RIPARIAN AREA MANAGEMENT

Procedures for Ecological Site Inventory — With Special Reference to Riparian-Wetland Sites

by

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I. Introduction

Soil, water, and vegetation are the operating capital in the business of land management. Sustainable production of goods, values, and services from renewable resources is possible without depreciation of initial operating capital under proper management — an enviable situation in most businesses. As in any business, however, an inventory of resources is essential. Changing social and economic values require the capability to evaluate potential resource availability as well as the present situation. Resource inventories establish a baseline to evaluate levels of use that do not depreciate or degrade the operating capital.

Inventory and management of riparian-wetland resources are a priority in the Director's "Riparian-Wetland Initiative for the 1990's." The Bureau of Land Management (BLM) defines wetlands as areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support and which, under normal circumstances, do support a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands include marshes, shallows, swamps, lake bogs, muskegs, wet meadows, estuaries, and riparian areas. Riparian areas are a form of wetland transition between permanently saturated wetlands and upland areas. These areas exhibit vegetation or physical characteristics reflective of permanent surface or subsurface water influence. Lands along, adjacent to, or contiguous with perennially and intermittently flowing rivers and streams, glacial potholes, and the shores of lakes and reservoirs with stable water levels are typical riparian areas. Inventory and management of rangeland resources are also crucial to BLM's "Range of Our Vision" plan and other national strategies. Independent inventories of specific natural resources often overlook relationships that may apply to the overall land management strategy. In particular, soil and vegetation inventories are often conducted on uplands that are independent of, and indicate little relationship to water resource and habitat inventories of riparian-wetland areas in the same watershed. Ecological site inventories provide an interdisciplinary approach to resource inventory and analysis that applies equally to upland and riparian-wetland areas.

The Federal Land Policy and Management Act of 1976 (FLPMA) requires BLM to inventory lands and resources on a continuing basis. In 1982, BLM adopted the Range Site Inventory procedure described in the Soil Conservation Service (SCS) National Range Handbook (NRH) (USDA, 1976) as its principal rangeland inventory method. The term "ecological site" has been adopted by BLM in place of the term "range site." While the term ecological site as defined by BLM is synonymous with range site as defined by SCS on rangelands, the concept also applies to grazeable woodlands, forests, and riparian-wetland sites (USDI, 1990).

Sections 200, 300, 400, 500, 600, and 700 of the NRH, and additional guidance provided in BLM Manual Handbook H-4410-1, Release 4-101, established the basic procedural guidance on Ecological Site Inventory (ESI). The BLM Riparian Area Management Technical Reference TR 1737-3 (Meyers, 1989) addresses general ecological site concepts in relationship to overall riparian-wetland inventory and monitoring requirements. Vegetation, hydrology, and wildlife information is best obtained in conjunction with ongoing soil surveys or soil survey updates to provide an ecological site inventory.

Past soil and vegetation inventory efforts to classify upland areas have often overlooked riparian-wetland areas in the Western States. Cooperative soil survey area Memorandums of Understanding (MOUs) for public lands emphasized broad objectives appropriate for uplands. The resulting soil surveys and associated vegetation inventories relegated many riparian-wetland areas to minor components within a soil map unit. Increased attention to riparian-wetland values and management will require inventory updates to establish permanence of baseline information for reference and evaluation. Map unit design in new soil survey area inventory starts must consider specific requirements to include riparian-wetland areas. These requirements are to be incorporated as part of any cooperative soil survey area MOU.

The process of documenting and describing range sites has traditionally resided with the SCS. However, BLM has equal responsibility for the process where public lands administered by BLM are involved (USDA, 1985). The increased emphasis on riparian-wetland area management, along with a rapidly expanding information base, has dictated the need for many updated or new ecological site descriptions. There are additional information requirements, particularly for hydrologic information, necessary to effectively describe the environmental factors characterizing riparian-wetland sites. Processes affecting physical changes and subsequent vegetation responses must also be interpreted to understand and evaluate site dynamics.

II. Purpose

The purpose of this technical reference is to detail field procedures for describing and documenting ecological site information as it applies to the interaction between soils, climate, hydrology, and vegetation for riparian-wetland resources and uplands. Possible uses of this information in BLM's planning process, resource evaluations, and other applications are discussed. Maintenance and permanence of baseline data are also incorporated. This document is intended to be used in conjunction with, not as a replacement for, guidance provided in the National Range Handbook Manual H-4410-1, National Range Handbook, National Soils Handbook (USDA, 1983), Soil Survey Manual (USDA, in press) and appropriate technical references.

III. Ecological Site Inventory

A. Inventory Elements

1. Coordinated Resource Inventory and the Interdisciplinary Team.

   a. Background

   The National Range Handbook defines a range site as a “...distinctive kind of rangeland that differs from other kinds of rangeland in its ability to produce a characteristic natural plant community. A range site is the product of all the environmental factors responsible for its development...” The environmental factors responsible for a site development are the same as in the general soil model:

   Soil = f [Parent material (PM), Relief (R), Climate (C), Biota (B), (vegetation, animals), Time (T_1)]

   The variables are simply transposed to make an ecological site model:

   Ecological Site (potential vegetation) = f [soil, PM, R, C, B (animals), T_2]

   where T_1 = geologic time in place and T_2 = time for the biotic community to approximate a dynamic equilibrium with soil and climate conditions.

   The relationship between soils and ecological sites is evident in the models but not necessarily easy to establish at all times in the field. There can be many confounding factors (i.e., those irritating and confusing circumstances that prevent people from presenting ecological functions in the simple linear relationships they would like them to be). In almost all surveys, ecological sites are encountered where apparently different soils produce essentially similar potential vegetation because of compensations in climate, topographic orientation, or combinations of these and other factors. Temporal characteristics associated with secondary vegetation succession, soil surface properties, and short-term climate fluctuations also provide potential sources of confusion.

   Riparian-wetland sites present additional challenges because of hydrologic actions on the landscape, as well as interactions with soil, vegetation, and other factors. Some of these additional challenges include determining an ecological site’s capability to change its potential vegetation (site progression), to migrate (change location), or to change its extent (expand or contract) in response to environmental dynamics.

   b. Coordinated Inventories

   Resource inventories need to be designed and carried out to most effectively establish the interrelationships between ecosystem components. The ecology and management of natural units of vegetation can best be understood if the soils and hydrology are investigated at the same time that vegetation and animal (wild and domestic) uses are appraised. Concurrent investigations allow for interdisciplinary interaction to strengthen immediate soil-site correlation and support documentation for site interpretation.

Data gaps and/or new information indicating the need for revised or new ecological site descriptions are most often recognized during the inventory process. Coordinated resource inventories offer the best opportunity to provide necessary documentation to support revisions or to develop new site descriptions. Resource coordination is provided for in the following references:

1) Section 601.05, NSH, provides that the soil survey plan consider “coordinating woodland, range, biology and engineering with soil surveys; ...”

2) Section 303, NRH, provides that “Soil scientists and range conservationists must work as a team...” and

3) Section 303, H-4410-1, further requires that:

    a) An interdisciplinary team develop the inventory plan and conduct reviews.

    b) Soil survey team and vegetation inventory teams “... should work concurrently and consult other resource disciplines as necessary.”

To fully implement part 3, a water resource (stream surveys, etc.) inventory needs to be conducted concurrently with ESI and soil surveys where possible. If water resource inventories have been completed prior to ESI, a hydrologist should reevaluate the existing inventory relative to ESI information requirements.

c. Interdisciplinary Team Approach

1) Multidisciplinary vs. Interdisciplinary

The multidisciplinary approach involves each discipline addressing their individual resource needs independently of others and collecting inventory data that is only needed by that program. Each component is then combined into a package for planners and managers to analyze and use. If this concept was applied to the construction of an automobile, the end product may look something like Figure 1.

Each component may be technically correct for some application, but the combination is not very utilitarian and is often confusing.

The interdisciplinary approach to resource inventory is designed from the beginning to provide a coordinated, integrated information base for overall land use planning and management. The interdisciplinary approach applied to the construction of an automobile should look something like Figure 2.

Each component is not only technically correct, but functions harmoniously with all other components to meet the intended use efficiently and effectively.

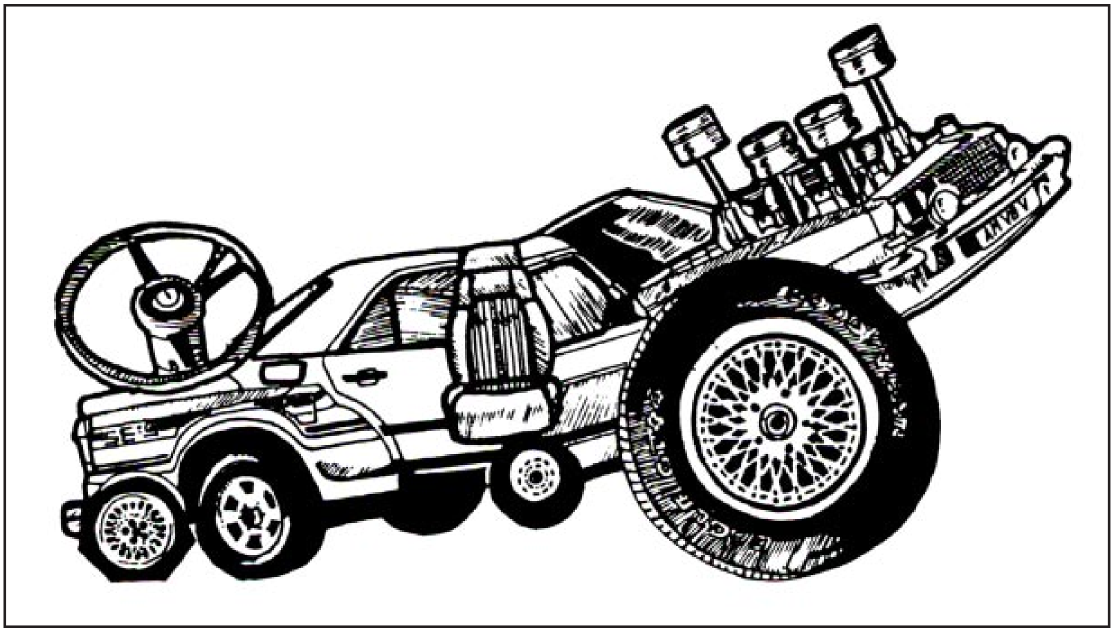


Figure 1. *Multidisciplinary.*

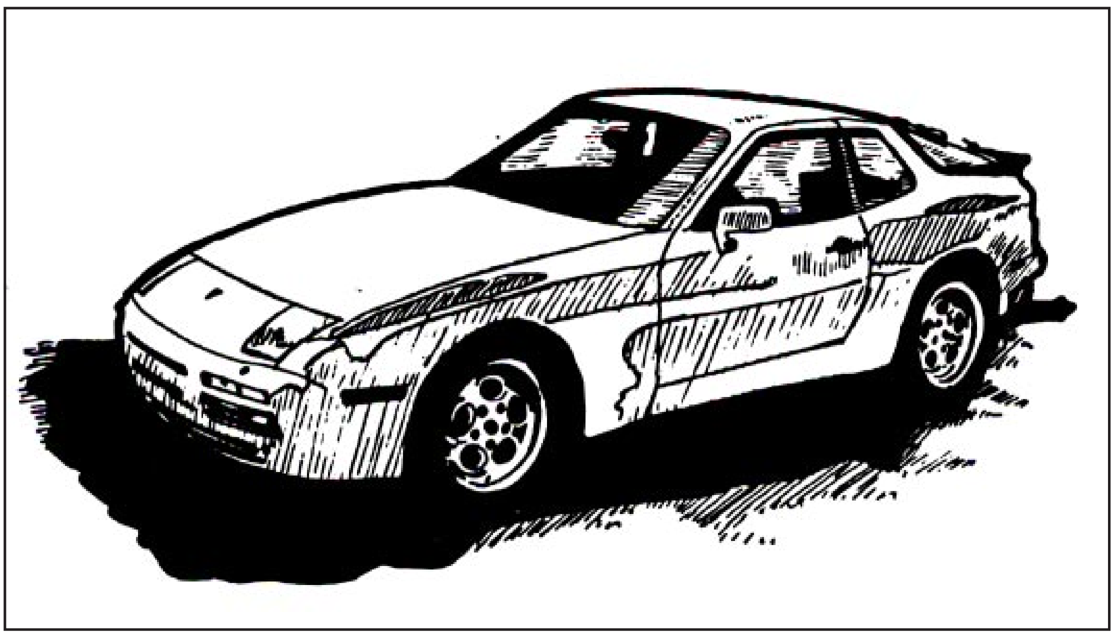


Figure 2. *Interdisciplinary.*

2) Team Composition

Team composition and function may be tailored somewhat to individual skill available. Team members may come from different levels within BLM or from other agencies by cooperative agreement. Specific team composition, and when, where, and how they will interact, needs to be identified in an inventory plan per section 303.3 of BLM Handbook H-4410-1.

Generally the team will require input from these disciplines:

a) Soils. An active survey may involve a soil survey project comprised of several soil scientists working with a project leader.

   An inventory update to consider additional riparian-wetland values will always require at least one soil scientist with mapping experience and knowledge of riparian-wetland soils and fluvial geomorphology. The soil scientist, in consultation with other specialists, makes the spatial distribution of soil and landscape characteristics that can be correlated with ecological sites and further interpreted for various resource and engineering uses and management.

   The primary responsibilities of a soil scientist are to identify soils, design map units, determine soils grouped into the site, identify landscape and soil factors, assist with climate factors, and ensure compatibility with other ecological site components and soil interpretations.

b) Vegetation. Ecological site inventories will include a vegetation inventory team, usually comprised of range conservationists and/or foresters, comparable in number to the soil survey party. A knowledge of both autecology and synecology of the plants in the inventory area is required, along with a good plant taxonomy background. Botany expertise may be required full or part time. For riparian-wetland inventory updates, at least one vegetation specialist with experience in wetland ecology and wetland plant taxonomy is required.

   The vegetation management specialist consults with the soil scientist on map unit design and soil-site correlation and further delineates and documents present vegetation units within each map unit. The vegetation management specialist usually has the lead responsibility for new ecological site descriptions or site updates. This responsibility includes describing the potential vegetation community, interpreting vegetation, including successional sequences, and working with the soil scientist on the landscape, soil, and climate factors. In addition, the vegetation specialist ensures input from other appropriate disciplines and initiates the ecological site approval process.

c) Hydrology. Hydrologist input for progressive soil surveys and ecological site inventories is critical during the planning phase and in map unit design to ensure accurate watershed hydrologic interpretations. Hydrologist input in mapping, describing, and updating riparian-wetland ecological sites is required. The hydrologist is responsible for the description of water features associated with riparian-wetland map units and ecological sites. The hydrologist works with the soil scientist and vegetation specialist to establish interrelationships and ecological responses to hydrologic events and changes over time and space attributable to stream dynamics or other surface and near surface water fluctuations.

d) Biology. Biologist input is recommended throughout ecological site inventories and soil surveys. Although not involved during all the field mapping, the biologist needs to have direct input at critical times. Critical periods are:

- initial planning phase and area base map preparation
- map unit design to assure that wildlife habitat vegetation components are recognized and wildlife interpretation needs are met
- ecological site description interpretation development and revision
- development of applicable soil-wildlife habitat interpretations

Because of the extremely high wildlife values associated with riparian-wetland areas, biologist participation in field mapping these sites is critical. Biologist participation in riparian-wetland ecological site descriptions and updates is required.

The biologist is responsible for developing animal species lists associated with a site and for interpreting wildlife values and limitations. For most ecosystems, species lists have been developed by State and Federal agencies, universities, society groups, and/or museums. However, on occasion, new lists may need to be developed. Various ways to develop a species list or determine what species might be present are found in the Field Procedures section of this document.

Species lists that have been developed before human disturbance/alteration of a particular ecosystem are extremely important because they provide a good concept of what the Potential Natural Community (PNC) may have been or was at one time. If the system is in a degraded condition and human activities have not greatly altered such things as flow regime, water quality, etc., a plant community similar to this potential should be achievable again through practical management if that is the resource objective.

An additional role of the biologist is to provide assistance to the other members of the interdisciplinary team (e.g., hydrologist) in completing their field work for developing the site description. In some cases, the biologist may be able to complete other sections of the site description. For example, a biologist with a strong background in plant taxonomy, should be able to complete the vegetation section of the site description.

e) Other Input. Input from other resource disciplines and managers should be actively sought to identify needs whenever necessary. Their input is especially valuable during inventory planning and again in development of site and soil interpretations. However, assistance from recreation specialists, geologists, geomorphologists, fire managers, and others are often helpful throughout inventory and site description processes, depending on the complexity and resource values associated with individual areas.

2. Soil Survey Map Unit Concept

Soil map units are areas of soils delineated on a map. The soil survey project leader is responsible for the design of map units that meet the needs of users within each soil survey area, in consultation with other resource disciplines and users of soil surveys. Comparable map units in adjoining survey areas are similar.

A map unit is a collection group of soil areas or miscellaneous delineations in a soil survey. Small areas of similar and dissimilar soils are classified as inclusions per section 602-55, NSH. These inclusions are discussed in the soil map unit description, but are not mapped because they are either too small to be delineated at the scale of mapping or their interpretations are similar to the dominant soil.

There are four kinds of map units:

A **consociation** is defined as a map unit having the following characteristics per section 602-52, 53, NSH:

- The *dominant* single soil taxon or miscellaneous area makes up at *least 50 percent* of the area.

- The *similar* soil, per section 602-55, NSH, or miscellaneous areas (soils or miscellaneous areas so similar to the dominant component that major interpretations do not significantly differ) make up *less than 50 percent* of the unit.

- The unit has *15 percent or less* limiting inclusions of dissimilar soils per section 603-55, NSH or miscellaneous areas (soils whose interpretations differ from the dominant soil).

A **complex** can be described as follows per section 602-53, NSH:

- A complex is a collection of two or more dissimilar kinds of soils or miscellaneous areas in a regular repeating pattern so intricate that they *cannot* be delineated separately due to the scale of mapping selected.

- A complex consists of two or more of the following:

  different soils series, and/or
  different phases of soils series, and/or
  miscellaneous areas that occur in regular patterns, like rock outcrops.

- The unit has *15 percent or less* limiting inclusions of dissimilar soils or miscellaneous areas (soils whose interpretations differ from the dominant soils).

An **association** can be described as follows per section 602-53, 54, NSH:

- An association is similar to a complex, but differs because the major soil components or miscellaneous areas occur in repeatable patterns and *could* be broken out into separate soil map units at the scale of mapping, but were not.

Soil associations mapping for low intensity land use management and decisions is deemed more efficient and cost effective than more detailed mapping without detracting from the utility of the soil survey. Due to the map scale, it is more efficient to group and interpret several soils by including them in one map unit rather than designing separate map units for use and management.

The information about the soils is not lost, since the soils, their percentages, and positions on the landscape are identified in the soil map unit description and can be retrieved for use in more detailed planning and site evaluation if necessary.

- This unit is allowed *15 percent or less* limiting inclusions of dissimilar soils (soils whose interpretations differ from the dominant soils) or miscellaneous areas.

An **undifferentiated group** can be described as follows per section 602-54, NSH:

- Undifferentiated soil groups consist of two or more soil components that are not consistently coterminous but are combined. The soil groups are combined because use and management of the soils are the same or are very similar for common uses.

- Undifferentiated soil groups have major soil components that are generally of a large enough extent to be separated at the scale of mapping. Each delineation has at least one of the major components and may have all components.

