Planning Aid #7
Guide to the Identification of GIS Data Themes for Use in the Resource Management Plan Process

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ABSTRACT

This Planning Aid provides guidance on developing a GIS database to support Resource Management Plans, including selecting data themes, defining needs, locating data sources, and designing data preparation, entry techniques and requirements.

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RMP/GIS DATA THEMES - PLANNING AID

Objective

To provide RMP Teams and Managers with guidance on developing a GIS database to support the RMP process. This includes:

1. How to determine what information is needed in the GIS database – selection of themes.
2. What are the considerations in defining needs.
3. What types of data are available and useful.
4. What are the sources of data.

CONTENTS

I. INTRODUCTION AND PURPOSE

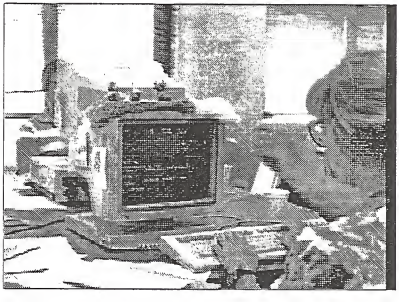
Perhaps one of the more painful work experiences for a BLM Resource Area staff is to be assigned the task of completing a Resource Management Plan (RMP) when no significant advance preparation has occurred. The usual dialogue is, ". . . we don't have the data necessary. . .," ". . . insufficient personnel available . . .," ". . . too much 'real work' to do . . .," and so on.

This situation is often magnified by "Management's" last minute decision to use Geographic Information System (GIS) technology as a tool in plan development and analysis.

The PrePlanning Contract is one of the best possible vehicles for resolving many of the foregoing kinds of problems. **The very best possible solution, however, is advance planning and the effective use of the Budget System.** *(See Planning Aid #5, Pre-PrePlanning).*

Whether you are in the very *Pre*-PrePlanning stage or ready to use GIS in the RMP, the process can be made far more efficient and effective through a systematic analysis of data needs and costs.

The BLM has been using GIS technology successfully to support RMP efforts since the early 1980's. The analytical capabilities of GIS have provided resource specialists and managers with a new tool for resolving complex issues and identifying opportunities for management of the public lands.



To use the capabilities that GIS technology offers in the RMP, a GIS database must be developed for the geographic area covered by the planning effort. A GIS database is composed of a number of single "layers" of information such as vegetation, ownership or transportation. These layers of information are referred to as **data themes**. Data themes needed for an RMP will vary between resource areas based on the natural resources and the issues involved in managing them. A variety of data is necessary to assure that the RMP is comprehensive and addresses the planning issues as well as the determinations that are required in BLM's Manual Sections 1620 to 1625.

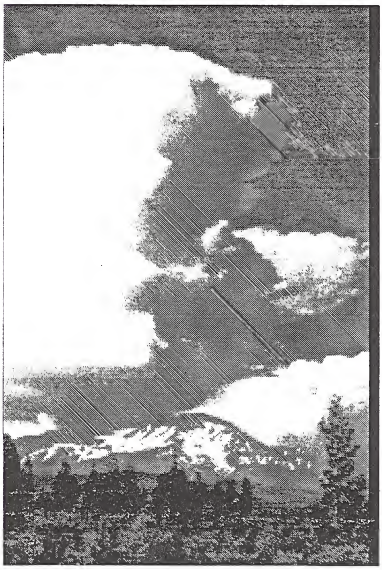
This document provides specific guidance to RMP Teams for GIS database development necessary to support the use of GIS technology in the RMP process. It is not intended to duplicate what is being done by the data standardization project but may be valuable in developing data elements that address factors of analysis for land use planning. This guidance also builds on other BLM Land Information Systems' (LIS) efforts including ALMRS, GCDB and Mapping Sciences, and provides supplemental information for RMP teams and managers.

The use of GIS can enhance the RMP process, but the full investment needed to encourage its use cannot be fully justified for planning purposes alone. The RMP is an opportunity to begin building the LIS database that will be used over many years of implementing the RMP and for other applications such as environmental assessments and resource studies. This long-term use of the data is what justifies the investment. For that reason, this guidance focuses on those data requirements that expedite the planning process. Additional information needs that resource specialists may have for post-RMP or program specific applications are not addressed.

II. OVERVIEW OF GIS DATA & RMP DATABASE DEVELOPMENT

Each RMP will have its own specific data requirements although many data themes will be common to all planning efforts. Regardless of which individual themes are used, there are considerations that must be addressed at the outset to ensure the database meets the needs of the resource specialists and managers. Development of a GIS database for an RMP is not a simple undertaking and requires careful design with plenty of time allocated to ensure that it is completed prior to starting the RMP. The development of the database can take as long as two years depending on how the GIS will be used in the RMP, the availability of existing GIS data, the requirement for data preparation, and the amount of digitizing to be accomplished in-house or by contract.

An understanding of GIS capabilities is not necessarily required to determine what data is needed for the RMP. The decisions that must be made in the RMP generally are based on the same information, regardless of whether the tools are automated or manual. When establishing data requirements for an RMP it is important to understand that the RMP must be comprehensive and issue driven. The Supplemental Program Guidance (SPG) determinations for individual programs in the RMP help assure that the planning effort is comprehensive. As such, a review of the SPG provides an initial assessment of preliminary requirements for data themes to support the RMP.



Once the data needs for the RMP are determined by the RMP team, the actual database development process is underway. Existing BLM inventories must be reviewed to see what information is currently available and if it is mapped or already in a GIS database or digital format. Other sources of information must also be pursued with other federal, state and local

agencies. Existing information that is not already in a GIS or digital format must be prepared for digitizing. The actual digitizing of maps may be accomplished by staff at the resource area, district or state office. Another possibility for digitizing is through the BLM's contract for digitizing services. Information may also be available in digital format from other agencies such as the USGS, Soil Conservation Service, Forest Service, etc....

In designing the GIS database it is important to know how the data will be used so that it can effectively take advantage of GIS capabilities. For example, digitizing a general wildlife habitat is insufficient when data identifying specific crucial big game habitat are essential for management decisions.

III. DATA THEME IDENTIFICATION

Specialists on the RMP team should identify data needs as reflected by the RMP issues, management concerns, planning criteria, base mapping needs and data requirements for comprehensive analysis (which may be above and beyond the issues). They should recognize the cost of digitizing as a consideration in limiting data theme selections, using only those data themes really needed to prepare the RMP should be selected. Despite cautions, many RMP teams continue to select data that is not mandatory, is inaccurate or that could have been derived through combining other data sets within the GIS analytic system. For instance, one need not digitize "aspect" if USGS Digital Elevation Models (DEM) are available. There is an ASPECT command within the GIS that takes elevation and automatically produces an aspect map. Sometimes specialists identify the need for very precise inventory data such as a sign inventory; yet this is not the most valuable use of GIS. Little analysis can be done on the data; it only serves as an electronic or retrieval capability. For more information on selecting data themes, see *Appendix B - Database Development Considerations.*

The data themes required for the GIS database can be categorized typically into two types of information:

1. Base Mapping Themes: General information that defines the geographic area including the cultural infrastructure, political/administrative characteristics, physiographic features and basic cartographic requirements.

2. Resource Themes: Resource information that describes the environmental characteristics and resource uses within the RMP planning area.

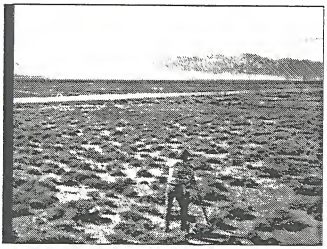
A. BASE MAPPING THEMES

The base mapping themes are basic to defining any geographic area, including the Resource Area which is the preferred unit for resource management planning. These themes must be in place before any subsequent analytical effort occurs. The need for these basic themes should not be regarded as being generated by the scheduling of an RMP or purely for their use in the RMP; they should be the first themes established for any area of BLM management responsibility.

The base mapping themes provide general cartographic information which may be found on typical map bases such as the USGS quad maps or taken from other sources, including public land survey system, land status and administrative boundary information. These base themes should represent the level of accuracy of the 7.5 minute USGS (1:24,000) quad maps. Accuracy is critical for these themes as they often represent boundaries for other themes. As a result, the lines or features from the base themes often are duplicated in the digitizing process to avoid potential registration problems that may affect analysis and processing functions.

