STATEWIDE OUTSTANDING RIVERS INVENTORY

PROJECT REPORT

Minnesota Department
of Natural Resources

Statewide Outstanding Rivers Inventory

PROJECT REPORT

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Prepared by:

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Office of Planning
Rivers Section

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Cover Photo: Confluence of the Snake and St. Croix Rivers.
Photo by Tom Rumreich, Forest Lake, Minnesota.
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ABSTRACT

A comprehensive, statewide study of 157 Minnesota rivers and forks using computerized and manual data collection and analysis was conducted. The primary goal of the study was to provide rational and sound priorities for river management planning by the Minnesota Department of Natural Resources. Characteristics measured were those specifically addressed in river management enabling legislation. Computer measurement provided ratings for Natural and Scenic Conditions and Urban and Agricultural Development Potential. The data source for computer analysis was the existing 40 acre grid of the Minnesota Land Management Information System.

Manual data collection and analysis used original and previously employed methods. Surveys of resource management personnel and user groups, literature searches, and recommendations from specific resource management disciplines and programs were combined with computer measurements to identify those streams having resource values, potential for recreational use, and potential for being impacted by development.

Finally, a method for studying the streams identified as having priority for river management was developed. Designed to allow more detailed study than possible on the statewide level, the detailed study included computer analysis of terrain, natural and intensive land uses, cultural characteristics and river characteristics based on aerial photo and topographic quadrangle analysis.

SUMMARY

The Statewide Outstanding Rivers Inventory was conducted to provide the Minnesota Department of Natural Resources DNR with priorities for detailed study and development of comprehensive river management plans. The approach used to develop these priorities addresses resource values mentioned in enabling legislation for river protection, primarily the Minnesota Wild and Scenic Rivers Act (Minn. St. Ch. 104.31-104.40); the Rules of the DNR Chapter Six: NR78-81 6 (MCAR 1.0078-81) developed for implementing the Act; and the Department of Natural Resources River Management Policy (effective 9-15-80). In addition to measuring resource values, the study also addresses the need for managing and protecting such outstanding rivers according to their development potential for urban and agricultural uses and their proximity to population within the state.

The rationale and process by which measurements and analysis were performed are discussed in general terms in the Project Narrative beginning on page 1, and in detail in the Process Narrative beginning on page 7.

Those streams identified as having First Priority (see page 42) for detailed study and plan development include the following:

Blue Earth River
Cottonwood River
Crow River
Mississippi River (lower)
Minnesota River
(LeSueur to Mississippi River)
Root River
St. Louis River
Snake River
Whitewater River
Zumbro River

Other catagories of priority include Second Priority, and Third Priority. (See Priority Rankings, pages 43-44).

A method for making detailed computerized measurements was developed for use on those rivers identified as priorities for study. This method concentrates on biological, physical, and cultural characteristics that influence those values addressed in legislation and policy. These characteristics include land use and cover, point land uses, river characteristics, generalized terrain, and terrain features. The techniques used are explained in Part III, page 47, and examples presented in Appendix E and F. The intent and scope of this study requires that improvements and additions be incorporated as they become necessary or available. The text of this report discusses the rationale and limitations that were encountered, and points out that this study is designed to take advantage of additions in the future. The need for certain improvements were apparent during the project and have been suggested in the review process. These are discussed in Appendix G, and fit into the study process as part of Step 7 (See page 7).

Part One: PROJECT OVERVIEW

PART I - PROJECT OVERVIEW

The Need for the Inventory

River protection and management has been formally recognized by the citizens and Legislature of Minnesota as being in the best interests of both rivers and the present and future generations of Minnesotans. Efforts are being made at all levels of government to keep Minnesota's rivers healthy and beautiful.

The importance of protecting rivers, and lake shores and wetlands has been recognized through several special programs. The Shoreland Management Program regulates development along rivers and lakes in the state. The Floodplain Management Program controls development in river valleys to reduce flood hazards to life and property. The Protected Waters Program is an inventory of the wetland resources of the entire state to determine which ones qualify for protection under law. The Canoe and Boating Routes and Public Access Programs promote and manage recreational use for 18 designated rivers around the state. Finally, the Wild, Scenic and Recreational Rivers Program provides detailed management plans for specially designated streams of outstanding quality.

All of these programs have been created because it is recognized that the system of rivers, lakes, and wetlands in Minnesota is of great importance to all citizens. Every citizen of the state benefits directly or indirectly from these resources in some way. The list of benefits includes everything from fundamental physical needs like drinking water, to less tangible but no less important spiritual and psychological needs like beauty. The people of Minnesota want these resources protected and properly managed.

Legislative authorization and intent to protect natural resources is the first step toward protection and management. Many activities must follow that culminate in an effective, on-going program to get the job done. This Statewide Inventory is a part of the program charged to the Department of Natural Resources to protect the best and most important rivers in the state. It is designed to provide guidance in deciding where management is required, so that the greatest benefit can be derived. The Inventory recognizes that responsible actions should be based on as complete and accurate information possible, so that the intent can be achieved even when the resources to do it are diminishing.

This Inventory is a part of the process started with the creation of the State Wild, Scenic, and Recreational Rivers Program. This program is the most specific and wide ranging program addressing river management that Minnesota has. Passed in 1973, the program moved ahead with the environmental enthusiasm that characterized the 1970's. Controversy existed every time a river became a candidate for protection under this program. Not all proposals resulted in adoption of a management plan, and as time passed planning processes became extremely heated and politicized as citizens opposing the controls and actions felt they were un-needed, ineffective, or heavy handed. Public support still existed, but often was not sufficient to ensure that high quality, effective management plans were approved. The Statewide Inventory was conducted to gather the information and conduct analysis to help set the direction for future development of management plans for Minnesota's outstanding rivers.

The orientation of the Inventory toward outstanding rivers should not be intepreted that those streams not mentioned or not shown to be a priority are of no value or significance and therefore not deserving protection and management. The orientation taken herein is the one authorized by the Legislature at the present time, which emphasizes the highest quality streams for singling out as candidates for special management efforts. It should be recognized that because of the nature of river systems, each stream is important not only in its own right, but has a direct and significant impact on whatever is down stream whether it is a nationally known river or an un-named tributary or wetland. Rivers are one of the best illustrations of the ecological premise that all things are connected, and to adequately protect and manage the resources and opportunities they offer requires attention to all parts of the river system to the maximum extent possible.

Goals of the Statewide Inventory

The overall goal of the Statewide Outstanding Rivers Inventory is the following:

> To provide the Department of Natural Resources with a rational and objective measurement of river characteristics and the need for protection from which to draw priorities for comprehensive river studies, management planning and to prioritize rivers for such studies and planning.

Upon achieving the above goal the following objectives were regarded as necessary to improve the capability and effectiveness of river management:

1) To utilize existing computer data where possible so that statewide river oriented measurement capability would be created.

2) To remove river management from the stigma of subjectivity and political motivation through an understandable and rational approach to the question of long term river management priorities in Minnesota.

3) To assist river management programs and river interest groups in their efforts to understand the river resources of Minnesota through sharing information, suggestions, and direction where requested.

4) To identify those areas where knowledge is incomplete regarding river resource characteristics and use of the resources by the public. To gather additional information for the above deficiencies where and when it becomes available.

Considerations for Statewide Analysis

Conducting a project that measures the characteristics of an extremely diverse resource, such as the rivers of Minnesota, requires repeated dedication to several important concepts. Abandoning these fundamental considerations creates the risk of producing an unreliable, and largely unusable result.

The most fundamental need is for a rational and objective process of data collection, measurement, and analysis. Identification of those rivers for study should be done on the basis of an understandable set of criteria. These criteria should be relevant to the subject being measured and not an arbitrary value based on the needs of those doing the research. All data must be objectively gathered and used in every phase of the project. Where data is not objective, it must be noted and considered as such in all analysis. If the study is to help formulate policy and priorities for future Department of Natural Resources river management activities, objectivity and candor are the most important considerations. The process developed is described in detail in Part II, the Process Narrative.

Considerations that set the direction, goals, and objectives of the project are the enabling legislation, rules promulgated by the DNR for river management programs, and the DNR River Management Policy. Characteristics measured should be those that are addressed in existing management programs to the maximum extent possible. Since the project was intended to identify high quality streams that should be candidates for protection and management, it was decided that the definitions, standards and criteria set forth in the Wild, Scenic, and Recreational Rivers program would be used for determining the direction and goals of the inventory.

Another consideration that influences the quality and useability of the results of a statewide project is that a true statewide perspective should be present in the data. Rivers, and the general network of water resources they are a part of, have been the subject of many studies and programs in Minnesota. Unfortunately, very few are of a scope that is useful to a study that wants to look at streams from all parts of the state. It is possible to note a consistency in the streams that have been studied, mostly being limited to those best known recreationally or closest to urban areas. Careful screening of data is needed to ensure that a consistent statewide perspective is maintained. Many potentially interesting sources of information were investigated only to be excluded on this consideration. An example is the data from water quality monitoring stations maintained by the Minnesota Pollution Control Agency. The nature and quality of the data is excellent, but is limited both in the coverage of streams relative to the number of streams that should be considered in this inventory, and also in terms of the time periods for which records exist. Using this data for streams where it exists, and not having comparable data on all other streams would make conclusions of a statewide study highly suspect. The decision was made to include data possessing a statewide perspective to the maximum extent possible. If any data were included with less than a statewide perspective it would be noted and treated accordingly in all analysis.

The inventory project is regarded as one that should remain on-going to the extent that as new data becomes available it will be added. This is the first statewide, systematic measurement of a combination of river characteristics done in Minnesota. There are many gaps in the information needed to have a complete river resource data base. These include comprehensive flow data, pollution records, erosion and sedimentation data, fisheries data, demand for river recreation opportunities and areas with special values such as rare and endangered species, historic sites, biologic communities and those with scientific potential.

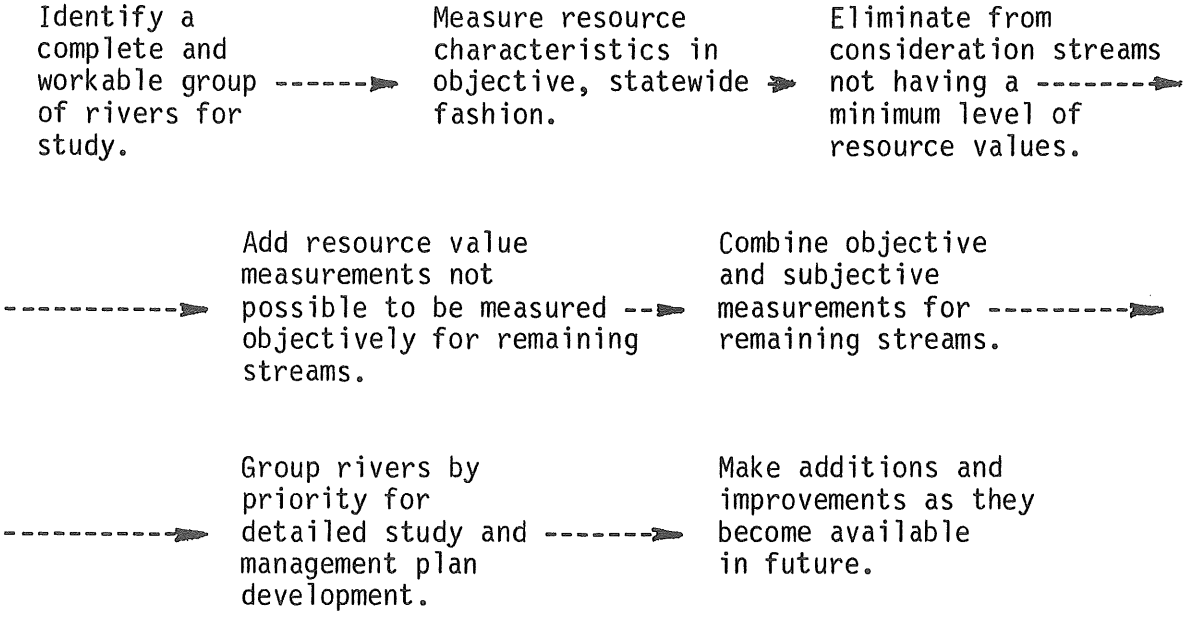
Being able to add new data accompanies the need to make the project, or parts thereof, repeatable if needed in the future. This should be accomplished by straight forward, soundly documented methodologies. The end result of this project is a report that helps set priorities and direction, but remains dynamic and flexible in future use.

A final overall consideration for the project is efficiency. Staff time and funding for conducting the project are limited and only one part of the Rivers Section's work program. Greatest efficiency will be achieved by using reliable pre-existing data when ever possible. Duplicating existing data, using inappropriate data, and spending inordinate amounts of time on any one phase of the project should be avoided.

Methodology

A process involving six steps was designed to identify streams for study, measure characteristics, eliminate those not having a minimum level of quality, and group the remaining streams by priority for detailed study and possible management plan development. Designing and conducting this process required constant evaluation and assessment for validity and usefulness of data sources. (A detailed description of this process is found in Part II - Process Narrative).

The steps of the process were designed to accomplish the following functions:



Data was collected and analyzed by both computerized and manual methods. Statewide land use and resource characteristic information from the Minnesota Land Management Information System (MLMIS) was used to measure natural and scenic conditions along with urban and agricultural development potential. Computer maps were generated showing ratings for 40 acre parcels corresponding to the existing township and range line system. The maps were accompanied by frequency counts for a corridor of land 1/2 mile back on both sides of the river. Regionalized values were included in making the ratings so that rivers could become comparable on a statewide basis. The Biocultural Regions of Minnesota were used as the format for developing the regionalized values.

Certain other characteristics were measured in a non-mechanized fashion. Historical significance was measured through a literature search. Recreation management potential was measured through an existing study done by the Canoe and Boating Routes Program. Fisheries values were measured through DNR Section of Fisheries inventories, recommendations, and program designations such as Trout Streams. Recommendations for streams to be studied and the values they possessed were collected from user groups and resource management field personnel.

All ratings and notations were displayed in tables for comparison, and were then entered onto a shortened matrix for grouping by priority. Criteria for grouping were developed according to the reliability and nature of the measurements summarized on the matrix, with greatest importance given to those that were regarded as most objective and reliable from a statewide perspective. This matrix is found in Part II, Table# 4, p. 38-40.

Recommendations for future monitoring and resource management activities were included with the priority groupings. Priority for management planning can be amended according to improved data availability, which is compatible with the belief that this study should remain an on-going tool for future decision making.

A computerized method for measuring land cover, development, scenic, and physical characteristics in greater detail was developed for priority streams. The methodology is based on interpreting aerial photos, noting certain information on topographic quadrangles, and then coding the information for computer input. Computer input and anaylsis was done in the same 40 acre parcel format as MLMIS. The intent of this additional level of analysis is to make more definitive statements and assessments possible than can be made from the statewide MLMIS data, as well as to fill in gaps that MLMIS seems to have. Part III of this report gives a detailed description of this methodology.

Part Two: PROCESS NARRATIVE

Part II - PROCESS NARRATIVE

The identification of rivers, data collection, and evaluation for the Statewide Inventory followed a series of six steps. These steps were designed to be a rational process that made sound and complete use of both existing and new data. Chart #1 shows the entire process:

Chart #1

STEP 1

Systematic Stream Identification (min. 100 km length)

↓

Step 2 ↓

Addition of shorter streams through surveys, studies and recommendations. ----------→

Result:

Initial Study Rivers (157 streams and forks) See Table #1, p. 15 and also Map #1, p. 17.

↓

STEP 3 ↓

Subtract streams not having a minimum of 50% MLMIS Natural or Scenic conditions. -----→

Result:

List of streams with high quality natural and scenic values for further study. See Table #2, pp. 21 - 24.

↓

Step 4 ↓

Add Reinforcing Social Resource Characteristics for streams remaining after Step 3. See Table #3, pp. 30-32.

↓

STEP 5	Result:
Combine MLMIS Natural and Scenic Conditions Rating with Social Resource Characteristics. ⟶	List showing overall resource value measurements for high quality streams. See Table #4, pp. 38-40.
↓	
Step 6	Result:
Analysis of rivers by Development Potential Rating and proximity to population See Table #4, pp. 38-40. ⟶	Prioritized list of rivers for detailed study and potential river management planning. See Priority Rankings pp. 42-44.
Step 7	Result:
Add sources of data as they become available in future. ⟶	Reinforcement or modification of priorities as identified by new data.

Each step in the process will be explained using the following format:

1) Purpose of step
2) Considerations - including assumptions, definitions, limitations
3) Techniques and procedures used
4) Results of step
5) Interpretation of results

A summary of the development and use of results of this process can be found in Part I, Project Overview. The Overview describes the basic purpose, rationale, limitations, etc. that influenced the completion of the steps described here.

STEP 1 - SYSTEMATIC STREAM IDENTIFICATION

Purpose

To locate and identify in a systematic way those streams that are most likely to have characteristics mentioned in Minnesota's river management enabling legislation. These streams will partially create the initial group to be studied. Addition of more streams for study is made in Step #2.

Considerations

The following considerations were incorporated into identifying the initial group of rivers:

a) The Minnesota legislature has authorized programs concerned with the management and protection of rivers in various ways. The Wild, Scenic, and Recreational Rivers Act (Minn. St. Ch. 104.31-104.40) and the Rules of the Department of Natural Resources Chapter Six: NR 78-81 6 (MCAR 1.0078-81) address the values and criteria specifically relating to streams with outstanding scenic, recreational, natural, historical, and scientific values. Therefore, the primary purpose of this study is to guide the planning and management efforts on streams of this character. Other programs that influenced the identification of potential study rivers were the Shoreland Management Program and the Canoe and Boating Routes Program. The Shoreland Management Program (Minn. St. Ch. 105.485), which regulates development on lakes and streams of the state, was considered to be a likely recipient of management recommendations resulting from the study. The Canoe and Boating Route Program (Minn. St. Ch. 85.32), which develops recreational facilities on 18 designated streams, might also be able to use results of the study for selection of future routes. While it is hoped that these programs could benefit from the results of this study, the primary characteristics and values for which measurement and analysis was made were those put forth in the Wild, Scenic, and Recreational Rivers Act and Rules.

b) A logical and systematic method was needed to insure that streams from all parts of the state were accurately included.

c) The group of rivers should be complete enough to include all streams with potential for outstanding values, yet remain small enough to be workable within the constraints of time and personnel.

Methodology

Systematic stream identification was made by selecting the longest streams listed by SIDRS (Stream Inventory Data Retrieval System) in the major river basins of the state as shown on the Height of Land Watershed Boundary map developed by the DNR, Office of Planning, in 1979. As shown in the basin summaries by SIDRS, there are generally a small number (2-3) of streams in each river basin having a length of 100 km or more. The number of streams increases drastically as length shortens. A minimum length of 100 km was chosen to identify those streams for automatic study based on this statistical break, because 100 km is a distance that will provide potential for single as well as multi-day dispersed outdoor recreation activity. This length also insures including streams that flow through a variety of biological, geological, and cultural settings that may add potential for outstanding values. Appendix A describes the SIDRS system from which the river lengths were obtained.

By using the statewide Height of Land Watershed Boundary map an evenly distributed group of rivers for study is assured. In certain parts of the state where natural and scenic conditions are known to exist, and where there were very few streams with a length of 100 km, streams were added to allow at least 2 streams from each major watershed to be included in the group identified in this step. The North Shore area, where streams are generally very short, is the best example of this addition to systematic stream identification.

Results

Following is a list of those streams within the major watersheds of the Height of Land Watershed Map that are 100 km or longer. Where streams have forks that are 100 km or longer, the forks are included with the name of the main branch of the stream:

RIVER	LENGTH (Km)	RIVER	LENGTH (Km)
Big Fork	355	Mustinka	115
Blue Earth	181	Ottertail	297
Boy	117	Pine	119
Buffalo	214	Pomme De Terre	208
Buffalo Creek	135	Prairie	102
Cannon	194	Rapid (S.Br.)	114
Chippewa	256	Rat Root	109
Clearwater	232	Red Lake	407
Cloquet	161	Red River of the North	737
Cobb	124	Redeye	101
Cottonwood	234	Redwood	203
Crow (+ 3 forks)	287+	Rock	143
Crow Wing	191	Root (+4 forks)	230+
E. Br. Chippewa	109	Roseau	187
Elk	132	Rum	272
Elm Creek	133	Sandhill	158
Hawk Creek	117	Sauk	192
High Island Creek	109	Snake (West)	134
Hill	100	Snake (East)	163
Kawishiwi (both forks)	110+	St. Croix	227
Kettle	132	St. Francis	121
L. Cottonwood	126	St. Louis	318
Lac qui Parle	183	Swan	123
Le Sueur	164	Thief	114
Little Fork	262	Two Rivers(+3 forks)	123+
Long Prairie	196	Watonwan (+4 forks)	178+
Lost	119	Whiteface	147
Maple	125	Wild Rice	279
Middle	135	Willow	164
Minnesota	597	Yellow Medicine	179
Mississippi	1098	Zumbro (+5 forks)	181+

The following streams were added to create a balanced statewide distribution even though they are not 100 km or more in length. They are chosen from the same major watersheds of the Height of Land Watershed map as the streams 100 km or longer. This gives the initial study group representation from each major watershed, with the exception of watersheds containing only the head waters of creeks flowing into Iowa and South Dakota.

RIVER	LENGTH	RIVER	LENGTH
Baptism	43	Red Cedar	84
Battle	71	Ripple	82
Beaver	34	Schoolcraft	57
Black Duck	63	Shell	83
Des Moines	97	Straight (south)	98
Grand Marais Creek	70	Tamarac	92
Marsh	78	Temperance	62
N. Cormorant	67	West Branch Rum	84
Nemadji	52	Whitewater (+2 forks)	54+
Pigeon	78	Wing	73
Rabbit	59		

Interpretation

The final list from this step included 83 streams. Seven of these streams have multiple forks which were included with the main stem. Because of the wide variation in many characteristics along its length the Mississippi River was listed in 4 sections (lower: from Hastings to Iowa border; metro: Hastings to Anoka; upper: Anoka to Brainerd; headwaters: Brainerd to Lake Itasca).

The Stream Inventory Data Retrieval System (SIDRS), combined with the Height of Land Watershed Map allowed creation of an evenly distributed group of rivers for study. Using this system presented the first situation where the extreme variability of river types in Minnesota made identification, measurement, and analysis complex. SIDRS identified several river systems that include multiple forks of varying lengths. Since the objective of the inventory is to identify river systems with priority for river management, inclusion of all forks was considered appropriate for completeness and accuracy of the group of rivers to be studied.

STEP 2 - ADDITION OF SHORTER STREAMS THROUGH NON-SYSTEMATIC METHODS

Purpose

To include those streams for study that may have the high resource values addressed in legislation that are less than 100 km. in length that were not identified in the systematic identification process.

Considerations

A state like Minnesota has a climatic, physical, biological and land use pattern varied enough to have streams of all lengths with extremely high resource value. The 100 km. standard used in Step 1 was used as a starting point by which to identify a minimum statewide distribution of rivers to study. The effect of length in creating potentially high values is not regarded as being direct in all situations. Shorter streams can also have outstanding natural, scenic, historical, recreational, scientific and similar values. Length was looked upon only as an indicator of potential for public use and presence of varied biological, physical and cultural conditions.

A method was needed to add shorter streams with potentially high resource values. Once again it was decided to add shorter streams by a method that ensured completeness, even if the result was an initial group that possessed candidates with less potential than others.

