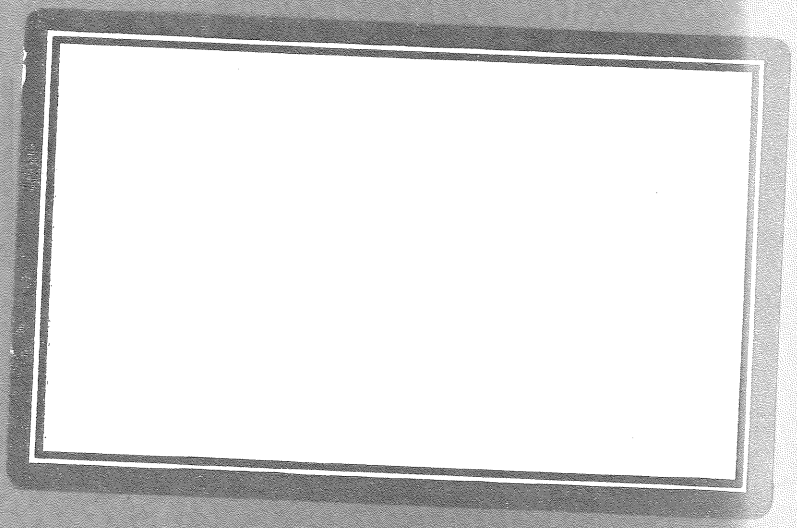


Iron Range Information System (IRIS)
A Biennial Status Report For fiscal years 1978-1979

Presented To
The Legislative Commission on
Minnesota's Resources

Prepared by
The Minnesota Department of
Natural Resources
Division of Minerals
July, 1979

ADMIN 1000 (Rev. 1/78)

STATE OF MINNESOTA

DEPARTMENT NATURAL RESOURCES

Office Memorandum

TO : Robert Hanson
Executive Director
Legislative Commission on
Minnesota Resources

DATE: July 30, 1

FROM : William C. Brice
Manager, Environmental Services

William C. Brice (by Patricia Lang)

PHONE: 296-4807

SUBJECT: Iron Range Information Analysis

Attached is the July, 1979 status report on the Iron Range Information Analysis, which has been renamed the Iron Range Information System (IRIS). Since the report was prepared prior to our receiving the approved format, this memo is intended to supplement the report.

Program Title: Iron Range Information Analysis
Date of Report: July 20, 1979
Date Work Program
Approved by LCMR: June 13, 1977

I Financial

A. Appropriation Number 31602:53-10
Total LCMR Appropriation $100,000.00
Amount Expended to date 60,000.00
Balance Remaining 40,000.00

B. No non-state monies have been employed.

II Program Description

The purpose of the project is to provide a comprehensive natural resource data base for the Mesabi Iron Range. This will be used as a tool in evaluating mining and reclamation proposals. The project objectives and the status of each are detailed in the attached report.

Due to initial staffing and organizational problems the project is behind schedule. Approximately three-fourths of the objectives stated in the original work plan have been completed and the remainder will be completed in fiscal year 1980.

