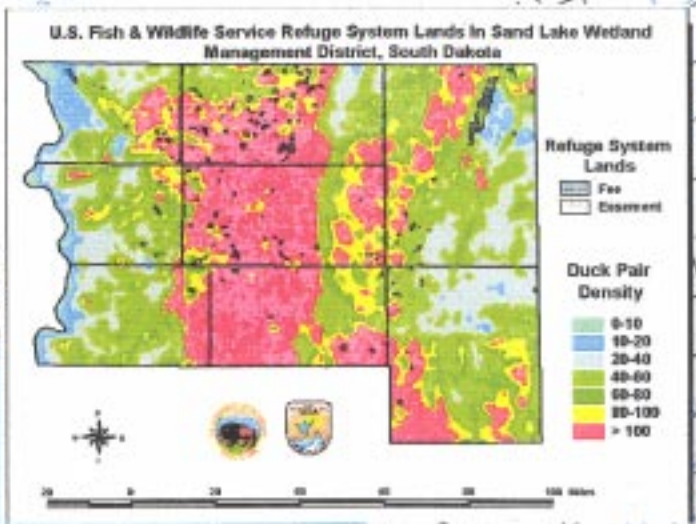
Strategic Framework for GIS: Region 6 Refuge Program



	Date	Location	W Fronts	Ca
2	02/18/88	MALLARD HAVEN	550	
3	02/18/88	HANSEN	15	
4	02/18/88	MASSIE	0	
5	02/18/88	HARVARD	600	
6	02/18/88	RIVER - KEARNEY TO G.I.		
7	02/18/88	HAMILTON 1	0	
8	02/18/88	YORK 9	0	
9	02/18/88	YORK 65	0	
10	02/18/88	FILLMORE 11	1800	
11	02/18/88	FILLMORE 24	0	
12	02/18/88	CLAY 49	650	

WILDLIFE

Type I
Type II
Type III
Type IV
Type V

Strategic Framework for GIS: Region 6 Refuge Program

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GIS Work Group

Chuck Loesch, Habitat and Populations Evaluation Team
Jaymee Fojtik, Division of Refuge Planning
Manuel DeLeon, Ouray National Wildlife Refuge
Wayne King, Division of Resource Management
Steve Henry, Charles M. Russell National Wildlife Refuge
Gene Mack, Chairman, Rainwater Basin Wetland Management District

Introduction

A geographic information system (GIS) is a computer-based tool for collecting, managing, and interpreting spatial data. It combines the ability to associated unique characteristics to specific geographic locations. GIS produces maps that integrate information in a visual manner to help solve complicated management problems. The created spatial databases can be queried and statistically analyzed to help managers make management decisions.

The duck pair density or "thunderstorm" maps (see Appendix), created by Habitat and Population Evaluation Team (HAPET) in Bismarck, North Dakota, are excellent examples of how GIS can assist in directing funds and management actions over a large landscape. Thunderstorm maps have identified the most effective areas to restore and protect grasslands, restore wetlands, purchase land in fee title, etc. Prior to GIS, those decisions relied on subjective information; often lost with changes in personnel. With GIS, the information remains readily available to future managers. And, the information is not restricted to those who collected or stored it in files, but is available to every individual, station, or agency who needs it.

GIS technology is used to assist in tasks such as presenting information at public meetings, matching management strategies with species needs, and planning future budget needs. The speed and efficiency of GIS allows managers to pose multiple scenarios to determine the effect of various options.

GIS can be an excellent source of historic records. Today, an agency without GIS can be likened to an a visually impaired person standing in a library without eye glasses: He knows he is surrounded by valuable information, yet failed to buy the one piece of equipment that would allow him access to it.

Significant changes in GIS technology have made it practical for field application. Today, equipment and software is cheaper, more powerful, and more user-friendly. Baseline information is more abundant and cheaper to obtain than it was a few years ago.

Objective

A successful GIS operates according to a well-designed plan which contains the models and operating practices unique to each organization. The objective of this plan is to develop a Region 6 GIS program to meet the needs at both the field and landscape level. Applications need to:

1. Be economical and practical for field station use,
2. Create station-specific databases, consistent with established standards, to help managers make station-specific management decisions,
3. Create landscape-level databases, consistent with established standards to help Regional staff (Refuge Supervisors and Support Services) make management decisions at the landscape level.

The success of GIS at HAPET and all refuge offices is dependent on four key components: technical support, data management, hardware and software, and acceptance by potential users.