Methodology

A combination of sources for adding shorter streams was chosen. This approach employs some methods from other river inventories that depended solely on non-systematic methods for identification of study streams. Potential weaknesses lie in the completeness of each source. By choosing a variety of sources for indicating shorter streams, it is thought that the cumulative effect will compensate for incompleteness of any one indicator.

The following were sources of stream names that were added to the list created in Step 1:

1) Streams recommended for inclusion in the state Canoe and Boating Route Program. Recommendations were the result of a statewide study done in 1979-1980 that utilized on-site river surveys by University of Minnesota Recreation and Parks students, Boy Scouts and DNR personnel.
2) Results of a survey of recommendations from Department of Natural Resources personnel in 1980. Personnel were asked for their recommendations for high quality streams for further study, and also asked what values they felt were of greatest importance (see Appendix B for example of the survey form distributed).
3) Results of literature searches of past studies of Minnesota rivers. Several efforts by public agencies, consultants, private individuals and organizations have been made to document characteristics of rivers. These studies vary in purpose and perspective, and few were comprehensive enough to address streams from all parts of the state.

4) Minnesota Streams include the Nationwide Rivers Inventory conducted by the United States Department of the Interior, Park Service, as listed in their report issued January of 1982.

Results

The following streams were added as a result of the above recommendations:

RIVER

Basswood
Black
Blackhoof
Bowstring
Brule
Caribou
Cascade
Cat
Cobb
Cross
Dark
Deer Yard Creek
Devil Track
E. Savanna
Embarass
Flute Reed
Gooseberry
Groundhouse
Isabella
Kadunce Creek
Knife (north shore)
Leaf
Leech Lake
Lester
Manitou
Marsh
Moosehorn
Net
Nett Lake
Onion
Partridge
Pelican (N)
Pelican (S)
Platte
Poplar
Popple
Rice
Rush
Split Rock
Straight (N)
Stony
Sturgeon
Sunrise
Swamp
Three Mile Creek
Turtle
Vermilion (N)
Vermillion (S)
W. Swan
Yellow Bank

INITIAL GROUP OF RIVERS FOR STUDY RESULTING FROM STEP #1 & #2:

Steps 1 and 2 resulted in a group of 157 streams and forks for study. The following list shows the stream names as they appear in further analysis. Forks and branches were separated from the main stem for purposes of clarification in computer listing, but will be combined into entire river systems for analysis. Map #1, p. 17, shows the statewide distribution obtained from steps #1 and #2. Each river is numbered to allow locating on Map #1.

Table #1

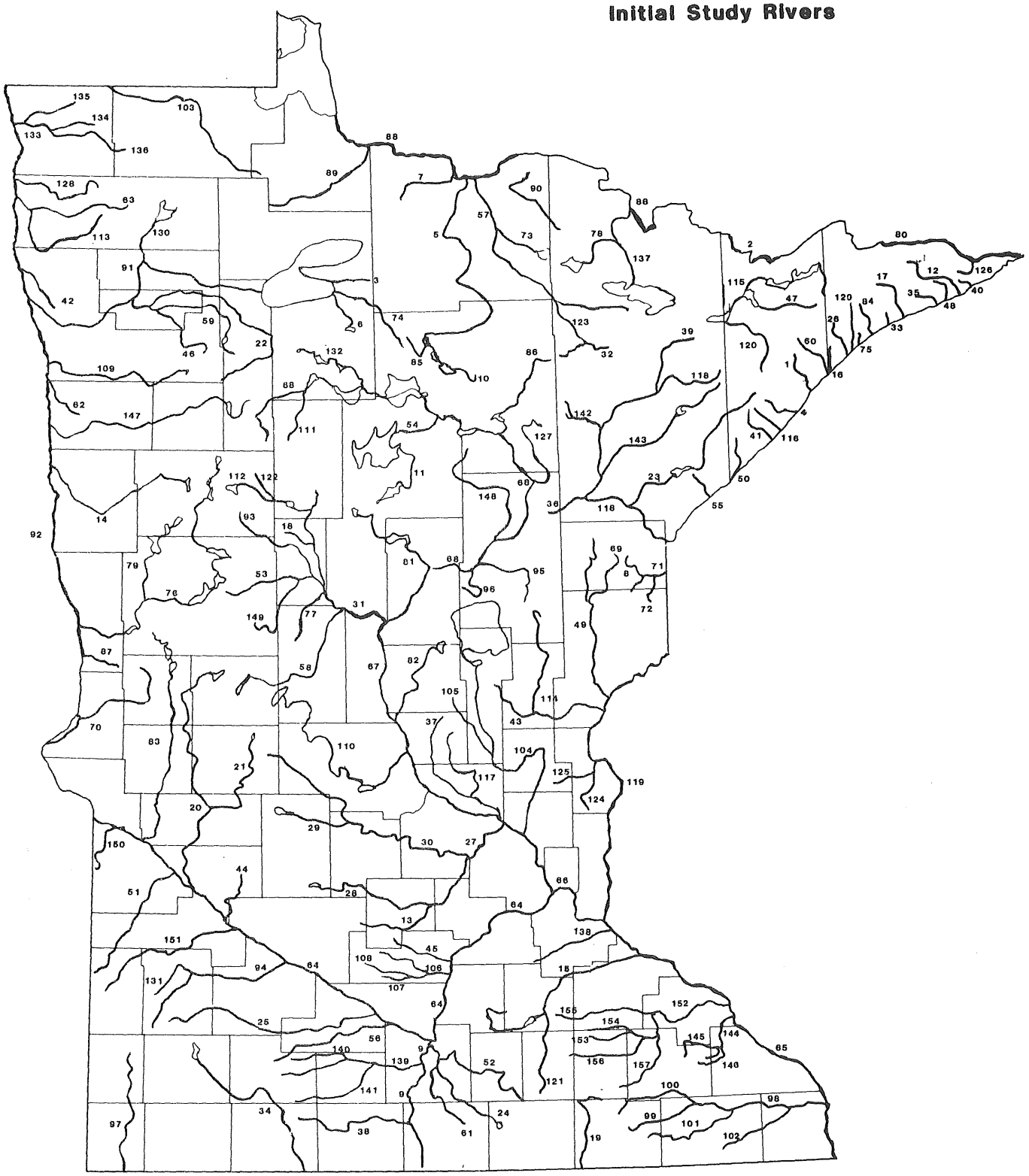
1	Baptism
2	Basswood
3	Battle
4	Beaver
5	Big Fork
6	Black
7	Black Duck
8	Blackhoof
9	Blue Earth
10	Bowstring
11	Boy
12	Brule
13	Buffalo Creek
14	Buffalo
15	Cannon
16	Caribou
17	Cascade
18	Cat
19	Cedar
20	Chippewa
21	Chippewa-East Branch
22	Clearwater
23	Cloquet
24	Cobb
25	Cottonwood
26	Cross
27	Crow
28	Crow South Fork
29	Crow-Middle Fork
30	Crow-North Fork
31	Crow-Wing
32	Dark
33	Deer Yard Creek
34	Des Moines
35	Devils Track
36	East Savanna
37	Elk
38	Elm Creek
39	Embarrass
40	Flute Reed
41	Gooseberry
42	Grand Marais Creek
43	Groundhouse
44	Hawk Creek
45	High Island Creek
46	Hill
47	Isabella
48	Kadunce Creek
49	Kettle
50	Knife
51	Lac qui Parle
52	Le Sueur
53	Leaf
54	Leech Lake
55	Lester
56	Little Cottonwood
57	Little Fork
58	Long Prairie
59	Lost
60	Manitou
61	Maple
62	Marsh
63	Middle
64	Minnesota
65	Mississippi (Lower)
66	Mississippi (Metro)
67	Mississippi (Upper)
68	Mississippi (Headwaters)
69	Moose Horn
70	Mustinka
71	Nemadji
72	Net
73	Nett Lake
74	North Cormorant
75	Onion
76	Otter tail
77	Partridge
78	Pelican (North)
79	Pelican (South)
80	Pigeon
81	Pine
82	Platte
83	Pomme De Terre
84	Poplar
85	Popple
86	Prairie
87	Rabbit
88	Rainy
89	Rapid
90	Rat Root
91	Red Lake
92	Red R. of the North
93	Redeye
94	Redwood R.
95	Rice
96	Ripple (Mud)

Table #2 (con't)

97 Rock
98 Root
99 Root-Middle Branch
100 Root-North Branch
101 Root-South Branch
102 Root-South Fork
103 Roseau
104 Rum
105 Rum-West Branch
106 Rush
107 Rush-Middle Branch
108 Rush-South Branch
109 Sandhill
110 Sauk
111 Schoolcraft
112 Shell
113 Snake (East)
114 Snake (West)
115 N. & S. Kawashiwi
116 Split Rock
117 St. Francis
118 St. Louis
119 St. Croix
120 Stony
121 Straight (South)
122 Straight (North)
123 Sturgeon
124 Sunrise
125 Sunrise-North Branch
126 Swamp
127 Swan
128 Tamarac
129 Temperance
130 Thief
131 Three Mile Creek
132 Turtle
133 Two Rivers
134 Two Rivers-Middle Branch
135 Two Rivers-North Branch
136 Two Rivers-South Branch
137 Vermilion (North)
138 Vermillion (South)
139 Watonwan
140 Watonwan-North Fork
141 Watonwan-South Fork
142 West Swan
143 Whiteface
144 Whitewater
145 Whitewater-North Fork
146 Whitewater-South Fork
147 Wild Rice
148 Willow
149 Wing
150 Yellow Bank
151 Yellow Medicine
152 Zumbro
153 Zumbro (Middle Fork)
154 Zumbro (N. Br. Middle Fork)
155 Zumbro (North Fork)
156 Zumbro (S. Br. Middle Fork)
157 Zumbro (South Fork)

Map #1

Initial Study Rivers



STEP 3 - SUBTRACT STREAMS NOT HAVING A MINIMUM OF NATURAL AND SCENIC CONDITIONS.

Purpose

To measure the natural and scenic conditions within the corridors of the 157 streams named for study in an objective and rational manner.

To remove from consideration those streams not having a minimum level of natural and scenic conditions.

Considerations

The group of rivers chosen for study in Steps 1 and 2 were identified by either a systematic method, recommendation, or by virtue of having been designated part of an existing management program. None of these procedures automatically means that these streams have the characteristics and values addressed in the Wild, Scenic, and Recreational Rivers program.

There is no known comprehensive study in existence that measures any of those values addressed in the legislation. Several studies and works have been done describing rivers in Minnesota, but they all lacked the depth or breadth to fully describe all the rivers identified for this Statewide Inventory.

The history of planning for the Wild and Scenic rivers program is one full of controversy. It is unlikely that this controversy will ever be completely removed, but accurate and objective measurement of resource characteristics can answer a serious question that has been asked in every planning process so far: "Why does this river qualify more than another?" The basic measurement of resource character should be as objective as possible, making it unnecessary to rely only on the subjective opinion of river planning staff.

Measurement of scenic character has been attempted in many river inventories. The use of such measurements has ranged from simple description to quantification that assigned a relative value to various scenic settings. The measurement techniques developed for this step made no attempt to assign such values because it is recognized that perceiving beauty is truly an individual experience. Stating that mountains are more beautiful than prairies indicates personal bias, which creates room for error and personal interpretation. Since the inventory was done to measure rivers statewide, and responsibility to all citizens exists, personally biased values systems were avoided in designing the measurements made in this step.

The most fundamental characteristic of outstanding rivers is the combination of natural and man made biological communities and physical features that influence the perceptions and experience of people using the river or adjacent lands. This combination of biological communities, topography, and interesting landforms is what creates "natural and scenic" value. Scenic terrain features add visual interest and help give a feeling of curiosity and closeness to the natural environment. An effective, accurate means to measure the presence of natural and scenic characteristics is crucial to identifying rivers with highest potential for public use and enjoyment.

Methodology

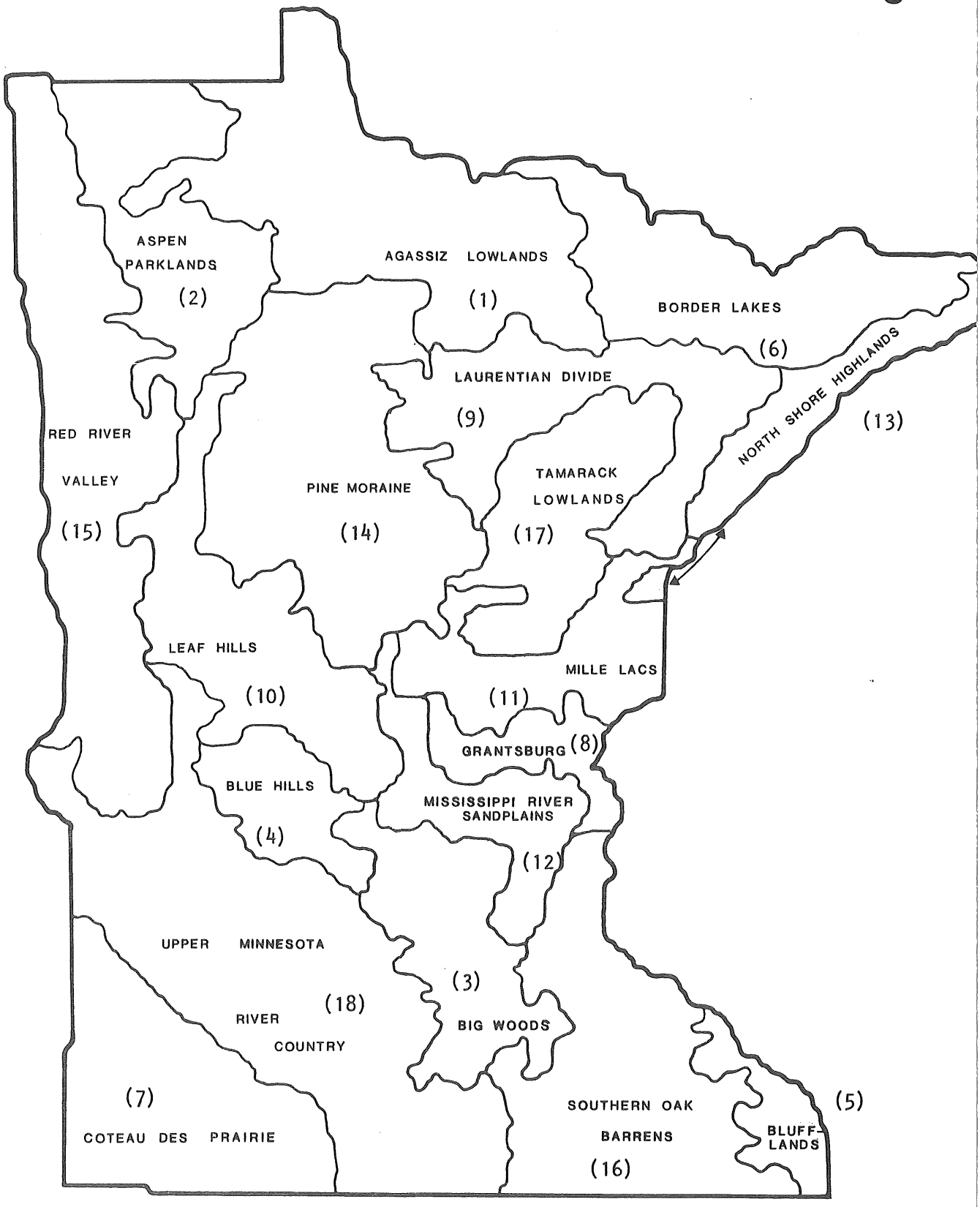
Requirements for objectivity and statewide scope were met by using the Minnesota Land Management Information System (MLMIS) data base. A variety of information has been stored for all parts of the state in a 40 acre parcel grid format. Lines of the grid correspond to the original public land survey lines. A map showing natural and scenic characteristics in a corridor 1/2 mile back from the banks of each river identified in Steps 1 and 2 was developed from MLMIS data. Percentages of each river corridor having natural and/or scenic conditions were measured with frequency counts of 40 acre parcels possessing these conditions. The MLMIS Land Use/Land Cover-variable was used to describe naturalness. Parcels coded Forested, Marsh, Open water or Pasture/Open were considered to be in a natural condition. A terrain model based on MLMIS Geomorphic Region and Soil Landscape Region variables was used to describe scenic potential. In general our guideline was that topographic diversity increases the potential for scenic opportunity while lack of diversity does not have a negative impact. Appendix C describes the MLMIS system and the computerized process required to create these natural and scenic condition ratings.

Minnesota, being a large area that includes many biological, physical and cultural patterns, will possess a wide variety of rivers. This natural diversity makes comparing all 157 named rivers and branches based on direct observation totally unworkable. The extreme diversity of land use requires a means of measuring conditions so that parts of the state with intensive land use are not overshadowed by the near wilderness conditions of northeast Minnesota. In order to allow values to be shown for developed areas the DNR Biocultural Region system was used to allow for regional land differences (See Map 2). By assigning a negative or neutral effect that an intensive land use may have on natural or scenic conditions to each Biocultural region, land use differences can be balanced throughout the state. The impact of a negative rating for a parcel was to neutralize any positive value assigned that parcel due to natural and/or scenic qualities. Intensive land uses include those that destroy or seriously alter the existing natural land covers. These uses include intensive agriculture, urban areas, roads, mining, and housing development. For example, a paved road will have more impact on natural and scenic character in northeastern Minnesota than near the metro area. The effects of these land use factors were assigned seperately to each of the 18 Biocultural Regions. A chart showing how each land use class was treated for each Biocultural region appears in Appendix C.

The end product was a map showing a rating for each 40 acre parcel in the corridors of all 157 streams named. Each parcel was rated either as 0 (no natural or scenic conditions present or intensive land use present), + 1 (natural or scenic conditions present), or + 2 (natural and scenic conditions present). A listing was made of the entire group of rivers based on the percentage of parcels in each river corridor with ratings of +1 or +2. This listing allowed comparison of river corridors for relative percentages of natural and scenic conditions. Since the relative impacts of intensive land uses around the entire state were built in with the Biocultural Region format, rivers could thus be compared on a statewide basis.

Map 2

Minnesota Biocultural Regions



(see Appendix C)

Results - MLMIS Data listings

The listing produced from the MLMIS data sorted the streams by the percentage of 40 acre parcels with ratings for natural and scenic conditions. The following list shows these percentages. It should be remembered that since the rating is a percentage of 40 acre parcels with natural, scenic, or both conditions present, in general the higher the percentage the higher the quality indicated.

TABLE #2

RIVER	PERCENTAGE OF PARCELS WITH NATURAL & SCENIC RATING (includes regionalized values)
Isabella	98.86
Root (system)	97.70
Basswood	97.48
Pigeon	97.14
Turtle	96.87
Boy	96.83
Schoolcraft	96.48
Popple	96.07
Zumbro (system)	94.12
Black Duck	93.78
Snake (East)	93.74
Battle	93.39
Groundhouse	92.94
Swamp	92.54
Vermilion (North)	92.47
West Swan	92.09
St. Croix	91.51
Rice	91.25
Split Rock	90.89
Caribou	90.54
Kawishiwi (system)	90.28
Pine	90.24
High Island Creek	90.16
Cannon	89.84
Cedar	88.92
Swan	88.85
Mississippi (Lower)	88.60
Poplar	88.53
Manitou	88.50
Cross	88.39
Nett Lake	87.90
Kettle	87.79
St. Francis	87.45
Whiteface	86.71
East Savanna	86.40

Table #2 (con't)

RIVER	PERCENTAGE OF PARCELS WITH NATURAL & SCENIC RATING (Con't) (includes regionalized values)
Pelican (Northeast)	85.86
Gooseberry	85.77
Vermillion (South)	85.31
North Cormorant	85.23
Beaver	85.02
St. Louis	84.10
Moose Horn	84.06
Net	83.99
Sunrise	83.99
Straight (South)	83.97
Ripple (Mud)	81.62
Bowstring	81.47
Rum (system)	81.00
Deer Yard Creek	80.99
Brule	80.89
Leech Lake	80.80
Willow	80.78
Crow Wing	80.33
Stony	80.15
Nemadji	78.74
Cloquet	78.65
Mississippi (Headwaters)	78.00
Buffalo Creek	77.25
Cascade	77.22
Crow (system)	77.10
Temperance	76.45
Onion	76.24
Kadunce Creek	75.37
Black	75.17
Baptism	74.95
Blackhoof	74.86
Rat Root	74.61
Le Sueur	74.21
Shell	70.78
Sunrise (system)	70.70
Big Fork	68.81
Elk	68.57
Minnesota	67.60
Hawk Creek	67.72
Knife	66.67
Cat	65.99
Platte	64.90
Rapid	64.69
Prairie	64.36
Pomme De Terre	62.46
Devils Track	61.86
Flute Reed	61.11

Table #2 (con't)

RIVER	PERCENTAGE OF PARCELS WITH NATURAL & SCENIC RATING (Con't) (includes regionalized values)
Clearwater	60.29
Embarrass	58.96
Straight (North)	58.96
Little Fork	57.82
Sauk	57.83
Roseau	56.25
Sturgeon	55.84
Dark	54.97
Redeye	53.10
Leaf	52.70
Mississippi (Upper)	52.20
Chippewa (system)	52.00
Long Prairie	51.14
Chippewa	50.66
Partridge	50.45
Two Rivers - Mid Br	45.37
Blue Earth	43.74
Two Rivers - S. Br	43.69
Rainy	43.14
Wild Rice	41.66
Wing	41.23
Lost	39.05
Rush - S. Br	37.28
Otter Tail	36.95
Lester	35.53
Mississippi (Metro)	34.19
Hill	30.69
Yellow Bank	29.29
Des Moines	28.82
Red Lake	27.96
Pelican	27.41
Rush	25.69
Two Rivers - N. Br	24.61
Redwood	24.13
Watonwan	24.11
Cottonwood	23.34
Buffalo	21.15
Little Cottonwood	20.63
Sandhill	19.51
Middle	18.38
Maple	18.02
Two Rivers	17.81
Watonwan - S. Fk	17.70
Red R. of the North	16.82
Rock	15.87
Yellow Medicine	14.45

Table #2 (con't)

RIVER	PERCENTAGE OF PARCELS WITH NATURAL & SCENIC RATING (Con't) (includes regionalized values)
Thief	14.00
Cobb	13.80
Lac Qui Parle	13.16
Three Mile Creek	11.99
Elm Creek	10.45
Rush - Mid Br	9.23
Snake (Northwest)	7.94
Mustinka	7.13
Watonwan - N Fk	6.46
Marsh	6.18
Grand Marais Creek	5.56
Rabbit	0.00

Interpretation of Listings and Application of Elimination Criteria

Before developing an elimination criteria for natural and scenic conditions, the results and validity of the MLMIS data were scrutinized. Several considerations became apparent regarding the ratings that resulted.

First, the model for noting and displaying scenic characteristics created by rough terrain was incomplete. Certain rivers, particularly those in southwestern Minnesota, known to have extensive blufflines and incised valleys over part of their length had little or no such conditions noted. The cause of this breakdown in the computer model was because of a deficiency in the soils data, especially related to alluvial soils. Where the scenic conditions model was found to be inaccurate over all or part of a river's length, manual analysis using the same criteria as in the computer analysis allowed certain rivers to be kept for further study. An example of this occurrence was with the Cottonwood River that has an incised valley for the lower 60 miles of its reach.

Second, the application of Landscape Regional values created a listing which allows comparison on a statewide perspective. An example is the first two streams on the list - the Isabella River in the Arrowhead region and the Root River system in southeastern Minnesota. Analysis that can be made from these figures is that both rivers have very high natural and scenic values for their parts of the state. The Root River thus has very high natural and scenic values for southeastern Minnesota, and the Isabella River the same for the Arrowhead. The numbers then become a guide to show streams with high values from all parts of Minnesota.

