or Trout Lakes, Big Spider Lake vs Little Spider Lake, etc. Limnologists, on the other hand, spend much of their time studying all facets of inland waters and classifying them into numerous categories based on lake genesis, geography and trophic status. What type of classification scheme gets used in a particular situation generally depends on judgments in four fundamental areas:

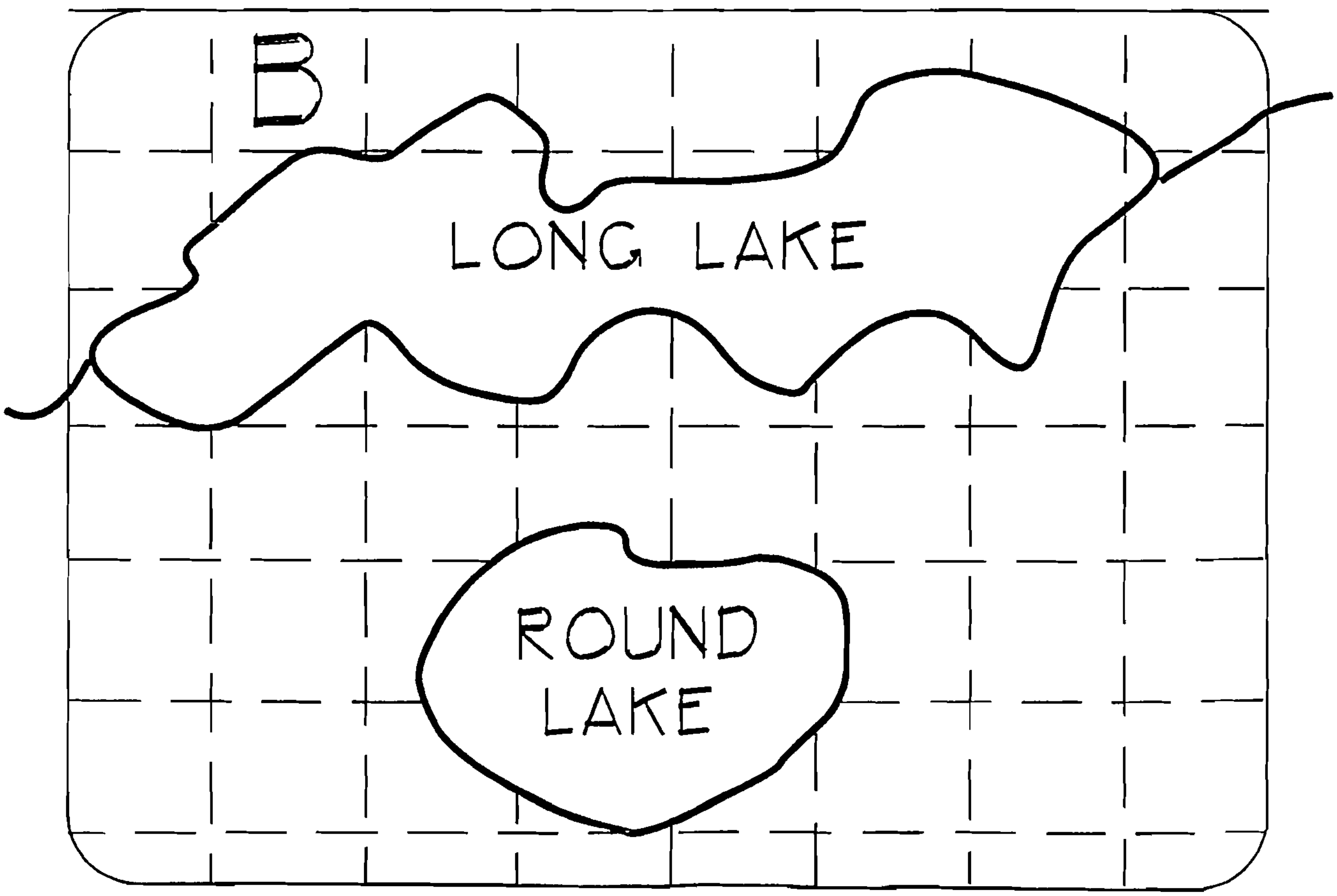
1. The nature of the resource. Lakes are complex and dynamic systems with highly individual characteristics. They are also systems that interrelate intensively with other ecosystems such as land, air, wildlife and fisheries, etc. In truth, man's understanding of lakes and their interrelationships falls far short of the ideal and, even within the limits of presently available knowledge, requires such time-consuming and expensive investigation that is possible to establish relatively clear-cut, quantifiable cause and effect linkages only for a selected few demonstration projects. Contrariwise, man's studied observations concerning general lake processes are developed and accurate enough to permit, and even encourage, practical "middle--ground" approaches to management.