Technical Support

Technical support can be likened to the oil that keeps a GIS program running smoothly. The term "technical support" is often used synonymous with the person who enters GIS data. Although they may be the same person, their roles are totally different. Technical support are the people who provide expertise to use the power of GIS to answer management questions (e.g. data entry methodology and analysis).

Several actions need to be taken to form a solid GIS foundation.

Action: Hire GIS staff (see Staffing Needs section below)

GIS staff would legitimize a GIS program within the Region in numerous ways:

- They are the experts who can identify GIS needs and direction.
- They would demonstrate the Region's commitment to GIS in a way that would help build support within and outside the Service. In doing so, it opens opportunities for funding and partnerships.
- GIS staff insures standardization of a Region-wide GIS program. They would administer National and Regional policies, priorities and methodologies. Five users consulting the same "expert' about the same question will each get the same answer. Under the current system, five users are consulting five "experts" and getting five different answers.
- GIS staff would represent Region 6 at the national and professional level.
- GIS staff can build central libraries and make the information accessible throughout the Region.
- GIS staff can insure the appropriate hardware is purchased to meet each station's use or need. This would ensure the purchase of sufficient and standardized hardware and software.

Action: Develop standards of GIS protocol within the Region

There is an old adage in compiling data: "garbage in—garbage out". Protocol needs to be established in all aspects of GIS: data management, hardware/software requirements, metadata, etc.

Action: Develop a training program for GIS

Training needs to address the full spectrum of users and uses of GIS. They include

- Basics of computers, GIS, and data entry

- Data management, including creation of metadata, archiving and retrieving data from multiple sources
- Spatial analysis
- Updates of software and hardware technologies

Action: Become involved in developing National standards and protocols

GIS is growing in its use within and outside the Service. Standards and protocols are being developed that affect how GIS will be done within the Region. Our involvement is necessary to ensure Region 6 needs are being addressed and that National efforts include Region 6 needs.

Data Management

Data management is a critical and difficult part of developing GIS. It becomes a "chicken and egg" dilemma. GIS is of little value unless spatial data exists. Public domain data is becoming more available. But, none of this provides detailed information about wildlife resources on refuge lands. Obtaining this data can be costly. Managers are reluctant to make the staff and cost commitments when they are uncertain what the benefits will be. Thus, GIS development is slowed. Actions currently being taken are independent initiatives, scattered among field stations: Each using GIS to meet their local needs with no guidance on managing the data. Obtaining and managing data has to be carefully planned in order to fully utilize it.

Several actions need to be taken to improve Region 6's ability to create and manage spatial data.

Action: All spatial data adhere to ArcView™ shapefile format

Variations in the software used to create spatial information can restrict data sharing. ArcView is recognized nationally as a leading mapping and GIS software. It has the capability to access records from existing databases and display them on maps. Maps and databases generated in other common formats (ArcInfo™, ESRI, AutoCad, SDE, dBASE, TIFF, JPEG, and numerous others) can be loaded into ArcView applications. Data created by ArcView can also be exported to other formats. These features would allow field stations to spatially connect historic information to a geographic location.

ArcView has an object-oriented scripting language to develop custom tools, interfaces, and complete applications. Costum-made interfaces assists casual users with data entry. Many biological interface programs are being created using ArcView as the GIS software.

Action: Non-spatial data be compiled in a format compatible with Microsoft Access™

Softwares for storing tabular data are even more common than those for spatial data.

Microsoft Access is commonly recognized as a standard and is used by both ArcInfo and ArcView. Data created independent of ArcView, but stored in Access can be easily incorporated into GIS. Many database interfaces are created using Access.

Action: A standardized list of attributes and their respective definitions be developed at the Regional level

Attributes and method of collecting data need to be standardized so data from various field stations can be compiled, compared, and shared. For example, a cultivated tract of land could be described as farmed, cropped, tilled, plowed, etc. A data search, at the Regional level, for all refuge lands under cultivation would miss those areas identified as "farmed" and vise versa. Standardized attributes would make information consistent across field stations and capable of being summarized at the Regional level.

Action: Create a standardized interface that improves efficiency and accuracy of data entry

Interface software is a custom-made program that contains the fields and attributes associated with a specific application. One example of a refuge interface is the "Windom Program" developed by the Windom Wetland Management District in Region 3. The software contains pertinent fields wetland managers use to describe biological and natural resources, as well as management actions taken. A standardized interface, meeting R6's needs, would ensure all field stations are entering data for a standard set of fields (variables), using the same list of attributes.