A third consideration in analysis of the percentages and map came with streams having only a short segment showing a high concentration of 40 acre parcels with natural and scenic conditions. By figuring the percentage of natural and scenic parcels for the entire length of the river, a short natural or scenic segment would not be apparent in the percentage figures alone. In these cases a visual analysis of the map itself showed streams with these high quality short segments, so these streams were kept for further study.

The final use of the ratings came in eliminating from consideration those streams that did not have deficiencies in their scenic condition measurements or have short stretches with concentrated natural and scenic conditions. Streams with a rating of less than 50% were eliminated. A 50% rating would ensure that any stream would have a majority of the landscape in natural and/or scenic conditions.

Application of the 50% criteria resulted in elimination of the following streams:

Buffalo
Elm Creek
Grand Marais Creek
Hill
Lester
Lost
Marsh
Middle
Mississippi (Metro)
Mustinka
Pelican (West)
Rabbit
Red River of the North
Rock
Rush
Rush - Mid. Br.
Rush - S. Br.
Sandhill
Tamarac
Snake (West)
Thief
Three Mile Creek
Two Rivers
Two Rivers - Mid. Br.
Two Rivers - M. Br.
Two Rivers - S. Br.
Watonwan - N. Fk.
Watonwan - S. Fk.
Wing

Manual analysis of soils information for scenic conditions and visual analysis of the map for short segments of high quality resulted in the following streams having a rating of less than 50% being kept for further analysis:

Blue Earth
Cobb
Cottonwood
Des Moines
Lac qui Parle
Maple
Ottertail
Rainy
Red Lake
Redwood
Watonwan
Wild Rice
Yellow Bank
Yellow Medicine

Step 4 ADD REINFORCING SOCIAL RESOURCE CHARACTERISTICS

Purpose

To identify those rivers having social resource values as shown by a combination of indicators.

Considerations

Very few definitions exist for the broad values addressed in the enabling legislation for river management. Exact criteria for measuring values are non-existent, although much literature and research has attempted to measure, describe, quantify, or summarize what creates a situation that people recognize as an outstanding river. Use of this existing body of research and theory proved difficult due to a lack of a statewide perspective, regional specialization, or questionable value of quantification of relative and subjective values.

Extremely time consuming and complex measurement for each river was also not possible given the project's wide scope and limited personnel time available. Many programs and studies are in existence that specifically address river related subjects in Minnesota ranging from water quality and flow to general and specific recreational potential. A common problem exists with virtually all of these sources in that they do not have sufficiently comprehensive data applicable to all the streams identified in steps 1 & 2 of this study. Use of information lacking a statewide perspective would make an accurate comparison impossible. The decision was made to include only those sources that provided a sufficiently comprehensive level of information to allow all parts of the state to be equally represented.

Methodology

Five sources for indication of existing and potential social values (recreational, historical, scientific) were identified. Notations of each indicator were entered on a matrix for measurement and graphical representation. The indicators used and their rationale are discribed below:

a) Rivers designated as part of the State Canoe and Boating Route program. (Minn. St. Ch. 85.32)

There are 18 rivers in the program administered by the DNR that are being promoted and developed for recreational use. Maps and other informational materials are produced for general distribution showing accesses, campsites, rest areas and portages that are developed and maintained. Listing these Canoe and Boating Routes provided notation of the best known, most accessible and developed recreational rivers in the state.

b) Rivers recommended for inclusion in the Canoe and Boating Route program in an inventory conducted in 1979-1980.

This inventory utilized University students, Boy Scouts and DNR personnel who visited approximately 25 rivers around the state and noted the characteristics that influence canoeability and aesthetic quality. This inventory was conducted as part of the procedures called for in DNR River Management policy. These rivers represent those believed to be able to provide a high quality recreational rivers system statewide, and offer the greatest potential for varied use.

c) Streams mentioned in a survey of DNR field personnel and private user groups.

This survey attempted to reach professionals and recreationists with the greatest level of practical knowledge of the rivers of the state. The form used to survey DNR personnel and user groups asked them to indicate what characteristics were the basis of their recommendations. The results of this survey were not consistent throughout the state so all notations were grouped into one category on the matrix instead of singled out by subject. Thus all characteristics noted in this survey were treated equally in matrix notations.

d) Results of a literature search concerning the role of rivers in the history and pre-history of Minnesota.

The significance of historical features and human activities can be noted only after basic decisions are made about how far back and what level of importance will be noted. For example, virtually all rivers have been used by people for some purpose during the 12,000 years mankind has been in Minnesota. Archaeological records are not complete for all parts of the state, yet it is clear that rivers were important in the lives of pre-historic peoples for water, transportation, food, tribal boundaries, spiritual and religious significance. Recent history shows utilization of some rivers for intensive use such as personal travel, food sources, and transportation of commodities, and little or no use of others. Notation of all individual historic sites, such as homesteads, buildings, or trading posts around the state is not possible within the capabilities of this project. Thus for this project only those streams that played a role in the major stages of discovery and development of Minnesota were noted. Lesser known or locally significant sites are not noted for any part of the state.

e) Streams recommended as good warm water fisheries in publications by the DNR Section of Fisheries; designated trout streams; and those streams showing a good sport fishery in recent biological stream surveys.

There is no systematic data base on sport fisheries from which recommendations can be drawn. With the lack of a data base and the lack of clearly defined criteria for what are the characteristics of the highest quality warm and cold water fisheries, the above combination of sources was designed to identify both existing fisheries and streams capable of supporting specific resource quality dependent experiences, such as trout fishing. By combining these sources it was felt that those streams having either high quality existing sport fisheries or the environmental characteristics that can offer high quality aesthetic and fishing experiences would be included.

All of these indicators can be expanded in the future with improvements in their data, and new indicators can be added as they become available. Indicators that should be added to give a more complete picture include comprehensive water quality data; better fisheries resource documentation; stream flow as it effects fisheries, wildlife and recreation; complete documentation of unusual or interesting biological, historical, and geological features; and areas of critical habitat for endangered or threatened species of plants and animals.

The complete listing of social resource characteristics is shown in the next step combined with each river's MLMIS natural and scenic rating. Interpretation of the list is also included with the interpretation of the combined data.

Results

Social resource indicators discussed in this step are shown on the completed list resulting from Step 5 on Table #3, pp. 30-32.

Step 5 COMBINE NATURAL AND SCENIC CONDITION RATING WITH SOCIAL RESOURCE CHARACTERISTICS.

PURPOSE

To combine the Natural and Scenic Condition ratings with Social Resource Characteristics, resulting in identification of rivers with relative amounts of resource values for river management.

Considerations

A method for combining the numbered ratings and the less systematic social resource indicators was needed to allow accurate comparison of rivers. The method of comparison should be subject to limitations of the data, and must put all streams on an equal basis for evaluation. Combination should also allow additions to social resource characteristics at a later date as they become available.

Methodology

A chart was developed that combined the MLMIS natural and scenic condition ratings and social indicators noted on the matrix.

This combination placed primary importance on the natural and scenic conditions measured by MLMIS, and made all social indicators of equal importance. Social indicators thus function to reinforce the natural and scenic characteristics that are of fundamental importance in present river management programs.

The chart format was felt to be the best means to identify streams that combined a number based value (MLMIS) and the broader, less tangible measurements resulting from the matrix social indicators. Such a chart format allows utilizing information that cannot be rigidly interpreted. A chart format will allow visual analysis of rivers by displaying their combined natural, scenic, and social characteristics. In the case of streams that had forks and branches separated in the MLMIS ratings all forks and branches were combined into one MLMIS rating.

Results

Results are found on Table 3, pp. 30-32, Combined Natural and Scenic Ratings and Social Resource Indicators.

Table 3

Combined Natural and Scenic Ratings and Social Resource Indicators

River	MLMIS Natural & Scenic Rating	Fisheries	Designated Canoe & Boating Route	Recommended Canoe & Boating Route	Historical Notation	User & Pers Surv
Isabella	98.86					
Root(system)	97.70	X	X		X	
Basswood	97.57					
Pigeon	97.14				X	
Whitewater	97.00	X				
Turtle	96.87					
Boy	96.83					
Schoolcraft	96.48	X				
Popple	96.07					X
Zumbro(sys.)	94.12	X	X			X
Black Duck	93.78	X				
Snake	93.74	X	X		X	X
Battle	93.39					
Groundhouse	92.94					
Swamp	92.54	X				X
Vermillion-N	92.47	X		X		X
W. Swan	92.09					X
St. Croix	91.51	X	X		X	X
Rice	91.25					X
Split Rock	91.25					X
Caribou	90.54	X				X
Kawishiwi	90.28					X
Pine	90.24			X		X
High Island Creek	90.16					X
Cannon	89.84	X	X			X
Cedar	88.92					
Swan	88.85			X		X
Mississippi (lower)	88.60	X	X		X	X
Poplar	88.53	X				X
Manitou	88.50	X				X
Cross	88.39					X
Nett Lake	87.90					X
Kettle	87.78	X	X			X
St. Francis	87.45					
Whiteface	86.41			X		X
E. Savanna	84.40				X	X
Pelican	85.86			X		X
Gooseberry	85.77	X				X
Vermillion-S	85.31	X				
N. Cormorant	85.23					
Beaver	85.02	X				X
St. Louis	84.10	X	X		X	X
Moosehorn	84.06	X				X
Net	83.99	X				X

Table 3

Combined Natural and Scenic Ratings and Social Resource Indicators (con't)

River	MLMIS Natural & Scenic Rating	Fisheries	Designated Canoe & Boating Route	Recommended Canoe & Boating Route	Historical Notation	User Group & Personnel Survey
Straight(S)	83.97		X			X
Ripple(Mud)	81.62					
Bowstring	81.47					X
Rum	81.00	X	X		X	
Deer Yard Creek	80.99	X				X
Brule	80.89	X				X
Leech Lake	80.80					X
Willow	80.28			X		X
Crow Wing	80.33	X	X		X	X
Stony	80.15					X
Namadji	78.74	X				X
Cloquet	78.65	X	X		X	X
Mississippi (headwaters)	78.00	X	X		X	X
Buffalo Creek	77.25					X
Cascade	77.22	X				X
Crow	77.10	X	X		X	
Temperance	76.45	X				X
Onion	76.24					X
Kadunce Creek	75.37					X
Black	75.17					X
Baptism	74.95	X				X
Blackhoof	74.86	X				X
Rat Root	74.61					X
Le Sueur	74.21					X
Shell	70.78					
Sunrise	70.79			X		X
Big Fork	68.81	X	X		X	X
Elk	68.57			X		
Minnesota	67.60	X	X		X	X
Hawk Creek	67.27					X
Knife	66.67	X				X
Cat	65.99					X
Platte	65.90					X
Rapid	64.69					X
Prairie	64.36			X		X
Pomme de Terre	62.46	X				X
Devils Track	61.86	X				X

Table 3

Combined Natural and Scenic Ratings and Social Resource Indicators (con't)

River	MLMIS Natural & Scenic Rating	Fisheries	Designated Canoe & Boating Route	Recommended Canoe & Boating Route	Historical Notation	User (& Pers Su
Flute Reed	61.11	X				X
Clearwater	60.29	X		X		X
Embarass	58.96					X
Straight(N)	58.96	X				X
Little Fork	57.82	X	X		X	X
Sauk	57.73			X		
Roseau	56.25					X
Sturgeon	55.84			X		X
Dark	54.97	X				X
Redeye	53.10					X
Leaf	52.71			X		X
Mississippi (upper)	52.20	X	X		X	X
Chippewa	52.00					
Long Prairie	51.14			X		X
Partridge	50.45					X
Blue Earth	43.74	X		X		X
Rainy	43.14	X			X	X
Wild Rice	41.66			X		X
Ottertail	36.95			X		X
Yellow Bank	29.29					X
Des Moines	28.82		X			X
Red Lake	27.96		X			X
Redwood	24.13	X				X
Watonwan (system)	24.11					
Cottonwood	23.34	X		X		X
Little Cottonwood	20.63					X
Maple	18.12					X
Yellow Medicine	14.45			X		X
Cobb	13.80			X		
Lac qui Parle	13.16					X

Interpretation

Combining the MLMIS natural and scenic rating with notations of social value provides both good and bad potential for interpretation. Since both sets of data have their own strengths and weaknesses, each will be discussed separately and then in combination.

First, the MLMIS ratings represent a mechanized means to objectively measure certain characteristics among all rivers. In addition to the cautions discussed in Step 4 about rigidly interpreting percentages, there are difficulties originating in the type of data that computerized systems provide. The 40 acre parcel format requires a broad perspective where one looks for concentrations, patterns, and consistency. Looking at a few parcels and drawing a conclusion from their particular rating is too narrow an approach for accurately interpreting what the data says. A 40 acre parcel map allows broad summaries and descriptive statements only. While a detailed site analysis of each river would be the ideal, there is no way to obtain one for each river in this project. The use of frequency counts giving percentages of certain characteristics proves to be very useful in summarizing and describing this computer data. Visual analysis is useful only for finding areas of concentrated natural and scenic conditions.

Another limitation in interpreting computer ratings is the original data from which the ratings were created. Accuracy of the original land use data is completely dependent on the accuracy of those interpreting and coding the aerial photos in the original MLMIS study. Original photo analysis was done in 1969, so present accuracy is also subject to the amount of land use change that has taken place. There is no way of knowing on a statewide basis how much land use change has happened, exactly what types of changes are taking place, and which parts of the state have seen what type of change. Existing systems are in place to show up-to-date land use, such as LandSat, but the scale of these systems do not provide useful corrections to MLMIS information in this case. Cost and data format are also limitations to using LandSat to correct MLMIS data at the present time.

Second, interpretation of the social indicators noted on the chart must be made with thorough understanding of what they were intended to measure. A large part of the values addressed in river protection legislation are "people oriented". Recreational, historical, scenic, and scientific values all involve people interacting with their environment and deriving some meaning from the experience. Motivational research shows that river resources can satisfy a complete spectrum of needs and preferences existing among the general population. Exact data to measure which rivers or parts of the state are meeting these needs do not presently exist.

The chart shows streams that combine natural and scenic conditions with indicators of social resource values indicative of existing or potential uses. Combination of these characteristics shows a range going from streams with high natural and scenic characteristics along their whole length and all the indicators of social values, e.g. the St. Croix, to those with lower natural and scenic characteristics and few or no idicators of social resource values, e.g. the Redeye River. Rivers with the highest natural and scenic conditions and presently identified social values can be noted and studied in greater detail. Streams with high resource values can also be identified for study by other management and resource protection programs.

Step 6 ANALYSIS OF DEVELOPMENT POTENTIAL AND PROXIMITY TO POPULATION

Purpose

To assess the need for management among those rivers for which measurements are listed in Step 5 for further study.

To identify those streams which will be high priority for river management planning, and for which detailed land use data and river characteristics will be gathered.

Considerations

The identification of rivers having the values addressed in river management legislation is an important part of carrying out legislative intent. Other considerations enter into the actual decisions where planning and management efforts will take place, including technical data on development and recreational potential, as well as subjective factors such as political acceptability of management proposals. The DNR has developed an extensive and coordinated set of policies for river management. Responsibilities and procedures for management decisions are established therein. See Appendix D, DNR River Management Policy.

Minnesota rivers have a complete range of land uses from inner city to wilderness. The pattern of land use is created by physical, biological, and cultural factors of extreme diversity. Measurement of land use and the potential effects on rivers must be comprehensive and detailed enough to show both present conditions and potential areas of rapid growth, concentrated development, and intensive land use types.

Recreational use of rivers is not completely documented in Minnesota. Type of use, seasonality, amount of use, and geographic areas from which use originates have not been measured in sufficient detail to give accurate projections upon which judgements of the need for recreational management can be made. Numbers of potential users can be obtained through fishing, hunting, canoe and boat license records but they do not tell where, when or of what quality is the recreational activity and experience.

Many studies of behavior, perceptions, and preferences exist from around the country that determine what river users think and do, but none address the entire state of Minnesota either from the user or resource perspectives. Among resource characteristics known to influence use are proximity to the user, accessibility by road, facilities present, reputation of scenic and natural characteristics, and skills required to participate. Personal characteristics and resources of users also influence their choice of rivers for recreation. These include what activity they wish to participate in, past experiences, personal and group needs, family structure, age, socio-economic group, individual skill level, equipment available, willingness to travel, amount of time available, and the setting needed to provide the experience desired.

Methodology

The need for management was measured in two ways. Development potential for agricultural and urban uses was measured for all rivers using MLMIS urban, agricultural, road, and soils data. Recreational use potential was measured by combining river length with proximity to population as indicated by State Comprehensive Outdoor Recreation Plan travel zones. Both methodologies will be explained seperately and then combined into a table later in this section.

Development Potential

Statewide MLMIS land use information was combined to create a rating of urban and agricultural development potential. The rating shows development potential in the same river corridors for which natural and scenic conditions were measured. Because of the way land uses were measured in the original MLMIS study, the data is a probability model that makes the land use in any parcel or combination of 40 acre parcels effect the rating for development potential in adjacent parcels. For example, parcels listed in MLMIS as being predominantly agricultural surrounding a parcel that is predominantly forest give a high probibility that there is some agricultural use in the forested parcel. Appendix C gives a discussion of the development potential rating used in this step.

Measurement of urban and agricultural development potential is designed to address the emphasis of present regulatory programs, and also the results of recent research into land uses most likely to have impact on the river environment. Urban development, rural residential development and agriculture have great potential to negatively affect water quality, wildlife and fish habitat, plant communities, archaeological and historic sites, and scenic views.

Recreational Use Potential

Measurement of recreational use potential was made by assigning a simple numerical rating based on river length and proximity within the population center recreational travel zones as defined in the State Comprehensive Outdoor Recreation Plan (SCORP). The rationale in developing this rating is that longer, larger rivers can attract and accomodate a greater number and variety of recreationists than shorter streams, especially when within an acceptable travel distance for those wanting such recreation. Shorter streams can accomodate significant recreational use if they are of high quality and are within the travel distance of large population centers.

Length is the only measure of stream size available on a statewide basis in Minnesota. Stream length is available for all streams from SIDRS (See appendix A). Length has been shown to be directly proportional to both watershed size and the amount of stream flow, which directly influence the type and amount of recreational use that rivers will support. A minimum length of 150 km (93 miles) was used in determining which streams were to be considered "long" in this measurement. Thirty four of the 129 streams that made the screening for MLMIS natural and/or scenic ratings are 150 km or more in length. One hundred fifty km represents a length that can support multi-day and varied types of recreation uses if a river has a sufficiently high and varied level of resource quality.

Public willingness to travel for canoeing and camping was determined in the 1979 SCORP study as approximately 110 miles (1.5-2 hours) for residents of the metropolitan area, and about 60 miles (1 hour) for non-metropolitan residents. Willingness to travel for fishing was measured as shorter than for camping and canoeing, so fishing recreation would mainly fall within the travel zones used. Hunting travel is slightly farther by about 20 miles, but not far enough to make use of the travel zone for canoeing and camping inaccurate in measuring the proximity of a river for potential recreational use.

Rivers were noted as being in the travel zone for the metro area, in the travel zones of 2 or more cities with populations of 10,000 and above, or both. Choosing cities of 10,000 or more is based on a finding of a study that Minnesota canoe and kayak owners are primarily city residents.

The following numerical ratings were applied to all rivers remaining after the eliminations made in Step 3.

River Length/SCORP Travel Zone Indicator	Rating	
Long or short streams outside of at least 2 non-metro SCORP travel zones, and the metro travel zone.	1	Less Potential Use
Short rivers in 2 or more non-metro travel zones only.	2	
Long rivers in 2 or more non-metro zones only.	3	
Short rivers in both metro and 2 or more non-metro zones.	4	
Long rivers in both metro and 2 or more non-metro zones.	5	Greater Potential Use

Results

Measurement of development potential using the MLMIS data base resulted in a percentage of 40 acre parcels within each of the remaining river corridors. The percentages are similar to those of the Natural and Scenic Condition ratings in that the larger the number, the greater the development potential within the corridor is indicated. These percentages are listed in Table 4, pp. 38-40. Each river was also assigned a rating based on the River Length/SCORP Travel Zone Indicator method. These ratings are listed in Table 4 also. For purposes of analysis and identifying rivers that should be of high priority for management, all measurements made to this point were combined into one table. Since resource quality is the underlying requirement for protection, streams were listed in the order of their MLMIS Natural and Scenic Condition rating. In all measurements, higher numbers indicate greater magnitude of the characteristic in question.

Table 4
Combined Inventory Measurements

River	MLMIS Natural & Scenic Rating	Social Resource Indicators	MLMIS Development Potential AG. & Urban Combined	River Length SCORP Zone Rating
Isabella	98	1	0	1
Root	97	3	64	5
Basswood	97	1	0	1
Pigeon	97	2	.19	1
Whitewater	97	2	64	4
Turtle	96	1	0	1
Boy	96		16	2
Schoolcraft	96	1	.51	1
Popple	96	1	.43	2
Zumbro	94	3	79	5
Black Duck	93	1	0	1
Snake	93	3	18	5
Battle	93		0	1
Groundhouse	92		1	4
Swamp	92	2	0	1
Vermilion (N)	92	2	.69	2
W. Swan	92	1	22	2
St. Croix	91	4	31	5
Rice	91	1	.46	2
Split Rock	90	2	.25	2
Caribou	90	2	0	1
Kawishiwi	90	1	1	1
Pine	90	2	53	2
High Island Creek	90	1	98	4
Cannon	89	3	76	5
Cedar	88		99	4
Swan	88	2	10	2
Mississippi(Lower)	88	4	69	5
Poplar	88	2	.43	1
Manitou	88	2	.43	1
Cross	88	1	1	1
Nett Lake	87	1	0	2
Kettle	87	3	4	4
St. Francis	87		13	4
Whiteface	86	2	.84	2
E. Savanna	84	2	2	2
Pelican	85	2	.50	2
Gooseberry	85	2	.21	2
Vermilion (S)	85	1	75	4
N. Cormorant	85		0	1
Beaver	85	2	23	2

Table 4
Combined Inventory Measurements (con't)

River	MLMIS Natural & Scenic Rating	Social Resource Indicators	MLMIS Development Potential AG. & Urban Combined	River Length SCORP Zone Rating
St. Louis	84	4	28	3
Moosehorn	84	2	40	4
Net	83	2	.65	4
Straight (S)	83	2	94	4
Ripple (Mud)	81		73	2
Bowstring	81	1	.29	2
Rum	81	4	39	5
Deer Yard Creek	80	2	4	1
Brule	80	2	.30	1
Leech Lake	80	1	1	2
Willow	80	2	.67	3
Crow Wing	80	4	11	3
Stony	80	1	.13	1
Namadji	78	2	0	4
Cloquet	78	3	6	3
Mississippi(head)	78	4	19	3
Buffalo Creek	77	1	99	4
Cascade	77	2	.25	1
Crow	77	2	69	5
Temperance	76	2	.37	1
Onion	76	1	.79	1
Kadunce Creek	75	1	.99	1
Black	75	1	.13	1
Baptism	74	2	16	1
Blackhoof	74	2	.58	1
Rat Root	74	1	.41	1
Le Sueur	74	2	100	5
Shell	70		2	2
Sunrise	70	2	38	4
Big Fork	68	4	1	3
Elk	68	1	35	4
Minnesota	67	4	88	5
Hawk Creek	67	1	100	2
Knife	66	2	54	2

Table 4
Combined Inventory Measurements (con't)

River	MLMIS Natural & Scenic Rating	Social Resource Indicators	MLMIS Development Potential AG. & Urban Combined	River Length SCORP Zone Rating
Cat	65	1	0	2
Platte	64	1	1	4
Rapid	64	1	2	1
Prairie	64	2	16	2
Pomme de Terre	62	1	79	2
Devils Track	61	2	10	1
Flute Reed	61	2	3	1
Clearwater	60	3	25	1
Embarass	58	1	21	2
Straight (N)	58	2	31	2
Little Fork	57	4	1	3
Sauk	57	1	61	5
Roseau	56	1	20	1
Sturgeon	55	2	11	2
Dark	54	2	0	2
Redeye	53		2	2
Leaf	52	2	21	2
Mississippi(upper)	52	4	62	5
Chippewa	52	1	66	3
Long Prairie	51	2	12	3
Partridge	50	1	10	2
Blue Earth	43	3	99	4
Rainy	43	3	21	1
Wild Rice	41	2	41	1
Ottertail	36	2	57	2
Yellow Bank	29	1	95	1
Des Moine	28	2	86	2
Red Lake	27	2	57	1
Redwood	24	2	92	2
Watonwan	24		94	4
Cottonwood	23	3	87	4
Little Cottonwood	20	1	87	4
Maple	18	1	100	4
Yellow Medicine	14	2	100	2
Cobb	13	1	99	4
Lac qui Parle	13	1	99	2

Interpretation For River Management Planning Priorities

Interpretation for planning priorities from the Combined Inventory Measurements chart is best done by looking at each river as an individual situation and identifying those showing resource quality, need for protection or a combination of both.