2. Data availability. Much information exists and can be utilized in classification schemes ranging from the simple to the complex. In Wisconsin, for instance, at least three valuable sources are readily employable for local projects. One source is the Surface Water Resources report, prepared by the Department of Natural Resources, which exists for each county. It contains statistical tables with more than twenty different types of information on each lake in the jurisdiction. Another source is the even more detailed data which DNR keeps stored on computer tapes. This again exists by individual lake within each jurisdiction. And, another important source is the firsthand experience and perceptions which local lake users can bring to bear through their participation in a classification project.

3. Intended use. This helps assure relevancy and efficiency. It does not make good sense to classify lake resources into eight groupings if only three divisions are to be used in the local land use program. Likewise, it does not really pay to devote a lot of effort to interrelating twenty-four different types of information if an interplay of three or four variables will accomplish almost the same result. And it is senseless to use an overly

The Relation of Lake Size (A) and Shape (B) to Potential Shoreline Pressure





simple classification scheme, like lake names, if not all lake resources are named or if the names are misleading and inaccurately based on subjective and non-verifiable criteria. For instance many lakes are not named at all and, of the named lakes, only a handful of the names are descriptive. And, among the descriptive names are lakes such as Bass, Bluegill and Round (shape) may be verifiable, but Red (color) and Snake (shape) may not be. The participants from the jurisdiction, therefore, may play a judgmental role in identifying what is of primary concern to them, what is ultimately desired, and in reviewing alternative classification schemes for solving these problems and meeting their objectives.

4. User friendly schemes. The classification scheme is one, hopefully, which can be understood and accepted by those within the locality who must live by it as well as by those who must apply it. This is particularly important for land use programs. If people cannot follow the basic thrust of what is being done, and why, they will probably challenge and reject it out of hand.

In this classification methodology, the focus is placed on rating lakes according to one basic index, vulnerability. The vulnerability determination amounts to scoring lakes on the basis of their physical parameters such as size, shape, depth and flush potential. In those cases where additional and reliable qualitative data are available, a quality index may be incorporated as well. The quality determination is derived from scoring lakes according to characteristics of interest to the locality (fish and vegetative types, and water quality parameters)

Data Interpretation

The discussion suggests that what is sought is a scheme which allows a locality to separate its highly vulnerable lake resources from those of lesser vulnerability. The locality can then provide maximum land use protection to lakes which could be expected to benefit most from this type of management (the regulatory incentive is high). Lakes which stand to benefit little from land use measures, on the other hand, would receive only minimum protection (the regulatory incentive is low). And lakes which fall in-between can be managed in accordance with a mid-level or moderate regulatory program. An alternative for these in-between lakes could be to scrutinize them further until a clearer decision concerning their sensitivity can be arrived at. This might mean looking at a new set of data variables (public land ownership and access, existing development, type and distribution of soils) which, for one reason or another (not readily available, too complex, etc.) had been omitted in the initial classification scheme.

In this example, local participants decided to proceed with a three-tier--maximum-moderate-minimum-classification system. This procedure allows a locality to reserve new data variables for lakes for which a re-classification is requested, or for use when the regulatory agency is petitioned for a variance or special exception.

Lake Classification System Model

This model classification scheme utilizes a combination of natural resource factors that determine lake vulnerability or sensitivity.

Lake Surface Area

Lake surface area is an important determinant of the ability of a lake to support shoreline development and avoid lake user conflicts. As a general rule, smaller lakes (under 50 acres in size) are more susceptible to environmental degradation and visual impacts resulting from shoreland development and intensive recreational use.

The following scoring factors are used to rank lakes based on their surface area. The lower scores indicate greater lake vulnerability.