1. PUBLIC LAND SURVEY SYSTEM (PLSS)

The public land survey is often referred to as the "landnet" which is comprised of township, range and section lines. As part of the LIS database development, the Geographic Coordinate Database (GCDB) will automate the PLSS. The landnet portrayed on the 7.5 minute USGS quads generally meets the needs of most GIS applications within the RMPs. However, there are areas where this landnet is not accurate or not available. Prior to utilizing the landnet from the USGS quads, the State Office Branch of Cadastral Survey should review the project area to determine the reliability and accuracy of the PLSS depicted on the quads. This information may be available in a digital format from the USGS as a Digital Line Graph (DLG). If the landnet is not available from the USGS, it can be digitized or possibly acquired from a vendor of digital products.



Note:

If a digital product is acquired from a vendor there may be a licensing requirement that limits our ability to share the data with other agencies.

The LANDNET theme is often duplicated to reflect boundaries for other themes that is coincident with the section lines such as Status, BLM Administrative Boundaries, Habitat Management Plans (HMP), Allotment Management Plans (AMP), Areas of Critical Environmental Concern (ACEC), Wilderness Study Areas (WSA), fencelines, etc....

2. RESOURCE BASE DATA (RBD)

Information such as terrain, transportation, surface hydrography and cultural features that are cartographically portrayed on USGS quads is considered the RBD. This information generally is digitized directly from the USGS 7.5 minute quads or acquired as a DLG from the USGS. The surface hydrography that is part of the RBD includes all flowing surface water, standing water and wetlands. The terrain information depicting topographic relief of an area or contours is acquired from the USGS or can be produced photogrammetrically by the BLM Service Center as a Digital Elevation Model (DEM). If the DEMs are not available or cannot be produced by the BLM to meet the RMP/project schedule, more generalized topographic information is available at the 1:250,000 scale from the USGS as Digital Terrain Elevation Data (DTED). A copy of BLM's Resource Mapping Suport Study (RBD) is available upon request. Please contact Director, WO-704 or SC-670 for a copy.

Typical Themes:	Preferred Scale
Surface Water - Rivers/Streams (Lines)	1:24,000
Surface Water - Lakes/Wetlands (Polygons)	1:24,000
Transportation - Roads/Railroads/etc	1:24,000
County Boundaries	1:24,000
Cities and Towns	1:24,000
Terrain	1:24,000
Miscellaneous Cultural Features (from USGS quads; bldgs., wells, overlooks, camps, communication facilities and other manmade features)	1:24,000

Note:

The USGS has 1:100,000 DLGs available for transportation and hydrography. However, at this scale the primary value is for generalized mapping.

These RBD themes can have additional BLM information (e.g., BLM road numbers, maintenance/use schedules, stream characteristics or designations, etc...) added to them for more descriptive and useful resource management applications or to meet specific program needs.

3. STATUS

Status refers to a broad range of surface and subsurface information regarding ownerships, rights in titles and authorizations that will comprise the ALMRS component of the LIS. Currently much of this information is transferred from the Master Title Plats (MTPs) to overlays of the 7.5 minute quads and then digitized. Also, BLM publishes surface and subsurface ownership status on the USGS 1:100,000 scale map base. With the alphanumeric information in the current ORCA/Case Recordation databases, the parcel generator software is used to graphically portray this information. While there are limitations associated with parcel generator it does offer some efficiencies and opportunities.

Typical Themes:	Preferred Scale
Surface Ownership (i.e., BLM, Federal, State and Private)	1:24,000
Federal Subsurface Mineral Reservations	1:24,000
Withdrawal	1:24,000
Classifications	1:24,000

Note:

Surface and Subsurface ownership codes should follow guidance from BLM Manual H-9671, Cartography.

4. ADMINISTRATIVE/POLITICAL BOUNDARIES

These refer to a variety of delineations that represent geographic areas based on political jurisdiction and/or management authority.

Typical Themes:	Preferred Scale
BLM District Boundary	1:24,000
BLM Resource Area Boundary	1:24,000
BLM Planning Areas (If other than District/RA)	1:24,000
Management Areas/Geographic Reference Area	1:24,000
Cities And Towns	1:24,000
County Boundaries	1:24,000
State Boundaries	1:24/100,000
County Zoning Classifications	1:100,000
State Legislative Districts	1:100,000
Federal Congressional Districts	1:100,000

B. RESOURCE THEMES

Resource information necessary to support GIS use in the RMP varies for each planning effort based on the issues and planning criteria addressed in the plan, and by the resource characteristics, diversity and uses within the planning area. The amount of data, level of detail and accuracy therefore are somewhat unique to each RMP. The following list of resources and/or programs identifies typical themes which may be required or helpful in the development of an RMP. For the most part, it is desirable to build the resource database at the 1:24,000 scale of the 7.5 minute USGS quad. The 1:100,000 surface/mineral management map series may be suitable for some themes which are more general and do not require precise positional accuracy. Scales smaller than 1:100,000 such as 1:250,000 or 1:500,000 often have limited value or use in making resource allocation or management decisions.

The following is a list of typical themes that might be used in an RMP, though not all of these themes will be used in every RMP. The lists do not necessarily include all themes that may be required.

In scanning the following lists of data themes, specialists should be aware of opportunities to add more information about the themes which can further define qualitative and quantitative resource characteristics. For example, levels of use, productivity and special value information may enhance the RMP.

Additional statistical information can be included to provide more descriptive values to the spatial data. Often times, some of this information already exists in databases developed by resource specialists on personal computers and can be linked to the spatial data in the GIS.

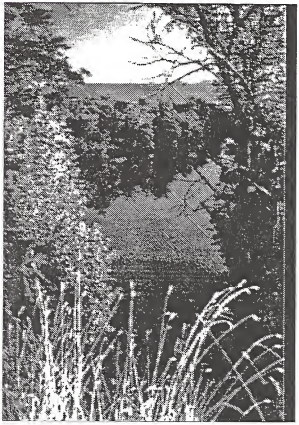
Existing Bureau data standards should be employed in the development of the database, particularly the labelling of subjects. Where Bureauwide standards have not yet been adopted, statewide or district standards should be maintained to allow more efficient conversion to new standards in the future.

1. ENVIRONMENTAL RESOURCES

Air Resources. Data concerning air resources is used to establish air quality management objectives and to determine management actions necessary to meet these objectives.

Typical Themes:	Preferred Scale
Air quality status	1:250/500,000
Visibility	1:250/500,000
PSD Areas*	1:250/500,000
Non-attainment areas	1:100/250,000
Emission sources	1:100/250,000
Air classes	1:250/500,000
Airsheds	1:250/500,000
Climate:	
Precip. isolines	
Wind direction	
Wind speeds	
Temperature	
Humidity	
Weather stations	1:24/100,000
Precipitation - 24hr/2yr averages	500,000

* Prevention of Significant Deterioration (Class I-II Airsheds)

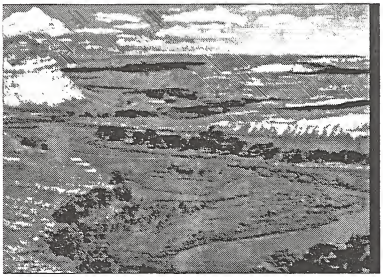


Soil and Water Resources. The RMP will require varying degrees of soil and water information depending upon the issues addressed. This information is needed to establish resource condition objectives and determine constraints that may affect management activities.

Typical Themes:	Preferred Scale
Soils	1:24,000
Soil Pits/Numbers	1:24,000
Soil Associations	1:24/100,000
Soil Surveys/Status	1:24/100,000
Soil Productivity	1:24/100,000
veg. lbs/unit area/year	
Landslides	1:24,000
Fragile Soils	1:24,000
Watershed Boundaries	1:24/100,000
Watershed Conditions	1:100,000
Erosion	
Sediment	
Runoff	
Streamflow Sediments	
Water Rights	1:24/100,000
Analytical Watersheds	1:100,000
Soil/Water Improvements	1:24,000
Community Watersheds	1:100,000
Gauging Stations	1:24,000
Flood Plains	1:24/100,000
Ground Water/Aquifer	1:100/250,000
State Water Quality Planning Areas	1:100/250,000

Vegetation. A wide range of vegetation information can be used in the development of an RMP. The level of detail and accuracy required varies based on the vegetative complexity, the planning issues, resource characteristics and conflicts, and future applications of the automated data. Vegetation data are required to establish vegetation management objectives and the management actions required to achieve those objectives. Vegetation information may be critical to assessing opportunities for other resource programs/uses and potential conflicts among uses.

Typical Themes:	Preferred Scale
Vegetation/Surface Cover Types	1:24/100,000
T/E Plant Species	1:24,000
Sensitive Plant Species	1:24,000
Unique Plant Assemblages	1:24,000
Utilization	1:24,000
Riparian Areas/Zones	1:24,000
Ecological Site Descriptions	1:24,000
Site Write-up Areas	1:24,000



Visual Resources. Visual Resource Management (VRM) information relates either to established VRM classes or the inventory data necessary to establish VRM classes. Additionally, this information is used to help designate scenic Areas of Critical Environmental Concern (ACEC).