Present and recent planning efforts have encountered conditions that require sound proof of need in combination with high resource quality. The proof of need for management and protection has become of critical importance due to the interpretation of the Administrative Procedures Act, Minnesota Statutes Chapter 15, made by the State Office of Hearing Examiners. Designation of Wild and Scenic Rivers by the Commissioner of Natural Resources is determined in part by the recommendation made by the Office of Hearing Examiners, so need for protection must be adequately proven.

Another factor making it necessary to set priorities for those rivers that have the greatest need for management is the present reduced level of planning capability. Budget reductions have reduced the river management planning section to about 1/5 of original staffing. In such a situation practicality dictates that efforts go first to those high quality rivers that are in the most imminent danger of losing their outstanding values due to unwise development and/or recreational over use.

The MLMIS Development Potential ratings and River length SCORP travel zone ratings are the best measurements currently available on a statewide basis for this study. Computer models and potential recreational use ratings help identify streams of interest at a very broad level. Interpretation of these ratings should be made in combination with known land use conditions and common sense for real accuracy in setting priorities. Selections for planning priorities made from these figures are regarded to be rivers needing detailed analysis to determine the nature and extent of resource characteristics, existing recreational and land uses, and specific types of management needed to protect and preserve resource quality.

Priority Rankings

By considering streams according to the measurements from Table 4 on an individualized basis they can be grouped for river management study and planning priorities. Three levels of priority are listed below along with recommendations for each category.

I. First Priority

Blue Earth River
Cottonwood River
Crow River
Mississippi River (Lower)
Minnesota
(LeSueur to Mississippi River)
Root River
St. Louis River
Snake River
Whitewater River
Zumbro River

Indicators:

First Priority streams are those that combine high Natural and Scenic Ratings over all or a large segment of their length, with high Development Potential Ratings over all or a large segment of their length, and moderate to high Social Resource Values and River Length/SCORP Travel Zone Ratings.

Recommendations

1) These rivers should be the subject of immediate detailed study where resource values and issues are documented and provided protection and management under an appropriate comprehensive management plan.

2) In the time required to study and develop such plans these streams should be provided upgraded Shoreland Management Program classifications and resultant protection where ever possible.

3) In the time required to develop these plans, local units of government are encouraged to recognize and implement protective measures and programs to preserve and protect the natural, cultural, economic and social values offered by these streams within their jurisdictions.

4) In addition to the river management studies and plans recommended, resource management programs should be implemented on these streams by appropriate agencies and organizations that will maintain or improve the current level of resource quality present.

II. Second Priority

Baptism River
Beaver River
Big Fork River
Blackhoof River
Brule River
Caribou River
Cascade River
Clearwater River
Cloquet River
Crow Wing River
Dark River
Deer Yard Creek
Des Moine River
Devil Track River
East Savanna River
Flute Reed River
Gooseberry River
Knife River
Leaf River
LeSueur River
Little Fork River
Long Prairie River
Manitou River
Moosehorn River
Nemadji River
Net River
Ottertail River
Pelican River
Pigeon River
Pine River
Poplar River
Prairie River
Rainy River
Red Lake River
Redwood River
Split Rock River
Straight River (N)
Straight River (S)
Sturgeon River
Sunrise River
Swamp River
Swan River
Temperance River
Vermilion River (N)
Vermillion River (S)
Whiteface River
Wild Rice River
Willow River
Yellow Medicine River

Indicators:

Second Priority streams are those that have high natural and Scenic Ratings over all or a large segment of their length combined with low Development Potential, low Social Resource Values, low River Length/SCORP Travel Zone Rating or a combination thereof.

Recommendations:

1) These rivers should be re-assessed for their priority for detailed study and management plan development once each biennium, and the results reported with suggestions for appropriate action.

2) These rivers should be provided upgraded Shoreland Management Program classification and resultant protection where ever possible.

3) Local units of government are encouraged to recognize and implement measures to preserve and protect the high quality natural, cultural, economic, and social values offered by these streams within their jurisdictions.

4) To protect and manage the high resource values that these rivers possess, resource management programs should be implemented on these streams by appropriate agencies and organizations that will maintain or improve the level of resource quality present.

III. Third Priority

Battle River
Basswood River
Black River
Black Duck River
Bowstring River
Boy River
Buffalo Creek
Cat River
Cedar River
Chippewa River
Cobb River
Cross River
Elk River
Embarass River
Groundhouse River
Hawk Creek
High Island Creek
Isabella River
Kadunce Creek
Kawishiwi River (system)
Lac qui Parle River
Maple River
Nett Lake River
North Cormorant River
Onion River
Partridge River
Platte River
Pomme de Terre River
Popple River
Rapid River
Rat Root River
Redeye River
Rice River
Ripple (Mud) River
Roseau River
Sauk River
Schoolcraft River
Shell River
St. Francis River
Stony River
Turtle River
Watonwan River (system)
West Swan River
Yellow Bank River

Indicators:

Third Priority are streams that combine Natural and Scenic Ratings, Development Potential Ratings, Social Resource Values, and River Length/SCORP Travel Zone Ratings in such a way that high resource values and need for protection and management are not presently indicative of special study or management plan development.

Recommendations:

1) These rivers should be given strengthened protection and management through a combination of up-graded Shoreland Management Program classification where ever possible, local unit of government recognition and measures within their jurisdiction, and resource management programs by agencies and organizations to enhance or maintain their resource values.

2) These rivers should be the subject of the refined and accurate analysis method for segments recommended in Appendix G of this Report.

3) These rivers should be monitored periodically for purposes of identifying changes in any of the measurements and ratings made in this report, with results fully documented and any changes in priority assigned.

Management Plans Currently in Effect

Kettle River-Pine County, State Wild and Scenic River, 1975.
Mississippi River-St. Cloud to Anoka, State Wild and Scenic River, 1976.
Minnesota River-Lac qui Parle to Franklin, State Wild and Scenic River, 1977.
North Fork Crow River-Meeker Co., State Wild and Scenic River, 1976.
Rum River-Lake Ogechie to Mississippi River, State Wild and Scenic River, 1978.
Cannon River-Faribault to the Mississippi River, State Wild and Scenic River, 1979.
Mississippi River-Lake Itasca to Southern Morrison County Line, Mississippi Headwaters Board, 1981.
Minnesota River-Franklin to LeSueur, Project River Bend Board, 1982.
St. Croix River-National Wild and Scenic River, above Taylors Falls-1968, Below Taylors Falls-1972.

Part Three: DETAILED STUDY METHOD FOR PRIORITY STREAMS

PART III - DETAILED STUDY METHOD FOR PRIORITY RIVERS

A method of study for priority streams is needed that allows more detailed analysis than that possible in a statewide study. This detailed methodology should address the same broad areas as the statewide study including natural, scenic, recreational, scientific and historical values as well as the need for protection and management resulting from development pressure, intensive land uses, and potential recreational overuse.

An outstanding river is the result of a combination of characteristics and conditions. This combination results in each river, and the surrounding area, having a unique setting, quality or combination of settings along the entire or certain reaches of the stream. These settings can range from remote, wild, areas dominated by natural characteristics, to more developed areas supporting a range of intensive land uses with a small percentage of lands in natural cover. Each of these settings offer potential to meet different needs and desires among the population. Management for preservation and protection of these values must consider all these needs and desires according to their effect on the resource values offered by the river. The ability to address the interaction of human use of the river and the surrounding land is dependent on accurately measuring these factors where possible.

The detailed methodology developed for this project attempts to measure certain characteristics and conditions in an objective fashion so that the information, and conclusions are reliable at all phases of study, planning and management. The overall methodology developed includes two parts:

A) Computerized measurement of biological, physical, and cultural characteristics in as detailed manner possible that is compatible with the pre-existing MLMIS statewide grid of 40 acre parcels. Data collection, coding, storage, and analysis thus used a pre-existing format, but provided greater detail that was possible from the existing data base. This resulted in computer maps with frequency counts of individual and combined conditions that are useful in describing and quantifying characteristics that create an outstanding river.

B) Collection of pre-existing information from various sources that can help in analysis of river conditions, characteristics and problems. These sources include government agency activities (county government, PCA, DNR, etc.) and reports and projects that have studied river related subjects in the past. The availability of useful information from these sources is extremely variable from one part of the state to another, but should be included to insure as complete a body of knowledge as possible. This type of research is the standard activity that takes place in detailed river resource analysis studies.

The above methods supplement each other in their approach to studying and planning river management. The sources of data and methods in B are well established and used regularly, although possibly less reliable in some areas than others. The computerized method developed in A is designed to supplement these established methods with objective and quantifiable data. The computerized method is the detailed form of river study that will be discussed in this report.

Computer Measurements

Rationale

The overall situation that makes a river of high quality is the result of the combination of several conditions and characteristics. A method of measurement and analysis is needed that allows both separating out individual characteristics, and combining various characteristics to accurately depict a complex resource. Developing a sound method for measuring such potentially subjective and relative values as "scenic", "natural", or "recreational" requires knowledge of what factors combine to create these values. Some factors are known to be measureable and others are not, while still more have yet to be discovered.

The known characteristics that combine to create outstanding river values are listed in Table #5. Each characteristic will have many variations that influence their relative impact, so that each river becomes an individual situation. It should be remembered that conditions change along the length of a stream, often enough that the character of the river and surrounding land changes drastically. As with all natural resource related subjects, individual characteristics cannot be separated out and considered or managed alone, but are interdependent in all respects.

Table #5 illustrates this principle of river resource quality. The following example serves to illustrate the principle. One of the reasons people engage in recreation on rivers is to obtain a feeling of "getting away from it all". This involves several factors including the individual's psychological needs, and usually includes the sense of being removed from everyday surroundings. Remoteness is often a contributor to the feeling of getting away from their daily surroundings. Not all people require the same degree of remoteness to feel like they are getting away. In most cases, the sense of remoteness is created by a perceived dominance of natural cover, lack of intensive development such as roads or housing, quietude, and a decreased number of encounters with other people. In the case of rivers, a state of remoteness is often influenced by topography and floodplain characteristics that have created difficulties in developing and using adjacent land. Thus there are several characteristics that unite to create a remote or non-remote setting that gives the feeling of getting away, some of which can be measured and some that can't. The detailed methodology discussed here addresses conditions and characteristics that presently can be measured, and is adaptable to additions in the future.

Table #5

Characteristics and Conditions Contributing to Outstanding River Values

River Resource Values	Primarily Influenced By	Remarks
Natural	1) Aquatic and terrestrial biotic communities - abundance and condition 2) Intensive land uses and their impacts on the biologic system a. Area types: agriculture, urban, extractive logging b. point types: housing, industrial and commercial	Natural values are fundamental to river management program priorities. Naturalness combines with other factors to create the total setting present, one which attracts different uses for different reasons. Naturalness can be visualized as existing on a continium from total (wilderness setting) to virtually non-existent (urban setting).
	3) River form and Characteristics a. Channel width b. Sinuousity c. Bottom type d. Gradient e. Water quality f. Rapids, whitewater, pools, riffles g. Seasonal flow pattern	Natural values are the sum of many factors, and inevitably involve individual values which is the factor for which we have the least data. The relative amounts of natural cover can be measured and used for comparison and description. The value of specific cover types (e.g. prairie vs forest) and combinations remains an individual priority.
	4) "By-products" of development, or lack of same a. noise b. litter c. air and water pollution	
	5) Individual perception a. personal experience b. personal needs and expectations c. location of river relative to home d. composition of group vs participating alone e. awareness of surroundings	

Table #5 (con't)

River Resource Values	Primarily Influenced By	Remarks
Scenic	1) Topographic characteristics 2) Geologic features 3) Natural values (see above) 4) Historic and significant development that doesn't detract 5) River form and characteristics (see above) 6) Individual perception	An important value in river management that is also relative to each person's preference. Attempts have been made to quantify scenic characteristics but results are not useful when the entire population of the state is being considered. Certain factors can be measured and used for description independent of value judgements.
Recreational	1) Natural values (see above) 2) Scenic values (see above) 3) River form and characteristics (See above) 4) Facilities available for public use a. accesses b. camping and rest sites c. portages d. outfitters and other commercial facilities 5) Travel distance to river 6) Personal considerations a. personal and group needs b. experience desired c. setting preferred to fulfill a) and b) d. amount of time available e. skill levels f. equipment required	Present use and demand for river recreation is not fully documented. Profiles of certain user groups are available, and some of the recreation settings preferred by these groups can be described. The recreation settings, and the activities they support, include the full range from wilderness to urban. Recreation demand is both short and long term, subject to many external factors including economic conditions, energy price and availability, weather, and fads that are extremely difficult or impossible to forecast.
Historic	1) Known historic sites 2) Known pre-historic sites 3) Local historic interpretive and preservation efforts. 4) Known historic or pre-historic role of river and adjacent area.	An important and difficult value to measure requiring extensive research and time to document. In certain situations historic sites can contribute to scenic conditions in addition to a more general cultural interest.

Table #5 (con't)

River Resource Values	Primarily Influenced By	Remarks
Scientific	1) Animal and plant communities of unusual, rare, endangered or threatened condition. 2) Geologic features of interest. 3) Undisturbed tracts of pre-settlement origin. 4) Priorities of scientific researchers and the academic community. 5) Locations of certain man caused environmental conditions or impacts.	A value that is extremely specific in its requirements and time frame for utilization of a river. Measureable through extensive research and monitoring only.

Conditions and Characteristics Measured

A series of computerized measurements were developed for the measureable conditions and characteristics discussed previously. Separate characteristics were placed by subject and method of measurement into six groupings, called "files". Each file's purpose, source of data, and use are described here, with detailed data collection and coding rules appearing in Appendix E.

The following files were measured for certain rivers chosen from those shown as First Priority and Second Priority in Part II of this report. Each file resulted in a 40 acre parcel computer map and a frequency count for anaylsis.

1) Generalized Terrain (See example: Appendix F, Map #1)

   a) Purpose: To identify the overall landform and terrain characteristics within a designated river corridor. To specify the proximity of terrain types to the river. Terrain types were classified as flat (0-3% slope), rolling (3-13% slope),and high slope (13%+). Parcels were listed either as all of one terrain type or a specific mixture.

   b) Source of Data: U.S. Geological Survey Topographic Quadrangles, 7.5 and 15 minute series, varying dates.

   c) Use: Results from this file are used in making descriptions of the scenic character of the river corridor. Areas that are also most likely to support or inhibit development due to terrain characteristics can also be identified.

2) Terrain Features (See example: Appendix F, Map #2)

   a) Purpose: To identify high slope features (those with slopes greater than 13%) by their location, proximity to the river, and height. Terrain features were measured by height groupings (30'-100', 100'-200', 200'+), and their proximity to the river as adjacent (within 400'), distant (beyond 400'), or mixed.

   b) Source of Data: U.S. Geological Survey Topographic Quadrangles, 7.5 and 15 minute series, varying dates.

   c) Use: Data from this file are used to describe and quantify landforms that contribute to scenic character such as bluffs, cliffs, incised valleys, etc.

3) Land Use: Cover Types

a) Purpose: To identify and measure land uses including forest, cultivated agriculture, open and pasture, wetlands, extractive (mining), and urban. Up to 3 types of cover were measured by their relative dominance in the 40 acre parcel.

b) Source of Data: Aerial photography in the form of 35mm color slides taken yearly by the Agricultural Stabilization and Conservation Service (A.S.C.S.) showing one section per slide for crop monitoring activities, and black and white 1:20,000 scale forestry photos of varying dates.

c) Use: Data from this file are used for describing and quantifying natural and scenic values, as well as identifying areas experiencing development pressure.

4) Point Land Uses: Structures

a) Purpose: To identify and measure the number and type of structures built along the river. These include large scale industrial facilities, non-farm residences, farmsteads, and those that are unidentifiable. Proximity to the river is also noted by adjacent (within 400') or non-adjacent.

b) Source of Data: The same aerial photos that are used to measure land use and cover.

c) Use: Measuring the abundance and location relative to the river of certain types of development are useful in describing the scenic, natural, and recreational characteristics of the river corridor. Point land use data also makes more objective analysis of development pressure possible.

5) Non-Buffered Intensive Land Use

a) Purpose: To identify intensive land uses located adjacent (within 400') to the river that do not have a minimum 30' strip of natural vegetation between an intensive land use and the water. Intensive land uses include extractive, urban, cultivated agriculture, and structures.

b) Source of Data: A.S.C.S. 35mm color slides taken for crop monitoring activities.

c) Use: This information is used to describe the scenic and natural values, as well as identify those land uses that are most likely to have a direct effect on the river through run-off, erosion, and loss of stream bank vegetation.

6) River Characteristics

a) Purpose: To record the location and frequency of certain physical and cultural characteristics including rapids, islands, stretches with high gradient, waterfalls, lakes, dams, impoundments, utility crossings, road and railroad crossings.

b) Source of Data: U.S. Geological Survey Topographic quadrangles, aerial photos, county road maps, and reports where available.

c) Use: These characteristics are used to describe the scenic and recreational character of the river.

In addition to the files described above, maps with frequency counts based on combinations of certain files are possible. Combinations can be developed to answer certain questions, describe resource values, and make future monitoring of resource character possible. The following combinations of characteristics are given as examples. Other combinations are possible and are being developed to allow better analysis and description of rivers and river corridors.

1) Dominant and Secondary Land Covers displayed for River Oriented parcels. (See example: Appendix F, Map #3)

a) Purpose: To give a more accurate description of conditions in the immediate vicinity of the river.

b) Use: Measuring characteristics in the 40 acre parcels the river flows through will give greater ability to describe the natural and scenic conditions that contribute to creation of various natural and river recreation settings. These settings can be described in terms of relative degrees of natural or intensive land uses present. Stretches of river that offer greater dominance of natural cover can be shown and the potential for wildlife, fisheries, and nature oriented recreation documented. Conversely, those reaches of the river dominated by intensive land uses can be identified for appropriate natural resource management decisions.

2) Dominant and Secondary Land Use Covers combined for entire river corridor. (See example: Appendix F, Map #4)

a) Purpose: To identify and measure the relative dominance of natural and intensive land uses for description of individual rivers and comparing rivers for natural and scenic values.

b) Use: Each 40 acre parcel was mapped by the following combinations according to the dominant and secondary land use covers. The land uses for each parcel resulted in the parcel being shown in one of the following groups:

1) Natural land cover dominant with natural land cover secondary.

2) Natural land cover dominant with intensive land cover secondary.

3) Intensive land cover dominant with natural land cover secondary.

4) Intensive land cover dominant with intensive land cover secondary.

The final use of this map is to identify those stretches of the river corridor that have the greatest amount of natural cover which contributes strongly to several of the basic values for which rivers are protected including natural, scenic, recreational and scientific.

3) Generalized Terrain combined with Natural Land Use Covers.

a) Purpose: To provide a descriptive and quantitative measurement of the overall scenic and natural character of the river corridor.

b) Use: Scenic character is primarily created by the combination of natural cover and terrain. Flat, rolling, and high slope terrain types are represented to varying degrees around the state, as are the types and amounts of natural cover. This map, with frequency count, will provide a basis for making statements of the overall scenic values represented in the river corridor.

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APPENDICES

APPENDICES

A. Stream Inventory and Data Retrieval System (SIDRS) description.

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APPENDIX A

THE STREAM INVENTORY AND DATA RETRIEVAL SYSTEMS PROGRAM

Prepared by
Minnesota Department of Natural Resources
Office of Planning
Natural Resource Data Systems Unit
Research and Policy Section

Prepared for
Systems for Water Information Management
(SWIM)
November 1981

Funding Provided by
The Legislative Commission on Minnesota Resources

ABSTRACT

The primary purpose of this document is to provide a general description of the standardized hydrologic reference system developed by the Minnesota Department of Natural Resources. The reference system was established to serve as a mechanism to tie together the users of water oriented data with those agencies which collect and store such data. Development of the hydrologic reference system was guided by the Systems for Water Information Management (SWIM) User's Committee.

INTRODUCTION

The Stream Inventory and Data Retrieval System Program (SIDRS) is part of an on going effort to standardize and store data on Minnesota's surface-water resources. The primary objective of the SIDRS program is to develop an official reference standard for establishing the hydrologic location of water-oriented activities and resources. The program was conducted from June, 1979, through July, 1981, by the Minnesota Department of Natural Resources, Office of Planning, Research and Policy Section. Funding for the two-year program was provided by the Legislative Commission on Minnesota Resources.

What Is A Hydrological Reference System?

To determine the location of water-related data in a useful manner, it is necessary to employ the concept of hydrologic order (i.e., upstreamness, downstreamness). A hydological reference system then, is simply a system to arrange water-related phenomena in the proper hydrologic order.

Why Is A Standardized Hydrologic Reference System Needed?

A hydrologic reference system is needed for a variety of reasons. First, as mentioned above, a hydrologic reference is needed to establish the hydrologic relationships amoung water-oriented data. Second, storing the hydrologic locations of data enables users to retrieve and analyze water data on the basis of hydrologic relationships. Finally, by standardizing the manner in which location is reported and coded it becomes feasible to bring together and organize the vast amounts of data collected by multiple governmental agencies and private groups. This ability to integrate data from separate water oriented data bases will facilitate a more comprehensive, interdisciplinary approach to water resource planning and management.

Does The Hydrologic Reference Eliminate The Need For Geographic Locators?

The intent of this paper is to outline the standardized hydrologic reference system developed for reporting the location of water and related land resource data. It is not the intent of this document to suggest that hydrologic locators can replace geographic descriptors such as public land survey or latitude-longitude coordinate references. Rather, it must be understood that in order to ensure data relatability and transferability, each water data element must contain both geographic and hydrologic locators.

THE HYDROLOGIC REFERENCE SYSTEM

The automated statewide reference system is based on two units: (1) minor watersheds, and (2) river kilometers. The minor watershed unit provides the reference system with an area reference capability. Basically, the unit defines the drainage area within which a specific feature lies rather than the position of the feature itself. In contrast, the river kilometer index unit provides a more precise point reference capability. The reference unit is capable of describing the actural location of a point, by kilometers upstream.