Action: Establish a priority list of spatial themes at the Regional level

The collective effect of spatial data is lost if each field station is allowed to establish its own priority of data collection. One field station may be focusing on recording data associated with bird abundance and distribution, while another is mapping vegetational cover. The data, although valuable, is scattered and does not give a Regional description of either bird abundace or landcover.

Priorities need to be established so baseline information exists for all stations. Priorities should be on a two-tiered approach: Regional needs and station-specific needs:

Refuge Database Needs (entered by station staff)

1. Property boundaries
2. Sitings of endangered, threatened, and species of concern
3. Vegetative/land cover mapping
4. Wildlife distribution and density
5. Management activities
6. Location of real property and landscape features

Landscape Database Needs (obtained from other sources)

1. Landscape features (e.g. streams, wetlands, forests) and land cover

2. Sitings of endangered, threatened, and species of concern
3. Other public ownerships (e.g. state and federal lands)
4. Issues of concern (e.g. contaminants, critical habitats, elk wintering range, etc.)

Action: Baseline data needs, at the Region-wide level, be required of field stations

In conjunction with establishing database priorities, action needs to be taken to ensure field stations create a minimum level of baseline information. That baseline may only be one or two layers, e.g. land cover and endangered species location. This requirement, however, should not be made until a Region-wide software interface is developed and appropriate support is provided.

Action: Individual stations be responsible for maintaining and sharing their databases

Field stations need to collect and record data with the attitude that the data is of value to users outside their respective field station. If the information is important enough for them to compile, it is important enough to share. This action item is reinforced by Executive Order 12906. It requires all spatial data to be made available through the "National Spatial Data Infrastructure (NSDI)".

Action: Develop a centrally organized (corporate) database library at the Regional level

Using the library analogy described earlier, a library is of little value if all the books are scattered (stored) in homes throughout a community. The same is true if spatial data remains scattered. A central data storage or clearing house is necessary to eliminate duplication of effort and increase field use. Field stations may re-create existing data, or make less-informed management decisions, if they are unaware of what data exists. A central library would make it easier for support services, such as Realty and Refuge Planning, to obtain information needed for acquisition and planning.

Action: Assist field stations in building a baseline of spatial data

Historic information buried in files can provide a long-term perspective to management. Field stations have cabinets full of information on past management, bird use, and vegetative cover that can help with future management. Having this information in spatial format would help managers recognize trends and effects of management. It would also serve as a valuable tool for informing the public of changes that have occurred on the refuge or area landscape.

Hardware and Software

The common thought associated with GIS is "If we had money to buy computers and software, we could do GIS." Funding is only a part of the equipment problem: inconsistency and incompatibility are the others.

Action: Establish minimum hardware and software requirements for all GIS workstations

Minimum requirements would ensure data can be compiled and transferred between stations and the Regional Office. Current minimum equipment needs are:

Field Stations Level

- Pentium III or better computer
- 17-inch color monitor
- Color inkjet printer
- Internet capability
- ArcView software
- Software interface
- Microsoft Access software

Corporate Database Level

- Equipment used at field station level
- Oracle or SQL server

These standards need to be revised as appropriate to keep pace with advancing technology.

Action: Acquire minimum level of equipment for each workstation

Much of the equipment required is already in the possession of field stations. It is important that when the GIS program is implemented, a software interface be developed before field station be required to own the full complement of GIS equipment.

Acceptance of GIS

Acceptance of GIS (both at the field and Region level) has and continues to be difficult to achieve. Ironically, past attempts at developing Regional GIS applications have increased skepticism, especially at the field level. In the early 1990's, MapInfo™ software was distributed to all field stations. The goal was to have all refuge field stations enter spatial data in a consistent manner. The software was difficult to use and resulted in only a few maps being made. Stations judged GIS to be an expensive mapping software. That same perception remains.

Action: Promote GIS applications to build Region-wide support

Two ways to convince managers to support GIS is to show them what it is capable of doing, and to have upper level supervisors acknowledge the value of GIS for field and Regional use. Right now, there is much confusion as to what GIS can do for specific stations. Some see it as an expensive mapping system. Some see it as requiring highly trained staff. Training would demonstrate what skill and equipment are required to create

GIS databases. More importantly, training would show how GIS will help make management decisions and build local and regional support for special projects.

Applications like those used by HAPET and Charles M. Russel NWR (see Appendix) help show how GIS can influence management decisions at the landscape scale. Small scale, refuge-specific applications also need to be developed. These demonstrations would show the ease of data entry, the minimal amount of equipment required, and its benefit to trust resources.