Typical Themes:	Preferred Scale
VRM Management Classes	1:100,000
Scenic Quality	1:100,000
Sensitivity Levels	1:100,000
Distance Zones	1:100,000

ACECs. It is important to identify existing ACECs as well as proposed or candidate areas. Information related to both existing or proposed ACECs is important for evaluating the need to change the management of an existing ACEC (or even the continuing need for the designation) and for establishing management direction in proposed areas, including management objectives, constraints and special designations (such as nomination to a Historical Register).

Typical Themes:	Preferred Scale
ACECs (Designated)	1:24,000
ACECs (Candidate)	1:24,000
Existing Protected Natural Areas (w/o ACEC designation)	1:24,000
Rare, Unusual or Relic Natural Resources	1:24,000
Natural Hazards	1:24/100,000

2. RENEWABLE RESOURCES

Fish and Wildlife Habitat Management. Information needed for the RMP relating to fish and wildlife generally includes habitat types, special features and administrative units (i.e., HMPs, herd units and co-op management areas). Wildlife information/ themes should be developed by dominant species or associations and include T/E as well as any sensitive species.

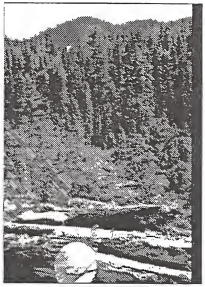
Typical Themes:	Preferred Scale
Crucial/Critical Habitat	1:24/100,000
Seasonal Habitat	1:100,000
Migration Routes	1:24/100,000
Special Features (Calving Areas, Strutting Grounds, Nest/Roost Sites, Dens, etc.) by species:	1:24,000

Antelope	Bighorn Sheep	Caribou
Chukkar	Deer	Elk
Javelina	Moose	Mountain Lion
Mule Deer	Non-Game Species	Quail
Raptors	Sage Grouse	Spotted Owl
Turkey		

Habitat Management Plan (HMP) Boundaries	1:24/100,000
Herd/Hunting Units	1:100,000
Cooperative Management Area	1:100,000
T and E Animal Species by species:	1:24,000

Desert Tortoise	Black-footed Ferret	Kaibab Squirrel
Bald Eagle	Peregrine Falcon	Grizzly Bear
Wolf	Jaguar	Kit Fox
Giant Kangaroo Rat		

Sensitive Animal Species (by Species)	1:24,000
Anadromous Fisheries	1:24,000
T and E Fish Species	1:24,000
Waterfowl	1:24/100,000
Migratory Birds	1:24/100,000



Forest Management. This information is needed to determine timber management alternatives including the availability of lands for intensive or restricted management of forest products as well as opportunities where forest management can enhance other uses.

Typical Themes:	Preferred Scale
Forest and Woodland Types	1:24,000
Commercial Forest Lands	
Non-Commercial Forest Lands	
Woodlands	
Special Use Areas	1:24,000
Post And Pole Areas	
Christmas Tree Cutting Areas	
Wood cutting Areas	
Operations Inventory	1:12/24,000
Five Point Inventory	1:12/24,000
Tree Improvement Cooperative Units	1:24,000
Forestry Breeding Units	1:24,000

Livestock Grazing. Data needed on livestock grazing includes resource condition/capability, allotment characteristics and rangeland facilities/improvements.

Typical Themes:	Preferred Scale
Allotment Boundaries	1:24,000
Pasture Boundaries	1:24,000
Range Improvements	1:24,000
Range Condition And Trend	1:24,000
Kind of Livestock (generally by pasture/allot.)	1:24,000
Areas Unsuitable for Livestock Grazing	1:24,000

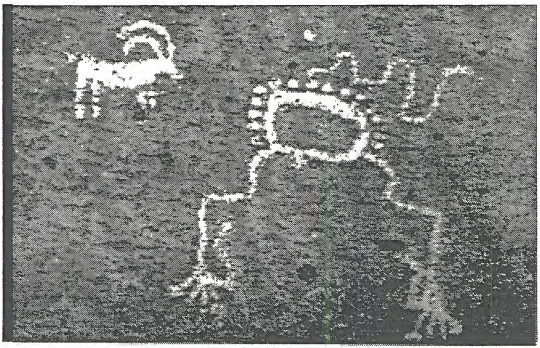
Wild Horse and Burros. This information is necessary to help establish management direction for herd management areas, herd size, constraints on other uses and proposed range designations.

Typical Themes:	Preferred Scale
Wild Horse or Burro Management Areas	1:100,000
1971 Herd Distributions	1:100,000
Wild Horse or Burro Herd Units	1:100,000

3. LAND RESOURCES

Cultural Resources. Information on cultural resources is used to establish management objectives and the actions necessary to achieve those objectives.

Typical Themes:	Preferred Scale
Cultural Sites	1:24,000
Distribution Of Cultural Resources	1:24,000
Paleontological Resources	1:24,000
National Historic Register Sites	1:24,000
Cultural Surveys	1:24,000
Historical Trespass Areas	1:24,000



Lands. This information relates to a broad range of land tenure actions and potential management implications.

Typical Themes:	Preferred Scale
Proposed Disposal Applications	1:24,000
Unauthorized Use Areas	1:24,000
Classifications	1:24,000
Recreation and Public purposes Act (R&PP)	
Desert Land Entry (DLE)	
etc.	
Withdrawals	1:24,000
Land Tenure Adjustments	1:24,000
Disposal	
Acquisition	
Leases	
Apiary permits, etc.	

Right-of-Ways (ROWs). This information is helpful in determining the need for or designating additional corridors and windows as well as avoidance and exclusion areas.

Typical Themes:	Preferred Scale
Corridors and Windows (Existing/Designated)	1:24/100,000
Avoidance Or Exclusion Areas (Existing)	1:24,000
Right-Of-Ways (Existing)	1:24,000
Utility Corridors (Designated)	1:24/100,000

Recreation. Information needed includes management areas, facilities/developments, use patterns and special features/characteristics. This information can be useful in designating recreation management areas, establishing settings to be maintained, initiating major actions, setting activity planning priorities, and establishing Off Road Vehicle (ORV) use/designations.

Typical Themes:	Preferred Scale
ROS Classes (Previously established)	1:24/100,000
SRMAs (Previously established)	1:24,000
ERMAs (Previously established)	1:24,000
ORV Existing Designations	1:24/100,000
Recreation Facilities	1:24,000
Special Designations (Existing And Recommended)	1:24,000
Wild And Scenic Rivers	National Scenic Areas
Scenic Byways	Historic Trails
Caves	1:24,000

Wilderness. It is important to know where designated wilderness areas and/or existing WSAs are located so that it can be determined how wilderness might affect the development of other resource or land use Management Actions and vice versa.

Typical Themes:	Preferred Scale
Designated Wilderness Areas	1:24,000
WSAs (Inventory/Interim Management)	1:24,000

4. ENERGY AND MINERAL RESOURCES

Coal. This information is important for defining areas suitable for coal mining and the potential for development activities.

Typical Themes:	Preferred Scale
Coal Development Potential	1:100,000
Coal Unsuitability	1:100,000
Alluvial Valley Floors	1:100,000
Preference Rights Lease Areas (PRLA)	1:24/100,000
Federal Coal Leases (Existing)	1:24,000
Coal Facilities (Existing) (Including Non-Federal)	1:24,000

Fluid Minerals. This information is necessary to project the potential for fluid mineral development and the types of constraints that may be necessary to open an area for exploration or production. (These pertain to oil and gas, geothermal, tar sands and oil shale.)

Typical Themes:	Preferred Scale
Fluid Minerals Potential	1:100,000
Wells - Fluid Mineral (Lat/Long or Footage Calls)	1:24,000
Leases - Fluid Mineral	1:24,000
Pipelines and Facilities - Fluid Minerals (Those not covered under rights-of-way)	1:24,000
Fluid Mineral Facilities (Including Non-Federal)	1:24,000

Locatable Minerals. The following information helps determine areas that can be open under the 1872 mining law and the types of constraints necessary to manage potential locatable mineral activities.

Typical Themes:	Preferred Scale
Locatable Mineral Potential	1:100,000
Mining Claims	1:24,000
Existing Mine Facilities (Including Non-Federal)	1:24,000
3809 Plans Of Operation	1:24,000

Mineral Materials. This information is valuable in determining areas that will be opened to mineral material sales as well as its effect on land tenure actions.