cc: Dick Maloney

Contents

ILLUSTRATIONS

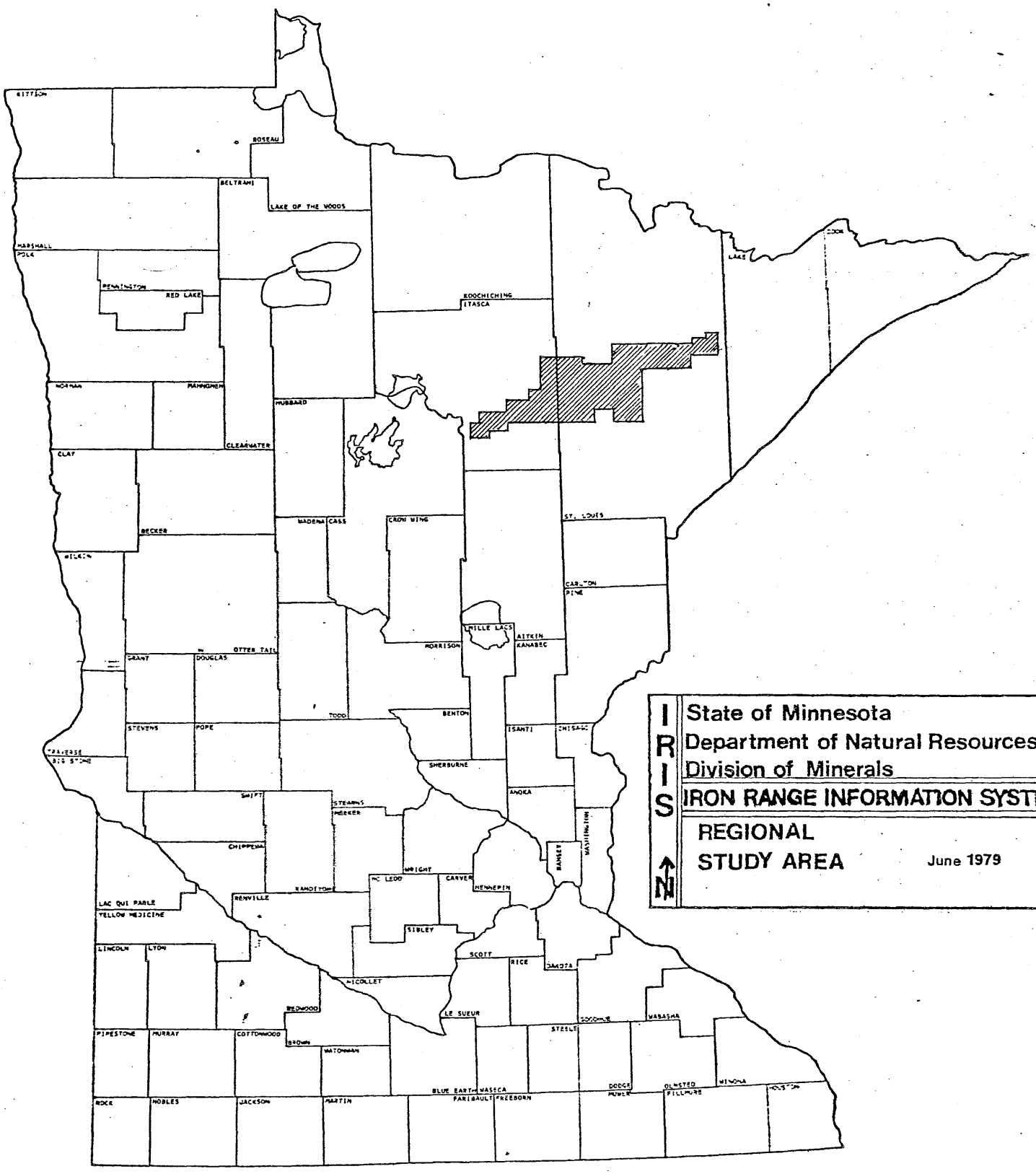
TABLES

cite: 1977
Ch 455

INTRODUCTION

The Mesabi Iron Range has been and will continue to be a major iron producing region in the United States. Experience has shown that better planning and a comprehensive data base could aid in reducing the disruption caused by conflicting land uses in the area. Many conflicts have arisen from building communities on iron ore reserves or directly adjacent to the industrial activities associated with mining. Poorly planned location of stockpiles, tailings basins and transportation corridors have also plagued the Range. To date, less than one billion tons of taconite tailings have been deposited in the area, yet we must anticipate accommodating thirty to sixty billion tons of this material during the life of mining on the Range. Similarly, large quantities of other material, such as lean ore and waste rock must also be stored in the area.

Under a program sponsored by the Legislative Commission on Minnesota's Resources (LCMR), the Minnesota Department of Natural Resources, Division of Minerals, has begun to develop a computerized Iron Range Information System (IRIS). By compiling natural resource information available from governmental and private sources, the IRIS will constitute a comprehensive, detailed inventory of natural resources on the Mesabi Iron Range. This system will ultimately provide data and analysis capabilities for future land use planning, mineland reclamation permit evaluation and criteria for comprehensive resource management.



I R I S

State of Minnesota
Department of Natural Resources
Division of Minerals

IRON RANGE INFORMATION SYSTEM

REGIONAL STUDY AREA

June 1979

N

DESCRIPTION OF THE REGIONAL STUDY AREA

The Iron Range Information System covers the Mesabi Iron Range in northeastern Minnesota. The regional study area contains approximately 1100 square miles of land from Grand Rapids to Babbitt (figure 1). The irregularly shaped study site encompasses all of the mining operations along the Biwabik Iron Formation, as well as adjacent land which includes processing plants, tailings basins, stockpiles and potential expansion areas (figure 2). The study boundaries can easily be expanded if required in the future.

As with the Department's other mineral related computer study, MINESITE, the Universal Transverse Mercator (UTM) coordinate system was chosen to describe the IRIS study boundries. The data cell size used is one hectare (2.47 acres) which corresponds with the metric UTM system. There are approximately 300,000 data cells within the regional study area.

To identify land characteristics in the study area, five broad types of resource variables were developed:

1) A Public Land Survey reference system

   a. Township
   b. Range
   c. Section
   d. Forty
   e. Government Lot

2) Bedrock Geology
3) Soil Association
4) Surface Hydrology
5) Watershed

These variables are essential building blocks for analyzing many of the physical aspects of mining in relation to the environment. The degree of completion for these variables is illustrated in Table 1. A general description of each is presented below.

PUBLIC LAND SURVEY VARIABLES (V02-V06)

The Township and Range variables reflect the major subdivisions of land according to the United States Public Land Survey. Townships are six mile wide strips of land bounded on the north and south by lines of latitude. Ranges are six mile wide strips of land bounded on the east and west by lines of longitude. The intersection of a Township and Range creates a six mile by six mile unit of land commonly referred to as a township.

Sections are square mile units of land identified by the United States Public Land Survey. There are normally thirty six sections in one township.

Forties are forty acre parcels of land identified by the United States Public Land Survey. In one regular section there are sixteen forty acre parcels.

A Government Lot is a United States Public Land Survey unit used to describe irregular parcels of land within nonuniform Sections. Lots occur around bodies of water and where the Sections are not quite square. This is often the case on the Mesabi Range since the magnetic field induced by the iron formation often played havoc with the surveying equipment.

Each cell in the data system is assigned a Township/Range, Section, Forty and/or Government Lot designation. This cell assignment is approximated to most closely represent the actual Public Land Survey. Irregularities in the survey are taken into account; accuracy is approximately 1/2 cell (50 meters).