Action: Build a network of support for users throughout the Region

Building a network of support would help build a connection between Regional and field station GIS efforts. Support strategies would include newsletters, lists of contacts for technical questions, lists of sources for equipment and software, highlighting GIS projects throughout the Region, and mentoring programs.

Action: Provide technical assistance to help stations get past the "start up" phase

One barrier that stops many field stations is the unknowns (e.g. what equipment, installing software, and how to enter basic data) associated with getting started. Arrangements need to be made for experienced users to help new users get started.

Staffing Needs

Currently, the approach is to purchase GIS and add it as a collateral duty to existing staff. Basic data entry can possibly be done that way—assuming field stations are already spending staff time recording data in some format. But, building a unified program has to have people dedicated to that task alone. The staffing approach identified in this document is a step-by-step approach: fund what is possible, with an identified goal in mind.

Organizational structure

Figure 1 shows the organizational structure of the GIS staff. Its structure is similar to the existing Regional Fire Program (e.g. Regional Fire Coordinator with Fire Management Officers scattered throughout the field). The Regional GIS Coordinator is responsible for development and implementation of the Regional GIS program. Scattered throughout the Region will be Area GIS Coordinators who will be responsible for GIS activities within their geographic area. The Area Coordinators will ensure standardization of data and provide support to their respective field stations. A special position, called a Geospatial Database Coordinator, will be responsible for maintaining a corporate database that can be accessed and updated by field stations, support services, and GIS Coordinators. A detailed description of the role of each position is described below in the "Duties of Position" section.

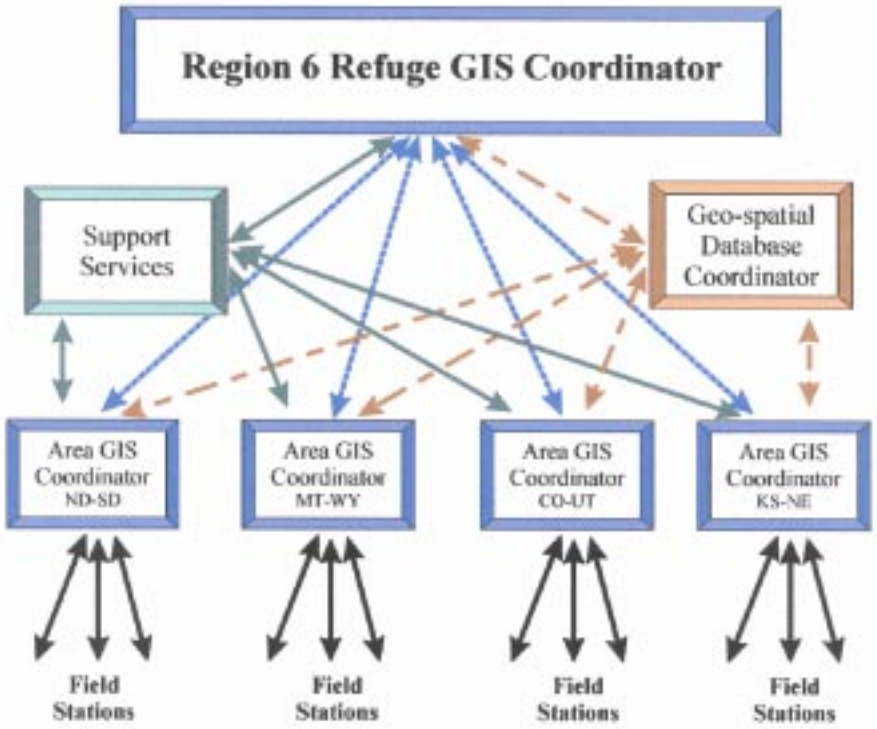


Figure 1. Organizational Structure for GIS Staff in Region 6

Support Services (law enforcement, fire, realty, planning, HAPET, and archeology) would work closely with each zone GIS to obtain appropriate information. For example, if archeology wanted information about archeological sites within Montana, the Area Coordinator would be their contact. Region-wide information would be obtained from the Geospatial Coordinator.

Field offices would work closely with Area Coordinators to obtain the necessary technical support and planning. They would be responsible for obtaining and recording spatial data associated with their respective station. Field offices would provide these databases to the Zone Coordinator for compilation.

Staffing Priority

Staffing priority is as follows:

Priority 1. Create and fill a Region 6 Refuge GIS Coordinator position.

Priority 2. Create and fill positions for Area Refuge GIS coordinators–one for each two-state area (ND-SD, MT/WY, CO/UT, and KS/NE).