Typical Themes:	Preferred Scale
Mineral Material Potential	1:24/100,000
Existing Community/Commercial Sites	1:24,000

Non-Energy Leasable. This information helps project potential development activities as well as the potential effect on other resources/uses.

Typical Themes:	Preferred Scale
Non-Energy Leasable Mineral Potential	1:100,000
Existing Mine Facilities (Including Non-Federal)	1:24,000
Existing Leases	1:24,000
Existing Mines	1:24,000

5. SUPPORT SERVICES

Acquisition. This information is useful in addressing proposed land tenure adjustment actions and access availability.

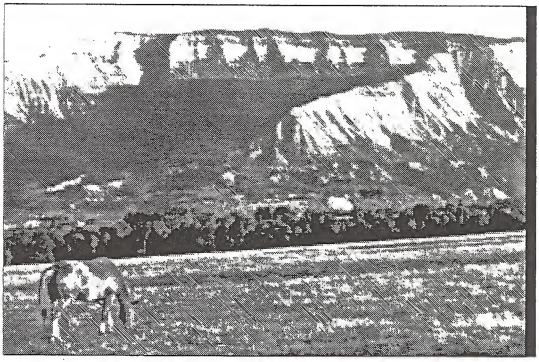
Typical Themes:	Preferred Scale
Acquired Easements	1:24,000
Identified Easements	1:24,000
(Those easement needs identified in past planning efforts.)	
Identified Transportation Plan Easements	1:24,000
(Those easements needed to fill gaps in the transportation plan.)	

Fire Management. This information helps establish fire management objectives and determine the effects of fire management activities addressed in the RMP.

Typical Themes:	Preferred Scale
Fuel Load Models (NFRDS or NFFL)	1:100/250,000
Historical Fire Occurrence	1:24/100,000

IV. SUMMARY

It is important to address the selection of data themes early in the RMP schedule so that database development requirements, costs and timing can be factored effectively into the pre-planning aspects of the planning effort. In selecting data themes required for the RMP it is often easy to overestimate what information actually is needed in relation to the decision that must be made in the RMP. On the other hand, make sure the appropriate information required to answer questions addressed in the RMP is included. The information required for an RMP should consider SPG determinations required in the RMP as well as the planning issues and management concerns.



V. APPENDICES

APPENDIX A. USING GIS IN THE RMP

RMPs are intended to help set direction for managing the public lands and their resources and uses. The RMP process is used to make land use decisions and allocations as well as establish management priorities and coordinate activities among resource programs. In addition, the RMP documents what the Bureau intends to do and why, and ensure compliance with Federal Land Policy Management Act (FLPMA) and National Environmental Policy Act (NEPA). The BLM is using GIS as a means to automate the planning process and utilize the computer as a resource management tool.

The capabilities of GIS allow for a more complete and consistent approach to complex resource analysis requirements. The primary benefit of GIS is that it allows for a systematic approach in which management decisions or assumptions can be applied uniformly for all alternatives and conflict analyses.

GIS can assist in developing several of the steps in the planning process. Some steps, such as Pre-planning, Issue Identification and Planning Criteria will set the basis for using GIS. They lay the groundwork for budget development, training, database design, hardware selection, data standardization, and scheduling applications as well as developing the end products to be used for the RMP. It cannot be over emphasized that the use of GIS must be determined early on and planned for from the outset of the scoping for an RMP.

As a tool, GIS capabilities are realized most in the Analysis of the Management Situation, Alternative Formulation and Environmental Consequences steps of the RMP process. From a simplified standpoint, GIS is used to quantify and locate resource characteristics, identify conflicts between resources and/or uses, develop models and composite analyses, and produce graphics. Additionally, the use of GIS allows for a well documented process leaving a "paper trail" of how decisions are reached throughout the planning effort.

An added benefit to GIS is more effective utilization of maps and better illustrated documents. Cartographic costs can be reduced by as much as 60% over traditional methods by using GIS. Maps showing resource characteristics or various alternatives can be generated quickly for meetings between specialists as well as with other agencies or user groups. The map products can range from simple working maps to presentation graphics suitable for public meetings or publication.

The use of GIS is also seen as an opportunity to enhance cooperation with other agencies and user groups. GIS provides the capability to be more responsive to reviewers' comments as well as new assumptions in developing alternatives or assessing the extent of impacts. It also promotes cooperative database development efforts and data exchange.

Development of an RMP generally occurs over a four year period. To effectively take advantage of the Bureau's budget process, RMP funding requirements should be identified in the Program Year Budget Plan (PYBP) three years prior to the time the Notice of Intent (NOI) is filed to start the planning process.

The following outline identifies some of the key GIS related actions or processes that occur throughout the planning process.

Pre Pre-Planning (2-3 years in advance of the Preplan)

- Decide to use GIS
- Prepare GIS Implementation Plan
  - ✓ Budget
  - ✓ Hardware Configuration
  - ✓ Staffing
  - ✓ Timeframes
  - ✓ Base Data
  - ✓ Remote Sensing Needs
- Update the Procurement Plan (5 yr. ADP Plan)
- Conduct a "Training Project"
- Prepare and Digitize Base Data

Pre-Planning through Data Collection

- Install GIS Hardware
- Recruit Full-Time GIS Specialist
- Incorporate GIS Plan into RMP Preplan
- Select Data Themes
  - ✓ Supplemental Program Guidance
  - ✓ Anticipated Planning Issues
  - ✓ Management Concerns
- Acquire Source Materials (DLGs, aerial photos, soils data, etc...)
- Prepare and Enter/Digitize Data
- Enforce Quality Assurance Standards and Procedures
- Provide Necessary GIS Training for RMP Team
- Develop Analytic Models

Analysis of the Management Situation

- Merge Data Themes and Overlay with Planning Boundary
- Produce Area Tables
- Run Analytic Models and Composites

- Produce Maps/Graphics for Resource Locations
  - ✓ Affected Environment (What's there)
  - ✓ No Action (Current Management)
  - ✓ Capability Analysis (Opportunities)

Alternative Formulation

- Refine Themes Based on Analysis of Management Situation (AMS)
- Determine Compatibility of Themes (Resources/Uses)
- Define Array of Alternatives For Each Alternative:
  - ✓ Apply ranking Order
  - ✓ Cover and Intersect
  - ✓ Produce Area Tables/Statistics
  - ✓ Generate Graphics
  - ✓ Change as Necessary

Estimation Of Effects

- Each Alternative Should Be Different
- Develop Reasonably Foreseeable Action Scenario (RFAS)
- Intersect Uses to Locate Conflicts
- Quantify with Acreage and Narratives
- Make Sure Impacts are Specific
- Analyze Cumulative Effects
- Determine Carrying Capacity
- Produce Maps/Graphics for In-House Use

Selection Of The Preferred Alternative

- Tally Resource Allocations by Alternative
- Develop New Reasonably Foreseeable Action Scenario (RFAS)
- Analyze Environmental Effects
- Develop Alternative Matrix
- Review Maps/Graphics to Assess Allocations
- Evaluate Team and Public Input

- Refine Preferred Alternative
- Evaluate Issues, Criteria and Management Concerns

Publish The Plan (Draft RMP/Draft EIS and Proposed RMP/Final EIS)

- Produce Black and White Page Size Graphics
- Design and Produce Color Fold-out Maps
- Develop Acreage Tables
  - ✓ AMS
  - ✓ Each Alternatives
  - ✓ Location Map
  - ✓ Land Status Map
  - ✓ ORV Designations
- Allow Adequate Time for Preparation and Printing
- Use System at Public Meetings
- Prepare for the Demand for GIS Products

Publish The Approved RMP and Record of Decision

- Produce Final Maps, Graphics and Tables
- Provide Data Maintenance
- Implement Decisions (Implementation Schedule, Priorities, etc...)
- Monitor RMP Decisions and Implementation
- Monitor the the Environmental Effects

APPENDIX B. DATABASE DEVELOPMENT CONSIDERATIONS

1. Selecting Data Themes

For the database to meet the needs of the RMP it is critical to ensure that each specialist adequately identifies the level of detail required. At the same time, the amount of information should not exceed the actual RMP needs since the database development costs and the time necessary to build the database may be restrictive within the RMP schedule. A systematic process can be employed in the field office to determine data needs for a GIS-assisted RMP. The steps in this process are as follows:

1. Assemble Lands, Minerals and Resource specialists, along with the team leader, area manager and other critical team members.

2. Explain how the data will be used in the GIS (e.g., overlay, proximity, data modeling, graphic production, distance and area calculations, weighted composite analysis, etc...), and what it will be used for (e.g., AMS, Alternative Formulation, Conflict Analysis, quantification, acreage calculation, map production, etc...).