BEDROCK GEOLOGY (V07)

The major geologic formations of the Mesabi Iron Range are well known since mining has been occuring on the range for almost a century. There are five major formations: the Biwabik Iron Formation, the Pokegama Quartzite, the Virginia Formation, the Giants Range Granite and the Duluth Complex. Where detailed mapping was available, such as for the Duluth Complex and the Giants Range Granite, formations are coded according to their component rock units. It should be noted, however, that the contacts delineated between the individual units are less reliable than those between the major formations.

SOIL ASSOCIATION (V08)

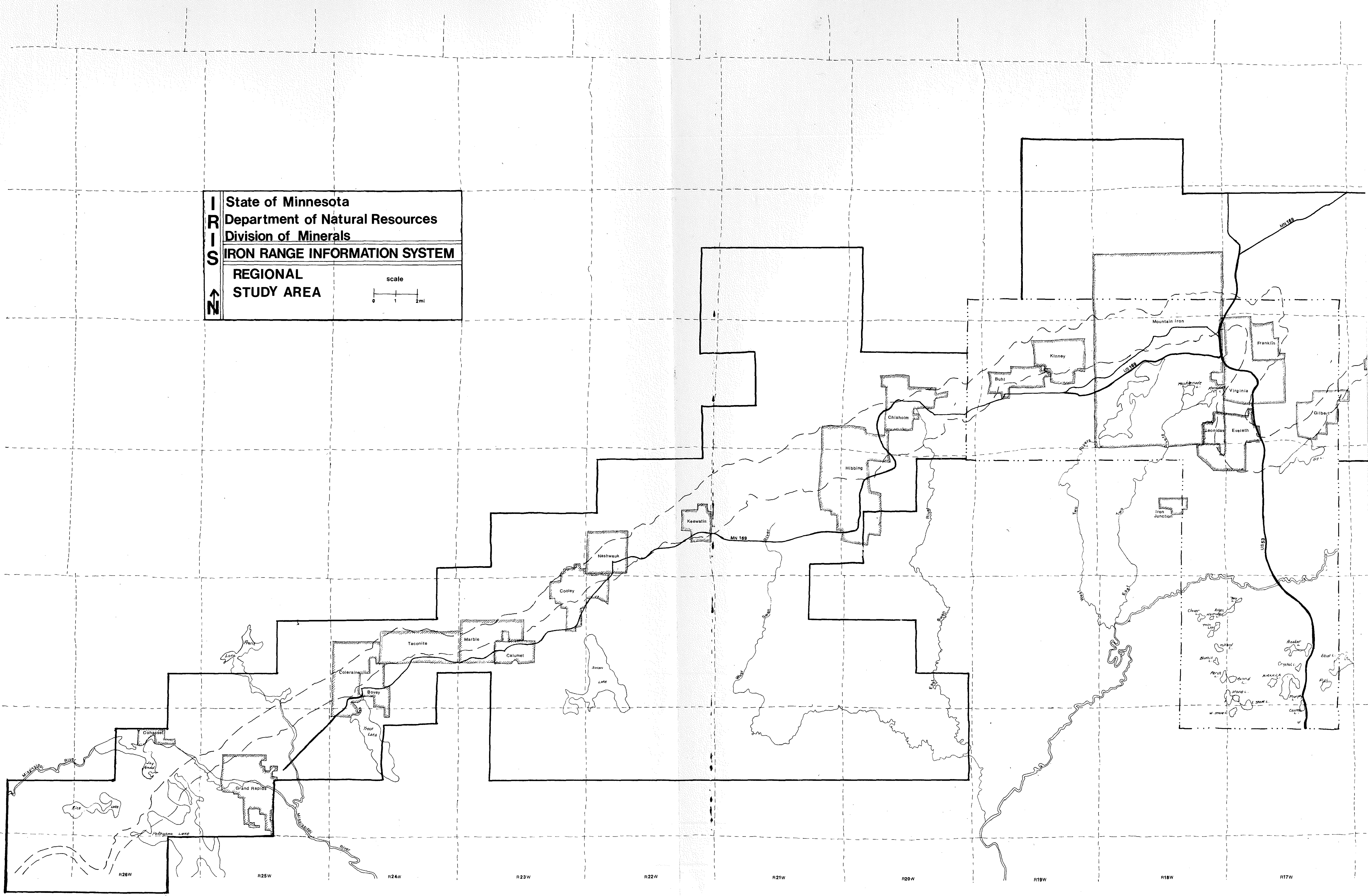
Soil Associations are interpreted from characteristic geographical patterns visible on aerial photographs. The interpretations are refined by field verification. Factors considered in defining soil series and associations are: profile, color, structure, consistency, sequence of horizons, conditions of relief and drainage, and origin and mode of formation. Accuracy of the soil mapping units are unreliable below forty acres. More detailed soil mapping in Itasca County was to become available during this initial phase of the program. Since it is not yet completed, it will be included at a later date.

WATERSHED (V09)

A Watershed is the drainage basin of a particular stream. A Watershed boundary is defined by a topographic highland which surrounds the basin and segregates it from neighboring basins. Those watersheds with drainage areas greater than five square miles are identified.

SURFACE HYDROLOGY (V10)

Surface Hydrology describes the surface water resources of the Mesabi Range. The hydrology of each watershed was classified by uniquely identifying each lake and each segment of the stream hierarchy with a two digit number. Streams were segmented whereever they were intersected by a tributary, marsh, gaging station or other unique feature. The two digit system allows stream order to be maintained.