- This unit is allowed a total of *25 percent or less* dissimilar soil inclusions. A single dissimilar soil should not exceed *10 percent*.

a. Map Unit Design

Soil map units are developed by first observing the broad landscapes that occur within a survey area. Landscapes are further broken down into characteristic landforms and geomorphic components (i.e., hills, side slopes, toe slopes, floodplains, depressions, etc.) and the kinds of soil areas that show a pattern associated with these segments are then identified. Often distinct vegetation patterns occur along these same landform and geomorphic surfaces and aid in determining final map unit design.

The soil scientist designs map units representing sets of soil properties that are repeated in characteristic landscapes. Map units also represent spatial extent that can be delineated on maps and satisfy survey objectives. When objectives involve identification of range, forest, or riparian-wetland values, map unit design must include input from range conservationists, foresters, and other members of the interdisciplinary team as needed.

b. Map Unit Naming

Naming of map units depends upon the purpose, design, and categorical level of soil identification. Naming of soils above the series level is permissible, with the understanding that the amount of soil information, data access, and related interpretations diminish proportionally at higher categories.

Taxonomic class names and accompanying phase terms are identified and defined per section 602-57 to 70, NSH. They are described in terms of range of soil properties within limits defined for soil taxa. Common kinds of phases used for components of map units are summarized in Appendix I. Areas with little or no identifiable soils are called miscellaneous areas and are defined per section 602-70 to 74, NSH.

Map units are named using one or more of the dominant component soil taxa or miscellaneous area names within a map unit. An abbreviated process in naming map units using soil series or other levels is as follows:

1) Consociation - Start with the dominant soil name, rock fragment modifier, texture, and any other phase designator as needed, or the miscellaneous area name per section 602-75, 76, NSH.

2) Complex - The dominant soil or miscellaneous area names are joined by hyphens, followed by the word "complex," and then any other necessary phase designator per section 602-76, NSH.

3) Association - The dominant soil or miscellaneous area names are joined by hyphens, followed by the word "association," and then any other necessary phase designator per section 602-76, 77, NSH.

4) Undifferentiated Group - Where two named soils are dominant, separate by an "and," and where three soils are dominant, separate by a comma between the first and second names and an "and" between the second and third names. This is followed by the term "soils." If necessary, other phase designators may be used, such as for slope or erosion per section 602-77, NSH. *A unique map unit symbol is assigned that identifies each delineation on a soil map and that ties to a corresponding map unit description.*

c. Map Unit Descriptions

Map unit descriptions characterize the map unit as it is identified and delineated during the soil mapping process. The contents of a map unit description will provide information to the user detailing the setting for each dominant soil component. A brief soil profile description that details distinctive surficial features, vegetation relationships, and soil properties that affect use and management is given. All dissimilar soil inclusions are identified and their differences in landscape setting and soil profile characteristics are noted in the description. From these descriptions, the user should be able to determine the patterns and percent of occurrence of each component soil and soil inclusion within the map unit, and their position on the landscape.

d. Detailed Soil Maps

Base maps for publication purposes in soil surveys are primarily of two kinds: (1) rectified photo base maps (high-altitude photography), and (2) orthophoto base maps (high-altitude photography with the displacement of images removed). High quality field sheets and orthophoto quads with black and white images at 1:24,000 scale are preferred.

Soil map units are delineated on the base map to provide location and spatial relationships of soils for subsequent analysis. A map unit symbol can either be numeric, alphabetic, or a combination of both per section 602-108, NSH. It consists of no more than five elements (characters), including digits, letters, and hyphens, that identify the delineation. The symbol also provides the reference to a map unit description and associated information. Figure 3 is a schematic representation of what a soil map may look like. Each area with a symbol represents a soil map unit.

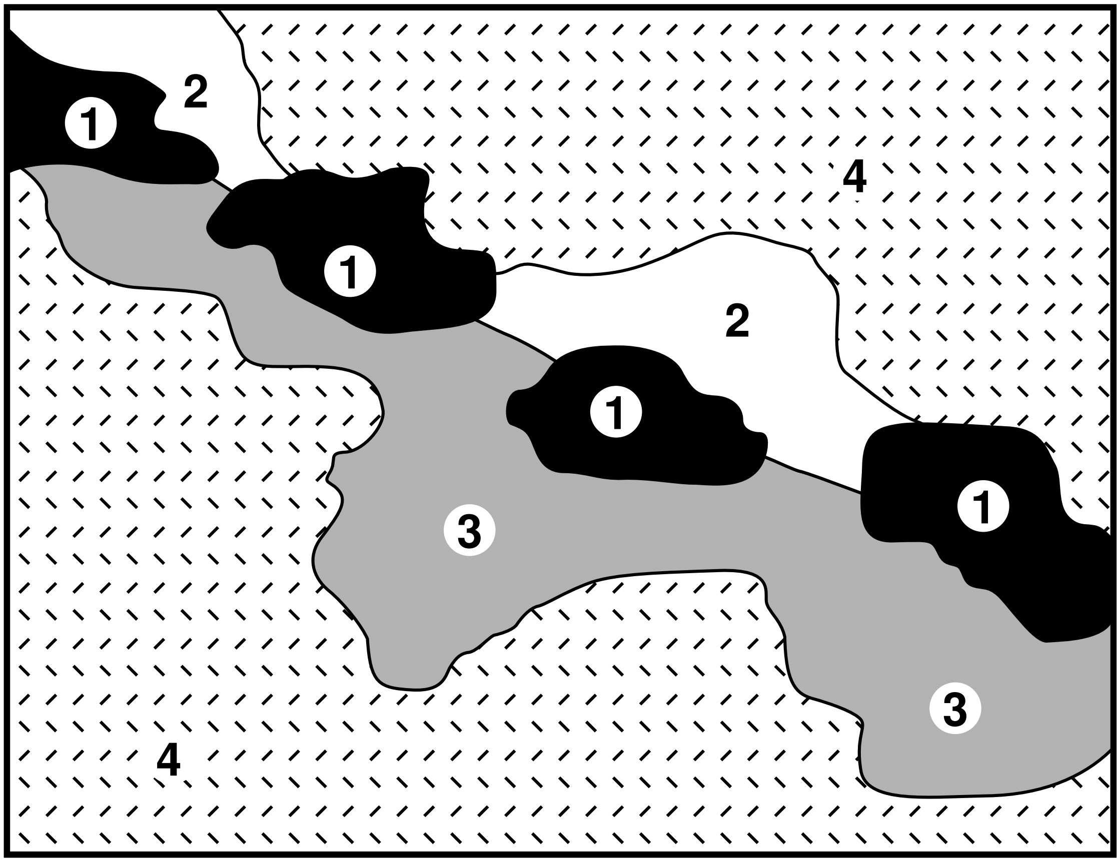
e. Riparian-Wetland Areas

In many riparian-wetland areas, a 1:24,000 scale map base may be appropriate for use of the standard closed line delineation concept. However, most streams, seeps, springs, potholes, and other wet areas are too small to use maps of this scale. This complicates use of detailed riparian-wetland data within a Geographic Information System (GIS).

One alternative, where GIS capability is available, is to photographically or digitally enlarge an orthophotoquad base map to scales between 1:6,000 and 1:12,000 (Batson et al., 1987), delineate and identify the riparian-wetland map units, and then digitize the areas of the base maps. It is feasible to map riparian-wetland areas at a photo scale of 1:2,400 and perform a map transfer to 1:6,000 scale (a reduction of 2.5 times) if that amount of detail is needed. Riparian-wetland map unit delineations using this method would be quite small, but data entry into GIS would be possible.

A second alternative is to simply designate line segments on a scale of 1:24,000 map to represent stream segments as a map unit and spot symbol map units for other kinds of riparian-wetland areas. When either line break to line break or dot to dot line segments and ad hoc or dot spot symbols are used, the average width of stream segments or average area of spot symbols will have to be described in the map unit description. This method is used with or without GIS capability and soil survey area base maps are needed for reports. See Appendix II for more details on using these techniques.

Figure 4 is a schematic representation of what a soil map might look like that uses line segments as map units. In either alternative above, the map unit symbol must be placed outside the delineation (if reduced to 1:24,000 for the standard field sheet), segment, or spot symbol.



Map Unit Symbol	Number of Delineations
#1	4
#2	2
#3	1
#4	2

Figure 3. *Schematic of soil map.*

f. Importance

The soil map unit provides the spatial relationship between soils or groups of soils and landscapes. The map unit also provides the link between the location of named soil taxa and tabular information on specific soil properties and interpretations for use and management.

In addition, soil map unit delineations provide the initial spatial relationship between ecological sites, which are correlated to the soil components of a map unit. Because of the relationship between landscape patterns, soils, and ecological sites, the soil map becomes an excellent base for other resource delineations or interpretive maps such as wildlife habitat, recreational areas, watershed conditions, livestock utilization, and many others.

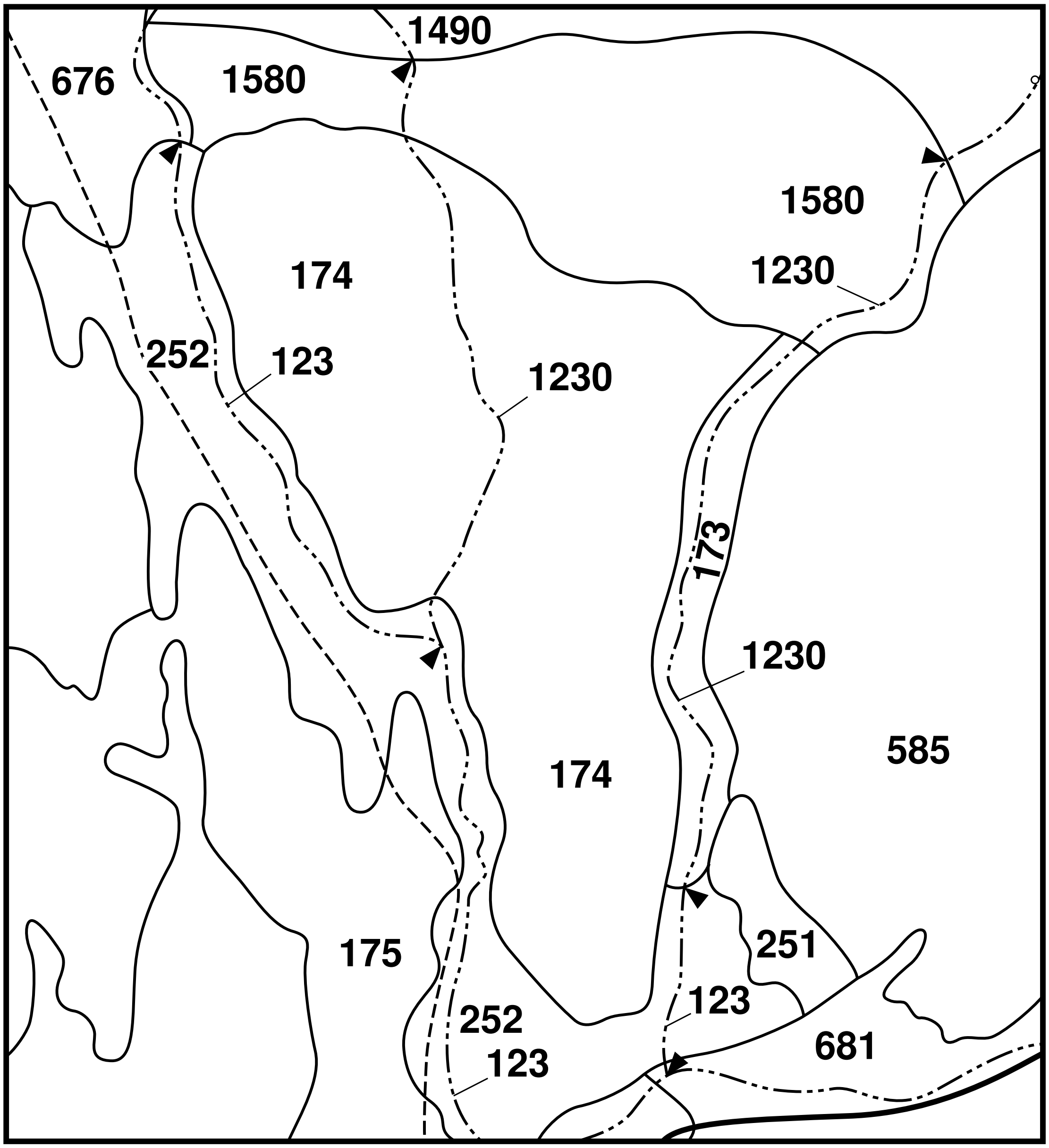


Figure 4. *Schematic representation of a soil map.*

3. Soil and Ecological Site Correlation

   Correlation as applied to soil surveys and ecological site inventories is a process to ensure that both soils and ecological sites are accurately and uniformly described, classified, and named within and between inventory areas. The correlation process ensures that consistent relationships are established between soil taxa (and their physical and chemical attributes), other ecosystem components (landscape, climate, etc.), and a resulting potential natural plant community for an ecological site. Correlation is a continuous quality control process.

   Soil and ecological site correlations have three major components that are achieved simultaneously as surveys progress:

a. Soil Correlation

Soil correlation is discussed in detail in section 602.00-4, NSH. The process is divided into two parts:

- Informal correlation begins with the initial field mapping and first draft of a descriptive legend by the soil survey project leader and continues as an ongoing process as field work progresses. Correlations represented by defined map units are continually tested against sets of soil properties that are observed on the ground and in the laboratory. Refinements in soil descriptions, map units, and soil maps are made following periodic field reviews.

- Formal correlation ensures the validity of soil phase separations and their respective names and further provides quality assurance from local, state, and national points of view. The formal correlation process starts with a field correlation and results in a final correlation and memorandum documenting complete records and validity of the soil survey.

b. Soil-Ecological Site Correlation

Soil-ecological site correlation establishes the relationships of individual soil taxa with ecological sites. This procedure enables the soil map to also become a map of potential plant communities. The separation of two distinct soil taxa does not automatically indicate the separation of two ecological sites. Likewise, some soil taxonomic units occur over broad environmental gradients and may support more than one distinctive PNC. This is brought about by other influences such as an increase or decrease in average annual precipitation (USDA, 1976). When more than one PNC occurs on a soil taxa, the soil taxa can be phased per section 602.00-5(c)(3), NSH. Appendix I lists taxonomic phase class criteria. Plant association tables (Appendix III) in section 302.7A and 302.7B, NRH, are an excellent way of grouping soils and sites, as well as documenting production and plant composition for ecological site descriptions. Exhibit 302.7A is simply a recording of production and composition data and soils from plant communities judged to be climax. Exhibit 302.7B illustrates that composition and production of the climax plant community on one soil is comparable, and that different soils can be grouped into a single site. It could also be speculated that soils 2 and 3 are the same soil taxa separated only by a phase criteria to indicate that soil 2 is a "dry" phase (i.e., lower precipitation zone) of soil 3 as indicated by lower productivity and differences in plant composition.

Some scientists use expanded plant association tables catalogued by ecological site to record all plant communities observed during inventory by soil and with associated map unit symbols listed beneath the soil. The expanded plant association tables are useful for maintaining soil-site correlation as well as for developing additional plant community interpretations.

c. Ecological Site Correlation

The ecological site correlation procedures described in Appendix IV are designed to be compatible with soil correlation standards set forth in the National Soil Handbook. As with soil correlation, site correlation is a continuous process initiated at the beginning of any soil or vegetation survey and progressing through a final correlation. Site correlation is best accomplished in conjunction with soil survey correlation (including soil-site correlation). However, site correlation may be necessary because of updates or revisions to ecological site descriptions.

Site correlation involves: 1) examination of individual descriptions for internal consistency and accuracy, and 2) comparison between sites to maintain consistency in distinguishing between site classifications.

The criteria used to differentiate one ecological site from another at or near the potential natural community are:

- Significant differences in the species or species groups that are dominant.

- Significant differences in the proportion of species or species groups that are dominant.

- Significant differences in the total annual production of the plant community.

The site correlation procedures provide additional guidelines on criteria for comparing and distinguishing between ecological sites, as well as identify responsibility, documentation, and records associated with ecological site correlation.

4. Present Vegetation

Mapping and describing present vegetation associated with a soil and its relationship to the potential plant community of an ecological site is often perceived as a separate process to be used primarily in resource condition analyses, planning, and management activities. However, if present vegetation is mapped and documented concurrently with soils and ecological sites, the process provides tremendous value for soil and ecological site correlation processes, development of ecological site interpretations, and information for subsequent analyses, planning, and management activities. Moreover, the mapping and documentation of present vegetation in conjunction with soils and ecological sites can usually be accomplished at a fraction of the total cost of individual efforts since the inventory area does not have to be covered twice by two different groups.

a. Present Vegetation Maps

The present vegetation map uses the soil map as a base; however, since present vegetation is subject to rapid changes over time and space, the repeatability of soil map units is not appropriate for present vegetation. Each delineation of a soil map unit is considered independently for the present vegetation map. Similar present vegetation may be observed in a number of contiguous map unit delineations. An individual delineation of a soil map unit may also be subdivided, if necessary, based on observed vegetation patterns associated with differences in seral stages or different communities within a seral stage (i.e., caused by fire, grazing patterns, etc.). Soil map unit delineations are always subdivided by administrative boundaries (allotment boundaries, pasture fences, etc.) that traverse a delineation. Subdivisions of soil map unit delineations are indicated by dashed lines per exhibit 304.1, H-4410-1.

The smallest delineation on a map is designated as a Site Writeup Area (SWA) and is assigned a unique SWA number on the map. The number consists of one letter and three digits (i.e., A123). As with riparian-wetland soil map units that are too small to delineate at the map scale used, SWAs may be stream segments or spot symbols for springs, seeps, etc. An SWA number is assigned beneath the soil map unit symbol.

b. Present Vegetation Documentation

An SWA delineation may be represented by a single plant community occurring on a single ecological site. However, the SWA will often represent a complex or association (in the soil map unit context) of ecological sites and/or plant communities. The present vegetation attributes of each distinct plant community are recorded separately for each ecological site within an SWA on an ecological status worksheet per exhibit 305.5b, H-4410-1 (Form 4410-1), along with the proportion of the SWA represented and other site specific information.

c. Application of Present Vegetation Information to Soil-Site Correlation, Ecological Site Description, and Map Refinements

An initial set of ecological site descriptions (range site descriptions, etc.) is available for nearly all BLM administered lands. However, as inventories progress and management needs change, new information gathered nearly always indicates a need for "new" site descriptions to be developed or existing site descriptions to be updated. The continuing correlation process throughout an inventory nearly always leads to map refinement and adjustment of soil map units and their boundaries as the inventory progresses. Present vegetation information is often a first indicator triggering these processes.

A modified plant association table similar to exhibit 302.7B, NRH (Appendix III) is an excellent tool for assessment. A plant association table is prepared for each ecological site in the inventory area. Ecological status worksheet data are transferred to the plant association table as gathered or the table can be generated periodically if the Inventory Data System (IDS) or Inventory Data System Utilities (IDSU) computer programs are used. Species composition by Air-Dry Weight (ADW) can be substituted for individual species production if desired. SWA(s) and appropriate transect number(s) are listed in place of soil taxonomic unit number. The SWA and transect number provide a direct tie to the soil map unit and soil component through the map and map unit description. However, the soil map unit symbol for an SWA can also be substituted for the location number for convenient reference.

The modified plant association table provides several avenues of analysis:

1) Plant communities in all known seral stages are displayed in tabular format. Those communities determined to be at or near potential can be located and used as comparison areas for the potential natural community of the site. Plant communities in other seral stages document community dynamics associated with use, management, or disturbances to the site and can be interpreted for their respective resource values or limitations as management alternatives.