Lake Surface Area	**Scoring**
Less than 50 acres	1
50 to 249 acres	2
250 or more acres	3

Maximum Depth

Lake maximum depth is used as a second indicator of vulnerability. Shallower lakes, which do not stratify, have greater circulation of dissolved nutrients that enter the lakes. These lakes tend to have a larger variety of aquatic plant communities that are valuable for a wide range of wildlife and fish. Beds of aquatic plant materials can easily be disturbed by intensive water recreation use and shoreline activities, such as cutting and chemical treatment of aquatic vegetation to create swimming and docking areas.

Shallow lakes are particularly susceptible to nutrient loading and turbidity problems, both of which can be increased by intensive shoreline development and recreational use. In general, shallower lakes are more appropriate for wildlife habitat protection and passive recreation than for motor boating, water skiing, and other more intensive lake uses associated with shoreline development.

The following scoring factors are used to rank lakes based on the maximum depth. The lower scores indicate greater lake vulnerability.

Maximum Lake Depth	**Scoring**
Less than 20 feet	1
20 to 39 feet	2
40 or more feet	3

Lake Type

In Wisconsin, many of the smaller lakes are seepage lakes formed by groundwater seeping into depressions in the glacial outwash plain. Most of these lakes are "landlocked" and have no external drainage. These lakes are the most vulnerable to premature eutrophication and contamination caused by development in the shoreland zone.

Drainage lakes flow into the surface water system of rivers and streams. These lakes, along with man-made impoundments, possess varying degrees of ability to naturally circulate and flush nutrients and other forms of contaminants, but generally these lakes are less vulnerable to environmental damage than the seepage lakes. A third category of lakes is spring lakes that are fed primarily by natural springs. These lakes have intermediate vulnerability.

The following scoring is used to rank lake vulnerability with respect to lake type. The lower scores indicate greater lake vulnerability.

Lake Type	Scoring
Seepage Lake (SE)	1
Spring Lake (SP)	1
Drainage Lake (DG)	3

Watershed Area

The natural ability of lakes to flush and circulate water is also a function of watershed size, lake volume, and average rainfall. Lakes with larger watersheds tend to have a higher volume of water circulating through them and may have higher flushing rates.

Lakes with smaller watersheds tend to have a lower nutrient input; however, nutrients accumulate because of longer retention times. Generally lakes with smaller watersheds and long retention times are more vulnerable to nutrient loading from activities that occur in the shoreland zone, which is a larger percentage of the total watershed area.

The following scoring is used to rank lake vulnerability with respect to watershed size. The lower scores indicate greater lake vulnerability.

Watershed Size	Scoring
Under 1 square mile	1
1 to 9 square miles	2
10 or more square miles	3

Shoreline Development Factor (SDF)

Shoreline development factor (SDF) is a convenient method of expressing the degree of irregularity of the shoreline of a lake compared to the surface area. The SDF ratio is the length of shoreline versus the circumference of a circle having the same surface area as the lake. A perfectly round lake would have a surface area of 1.00. The SDF can never be less than 1.00.

Lakes with a higher SDF have more shoreline in relation to the surface area and thus are more vulnerable to development pressures per linear foot of shoreline that is developed. These lakes can more easily become overdeveloped and are more susceptible to various types of contamination and runoff resulting shoreline development.

The following scoring is used to rank lake vulnerability with respect to the shoreline development factor (SDF). The lower scores indicate greater lake vulnerability.

Shoreland Development Factor (SDF)	**Scoring**
2.00 or more	1
1.50 to 1.99	2
1.00 to 1.49	3

Development Density

The existing level of residential density around a lake or on a river is an indicator of a water body's development status.

In previous studies such as the Minnesota Classification Scheme and observations of existing conditions on local northern Wisconsin lakes, a development density near 200 feet per structure indicates a high density ratio. This high development density in most cases indicates that the majority of the shoreline is developed and that the potential for additional new single family dwellings is low. A lake with a high development density normally will score high and fall into the category of lakes requiring less development protection measures.