Priority 3. Establish a Regional Geospatial Database Coordinator.

Priority 4. Build up Area and Regional Office staff according to specific funding and needs. (This would be optimum staffing level that is currently undefinable because of changing technology, needs, and incorporation of potential partners.)

Responsibilities of Staff

The success of GIS depends of each employee, either at the Regional level or the field level. Table 1 (located at the end of this document) lists the key offices or individuals responsible for each action listed in this document.

Regional GIS Coordinator

The Regional Coordinator is a permanent (GS 13) position. The Coordinator would lead the GIS program (outlined in this plan) at the Regional level. The individual would not be involved in compiling data, but rather would coordinate the development of Regional standards in collecting, defining, and archiving data. The person would work with appropriate individuals to establish national and Regional GIS priorities and policies. The Coordinator would also serve as head of the GIS Team. Supervision of the position would be done by the Assistant Regional Director for Refuges.

Area GIS Coordinators

The four individuals associated with these positions would have a full performance level of GS-12. There primary skill would be in GIS with a biological background to assist field stations in developing specific GIS objectives. They would be located at optimal field locations to provide easy access for their respective field stations. Duties would include compiling their respective field station data, metadata, and landscape (multiple sources) data into one central location for field and Regional Office use.

The Area Coordinator will be the point of contact for information and technical assistance for their respective field stations and ecoteams. Supervision of the position would be done by the Regional GIS Coordinator. The four serve with the Regional Coordinator to make up the core of the GIS Team.

Geospatial Database Coordinator

This position is a permanent (GS-12) position, responsible for the Regional corporate database. This includes planning, developing, creating and maintaining. The individual would also be responsible for developing software interfaces to facilitate data entry. Supervision would be done by the Regional Coordinator. The Database Coordinator would also serve on the core GIS Team.

GIS Team

The GIS Team would be made up of two components: permanent GIS staff and temporary field experts (e.g. refuge biologists, support staff, etc.) who would provide their expertise in addressing specific issues or geographic areas. The number and type of field experts would vary with each project. For example, to develop Regional and National standards, the team would consist of the core members, managers, biologists, and field users.

Field Staff

Field staff are individuals specifically hired or assigned GIS responsibilities on each refuge. Their responsibilities include data entry and management at the field station level. They would be the point of contact for their respective Area Coordinator. Supervision would be by refuge staff.

Operation and Maintenance Budget

Regional Refuge GIS Coordinator (PFT, GS-13 FPL)		
Salary/Benefits		$84,000
Start-up Costs		$25,000
Annual Operation Cost		$22,000
Zone GIS Coordinator (PFT, GS-12 FPL)		
Salary/Benefits		$70,000
Start-up Costs		$75-120,000
Minimum	$75,000	
Optimum	$120,000	
Annual Operation Cost		$25,000
Geospatial Database Coordinator (PFT, GS-12 FPL)		
Salary/Benefits		$70,000
Start-up Costs		$70,000
SDE connection & software	$20,000	
Oracle database	$30,000	
Server and computer	$15,000	
GIS software	$ 5,000	
Annual Operation Cost		$22,000

Addressing Specific Concerns

Below are actions that would have to happen to answer questions commonly asked about GIS technology and capability.

Question: *"How do we develop or use existing GIS technology and programs for field station use to make station-specific management decisions and create station-specific resource databases for the station?"*

Answer: The key components identified are: 1) Develop a standardized interface that would make all field data entry conform to specified fields and definitions. 2) Develop a centralized Regional data library (corporate database) that is available remotely to all field stations. This corporate database would allow data to be accessed, queried, and updated from field stations.

To accomplish this:

- Equipment would include an Oracle or SQL server.
- Prioritize data collected in field; targeting high priority databases for sharing throughout the region.
- Use Comprehensive Conservation Plan-process to develop station GIS capabilities and identify priority data layers.
- Develop and institute data standards to ensure that data collected is compatible with ArcView shapefile format across the region. National standards would be used where available.
- Area Coordinators will consult with field to develop station-specific databases that follow regional and national standards.
- Area Coordinators would work with field stations to document databases following FGDC digital geospatial metadata content standard. A NSDI clearinghouse node(s) would be established and populated with metadata records.
- Develop Regional GIS training standards for field personnel (use resources of NCTC as possible).
- Develop standardized regional GIS user interface compatible with ArcView. This would include evaluating "Wetland Management District GIS" interface developed in Region 3 as a potential standard.
- Link tabular data to spatial data; but data doesn't necessarily have to reside in same place.