2) The occurrence of plant species, groups of species, or productivity values that are normally not associated with an ecological site are easily recognized and may indicate miscorrelation. If a plant community is determined not to be a typical successional community for the ecological site, the soil attributes and other factors (landscape, water, climate, etc.) must be evaluated at the SWA location to determine if the original soil and site description are correct. Where either one is deemed deficient, they are best correlated to another known soil and site or a "new" site description may need to be developed and "new" soil taxa identified.

d. Vegetation Species Listing

When conducting a vegetation inventory, a full listing of all vegetation species occurring on the site will be beneficial as complete identification and listing of each plant species that occurs on the site is an important attribute that should be documented. This may be documented by 1) listing all species found on the site but not necessarily encountered during the random sampling, and 2) listing all species encountered in the random sampling but of negligible weight by recording species with a zero weight.

5. Hydrologic Information

The identification, correlation, and description of riparian-wetland area ecological sites requires an understanding of the water resources associated with these sites. Hydrologic processes act upon the landscape setting and the various other factors (e.g., soil, vegetation, etc.) that are used to characterize riparian-wetland sites. In order to describe interactions between water resources and these other factors, information on associated water features is required for describing ecological sites in riparian-wetland areas. Water features associated with these sites vary, but are generally grouped into six categories: morphological characteristics, water regimes, associated ground-water systems, watershed characteristics, water chemistry, and special modifiers.

Morphological characteristics associated with a riparian-wetland site's hydrology are used to describe the morphology of the stream channel, marsh, pond, lake, or other water body associated with the site. In stream-adjacent riparian-wetland zones, streams are classified according to the Rosgen Stream Classification System (Rosgen, 1985) or with the channel characteristics used in the Rosgen system. Stream classification thus requires information on the channel gradient, sinuosity, width/depth ratio, bed and bank materials, and confinement of the channel within the floodplain.

Morphological features associated with nonstream riparian-wetland areas include surface area of open water, relationships between limnetic (open water) and littoral (shallow, shoreline) areas, and the characteristic shape (e.g., concave, convex, etc.) and substrate of the shoreline areas.

The water regime associated with riparian-wetland areas has a significant effect on site progression, soil development, and vegetation composition of the site. Classification of water regime includes determination of the presence and availability of surface or near-surface water with respect to time, space, and the ground-water system. Along streams, the position (stage) of the water column in the channel is estimated on a seasonal basis, and extremes of high and low flows are expressed in terms of magnitude, duration, and frequency. Flood-frequency estimates are compared to estimates of bankfull flow to determine frequency of floodplain inundation. Low flow information is used to determine interactions with ground water, i.e., whether the stream is gaining water from or losing water to the ground-water system. In lentic systems (i.e., standing water), the frequency and duration of inundation are estimated.

Interaction with ground-water systems also is important for describing riparian-wetland ecological sites. Ground water associated with riparian-wetland vegetation may be part of a local, intermediate, or regional flow system, with more stable supplies of ground water coming from larger systems. Interaction with the local water table is important for determining dependency of the riparian-wetland site on local supplies of surface water. Where the water table contributes to local expressions of surface water (e.g., lakes, gaining streams), riparian-wetland vegetation may be less dependent upon surface flows than in areas where the water table receives seasonal recharge from surface water (losing streams). Similarly, the nature of ground-water discharge as discrete or lateral may affect the distribution and composition of vegetation on an ecological site.

Other hydrologic characteristics that may influence the development and condition of riparian-wetland ecological sites are the size and condition of the watershed, including factors affecting surface and ground-water quality. For riparian-wetland areas dependent upon surface runoff and/or local ground-water flow systems, watershed size provides an index of annual water yield. It also provides a mechanism for relating sites associated with various watershed sizes by prorating water regime information on the basis of drainage area. Water quality factors of interest include salinity and relative acidity/alkalinity (pH) of surface water, ground water, and soil water at the site. The presence of certain trace elements (e.g., selenium) in watershed runoff or shallow ground water also may influence the composition of vegetation on a site.

Additional hydrologic information required for evaluating riparian-wetland ecological sites falls in the category of special modifiers. For stream-adjacent sites, special modifiers include depositional features, such as point bars and lateral bars, and stream adjustment features, such as meander loops and cutoffs. For nonstream riparian-wetland areas, special modifiers include cultural modifications, such as impoundments, dikes, or drainage.

Not all of the hydrologic information described above will be available for every site. However, where this information can be developed, the site description and interpretation will be more useful for management.

6. Ecological Site Description Content

   The model described previously in this document establishes a functional relationship between vegetation, soils, climate, and so on. Closely related ecological sites may produce similar plant communities in early seral stages (Neiman and Hironaka, 1989). Therefore, ecological site descriptions must contain descriptions of soils and other environmental factors that adequately depict each individual site's capability to produce a characteristic PNC even in the absence of that community. Soil survey, present vegetation inventory, associated hydrology, and use (grazing, wildlife, etc.) information from an inventory area and other completed inventories, through the correlation process, provide the basis for ecological site development. Existing climate records, geology maps, and related research as outlined in the Field Procedures section are also needed to support the relations depicted in site descriptions.

   Riparian-wetland ecological site descriptions needs to contain sufficient information to identify potential "state changes" (USDI, 1990) that may lead to development of a different PNC, migration of the site, or a change in extent of the site.

   The Standard Site Description format contained on the SITEFORM (USDI, 1991) computer program available from the BLM Service Center is used by BLM to describe ecological sites. The SITEFORM program can be used to produce ecological site descriptions in traditional narrative format for general use as well as provide a data base for correlation and other analyses.

   Appendix V provides a complete display of the data entry format for the Standard Site Description. Instructions for entries can be found in the SITEFORM user guide. The Standard Site Description is a comprehensive format that can be used to describe any ecological site: rangeland, forest, tundra, desert, or riparian-wetland. Therefore, all entries are not applicable to all kinds of sites. Only those attributes that are necessary to describe and interpret a particular site and consistently distinguish that site from similar sites need to be used. The SITEFORM computer program provides a structure for organized data input, revision, storage, retrieval, and evaluation of Standard Site Description components. Even though there is considerable variation in specific attributes necessary to adequately describe an ecological site, there are major components that are common to all sites. The ecological site description has an administrative section and two descriptive parts. The administrative section contains an identifying site number, common site name, a plant name indicating dominant species in potential, date of origination or revision, and initials of the originating author and agency. Part A is a description of physical and biological factors characterizing the site and its potential natural community. Part B is the major vegetation interpretations for use and management of the site.

   a. The components of Part A include data base and narrative descriptions of the following factors:

1) Landscape Factors

Landscape factors contain the geographic location and physiographic attributes (landform, elevation, slope, etc.) typical of the site.

Water features and hydrologic attributes of riparian-wetland sites are also described in this component.

2) Climate Factors

Climate factors describe both ambient and soil climate characteristics of the site.

3) Soil Factors

Soil factors include physical and chemical characteristics of soils correlated with the site as well as typical soil family classifications and geologic formations.

4) Vegetation Factors

Vegetation factors provide information about species composition and productivity of the PNC. Other plant community attributes such as cover, structure, and litter or residue can also be described.

5) Wildlife

Wildlife species associated with the site are listed and pertinent information about uses are described relative to the PNC.

6) Community Dynamics

Community dynamics (narrative only) of the PNC associated with natural occurrences of fire, flooding, etc., is presented relative to expected frequency over time.

7) List of Commonly Associated Sites

A list of commonly associated sites indicate other ecological sites that frequently occur in complex, association, or adjacent to the site being described.

8) List of Competing Sites

A list of competing sites indicates other ecological sites that may be easily confused with the site being described, especially in earlier seral stages. Differentiating criteria are described.

9) List of Soils Grouped Into the Site

A list of soils grouped into the site provides all named soils correlated to the site by soil survey area and map unit.

b. The vegetation interpretations contained in Part B of the site description are all presently in narrative format and include:

1) Plant Community Characteristics

2) Riparian or Wetland Site Progressions

3) Grazing

4) Forestry

5) Insects and Disease Pests and Animal Damage

6) Wildlife

7) Recreation and Natural Beauty

8) Fire

9) Range and Forest Understory Rehabilitation

10) Other Interpretations

11) Applicable Field Offices

Plant Community Characteristics interpretations are of particular importance to BLM vegetation management programs. Traditional range site descriptions commonly discuss general patterns of succession and retrogression associated with common perturbations (fire, grazing, etc.) and associated increaser, decreaser, and invading plant species are noted.

BLM interpretations needs to describe known successional community types by ecological status. There can be considerable variation of communities within earlier seral stages. Likewise, there can be considerable variation in the value, limitations, or opportunities for management of those communities. Because ecological status (seral stage) does not imply value for a particular use, management alternatives need to consider the kinds of plant communities a site is capable of producing in relation to intended uses and management capability, i.e., resource objectives.

Riparian-Wetland Site Progressions are a relatively new concept to be included in riparian-wetland ecological site descriptions. Changes in physical site characteristics associated with stream dynamics and other hydrologic influences are common in riparian-wetland ecosystems. Changes in the physical state of a site, particularly a significant change in soil-water status, can lead to development of a new or different site and corresponding PNC. Possible changes in site potential are described relative to aggrading processes such as sediment deposition, bank building, channel narrowing, etc., and degrading processes such as channel widening and lowering, or channel incision in more extreme cases. The implication of site progressions relative to expansion or loss of riparian-wetland area should be addressed.

The remaining interpretation sections are completed in accordance with individual state guidelines in cooperation with SCS resource specialists. Bureau of Land Management specialists may elect to incorporate additional information in any section specific to individual community types identified in the Plant Community Characteristics. It is extremely important, however, to ensure that additional information supplements rather than conflicts with general interpretations developed cooperatively.

Appendix VI provides a complete riparian-wetland site description example including data base and narrative information.

7. Documentation and Data Permanence

Resource information is seldom static. New information, changing information needs, use of resources, and cyclic or long-term changes (i.e., climate) all affect either how resource information is classified and described or effect changes in the resource directly. It is imperative, however, that resource information gathered during soil survey and ecological site inventory is documented with sufficient permanence to establish a baseline for future comparison and analysis.

The standards established by the National Cooperative Soil Survey (NCSS) in the NSH provide the criteria for soils documentation, storage, and retrieval of information in a permanent data base and publication. Circumventing the standards established often results in lost information or limited availability for future analyses. Likewise, data standards established for BLM's Inventory Data System (IDS), Standard Site Description, and Land Information System (in development) must be met before a permanent data base is established. Required documentation for soil survey, ecological site description, and present vegetation to meet established standards are described in greater detail in the Field Procedures section of this document.

B. Inventory Preparation

Adequate inventory preparation is essential whether a full soil and ecological site inventory is planned for a resource area or an inventory update for riparian-wetland areas is all that is required. Inventory preparation needs to be started at least 1 year prior to the start of field work; starting 2 years ahead is better and is usually required if MOUs or other agreements are necessary for interagency efforts. The basics of inventory preparation are the same and include:

1. Memorandum of Understanding

   Soil surveys associated with ESI are initiated as part of the NCSS. This is accomplished through an MOU with the SCS at the state level per section 601, NSH. The process will assure necessary soil survey guidance and quality control of the final product. Without this MOU in place, the end results of the survey may be less than desirable with limited value for future analysis, and possible lost data if not part of the permanent data base.

   The MOU for a soil survey is prepared in cooperation with all national soil survey cooperators with SCS State Conservationist as the primary responsible party. Although an MOU is not a legally binding contract, it does provide a record of intent for all cooperators in making a soil survey and in performing related work. The purpose of the survey, description of the area, list of cooperators and responsibilities, and specifications for making interpretation and publishing the soil survey are recorded in the document.

   The minimum requirements of an MOU include:

   - the kind of soil survey, its objectives, specifications, and its guidelines for design;

   - the role and function of each cooperating agency to help prepare schedules and make work assignments;

   - the designation of a mapping base that meets the objectives in relation to landscapes, soils complexity, ecological sites, and riparian-wetland considerations;

   - the laboratory and soil investigations required to meet the needs for soil-vegetation relationships, soil classification, soil interpretations, and riparian-wetland soil hydrology; and

   - realistic schedules and publication plans.

2. Inventory Plan

   An inventory plan is developed by an interdisciplinary team and approved by line management. If an ESI is conducted in conjunction with an SCS soil survey or soil survey update, the inventory plan should be consistent with the soil survey MOU and plan of operations per section 601.05, NSH. The inventory plan needs to be updated annually if the inventory exceeds 1 year.

   Some of the topics and questions to consider in the inventory plan per section 303.3, H-4410-1 are:

   a. Purpose - Why in general terms is the inventory being done?

      - Legal requirements, FLPMA, Public Rangeland Improvement Act (PRIA), Clean Water Act (Section 404)

- Identify *capabilities and risks* for use and management decisions involving *what uses, what issues.*

- Others?

b. Objectives - Are there specific objectives for the inventory data in relation to uses or issues?

   Example objectives for riparian-wetland inventory might include:

   1) Identify the most extensive or important sites within each management unit (benchmark sites).

   2) Identify vegetation communities within riparian-wetland sites that are most capable of response to management (potential key areas).

   3) Document realistic resource management objectives within a site's known capability.

   4) Identify location and extent of jurisdictional wetlands.

c. Description of the Inventory Area

   - Where is it?

   - What are the boundaries?

   - What does it look like?
     Vegetation diversity
     Topographic diversity, etc.

d. Information Required to Resolve Identified Issues

   - There are *minimum* standards required for ESI: Production and Composition ADW

   - Other information necessary for resource interpretations *can and should* be gathered during ESI.

   - Soil resource values and condition

   - Vegetation cover for watershed

   - Vegetation structure for wildlife habitat criteria

   - Mean annual increment, wood volumes, etc., for forestry

   - Etc.

- Additional information can be tailored for local needs or be specific to certain areas within the inventory.

e. Inventory Design

- Level of detail? Level of detail needs to be identified depending on resource values and interpretation needs. A higher level of detail may be required in riparian-wetland or other high value areas.

- Map scale? Different scales may be required in mapping uplands and riparian-wetland areas.

- Where will it start?

- How will it progress (seasonal constraints, etc.)?

- In conjunction with a soil survey or afterward?

- How much time?

f. Personnel and Funding Requirements and/or Constraints

- How many personnel?

- What skill levels are needed (professional levels vs. seasonal or entry level)?

- Who?

- Special needs (helicopter costs, equipment, etc.)?

g. Logistics

- Agreements or MOUs?

- Transportation (vehicles, helicopter, etc.)?

- Office space?

- Lodging (camps, motels, etc.)?

- Food or per diem requirements?

- Equipment, photos, maps, etc.? (Some procurement may need to be done a year in advance.)

- Contracts?

h. Field Measurements and Procedures

- Minimum standards? Composition and production by species by SWA by ecological site are required.

- Other requirements? Sampling procedures like Daubenmire, toe-pace, point frame, etc.?

- Handbooks and other written guidance?

- Training?

- Soil survey and ecological site quality control?

i. Compilation Procedures

- Maps
  Cartographic requirements?
  GIS?

- Tabular Data Input
  Hand?
  Computer?
  Service Center or local?

- Reports generated?

j. Reporting and Quality Control (Inventory Reviews and Results) Requirements

- Initial

- Progress

- Final

- Who? When?

k. Approval Process

- Who are the responsible individuals?

- When?

- What administrative levels?

l. File Maintenance

- Field worksheets? Boxes in basement?

- Computer files? Service Center or local?

- Reports?

- Maps?

- Updates?

- Inventory code?

3. Existing Data and Other Information

   There has been considerable information already gathered and documented for various land evaluation and management activities. Much of this information is directly applicable to soil and ecological site inventories in one form or another. Some of the information is most valuable in obtaining a general overview of the entire inventory area while other information may be pertinent to specific soil and ecological responses in a small area. It is extremely important in any inventory effort to capitalize on what is already known about an area before attempting to learn more.

   Much of the information exists in BLM office files, while other information can be obtained from other agencies such as SCS, United States Fish and Wildlife Service (USFWS), United States Geological Survey (USGS), United States Forest Service (USFS), National Oceanic and Atmospheric Administration (NOAA), etc., and from published literature. Time needs to be taken to explore as many sources as possible. The following list provides some of the more common sources, but is by no means all inclusive:

   a. Landscape

      - 1:250,000 scale USGS quads and 1:250,000 scale color infrared landsat images provide an excellent overview of broad topographic features as well as a base for overlaying other general soil, climate, and vegetation information.

      - 7 1/2" or 15" USGS quads provide the specific topographic base for mapping and site description.

      - Landscape terminology references such as the "Glossary of Landform and Geologic Terms" per section 607, NSH, and "Landforms of the Basin and Range Province" (Peterson, 1981) help develop a clear understanding and consistency in the use of each term.

   b. Geology

      - State, county, or local area geology maps provide information to help determine changes in substrates that may influence breaks in soil types and vegetation responses.

c. Climate

- State maps available from the State Climatologist or other published sources help determine precipitation and temperature gradients at a broad scale.

- NOAA publications provide data on official National Weather Service stations.

- Western Regional Climate Center, Reno, NV, can provide climate summaries on NOAA stations as well as BLM and USFS Remote Automated Weather Stations (RAWS) and SCS stations.

- BLM monitoring files often have precipitation and some temperature information for specific allotments.

- The data analysis group of the West National Technical Center (SCS) can provide summaries on snow survey data, water supply outlook, and select daily or monthly climatic data for weather stations.

d. Soils

- The existing soil survey report is the best source for inventory updates.

- If a new soil survey is planned, soil surveys for contiguous areas (completed or ongoing) needs to be obtained along with a general soil map for the surrounding soil survey areas and state.

- A set of existing official soil series for the state should be available for use as a reference in correlating soil documentation to a series.

- USFWS may have some recently completed national wetlands inventory data that is available for use in locating probable hydric soils.

- A current list of hydric soils that may apply to some soils in the area is available from the SCS.

e. Vegetation

- Existing SCS range site and grazeable woodland descriptions for the Major Land Resource Area(s) (MLRAs) in the survey area should always be available and at hand.

- General vegetation maps for the state are also usually available for a broad overview.

- Many BLM resource areas have older vegetation inventories such as Ocular Reconnaissance, Forest Inventories, or others that still provide an excellent approximation of species distribution within the area.

- The BLM Riparian Aquatic Information Data Summary (RAIDS) data base provides an overview of riparian-wetland vegetation where available.

- Riparian-wetland classification references such as those developed by Kovalchik (1987), Hansen and others (1989), and Youngblood and others (1985) provide excellent background for riparian-wetland site development and associated community dynamics.

- Regional wetland plant lists are available from USFWS.

f. Hydrology

- USGS, Bureau of Reclamation, and State Engineer's offices are often sources of streamflow data and sometimes can provide pertinent ground-water information.

- USFWS may have some wetland inventory data within an inventory area.

- Possible BLM sources include stream surveys, watershed studies, and the Riparian Area Information Data System (RAIDS, BLM User Guide 6601-2).

4. General Resource Reference Map

Once existing information for the area is collected by the team, the assembly process begins. The team coordinates the information by subject for input into broad data layers such as:

- Major landforms (e.g., Central Nevada Basin and Range)

- Existing general soils maps.

- Geology for the area.

- Climate for the area (i.e., air temperature, precipitation, frost-free season).

- Vegetation types (i.e., existing general vegetation maps and old inventory).

- Watershed boundaries and major drainages.

- Wildlife use areas.

- Other (i.e., allotment, district, or other jurisdictional boundaries and transportation routes, etc.).