Why Is The System BAsed On Two Units?

Experience gained in water resource planning, management, regulation and research has demonstrated that both point and non-point data provide important insights to existing and future environmental conditions. The hydrologic reference system, therefore, has to be capable of establishing the location of both point and non-point water and related data. Unfortunately, the watershed and river index reference units have inherent limitations which prevent them from staisfying this basic criterion. For example, the river index unit is incapable of referencing non-point pollution sources or activities located away from a watercourse. Watershed units, on the other hand, provide a logical unit for referencing non-point data but cannot describe the location of stream oriented point data with requisite accuracy and resolution. Because of this, the reference system is based on the minor watershed and river kilometer units. Together the two units form a reference system capable of describing the location of all water related phenomena within the state. The two components of the reference system are described below.

The Minor Watershed Reference Unit

The minor watershed reference unit is useful for describing the hydrologic location of both point and non-point features. The reference can be used in connectin with such phenomena as: land use, precipitation, non-point pollution sources, and point pollution sources (e.g., feed lots) located away from a watercourse.

The minor watershed reference unit divides the state into over 5,600 officially recongized drainage basins. Each basin is an area of at least five square miles defined by a height-of-land drainage divide. The watershed boundaries were systematically delineated on large scale topographic maps and geocoded by forty acre parcels into the Minnesota Land Management Information System (MLMIS).

A major problem facing the watershed reference was the development of a hierarchical numbering system capable of describing the interrelations and hydrologic order among the watersheds. To accomplish this, the Common Stream And Watershed (CSAW) numbering system was devised.

The main attributes of the CSAW numbering system are:

- The main stream draining the watershed is idenfified
- Rivers, ditches, and streams are numbered in a fashion which allows the tributary order to be established
- The inter-relations among watersheds can be determined
- The relative hydrologic position of each watershed in the drainage network can be ascertained

The watershed numbers are stored in computer files at LMIC and at the University of Minnesota Computer Center (UCC). An interactive computer program was written to enable the user to produce listings of all minor watershed units upstream from a given point on a stream. This program can be used to define the drainage area of a lake or stream for such uses as preparing individual management plans, calculating drainage areas, or combining watershed and other MLMIS data.

The River Kilometer Reference Unit

The second element of the hydrologic reference system is known as the river kilometer index unit. The primary purpose of this unit is to establish the hydrologic locations of points of interests along the state's watercourse. River kilometers can be used in connection with such activities as: the location of cities, water quality stations, point discharges, and so on. River kilometers are measured in an upstream direction from the mouth of a watercourse, or from the point where a stream flows permanently across the state boundary.

In order to provide for accurate stream indexing, the Department of Natural Resources developed the River Kilometer Indexing System. This computer oriented approach of indexing streams eliminates most of the problems (e.g., mechanical inaccuracies, inability to replicate measurements, etc.) associated with traditional indexing methods.

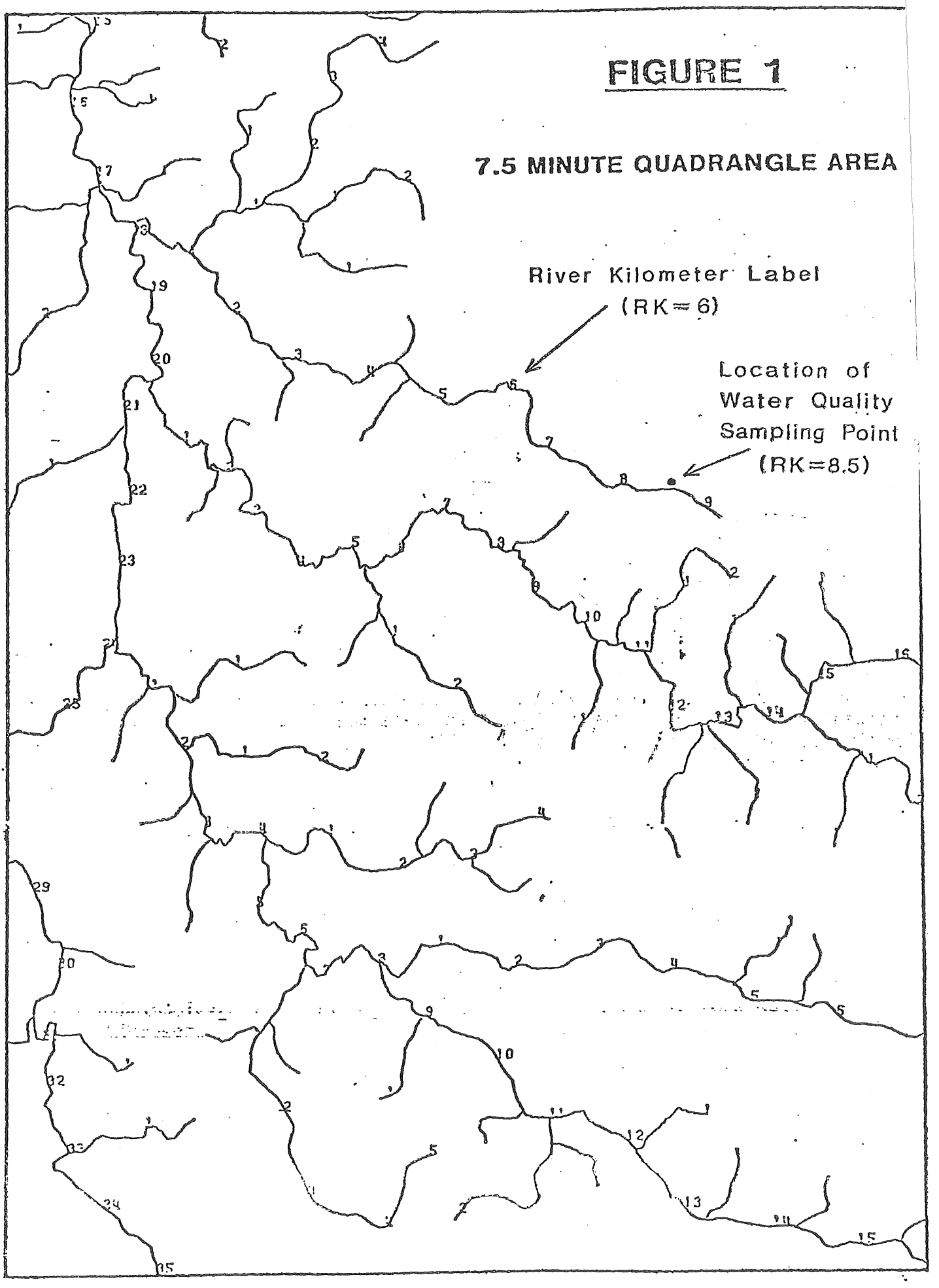
The major attributes that characterize the RKI system are:

- The system is user-oriented, simple and inexpensive to use.
- All basic functions are provided including data entry, editing and distance indexing. In addition, several special purpose programs are available to analyze stream data.
- The data base contains the center trace of most of the watercourses shown on the large scale (1:24:000 or 1:62:500) topographic maps covering Minnesota.
- A total of 37,793 watercourses, or some 147,930 kilometers (91,944 miles) of streams, rivers and ditches were indexed.
- The information can be mapped at any scale with distances (e.g., river kilometers) displayed.
- The data is compatable with MLMIS and may be converted into grid format for use with the watershed data or other data stored on the system.

Figure 1 shows a computer generated map of the Medford East quadrangle area located in southeastern Minnesota. The lines on the map represent the center trace of the watercourses shown on the 7.5 minute topographic map. The numbers along the streams indicate the river kilometer distances.

FIGURE 1

7.5 MINUTE QUADRANGLE AREA



MEDFORD EAST

APPLICATIONS

The potential applications of the reference system are significant and diverse. The system may be used for organizing and relating data collected by local, regional and statewide programs. In addition, the reference system may prove to be of considerable use in environmental impact studies, water appropriation permit programs, flood studies, and so on. But perhaps the greatest potential is the system's capability to tie together existing and future water-oriented data banks thereby enabling planners and managers to access data collected by various governmental agencies. This capability will help to ensure the decision-makers are provided with sufficient up-to-date information on which to base their decisions.

In addition to the hydrologic reference applications, the stream and watershed data have tremendous potential as a water and related land resource planning and management tool. The data has a variety of applications are as follows:

1. MLMIS soils, slope, and land use data have been combined to predict the soil erosion within a drainage basin.

2. The standardized stream numbers are used to identify watercourses among agencies and to facilitate the transfer of stream related data.

3. The drainage area, number of tributaries and total length of a river's stream network can be calculated for use in flow analysis.

4. The sinuousity of a stream (i.e., amount of meandering) can be quickly calculated for use in stream modeling or recreational river planning.

CONCLUDING REMARKS

In summary, the primary objective of the SIDRS Program was to develop an official reference standard for establishing the hydrologic location of water-oriented data. Such a system is necessary in order to standardize the manner in which hydrologic location is reported, coded and stored in water data bases. In developing the reference system, a vast amount of data were created which are valuable for a variety of water planning, management and research applications. The full applications and capabilities of the data systems are too numerous to be fully described in this report. Please contact the following Agencies for additional information or data request.

Department of Natural Resources
Office of Planning, Research and Policy Section
Natural Resources Data Systems Unit
Box 10-F Centennial Building
St. Paul, Minnesota 55155
(612) 296-0565

Land Management Information Center
Metro Square Building, LL45
St. Paul, Minnesota 55101
(612) 296-1211

COMMON STREAM AND WATERSHED NUMBERING SYSTEM

INTRODUCTION

The common stream and water shed numbering system was developed for the river mile indexing project being carried out by the DNR Office of Planning and Research. The predecessor to the river mile indexing project was the Minnesota Watershed Mapping Project.

In the Watershed Mapping Project, watersheds were delineated for all streams, rivers, or ditches having a drainage area of five square miles or greater. Streams with a drainage area of less that five square miles were aggregated with one or more adjacent watersheds to form a large watershed, which was then coded as an independent watershed.

The purpose of the common stream and watershed numbering system is to establish a hierarchical numbering scheme for the approximately 5,700 independent watersheds delineated within the state. The common stream and watershed number (CSAW number) identifies land surface areas which provide runoff to corresponding stream segments. Once the watersheds are assigned a CSAW number, a given land area (e.g. watershed) is linked to a specific stream segment and provides one with much information.

The numbering system for streams and minor watersheds presented here has the following features:

* A unique number identifies each minor watershed
* Rivers, streams, ditches and minor watersheds are numbered in a hierarchical fashion
* The relative position of each watershed in the network can be ascertained
* The watershed numbering system incorporates an existing stream identification system
* The interrelations of watersheds to the whole land and water network may be discerned which facilitates impact analysis.

What the common stream and watershed number means:

The common stream and watershed number (CSAW number) is a minimum of a two digit code indicating the main stream draining the minor watershed and the corresponding land area linked to the stream segemtn. Because the system was devised to establish a common stream and watershed numbering hierarchy the system is best understood if broken down into its components.

The first half of the CSAW number specifies the main stream draining the watershed. The second half of the number directly links a given land area providing surface runoff to a specific stream segment.

The Minnesota stream identification system developed by DNR fisheries staff, was adapted for the hierarchical numbering of streams.

The fact that the CSAW numbering system enables the planner/resource manager to discern the interrelations of watersheds is worth emphasizing as there are numerous other situations where such an understanding is important. For example, the hierarchical ordering can be used in calculating stream flows, or be used to integrate land and water data for resource planning.

The common stream and watershed numbering system was developed for the river mile indexing project. The purpose of the system is to establish a hierarchical numbering scheme for the approximately 5,700 minor watersheds delineated within the state. Once the watersheds are assigned CSAW numbers, all catchment areas (e.g. watersheds) are hierarchically linked to a specific stream segment which provides one with much information.

Any one having questions regarding the CSAW numbering system should contact:

Jim Thornton
Research and Policy, Office of Planning
Minnesota Department of Natural Resources
Box 10F - Third Floor Centennial Building
St. Paul, Minnesota 55155
Telephone: (612) 296-4891

APPENDIX B: Survey Form for resource management personnel and user groups

DNR Office of Planning and Research

Rivers Section

Statewide River Survey

Purpose of the Survey:

To identify and study Minnesota rivers possessing outstanding scenic, natural, scientific, historic, and recreational qualities. The results will help to develop recommendations and prioritization of river for future protection and management.

What the Survey is looking for:

We are gathering recommendations from groups and individuals that will help us identify the best rivers of the state. This implies the best in all regions, without comparing regions against each other (i.e., all regions can have "best rivers"). The types of characteristics are described below:

Scenic character:

- -landscape features exhibiting variation, uniqueness or spectacular qualities.
- -vegetative and wildlife communities offering the opportunity to experience diverse and functioning natural ecosystems.
- -river and water characteristics offering variety and beauty.

Natural values:

- -important fisheries areas
- -areas providing habitat to endangered or threatened wildlife or plants.
- -areas with biological communities in danger of destruction on a statewide basis such as native prairie or virgin forest, etc.
- -areas with biological communities typical of pre-settlement Minnesota.
- -wildlife management areas.

Scientific values:

- -areas that offer opportunity to study subjects dependent upon the resource along the river-botanical, zoological, archeological, geological, ecological, etc.

Recreational values:

- -outstanding opportunities to experience recreational pursuits including hunting, fishing, canoeing, boating, hiking, camping, bird watching, kayaking, etc.

Historical values:

- -known historic and pre-historic sites.

Land Use and Development:

- -areas where the character of outstanding rivers is being threatened by unwise development or over use.

Questions or comments can be directed to:

Gordon Kimball
Rivers Section
Box 10G, Centennial Office Bldg.
St. Paul, MN 55155
Phone-(612) 296-4784

DNR Office of Planning and Research

Rivers Section
Statewide Outstanding River Survey

Your Name:_____

Address:_____

Telephone:_____

1) List outstanding rivers:

River name:_____ Location:_____
(segment)

Outstanding characteristic(s):

Scenic:

____varied or rugged topography
____rapids, pools, river characteristics
____remoteness or solitude
____scenery exemplary of region
____other:_____

Scientific:

____Scientific & Natural Area
____Federal Wildlife area
____State Fisheries or Wildlife area
____Area used for educational or
____scientific study
____other:_____

Historical:

____known historic sites
____known pre-historic sites
____other:_____

Natural:
____fisheries resource
____wildlife habitat (any endangered or
____threatened species?)
____native prairie
____virgin forest
____unique biological communities
____other:_____

Recreational:

____canoeing
____boating
____fishing
____hunting
____other:_____

Comments:_____

_____

River name:_____ Location:_____
(segment)

Outstanding characteristic(s):

Scenic:

____varied or rugged topography
____rapids, pools, river characteristics
____remoteness or solitude
____scenery exemplary of region
____other:_____

Scientific:

____Scientific & Natural Area
____Federal Wildlife area
____State Fisheries or Wildlife area
____Area used for educational or
____scientific study
____other:_____

Historical:

____known historic sites
____known pre-historic sites
____other:_____

Natural:
____fisheries resource
____wildlife habitat (any endangered or
____threatened species?)
____native prairie
____virgin forest
____unique biological communities
____other:_____

Recreational:

____canoeing
____boating
____fishing
____hunting
____other:_____

Comments:_____

2) What is this recommendation being based on? (e.g., knowledge or data from work or study, experience as a user of the resource; etc.)

3) To your knowledge, to what extent and where is the quality of these resources being threatened by development or over use along the river? If there is little or no threat at present, indicate this also.

4) Do you have any sources of information data, studies, maps, etc. that you can share with the Rivers Section to better study those recommendations? yes_____ no_____
What are they?_____
If so, who can we contract?
Name_____
Address_____
Phone #_____

Thank you! If you have any further comments or questions about this survey, contact the Rivers Section.

Please return this survey to:

Gordon Kimball
Rivers Section
Box 10G, Centennial Office Building
St. Paul, MN 55155

APPENDIX C:

Natural and Scenic Ratings, and Agricultural and Urban Development Pressure Rating developed from the Minnesota Land Management Information System data base. This Appendix was prepared by Rick Gelbmann and David Morley.

The purpose of this project is to examine suitability of Minnesota rivers for potential detailed study and management plan development. The process has two major components: 1) A statewide inventory of potential wild and scenic river candidates, and 2) Detailed analysis of individual rivers. The statewide inventory uses both cellular and polygon based data and examines resource and cultural conditions to a 40 acre parcel resoulution. Analysis is guided by organization policy and state legislation. The detailed river analysis collects data specifically for river monitoring and planning and is compatible with other state data sets. The primary benefits of this two stage automated design are the ability to compare rivers statewide for priority setting and to describe candidate rivers in terms useful for river planning.

INFORMATION SOURCES

The Minnesota Land Management Information System (MLMIS) is one of the main sources of data. This system utilizes a 40 acre parcel as a basic data unit, often refered to as a 40 acre cell. A variety of resource and cultural variables with statewide coverage are available. Among these are interpretations of land use, soils, geomorphic regions, water and highway orientations. Data gathered for this project will correspond with the MLMIS format. This allows for the broadest comparisons and analysis with the greatest detail available from any single source. MLMIS will allow for extrapolation to rivers where data were not collected.

In the development stage eight sample sites were used to test the statewide model. The sample sites were selected to represent the diverse character of rivers throughout the state. Data was collected for each of these sample sites using the guidlines in Appendix E. The MLMIS models were compaired to the collected data and adjusted to fit the collected data as close as possible. The sites are listed below along with their representative characteristics.

Root River (Houston Co.) -Large bluff lines, wide river bottoms and complex land use.

T104n R5w S36
T103n R5w S1
to
T104n R5w S25

Whiteface River (St. Louis Co.) -No alluvial soils shown on MLMIS maps.

T53n R19w S27
T52n R20w S24

Buffalo River (Clay Co.) -Glacial lake Agassiz lake bottom.

T141n R48w S36
T141n R48w S3

Temperance River (Cook Co.) -North shore stream, year round flow, shows LLWL and SSWL soil landscape units on MLMIS.

T60n R4w S17
T59n R4w S31

Blue Earth River (Blue Earth Co.) -River bottom is wide here with well developed bluffs, large meanders, then narrowing down but retaining its bluffline, lots of forest with agricultural and open interspersed.

T107n R27w S6 (start) S31 (end)

Snake River (Pine Co.) -Scattered development, very scenic with rugged topography and natural features.

T39n R21w S26
T39n R19w S31

Straight River (Rice Co.) -Little senuosity, vegetation pattern such that woods are mainly left on east side of river due to topographic pattern, urban influence.

T109n R20w S6-33

The other main source of information was the Stream Inventory and Data Retrieval System (SIDRS). This data base was created by the Minnesota Department of Natural Resources and contains extensive polygonal data for over 30,000 streams statewide. It is the most accurate source of stream identification , trace location, measurement of length, and relation to watersheds. In the future, additional utilization of SIDRS is envisioned for calculating river sinuosity and for transfering new sets of polygonal information (such as river crossings) as they become available. For further information on SIDRS see Appendix A.

This project utilized the facilities at the Land Management Information Center (LMIC) of the Minnesota Department of Energy, Planning and Development.
New detailed data were coded by the staff of the Rivers section, Minnesota Department of Natural Resources. Technical assistance and support was supplied by the Research and Policy section of the Minnesota Department of Natural Resources. The Legislative Committee on Minnesota Resources (LCMR) funded the project, which is envisioned as a continuing process after the initial identification and analysis.

PRELIMINARY RIVER SELECTION AND SITING

A systematic approach was used to determine which rivers to include in the inventory as potential Wild and Scenic Rivers. Rivers were selected based upon size, recommendations or previous inclusion in other DNR programs.

The primary river (based upon dominant receiving stream) in each major watershed was identified using SIDRS. Other major rivers for automatic inclusion were considered to be the next two longest rivers per major watershed with a minimum length in most cases of 100 kilometers.

Rivers section staff surveyed DNR field personnel for specific recomendations of rivers in their areas. This pool of rivers based upon 'expert knowledge' was also included in the inventory. The other source was 'known resource' rivers which have been previously designated as canoe and boating routes, special fishery streams or the subject of detailed studies.

This resulted in a total of 157 rivers and streams as potential candidates. Most major branches of rivers were included, but as separate rivers. Furthermore, the Mississippi River was split into 4 segments for analysis. These segments are 1) Lower (below Hastings) 2) Metro (Hastings to Anoka) 3 Upper (Anoka to Brainerd) 4) Headwaters (above Brainerd).

CSAW (Common Stream And Watershed numbering system) identification numbers were then determined for the 156 rivers, with care taken to avoid the problem presented by duplicate names. All of the minor watersheds along each river could then be identified using the CSAW numbers.

Using the eight sample sites throughout the state, a one half mile wide zone on both sides of the river was determined to be an appropriate zone for resource analysis. Conditions within this zone have the greatest impact on the rivers. Floodplain siting was taken into consideration, and this width was considered to include full view-shed coverage.

The one mile wide sites, or more if the river was wide or sinuous, are centered around permanent rivers or streams (classes 3 and 4 in the MLMIS Water Orientation variable). Sites had to be in the watersheds identified from SIDRS. There is no overlap of river sites. The dominance of the receiving stream as well as watershed boundaries were taken into consideration for determining junctions of rivers. Some manual clean up of the river sites was necessary to assure continuous river sites with only the rivers of interest to the project. Parts of the rivers within the 1 mile site that were not among the 157 selected rivers were eliminated. Where rivers were interupted by channelized river segments or lakes, parcels were added to complete river sites.

Each river site was assigned a unique identification number (see Map #1 page 17). Frequency counts and maps were produced to analyze the initial stages of the inventory for geographical distribution and to check for siting discrepancies.

MEASUREMENT OF NATURAL AND SCENIC CONDITIONS

The next step involved determining to what degree each river site was scenic or in a natural condition. The MLMIS Land Use/Land Cover variable was used to describe the naturalness of each forty acre parcel within a river site. Each parcel is described as dominantly having one of the following land use/land cover conditions. 1-Forested, 2-Cultivated, 3-Water Covered, 4-Marshland, 5-Urban Residential, 6-Extractive, 7-Pature and Open, 8-Non-Residential or Mixed Residential, or 9-Transportation. For this project any parcel described as being dominantly Forested, Water covered, Marshland or Pasture or open were considered to be 40 acre parcels in a natural condition and given a rating of 1.

Scenic potential is used here to mean the potential for scenic opportunity. Rough terrain is assumed to enhance scenic opportunity by providing a variety of vistas and landscapes defined by terrain features. Scenic potential was based on a description of the terrain within a forty acre parcel. The terrain variable which was used has five catagories; 1-flat (0 to 2% slope), 2-Rolling (2% to 6% slope),; 3-Steep (+6% slope), 4-Rolling with a high likelihood of having river bluff features, 5-Steep with a high likeihood of having river bluff features. The roughness of terrain is based on two MLMIS variables, Geomorphic Regions and Soil Type. Areas likey to have river bluff features are defined as forty acre parcels along the edge of alluvial soils and rough or rolling terrain.

Any occurrence of a dominant intensive land use within a forty acre parcel negated natural or scenic conditions. Intensive land use includes all Urban, Extractive and Cultivated cells. Natural and scenic conditions imply not only the presence of natural land cover and topographic diversity but also a lack of intensive land use. For this reason the presence of a dominant intensive land use neutralized any positive rating of a parcel due to natural land cover or topographic diversity. Throughout the state any parcel dominantly extractive (mining) or urban land use was considered intensive land use. Cultivated land was treated as an intensive land use only in parts of the state where it was generally an intrusion on normal land cover conditions. To select which parts of the state cultivated land was considered normal. DNR Biocuyltural regions were used. (See Map 2) These Regions have generally homogenlous vegetation and topography.Roads also were considered to be intensive land use in some parts of the state. The reasoning behind this is that in less populated areas human activity contrasts more sharply with nature than in other parts of the state. A road in a sparcely populated area represents a significant intrusion upon natural condition. The manner in which each Biocultural region was treated is layed out in the chart below.