IRIS
State of Minnesota
Department of Natural Resources
Division of Minerals
IRON RANGE INFORMATION SYSTEM
REGIONAL STUDY AREA
scale
0 1 2mi
N
Mountain Iron
Kinney
Franklin
Buhl
Virginia
Chisholm
Gilbert
Leonidas
Eveleth
Hibbing
Iron Junction
Keewatin
MN 169
US 169
US 53
Nashwauk
Cooley
Taconite
Marble
Calumet
Coleraine
Bovey
Cohasset
Grand Rapids
R26W
R25W
R24W
R23W
R22W
R21W
R20W
R19W
R18W
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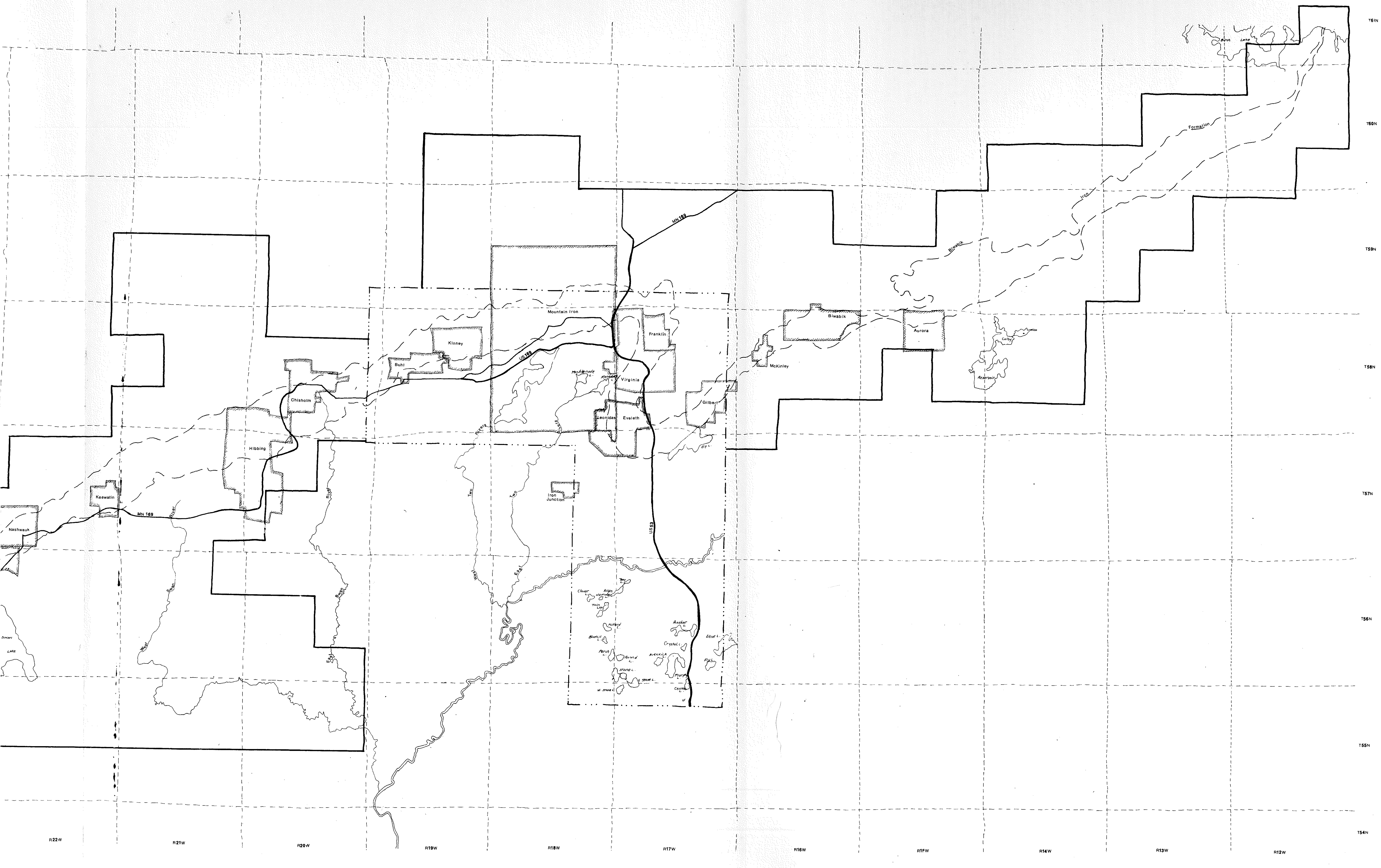

T61N
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R22W
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R19W
R18W
R17W
R16W
R15W
R14W
R13W
R12W
Biwabik Iron Formation
MN 169
US 169
US 53
Mountain Iron
Kinney
Buhl
Chisholm
Hibbing
Keewatin
Nashwauk
Franklin
Virginia
Leonidas
Eveleth
Gilbert
McKinley
Biwabik
Aurora
Iron Junction