The team then selects the most useful base map for the total area. Availability is an important factor here. Reference maps are usually at a scale of 1:100,000 to 1:250,000. Landsat imagery at a scale of 1:250,000 is preferred. This imagery is excellent to display large areas and provides the user with a good visual perspective of the area. The use of mylar overlays registered to the reference map will allow the team to broadly develop their concepts for each data layer. They can predelineate each of the data layer groupings on the mylar relative to its location on the reference map. Each data layer predelineated on the mylar is considered to be the team's initial draft of baseline information. It is to be revised and updated as new information and field verification indicate a need. The reference map and data layers will be tested for accuracy and refined throughout the inventory process. End products will result in a general soil map, general vegetation map, and other information suitable for broad scale planning analysis.

This process is considered to be the team's most important step in developing an initial understanding of the area's components.

5. Tools for Inventory

Tools for inventory include both "software" and "hardware" in much the same context as the computer world. Software as used here includes all items such as photos, maps, references, forms, etc., as well as computer programs. Hardware refers to equipment needs from pens and pencils to backhoes, if required, and of course a computer or computer access. Figure 5 contains tools for inventory common to all disciplines. Specific needs are as follows:

a. Soils

1) "Software" needs include but are not limited to:

- Handbooks and manuals on procedural guidance
  USDA SCS National Soils Handbook (NSH)
  USDA Soil Survey Manual, Agricultural Handbook No. 18
  USDA Soil Survey Manual (in press)
  USDA Soil Taxonomy, Agriculture Handbook No. 436 and recent amendments
  SMSS Keys to Soil Taxonomy, Technical Monograph No. 19, Fourth Edition, 1990
  SCS National Range Handbook (NRH)
  SCS National Forestry Manual (NFM)
  SCS National Biology Manual (NBM)
  SCS National Cartographic Manual (NCM)
  SCS Technical Specifications, Photobase Map Compilation (Rev. Mar. 1984)
  SCS Technical Specifications, Soil Map Finishing (July 1976)
  USDA Diagnosis and Improvement of Saline and Alkali Soils, Agricultural Handbook No. 60
  USDA-SCS Soil Series of the United States, including Puerto Rico and the U.S. Virgin Islands, Their Taxonomic Classification, Miscellaneous Publication Number 1483
  Other suggested technical references, see section 602-4, NSH

General Equipment	Soils	Vegetation	Hydrology	Biology
Software				
MOU	X	X	X	X
Inventory Plan	X	X	X	X
Handbooks & Manuals (See specific lists under Soil, etc.)	X	X	X	X
Forms	X	X	X	X
Field notebook	X	X	X	X
Aerial photographs (infrared to color infrared; quartered quad centered black and white - scale 1:24,000; registered orthophotoquad 1:24,000 scale as the base map for soil compilation)	X	X	X	X
Registered stable mylar (matte finish) overlays	X	X		
USGS topographic maps 7 1/2" or if not available 15"	X	X	X	X
Index maps for field sheets and orthophotoquads	X	X	X	X
Existing site descriptions common to the resource area	X	X	X	X
Plant ID references		X		
List of plant names and symbols found in the state		X		
Geomorphology reports for the area and related scientific papers	X			
Plat or land status maps	X	X	X	X
SITEFORM computer program	X	X	X	X
Hardware				
Abney level or clinometer	X	X	X	
Stereoscope, mirror and pocket	X	X		
Camera	X	X	X	X
Pens, ink, and pencils	X	X	X	X
Compass, magnetic	X	X		
Paper bags		X		
Auger or probe, hand and/or power	X	X	X	
Shovel (standard) and tile spade	X	X	X	
Tape measure, metric and English	X	X	X	
Computer	X	X	X	X
Other items that make the job easier	X	X	X	X
Vehicle and aircraft	X	X	X	X
First aid kit	X	X	X	X

Figure 5. *Common tools for inventory of an ecological site.*

- State Hydric Soil List

- Forms
  Map Unit Transect forms commonly used in the state SCS-SOI-232 Pedon Description or as revised by the state
  SCS-SOI-232F Soil Description or other like forms commonly used in field note taking

- Access to the soil survey data base software for data entry to SOI-5 forms and retrieval

- Field Soil Survey Database (FSSD) for transect management, pedon management, map unit records (SOI-6), soils data base software

- Pedon description program software

- Map unit description program software that the state may be using

2) "Hardware" (equipment) needs include:

- Altimeter

- Area measurement system (planimeters)

- Color charts, Munsell

- Crowbar, heavy

- Electric conductivity meter

- Geology pick

- Hand lens

- Knife

- Large and small handpicks

- Light table

- Map board

- Penetrometer

- pH kit, chemical

- pH meter

- Sieve set

- Soil analysis - portable field laboratory
- Soil sample bags and boxes
- Soil test kit, chemical
- Soil thermometer
- Spot plate

b. Vegetation

1) "Software" needs include but are not limited to:

- Handbooks and manuals on procedural guidance
  SCS National Range Handbook (NRH)
  BLM Manual 4400 Rangeland Inventory, Monitoring, and
  Evaluation
  BLM Manual 4410 Ecological Site Inventory
  BLM Manual Handbook 4410-1, NRH Supplement
  BLM Manual 1737 Riparian-Wetland Area Management (Draft)
  Other written guidance, supplemental information, and procedures;
  i.e., TR 1737-3 (Inventory and Monitoring of Riparian Areas)
  This technical reference, etc.
- National List of Plant Species That Occur in Wetlands (USFWS)
- Soil-site correlation legend
- Soil map unit descriptions
- Forms
  4410-1
  4410-1a
  4410-2
  SCS Range 417
- IDSU (Inventory Data System Utilities) computer program and/or access to IDS at Service Center

2) "Hardware" (equipment) needs include:

- 9.6 sq. ft. hoops (and other measurement frames as appropriate)
- Clippers
- Scales
- Planimeters (if acreages are to be compiled by field crews)

c. Hydrology

1) "Software" needs include but are not limited to:

- Handbooks and Manuals for Procedural Guidance
  - Stream Classification Reference (Rosgen, unpublished)
  - Water Resources Council Bulletin #17B of the Hydrology Committee, "Guidelines for determining floodflow frequency"
  - USGS Techniques of Water-Resource Investigations Reports:
    - Book 3, Chapter A1: General field and office procedures for indirect discharge measurements
    - Book 3, Chapter A2: Measurement of peak discharge by the slope-area method
    - Book 3, Chapter A8: Discharge measurement at gaging stations
    - Book 4, Chapter A2: Frequency curves
    - Book 4, Chapter B1: Low-flow investigations
  - Reference guide for estimating Manning's roughness coefficient
  - Reference guides for water-quality field techniques

- Computer Software and Documentation
  - Statistical software, with documentation, capable of performing frequency analysis using a log-Pearson Type III frequency distribution
  - Open-channel flow software, with documentation, capable of analyzing channel cross-section data, using normal depth and/or standard step calculations to produce relationships between discharge and other hydraulic parameters

2) "Hardware" (equipment) needs include:

- Surveying Equipment
  - Level, rod, tripod, and survey notebook

- Discharge Measuring Equipment
  - Tape measure
  - Top-setting wading rod
  - Current meter (Marsh-McBirney or vertical-axis current meter)
  - Headset and stopwatch, if using vertical-axis current meter
  - Clipboard
  - USGS discharge measurement forms

- Well Points

- Water Quality Sampling Equipment
  - Thermometer
  - Conductivity meter and calibration standards
  - pH meter and calibration standards

Bottles, labels, and preservatives for water samples
Coolers with ice for sample transport to laboratory
Field forms
Sampling equipment for special situations
- Depth-integrating sampler (e.g., DH-48), treated for trace elements, for integrated cross-section sampling
- Bedload or bed-material sampling equipment
- Submersible, peristaltic, or other pump for shallow ground-water sampling
- Field filtration equipment for sampling dissolved chemical constituents, as opposed to sampling for total chemistry

d. Wildlife

For most cases, the information that is necessary to complete the wildlife section of the site description, will have already been compiled and there will be no equipment needs. If this is not true, the Field Procedures section contains references that provide equipment lists or refer to documents that do. These documents provide various techniques to determine species present for the purpose of developing a species list.

If completing or assisting other team members in the collection of field data (e.g., vegetation), the biologist needs to be aware of the equipment needed to collect the necessary resource information. Equipment needs can be found in the soil, vegetation, and hydrology sections described above.

6. Field Sheets

Part of the preparation process involves securing adequate field sheets (high altitude photography) and photobase map sheets for the area. The process to clean and prepare the field sheets as outlined in the section 602.01-2, NSH, "Prepare field sheets" is as follows:

a. Draw match lines

The soil survey project leader is responsible for drawing match lines on field sheets other than photobase map sheets. The number of the adjoining map sheet is written in black ink on field sheets other than photobase map sheets next to the outside of the match lines and parallel to them. Size of lettering is the same as that used for soil symbols. Cartographic units will draw neat lines (match lines) on photobase map sheets from the field sheets.

b. Trim

The map sheet is trimmed, if necessary, to no closer than 2.5 cm of the match line. If the trimmed portion of the map sheet is necessary for stereo coverage of an adjoining map sheet, it is filed in a convenient way for easy use. Where heavy use occurs, map sheets may fray, requiring edges to be bound with tape.

c. Identify

For proper identification where SCS is the lead agency, each field sheet will bear the following data:

- Department, lead agency, and full name of cooperating agencies.
- Soil survey area name and state.
- Scale on field sheets where copies are made for distribution. Scale is indicated by a bar scale so that accuracy is preserved after enlargement or reduction.
- Name(s) of soil scientist(s) who mapped sheet.
- Date sheet was completed.

The above sequence is the same where the lead agency is different than SCS, except that the lead department or agency name will replace USDA, SCS.

d. Identify Photographic Copies

The first three items in d. above and the note "ADVANCE COPY SUBJECT TO CHANGE" are placed on the front of field sheets if photographic copies are made for distribution.

7. Training

The need for training in specific sampling techniques for each discipline represented in an ESI will vary greatly depending on individual background and expertise. Soil survey project leaders and inventory team leaders are responsible for assessing specific training needs. Assistance, if needed, can be requested from BLM and SCS state offices and BLM's Service Center.

a. The following training exercises and courses are highly recommended for the entire inventory team regardless of background and qualifications:

1) The Ecological Site Concept, course number 4000-ST-2, is a self-study course and video available through BLM's Phoenix Training Center. Team members need to review the course together even though they are well versed in the concept. If possible, the course should be followed by a review of soil map unit and ecological site concepts and SWA mapping criteria *in the field* to ensure mutual understanding between team members.

2) Coordinated Riparian Area Management, BLM's Phoenix Training Center Course 1737-1, is presented three to four times annually at various locations. This course provides an introduction to riparian-wetland ecological site concepts as well as substantial information on BLM riparian-wetland policies, values, and management concepts.

3) Riparian-Wetland Ecological Site Classification, BLM's Phoenix Training Center Course 1737-4, is an advanced course for mapping and describing riparian-wetland sites.

4) GIS - Fundamentals of Geographic Information Systems, an SCS South National Technical Center (SNTC) Ft. Worth Employee Development Unit course, provides a basic understanding and hands-on experience in the concepts, use and application of GIS.

5) RMT SEN - Basic Photo Interpretation, an SCS SNTC Ft. Worth Employee Development Unit course, provides students with the background and ability to interpret and use various kinds of aerial and remote sensing photography.

6) Soils - Basic Soil Survey: Field and Laboratory, an SCS SNTC Ft. Worth Employee Development Unit course, is designed to provide new soil scientists and other disciplines an opportunity to experience what it takes to complete a soil survey. Output potential of soil interpretations, and use of field and laboratory methods and data analysis in soil survey are discussed as well.

b. Additional courses recommended for specific disciplines include:

1) ECS - Range Plant Ecology, an SCS SNTC Ft. Worth Employee Development Unit course, is an advanced course that provides information on the ecological interaction of range vegetation.

2) RES CONS - Saline and Sodic Soils, an SCS SNTC Ft. Worth Employee Development Unit course, provides a background and hands-on experience in understanding chemical relationships, testing and analyzing data, recognizing problems, and recommending management solutions.

3) Soils - Soil Correlation, an SCS SNTC Ft. Worth Employee Development Unit course, is an advanced course for soil scientists. It is designed to provide insight and techniques to apply soil classification, soil correlation procedure, geomorphic relationships, soil survey area handbook development, and laboratory data analysis and sampling procedures.

4) Soils - Soil Lab Data Use, an SCS SNTC Ft. Worth Employee Development Unit course, is an advanced course for soil scientist. It is designed to provide insight and techniques for using laboratory data in soil classification and plant relationships.

C. Field Procedures

1. Review of Memorandum of Understanding

This is the first of several times where the MOU is reviewed to assure that it adequately reflects the inventory purpose and objectives. It is extremely important that the MOU addresses the requirements needed to produce the desired product per section 602.01-1, NSH. Since the original MOU may have been developed up to 2 years prior to the survey start, it may not always reflect current needs.

Where noted deficiencies are minor, they can usually be handled between the responsible individuals for cooperating agencies with pen and ink modifications. Significant changes in the work or work area will require a new MOU for review, approval, and distribution per section 602.02, NSH. Examples of significant change for a soil survey area MOU are:

- the area to be mapped is changed;
- the purpose for doing the survey is changed in full or in part;
- specific plans for publishing the survey are changed; and
- specifications for map scale or format or text format are changed.

Only those sections requiring changes are rewritten. The above information is not all inclusive, but does provide an indication of where major revision to an MOU is needed.

2. Preliminary Field Study

Prior to this time, all known information about the area has been organized and displayed on a general resource reference map. This information will be taken to the field for hands-on testing of the broad concepts of mapping and data collection for developing ideas about the area. From this point on, all field work will require a team effort. The stated purpose and objectives of the MOU and inventory plan, the validity of each data layer, and the application of other data collected to unique situations are tested, and map unit concepts are developed by the team.

a. Reconnaissance Testing

Preconceived concepts are developed and tested in actual field application by the team using the preexisting data and predelineated data layers as the base. This process is a learning experience and provides an opportunity for team members to become familiar with the area and the other team members' discipline needs, as well as to gain cross-training from the other team members. The purpose of the reconnaissance is to:

- Traverse the area to learn the land features and accessibility to all parts of the survey area.
- Make frequent stops to check the validity and accuracy of the data layers. This also gives the team members the opportunity to look at various technical aspects in more depth.
- Allow the team to adjust predelineated boundaries such as landform units and merge common delineations of the reference map as a result of field observations.

- Check existing soil map unit descriptions, pedon description, ecological site descriptions, hydrologic data, etc., for accuracy and utility for incorporation into the inventory process.

- Identify data such as soil taxa, soil map unit descriptions, ecological sites, stream hydrology, and other data for use in the area.

- Investigate outside of the soil survey area to determine area extent, relationships, concepts, or other purposes. Reviewing adjacent areas will broaden the team's familiarization to the current inventory area.

Reconnaissance testing may last only a short time if the survey area is adjacent to or is similar to other recently completed soil surveys. It may require significantly more time if there is little existing knowledge of the soil, vegetation, hydrologic, or biotic resources. The team approach to obtain a field overview of an area does not require a large block of time or intensive labor. However, it is an important step in obtaining a feel for the area and related past efforts leading to a conceptual approach, and an interdisciplinary effort that will be applied during the total inventory.

b. Provisional Field Inventory

During reconnaissance testing, numerous concepts about the area were formulated by the team and tested on a more detailed basis. This is accomplished by subdividing the broader data layers into each of their individual components applicable to the outlined objectives of the survey or inventory. Team members need to work together in this process to assure that all the discipline requirements are addressed. Good communication between disciplines is the key to a quality product and efficient production.

The preliminary field inventory provides the initial development and documentation of the descriptive legend and ecological sites for the survey area.

3. Survey Design

In the field, the team's accumulated knowledge of the area is applied. Soil survey-inventory objectives must be considered in field testing of repeatable map units. The soil scientist project leader has the ultimate responsibility in designing the soil survey to meet the objectives outlined in the MOU. The following attributes are considered in the survey design per section 602.01-5, NSH:

- Map unit application. Map units in a soil survey can be dominated by a single soil taxon or miscellaneous areas plus allowable inclusions or by two or more taxa that are less homogeneous and are generally less refined. Map unit design is flexible and provides the degree of refinement necessary to meet the objectives of the survey. Many upland areas that are less intensively managed may only need broader units with two or three component soils in association or complex plus inclusions over repeatable landscapes. Detailed information for site specific purposes can be obtained on the ground with onsite investigation by a soil scientist as needed to verify soil component location. Recreation areas, floodplains, riparian-wetland areas, etc., that may require intensive management are better suited to single taxa units or complexes of two or more taxa plus inclusions. The confidence levels of these units are generally higher for the user. This kind of map unit allows for a more precise prediction of the soil, vegetation, hydrologic, and biotic relationships that are common to each repeatable delineation with a minimum of onsite evaluation.

- Kinds of soil taxa used. The objectives of the soil survey will determine the kinds of soil taxa used. Phases of a soil series are the most narrowly defined set of soil properties. Therefore, a map unit identified by a phase of a soil series will provide the user with more precise information and interpretations about the soils and ecological sites of an area. Soils identified at the family level or higher categories in *soil taxonomy* are progressively less definitive about their soil properties and offer less specific interpretations or are unavailable to the user. This is an extremely important point to consider in relation to using broad soil concepts and applying them to more specific soil, ecological site, hydrologic, and biological interpretive needs and objectives. The risk for misuse of interpretive data and associated values is increased when categorical levels higher than soil series are used. In most cases, the phase of a soil series is the kind of soil taxa that meets most long-term objectives.

- Kind and intensity of field procedures. The objectives of the soil survey and need for kinds of information are the main factors in determining the intensity of soil survey. The purity of map units is important in the interpretation of soil surveys. Most delineations of a map unit contain some kind of map inclusions not identified in the map unit name. Many inclusions cannot be delineated by practical field mapping methods, but others can be. For field mapping expediency, some soil inclusions are deliberately identified with other kinds of soils to avoid excessive detail of the soil map or legend. This is a common procedure, especially where small riparian-wetland areas are concerned (Appendix II).

  Standards of purity in any soil survey are attained by adjusting the kind and intensity of field investigation. If the identification of the soil and ecological site of each delineation is made by direct examination and boundaries are observed throughout their lengths, there is a greater opportunity to control purity of map units and increase interpretative value for predictive use.

- Minimum size delineation and map scale. Minimum size delineation is determined by the interdisciplinary team prior to preparation of the MOU. The delineations should be of a size that will satisfy the needs of the user and be of reasonable size considering map scale. A 1:24,000 map scale is usually sufficient to handle most delineations encountered in field mapping. There are some situations, such as delineation of riparian-wetland areas, where normal scale is not adequate using polygon map techniques. Using the suggested line segment or spot symbol procedure outlined in Appendix II will overcome the limitation that requires a larger scale map. The procedure will provide an innovative method to supply the user with accurate and concise interpretations for soil, ecological site, hydrology, and biology.

4. Major Landform Design

A good understanding of local landforms will be required by the team in testing their knowledge of the area and implementing the survey design concepts. The approved terms and definitions used in soil survey are found in section 607, NSH. A list of these terms without their associated definitions are in the SITEFORM User Guide general instructions. Emphasis for each landform is directed towards the terms that best represent a location on a landscape. The progression is from the more general to the most specific parts of the landscape.