ATURAL CONDITION RATING FOR LAND USE/LAND COVER CLASSES BY BIOCULTURAL REGION

	Natural Conditions				Intensive Land Use Conditions				
Bioicultural Regions	Forested	Pasture Open	Marsh	Open Water	Cultivated	Extractive	Urban (mixed Res. & Trans.)	Paved Road O.	Gravel Road O.
Agassiz Lowlands	1	1	1	1	Drop*	Drop*	Drop*	Drop*	Drop*
Aspen Parklands	1	1	1	1	0	Drop*	Drop*	0	0
Big Woods	1	1	1	1	Drop*	Drop*	Drop*	0	0
Blue Hills	1	1	1	1	0	Drop*	Drop*	0	0
Blufflands	1	1	1	1	0	Drop*	Drop*	0	0
Border Lakes	1	1	1	1	Drop*	Drop*	Drop*	Drop*	Drop*
Coteau Des Prairie	1	1	1	1	0	Drop*	Drop*	0	0
Grantsburg	1	1	1	1	0	Drop*	Drop*	0	0
Lauertian Divide	1	1	1	1	Drop*	Drop*	Drop*	Drop*	Drop*
Leaf Hills	1	1	1	1	Drop*	Drop*	Drop*	0	0
Mille Lacs	1	1	1	1	Drop*	Drop*	Drop*	0	0
Mississippi River Sandplains	1	1	1	1	0	Drop*	Drop*	0	0
North Shore Highlands	1	1	1	1	Drop*	Drop*	Drop*	Drop*	Drop*
Pine Moraines	1	1	1	1	Drop*	Drop*	Drop*	0	0
Red River Valley	1	1	1	1	0	Drop*	Drop*	0	0
Border Lakes	1	1	1	1	0	Drop*	Drop*	0	0
Tamarack Lowlands	1	1	1	1	Drop*	Drop*	Drop*	0	0
Upper MN River Country	1	1	1	1	0	Drop*	Drop*	Drop*	Drop*

TE: *Drop indicates that if this Land Use/Land Cover condition exists any positive rating for that parcel due to natural or scenic conditons would be dropped and a natural and scenic rating of zero assigned to that parcel.

Selecting potential outstanding river candidates based only on a statewide rating of their natural and scenic conditions does not take into consideration the great terrain and vegetative diversity within Minnesota. Terrain conditions unique in one part of Minnesota may be common in another location. To balance the relative importance of terrain to unique scenic potential throughout the state regional ratings were used. DNR Biocultural Regions were selected as the regional unit (see Map 2). These regions have generally homogenous topographic and biologic characteristics (Miles 1978).

Generally, the more common the terrain type within a region the less importance that terrain type plays in the regional uniqueness of a river's scenic rating. This rule applies most firmly to the flat terrain types since steep terrain by its very definition is diverse and therefore maintains its scenic uniqueness even when much of the region is steep. The terrain ratings which were applied to each biocultural region are listed below.

SCENIC POTENTIAL RATING OF TERRAIN CONDITIONS BY BIOCULTURAL REGION

Boicultural Regions	Flat	Rolling	Steep	Rolling with Possible Bluff Feature	Steep with Possible Bluff Feature
Agassiz Lowlands	0	1	1	1	1
Aspen Parklands	0	1	1	1	1
Big Woods	1	1	1	1	1
Blue Hills	0	1	1	1	1
Blufflands					
Border Lakes	1	1	1	1	1
Coteau Des Prairie*	1	1	1	1	1
Grantsburg*	0	0	0	0	0
Lauertain Divide	1	1	1	1	1
Leaf Hills	0	1	1	1	1
Mille Lacs	0	1	1	1	1
Mississippi River Sandplains	0	0	1	1	1
Northshore Highlands	0	1	1	1	1
Pine Moraines	1	1	1	1	1
Red River Valley	0	1	1	1	1
Border Lakes	0	1	1	1	1
Tamarack Lowlands	1	1	1	1	1
Upper Mn River Country	0	1	1	1	1

*NOTE Because of the way in which geomorphic and soil data were originally collected the terrain model is a poor prediction of terrain features in this part of Minnesota. To avoid misinterpretation of the information these areas were set to a zero rating (no impact).

The result of the above process was a Natural and Scenic rating for each cell in all 157 river sites. The ratings are as follows:

0 - no natural or scenic conditions present or intensive land use present.
1 - either natural or scenic condition
2 - both natural and scenic conditions

A determination was made by the DNR Rivers section staff that any river with 50% or more of its site having intensive land use or no natural or scenic conditions should be dropped from further consideration. While this served as the minimum standard for natural and scenic conditions, some rivers that were below this threshold were maintained in the inventory. These rivers had highly regarded stretches or were recognized to have extenuating circumstances (i.e. Minnesota River tributaries where the terrain model does not work properly) .

This second step of the process produced frequency counts of the Natural and Scenic conditions rating for every river and a map of all 157 river sites showing the rating distribution for visual analysis. The result was that 129 rivers were determined to be at least minimally natural and scenic.

IDENTIFYING NEED FOR PROTECTION

Since the goal of the various river protection programs, such as Wild, Scenic and Recreational Rivers, is to protect the natural resources of a river from development, it was necessary to determine some measure of a need for protection. This was defined in terms of urban and agricultural development pressures.

Since no actual pressure data was available at the time of this project's development a model had to be developed which would approximate development pressure. The assumptions on which these development pressure models are based are: 'A particular land use is most likely to expand in areas where it is currently concentrated.' and 'The higher the concentration the greater the pressure.

Urban Development Pressure included any cell which was classed urban (Residential, Mixed residential or Transportation from MLMIS Land Use variable). In addition parcels having 4% of the parcels within 5 miles classed as urban were also classed as cells with Urban Development Pressure. Every cell in each river site was rated 0-no urban pressure or 1-under urban pressure.

Agricultural Development Pressure includes lands with high cropland potential (groups 1 and 2 of the MLMIS Agricultural Productivity variable) and forty acre parcels in which 80 percent of the parcels within one mile are coded Cultivated in the MLMIS Land Use variable. Here again, each river site cell is rated 0-no agricultural pressure or 1-under agricultural pressure.

Combining the two development pressure indicators, a rating was given to every cell within a river site. The classes are listed below.

0 - no pressure
1 - either urban or agricultural pressure
2 - both urban and agricultural pressures

A map of the 129 remaining rivers was plotted showing the distribution of the urban and agricultural development pressure across the state. The frequency counts document the impact within each river site.

SUMMARY

The immediate purpose of this inventory has been to determine which rivers should be studied in greater detail for river management consideration. Besides the rivers qualifying above, rivers may be considered which rated high only in natural and scenic conditions but where extensive development is known to be occurring. The basis for this decision is that the land use data in MLMIS was coded over 10 years ago and may have changed considerably in certain areas.

A need to update this data is only one of the reasons for the detailed studies described in Part III. Another is to collect previously unavailable data that would help in analyzing the individual site situations. Examples of this new data would include secondary and tertiary land uses, specific point land uses, and more exact terrain data.

Within the Rivers planning section these new methods facilitate on-going river monitoring. Since sites and methods have already been established, new data may be added with relative ease which will make it possible to monitor using the existing methods. Beyond the resource and cultural data used for this analysis, recreational demand and facility data may be employed to assist river planning efforts.

The automation of river data has resulted in products useful outside of the original intent. One of the most useful information products is the identification and location of 157 rivers in the MLMIS forty acre cell data base. Previous to this effort, although all river and stream oriented cells were identifiable, individual rivers were not distinguishable from their tributaries or even from other rivers. River identification is not only useful when examining an individual river or groups of rivers, but it also provides a means of selecting only major Minnesota receiving streams.

Individual river site data may also be useful to outside users. Since most MLMIS 40 data is designed for general purpose use it may not always meet specific research needs. One way of meeting these needs, short of collecting data statewide, is to project a sample onto the existing statewide data. In this case, specific river site data may be used to project results at the state-wide scale.

Minnesota

DEPARTMENT OF NATURAL RESOURCES

Policy

Effective Date 9/15/80	Rev. 2/13/81 Approved: Joseph N. Alexander
Number 7	
Supersedes Number ____	Other Guidelines
Date ____	Commissioner Orders # ____
	Rules & Regulations ____
	Operational Order ____
	Dept. Manual ____
	Other M.S. 85.32, 84.027, 104.01-014.07, 105.485 104.31-104.40

SUBJECT: RIVER MANAGEMENT 0320B

Preamble

Minnesota Statute 84.027 establishes the powers and duties of the Commissioner of Natural Resources. Minnesota Statute 84.027, subdivision 2, states: "Duties. The commissioner shall have charge and control of all the public lands, parks, timbers, waters...." Charge and control of Minnesota's rivers is a major component of these stated duties.

In keeping with this legislative mandate, the department has established a single goal for all river management activities. It is the goal of the Department of Natural Resources in managing the state's river resources to:

PRESERVE, ENHANCE, AND PROVIDE FOR THE WISE USE OF THE NATURAL, EDUCATIONAL, RECREATIONAL, AND ECONOMIC VALUES OF ALL OF MINNESOTA'S RIVERS AND THEIR ADJACENT LANDS.

The legislature has authorized a number of management programs which provide the commissioner with a means to accomplish this goal. Each legislatively authorized river management program has a particular mission which provides the basis for proper application of the program. The four major river management programs and their missions are:

1. Shoreland Program (M.S. 105.485): to guide shoreland development in order to protect the water resource and adjacent lands

2. Floodplain Program (M.S. 104.01-104.07): to reduce flood damage and flood-related loss of life

3. Wild, Scenic, and Recreational Rivers Program (M.S. 104.31-104.40): to preserve and protect the state's outstanding river qualities

4. Canoe and Boating Route Program (M.S. 85.32): to mark canoe and boating routes and provide recreational facilities on legislatively designated rivers (18 rivers at present)

To facilitate meeting its stated goal, the department has identified river management objectives and policies to provide for the implementation and coordination of the department's river activities into a comprehensive river management program. These objectives and policies have been formulated in the following areas:

General Procedures

Program Application
(Designation Criteria and Procedures)

I. Shoreland
II. Floodplain
III. Wild, Scenic, and Recreational Rivers
IV. Canoe and Boating Routes

Management

I. Land Use
II. Water Surface Use
III. Recreation Development
IV. Land Acquisition
V. Resource Development

To ensure coordination and to prevent unnecessary duplication or overlap in areas of river management (i.e., data collection, storage and analysis, planning, plan implementation, and evaluation) the department will consult with the appropriate local, regional, state and federal units of government and their agencies.

GENERAL PROCEDURES

To ensure a coordinated approach to the management of the state's river resources, the department will adhere to the following general procedures:

A. Conduct a comprehensive, statewide river resource inventory. Data collected must include that necessary for initial review by the four major programs (e.g., data necessary for the identification of areas with major soil erosion problems).

B. Develop and implement a river classification system through the Shoreland Program.

This classification system will be a comprehensive one that can be used by all river management land use programs. Classes within the system will be assigned to river segments. (As the system is developed, a minimum segment length will be established.) Classes will be based on the physical and cultural features of a segment and its adjacent lands. (Topographical, hydrological, biological, geological, archaelogical, present land use, ownership, and existing or potential development data will be included.)

C. Identify appropriate application of individual river management programs.

PROGRAM APPLICATION

To ensure a coordinated river management effort among the four key programs, the department has identified designation criteria and procedures for each program's application. These criteria and procedures are listed below.

I. THE SHORELAND PROGRAM

The Shoreland Program, as mandated by Minnesota Statute 105.485, is applicable to all rivers which have a drainage area of at least two square miles.

Shoreland Procedures

A. The department will design a river classification system based on the comprehensive river inventory. The system will include land use zoning provisions for each class.

B. PERT will review the classisfication system.

C. The department will propose classification for all river segments.

D. Proposed classifications will be sent out for local review.

E. Taking into consideration local reviews, the commissioner will approve classifications for each zoning authority.

F. Local units of government will be requested to amend or adopt local zoning ordinances to comply with classifications.

G. The department will provide continuing technical and administrative assistance to zoning authorities.

II. THE FLOODPLAIN PROGRAM

The Floodplain Program, as mandated by Minnesota Statute 104.01-104.07, is applicable to all rivers for which the department has adequate data to delineate the floodplain.

Floodplain Procedures (now in effect)

A. The department obtains data and delineates the 100-year floodplain.

B. Communities with delineated floodplains have up to one year to adopt floodplain provisions which comply with state standards.

C. Community ordinances are sent to the department for review and approval and are subsequently adopted by the community.

D. The department provides continuing technical and administrative assistance to communities in all phases of comprehensive floodplain management.

III. THE WILD, SCENIC, AND RECREATIONAL RIVERS PROGRAM

The wild and scenic rivers act, passed by the legislature in 1973, directs the department to "preserve and protect" Minnesota rivers that exhibit "outstanding scenic, recreational, natural, historical, scientific, and similar values." The act is not meant to restore river areas to wilderness, but is meant to protect exceptional rivers from the degradation that is caused by uncontrolled development and recreational overuse.

In general, proper application of the Wild, Scenic, and Recreational Rivers Program requires the identification and documentation or a river's resource values. If a river exhibits truly outstanding values, as defined by the designation criteria, application of the Wild, Scenic, and Recreational Rivers Program is appropriate. In addition to land use management, the program possesses the management tools of land acquisition, and user and water surface use management, which may be necessary to adequately protect the river resource. Any changes in land use management should be based on an analysis of the adequacy of present rules (floodplain or shoreland) to protect and preserve resource values.

To accomplish this process in a consistent manner, the department will adhere to the following criteria and procedures:

Wild, Scenic, and Recreational Rivers Designation Criteria

A. Proposed rivers or river segments (minimum reach: 25 miles) will contain outstanding scenic, recreational, historical, and/or natural and scientific qualities. (Outstanding means eminent, conspicuous, or distinctive.)

A river must exhibit outstanding resource qualities in only one of the following categories to be considered eligible.

1. Scenic - one or more of the following are observable:

   a. unity
   b. variety
   c. vividness

   Scenic quality is largely a subjective judgment and virtually impossible to define or quantify. There are, however, general guidelines which can facilitate evaluation.

Basic aesthetic criteria are unity, variety, and vividness (Pepper, 1937). Unity is that characteristic whereby all parts are joined into a single and harmonious whole. The water itself provides a continuing, unifying theme to the river landscape and is one that calls attention to itself. Variety indicates the complexity of different parts--"richness" or "diversity" carry the same idea. Vividness is the characteristic that gives strong visual impression. It indicates relations or combinations that are conspicuous. Contrast is one expression of vividness, another is more subtle--compositional reinforcement from repeated groupings or from somewhat similar aggregations.

2. Recreational - of the following, one or more of outstanding quality or several of good quality should be possible with appropriate management:

   a. Canoeing/boating (see Canoe and Boating Route Criteria)
   b. Fishing (existing game fish population or ability to sustain introduced game fish population)
   c. Hunting (presence of commonly hunted birds, and small and large game)
   d. Nature study (photography, bird/wildlife observation, sightseeing)
   e. Water contact sports

3. Historic - one or more of the following should be present:

   a. Prehistoric sites
   b. Historic sites
   c. Significant prehistoric or historic use

4. Natural and Scientific - one or more of the following should be present:

   a. Adjacent lands which are primarily undeveloped
   b. Rare or endangered plant or animal species
   c. Significant remnants of presettlement vegetation types
   d. Significant animal populations or colonies (e.g., heron rookeries)
   e. Potential for use in ecological studies
   f. Lands which are or which qualify as Scientific and Natural Areas
   g. Unique plant or animal communities
   h. Unique or significant geologic features

Wild, Scenic, and Recreational Rivers Procedures for Designation

The department will:

A. 1. Examine the statewide comprehensive river inventory for rivers or river segments which contain outstanding scenic, recreational, historical, and/or natural and scientific qulaities. (Prior to the completion of the comprehensive inventory, certain high quality rivers will be examined for specific outstanding qualities and prioritized.)

2. Prioritize the potential wild and scenic rivers or river segments on a:

a. Regional (DNR regions) basis, considering:

i. Existing development pressures
ii. Quantity and quality of outstanding characteristics
iii. Input from the general public

b. Statewide basis, using regional priorities and considering the three components used in the regional analysis

B. 1. Develop a work program for PERT review.

2. Conduct and document resource analyses of potential wild, scenic, and recreational rivers and river segments according to legislative authorization and in consultation with local officials. The analyses will:

a. Identify and document outstanding resource values
b. Identify and evaluate land uses
c. Identify recreational uses
d. Identify cultural and socioeconomic activities
e. Identify and evaluate existing land use controls

C. 1. Recommend, if designation criteria are met, that a management plan be developed for the river or river segment.

2. Have PERT review staff recommendations.

3. Develop a management plan which identifies and evaluates management alternatives ensuring local input. The plan will address proposed:

a. Land use controls
b. Recreation management
c. Water surface use controls
d. Need for land acquisition

4. Conduct public informational meetings on the resource analysis and management plan.

5. Hold public hearings (Chapter 15) on the designation proposal.

6. Submit the proposal to the commissioner for a designation decision.

IV. CANOE AND BOATING ROUTE PROGRAM

Minnesota Statute 85.32 authorized the Commissioner of The Department of Natural Resources to mark canoe and boating routes and provide recreational facilities on eighteen of the state's rivers. These are the Little Fork, Big Fork, Minnesota, St. Croix, Des Moines, Crow Wing, St. Louis, Rum, Kettle, Cloquet, Root, Zumbro, Crow, Mississippi, Cannon, Straight, Snake, and Red Lake Rivers.

To decide the reaches of these rivers on which to properly apply the program and to evaluate other rivers for recommended inclusion, the department will adhere to the following designation criteria and procedures.

Canoe and Boating Route Designation Criteria

A. The department will evaluate the statewide comprehensive river inventory for existing and potential canoe and boating routes (rivers or river segments, minimum five-mile reach) to determined whether they meet the following criteria:

1. Canoeable at least three months of the year, preferably between May 1 and September 1

2. Potentially free of numerous snags and manmade obstacles (no more than an average of one portage per mile) and unavoidable safety hazards

3. River shorelands are suitable for campsite and rest area development, preferably on land already owned by the state

4. Existing or potential accesses are compatible with the river resource, current recreational use, and the river's classification

5. Capable of sustaining controlled amounts of recreational use without substantial adverse impact on the resource, adjacent lands, or land uses

6. Present uses are compatible with canoeing and boating

7. Water quality is high enough to allow for body contact

8. Scenic qualities contribute to the recreational experience

9. Has reasonable proximity to potential users

Canoe and Boating Route Procedures for Designation.

A. Proposals for state canoe and boating routes may be submitted by any agency, division of the Department of Natural Resources, user group, or other group. Proposed rivers should meet the department's designation criteria.

B. The department will evaluate proposed rivers, taking into account the following factors:

1. Recreational demand - to be determined through analysis of SCORP and watercraft registration data and use monitoring

2. Resource characteristics - to include an analysis of:

   a. Geographical location
   b. Physical characteristics
   c. Water quality
   d. Land use--forestry, agriculture, resorts; level of development
   e. Water flow--slow, fast, quiet; rapids, whitewater
   f. Present recreational uses

3. Recreational potential - to include an analysis of:

   a. Promimity to population centers, areas of concentrated use, or areas of high demand
   b. User preferences and recreational experiences offered
   c. Proximity to other canoe and boating routes
   d. Proximity to recreational facilities

4. Comments from local, state, and federal units of government and the public

C. The department will prepare a general plan for the river which will include local input. This plan shall include, but not be limited to, a map showing the river resources (including dominant land uses) and information pertaining to expected amount and type of recreational use and the degree of recreational development which will satisfy user needs, protect the resource, and be consistent with total river management (e.g., other facilities and classifications).

D. The proposal will be reviewed by PERT.

E. Designation will occur by means of legislation. Legislation should include funding for acquisition, development, and maintenance for new canoe and boating routes.

MANAGEMENT

To ensure a unified river management effort, the department has formulated a single set of management objectives and policies. Objectives and policies have been identified for five general river management activities rather than for individual programs. These management activities are land use management, water surface use management, recreational development and user management, land acquisition, and resource development. The programs, with their particular management capabilities, are then applied as necessary to achieve the objectives.

The management activities authorized for the four key programs are:

Program	Management Activity
The Shoreland Program	Land Use Management
The Floodplain Program	Land Use Management
The Wild and Scenic Rivers Program	Land Use Management Water Surface Use Management Recreational Development and User Management Land Acquisition
The Canoe and Boating Route Program	Recreational Development Land Acquisition

To avoid unnecessary discrepancies or duplications, all rules pertinent to a management activity which are common to two or more programs must be reviewed and amended to ensure compatibility among programs (e.g., land use management used by Shoreland, Floodplain, and Wild, Scenic, and Recreational Rivers programs--rules pertaining to land use management in all three programs must be made compatible).

Any river managment program authorized to use any of the river management activities must adhere to the following objectives and policies.

I. LAND USE MANAGEMENT

General Policy

The department will adhere to the following administrative objectives in managing land use on Minnnesota's rivers:

A. To maintain or upgrade present water quality.

B. To prevent incompatible uses and overdevelopment of land along rivers.

Specific Policy

To fulfill these objectives the department will:

1. Obtain and maintain adequate data on the water quality of Minnesota's rivers.

2. Monitor all land use activities of local governments and take approriate enforcement action where local activities significantly violate minimum standards.

3. Provide annual training and workshop sessions for local planning and zoning officials.

4. Provide minimum standards for the installation of onsite sewage disposal facilities.

5. Provide for the identification and elimination of nonconforming sewage disposal facilities.

6. Develop and ensure enforcement of pre-construction, contruction, and post-construction erosion and sediment control measures.

7. Develop and ensure enforcement of no clear cutting in the area between the riverbank and the building setback line, in conjunction with commerical or residential development. Selective cutting or removal within specific guidelines will be allowed.

8. Develop and ensure enforcement of rules pertaining to vegetative management practices along rivers (e.g., cultivation and logging).

9. Provide for the protection and management of wetland types 1 through 8 within shoreland areas.

10. Expand public information and education efforts pertaining to river resources and management.

11. Ensure that no development takes place on lands (soils, slopes, floodplains, etc.) unsuitable for development.

12. Provide for the elimination of nonconforming land uses within river shoreland areas over a specified period of time.

13. Develop and ensure enforcement of dimensional land use zoning provisions (frontage, lot size, setback, etc.).

14. Formulate and ensure the enforcement of rules concerning development on slopes in excess of 12 percent, giving emphasis to those areas visible from the river.

15. Encourage local units of government to consider cluster developments and PUDs (Planned Unit Developments) as alternatives to traditional subdivision developments to minimize adverse impacts on the resource.

16. Ensure that existing substandard lots of record (e.g., those with insufficient acreage or frontage) be combined, if contiguous and under one ownership.