TABLE 1 - STATUS OF THE REGIONAL STUDY AREA'S RESOURCE VARIABLES

VARIABLE	DATA PROCESSING STAGES						
	COLLECT COMPILE	CODE	ENTER	VERIFY STEP 1	CREATE MAP	VERIFY STEP 2	FINAL MAP
V02 TOWNSHIP			X	X	X	X	
V03 RANGE			X	X	X	X	
V04 SECTION		X	X	X	X	X	X
V05 FORTY							
V06 GOVERNMENT LOT	X	X	X	X			
V07 BEDROCK GEOLOGY	X	X	X	X	X	X	X
V08 SOIL TYPE	X	X	X	X	X		
V09 WATERSHED	X	X	X	X	X	X	
V10 SURFACE HYDROLOGY	X	X	X	X	X		

All of these variables are either finalized or are in the process of final correction and updating, except for V05-Forties. The development of a Forties variable requires a complex modification of the Section's variable, and considerable correlation with the forty acre cell size used by State Planning's Land Management Information Center. The development of this variable will be a priority in the next biennium since it will facilitate data interchange between the two agencies.

TABLE - SOURCES FOR REGIONAL STUDY AREA VARIABLES

VARIABLE	SOURCE	DATE
V02, V03 TOWNSHIP / RANGE	Created by modifying Sections (V04)	
V04 SECTION	USGS 7 1/2 Minute Quadrangle Sheets	1969 Rev.
V05 FORTY	Created by modifying Sections (V04)	
V06 GOVERNMENT LOTS	U.S. Public Land Survey; USGS 7 1/2 Minute Quadrangle Sheets	 1969 Rev.
V07 BEDROCK GEOLOGY	Mesabi Range Map - MDNR; Hibbing Hibbing Sheet, Geologic Map of Minn. MGS White, David A.; The Stratigraphy and Structure of the Mesabi Range, Minn. MGS Bull. #38. MGS Miscellaneous Maps: M-15, M-16, M-18, M-19, M-20, M-22, M-23,	1973 1970 1954 1974
V08 SOIL ASSOCIATION	SCS Gen. Soil Map; Arrowhead Region	1974
V09 WATERSHED	DNR - Water Resources Planning	1978
V10 SURFACE HYDROLOGY	USGS 7 1/2 Minute Quadrangle Sheets	1969 Rev.

DESCRIPTION OF THE PILOT STUDY AREA

A Pilot Study area between Buhl and Gilbert was selected to evaluate land use on the Mesabi Range. The 225 square mile Pilot Study area contains several large residential communities and numerous mining operations (figure 3). This district has a high potential for mining related land use conflicts in the near future.

Seven land use variables were developed for the Pilot Study area in addition to the resource variables listed above.

1) Mining Land Use
2) Vegetation
3) Recreational and Historical/ Archeological Sites
4) Utilities
5) Roads
6) Urban/Rural Development
7) Water Appropriation and Discharge Points

In the next biennium, these land use variables will be expanded to describe the entire Range. The status of these variables is shown in Table 2. A general description of each is given below.

MINING LAND USE (V11-12)

The mining land use on the range falls into two categories: Storage Facilities, such as stockpiles, tailings basins, and reservoirs; and Extractive Operations, including pits, shafts, caved areas and buildings. These are currently on one map, but will be separated for display purposes at a later date.

Every stockpile, tailings basin and pit is given a unique number in order to be able to reference each land use individually. In this way, an information file can be maintained for each land use, and the variable map will act as a location map.

VEGETATION (V13)

Vegetation basically describes forest cover. The tree type, size, and density of the forested areas were interpreted from aerial photographs. Six classifications of tree types were identified: pines, upland spruce-balsam, aspen-birch, northern hardwoods, lowland hardwoods and

swamp conifers. Open areas were identified as cultivated, open field, pasture, wetland, unproductive or industrial.

RECREATIONAL - HISTORICAL / ARCHEOLOGICAL SITES (V14)

Recreation on the Range is increasing in importance as an industry. Some recreational activities are compatible with various mining land uses while others are very incompatible. Resorts, campgrounds, trails, rest areas, public boat accesses, golf courses and state and federal forest boundaries were identified.

Historical and Archeological sites consist of areas which are significant in terms of obtaining an historical perspective of the Mesabi Range. Indian trails, early roads, early railroads, logging sites, sawmills and early mining locations are contained in this variable.

UTILITIES (V15)

The location of utilities is an important indicator of the development in an area. The Utilities variable includes powerlines, substations, radio towers, waterworks, pipelines, railroads and airplane facilities. USGS quadrangle sheets were updated using information received from various utilities companies.

ROADS (V16)

Roads were entered as a variable separate from utilities since in many places roads and powerlines occupied the same cell. Each road was identified by a different number so that it could be easily classified by computer into a group. Criteria for classification included such factors as surface type, weight restriction and maintenance jurisdiction. This will be impractical to do for the entire regional study area because of the large number of roads and limited data level input capabilities.

URBAN and RURAL DEVELOPMENT (V17)

Urban and Rural Development depicts the location of residential and commercial areas. There are essentially three categories in this variable:

1. Incorporated - Developed. Fifty percent or more of the cell contains buildings.
2. Incorporated - Undeveloped. Within the boundaries of incorporation, but less than fifty percent of the cell contains buildings.
3. Unincorporated - Developed. Occurs in communities either listed in the 1970 Census, or served by a paved street other than county or state roads. These criteria were established to exclude farmsteads from the developed classification.

Cemeteries are also included in this variable.