Question: *"How do we develop new databases and use existing GIS data from the many state and private sources to create a region-wide database of landscape level resource information?"*

Answer: The key component is hiring of Area Coordinators who would be responsible for working with outside partners (other programs, agencies, data clearinghouses, NGOs, universities, etc) to assemble a landscape-level data "library" of critical layers.

To make this effective:

- Area Coordinators would pool priority data at the area landscape-level and work with the Regional Coordinator to migrate data to a region-wide landscape level.
- Regional-level layers would be maintained in online data "library"–accessible over internet to all Fish and Wildlife Service offices.
- Populate Regional NSDI node(s) with Federal Geographic Data Committee (FGDC) metadata records for regional databases.
- Comprehensive Conservation Plans would tie in to ecosystem goals and relate to larger landscape objectives and land acquisition priorities.

Table 1. GIS responsibilities throughout Region 6.

Action	Responsibility					
	Regional Staff	Regional GIS Coord.	Area GIS Coord.	Geo-Spatial Coord.	GIS team	Field Stations
Data Management						
All spatial data be compiled in a format compatible with ArcView format	X	X	X	X		X
Non-spatial data be compiled in a format compatible with Microsoft Access format	X	X	X	X		X
A standardized list of descriptors and their respective definitions be developed at the Regional level		X	X	X	X	
Create a standardized interface that improves efficiency and accuracy of data entry				X		
Establish a priority list of spatial databases at the Regional level					X	
Baseline data needs, at the Region-wide level, be required of field stations	X	X	X	X		X
Individual stations be responsible for maintaining and sharing their databases						X
Develop a centrally organized (corporate) database library at the Regional level.		X	X	X		
Assist field stations in building a baseline of spatial data			X			
Technical Support						
Hire GIS staff	X	X				
Develop standards of GIS protocol within the Region.		X			X	
Develop a training program for GIS		X			X	
Become involved in developing National standards and protocols		X			X	
Hardware and Software						
Establish minimum hardware and software requirements for all GIS workstations		X			X	
Acquire minimum level of equipment for each workstation	X					
Acceptance of GIS						
Promote GIS applications to build Region-wide support	X	X	X	X	X	X
Build a network of support for users throughout the Region		X	X		X	X
Provide technical assistance to help stations get past the "start up" phase			X			X

Appendix
Examples of GIS Products

The following two pages contain examples of the use of GIS technology for habitat management within the refuge system.

Duck Pair Density: Sand Lake Wetland Management District

The Management District's goal was to identify those areas within an eight county area where upland management would have the most benefit for waterfowl. The information would direct land acquisition, upland management and private lands activities.

To gain this information, several processes were involved. The first was to combine breeding pair use, associated with various types of wetlands, with data from the National Wetland Inventory. The result identified the breeding pair potential of individual wetlands throughout the District. Using GIS and the developed Accessibility Model, nesting ranges of each species, for each wetland could be mapped. Combining the data, the District can identify each wetland, the wetland's duck pair potential, and the amount of upland nesting area associated with it.

The map, shown on a following page, defines this management potential at the landscape level. The central portion of the map, marked in red, is the area where improving upland habitat could impact the most breeding pairs. The white hatch-marks show areas where easements have been purchased to protect habitat. Most of hatch-marked areas, fortunately, are located in the high density (red) area. GIS was able to show the range of waterfowl habitats and document the Service's response to habitat protection.