As part of the soil mapping and inventory process, each landform must be looked at from its broadest to its narrowest segment to be meaningful in soil and site placement on repeatable landscapes. An example in implementing this concept may be where a hill or mountain represents the broad landscape position of interest. More specifically, one map unit component may be on the side slope of a hill or mountain. The exact position on hill or mountain side slopes could be concave midslopes or lower slopes. An example of how the location of this component would read in a map unit or ecological site description would be "occurs on concave midslopes or lower slopes of hill or mountain side slopes."

As part of the field mapping process, a number of observations throughout the area are made by the team, such as broad areas of unique and repeatable physiography or contrasting isolated parts, and potential soil and vegetation patterns that occur within certain portions of the landscape. Differences in soil and vegetation are determined by concentrating on the characteristic segments of the landscape. These differences will usually result in different kinds of soils and associated ecological sites that can be placed on unique parts of the broad landscape. Physiographic position information will be an integral part of the map unit description and ecological site description. Riparian-wetland areas also have distinct soil and vegetation patterns associated with each segment of landscape. They reflect the various hydrologic relationships that influence the soils and vegetation. Hydrologic relationships such as flooding, ponding, and water table are affected by the position of the landscape. Stream gradient, sinuosity, width-depth ratios, etc., along with the position on the landscape, will also affect the soil, water, and vegetation relationships.

In map unit design, soil and vegetation patterns and landscape relationships are the key elements used in the mapping process. It provides the means to predict soils, ecological sites, and hydrology for accurate delineation of the area and assignment of soil map unit symbols. By knowing the map unit symbol for a delineation, users can take the descriptions to the field, place themselves on a segment of the landscape and confidently know the soil and ecological site for that specific segment.

The concept of locating oneself, a kind of soil, and ecological site on the landscape within a map unit delineation is extremely important in the application of interpretive information and management decisions.

5. Test Map Sample Areas

Looking at several different landscapes, the team uses the concepts provided in survey design to develop and agree on several proposed map units. In order to test their predictions, the team selects several test areas to determine the validity and repeatability of proposed map units in characteristic landscapes per section 602.01-6(a), NSH.

Predelineation of potential map units on one or more field sheets used in mapping will help the team in identifying potential test areas. This is accomplished by photo interpretation of stereoscopic field sheets. Photo interpretation aids in delineating areas of like landscapes and patterns prior to field testing. The predelineated field sheets and proposed map unit information are taken to the field by the team and several similar delineations are selected for testing. Each of the sample areas selected must contain map units that represent sets of soil properties and ecological sites that can be evaluated against the objectives of the soil survey.

Likewise, SWAs can be predelineated based on administrative boundaries and present vegetation differences that are observable from photo interpretation. SWA delineation and documentation are tested against vegetation information and interpretation needs identified in the inventory plan.

- Testing. Areas selected for testing are mapped in greater detail than normal mapping in order to determine the nature of the component soil taxa, vegetation, and hydrologic influence in relation to their pattern of occurrence and their size and shape. Combinations of soil, landscape, and hydrologic characteristics that will affect soil or vegetation behavior for various uses are outlined and evaluated.

  Sample areas are mapped by the same methods used in normal mapping. The following are checked:

  - Predictive value of the soil-vegetation-hydrologic-landscape features;

  - Internal properties of soil on either side of evident natural boundaries to determine if they differ significantly;

  - Slope gradient and shape, vegetation, and physiographic position relative to the surrounding soils to determine if they are reliable criteria for predicting the kind of soil;

  - Complexity of soil pattern (by detailed examination);

  - Soil and vegetation composition of mappable delineations of map units and SWAs (by transect); and

  - Degree to which limits established for concepts of map units can furnish soil-vegetation-hydrology data needed to develop resource interpretations to meet the needs.

Map units that meet these tests are described and form the first draft of the soil survey area descriptive legend.

- Documentation. Testing of actual map units under field conditions also includes obtaining necessary documentation to support the original or modified concepts. Documentation provides validity to field application. This is accomplished through verification of the patterns observed. Documentation is the information base to be evaluated in determining the modal concepts of each map unit component used to provide interpretations for use and management decisions.

  Each team member has standards and procedures for documenting baseline information. They also have a responsibility to coordinate and share their data with others to minimize duplication and conflicts. The following provides the documentation and map unit verification requirements by need.

a. Soils

Detailed support documentation is needed to determine location and percent composition of each major map unit soil component and soil inclusion. This includes soil profile descriptions that can be classified in *Soil Taxonomy* and correlated to existing soil series and any other information that affects soil-vegetation-hydrology-biology relationships. The soil scientist obtains support documentation for the subject area from:

- Soil profile description. Using Form SCS-SOI-232 or other similar and accepted forms, data will be collected and recorded that describe the soil's physical and chemical properties. This includes information about the typical location, landscape position, geology, elevation, ambient and soil climate, present vegetation, and any other factors of importance. The site location must be typical and representative for the soil and ecological site. Soil data may be entered into the SCS pedon description program for future retrieval.

- Soil transect data. This is data collected by transect of the map unit delineation on a locally or nationally accepted transect form. Data may also be entered into the SCS transect management field soil survey data base for future evaluation and statistical analysis. Transect data will verify and provide information on the percent composition and physiographic position of each major soil component and inclusion encountered in the map unit. Associated data concerning vegetation, hydrology, and biology may also be incorporated in the final product.

- Soil or map unit field notes. In addition to collection of formal documentation, additional information is collected that does not require time-intensive data gathering procedures. This information is usually collected on accepted field note forms as a result of field observation. The information on field notes is usually unique in nature, but may influence map unit design, soil or vegetation characteristics, interpretation values, etc. The notes are usually referenced by location, map unit, and major or inclusion soil components.

- Other supporting data and information. This is data or information not directly related to the soil map unit verification or field mapping process, but that is important to future management decisions. This may be information on past use, management practices applied, potentials of the area, etc., that are important in supporting the final evaluation of a specific soil or map unit.

b. Vegetation

1) Present vegetation community information is determined by the SWA delineation and supporting documentation. The SWA delineation is the smallest delineation on the inventory map and represents the location of present vegetation by kind, amount, and proportion of species. An SWA is usually an individual soil map unit delineation and is assigned a unique SWA number to distinguish it from other soil map unit delineations of the same designation. However, a soil map unit delineation should be subdivided if bisected by an administrative boundary. A soil map unit may be subdivided if significantly different plant communities or different seral stages occur within the same ecological site within a delineation. Each subdivision of a soil map unit delineation receives its own unique SWA number.

   Plant community attributes are estimated or measured for each ecological site and the soil taxa documented in each SWA. Present vegetation is also documented at each pedon description prepared by the soil scientists.

   Specific procedures for sampling and/or estimating plant community productivity and composition ADW are found in the National Range Handbook and BLM Manual Handbook H-4410-1. BLM technical references TR-4400-4 and TR-1737-3 provide acceptable procedures for collection of additional information that may have been identified in the inventory plan (i.e., cover, frequency, etc.).

   Present vegetation attributes must be documented on BLM Forms 4410-1 and 1a for storage in the Inventory Data System (IDS). Additional considerations include:

   - Documentation must be completed for each component of an SWA. However, many will be so similar that only a new SWA number or other minor changes (i.e., soil map unit, soil taxa, etc.) will be required.

   - Identify and flag communities believed to be in late and/or PNC seral stages for comparison area per notes, H-4410-1.

   - Additional data (e.g., percent cover, frequency, etc.) can be entered in additional columns developed in the *Notes* section or on a separate form. Add the data elements on the PC version of IDS to enter additional data.

- A plant species symbol and a value (i.e., 0) must be entered in the percent composition ADW or production column to enter an SWA in the National IDS System.

- The SCS Range 417 form can be used to calculate double-sampled production data but must be transferred to 4410-1 and 1a forms for IDS entry.

- Other forms - Daubenmire, etc., may be used for sample recording and calculation. This data must be transferred to the 4410-1 and 1a forms for entry at the local level.

- The data can be entered directly on PC IDS/IDSU programs or the completed 4410-1 and 1a forms may be sent to Service Center for data entry.

2) Ecological sites are correlated with soils as map units are designed, tested, and mapped. As part of the test and during the mapping process, the vegetation specialist cooperatively works with the soil scientist to ensure that the map unit design will accommodate the vegetation interpretations required to develop vegetation management objectives identified in the Resource Management Plan. The specialist provides the ecological site name, numbers, typical vegetation, etc., to the soil scientist for each soil component and soil inclusion in the map unit description. Ecological site descriptions, including interpretations, are developed or reviewed and tested as part of the documentation process. In areas where map units are designed and tested for riparian-wetlands, the vegetation interpretations must include documentation to support the potential for site progressions.

   All ecological site descriptions need to be updated, formatted to standard site description format, and entered on the SITEFORM data base. "New" sites that don't seem to fit any existing site concepts are often encountered and descriptions will have to be developed. Adequate documentation is required for description updates as well as new sites.

   Present vegetation support documentation combined with the data from the other disciplines are all necessary documentation for describing an ecological site. Data should reflect significant differences in a site's ability to produce vegetation as the primary criteria that will separate sites. Procedures for site correlation are outlined in Appendix IV. A plant association table is the preferred format for presentation of vegetation data associated with each ecological site in the survey area. When separating ecological sites, the soil, landscape, climate, and/or hydrology supporting documentation need to indicate significant differences to identify and map the site even in the absence of vegetation.

c. Hydrology

Water features associated with riparian-wetland ecological sites have previously been described in six general categories: morphological characteristics, water regimes, associated ground-water systems, watershed characteristics, water chemistry, and special modifiers. Specific information required to describe these characteristics will vary by the type of riparian-wetland area being described (e.g., freshwater systems versus brackish systems). Some items of information identified in the associated water features of the Standard Site Description and SITEFORM program may not always be available, or even needed, to describe some ecological sites.

Collection of most "field" data for describing a site's associated water features needs little explanation. Some data, such as that required to describe watershed characteristics, are taken directly from topographic maps. Other information, such as special modifiers, utilizes qualitative descriptors based on simple observation. Still other data are measured with straightforward procedures that are adequately described in the instructions for SITEFORM (e.g., sinuosity is the ratio of channel length to valley length). Most information for the Rosgen Stream Classification System falls into this latter category. (One exception, stream gradient, will be discussed in detail later in this section.)

Items of "field data" not covered by the previous paragraph require additional discussion. These items generally are associated with the water regime of the site, surface-water/ground-water interactions, and water quality of the system. Field procedures for these subjects must be addressed in detail. Description of a site's water regime requires a knowledge of frequency and duration of inundation at the site. For stream-adjacent systems, frequency and duration of inundation are a function of flow-frequency relations and bankfull channel capacity. Both topics are covered in detail, even though — strictly speaking — frequency analysis may or may not be based on field procedures.

In the best situations, frequency analysis will be based on available streamflow data. In these situations periodic measurements of discharge are used with a continuous record of stage (water level) to generate a continuous record of flow at the site. Unit values of streamflow (i.e., instantaneous values of flow) are summed to yield mean daily values, as well as monthly and annual summaries. Annual extremes (e.g., annual peak flows) are then subjected to frequency analysis to determine flows for a specified return period (e.g., 50-year flood).

Standard procedures for estimating flood frequencies in the United States are presented in Bulletin #17B of the U.S. Water Resources Council, "Guidelines for Determining Flood Flow Frequency," and are summarized briefly below. This procedure requires that the annual series of maximum values from a stream gage be fitted to a log-Pearson Type III distribution. General steps in the procedure are as follows:

1) Convert annual maximum values (x) to logarithms (y).

2) Compute the mean (avg-y), standard deviation (s_y), and skew (G) of the log-transformed values.

3) Determine the frequency factor, K, as a function of the skew and the return period of interest, T. (This is done from a table of K values - Table 1).

4) Apply the frequency equation: $\log x_t = Y_t = (avg\text{-}y) + K (s_y)$

5) Take the antilog of Y_t to get x_t.

The procedure utilizes all annual maximum values provided from the gage, but sets limits for values that are considerably higher or lower than what might be expected for a log-Pearson Type III distribution. Equations are given for detecting high and low outliers that should not be fit to the distribution:

High Outliers: $y_h = (avg\text{-}y) + K_n (s_y)$

Low Outliers: $y_L = (avg\text{-}y) - K_n (s_y)$

where K_n is from a different table than the frequency factor K above (Table 2).

When outliers are detected in the annual series, they are deleted from the data set and the analysis is repeated.

If there is only a small number of values in the annual series (i.e., if the gage has only a very short period of record), the gage record may give a biased estimate of the skew coefficient, G. To correct for bias in the estimate of skew, generalized (regionalized) skew coefficients have been developed for most locations, based on analysis of gaging stations with substantial periods of record. The correct skew coefficient to be used in the frequency analysis is a weighted skew computed from the gage skew with its variance and the regionalized (map) skew with its variance. Bulletin #17B contains details of the calculations.

If the riparian-wetland site of interest is near a stream gage operated by an agency other than the U.S. Geological Survey, there is a good possibility that flood-frequency relations have never been developed for that gaging station. If the station has about 10 years of record or more, the hydrologist may compute flood frequencies with the procedure described in Bulletin No. 17B for return periods up to about twice the length of record. For example, if the gage has 12 years of record, the hydrologist may estimate floods up to the 25-year event. If the gage has substantially less than 10 years of record, flood frequencies computed with the above procedure should be checked against other estimates for flood frequency in the area (see below).

Where USGS stream gages with more than 10 years of record are present, a flood-frequency analysis likely has already been done. Usually, USGS will publish the results of such an analysis in a "statistical summaries of streamflow data" report for a state or a portion of a state. If the data are not published, the hydrologist can request such a flood-frequency analysis for a nominal charge (frequently for free), and USGS will forward a printout of results to the person originating the request. Flood-frequency estimates from USGS gaging stations may be *carefully* transferred to ungaged sites. This assumes that the gaged and ungaged sites have similar climatic and physiographic characteristics, the drainage areas of the gaged and ungaged sites are similar, and flood estimates are prorated by drainage area when transferring from the gaged site to the ungaged site.

Recurrence Interval in Years											
Skew Coeff.	**1.0101**	**1.0526**	**1.1111**	**1.2500**	**2**	**5**	**10**	**25**	**50**	**100**	**200**
Exceedance Probability											
G	**.99**	**.95**	**.90**	**.80**	**.50**	**.20**	**.10**	**.04**	**.02**	**.01**	**.05**
Positive Skew											
3.0	-0.667	-0.665	-0.660	-0.636	-0.396	0.420	1.180	2.278	3.152	4.051	4.970
2.9	-0.690	-0.688	-0.681	-0.651	-0.390	0.440	1.195	2.277	3.134	4.013	4.909
2.8	-0.714	-0.711	-0.702	-0.666	-0.384	0.460	1.210	2.275	3.114	3.973	4.847
2.7	-0.740	-0.736	-0.724	-0.681	-0.376	0.479	1.224	2.272	3.093	3.932	4.783
2.6	-0.769	-0.762	-0.747	-0.696	-0.368	0.499	1.238	2.267	3.071	3.889	4.718
2.5	-0.799	-0.790	-0.771	-0.711	-0.360	0.518	1.250	2.262	3.048	3.845	4.652
2.4	-0.832	-0.819	-0.795	-0.725	-0.351	0.537	1.262	2.256	3.023	3.800	4.584
2.3	-0.867	-0.850	-0.819	-0.739	-0.341	0.555	1.274	2.248	2.997	3.753	4.515
2.2	-0.905	-0.882	-0.844	-0.752	-0.330	0.574	1.284	2.240	2.970	3.705	4.444
2.1	-0.946	-0.914	-0.869	-0.765	-0.319	0.592	1.294	2.230	2.942	3.656	4.372
2.0	-0.990	-0.949	-0.895	-0.777	-0.307	0.609	1.302	2.219	2.912	3.605	4.298
1.9	-1.037	-0.984	-0.920	-0.788	-0.294	0.627	1.310	2.207	2.881	3.553	4.223
1.8	-1.087	-1.020	-0.945	-0.799	-0.282	0.643	1.218	2.193	2.848	3.499	4.147
1.7	-1.140	-1.056	-0.970	-0.808	-0.268	0.660	1.324	2.179	2.815	3.444	4.069
1.6	-1.197	-1.093	-0.994	-0.817	-0.254	0.675	1.329	2.163	2.780	3.388	3.990
1.5	-1.256	-1.131	-1.018	-0.825	-0.240	0.690	1.333	2.146	2.743	3.330	3.910
1.4	-1.318	-1.168	-1.041	-0.832	-0.225	0.705	1.337	2.128	2.706	3.271	3.828
1.3	-1.383	-1.206	-1.064	-0.838	-0.210	0.719	1.339	2.108	2.666	3.211	3.745
1.2	-1.449	-1.243	-1.086	-0.844	-0.195	0.732	1.340	2.087	2.626	3.149	3.661
1.1	-1.518	-1.280	-1.107	-0.848	-0.180	0.745	1.341	2.066	2.585	3.087	3.575
1.0	-1.588	-1.317	-1.128	-0.852	-0.164	0.758	1.340	2.043	2.542	3.022	3.489
.9	-1.660	-1.353	-1.147	-0.854	-0.148	0.769	1.339	2.018	2.498	2.957	3.401
.8	-1.733	-1.388	-1.166	-0.856	-0.132	0.780	1.336	1.993	2.453	2.891	3.312
.7	-1.806	-1.423	-1.183	-0.857	-0.116	0.790	1.333	1.967	2.407	2.824	3.223
.6	-1.880	-1.458	-1.200	-0.857	-0.099	0.800	1.328	1.939	2.359	2.755	3.132
.5	-1.955	-1.491	-1.216	-0.856	-0.083	0.808	1.323	1.910	2.311	2.686	3.041
.4	-2.029	-1.524	-1.231	-0.855	-0.066	0.816	1.317	1.880	2.261	2.615	2.949
.3	-2.104	-1.555	-1.245	-0.853	-0.050	0.824	1.309	1.849	2.211	2.544	2.856
.2	-2.178	-1.586	-1.258	-0.850	-0.033	0.830	1.301	1.818	2.159	2.472	2.763
.1	-2.252	-1.616	-1.270	-0.846	-0.017	0.836	1.292	1.785	2.107	2.400	2.670
.0	-2.326	-1.645	-1.282	-0.842	0	0.842	1.282	1.751	2.054	2.326	2.576
Negative Skew											
- .1	-2.400	-1.673	-1.292	-0.836	0.017	0.846	1.270	1.716	2.000	2.252	2.482
- .2	-2.472	-1.700	-1.301	-0.830	0.033	0.850	1.258	1.680	1.945	2.178	2.388
- .3	-2.544	-1.726	-1.309	-0.824	0.050	0.853	1.245	1.643	1.890	2.104	2.294
- .4	-2.615	-1.750	-1.317	-0.816	0.066	0.855	1.231	1.606	1.834	2.029	2.201
- .5	-2.686	-1.774	-1.323	-0.808	0.083	0.856	1.216	1.567	1.777	1.955	2.108
- .6	-2.755	-1.797	-1.328	-0.800	0.099	0.857	1.200	1.528	1.720	1.880	2.016
- .7	-2.824	-1.819	-1.333	-0.790	0.116	0.857	1.183	1.488	1.663	1.806	1.926
- .8	-2.891	-1.839	-1.336	-0.780	0.132	0.856	1.166	1.448	1.606	1.733	1.837
- .9	-2.957	-1.858	-1.339	-0.769	0.148	0.854	1.147	1.407	1.549	1.660	1.749
-1.0	-3.022	-1.877	-1.340	-0.758	0.164	0.852	1.128	1.366	1.492	1.588	1.664
-1.1	-3.087	-1.894	-1.341	-0.745	0.180	0.848	1.107	1.324	1.435	1.518	1.581
-1.2	-3.149	-1.910	-1.340	-0.732	0.195	0.844	1.086	1.282	1.379	1.449	1.501
-1.3	-3.211	-1.925	-1.339	-0.719	0.210	0.838	1.064	1.240	1.324	1.383	1.424
-1.4	-3.271	-1.938	-1.337	-0.705	0.225	0.832	1.041	1.198	1.270	1.318	1.351
-1.5	-3.330	-1.951	-1.333	-0.690	0.240	0.825	1.018	1.157	1.217	1.256	1.282
-1.6	-3.388	-1.962	-1.329	-0.675	0.254	0.817	0.994	1.116	1.166	1.197	1.216
-1.7	-3.444	-1.972	-1.324	-0.660	0.268	0.808	0.970	1.075	1.116	1.140	1.155
-1.8	-3.499	-1.981	-1.318	-0.643	0.282	0.799	0.945	1.035	1.069	1.087	1.097
-1.9	-3.553	-1.989	-1.310	-0.627	0.294	0.788	0.920	0.996	1.023	1.037	1.044
-2.0	-3.605	-1.996	-1.302	-0.609	0.307	0.777	0.895	0.959	0.980	0.990	0.995
-2.1	-3.656	-2.001	-1.294	-0.592	0.319	0.765	0.869	0.923	0.939	0.946	0.949
-2.2	-3.705	-2.006	-1.284	-0.574	0.330	0.752	0.844	0.888	0.900	0.905	0.907
-2.3	-3.753	-2.009	-1.274	-0.555	0.341	0.739	0.819	0.855	0.864	0.867	0.869
-2.4	-3.800	-2.011	-1.262	-0.537	0.351	0.725	0.795	0.823	0.830	0.832	0.833
-2.5	-3.845	-2.012	-1.250	-0.518	0.360	0.711	0.771	0.793	0.798	0.799	0.800
-2.6	-3.889	-2.013	-1.238	-0.499	0.368	0.696	0.747	0.764	0.768	0.769	0.769
-2.7	-3.932	-2.012	-1.224	-0.479	0.376	0.681	0.724	0.738	0.740	0.740	0.741
-2.8	-3.973	-2.010	-1.210	-0.460	0.384	0.666	0.702	0.712	0.714	0.714	0.714
-2.9	-4.013	-2.007	-1.195	-0.440	0.390	0.651	0.681	0.683	0.689	0.690	0.690
-3.0	-4.051	-2.003	-1.180	-0.420	0.396	0.636	0.660	0.666	0.666	0.667	0.667