WATER APPROPRIATION AND DISCHARGE POINTS (V18)

Since the range is located at the top of a major watershed divide, water is a scarce commodity. Therefore, the consumption of ground and surface water resources, and the discharge of waste water, are important considerations in mineland planning.

The points at which water is appropriated and discharged were located from DNR and PCA permits. The accuracy of some of the points is questionable, since some of the permits only required a description to the nearest forty acres. In other permits, a map was included which plotted the point mor precisely.

In addition to the variables developed for the pilot area, a feasibility study was done to determine if the contents of existing stockpiles could be determined from scattered documentation. The purpose was to develop a classification system for these stockpiled materials based on content and potential use.

Over 400 stockpiles and tailings basins were located in the pilot study area. An attempt as made to obtain as much information as possible for each individual stockpile or tailings basin. This endeavor met with various amounts of success. Assay data was located for 39% of the stockpiles or basins, 53% were identified by type of material contained and no data was discovered for only 8%. A description of the classification system developed is included as Appendix 1.

One other feasibility study concerning mineral resources was also to have been completed this biennium. Dr. Ralph Maisden was to have supplied data concerning the southern

boundary of the Biwabik Iron Formation. He has not yet completely verified his work, however, and therefore is reluctant to release it. In the next biennium this will be included as it becomes available.

In addition, the Division of Minerals and the Dept. of Revenue will be co-sponsoring a contract to develop a computer program for calculating mineral reserves, resources and waste material volumes based on drilling data.

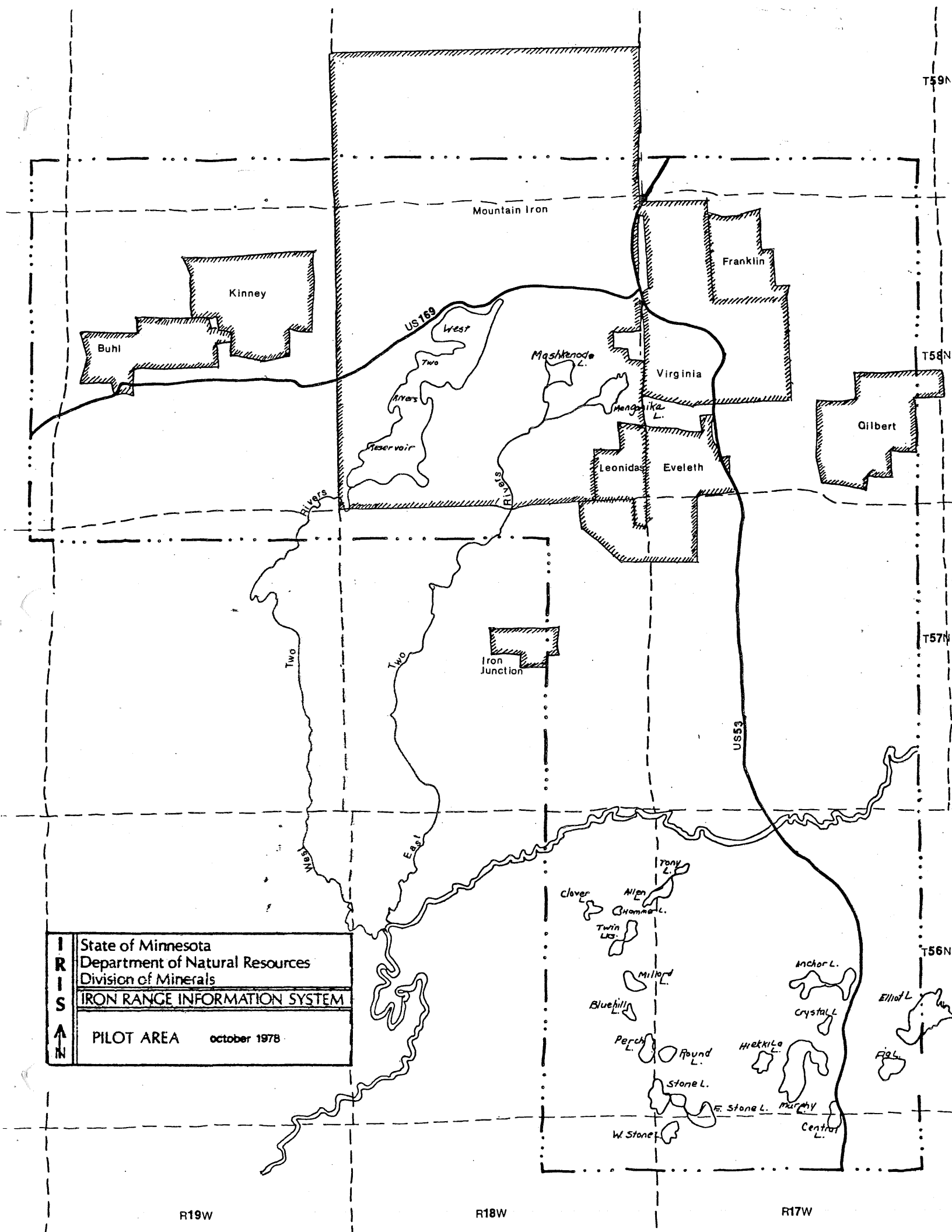
T59N
Mountain Iron
Franklin
Kinney
Buhl
US 169
West
Two
Rivers
Reservoir
Mashkenode L.
Virginia
Mengoosika L.
T58N
Gilbert
Leonidas
Eveleth
Rivers
Iron Junction
T57N
Two
Rivers
East
West
US 53
Tony L.
Clover
Allen
Chomma L.
Twin Lks.
T56N
Millard L.
Anchor L.
Elliot L.
Bluehill L.
Crystal L.
Perch L.
Round L.
Hiekkila L.
Stone L.
E. Stone L.
Murphy L.
W. Stone L.
Central L.
IRIS
State of Minnesota
Department of Natural Resources
Division of Minerals
IRON RANGE INFORMATION SYSTEM
PILOT AREA
october 1978
N
R19W
R18W
R17W