3. Have specialists determine what resource information they will require for their anticipated analyses. For example, a biologist might identify the need for all big game habitat, state game management units, plus vegetation, elevation, slope, aspect and distance to water data so that they can determine areas most suitable for relocating bighorn sheep. The selected information can be considered as separate layers within the database, each layer being a **theme**.

   Note:
   In addition to the resource themes, several other themes are always required. These are called **base data** or **resource base data**. Base data is used for geographic reference in cartographic products. These include transportation, ownership, county boundaries, cities and towns, and other base mapping information. Specialists need not identify these, although someone should be assigned responsibility for these base data. (See GIS Theme list - Resource Base Data)

4. Explain scale selection criteria:
   ✓ Any scale can be input; GIS allows overlays of different scales.
   ✓ Using less accurate 1:100,000 scale data in conjunction with 1:24,000 scale data is acceptable as long as it is understood that the 1:24,000 scale data will be degraded.
   ✓ Legal information must be entered at a scale which allows as much accuracy as affordable.
   ✓ Data which must align exactly with legal boundaries or section lines must be entered at the same scale as the legal data.
   ✓ Some data, like VRM, can be accurately represented at general or small scales (1:100,000); others, such as soils, require large scales (1:24,000) to maintain accuracy.

- ☞ Since a 1:100,000 scale map contains thirty-two 1:24,000 scale maps, the cost of digitizing a given geographic area is significantly less.

- ☞ The tendency is for people to select the scale that they already have on hand. In most cases this is OK, but sometimes a smaller scale (i.e., 100,000) would be more cost-effective.

5. Have specialists select a scale for each theme. Let other specialists review the choices (they help keep the process honest).

6. Distribute map indices to the specialists. An index should be available for scales from 24,000 to 250,000. (In some areas, smaller or larger scales, i.e., 1,000,000 or 12,000 may be necessary.)

7. Allow several days for each specialist to review their existing map data and mylar overlays for each selected theme. Be sure to check for data sources outside the BLM at this time.

2. Data Types

Data entered into the GIS database are commonly represented digitally in one of two forms, *vector* or *raster* (*cell*).

Vector data are characterized by X,Y coordinate representations of locations on the surface of the earth. These X,Y coordinates can be used to represent individual *points*, *lines* or *polygons*. Raptor nest sites as well as oil and gas wells are examples of point data. Line data include roads, streams and transmission lines made up of a series of points or coordinates. Resource information such as soil types, vegetative communities, ownership and VRM classes are examples of polygon data where the spatial boundaries are represented by a series of coordinates that complete an enclosed line.

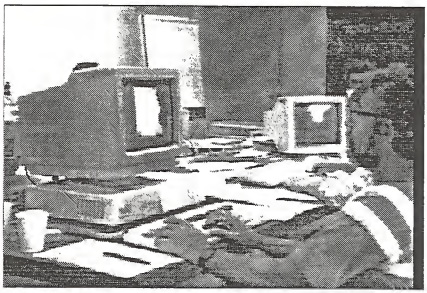
Raster or cell data (i.e., 100,000) are derived either from a grid placed over a base map or produced from satellite imagery. Each cell is assigned a value based on the subject or feature that the cell represents. Terrain data represented in Digital Elevation Models (DEMs) is another example of cell data.

As the data requirements are refined, it must be decided whether the final data should be in vector or cell format. The deciding factors concerning the data type are the type of analysis done and the quality of the output product desired. Cell processing allows more efficient processing of complex data analysis. Complex mathematical operations can be performed on cell data, such as weighting themes or applying formulas to data containing numeric values. Cell data has a choppy or irregular appearance as a result of the information being represented in a rectangular fashion. Vector data is more useful for less complex processing and is generally more appealing in output products since it provides a more accurate, smooth delineation of the data. Data acquired or entered in vector format may be converted to cell format for processing with other cell data or for more complex analysis.

3. Map Scales

Once the specialists understand the types of data used in GIS and the level of detail needed for the RMP, it is necessary to determine the appropriate scale and accuracy required. Much of the resource inventory information that exists in the BLM has been mapped on USGS topographic maps. These maps typically have a scale of 1:24,000 (7.5 minute) or 1:62,500 (15 minute). The scale required for various types of information is relative to its use. For example, the 1:24,000 maps are good for portraying more detailed information that requires precise location like raptor nest sites and T&E species, or information that has ownership or legal implications. This scale should be used as the base for all information duplicated for other themes with common boundaries or features. The standard scale for the BLM's resource base data is 1:24,000. The 1:100,000 Surface Management Maps can be used as a base to delineate resource characteristics that cover large areas and do not have precise boundaries such as wildlife habitat types or VRM classes. Smaller scales such as 1:250,000 or 1:500,000 have limited value for making land use allocations or decisions in the RMP and should be considered only where the data is very general in nature such as air quality maps.

Certain types of information (i.e., oil/gas well locations, ACECs, etc...) may require positional accuracies of a higher order than found on standard USGS 7.5 minute maps (±40 feet). Supplemental mapping surveys (photogrammetric, Global Positioning System, etc...) may be required to portray these features.



APPENDIX C. DATA SOURCES

Once data requirements are defined for the GIS database, data sources must be considered. During the data acquisition phase of the RMP, it should be determined if any of the data themes and coverages required already exists in digital form. Other agencies that prepare and/or use geographic data may have some of this data available. One important consideration is the format or type of GIS software used in the development of the digital data. Even if the data has not been digitized in MOSS, it may be possible to convert it to the specified GIS software. Besides digitized data, other agencies may have other alphanumeric data such as oil and gas wells, mines, or historic/archaeologic sites available that include latitude and longitude locations that can often be converted to MOSS. Potential agencies that may have pertinent data include (but may not be limited to) the following:

Bureau of Land Management

Fish and Wildlife Service

Forest Service

Geologic Survey

Soil Conservation Service

National Park Service

Bureau of Indian Affairs

State Departments of Natural Resources, Fish and Game, Transportation, Energy, Histgoric Preservation, Parks and Recreation, Tourism, Oil and Gas Commission, etc...

Cities and Counties

In addition to other agencies, many universities or private companies, particularly utility companies, prepare digital geographic data which can often be acquired through exchange or purchase agreements. Some of these sources include:

Petroleum Industry

Ducks Unlimited

The Nature Conservancy

Timber Companies

Mining Companies

Remotely sensed data may also be available either in digital or photographic form. Again, other agencies, local governments, private industry, etc... are possible sources for this type of information. Some specific suppliers include:

EROS Data Center

EOSAT - Landsat

SPOT Image Corporation

National Aerial Photography (NHAP) and National High Altitude Photography (NAPP) (High Altitude Photography ordered through the Service Center)

Data not already available in a digital format must be digitized as part of the GIS database. Depending on the information required for the RMP, data may be available from a wide variety of sources, including existing BLM inventory maps and field surveys. Other agencies may also provide a source for this type of map information not available in the BLM. Once this information is identified, it must be prepared for digitizing and subsequently digitized as part of the GIS database to support the RMP.

APPENDIX D. DATA PREPARATION

Preparing Data for Digitizing

Prior to preparing data for digitizing, thoroughly search other agencies, interest groups and corporations to determine if the required data is available in digital format. Several possible providers of data are listed under *Appendix C., Data Sources.* Also make sure that the data being to entered is current and accurate.

Selection of BLM Inventory and Compiled Data For Use In Data Entry

It is important to review existing BLM inventory information to determine the availability of data that can be digitized. Mylar overlays from past planning or inventory efforts often were drawn with little concern for precise representation of lines. The overlays typically line up on one corner of the base map but because of the pasting together of adjacent quads in preparing the base map the data does not align on the opposite corner. This level of accuracy is insufficient for GIS, which stores all points to a resolution measured in thousandths of an inch. It is critical to define the accuracy required based upon the type of data used. Many overlays designed as a graphic product were made with magic markers or wax pencils which at some scales would constitute a line a half mile wide. Also, the subject labels may not be descriptive or uniform enough to be useful in the GIS database.

Most GIS themes will be entered into GIS directly from USGS topographic quadrangles or quad overlays. This is because USGS quads are of good resolution and spatially more accurate than other map media used by the BLM. Typically, data which is not already on USGS Quads must be registered to a USGS quad base on stable material such as mylar.

Scale Transfer

If the available data is at a scale that is not optimal for its intended use, it should be transferred to an appropriate scale or medium. Keep in mind that if the available data is at one-half inch to the mile, transferring it to 1:24,000 will not make it more precise or accurate. In the transfer process, a specialist can realign some data based on contour lines, section lines or other features on a larger scale (such as 1:24,000) quad that is not as accurate as on a smaller scale (such as 1:100,000). Of course, it would not be realistic to think that data drawn at 1:250,000 could ever be significantly enhanced by transferring to a larger scale.