Table 1. *K values for Pearson Type III distribution. After Water Resources Council, Bulletin No. 15 (13).*

Sample Size	K Value	Sample Size	K Value	Sample Size	K Value	Sample Size	K Value
10	2.036	45	2.727	80	2.940	115	3.064
11	2.088	46	2.736	81	2.945	116	3.067
12	2.134	47	2.744	82	2.949	117	3.070
13	2.175	48	2.753	83	2.953	118	3.073
14	2.213	49	2.760	84	2.957	119	3.075
15	2.247	50	2.768	85	2.961	120	3.078
16	2.279	51	2.775	86	2.966	121	3.081
17	2.309	52	2.783	87	2.970	122	3.083
18	2.335	53	2.790	88	2.973	123	3.086
19	2.361	54	2.798	89	2.977	124	3.089
20	2.385	55	2.804	90	2.981	125	3.092
21	2.408	56	2.811	91	2.984	126	3.095
22	2.429	57	2.818	92	2.989	127	3.097
23	2.448	58	2.824	93	2.993	128	3.100
24	2.467	59	2.831	94	2.996	129	3.102
25	2.486	60	2.837	95	3.000	130	3.104
26	2.502	61	2.842	96	3.003	131	3.107
27	2.519	62	2.849	97	3.006	132	3,109
28	2.534	63	2.854	98	3.011	133	3.112
29	2.549	64	2.860	99	3.014	134	3.114
30	2.563	65	2.866	100	3.017	135	3.116
31	2.577	66	2.871	101	3.021	136	3.119
32	2.591	67	2.877	102	3.024	137	3.122
33	2.604	68	2.883	103	3.027	138	3.124
34	2.616	69	2.888	104	3.030	139	3.126
35	2.628	70	2.893	105	3.033	140	3.129
36	2.639	71	2.897	106	3.037	141	3.131
37	2.650	72	2.903	107	3.040	142	3.133
38	2.661	73	2.908	108	3.043	143	3.135
39	2.671	74	2.912	109	3.046	144	3.138
40	2.682	75	2.917	110	3.049	145	3.140
41	2.692	76	2.922	111	3.052	146	3.142
42	2.700	77	2.927	112	3.055	147	3.144
43	2.710	78	2.931	113	3.058	148	3.146
44	2.719	79	2.935	114	3.061	149	3.148

Table 2. *Outlier test K values. This table contains one sided 10 percent significance level K values for a normal distribution (38). Tests conducted to select the outlier detection procedures used in this report indicate these K values are applicable to log-Pearson Type III distributions over the tested range of skew values.*

In many states, flood-frequency estimates for USGS gaging stations have been correlated with certain climatic and basin characteristics. The result is a set of regression equations thatmay be used to estimate flood magnitude for various return periods in ungaged basins. Frequently the user needs only limited information (e.g., mean annual precipitation and drainage area) in order to calculate flood magnitudes at a site. While easy to use, these equations usually have a large standard error of the estimate.

Similarly, in many locations, flood-frequency estimates from USGS gaging stations have been correlated with certain channel-geometry characteristics. These correlations produce a set of regression equations relating some channel feature, usually active-channel width, to flood magnitudes for various return periods. Again, standard errors of the estimate are usually large.

Flood-frequency estimates also may be generated using precipitation data and watershed runoff models. The precipitation record for various return-period storm events is input to the watershed model to generate a runoff hydrograph and peak flow for that event. The modeled rainfall may be from historical data or from an assumed time distribution of precipitation (e.g., a 2-year, 24-hour rainfall event). This method of generating flood-frequency estimates assumes the return period of the runoff event equals the return period of the precipitation event (e.g., a 2-year rainfall event will generate a 2-year peak flow). The validity of this assumption depends on antecedent moisture conditions, basin size, and a number of other factors. Also, because many watershed models were developed for engineering design purposes, they may overestimate flood magnitude for a given return-period storm.

Regardless of the procedure or source of information chosen for obtaining flood-frequency information, flood estimates for the 1.25-, 2-, 5-, 10-, 25-, and (record permitting) 50- and 100-year flood events need to be plotted on standard log-probability paper and a smooth curve drawn between the points. The plot becomes the flood-frequency relation for the riparian-wetland site under investigation. It provides background information for evaluating bankfull discharge and frequency of inundation of vegetation communities along the channel.

Once the flood-frequency relations have been estimated for a channel, bankfull discharge is determined from a field survey of the channel cross-section and water-surface slope and application of Manning's equation. In its simplest form, Manning's equation for discharge is given by:

$$Q = (k/n)\ A\ R^{2/3}\ S^{1/2}$$

where Q= discharge in m^3/sec or ft^3/sec,
k = 1 for metric units and 1.49 for English units,
n = Manning's roughness (resistance) coefficient,
A= cross-sectional area of flow,
R= hydraulic radius (approximately equal to mean depth), and
S = energy slope (taken to be the water-surface slope).

Figure 6 depicts the variables contained in Manning's equation.

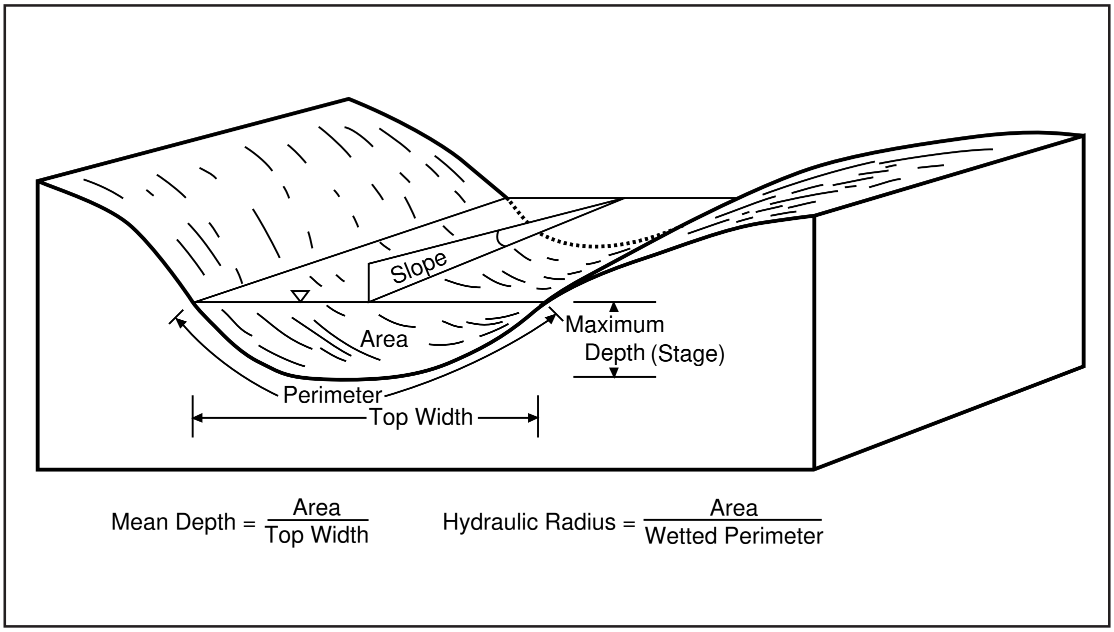


Figure 6. *Definition diagram for hydraulic parameters.*

It is important to point out the assumptions of Manning's equation so that surveyed cross sections may be properly located in the field. Manning's equation assumes a condition referred to as uniform flow, where pathlines of flow are parallel to each other and the streambed, and the energy slope, water-surface slope, and bed slope are parallel to each other. While perfectly uniform flow does not occur in natural channels, the condition is approached in sections of stream where the width, depth, shape, and cross-sectional area of the channel is relatively constant. Channel bends should be avoided. The equation also assumes channel control as opposed to section control, i.e., the point of zero flow is the lowest point on the cross section and not a result of backwater from some higher point downstream. Where backwater does occur (i.e., water level controlled by a downstream cross section), a standard-step water-surface profile model (e.g., HEC2) is more appropriate for estimating water surface elevation at a given cross section and flow rate.

Basic data required for application of Manning's equation are a surveyed channel cross section and the water-surface slope. The cross section is established perpendicular to the channel, and the points across the section are surveyed relative to a known or arbitrarily established benchmark elevation. Distance/elevation paired data associated with each point on the section may be obtained either by sag-tape or rod-and-level survey. Intricacies of correct survey procedures are beyond the scope of this document. For details of the sag-tape procedure, the reader is referred to Ray and Megahan (1979). Benson and Dalrymple (1967) present an excellent overview of rod-and-level survey procedures, including guidance on equipment, field notes, and vertical and horizontal control.

Information on water-surface slope also is required for analysis with the Manning equation. Survey of water-surface slope is somewhat more complicated than the cross-section survey in that slope of the individual channel unit at the location of the section (e.g., pool, run, or riffle) must be distinguished from the more constant slope of the entire reach. Water-surface slope in individual channel units may change significantly with changes in stage and discharge (Figure 7), while slope of the entire reach will remain essentially unchanged. Thus, at low flow, slope of the individual channel unit will have a strong influence on the depth-discharge relationship, while at high water, average slope of the reach will control the depth-discharge relationship. This is an important distinction to make when water-surface slopes are surveyed in the field. Low-water slopes may be approximated by change in elevation over the individual channel unit where the cross section is located (usually 1 to 5 channel widths in length). High-water slope is obtained by measuring change in elevation over a much longer reach of channel (usually at least 15 to 20 channel widths in length).

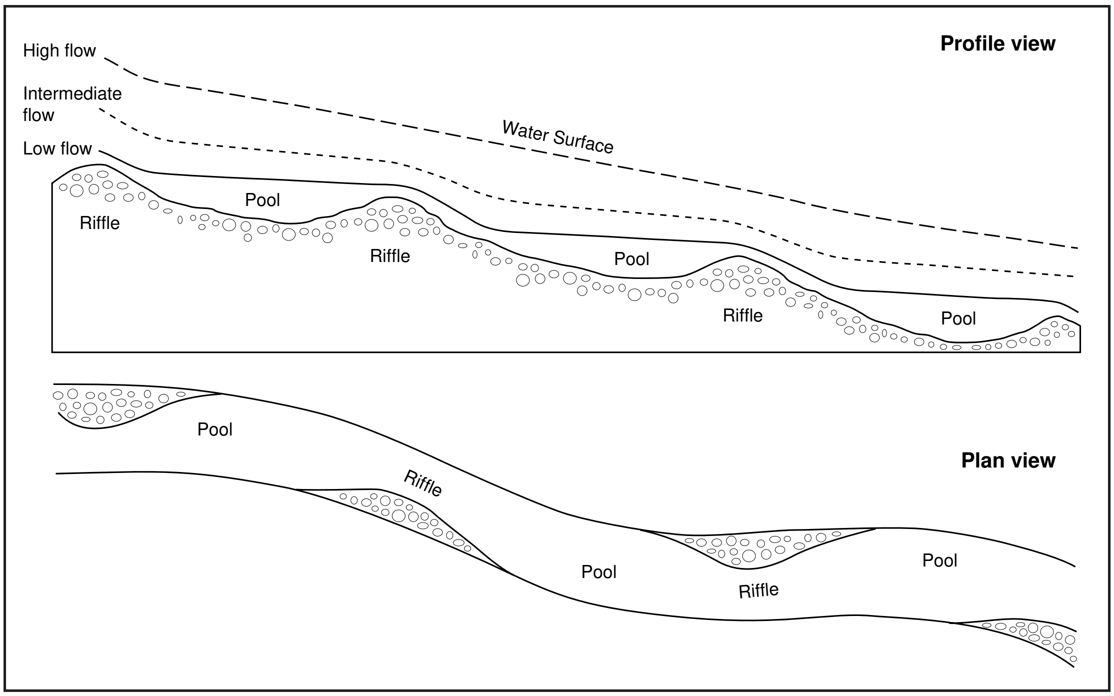


Figure 7. *Diagram of longitudinal profile and plan view of a pool-riffle sequience. Water surface profiles in upper figure represent high, intermediate, and low flow conditions.*

Application of the Manning equation to estimate bankfull flow requires one additional item of information, i.e., the roughness coefficient. Manning's roughness coefficient is an empirically derived coefficient related to energy losses from turbulence and friction and may be thought of as resistance to flow at the channel boundary. The roughness coefficient may be estimated by one of three methods. The direct solution method entails measuring stream discharge and the other variables in the Manning equation and solving directly for the value of n. The second method for estimating the roughness coefficient at a cross section involves comparing the reach to a similar, measured reach for which Manning's n has already been computed. Theoretically, this is done by comparing the reach with either a table of values or photographs of other natural channels. Practically, most experienced hydrologists estimate the channel roughness coefficient from experience, and the tables and photographs are never even consulted. However, unless the hydrologist has extensive experience analyzing channel cross sections using direct methods and water-surface-profile models, the tables and photographs are consulted to ensure a reasonable estimate of n. The third method of estimating roughness uses empirical formulas relating n to other hydraulic parameters. Frequently, these formulas make use of some variable relating depth of flow to largest particles in the bed.

It is important to remember that channel resistance to flow from roughness at the channel boundary will not be constant at all flow levels. Most authors have found that Manning's roughness coefficient decreases with increasing streamflow, up to bankfull stage. Above bankfull, roughness may tend to increase with flow as cross sections further downstream and over bank areas begin to influence the water surface elevation. Also, because of changes in roughness with changes in flow, it may be necessary to analyze divided channels and overbank areas separately, as each area may exhibit a different range in n-values. Most open-channel flow software allows the user to enter roughness values independently for overbank areas and the main channel, and some programs will allow the user to vary the roughness with stage.

Once the channel has been surveyed and the water-surface slope and roughness coefficient have been estimated, Manning's equation may be solved for the bankfull discharge. Comparison of bankfull flow with flood-frequency determinations described earlier allows the hydrologist to estimate frequency of flooding of stream-adjacent areas with their various vegetation communities. As vegetation communities change composition with distance above and away from the channel, changes in frequency of flooding may be related to changes in species composition.

The description of water regime for nonstream wetlands generally is much less involved. For marine and brackish-water systems, elevation of the riparian-wetland site is determined by survey and compared to tidal information for the area of interest. Similarly, in riparian-wetland areas associated with freshwater impoundments, elevation of the site is related to pool elevations identified in the operations plan and/or experienced historically from the project. Wetland communities associated with playa lakes would be related to frequency of runoff to the lakes as determined by statistical analyses of climate data and rainfall-runoff relationships and models. For most other freshwater riparian-wetland areas, the water regime is either dominated by streamflow or local ground-water flow systems (see below).

Field procedures for data elements describing ground water associated with riparian-wetland sites require additional discussion. The extent of the ground-water flow system (local, intermediate, or regional) will influence the persistence and reliability of subsurface water at the site. Field measurements of ground-water temperature and chemistry (discussed later in this section) may provide information that will help determine the extent of the flow system. Also, the nature of ground-water discharge as lateral or discrete will have a direct influence on the spatial distribution of vegetation at a site. Finally, identification of ground-water discharge to or recharge from a stream or other surface-water body may help determine dependency of riparian-wetland vegetation on surface water in the area.

The importance of documenting interactions between the SWA and the local water table cannot be overemphasized for developing accurate site interpretations. This means that, wherever possible, field measurements of the water table needs to be obtained, and the water table mapped along with vegetation at the site. Few areas will have sufficient existing information or wells for mapping the water table, so it may be necessary to install well points in selected SWAs. Installed well points should be surveyed for vertical and horizontal control, and water levels should be measured at least seasonally to document the relationship between the water table and local expressions of surface water in the area.

Channels may gain or lose water depending on their position above or below the water table. Figure 8C illustrates how the water table may change seasonally and thus influence streamflow in a nearby channel. Figure 8C is typical of many riparian-wetland sites and illustrates an important hydrologic function of such sites. The conditions depicted in Figure 8 may change within short distances and might not be identified with the limited data provided by well points. In such cases, seepage runs conducted at different times of year may be used to determine if the stream is gaining from or losing to the local water table.

A seepage run consists of measurements of discharge along intervals of a channel reach to identify small gains and losses of streamflow that may help to interpret the system. Occasionally stream temperature and conductivity also are measured to help interpret the data. As illustrated in Figure 8, the results of a seepage run may change seasonally or in extended periods of drought or above-average precipitation. Thus, it may be necessary to repeat the seepage run at different water levels to identify temporal variation.

Because seepage runs are intended to detect small (often very small) changes in streamflow, it is extremely important to use properly functioning discharge-measuring equipment and correct standard procedures. It is counterproductive to conduct seepage runs when water levels are fluctuating rapidly.

Standard current meters should be used and should be calibrated regularly and checked (e.g., spin tests) before and after each measurement. Placement of verticals for the cross-section measurement should make use of variable spacing in an attempt to include no more than 5 percent of the flow in any single vertical. Velocity in each vertical should be measured at the correct depth (either 0.6-depth or 0.2- and 0.8-depth, depending on total depth in the vertical) to obtain an accurate estimate of mean velocity. Meter limitations relative to depth, velocity, and proximity to vertical barriers must be observed, and vertical and horizontal angle coefficients used wherever applicable. While the intricacies of correct discharge-measurement techniques are beyond the scope of this document, the reader is referred to Buchanan and Somers (1969), and Rantz and others (1982) for an in-depth treatment of standard USGS procedures. Also, Smoot and Novak (1968) present procedures for calibration and maintenance of current meters to ensure accurate measurement of velocity and discharge. When equipment is functioning properly and standard procedures are followed correctly, it is possible to measure streamflow to within 5 percent of the true value.