TABLE 3 - STATUS OF THE PILOT STUDY VARIABLES

	DATA PROCESSING STAGES						
VARIABLE	COLLECT COMPILE	CODE	ENTER	VERIFY STEP I	CREATE MAP	VERIFY STEP 2	FINAL MAP
V11-V12 MINING LAND USE	X	X	X	X	X	X	X
V13 VEGETATION *	X	X	X	X			
V14 RECREATIONAL-HISTORICAL/ ARCHEOLOGICAL	X	X	X	X	X	X	
V15 UTILITIES	X	X	X	X	X	X	X
16 ROADS	X	X	X	X	X	X	X
V17 URBAN/RURAL DEVELOPMENT	X	X	X	X	X	X	
V18 WATER APPROPRIATIONS & DISCHARGE	X	X	X	X	X	X	

* It was necessary to obtain a consultant to interpret the vegetation in the pilot area from aerial photographs. This was not completed until May of 1979.

TABLE 4 - SOURCES FOR THE PILOT STUDY AREA VARIABLES

VARIABLE	SOURCES	DATE
V11 - V12 MINING LAND USE	Mesabi Range Maps; GNIOP.	1959
	"Land Cover Change in the Mesabi Iron Range, 1969-1975." MSPA Publication #165020.	1976
	Mine Plan Maps - DNR Minerals.	1969-1978
V13 VEGETATION	Black and white infrared aerial photographs; interpreted by Ralph H. Olson, Consulting Forester	1972
V14 RECREATIONAL-HISTORICAL / ARCHEOLOGICAL	Aguar, Charles; Exploring St. Louis Co. Historical Sites.	1971
	Lampa, Marvin; "A Report to the DNR on the Historical Aspects of the Vermillion Cuyuna, and Mesabi Iron Ranges." MDNR.	1977
V15 UTILITIES	USGS 7 1/2 Minute Quadrangle Sheets.	1969,1976 Rev
	Railroad Trackage: Burlington Northern; Burlington Northern; Duluth, Winnipeg and Pacific; Duluth, Mesabi, and Iron Range.	Current
	Transmission Lines: Minn. Power & Light; United Power Association.	Current
	Pipelines: Northern Natural Gas Co.	
V16 ROADS	USGS 7 1/2 Minute Quadrangle Sheets.	1969,1976 Rev
	MDOT - St. Louis Co. Highway Map.	1978
V17 URBAN / RURAL DEVELOPMENT	USGS 7 1/2 Minute Quadrangle Sheet.	1969,1976 Rev
V18 WATER APPROPRIATIONS / DISCHARGE	MDNR - Division of Waters; Permits.	
	MPCA - Permits Section.	

The general sources used for development of the variable are listed, although other sources may have been referred to. Contact the DNR - Division of Minerals for further information.

GENERAL PROCEDURES USED IN DEVELOPING VARIABLES

Data Collection and Compilation:

Information is collected which describes the study area in terms of each resource or land use variable. This often includes consultation with resource specialists and considerable review of available reports and maps. Many agencies are contacted to obtain information.

For some variables, the available information is very general while for others it is very specific. For example, the Soils variable contains data derived from the Soil Conservation Service's General Soils map of the Arrowhead Region, which is accurate to approximately 40 acres. In contrast, the Utilities variable mapped for the pilot study area was compiled from detailed trackage maps provided by commercial power and railroad companies.

Coding:

Once collected, the information is compiled on a base map. Usually USGS 7 1/2 minute quadrangle sheets are used. The coding process involves transferring the data off the base map onto a cell grid coding sheet suitable for computer entry.

Each constituent of the resource or land use variable is assigned a particular number, or "data level" which is represented by an alpha-numeric symbol. For example, the Surface Hydrology variable could be expressed in terms of the constituents; lakes, streams and marshes. Lakes could be assigned the data level 1, streams the data level 2 and marshes the data level 3. Using a transparent grid overlay, the base map is divided into one hectare (2.47 acre) cells. The information is then transferred off the base map and onto coding sheets. In general, if a particular constituent occupies more than 50 percent of a cell on the overlay grid, the corresponding cell on the coding sheet is given the symbol for that constituent. For linear data, such as roads, a cell is assigned if the road passes through it.

Computer Entry and Verification Step 1:

The data is entered into the University computer using a CRT terminal and an off site data storage facility. Once entered, a listing of the data is checked for accuracy against the coding sheets, and mechanical errors are corrected.

Creation of the Map and Verification Step 2:

The corrected data is stored in several computer files to facilitate entry. These are translated into the Environmental Planning Programming Language (EPPL5) format developed by the State Planning Agency. The individual files are then combined to form one large "map file" of the entire area. Once again, the composite map is checked against the coding sheets and errors corrected. In this way, a computer map is prepared for each variable.