Sharp-tailed Grouse Habitat: CMR National Wildlife Refuge

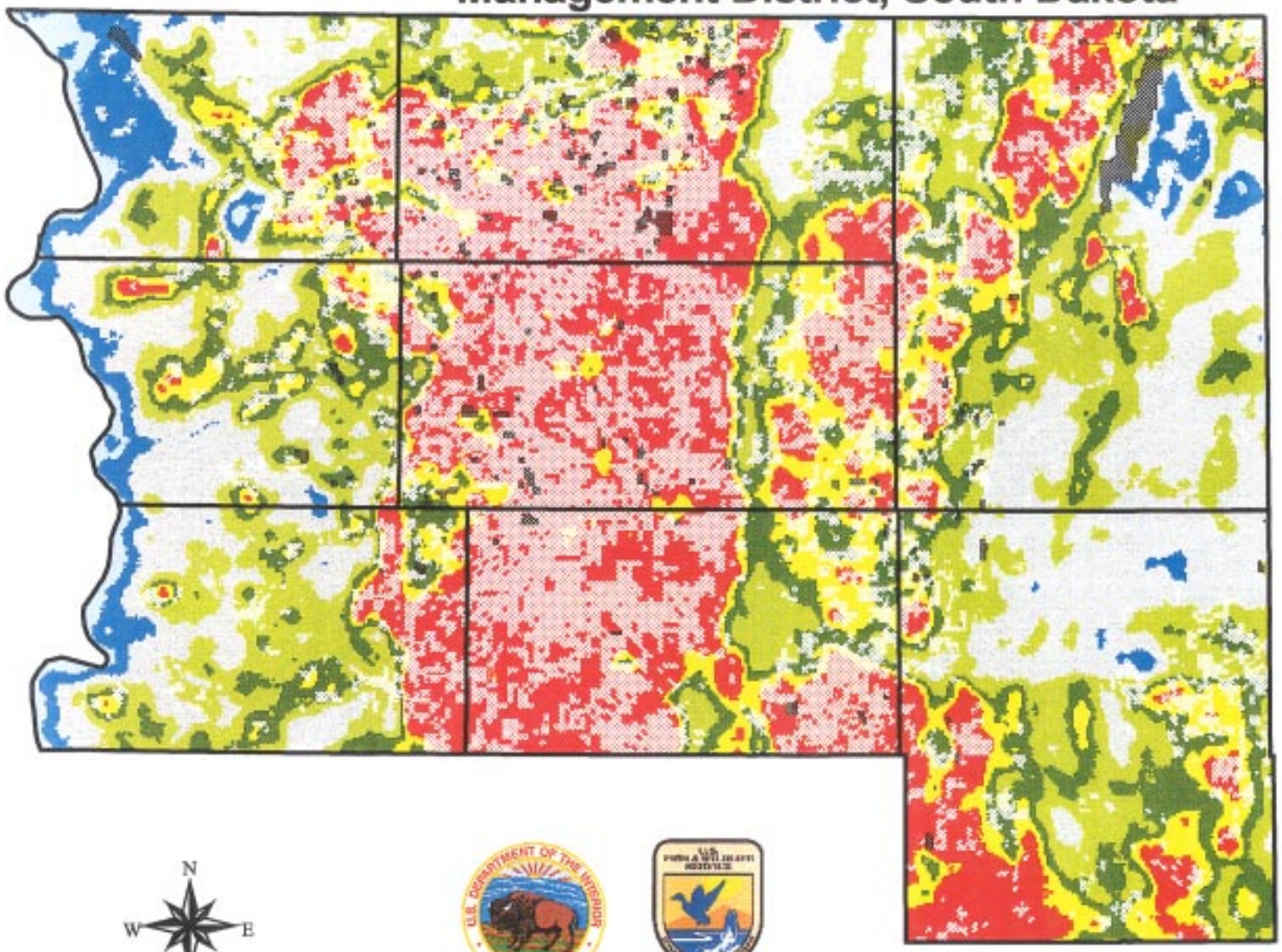
The Refuge's goal was to identify preferred sharp-tailed grouse habitat within a 26,314 acre habitat unit located on the Refuge. The habitat unit is too large to accurately delineate preferred habitat in a practical manner. Three criteria or parameters were used to describe preferred grouse habitat:

1. Range sites characterized by clay and shale soils which lack coniferous (i.e. ponderosa pine) cover,
2. Ten degree or less slopes, and
3. Ground elevations 2700 feet or higher (this eliminated bottomlands where nesting is minimal).

ArcInfo was used to "clip" from a range site thematic layer, those areas meeting the first criterion. Detailed data extrapolation was done from US Geological Survey digital elevation models (DEM) to map the slope of the land. Ground elevations were also mapped from DEM. The three data layers (range sites, slope, and elevation) were intersected. The polygons created marked those areas meeting the habitat needs of grouse. The new focus area for management was reduced to 3,270 acres.

To further refine the habitat areas, a fourth criterion was added. That criterion identified grouse habitat more than 0.5 miles from water. The assumption used was that livestock overused water areas, lowering its value for grouse. A thematic layer delineating all permanent water sources was created. ArcInfo created a 0.5 mile buffer around each water area. The more preferred areas, outside the buffer, represented 1,635 acres, only six percent of the total habitat unit. Both the numeric and the geographic data were created within GIS.