There is no need to stay with a single data entry scale because the GIS can read different input scales and manipulate or output the same data at a uniform scale by translating scales. Although scales can be mixed it is imperative that all sources, scales, techniques and other source information (Meta-data) be tracked through the process. If this is not adequately done the credibility of subsequent output will be diminished.

How to Transfer Data to a USGS Quad Base

Resource data may be directly drawn on the quad or on mylar sheet quad overlays indexed to the quad corners with precise tic marks aligned with the quad's latitude longitude tics. While slightly more time consuming, the mylar sheet approach is really the preferred method. This is because a single set of quads can be used to draw all the overlays. If one looks carefully, you can see that no two sets of USGS paper maps are exactly the same size – they shrink and stretch with the weather and storage techniques.

The mylar approach takes a little longer, because only one person can prepare an overlay for a specific quad at a time. For each quad being worked on, all adjacent quads (eight of them) must be used to check line edgematching and subject label consistency between overlays or maps. A large table must be used to lay out the block of quads while edges are checked.

Accuracy

Data accuracy can refer to validity or resolution. We often think that once map data is accurate it is always accurate. However maps have a deceptive tendency to change over time. This depends on the medium of the map (paper, mylar, canvas acetate), the way it was stored (hung on a rack, rolled, laid flat, folded), the environment it was stored in (humidity, temperature, light, insects, mice) and its use (wear and tear).

Validity includes correctness, age, currency, mapping accuracy and quality of editing. The degree of validity depends largely on the projected use and requirements of the users. For instance, for one user, land ownership could be classified Federal, State or Private. For another, all the State and Federal Agencies must be listed in order to be more meaningful, i.e., BLM, NPS, USFS, COE, BOR, BIA, DOD, FWS, etc.... The age of data is often a concern in BLM. The BLM has not done many inventories in the 80's. Specialists are often reluctant to digitize data more than a few years old. Five-year old vegetation data may lack the change induced by the latest wildfire but this may be OK for the geologist looking to identify rock outcrops, talus slopes and barren lands. Some data rarely changes (geology, elevation), and other data changes frequently (climate-temperature, stream flow). Legal information, such as mineral ownership, necessitates a high degree of validity while ROS classes does not. In selecting data for planning efforts, BLM Manuals and other documents provide guidance which requires using the best data currently available.

Resolution refers to the smallest unit of measure required to identify and place a feature on a map while maintaining locational integrity. This relates primarily to scale. As with validity, intended use of the data determines necessary resolution. Often several users have differing needs. One person only needs generalized resolution perhaps characterized by planning, but another needs very precise resolution such as for subsequent activity level planning. The resolution selected should be the most precise level affordable. This is where trade-offs are often made. What we really want may not be what we actually need to do the job– in other words, everyone wants a Mercedes even though a Chevrolet will get them where they want to go. Often, generalized information will suffice. Though we know we'll need more specific data in the future, the current users are not able to come up with the money to enter the data at the time of the RMP because they didn't program for future funds. As a result, we enter data that we recog-

nize may be replaced further down the road. This can be wasteful and illustrates why we try to coordinate these things well in advance. This also illustrates a problem that different agencies have in agreeing on data standards. Also note that you cannot take information from a small scale map (e.g., 250,000) and instill higher resolution by displaying it at a larger scale (e.g., 24,000). Resolution can have a major impact on cost of entry and storage (space) requirements on the computer system, much the same as data complexity.

Once the data needs for the RMP are determined by the RMP team, the actual database development process is fully underway. Existing BLM inventories must be reviewed to see what information is currently available and if it is mapped or already in a GIS database.

Data Preparation Steps/Checklist

Note:
Check with your State Office GIS Coordinator for state-specific standards and requirements

1. Establish a full-time GIS Coordinator/Data Preparation lead.

2. Acquaint RMP team members with data preparation and GIS processes (awareness level).

3. Notify team members of time and commitment requirements.

4. Identify needed map and remotely sensed data with resource specialists.
   - ☞ Generally, **no** new inventories.
   - ☞ Check the Supplemental Program Guidance.
   - ☞ Is the data in a Data Element Dictionary?
   - ☞ What are the State or Bureau accepted standards for the data set?
   - ☞ Make sure the data is absolutely necessary!
   - ☞ Is there a need for data security?

5. Choose appropriate map scales for each theme.
   - ☞ Anticipate future uses of the data and determine what is cost effective to include at this time.
   - ☞ Use the smallest scale (i.e., 1:100,000) which accurately reflects data quality needs.
   - ☞ The greater the accuracy requirements the larger the scale required (i.e., 1:24,000) and the more precisely the data must be drawn.

6. Inventory available data (check in-house and with other agencies or sources).
   - ☞ Aerial photos.
   - ☞ Existing digital data such as USGS DEM or DLG, or digitized.
   - ☞ Satellite and other remotely sensed data.
   - ☞ Can the data be derived from other themes?

7. Determine if available data meets quality, cost and accuracy requirements.

8. Establish a standard map naming convention for each theme (16-character maximum).

9. Identify subjects (attributes) within each theme (16- or 30-character maximum).

10. Develop a data maintenance plan.

11. Select an Automated Digitizing System (ADS) theme "menu" avoid creating a new one, use available guidance and BLM experiences.

12. Adopt a theme documentation procedure to control map (meta-data) header and change information (**See Figure D.1**).

13. Acquire a master set of USGS base maps at appropriate scales and coverage.

14. Lay master quads flat so as not to stretch and distort them. NEVER roll the master quads, even to ship.

15. Store master maps in a cool and humidity controlled environment.

16. Purchase roll type 3 mil-frosted mylar for use in preparing data for digitizing.

17. Copy map data onto mylar sheets.
    - ☞ Check base maps for proper edgematch with adjacent quadrangles.
    - ☞ Tape down base maps.
    - ☞ Place cut mylar sheets over base maps and tape down.
    - ☞ Use permanent, thin-tipped markers (0 or 1 rapidograph size).
    - ☞ Use color markers for greater readability if maps are complex.
    - ☞ Copy outside corner and interior lat-long ticks onto mylar.
    - ☞ Write the lat-long description next to four outside corner ticks.
    - ☞ Write the following information in the lower portion of the mylar.
        - ✓ USGS or BLM quad name
        - ✓ Theme Name
        - ✓ Map Naming Convention
        - ✓ Scale
        - ✓ Projection (done by digitizer)
        - ✓ Date (vintage) of base map
        - ✓ Current date
        - ✓ Prepared by: (Name)
        - ✓ Map legend and/or ADS menu (may be attached)
    - ☞ Draw line, point or polygon data on separate mylar overlays.

18. Extend the data coverage a couple of inches outside the perceived boundary. Do not incorporate the planning area boundary into the data.

19. Draw full, not partial quads.

20. Prepare all land information data, not just BLM lands.

21. Identify all lines that must be line-duped (geo-copied) from other themes.
    - ☞ Label the theme source of the line to be duplicated.
    - ☞ ALL lines that follow ownership, rivers, boundaries, or Public Land Survey should be line-duped.
    - ☞ **DO NOT CUT CORNERS AT THIS STEP!**

22. Verify the data when "complete."
    - ☞ Edgematch.
    - ☞ Close polygons.
    - ☞ All items have subjects (attributes).
    - ☞ Line-dupes noted.

FIGURE D.1

Documentation of Data Submitted to be Digitized

DATA	THEME
KEY WORDS:	Description of resource data
CONTACT:	Technical Coordinator responsible for data
MAP SOURCE:	Location where base map can be found
DATA SOURCE:	Referenced source(s) of information used
DATA VINTAGE:	Date the base map was created
PROJECTION:	Done by the digitizer
PROJECTION VALUES:	Done by the digitizer
MEDIUM:	Mylar, paper, blue line copy, etc...
ACCURACY:	Good, Fair, Poor
USE:	Restricted or unrestricted
DATA TYPE:	Polygon, line or point
ORIGINAL MAP SCALE:	Scale of data submitted
DIGITIZED MAP SCALE:	Scale digitized

COMMENTS:

APPENDIX E. DATA ENTRY

Digitizing is the primary data entry method for spatial data. Digitizing can be accomplished either as an "in-house" or contract effort. In-house capabilities vary by state and office. Resource areas can digitize data by training and using resource specialists or technical GIS staff. Other opportunities at the area office include using temporary staff, students from local colleges and volunteers for data entry. Some BLM State Offices have a Mapping Sciences or Cartographic staff that provides production GIS digitizing services.