APPENDIX 1

DESCRIPTION OF THE IRON RANGE INFORMATION SYSTEM CLASSIFICATION SYSTEM FOR STOCKED MATERIALS

Stockpiles on the Mesabi Iron Range are commonplace, but often little is known about what sort of materials the stockpiles contain. Some may have valuable metal which could feasibly be liberated under various processing technologies. Others may contain material which is potentially valuable in the construction or transportation industries. Currently these are stored resources which need to be inventoried for future use. For these reasons, an inventory of stockpiled materials and a classification system to categorize these materials based on all available data is being prepared.

By examining approximately 400 stockpiles in the IRIS Pilot Study area, six categories of stockpiled materials and tailings have been identified, as shown on Chart 1. The vertical axis of Chart 1 represents the various types of information potentially available for each type of material. The purpose of this classification system is to record as much information as possible about each individual stockpile or tailings basin. The system is designed flexibly because records are often incomplete on some stockpile sites while others can be described rather well. The following is a description of the various categories and how they can be used to classify stockpiles.

Unknown Stockpile - material which cannot be identified from available sources. At a future time a field inspection of these sites could eliminate this category.

Overburden Stockpile - unconsolidated material which must be removed to gain access to the ore body. Usually this consists of soils and glacial material. Occasionally it may also contain some waste rock. Overburden stockpiles are being mapped according to soil type by the Soil Conservation Service for Itasca County. This information will be included as it becomes available.

Rock Stockpile - most of the stockpiles will fall into this category. This heading is comprised of five types of material:

1. Ore - those stockpiles identified by various sources as ore. Sometimes it is possible to distinguish what type of ore is implied (e.g., natural, taconite,

etc.), but often the stockpile is just labeled "ore".

2. Lean Ore - may be described according to what type of lean ore the stockpile contains; however, often "lean ore" is the only specification.

3. Miscellaneous Taconite - some of the stockpiles are described only as taconite and contain material which may be ore, lean ore or waste rock. It is not possible at this time to determine into which class they fall.

4. Waste Rock - many stockpiles are described as waste material; they may be further defined as to type of waste.

5. Unknown Rock - some stockpiles are described as "rock" with no further explanation.

Mixed Stockpiles - contain different materials which have been intermingled to a point where they are inseparable.

Layered Stockpiles - consist of materials which have been piled on top of one another in layers. These are considered separable, since each layer is distinctive.

Tailings - these are divided into type of material and size of material. Types of material include natural ore, taconite and unknown tailings. Size of material is roughly divided into coarse, fine and mixed. For natural ore, jig tails and heavy media tails are also used to indicate size.

Table 5 is an example of how stockpiled materials may be classified. The categories on the vertical axis on the chart demonstrate the types of information available which can further define the contents. These are described below.

Type of Material - a general description of the material stockpiled.

Size of Material - can be used to describe either the grain size or the size of the broken rock pieces.

Descriptive Chemistry - this class is used to give percentages of important elements like Mn, P and Al, or it can be used to explain why the material was stocked rather than shipped (e.g. High Sulfur Ore).

Percent Iron and Silica - average percentages of these elements within the stocked materials.

Tonnage - indicates size of the stockpile.

Operator - indicates the mining company which stockpiled the material.

Fee Owner - indicates the owner of the stocked material

Mine Name - indicates the mine from which the material was removed.

Stockpile Name - often stockpiles are numbered or named by the Fee Owner or the Operator for their own records.

Categories of information which may be included in the future are: percent Magnetic Fe, percent Nonmagnetic Fe, grindability, liberation size, concentratability, and ore horizon.

SOURCES:

1) Department of Revenue Tax Reports on stockpiled materials
2) Mesabi Range Maps; Great Northern Iron Ore Properties, May, 1959.
3) "Land Cover Change in the Mesabi Iron Range 1969-1975"; Minnesota State Planning Agency Publication 165020: August, 1976.
4) Minnesota Department of Natural Resource Division of Minerals, Office and Field Report 1977
5) Mine plan maps submitted to MDNR 1969-1978

TABLE 5 - EXAMPLE OF THE CLASSIFICATION SYSTEM FOR STOCKED MATERIALS

GENERAL MINELAND USE	UNKNOWN STOCKPILE	OVERBURDEN STOCKPILE	ROCK STOCKPILE	LAYERED OR MIXED STOCKPILES	TAILINGS
DATA LEVEL	1-9	3-23	3-3	9-17	9-30
LOCATION	NW-SE 13/58/20	NW-SE 10/58/19	N1/2-SE 15/58/19	SE-NW,NE-SW 25/58/17	NW-NE 25/58/17
TYPE OF MATERIAL	Unknown	Overburden	Paint rock lean ore	1 Taconite 2 Lean Ore	Jig & H.D.Tails
SIZE OF MATERIAL				Blocky	-1.5 in
DESCRIPTIVE CHEMISTRY			P = .99 Al =9.36 Mn = .79	Hi Al L.O.	
% Fe			47.19	1: 34.16 2: 46.43	
% SI			12.96	1: 45.66 2: 23.44	
TONNAGE			1,979,910	1,645,569 (combined)	
OPERATOR			USS	J&L	
FEE OWNER		USS	USS	J&L	W.S. Moore (?)
MINE NAME			Kosmerl Midway	Schley	
STOCKPILE NAME			USS 3093		