17. Develop rules for industrial and commerical developments which require locations near a river.

18. Guide the establishment of land use districts within river corridors.

19. Establish rules for the development of recreational facilities (public and private) along rivers.

20. In land use control, take into account the natural meandering character of rivers.

21. Ensure the implementation and enforcement of flood damage reduction measures.

II. WATER SURFACE USE MANAGEMENT

General Policy

The department will adhere to the following administrative objectives in managing water surface use on Minnesota's rivers:

A. To maintain or enhance river water quality, adjacent land values, and fish and wildlife values.

B. To maintain or enhance river users' safety and reduce property damage.

C. To maintain or enhance river users' recreational experiences.

Specific Policy

To fulfill these objectives the department will:

1. Provide public education and information regarding water surface use controls.

2. Ensure, through coordination with the affected local units of government, the enforcement of water surface rules where it has been determined that recreational and commercial uses (including noise level) are detrimental to fish, wildlife, adjacent lands, or landowners.

3. Ensure the application of appropriate rules to minimize erosion.

4. Conduct shoreline and riverbed studies to determine the environmental impacts (including erosion and sedimentation) of water surface use.

5. Ensure the enforcement of all state boat and water safety rules.

6. Ensure the enforcement of water surface use controls by the responsible unit.

7. Promote the adoption of water surface use controls by local governments to ensure user safety, to eliminate conflicts between user groups, and to eliminate uses that are incompatible with the resource.

8. Ensure, through coordination with the affected local units of government, the enforcement of rules and regulations relating to all on-shore facilities, including docks, marinas, and boat moorings (e.g., State Statute 105.42 and Uniform Fire Code for Marinas and Docks).

9. Monitor recreational use to determine areas of conflicting uses.

10. Provide for user and citizen input to determine and resolve user conflict.

III. RECREATIONAL DEVELOPMENT

General Policy

The department will adhere to the following administrative objectives in managing recreational development on Minnesota's rivers:

A. To develop and maintain recreational opportunities and facilities, in accordance with identified needs, for the enjoyment and safety of the user on all waters which can offer desired recreational experiences.

B. To develop and maintain recreational opportunities and facilities in keeping with the river character, without causing significant adverse impacts on the resources or adjacent lands.

Specific Policy

To fulfill these objectives the department will:

1. Identify and cataegorize recreation rivers.

2. Provide public information and education about river recreational opportunities, proper river use, and all pertinent user controls, rules, laws, etc.

3. Evaluate regional needs and provide a variety of recreational experiences in each region.

4. Maximize resource-compatible recreational opportunities in areas adjacent to large population centers.

5. Encourage the participation of citizens and all levels of government in the development and/or maintenance of recreational sites.

6. Ensure that all recreation facilities supplied for public use conform to all appropriate rules.

7. Maintain a river level reporting system on all major boating and canoeing rivers.

8. Ensure the enforcement of laws, rules, and orders relating to recreational use.

9. Adopt rules and/or commissioner's orders, as authorized and necessary, to prevent environmental damage and violation of private property rights.

10. Clear minimum safe passage for water surface recreational users by removing obstructions as necessary.

11. Provide safe portages around dams, rapids, and other hazards.

12. Provide adequate signs warning of hazards and designating areas for public use.

13. Monitor the recreational use of rivers to determine conflicts and environmental damage, and to recommend feasible and enforceable solutions.

14. Analyze the recreational uses (type and intensity) that will be compatible with the river environment.

15. Control access (availability and type) to rivers to preserve river character and to regulate the amount of use.

16. Close, remove, and/or relocate recreational sites when their use causes excessive resource degradation.

17. Screen adjacent private and other public property where necessary.

18. "Harden" recreational sites, where use and resource considerations dictate, through the use of stairways, crushed rock paths, fireplaces, etc.

IV. LAND ACQUISITION

General Policy

The department will adhere to the following administrative objectives in the acquisition of interests in lands on Minnesota's rivers:

A. To preserve and enhance unique and outstanding river resources which are not adequately protected by zoning regulations.

B. To provide areas for resource and recreational development.

Specific Policy

To fulfill these objectives the department will:

1. Identify unique and outstanding river resources which are not adequately protected by zoning regulations.

2. Prioritize these identified areas according to immediacy of need for protection and funding limitations.

3. Coordinate with other governmental and private organizations the protection of these areas.

4. Provide management of the department's land interests.

5. Use easements or leases in preference to fee title purchase to acquire interests in lands to protect resources.

6. Identify state resource and recreational development demand.

7. Make use of existing public lands in preference to new acquisition.

8. Prioritize necessary acquistions of potential developement areas.

9. Coordinate with other governmental organizations the acquistion of these areas.

10. Use site specific analyses to determine the most appropriate form of acquisition for potential development areas.

V. RESOURCE DEVELOPMENT

General Policy

The department will adhere to the following administrative objectives in managing resource development on Minnesota's rivers:

A. To maintain or enhance water quality.

B. To ensure, to the extent possible, satisfactory instream flows for all users.

C. To maintain or enhance fish and wildlife values.

D. To provide guidance in the economic use of river resources and adjacent lands, consistent with preservation of the resource.

Specific Policy

To fulfill these objectives the department will:

1. Minimize water quality degradation resulting from alteration of the course, current, or cross-section of public waters or public wetlands.

2. Minimize point and non-point source pollution through cooperation with other agencies.

3. Develop and maintain a statewide instream flow data program.

4. Encourage land use practices that facilitate groundwater recharge and reduce surface runoff.

5. Provide for the protection of wetlands, lakes, etc., that moderate flow extremes.

6. Regulate water appropriations.

7. Ensure development and implementation of reservoir operation plans for the protection of downstream resource values.

8. Ensure continuous river studies to monitor the impacts of resource development on fish and wildlife values.

9. Coordinate all development activities with other state, federal, and local units of government.

10. Improve streambeds or banks for fish and wildlife habitat.

11. Develop fish spawning, rough fish control, and spawn-taking sites where it is determined to be beneficial to the resource.

12. Develop water level control facilities, consistent with riparian rights, where it is determined to be of benefit to fish and wildlife.

13. Determine the compatibility of the river resource with fishing, trapping, hunting, ricing, mining, etc., and to manage each river in accordance with that compatability.

14. Coordinate with other agencies the review of existing or proposed power generation facilities.

15. Study and participate in the regulation of commerical navigation with other affected federal and state agencies.

16. Ensure that the department has an active role in future channelization, dredging, and fleeting decisions, and lock and dam expansions, in order to minimize their impact on the river resource.

17. Ensure that the development and maintenance of marinas or multiple watercraft facilities are compatible with the river resource.

APPENDIX E

DETAILED RIVER STUDIES

CODING RULES

FOR

FILE GENERATION

GENERALIZED TERRAIN

File name: UPD.TERR

Purpose: To identify the overall landform characteristics along the river as well as the proximity of landforms to the river.

Procedure: United States Geological Survey (U.S.G.S.) seven and one half minute quads will be used to determine generalized terrain conditions along the river. Three broad terrain types will be distinguished according to the following rules and will serve as a permanent record of information coded into the Minnesota Land Management Information System (MLMIS).

1. General rules

   A. Sufficient area will be shaded with colored highlighters for a zone at least 1/2 mile back from the river when no high slope terrain exists.

   B. Where high slope terrain occurs, the following guidelines apply:

      1) An area 400 feet beyond the crest of the first high slope terrain within 1/2 mile of the river shall be shaded.

      2) If a second high slope terrain area with an elevation at least 100 feet higher is behind the first slope, the second slope will also be shaded if within 1/2 mile of the river.

      3) If a situation arises where a floodplain extends over 1/2 mile back from the river and then a bluff line occurs, shade all the way back to include this area as well.

      4) In situations where isolated high slope areas are found adjacent to the river, the 1/2 mile rule (see 'A' above) shall apply.

   C. Terrain definitions

      1) Flat terrain (shaded pink) 0-3% slope

         a. Areas where there are no no more than one 10 foot contour line for each 333 feet of horizontal distance are considered flat.

         b. All flat areas must be at least 40 acres in size.

         c. If the flat area is the only terrain form between the river and the first high slope area, then the 40 acre minimum size rule is dropped.

2) Rolling terrain (shaded blue) 3-13% slope

a. Areas where the distance between contour lines is between 77 and 332 feet of horizontal distance are considered rolling.

b. All rolling areas must be at least 40 acres in size.

c. If the rolling area is between the river and the first high slope area, then the 40 acre minimum size rule is dropped.

d. If the area qualifies as high slope (below) then high slope takes precedence.

3) High Slope terrain (yellow) 13% and higher slopes

a. Areas are considered high slope where there are at least three 10 foot contour lines within 231 feet maximum horizontal distance, or a comparable amount over a wider distance.

1) Stated another way, this is at least one 10 foot contour line for each 77 horizontal feet with a minimum rise of at least 30 feet within 231 feet. So at least 4 lines within 308 feet or 5 lines within 385 feet, etc. would qualify as well.

b. There is no minimum size for high slope areas.

D. Coding instructions

1) Indicate river site boundaries on the quads.

2) Overlay a 40 acre grid onto the shaded quads using section lines corresponding to the windowed site, and code each cell within the river site according to the appropriate class below based on the colors shown.

CLASS	
1	Flat (pink only)
2	Rolling (blue only)
3	High Slope (yellow only)
4	Mixed: Flat, Rolling, and High Slope (all 3 colors)
5	Mixed: Flat and Rolling (pink & blue)
6	Mixed: Flat and High Slope (pink & yellow)
7	Mixed: Rolling and High Slope (blue & yellow)

3) At least 10% of the cell must be shaded for that terrain type to be coded.

4) If the terrain type is adjacent to the river (within 400 feet), the 10% minimum rule does not apply.

5) The appropriate classification will be entered on the coding sheet in the far right data column (right justified).

   a. Example:

      If the cell has 40% blue and 60% pink then enter:

			5

6) In a case where the site exceeds 1/2 mile due to distant bluff features, make note of this condition so that any further coding will include these areas as well.

7) The file name will be UPD.TERR

8) Mark each coding sheet with the river name, page number, date and your initials.

TERRAIN FEATURES

File name: UPD.BLUF

Purpose: To identify features of high slope landforms that possess scenic value, to distinguish the proximity of the features to the river, and to classify the features by height.

Procedure: The U.S.G.S. quads that were shaded for generalized terrain will be used to identify the location of terrain features along the river. Only those areas which have 13% or greater slope are considered to have terrain features present.

1. General rules

   A. Only areas shaded yellow on the quads are examined for terrain features, since they are the high slope areas.

   B. Areas within 400 feet of the river are considered to be adjacent to the river.

   C. Height will be grouped into 100 foot vertical rise classes.

      1) Since the minimum requirement for high slope was 30 feet when coding generalized terrain, it remains the minimum height for a terrain feature.

   D. Coding instructions

      1) Overlay a 40 acre grid onto the shaded quads using the same site determined for generalized terrain, and code qualifying cells into one of the following classes.

CLASS	
1	30-100' height, all of feature adjacent to the river
2	30-100' height, partly adjacent and partly distant
3	30-100' height, feature entirely distant from river
4	100-200' height, adjacent
5	100-200' height, mixed
6	100-200' height, distant
7	200' or higher, adjacent
8	200' or higher, mixed
9	200' or higher, distant

2) At least 10% of the cell must be shaded yellow for coding to be done.

3) The appropriate classification will be entered on the coding sheet in the far right data column (right justified).
   a. Example:

      If the cell has a 120 foot high feature that is entirely within 400 feet of the river enter:

			4

4) The file name will be UPD.BLUF

5) Mark each coding sheet with the river name, page number, date and your initials.

LAND USE AND COVER

File name: UPD.COVR

Purpose: To identify the location of natural vegetative covers and intensive land uses along the river. Also to determine those areas having the greatest impact upon the river, which are areas immediately along the river bank.

Procedure: Aerial slides are interpreted to determine land use and cover. The Agricultural Stabilization and Conservation Service (A.S.C.S.) color slides taken in the summer of 1980 are used wherever available. Black and white ariel photos taken since 1971 may be used in other cases. The interpretations are noted on a different set of U.S.G.S. quads than are used in determining terrain.

1. General rules

   A. An area extending at least 1/2 mile back from the river will have land uses and vegetative covers interpreted and indicated on the quads.

      1) If the generalized terrain site extends beyond 1/2 mile to include distant river bluffs, then these areas should be coded for land use and cover as well.

   B. If boundaries of land use areas on the quads have changed current boundaries reflecting change will be drawn in.

      1) Example

         If a wetland is no longer as extensive as shown on the quad a new border will be indicated and the current land use or cover occurring on the reclaimed wetland will be indicated.

   C. In the case where a land use or cover becomes homogeneous over the entire balance of the river further upstream, indicate this situation on the quads.

      1) For instance, if the entire upstream portion of a river site is determined to be exclusively forest or agriculture, with no secondary or tertiary uses, then interpretation can be discontinued at that point and this situation should be documented on the quads as well as in the coding notes.

   D. Symbolization of land uses and covers

      1) Enter the following symbols on the quads under the appropriate conditions listed on the next page.

SYMBOL		
A	-	agricultural land use; all cultivated crops
E	-	extractive activities; gravel and sand pits, quarries, peat mines or other mining operations
F	-	forested areas; hardwoods, conifers or mixed
H	-	water; all open bodies of water such as impoundments, lakes, ponds and backwaters
O	-	open areas; areas not being used intensively with a cover of grass and/or shrubs, including pastures.
U	-	urban; densely developed residential, commercial, industrial or mixed in an incorporated community.
W	-	wetlands; all wetland vegetation types including marsh, swamp and sloughs.

E. Coding instructions

1) Indicate river site boundaries on the quads.

2) Overlay a 40 acre grid onto the quads using section lines corresponding to the windowed site, and code each cell within the river site using the following classes.

CLASS	
1	Urban (U)
2	Extractive (E)
3	Cultivated Agriculture (A)
4	Open or Pasture (O)
5	Wetland (W)
6	Forest (F)
7	Water (H)

3) Code each cell by determining the relative amounts of each land use or cover is present. The dominant or primary land use should be entered in the first data column (left justified) on the coding sheet. [LUC1]

   a. Example:

      If a cell is completely covered with forest (F) enter:

6			

4) If a secondary land use or cover comprises over 10% of the cell, enter that code in the second data column. [LUC2]

   a. Example:

      If a cell is 60% wetland (A) and 40% open (O) enter:

5	4		

5) If a cell has a tertiary land use or cover of at least 10% of the cell, enter that code in the third data column. [LUC3]

   a. Example:

      If a cell is 50% agriculture (A), 30% open (O) and 20% forest (F) enter:

3	4	6	

6) In case of a tie between land uses or covers, enter the lower coding class number first.

   a. This gives priority to the more intensive land uses, which are given numbers in terms of intensity.

   b. Example:

      If a cell is 50% urban (U) and 50% forest (F) enter:

1	6		

7) Indicate those cells in which the river is present by entering an 8 in the last column on the right. This is the only time the fourth data column is used. [LUC4]

   a. Example:

      If a cell is 70% agriculture (A), 30% extractive (E), and the river flows through it (river oriented) enter:

3	2	0	8

   b. Enter a zero into any empty data column when both the first and last column are in use as in the example.

8) When the land use or cover becomes homogeneous over the entire upstream balance of a river as indicated on the the quads, it will be systematically derived for the balance of the site so no coding needs to be done except for river oriented cells.

   a. This situation should be documented on not only the quads, but the coding sheets and note files as well.

9) The file name will be UPD.COVR

10) Mark each coding sheet with the river name, page number, date and your initials.

POINT LAND USES

File name: UPD.PTLU

Purpose: To identify the location of structures in rural areas along the river for monitoring and for impact analysis.

Procedure: The aerial slides used in determining land cover will also be interpreted at the same time for specific point land use locations. For rivers which were not photographed for A.S.C.S., interpretation will be done using black and white aerial photos taken since 1971 for state and federal forestry agencies. These rivers are mostly in the northeastern part of the state.

1. General rules

   A. If A.S.C.S. slides are used, the interpretation will be done at the same time and over the same areas as land cover.

   B. Where forestry photos are used, point land uses will be determined for an area 1/2 mile back from the river.

      1) Where terrain was extended beyond 1/2 mile due to distant river bluffs, include those areas as well.

   C. Sites within 400 feet of the river are considered to be adjacent to the river.

   D. Symbolization of point land uses

      1) Enter the following symbols on the same quads as used for land cover under the appropriate conditions:

SYMBOL	
C	rural non-residential development; including commercial, industrial, large scale agricultural and recreational outside of incorporated municipalities
B	farmstead; including house, barn and associated structures such as sheds, garage, barnyard, etc.
R	rural non-farm residence; including unincorporated communities
?	unidentifiable structures note as such on the quads

   E. Coding instructions

      1) Indicate river site boundaries if land cover was not coded.

CLASS	
1	one farmstead (B) in the cell, adjacent to the river
2	one farmstead (B), not adjacent
3	one rural non-farm residence (R), adjacent
4	one rural non-farm residence(R), not adjacent
5	one rural non-residential development (C), adjacent
6	one rural non-residential development (C), not adjacent
7	2-3 farmsteads (B), at least one adjacent
8	2-3 farmsteads (B), none adjacent
9	2-3 rural non-farm residences (R), at least one adjacent
10	2-3 rural non-farm residences (R), none adjacent
11	2-3 rural non-residential dev. (C), at least one adjacent
12	2-3 rural non-residential dev. (C), none adjacent
13	2-3 mixed types of dev. (C/B/R), at least one adjacent
14	2-3 mixed types of dev. (C/B/R), none adjacent
15	4 or more farmsteads (B), at least one adjacent
16	4 or more farmsteads (B), none adjacent
17	4 or more non-farm residences (R), at least one adjacent
18	4 or more non-farm residences (R), none adjacent
19	4 or more non-residential dev. (C), at least one adjacent
20	4 or more non-residential dev. (C). none adjacent
21	4 or more mixed types of dev. (C/B/R),at least one adjacent
22	4 or more mixed types of dev. (C/B/R), none adjacent
23	1 unidentifiable structure, adjacent
24	1 unidentifiable structure, not adjacent
25	2 or more unidentifiable structures, at least one adjacent
26	2 or more unidentifiable structures, none adjacent

2) Overlay a 40 acre grid onto the quads using the section lines corresponding to the windowed site, and code each cell based on the preceding classes.

3) If a development overlaps into more than one cell, code only for the cell with the largest share.

4) The appropriate classification will be entered on the coding sheet in the far right data column (right justified)

   a. If the classification is a two digit number, then it will be entered in the two furthest right columns.

   b. Example:

      If a cell has a non-farm residence (R) near the river and two farmsteads (B) also within the cell enter:

!	!	!	1	!	3 !

5) The file name will be UPD.PTLU

6) Mark each coding sheet with the river name, page number, date and your initials.

NOTE: Most early coding used an 'f' rather than a 'B' to represent farmstead, but this can cause some symbol confusion since 'F' is also used to represent forest.

NON-BUFFERED INTENSIVE LAND USE

File name: UPD.NONB

Purpose: To identify areas along the river where intensive land uses occur adjacent to the river where there is insufficient natural vegetation along the river bank to protect it or to act as a scenic buffer.

Procedure: The U.S.G.S. quads used for land cover and point land use will also be used to determine non-buffered land use. Rivers that do not have A.S.C.S. slides will depend upon forestry photos.

1. General rules

   A. A sufficient buffer is considered to be a minimum 30 foot wide strip of natural vegetation between the river and any intensive land use located adjacent to the river.

      1) Natural vegetations are considered to be:

         a. Forest (F)

         b. Open or pasture (O)

         c. Wetland (W)

      2) Intensive land uses will be represented on the quads as:

         a. Agriculture (A)

         b. Rural non-residential development (C)

         c. Extractive (E)

         d. Farmstead (B)

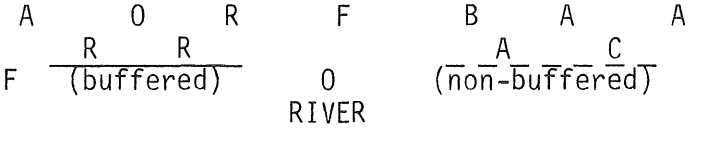
         e. Rural non-farm residence (R)

         f. Urban (U)

   B. Only cells that have intensive land uses adjacent to the river (within 400 feet) need to be examined for a buffer.

      1) Indicate those areas where a buffer exists by drawing a border between the land use and the river bank. In areas where no buffer exists, draw a broken border on the quads.

         a. Example



C. Coding instructions

1) Overlay a 40 acre grid onto the quads using section lines corresponding to the windowed site, and code each cell that has an intensive land use adjacent to the river with less than a sufficient buffer according to the classes below.

CLASS	
1	Urban (U)
2	Extractive (E)
3	Agriculture (A)
4	Rural non-residential development (C)
5	Rural non-farm residential (R)
6	Farmstead (B)
7	Mixed; Urban, extractive and Agriculture (U/E/A)
8	Mixed; Rural point land uses (C/R/B)
9	Mixed; Any combination from above (U/E/A/C/R/B)

2) In sitiuations where more than one non-buffered intensive land use is identified within a cell, the lower number will have priority.

3) The appropriate classification will be entered on the coding sheet in the far right data column (right justified).

a. Example

If there is cultivated agriculture and a farmstead adjacent to the river (within 400 feet) in the same cell and there is no buffer (less than 30 feet of natural vegetation) along the river bank enter:

!	!	!	! 2 !

4) The file name will be UPD.NONB

5) Mark each coding sheet with the river name, page number, date and your initials.

RIVER CHARACTERISTICS

File name: UPD.RIVR

PURPOSE: To record the location and frequency of occurrence of various physical attributes which influence the scenic and recreational character of a river.

Procedure: The U.S.G.S. quads will be confirmed and updated for the features listed below using a variety of sources including aerial photos, county maps and field studies.

1. General rules

   A. Only river oriented cells need to be checked in confirming the following features.

      1) Gradient

         a. Contour lines crossing the river

      2) Islands

      3) Rapids, waterfalls, lakes and impoundments

      4) Bridges, utilities and dams

         a. Dirt road crossing

         b. Paved road crossing

         c. Railroad crossing

         d. Powerline crossing

         e. Pipeline crossing

         f. Dam

   B. Indicate missing features on the quads and make a note in the map margin.

   C. Coding instructions

      1) Overlay a 40 acre grid onto the quads using section lines corresponding to the windowed site, and code each river oriented cell with the appropriate classes on the next page.

RAPIDS, WATERFALLS, LAKES, IMPOUNDMENTS		ISLANDS	
0	no data	0	no data
1	rapid	1	one island
2	waterfall	2	two islands
3	lake or impoundment	3	more than two islands
4	mixed		

CONTOUR LINES		BRIDGES, DAMS AND UTILITIES	
0	one line or none	0	no data
1	two lines	1	dam
2	three lines	2	powerline
3	four lines	3	pipeline
4	five lines	4	paved bridge
5	six lines	5	dirt bridge
6	seven lines	6	railroad bridge
7	eight lines	7	bridge and dam
8	nine lines, etc.	8	bridge and utility

2) When a bridge, dam or utility crossing lies partially in two cells, code the feature only for the cell with the largest portion within it.

   a. If it is a wide river at that point and the crossing is extremely long, code all appropriate cells.

3) When a rapids, waterfalls, lake or impoundment crosses into more than one cell, code for all appropriate cells.

4) The appropriate classes should be entered onto the coding sheet in the following manner.

   a. Contour line crossings into the first data column from the left. [RCH1]

   b. Islands into the second data column from the left. [RCH2]

   c. Rapids, waterfalls, lakes and impoundments into the third data column from the left. [RCH3]

   d. Bridges, dams and utilities into the far right data column. [RCH4]

   e. Example:

      If a river oriented cell has four contour lines with an island, a rapids and paved bridge, enter:

3	1	1	4

5) The file name will be UPD.RIVR

6) Mark each coding sheet with the river name, page number, date and your initials.