Field measurements of water quality also provide useful information for describing ecological sites associated with riparian-wetland areas. In some situations the quality of water in the stream or adjacent floodplain alluvium may directly influence vegetation present along the channel margin. Trace elements such as selenium may only be detected by direct sampling for the chemical of interest, while heavy metal pollution associated with mine drainage may be obvious from the color and pH of the stream.

Field measurements of water quality also are useful for defining surface-water/ground-water relationships. For example, water quality may help distinguish

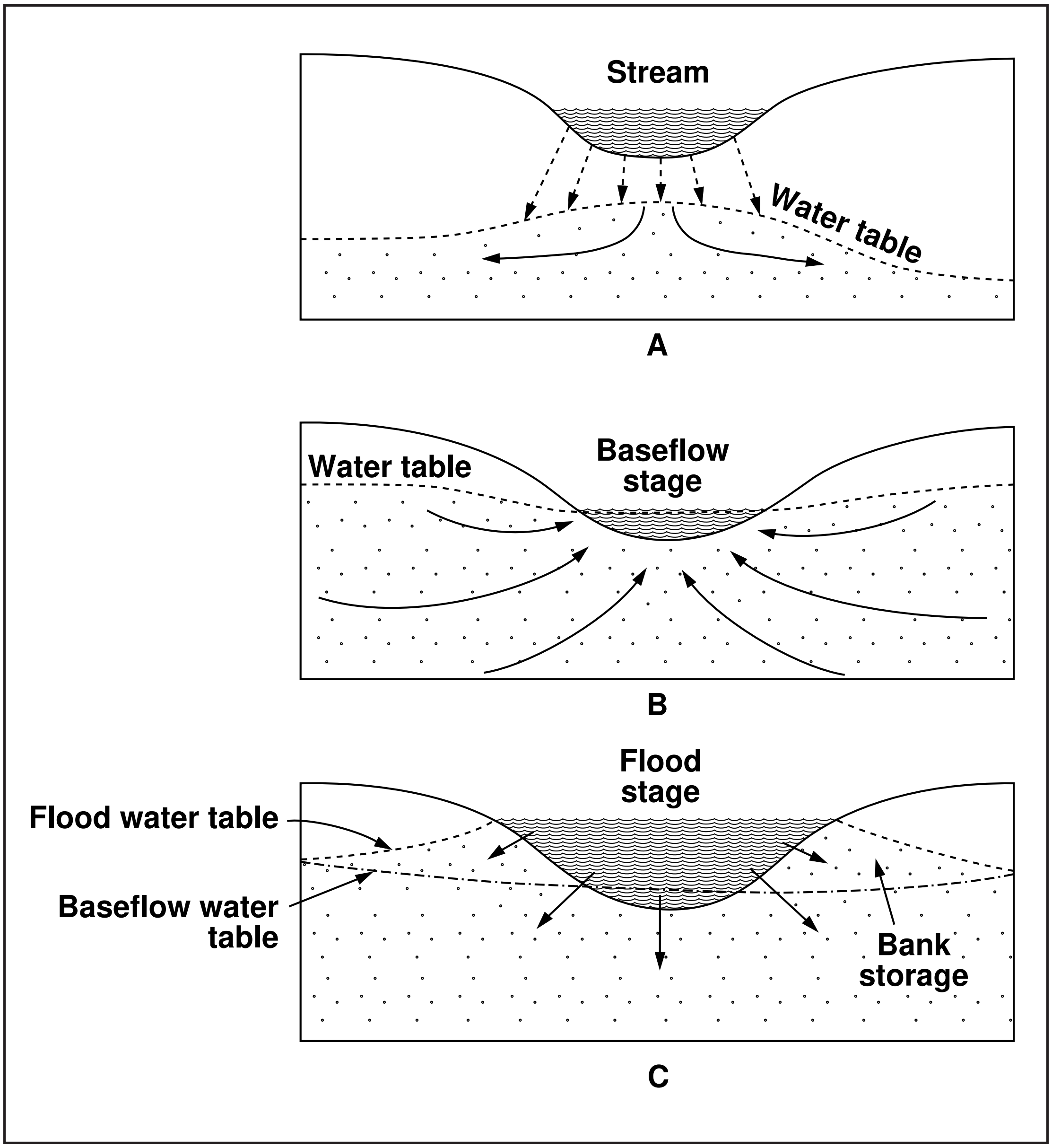


Figure 8. *Cross sections of gaining and losing streams. A. A losing stream; B. A gaining stream; C. A stream which is gaining during low flow periods but which may temporarily become a losing stream during flood stage.*

between ground-water discharge from deep regional flow systems and discharge from shallow, more local flow systems. Water from deep regional systems frequently is warmer than mean annual air temperature at the point of discharge, while ground water in local flow systems frequently discharges at or near mean annual air temperature. Similarly, ground water in deep regional systems frequently is more saturated with sulfate than bicarbonate, while the reverse is usually the case in local flow systems. Also, in permafrost regions, the dissolved-solids content of ground-water discharge in areas of aufeis accumulation may be indicative of the source of the ground water, i.e., whether it comes from aquifers below or above the permafrost layer.

For field parameters such as pH, alkalinity, specific conductance, and dissolved oxygen, the investigator needs to become familiar with the manuals and operating instructions that accompany probes and instruments to be used. Also, dissolved oxygen, conductivity, and pH meters should be calibrated against known standard solutions daily or before each measurement, if there is significant travel between measurement sites. For parameters to be analyzed in the laboratory, the sampling technique must ensure a representative sample and must include procedures for sample preservation and transportation that will depend on the chosen analytical procedure; these should be coordinated with the lab.

Results of laboratory analyses are usually presented in milligrams or micrograms per liter. Interpretation of the data is facilitated by converting all values to milliequivalents per liter, using conversion factors available in standard texts (Hem, 1985), and presenting the results in any of a variety of graphical displays (e.g., stiff diagrams, vector diagrams, histograms, or pie charts). Analysis of specific ions and ion ratios may reveal much about the geology of the aquifer and associated ground-water flow system. Similarly, analysis of certain isotopes may provide useful information regarding location of possible recharge areas. Mass-balance calculations for conservative elements may also quantify ground-water contributions to streamflow. The additional information gained from such water quality analyses will assist greatly in developing a complete understanding of the ground-water system associated with a site.

Information requirements for water features associated with riparian-wetland ecological sites are extensive, and much of the information ordinarily will not be available. While it is not critical to obtain all information allowed by SITEFORM for associated water features, it is extremely important to gain as much understanding as possible of relationships between the vegetation community, site characteristics, and hydrologic conditions associated with a site. The quality of the site description and management interpretations for any riparian-wetland ecological site will be strongly dependent on the amount of information provided on surface water, ground water, and water quality conditions associated with the site.

d. Biology

The biologist function is to support other team members in data collection and gather additional data about wildlife using ecological site components of a map unit to complete all or part of their life cycle. Documentation will be collected on vegetation structure and function of present and potential communities as they apply to wildlife species using the site. Particular attention will be given to wildlife occurrence relative to landscape, soil taxa, present vegetation communities, season of use, and proximity to water.

When species lists are not available for a particular ecosystems, they can be generated in a variety of ways. For terrestrial species, an excellent source is "Inventory and Monitoring of Wildlife Habitat," by Cooperrider, et al., 1986. This book has a section, titled "species groups," which contains 13 chapters that range from songbirds to ungulates. Within each chapter, there is a subcategory, titled "population measurement techniques," which gives various methods to determine species present for that wildlife group.

For example, in the songbird subcategory of "population measurements techniques," the following techniques are listed to determine what species may be present:

Winter Bird Counts
Spot-Mapping Census
Transect Methods
Breeding Bird Surveys
Point Count Method
Winter Transects
Variable-Circular Plots
Mark and Recapture Methods
Nest Monitoring

For ungulates, this subcategory contains the following:

Presence/Absence
Density/Abundance
Condition Indexes
Population Structure/Productivity

For each technique listed, the chapter usually provides a discussion of who developed it, who is using it, and the benefits, values, and weaknesses of the procedure. It also gives additional references for the various techniques.

For aquatic species "Inventory and Monitoring of Wildlife Habitat" can be used, as well as "Fishery Techniques" (Nielson & Johnson, 1983) and "Field Methods and Statistical Analyses for Monitoring Small Salmonid Streams" (Armor et al., 1983). The various techniques discussed include, but are not limited to, seining, electrofishing, toxicants, and hook-and-line. Additional references for the various techniques are also listed.

There are many other documents on terrestrial and aquatic species that provide techniques to collect species information. Additional techniques may be acquired from state fish and game agencies, universities, and/or professional society organizations. Any one of them may be used because how the information is collected is not that important (there is no one standard). Rather, the important thing is to determine what species exist, have existed, or have potential to exist, in the various ecosystems, and what the habitat requirements are for that species. If that is done, it will ensure that the map unit design is appropriate to guarantee that wildlife habitat vegetation components are recognized and wildlife interpretation needs are met.

6. Provisional Map Units

Valid and viable map units are the results of testing and documentation. These products are used to initiate the field mapping process.

At this stage, these products are now considered to be provisional in that the map units meet the tests, are described, and form part of the first draft of the soil survey area descriptive legend. This first draft is reviewed and approved by the state soil scientist or appropriate supervisor of the lead agency during the initial review per section 602.01-6(c), NSH. These map units are the core starting point, and any additional provisional map units may be proposed at any time during the survey by soil survey party members in cooperation with the team. The new map units are also described and tested to determine if there is justification for adding the unit to the legend. The map unit description and information to justify adding it to the legend are sent to the appropriate supervisory soil scientist along with the request for approval. If the unit is valid, it is approved by the appropriate supervisor during the course of the survey.

The soil survey project leader has the responsibility to develop and maintain certain items as part of any ongoing soil survey. These include decisions and support documentation that involve all or parts of map units. Complete records are kept on the use of all provisional map units. Recorded information includes:

- Acres mapped
- Exact locations where mapped
- Results of field studies
- Results of testing
- Records of soil behavior
- Records of interpretative data
- Records of ecological site assignment
- Map symbols
- Map symbols correlation and/or adjustment

7. Descriptive Legend

A descriptive legend, unique to each soil survey area, is required for all soil surveys per section 602.01-7, NSH. This legend contains information about each of the soils, map units, and symbols used by the team during the survey process. The descriptive legend is the basic document that governs how every soil survey is conducted. The soil survey project leader is responsible for developing and updating this document. Assistance in maintaining this document is provided by the soil survey party members and the team members. The descriptive legend is composed of the following parts:

- Description and classification of the soils. This is required for all soil taxons and map units in the soil survey area. These documents provide the detailed technical information necessary to identify soils and map units as they occur in the landscape. The table of soil classification is an alphabetical listing by soil series or higher level and its soil taxonomic classification. Representative soil profile descriptions and their range of soil characteristics are provided for each soil taxon identified in the soil survey area. The map unit description will provide additional information about the makeup of the map unit delineated, setting, inclusions, soils properties, and relevant soil and vegetation interpretations involving use and management. The project leader is responsible for preparation. For further details see section 602.01-7(a), NSH.

- Identification legend. This is required for all map units in which occurrence and justification were established during test mapping and agreed to during the review process. It is a tabular list of map unit symbols and associated map unit names. Map units are listed in alphabetical order of the series name and sequence based on soil taxon phases, complexes, associations, or undifferentiated groups. All map units must also have a narrative description before they can be approved and included as part of the legend. A working legend for field mapping, in addition to the above, may also contain a listing, by order of occurrence, of the soil component name, phase, percent composition, associated ecological site, and inclusions for each map unit.

  As each map unit is approved, the map unit symbol and map unit name are entered on Form SCS-SOI-6 for ease of tracking map units and recording changes. These forms can be used to obtain computer printouts of the ID legend for the area and correlation documents. See section 602.01-7(b), NSH for more detailed information concerning the identification legend.

- Conventional and special symbols legend. This legend is required for all survey areas. It consists of a list of conventional symbols to identify manmade works and structures, boundaries, and drainages. An additional part may include special symbols to identify areas of soil and vegetation, special features, or kinds of miscellaneous areas that are too small to be delineated at the scale of mapping.

  The conventional and special symbols legend is prepared by the project leader for inclusion in field review reports and use by the field party during the mapping process. Allowable symbols are noted on Form SCS-SOI-37A. Symbols being used by the field party are usually underlined. A more detailed review of the symbols legend may be found per section 602.01-7(c), NSH.

8. Provisional General Soil and Vegetation Map

   A provisional general soil map is prepared by the project leader and a vegetation map is prepared by the vegetation specialist during preliminary field study. The two maps should coincide using the same general delineation because the soil and vegetation relationships used in detailed mapping also apply to a more general map base. These maps serve as a guide to the team during the initial stages of the survey. Provisional maps are refined as map unit and vegetation concepts are clarified and boundaries are confirmed after each year's field work. Precise soil and vegetation association boundaries are located on the provisional maps in the area recently mapped. By the end of the survey, the general soil and vegetation maps are complete and no longer considered provisional.

9. Field Mapping Process and Application

   The prior parts of this technical reference, when put into place, have prepared the team for implementation of actual progressive field mapping. The team members have developed consistency in concepts and a solid understanding of the other disciplines' responsibilities.

   All parts applicable to field mapping procedures are covered earlier in this technical reference. The process has been condensed into a basic step-by-step list for use by the team as follows:

   - Identify the area(s) to be mapped.
   - Predelineate field sheets.
   - Field check delineations.
   - Design or identify a map unit, including:
     - major landscapes and landscape components;
     - soil components up to a maximum of three;
     - associated ecological sites for each soil component;
     - all soil and ecological site inclusions in the map unit up to a maximum total of 15 percent; and
     - percent composition of each major component soil and inclusion using field checking methods.
   - Identify and determine documentation needs.
   - Select a site. Each site must:
     - be typical for the soil-ecological site relationship
     - be representative of the soil component, ecological site component, hydrology and biological factors
   - Assign a map unit symbol.
   - Follow proper procedures and guidelines. Standardization of procedures are provided in:

  - National Soil Handbook (NSH), which sets the standards for soil scientists.

  - National Range Handbook (NRH) and BLM Supplements, which set the standards for range conservationists and other vegetation specialists.

  - Agency handbooks and procedures, which set the standards for hydrologists and biologists.

- Follow review and correlation procedures. As noted previously, these are accepted standards and procedures that provide direction to the team for application throughout the survey process. These processes and procedures are necessary for quality control in that they provide assistance to the team by recognizing and solving problems, recording progress, and identifying the workload remaining and the agreed to items for accomplishment. Quality control in any soil survey inventory is highly dependent on the map unit and soil-ecological site components. It is initiated through a correlation process.

  - Importance of the map unit. This is the basic unit where all evaluations and determinations are made.

  - The correlation process. This is a standardized ongoing process carried out by the team throughout the survey and at various intervals by assigned representatives of the state soil scientist, state range conservationist and/or other lead agency representatives.

  - Soil correlation. This process ensures the validity of soil phase separation, naming, documentation, and manuscript accuracy. It also ensures the accuracy and completion of all supporting attribute data and formalizes the correlation process.

  - Soil-site correlation. This is an ongoing process that is part of and is carried out during all phases of the total soil survey. This is the process that establishes the map unit soil taxa-ecological site relationships.

  - Ecological site correlation. This process ensures the validity of soil-ecological site correlation and site assignment within the survey process. It assures that the ecological sites are adequately documented and all existing or new sites are updated, revised, or proposed based on the information gathered.

IV. Relationships and Use of ESI with BLM Planning and Implementation Processes.

This section discusses sources of soil and vegetation information and general applications relative to Prescribed Resource Management Plan actions (BLM Manual 1616), Supplemental Program Guidance (BLM Manual series 1620), subsequent activity plans or management actions, and associated monitoring. Discussion is necessarily general since the number of possibilities through data base manipulation for specific needs is nearly endless.

A. Data Analysis for Planning and Management Applications (from draft Vegetation Management Handbook H-1621-1).

1. Basic Analysis - Analysis is required for the following:

   a. Calculating ecological status to fulfill reporting requirements. The calculation is based on a coefficient of community similarity (SRM, 1983) between the present plant community and the PNC documented in the ecological site description.

   b. Developing or updating known seral community type descriptions by aggregating all present vegetation communities, documented in IDS, into groupings of similar vegetation associations for interpretations. Seral community types are documented by ecological site and are stored in the interpretation section of site descriptions. Seral community type descriptions can be developed by hand, but are best developed through data base analysis using:

      - PC based software (Bureau approved) ASPEN/2 or dBASE III+ for ad hoc queries, sort routines, and screen entry/edit of data.

      - PC based Inventory Data System Utility (IDSU) for standard sort routines and screen entry/edit of data (available from BLM Service Center).

      - Mainframe based ASPEN/2 for ad hoc queries and sort routines.

      - Cluster analysis techniques available on commercial software.

      Sorting of data in the IDSU program is based on ecological site, seral state, and dominant species listed by highest producer.

2. Planning and Management Analyses - Components of the planning and management analyses are as follows:

   a. Resource value ratings can be developed for individual uses (specific wildlife habitat elements, initial stocking rates for livestock, forage values, wood products, recreation, etc.). Resource values can be quantitative or qualitative and are tied to specific community types and ecological sites.

   b. Site conservation thresholds can be predicted by evaluating present plant community characteristics with areas of known accelerated soil erosion or by using predictive models such as the Revised Universal Soil Loss Equation (RUSLE), Water Erosion Prediction Project (WEPP) model, and others. Other site limitations, such as vulnerability to weedy species, etc., can also be identified.

c. Vegetation requirements for multiple use alternatives can be evaluated by relating possible/known seral community types to known or predicted areas of use. Due to the utility of the vegetation cover attribute of a site to numerous multiple uses, cover can normally be acquired during the inventory process. Since cover can contribute significantly to the community and site, the cover can be collected by species and/or by three structural layers (basal, less than 3 feet, and above 3 feet). If cover is routinely acquired during the inventory/monitoring process, important understandings can be formulated on watershed/site health.

d. ESI data are the basis and documentation needed to establish and clarify realistic, achievable, and measurable vegetation management objectives.

    - Resource condition objectives are usually based on more generalized attributes of sites with similar vegetation attributes, response attributes, and/or similar uses.

    - Specific objectives for monitoring, activity plans, sensitive areas, etc., are usually based on specific site capabilities.

e. Ecological site data analysis is the basis of benchmark site selection for monitoring. Benchmark sites are the most important sites because they represent:

    - Large geographic extent.

    - High resource values (forage production, water production, wood products, wildlife habitat, etc.)

    - Unique characteristics (threatened & endangered species, Areas of Critical Environmental Concern, etc.).

f. ESI provides the basis for extrapolation of management successes (or failures) to achieve Desired Plant Community (DPC) characteristics, and for the technical transfer of that information.

g. ESI provides documentation for determining and reporting of vegetation management status.

B. Resource Management Plan (RMP)

The RMP provides a set of comprehensive, long-range objectives an decisions concerning the use and management of public resources in a planning area. Site specific information to resolve or address issues in the resource area is identified during development of planning criteria. With the exception of ACECs, and other sensitive areas, most analyses at the RMP level are more general, addressing broad geographic reference areas within a planning area. Nevertheless, RMP objectives need to be clear enough to identify the desired outcome of resources through management. If the RMP is not clear in this regard, a planned amendment is needed. Site specific information is used to refine resource management objectives associated with implementing actions such as activity plans and management actions resulting from the RMP.