Density (feet per structure)	Scoring
300 and less	3
301 - 600	2
601 and greater	1
no structures within 300' of shoreline	0

Lake Classification Scoring Criteria Summary

Lake Surface Area	**Scoring**
Less than 50 acres	1
50 to 249 acres	2
250 acres or more	3

Maximum Lake Depth	**Scoring**
Less than 20 feet	1
20 to 39 feet	2
40 or more feet	3

Lake Type	**Scoring**
Seepage Lake (SE)	1
Spring Lake (SP	1
Drainage Lake (DG)	3

Watershed Size	**Scoring**
Under 1 square mile	1

1 to 9 square miles	2
10 or more square miles	3

Shoreline Development Factor (SDF)	**Scoring**
2.00 or more	1
1.50 to 1.99	2
1.00 to 1.49	3

Density (feet per structure)	**Scoring**
300 and less	3
301 - 600	2
601 and greater	1
no structures within 300' of shoreline	0

Overall Vulnerability Ranking	**Lake Classification**	**Protection Level**
Total score ___ or over	Class 1	Minimum
Total score ___ to ___	Class 2	Moderate
Total score ___ or less	Class 3	Maximum

The Regulatory Program

After a locality has worked out its classification scheme, its next (and final) step is to attach to it a regulatory program. There are two basic mechanisms that can be used. The locality can vary the density of development around the lake and/or the distance of development from the lake. As illustrated earlier, the former, varying the distance around the lake, has the effect of assigning greater or lesser amounts of water surface area(or water volume) per lot per lake, depending primarily on a judgement of absorptive carrying-capacity of the water. The latter, varying distance from the lake, was not illustrated earlier, but it has the effect of allowing closer or farther development, depending on a judgment which relies primarily on a sense of absorptive carrying-capacity of shoreland adjacent to the lake. In actual fact, the use of either mechanism, or both in combination, affects the carrying-capacity of a lake's total micro-environment, the water and the land.

The following table contrasts the use of these mechanisms in Wisconsin and Minnesota at the state levels. Wisconsin opted to establish a minimum lot width and structural setback that, as was explained earlier, is insensitive to any particulars of a lake's micro-environment. Thus, a high quality-highly vulnerable lake receives a base-level of protection identical to that of a low quality-lowly vulnerable lake. The state of Minnesota, on the other hand,varies both the lot width and structural setback (and, therefore, by extension the density around, and distance from, the lake) depending on whether the lake belongs to a class of lakes judged to have a greater or lesser carrying capacity.

Illustration of How the Two Extreme Classes of Lakes Would be Regulated in Minnesota, Contrasted with Wisconsin

	Lot Width	Structural Setback
Burnett County Minimum Standard		
RR-3 High Vulnerability	300 feet	75 feet
RR-2 Medium Vulnerability	200 feet	75 feet
RR-1 Low Vulnerability	100 feet	75 feet
Minnesota State Standards+		
High Quality/High Vulnerability	200 feet	200 feet
Low Quality/Low Vulnerability	100 feet	75 feet

This is an over-generalized presentation of the Minnesota system which relies on four classes of lakes and three sets of regulatory level, the density around, and distance from, the lake depending on whether the lake belongs to a class of lakes judged to have a greater or lesser carrying capacity.

From the point of view of grounding a land use program to the carrying capacity of adjacent resources like lakes, any across-the-board minimum standard-be it 100 or 400 foot lot widths, is equally insensitive. The latter, of course, does provide a higher level of protection than the former. But it is still not known how much more protection, or around which lakes, there might be regulatory overkill or underkill.

In reality, since lakes are such complex and dynamic systems, no amount of classification-regulatory effort will result in a land use program where one can say with any degree of accuracy how much additional protection one more foot of lot width or setback, or one hundred more feet for that matter, will provide a given lake resource. Users of the method described in this paper should accept that limitation as fundamental. However, a tier of generalized regulatory levels can be established which will assure that a higher degree of protection will be assigned to more sensitive lakes, while a lower degree will go to less sensitive environments. What the levels might actually be may vary from jurisdiction to jurisdiction since, to be most effective, they will be based on judgments combining the following ingredients: 1) the locality's wishes: 2) the experience of others (states and localities) with various protective levels: 3) research guidelines for the parameters receiving emphasis in the program; and 4) professional, "political," and public input and common-sense.

Summary

** Lakes are important resources in Wisconsin and it is important to understand the interrelationships between these resources and land uses that occur along their shores and within their watersheds.

** The relationships are now not well accounted for, or reflected in, most of the minimum standard shoreline regulatory programs in use in Wisconsin.

** The data and methodology to establish a better linkage between water resources and adjacent land uses does exist and is available,

** Local units of government have the power to utilize this data and to establish a planning and regulatory approach that provides a more resource-sensitive shoreland program, beyond the minimum standard