Depending on local capabilities available at the State, District or Resource Area offices, contract digitizing may also be employed. The Bureau (Department) maintains two data entry contracts - one for table digitizing and the other for a process called scanning. These contracts can be effective in providing capabilities to meet requirements for the RMP. The contractors can provide a quick turnaround for large digitizing workloads that can not be accommodated in-house. If contract digitizing is to be used, funding must be identified early in the preplanning phase of the RMP to ensure the data needs are met sufficiently. To use the digitizing contracts, the data must be compiled in a form that can be easily understood by someone not familiar with the characteristics of the resource area, a task order must be written and the contractor must be supplied with the information.

Whether the resource information is digitized "in-house" or by contract, the resulting GIS data must be checked or reviewed for quality and accuracy before it can be used.

FIGURE E.1

GIS Data Entry Tips for Planners

- Follow the Data Preparation Checklist (Appendix D).
- Estimate time accurately; map preparation takes about the same amount of time as digitizing and under estimation leads to schedule delays.
- Select unique attributes. If subjects do not have a unique string of characters, they cannot be easily chosen (or selected) from the other items within the same theme. Quality of data entry is *not negotiable*; cutting corners at this critical stage will surely haunt you later.
- Assure that the data entry staff is line-duping coincident lines from legal or resource base data (RBD).
- Ensure that any new (mid-project) data entry or data preparation staff adhere to the agreed upon standards for line-duping, map naming and quality.
- Learn what data "slivers" are. They are tiny polygons or spaces between lines that were digitized independently but should have been line-duped. They create major problems with polygon overlays.
- Invest in the data. It may be very expensive, but will have long-term payoffs.
- Plan for future uses of the data; don't be too short-sighted even when requirements are for work beyond the RMP (i.e., activity plans, EISs/EAs, authorizations, etc...).
- Expect resource and mineral programs to pay for data preparation and entry as the data will be used far beyond the planning effort.
- Plan well ahead and budget for remotely sensed (satellite) imagery, topo updates and vegetation data if required.
- Three of the most universally required data sets, topography, soils and vegetation, are also some of the most expensive to acquire.
- Learn and understand what it means to "derive data." This is where several existing data themes can be combined (using the analytic power of GIS) to create a new theme that would otherwise have to be drawn and digitized. For example: slope can be derived from elevation, since GIS can interpret change of elevation (rise/run).
- Maintain the data in the GIS – you can easily update a digitized map.
- Separate point, line and polygon data onto individual overlays. This makes reading the mylar overlays easier for the person doing the digitizing.

- Document the data collection and entry effort; keep the data lineage (header and history) information where it is available to specialists and in a condition and format that your eventual replacement (or other resource specialists) can understand.

- Use BLM data standards though they may seem unimportant to you. This will make sense when you consider District, State and Bureauwide cooperative efforts, and interagency data sharing. Make contact with your State GIS Coordinator and Data Administrator prior to starting the project. Discuss themes, ADS menus, symbology, data element dictionary, and map naming conventions.

- GIS does not dramatically change the way we do RMPs. The GIS automates a manual methodology, and in some cases allows more sophisticated and complicated analysis.

- Set up a good data archive library if one does not exist in your state.

- Verify data. This can ensure project scheduling and avoid errors and modifications that require reworking data.
  - ✓ An error in the original digitized data will be built into many "derived" data products if not caught early. For example, an error in a single quad is merged in with 150 other quads in the planning area to make a new map. The map is then overlaid with the planning boundary to make a second map. Then it is overlaid with ownership for a third map. From then on, the erroneous data could be intersected with many other themes to develop analyses, determine impact, prepare graphics, etc.... If the error was found then, all the preceding maps must also be fixed.

- Plan for delays:
  - ✓ The first time through, the GIS process takes longer than the manual process due to data preparation and entry.
  - ✓ Unexpected personnel changes.
  - ✓ The "learning curve".

- Anticipate potential computer system problems:
  - ✓ Telecommunications.
  - ✓ Maintenance.
  - ✓ Supplies.
  - ✓ Other competing uses of the system.
  - ✓ New hardware installation.
  - ✓ Dependency on outside parties for support.

- Ask the DO, SO, Service Center and others for support; don't try to use GIS by yourselves.

- Use resources from other states where there are completed GIS-assisted plans. You aren't the first to use GIS for an RMP.

- GIS assisted planning is not a part-time job – have an energetic and assertive GIS specialist.

- Enjoy yourselves – the little problems along the way (which may seem overwhelming at the time) will be overcome and you will end up with a GIS database that can be used for many other applications!

APPENDIX F. GIS DATABASE COST ESTIMATING

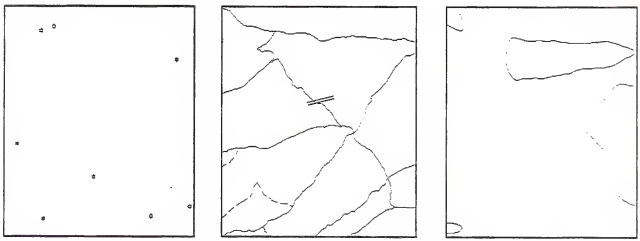
Whether the data is to be acquired, digitized "in-house" or digitized by contract, it is important to make an early projection of what the database will cost. Two initial factors that provide the basis for estimating these costs are the number and types of basemaps (i.e., 7.5 or 15 minute USGS quad maps, 1:100,000 Surface/Mineral Management Maps, etc...) as well as the complexity of the data. The costs are also affected by whether the digitizing is accomplished in-house or by contract. In-house digitizing costs are primarily workmonths since the BLM provides the workforce to accomplish the digitizing. Costs can be minimized if there is a source of volunteers or low cost temporary workers. Contract digitizing costs are a type of procurement cost which must be planned for and funded.

The following process can be used to develop a preliminary estimate of cost and time necessary to build the GIS database for an RMP.

1. Have specialists estimate how many quads will contain information for each theme. Partial quads may be identified, however it is usually best to use whole quads. It is rare for a specific resource data theme to cover all quads within the RMP. For instance, ACEC's may only cover three quads of 200 in a Resource Area. Most base data (ownership, public land survey, transportation, etc...) will cover all quads in the study area. The number of quads required should be recorded.

2. Assume that the hours needed to prepare and digitize map data varies according to the **type** of data (see figure F.1) and the level of data **complexity** (See Figure F.2).

FIGURE F.1, EXAMPLES OF POINT, LINE AND POLYGON DATA



A. Have each specialist determine whether each of their data themes is point, line or polygon.

B. Determine the level of complexity (determined by the "**straightness**" of the lines, **how many** lines, and the number of points or polygons there are on a quad: low, medium, or high). Examples of low complexity data are Wilderness or Resource Area Boundary. Most point data also falls into this category. Examples of medium complexity data are Allotment Boundaries or Streams. Line data generally falls into this category. Examples of high complexity data are Soils or Vegetation. Typically highly complex data is polygon data. (**See Figure F.2.**)

C. Apply table F.1 to each theme to determine hours required for each **single quad** of each theme.

FIGURE F.2, EXAMPLES OF DATA COMPLEXITY

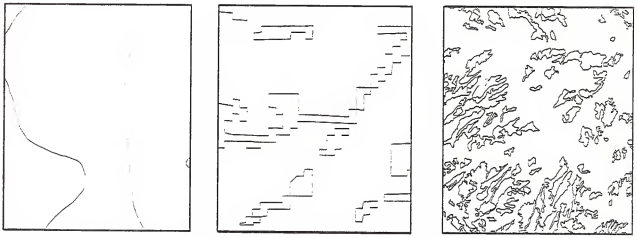


Table F.1

HOURS REQUIRED FOR COMBINED DATA PREPARATION AND DIGITIZING
(ADS digitizing, with ADS-TO-MOSS conversion)

1:24,000 scale

Type	Complexity Low	Medium	High
Point	2	5	8
Line	2	8	10
Polygon	2	7	25

1:100,000 scale

Type	Complexity Low	Medium	High
Point	4	7	10
Line	3	10	13
Polygon	4	6	30

3. Multiply number of quads by hours per quad.

Example:

145 Quads
X 6 Hours/Quad

870 Total Hours for this Theme

Recognize that the hours derived here will possibly be spent by different people. A resource specialist will have to assemble and proof the maps. The maps may need special preparation for digitizing by a cartographic staff whether or not the maps will be digitized by in-house or contracted personnel. Proofs must be reviewed by the original person who prepared the maps (resource specialist). The digitized data must be added to the BLM computer by the system manager or administrator and the on-line data must be proofed once again.