APPENDIX F

Detailed River Maps

Part III of this report explains the development of river corridor maps that are more detailed than those possible using Minnesota Land Management System Information. Data The maps included in this Appendix are examples of the type of data collected and the analysis made possible. More refined analysis and monitoring of resource characteristics can be developed in the future as this information is used.

Definitions of the terrain types, land use classification and other terms can be found in the appropriate sections of Appendix E, "Detailed River Studies: Coding Rules for File Generation".

Map 1: The Temperance River, Generalized Terrain

Legend

Symbol	Count	Percentage of Site	Description
	36	6.6	No Data
::	66	12.1	Flat
▲▲	47	8.6	Rolling
▓	234	42.8	High Slope
▒	100	18.3	High Slope mixed with rolling and/or flat
⁘	63	11.6	Flat and Rolling

Purpose of Map:

To identify the overall landform types for description of the scenic qualities present in various portions of the river corridor.

Discussion:

Reference 1

The river corridor included in this reference indicates a flat and rolling terrain throughout. This landform, while not one that creates spectacular scenery, can produce very interesting scenery in certain locations due to the erosive force of the river. Flat and rolling areas can be readily accessible to recreationists, subject to limitations imposed by features such as wetlands. If combined with a dominance of natural cover, flat and rolling river corridors offer high degrees of scenic and natural amenities.

Reference 2

The river corridor delineated by Reference 2 incicated a transition area between the flat and rolling headwaters and the deep, incised gorge of the lower portions of the river. Transition zones can offer rugged scenery in localized areas, yet be accessible by foot or vehicle subject to certain limitations such as wetlands, steep hills, cliffs, etc. Transition zones offer potential for good scenery combined with suitability or recreation sites such as trails and campsites.

Reference 3

The river corridor included here possesses the most spectacular scenery as indicated by the dominance of high slope, or high slope mixed with rolling and flat terrain types. These areas are commonly accessible by foot trail only and offer high potential for solitude, remote character, scenic vistas, and interesting geological features. This rugged terrain often makes siting of recreation facilities difficult, but offers high quality settings if such facilities are possible. The frequency count of terrain types shows approximately 60% of the parcels having some high slope terrain present, with all of those parcels located in the Reference 3 area.

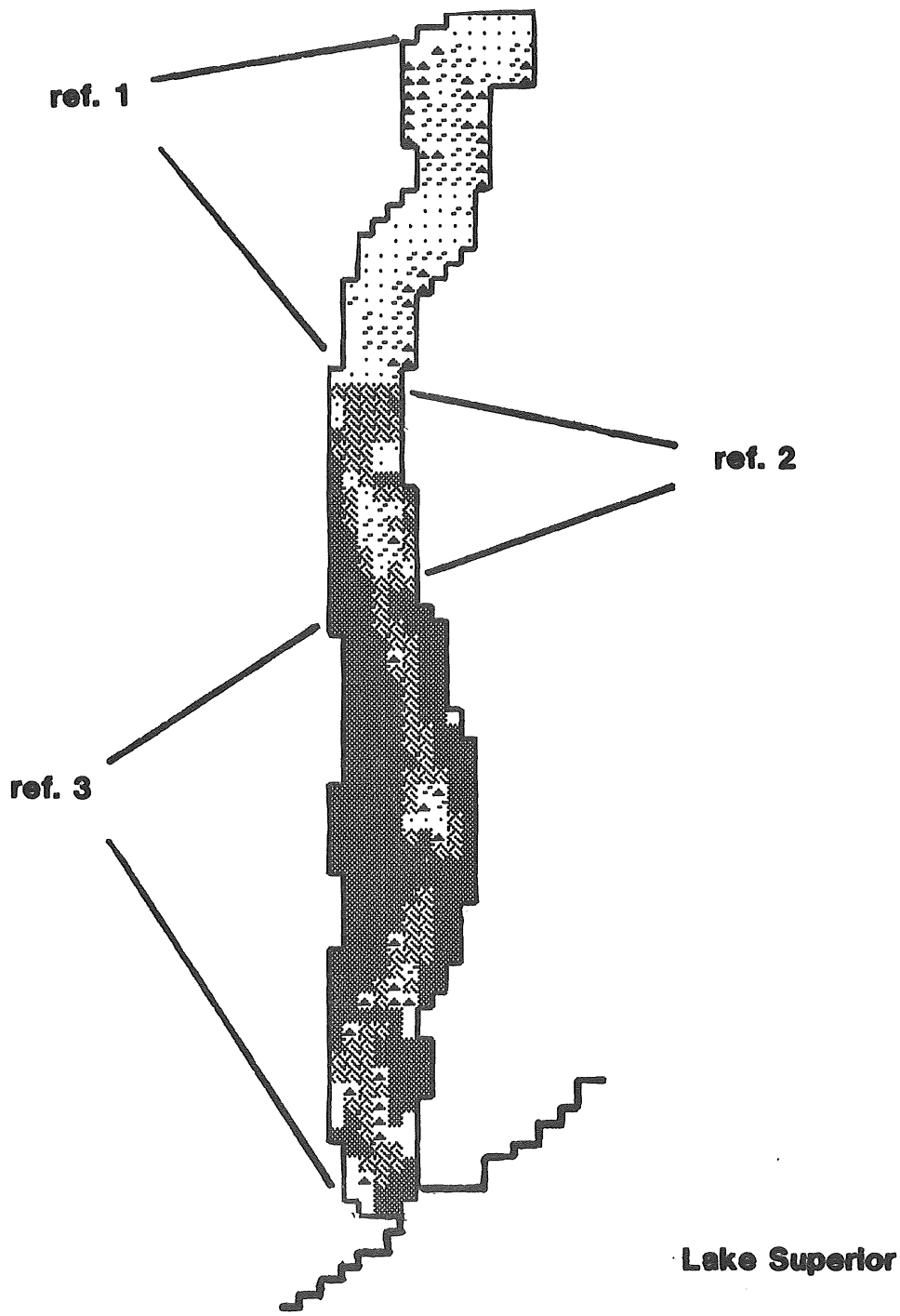
Map 1

scale: 5/16" per mile

The Temperance River

Cook County

Generalized Terrain



see legend and analysis on facing page

Map 2: The Temperance River, Terrain Features

Legend

Symbol	Count	Percentage of Site	Description
	221	40.5	No Terrain Feature
⁘	20	3.7	30 to 100 ft. height, all of high slope feature located at least partly adjacent to river (within 400 ft)
∷	50	9.2	30 to 100 ft. height, feature entirely distant from river
▲▲	16	2.9	100 to 200 ft. height, at least partly adjacent
∷	19	3.5	100 to 200 ft. height, distant
❖	34	6.2	200 ft. or higher, at least partly adjacent
■	186	34.0	200 ft. or higher, distant

Purpose of Map:

To identify high slope features by height groupings and their proximity to the river for description of scenic characteristics.

Discussion:

Reference 1

By looking at the Generalized Terrain map and this Terrain Features map the appearance of high slope features corresponds to the transition zone seen on Map 1 of this Appendix. The presence of 30' - 100' high features is largely found within the Reference 1 area, and indicates a gradual increase of topographic and geologic formations of potential scenic interest.

Reference 2

The Reference 2 segment of the river corridor shows the presence of features 200' or higher both adjacent (within 400') and distant from the river. Approximately 40% of the parcels on the entire map are shown to have 200' or higher features, and they are all located in this reference segment. The strong pattern of these features adds to the Generalized Terrain map in showing a deep, incised river valley that produces high scenic value. The river course can be followed through most of this segment by finding the parcels shown with either no terrain feature, or those parcels with a terrain feature either entirely or partly adjacent to the river.

Reference 3

Reference 3 shows the expansion of the area measured to include Carlton Peak, which is a prominant feature adding to the scenic values of the river corridor.

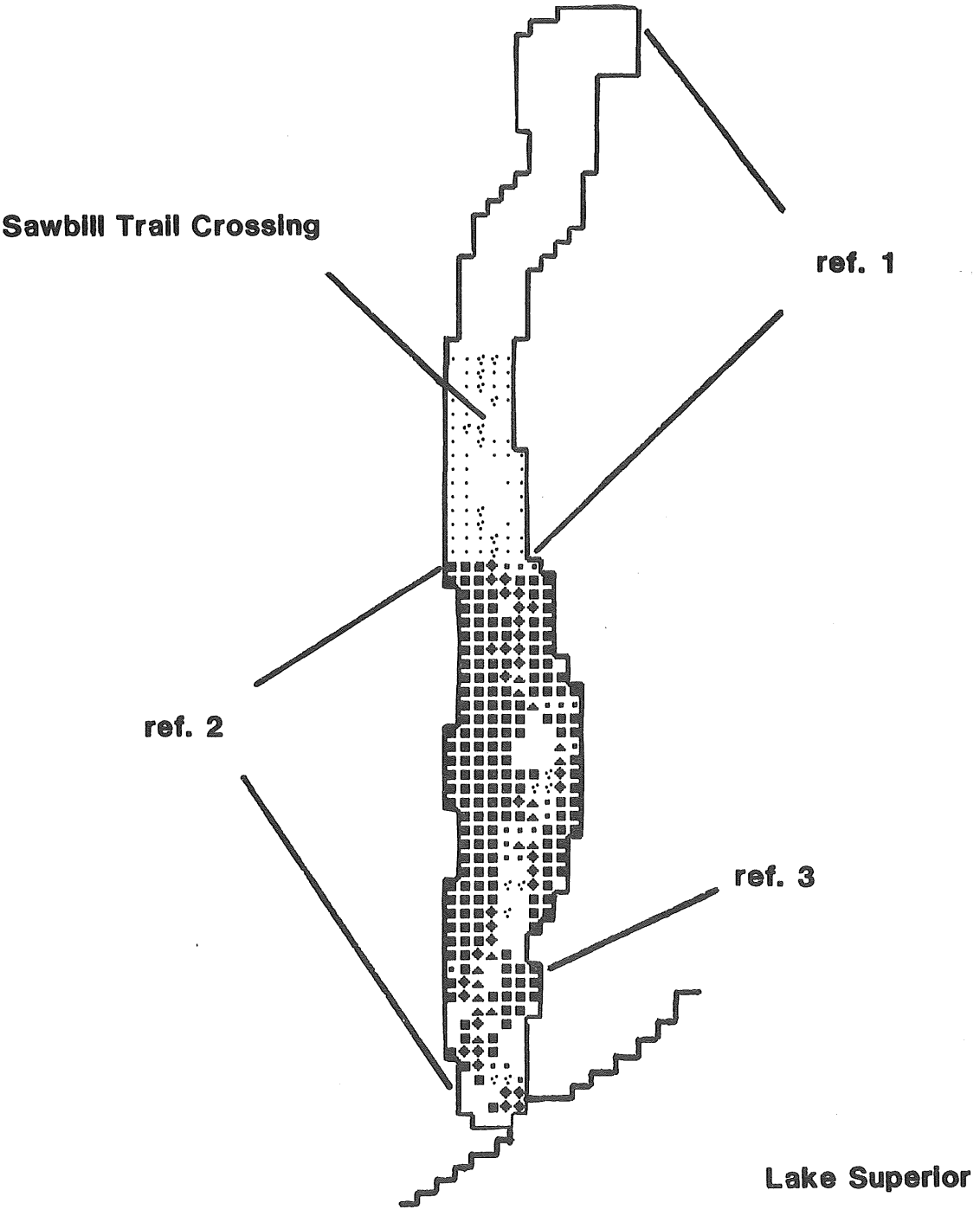
Map 2

scale: 5/16" per mile

The Temperance River

Cook County

Terrain Features



see legend and analysis on facing page

Map 3: The Snake River, Dominant Land Use in River Oriented Parcels

Legend

Symbol	Count	Percentage of Site	Description
			No land use coded or not river oriented
■	10	1.9	Urban
▤	145	28.9	Cultivated agriculture
::	32	6.2	Open and pasture
≈	16	3.1	Wetland
▒	297	57.6	Forested
▓	16	3.1	Water

Purpose of Map:

To give a more accurate description of natural and scenic conditions in the immediate vicinity of the river. River oriented parcels are those 40 acre parcels through which the river flows.

Discussion:

Reference 1

The reach of the river included shows a near total dominance of forest. The natural conditions a person will encounter will be very high, as well as there being a reduced likelihood of impacts created by intensive land uses such as agriculture, housing or industrial development. This reach corresponds to the approximate area of the Snake River State Forest, where there might be potential for recreation facility development if so desired.

Reference 2

This reach of the river shows a higher occurence of agricultural land uses in close proximity to the river which will cause certain impacts on the scenic, natural, and physical characteristics of the river and the surrounding area.

Reference 3

The Pine City area shows to be the only area where urban type development is dominant.

Reference 4

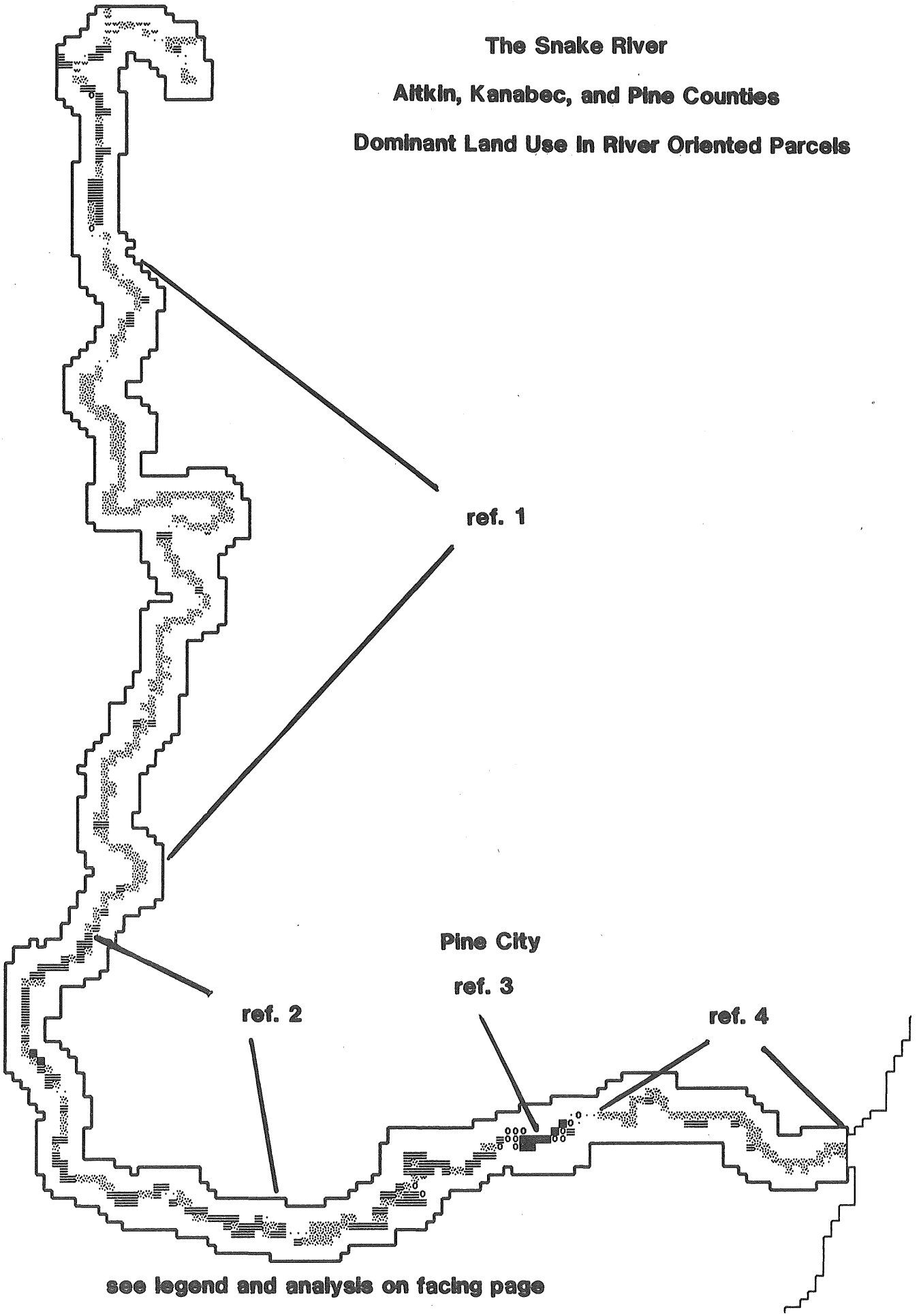
The reach below Pine City is shown to be mostly forested in the parcels closest to the river. This reach is known to be a scenic area that attracts significant development of cabins and homes, and also includes part of the Chenqwatana State Forest.

Map 3 scale: 1/4" per mile

The Snake River

Aitkin, Kanabec, and Pine Counties

Dominant Land Use in River Oriented Parcels



see legend and analysis on facing page

Map 4 The Snake River, Dominant and Secondary Land Uses (combined)

Legend

Symbol	Count	Percentage of Site	Description
■	1129	51.0	Natural land uses dominant and secondary
▒	159	7.2	Natural land use dominant, intensive land use secondary
≈	348	15.7	Intensive land use dominant, natural land use secondary
::	580	26.1	Intensive land use dominant and secondary

Purpose of Map:

To measure the relative dominance of natural and intensive land uses for describing individual rivers, and for comparing different rivers for natural and scenic values. (See Part III for a description of this map and the groupings made by land use types).

Discussion:

Reference 1

An area of almost total natural land use cover forms the immediate headwater area.

Reference 2

This reach of the river is shown to have the most consistent natural land covers, and thus offers the highest natural values. Areas with this dominance of natural cover also offer the greatest potential of remote character which contributes strongly to high quality river experiences for certain recreation users. The only other reaches that show this same strong pattern of dominantly natural land uses are the shorter Reference 1 and Reference 4 reaches.

Reference 3

A portion of the river showing a higher incidence of intensive land use covers that is a contrast to the reaches shown in References 1, 2, and 4. Natural and scenic characteristics will not be as high in the Reference 3 reach, and recreation potential as well as other impacts from intensive land uses will be influenced accordingly. The Reference 3 area may also have development pressure and characteristics that require study and planning to address management for protection of natural and scenic values.

Reference 4

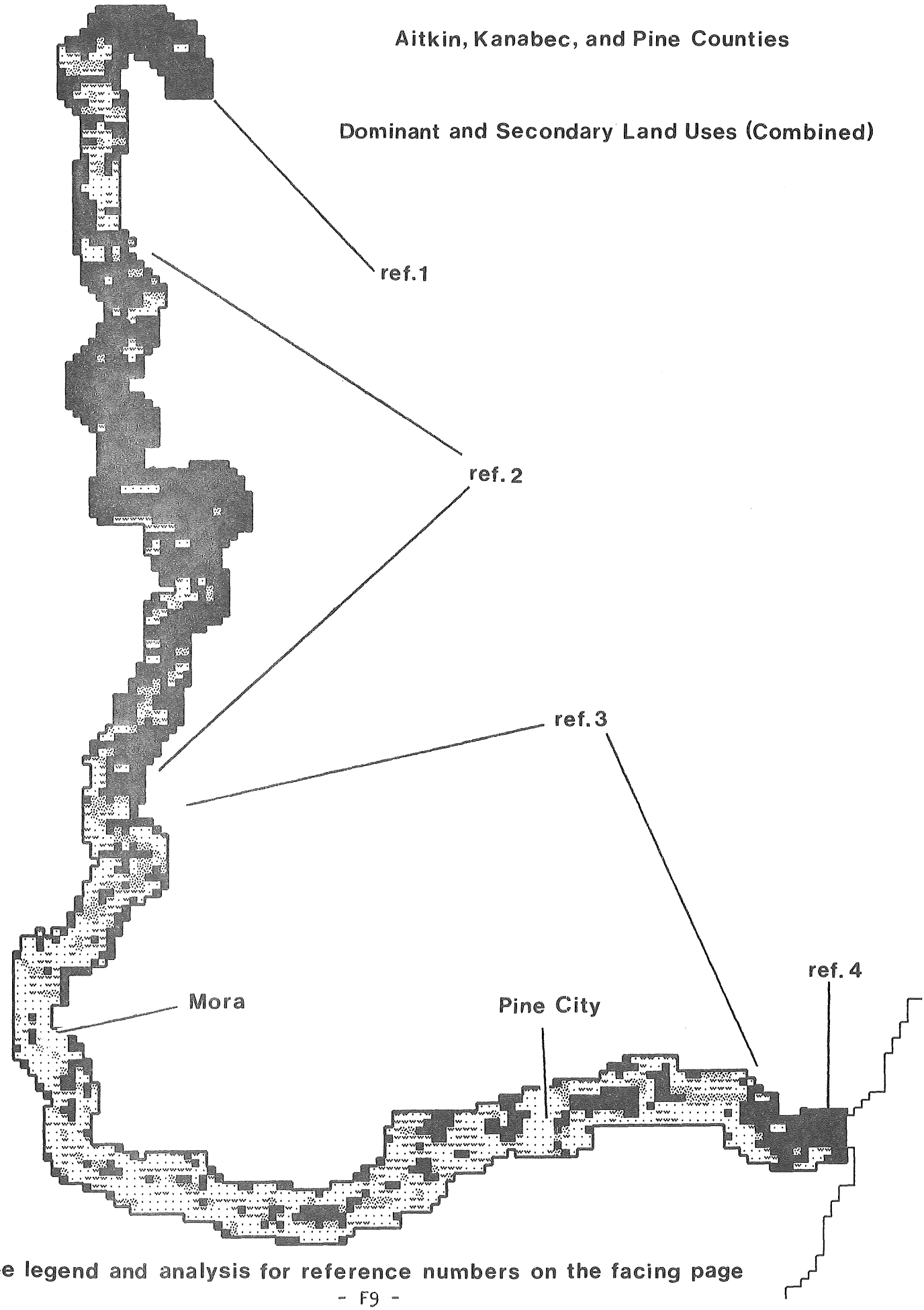
A short reach of dominantly natural land use covers that corresponds roughly to the Chenqwatana State Forest. This is known to be one of the more scenic and recreationally attractive parts of the Snake River.

Map 4 scale: 1/4" per mile

The Snake River

Aitkin, Kanabec, and Pine Counties

Dominant and Secondary Land Uses (Combined)



see legend and analysis for reference numbers on the facing page

APPENDIX G

Potential Improvements and Additions

The study of rivers in a state as diverse as Minnesota inevitably leads to inter-disciplinary subjects, and thus complexity. Such a study should remain dynamic to the point that as improvements become necessary and new sources of data become available, they are incorporated into the study and their efforts on the study results noted. Through suggestions resulting from internal review and rapidly developing new data sources it is planned that the following improvements and additions will be made in the biennium beginning July 1, 1983. These additions will be printed and made available to all who initially receive copies of the study or who request such additions to this document.

1. An improved and more precise analysis of each river for high quality, short segments that are not representative of the entire reach of the river. This deficiency was noted during the project and during the internal DNR review. Improving this capability may create another priority classification naming short segments requiring study and management, since short segments of certain rivers were felt to have been "averaged out" by looking at ratings for entire streams at one time.

2. The following data sources that are now or will be developed will be incorporated upon their availability in a form useable to the study:

    a. River Recreation Opportunity Spectrum classifications for each river and statewide population accessiblilty from the DNR Land Resource and Management Plan project.
    b. Sinuosity data from the River Kilometer Indexing System.
    c. Valley and river width measurements at 5 kilometer intervals for all streams.