U.S. Fish & Wildlife Service Refuge System Lands In Sand Lake Wetland Management District, South Dakota



Refuge System Lands

- Fee
- Easement

Duck Pair Density

- 0-9.9
- 10-19.9
- 20-39.9
- 40-59.9
- 60-79.9
- 80-99.9
- > 100

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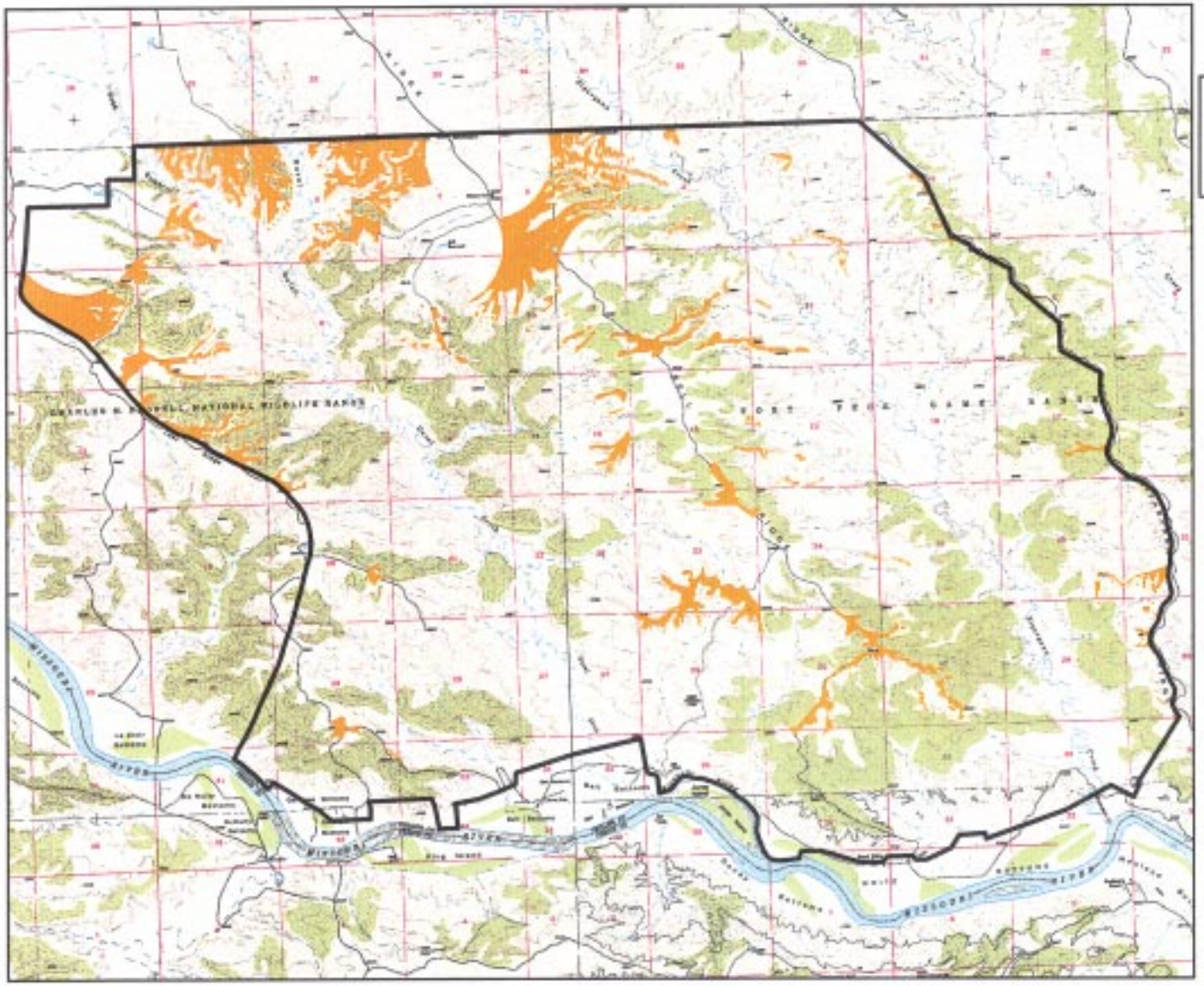
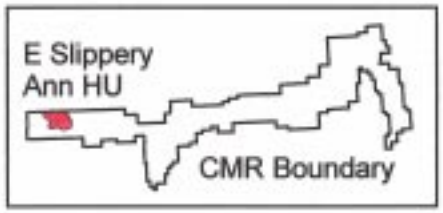
Fig. 6 Preferred Sharp-tailed Grouse Habitat > 0.5 mi from Water within the ESAHU



HU Boundary

Preferred STG Habitat = 1635 acres

Preferred habitat defined as:
Slopes 0-10°
Elevation > 2700'
Open, sagebrush range sites



3 0 3 6 Miles