Data preparation hours should not be interpreted into workmonths or dollars required to enter data for an RMP. In most RMPs, the majority of the data preparation is done by lands, minerals or resource specialists under existing programmatic funding. Several RMPs have entered their entire databases without requiring additional funding. Workstudy, temps or volunteers with BLM specialists supervision have been instrumental in these efforts.

Besides the actual costs of data preparation and digitizing there are other database development costs related to the processing of the data before actual analysis can begin. Data acquired from other sources may have to be converted to MOSS, including the DLGs and DEMs acquired from the USGS. Additionally, data must be merged to provide complete coverage for a particular geographic area addressed in the RMP such as a management area or the entire planning area. Other related tasks include preparation of base information, legends and titles.

APPENDIX G. GIS DATA THEMES/PROGRAM-ISSUES MATRIX

The accompanying worksheets may be copied and used effectively to begin to zero in on the themes or data layers that will be useful to the RMP process.

Decision needs are displayed, in part, on the left hand side each sheet with data themes listed across the top. Neither of these lists should be regarded as complete for your plan and you are encouraged to add to the lists.

The Supplemental Program Guidance determinations should be regarded as the minimum required, while many of the data themes will not apply to your plan.

To use the matrices, it is probably most effective to start with just the list of SPG determinations. For each determination listed, mark the corresponding space under each of the data themes that individual specialists think will be needed for analysis during the RMP. Specialists should be encouraged to add themes to the list which they believe will be necessary as well.

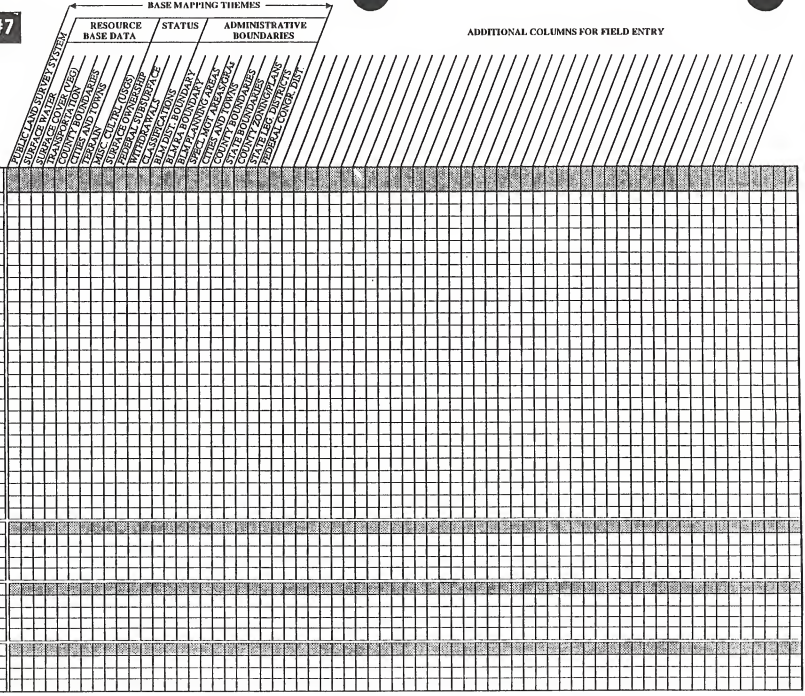
The next step would be to add the preliminary issues, management concerns and other questions the RMP is expected to answer.

The Interdisciplinary Team should then work through the full exercise again – **as a team!**

The final step is to involve the Management Team, identify costs (in both time and $) and define priorities for digitizing the data.

PLANNING AID #7

APPENDIX G
GIS DATA THEMES and PROGRAM-ISSUES MATRIX



PLANNING AID #7

APPENDIX G
GIS DATA THEMES and PROGRAM-ISSUES MATRIX

RENEWABLE RESOURCES

	Deer	Elk	Moose	Caribou	BigHorn Sheep	Mule Deer	Antelope	Javalina	Mountain Lion	Sage Grouse	Raptors	Spotted Owl	Turkey	Quail	Chukkar	Non-Game Species	HMP Boundaries	Herd/Hunting Units	Coop. Management Areas	T and E Animal Species	Desert Tortoise	Black-footed Ferret	Kaibab Squirrel	Bald Eagle	Peregrine Falcon	Wolf	Grizzly	Jaguar	Kit Fox	Giant Kangaroo Rat	Sensitive Animal Spp.	Anadromous Fisheries	T and E Fish Species	Waterfowl	Migratory Birds	Forest and Wdlnd Types	Commercial Forest	Non-Comm. Forest	Woodlands	Special Use Areas	Post and Pole	X-mas Tree Cut Area	Wood Cutting Area	Operations Inventory	Five Point Inventory	Tree Imp. Coop. Units	Forestry Breeding Units	Allotment Boundaries	Pasture Boundaries	Range Improvements	Range Condition/Trend	Kind of Livestock	WH&B Management Areas	1971 Herd Dist.	WH&B Herd Units											
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APPENDIX G
GIS DATA THEMES and PROGRAM-ISSUES MATRIX

	CULTURAL RESOURCES								LAND AND RECREATION RESOURCES																							ADDITIONAL COLUMNS FOR FIELD ENTRY
	Cultural Sites	Cultural Res. Distr.	Paleo. Resources	Natl. Hist. Reg. Sites	Cultural Surveys	Hist. Trespass Areas	Prop. Disp'l Appl'ns	Unauthorized Use Areas	Classifications	R&PP	DLE, etc.	Withdrawals	Land Tenure Adjustments	Permits	Corridors and Windows	Avoidnc Or Excl'n Area	Rights-Of-Way (Exist.)	Util. Corrdrs (Design.)	ROS Classes (Designated)	SRMAs (Prev. Design)	ERMAs (Prev. Desig'n)	ORV Exist. Designations	Recreation Facilities	Special Designations	W&S Rivers	Nat'l Scenic Areas	Scenic Byways	Historic Trails	Caves	Designated Wilderness	WSAs (Inv./Interim Mgt)	
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VEGETATION																																
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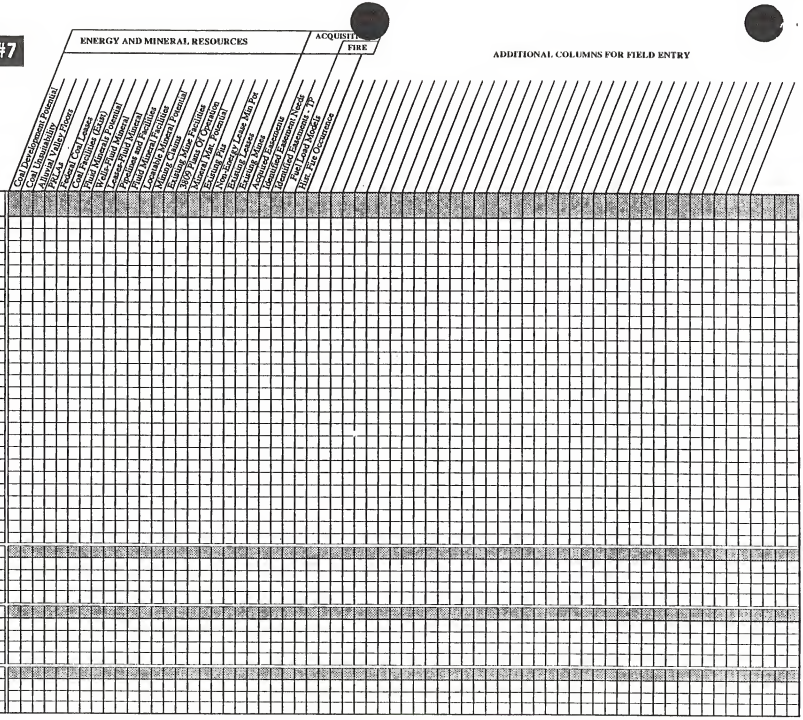
GIS DATA THEMES
and
PROGRAM-ISSUES
MATRIX



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APPENDIX G
GIS DATA THEMES and PROGRAM-ISSUES MATRIX

ENVIRONMENTAL RESOURCES

GUIDANCE REQUIREMENTS	
SUPPLEMENTAL PROGRAM	
VEGETATION	
VISUAL RESOURCES	
T&E PLANTS	
T&E ANIMALS	
ACECS	
AIR RESOURCES	
SOIL & WATER	
OHV CLASSIFICATIONS	
FISH & WILDLIFE	
FORESTRY	
LIVESTOCK	
WILD HORSE & BURRO	
CULTURAL RESOURCES	
LANDS	
RIGHTS-OF-WAY	
NATURAL HISTORY	
RECREATION	
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BACK COUNTRY BYWAYS	
CLASS. & W/D REVIEW	
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