1. Identification of Issues and Development of Planning Criteria

   When the RMP process is initiated prior to inventory, the identification of issues related to vegetation and soils becomes the basis for the Purpose and Objectives stated in the Inventory Plan. Likewise, the development of planning criteria for the RMP becomes the basis for Information Required to Resolve Identified Issues in the Inventory Plan.

   Many inventories have preceded the RMP. If an inventory plan was prepared, the Purpose, Objectives, and Information Required to Resolve Identified Issues sections of the plan become an excellent start for identification of issues and development of planning criteria for the RMP. However, some issues may have changed or were overlooked in the original inventory plan. The interdisciplinary RMP team will need to identify and document shortfalls in the present inventory and decide on a course of action to update the inventory. Inventory updates to include riparian-wetland documentation and values is a typical example.

   Data from the inventory process are often a source of new issue identification whether the inventory was conducted in conjunction with an RMP or preceded it. Typical examples are the SWA documentation of weed species or special status species (threatened, endangered, endemic, etc.). Update of ecological site descriptions completed during inventory may also indicate previous overestimation or underestimation of resource capabilities within an area.

2. Management Situation Analysis

   The management situation analysis provides 1) an overview of resources in the Resource Area Profile, 2) the Current Management Situation and Effects, and 3) Resource Capability Level. Analysis at this level requires aggregation of soil and vegetation data by resource area or geographic reference areas of interest.

   a. Resource Area Profile (RAP)

      General vegetation and soil maps produced during inventory provide an excellent reference for describing the area in broad terms.

      Approximate acreage or composition of major ecological sites and/or soils in the Resource Area or specific Geographic Reference Areas (GRAs) can be determined from the Map Unit File (MUF) in the State Soil Survey Area Database (SCS). An acreage summary of ecological sites and ecological status by allotment is also available as a standard report from IDS. Major ecological sites or soils are usually those of importance because of large geographic extent, high productivity, or high value (i.e., riparian-wetland sites). These sites are also the ones most appropriately designated as benchmarks for management and monitoring.

Natural processes of management importance, such as fire frequency, flooding, drought, etc., are determined from ecological site descriptions, either on the SITEFORM program or hard copies.

Specific parts of some ecological site descriptions, such as climate factors and community dynamics, will be applicable to more general statements within the RAP. Partial outputs from SITEFORM can be saved to a file and accessed later by WordPerfect or other word processing software for edit and direct inclusion into the RAP, if desired.

b. Current Management Situation

Response of ecological sites to specific practices, such as prescribed burns, seedings, timber harvest, etc., can be predicted by overlaying project locations over the SWA map. Ecological site, vegetation species, percent composition, production, etc., can be queries from IDS or IDSU by SWA(s) affected.

Response of ecological sites to broader practices such as grazing prescriptions is best accomplished by reviewing allotment community types within IDSU or developing a similar ad hoc query in IDS. This data can be compared with information within allotment files on type of prescription, time practiced, monitoring data, etc., if desired.

3. Resource Capability Level

Standard IDS output report on Dominant Plant Species by SWA or the Community Type report from IDSU provides basic information on resource capability levels. However, ad hoc queries reordering information (i.e., listing in order of site name instead of SWA# in IDS) or limiting species lists by minimum percent composition (i.e., only those species ≥10 percent composition ADW) may help organize information and reduce volume.

SITEFORM is also useful in aggregating ecological sites into broader groups for analysis and discussion at this level of planning. Ecological sites and community type characteristics (part B.1.a. of the Standard Site Description) can be easily listed by production breaks (i.e., ≤500 lbs. ave.; >500 and ≤1000 lbs. ave., etc.), elevation breaks, presence of associated water features (riparian-wetland sites), or other criteria as appropriate.

Note: Resource capability levels for riparian-wetland areas involve changes in the extent of certain ecological sites as well as the vegetation resource capabilities.

Possible reductions in the extent of riparian-wetland areas from past impacts and future capabilities are best identified from soil map unit descriptions and the State Soil Survey Area Database (providing this information was identified as a survey requirement). Drained phases of aquic subgroups or other wet soils presently correlated to drier ecological sites may indicate a possibility of reversal or at least partial reversal depending upon other management considerations (i.e., impoundments, etc.).

4. Alternatives and Estimated Effects

   The RMP must consider a range of management alternatives based on goods, values, and services expected from the area. Estimated effects of changes associated with each alternative must be summarized relative to resource conditions as well as uses and value. Changes in soil, hydrologic, and vegetation conditions are most often interdependent, but not always to the same degree between ecological sites.

   Ecological site interpretations provide an opportunity to relate changes in vegetation to resource values such as grazing, wildlife habitat, values, forestry, or other uses. Limitations associated with soil erosion, streambank stability, stream type, or other factors are often described. Ecological sites can be grouped by response similarity for alternative analysis.

   Unfortunately, ecological site interpretations in many areas are insufficient to use as the primary information source for analysis. The interdisciplinary team needs to rely on individual data bases to summarize information as it relates to each alternative, then collectively analyze opportunities and risks as they relate to expected changes. Collective analysis for planning purposes can provide the basis for updating ecological site interpretations. The interpretations developed can be further verified or refined based on subsequent inventory or monitoring activities.

5. Preferred Alternative and Selected Plan

   The preferred alternative and selected plan are developed from information previously described. Resource descriptions for various geographic reference areas are translated into Resource Condition Objective decisions, Land Use Allocation decisions, and Management Action decisions for the selected plan.

C. Implementing Actions

Implementing actions begin with the RMP Implementation Schedule. This schedule needs to include timeframes and guidance for 1) the development of the Monitoring Evaluation Schedule, 2) development of specific activity plans, and/or 3) resource conservation and improvements to meet land use goals.

The Monitoring Evaluation Schedule is prepared to 1) clarify and refine RMP objectives for various geographic reference areas, 2) identify treatments needed to meet these objectives, and 3) identify means to monitor success. This schedule is prepared by an interdisciplinary team that uses the following process for evaluation:

- Describe the PRESENT SITUATION.

- Compare RMP “Objectives” within geographic reference areas to make sure they are in COMPLIANCE and not in conflict. If conflicts exist, a plan amendment is needed.

- Determine the DESIRED SITUATION to meet Land Use Plan objectives (i.e., for vegetation, the desired plant community).

- Determine the TIME that is required/allowed to go from the "present" to the "desired." If the time period exceeds 20 years, it may be appropriate to reassess what is "desired."

- State the RATIONALE for the "Desired Situation."

- Determine the ACTION(S) required to achieve the "Desired Situation." The actions will provide a reasonable chance for success.

- Identify how to MONITOR success. Determine how success will be measured, and what determines success.

Present plant community characteristics are determined directly from the IDS. IDS information can be queried by allotment or by groups of SWAs for a particular geographic reference area. Consult the IDS user guide for guidelines on outputs.

DPC characteristics can be developed from IDS by reviewing actual transect data for individual sites or from community type summaries in the ecological site interpretations. If developed directly from IDS, several inventory areas may have to be queried to provide the full range of communities documented for a particular site; specific examples of desired plant community development are provided in TR-1621-1 (draft 1991).

The present situation for many riparian-wetland attributes can be determined from the RAIDS data base. Newer riparian-wetland inventories include ecological sites in the RAIDS data base so that the desired situation can be determined based on the known capability of a site or complex of sites. Older RAIDS data do not include ecological site identification, so care must be taken that like situations are being compared when assessing opportunities for change.

Present and desired situations for soils are dependent on interrelationships between soil factors such as erodibility (K factor), soil loss tolerance (T factor), and Wind Erodibility Group (WEG) with vegetation cover and degree of surface disturbance. Models such as the Revised Universal Soil Loss Equation (RUSLE), Water Erosion Prediction Project (WEPP), and Wind Erosion Prediction (WEP) model are helpful in establishing relationships between present and desired conditions. Hydrologic relationships between water table characteristics and annual pattern of soil water states must also be considered relative to frequency, extent, and duration of flooding, channel characteristics, and vegetation in riparian-wetland areas.

Actions to achieve or maintain desired situations nearly always include vegetation management practices such as grazing prescriptions and/or silvicultural practices. Spatial distribution of ecological sites and present vegetation within a particular management area will help determine the suitability of different management practices. The ecological site map (based on soil map units) and SWA map provide the spatial relationships. Ecological site interpretations often provide additional information on suitability for certain practices. However, additional information sources such as TR-1737-4, Grazing Management in Riparian Areas (USDI, 1989) and others can be consulted as well.

Additional actions such as mechanical, chemical, or fire manipulation may also be required to achieve DPC characteristics. Support facilities such as fences, cattleguards, roads, water developments, and others may be required to implement management practices. The Soil Interpretations Record (SCS-SOI-5) in the State Soil Survey Area Database provides considerable information regarding soil suitability and limitations associated with these practices and facilities. Some interpretations apply directly, some can be interpolated from other interpretations, and some must be developed from soil property information.

Suitability and limitations for local roads (and streets), pond reservoir areas, and equipment limitations are directly applicable interpretations in many cases. Suitability for, cattleguards, and certain other kinds of facilities can be readily interpolated from building site interpretations such as shallow excavations, dwellings with or without basements, etc.

Many other interpretations can be generated from the soil data base using local or regional criteria like fencing and seeding. The Nevada Range Seeding Suitability Guide provides an example of state criteria. Soil map units contained in the Bedell Flat Fire were queried using criteria in the suitability guide to obtain a suitability rating. The ratings apply equally well to any range improvement or reclamation project. All map units within a survey area can be rated just as easily with one query routine and stored in a computer file or hard copy for future evaluations.

Rosgen stream classification associated with ESI mapping procedures provides an additional opportunity to determine suitable instream fish habitat structures. Additional references are also listed in Appendix VII.

D. Monitoring

ESI provides the basis for extrapolation of monitoring information and analyses from a key area or specific location to a broader geographic area. Similar vegetation community types for an ecological site can be expected to respond the same way to various management practices over the extent of its distribution. Groups of similar ecological sites can also be interpreted to respond similarly under certain situations. For instance, Wyoming sagebrush/Thurber needlegrass, Wyoming sagebrush/bluebunch wheatgrass, and mountain big sagebrush/Idaho fescue sites can all be expected to respond similarly to prescribed fire under present conditions of similar brush canopy.

ESI also provides the basis for monitoring and extrapolation of information in riparian-wetland areas. However, there are some special considerations that need to be accounted for, especially in stream systems where aggradation and degradation processes lead to changes in ecological site position over time or where site progression leads to a new (different) ecological site. Monitoring studies must account for these changes as well as changes in vegetation or other resource conditions within an individual site.

One method to account for these changes is to establish a minimum of three valley bottom cross sections within a monitored stream segment. Each time the study is completed, the cross section must be replotted and site boundaries determined. Extent of site change over time can be determined from mean cross-sectional change. Vegetation transects (i.e., frequency, cover, etc.) or other studies such as soil moisture, water table, etc., also need to be designed so that data apply to the appropriate site. Permanent, fixed point plots or transects are, therefore, not recommended except for photo point stations.

E. Interpreting ESI Information for Identifying and Delineating Jurisdictional Wetlands

The Corps of Engineers (COE) and Environmental Protection Agency (EPA) are responsible for making jurisdictional delineations of wetlands regulated under Section 404 of the Clean Water Act (formerly known as the Federal Water Pollution Control Act, 22 U.S.C. 1344). The COE also makes jurisdictional determinations under Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403). Under Section 404, the Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits for the discharge of dredged or fill materials into the waters of the United States, including wetlands, with program oversight by EPA.

The following definition of wetlands is the regulatory definition used by COE and EPA for administering the Section 404 permit program:

> Those areas that are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas.

The COE and EPA have developed technical manuals for identifying and delineating wetlands subject to Section 404 (Environmental Laboratory, 1987 and Sipple, 1988, respectively). The SCS has developed procedures for identifying wetlands for compliance with the Food Security Act. While it has no formal method for delineating wetland boundaries, the USFWS has established guidelines for identifying wetlands in the form of its official wetland classification system report (Cowarden, et al., 1979).

In 1989, COE, EPA, SCS, and USFWS worked together to produce a manual describing the technical criteria for identifying and delineating wetlands. The criteria presented in that manual are under review. However, all wetlands possess three essential characteristics as follows:

1. Hydrophytic Vegetation Criterion

   An area has hydrophytic vegetation when, under normal circumstances: (1) more than 50 percent of the composition of the dominant species from all strata are obligate wetland (OBL), facultative wetland (FACW), and/or facultative (FAC) species, or (2) a frequency analysis of all species within the community yields a prevalence index value of less than 3.0 (where OBL = 1.0, FACW = 2.0, FAC = 3.0, FACU = 4.0, and UPL = 5.0). CAUTION: When a plant community has less than or equal to 50 percent of the dominant species from all strata represented by OBL, FACW, and/or FAC species, or a frequency analysis of all species within the community yields a prevalence index value of greater than or equal to 3.0, *and* hydric soils and wetland hydrology are present, the area also has hydrophytic vegetation. (*Note:* These areas are considered problem area wetlands.)

For each stratum (e.g., tree, shrub, and herb) in the plant community, dominant species are the most abundant plant species (when ranked in descending order of abundance and cumulatively totaled) that immediately exceed 50 percent of the total dominance measure (e.g., basal area or areal coverage) for the stratum, plus any additional species comprising 20 percent or more of the total dominance measure for the stratum. All dominants are treated equally in determining the presence of hydrophytic vegetation.

2. Hydric Soils Criterion

Hydric soils are defined as soils that are saturated, flooded, or ponded long enough during the growing season to develop anaerobic conditions in the upper part (USDA SCS, 1987). In general, hydric soils are flooded, ponded, or saturated for usually 1 week or more during the period when soil temperatures are above biologic zero 41 °F as defined by "Soil Taxonomy" (USDA Soil Survey Staff, 1975). These soils usually support hydrophytic vegetation. The National Technical Committee for Hydric Soils (NTCHS) has developed criteria for hydric soils and a list of the Nation's hydric soils (USDA SCS, 1987). (*Note:* Caution needs to be exercised in using the hydric soils list for determining the presence of hydric soil at specific sites.)

An area has hydric soils when the NTCHS criteria for hydric soils (USDA SCS, 1991) are met:

"Unless drained or protected from inundation:

1) All Histosols except Folists, or

2) Soils in Aquic suborder, Aquic subgroups, Albolls suborder, Salorthids great group, or Pell great groups of Vertisols, Pachic subgroups, or Cumulic subgroups that are:

   a) somewhat poorly drained and have a frequently occurring water table less at the surface for a significant period (usually more than 2 weeks) during the growing season, or

   b) poorly drained or very poorly drained and have either:

      (1) a frequently occurring water table at the surface for a significant period (usually more than 2 weeks) during the growing season if textures are coarse sand, sand, or fine sand in all layers within 20 in, or for other soils

      (2) a frequently occurring water table within 0.5 ft of the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is equal to or greater than 6.0 in/h in all layers within 20 in, or

      (3) a frequently occurring water table within 1.0 ft of the surface for a significant period (usually more than 2 weeks) during the growing season if permeability is less than 6.0 in/h in any layer within 20 in, or

3) Soils that are frequently ponded for long duration or very long duration during the growing season, or

4) Soils that are frequently flooded for long duration or very long duration during the growing season."

(*Note*: Long duration is defined as inundation for a single event that ranges from 7 days to 1 month; very long duration is defined as inundation for a single event that is greater than 1 month; frequently flooded is defined as flooding likely to occur often under usual weather conditions — more than 50 percent chance of flooding in any year or more than 50 times in 100 years. Other technical terms in the NTCHS criteria for hydric soils are generally defined in the glossary.)

3. Wetland Hydrology Criterion

Permanent or periodic inundation, or soil saturation to the surface, at least seasonally, are the driving forces behind wetland formation. The presence of water for a week or more during the growing season typically creates anaerobic conditions in the soil, which affect the types of plants that can grow and the types of soils that develop. Numerous factors influence the wetness of an area, including precipitation, stratigraphy, topography, soil permeability, and plant cover. All wetlands usually have at least a seasonal abundance of water. This water may come from direct precipitation, overbank flooding, surface water runoff due to precipitation or snow melt, groundwater discharge, or tidal flooding. The frequency and duration of inundation and soil saturation vary widely from permanent flooding or saturation to irregular flooding or saturation. Of the three technical criteria for wetland identification, wetland hydrology is often the least exact and most difficult to establish in the field, due largely to annual, seasonal, and daily fluctuations.

An area has wetland hydrology when saturated to the surface or inundated at some point in time during an average rainfall year, as defined below:

- Saturation to the surface normally occurs when soils in the following natural drainage classes meet the following conditions:

  - In somewhat poorly drained mineral soils, the water table is less than 0.5 feet from the surface for usually 1 week or more during the growing season; or

  - In low permeability (<6.0 inches/hour), poorly drained, or very poorly drained mineral soils, the water table is less than 1.5 feet from the surface for usually 1 week or more during the growing season; or

  - In more permeable ($\geq$ 6.0 inches/hour), poorly drained, or very poorly drained mineral soils, the water table is less than 1.0 feet from the surface for usually 1 week or more during the growing season; or

  - In poorly drained or very poorly drained organic soils, the water table is usually at a depth where saturation to the surface occurs more than rarely. (*Note*: Organic soils that are cropped are often drained, yet the water table is closely managed to minimize oxidation of organic matter; these soils often retain their hydric characteristics, and if so, meet the wetland hydrology criterion.)

- An area is inundated at some time if ponded or frequently flooded with surface water for 1 week or more during the growing season.

(*Note*: An area saturated for a week during the growing season, especially early in the growing season, is not necessarily a wetland. However, in the vast majority of cases, an area that meets the NTCHS criteria for hydric soils is a wetland.)

The above criteria will be changed as new information and research are obtained and conducted. These criteria serve only as technical guidance to identify and delineate boundaries of areas that meet wetland definitions provided by statute or regulation.

The field information collected on vegetation, soils, and hydrology are recorded during ESI and on SITEFORM and can be used to make an initial jurisdiction wetland determination so that managers will be aware of regulatory requirements.

V. Conclusion

BLM has the responsibility to inventory, document, and describe resources on public lands. The procedure presented will provide the framework on how to collect, compile, store, and evaluate this information to determine current ecological status and potential for all riparian-wetland and upland sites. The interdisciplinary approach to ecological site inventory is designed from the beginning to provide a coordinated approach in obtaining soil, vegetation, hydrology, and biological information for management to use on public lands.

Maintaining the ecological site information as a permanent record will provide baseline information and will allow the use of this information to determine how various management practices are performing in maintaining, enhancing, or restoring the proper functioning condition of these areas. The permanent record will also be instrumental in periodically evaluating if RMP objectives are being met.

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List of Acronyms

Agencies:

BLM	Bureau of Land Management
COE	Corps of Engineers
EPA	Environmental Protection Agency
NOAA	National Oceanic and Atmospheric Administration
SCS	Soil Conservation Service
USDA	United States Department of Agriculture
USDI	United States Department of the Interior
USFWS	United States Fish and Wildlife Service
USFS	United States Forest Service
USGS	United States Geological Survey

Others:

ACEC	Area of Critical Environmental Concern
ADW	Air-Dry Weight
ESI	Ecological Site Inventory
FLPMA	Federal Land Policy and Management Act of 1976
FSSD	Federal Soil Survey Database
GIS	Geographic Information System
GRA	Geographic Reference Area
IDS	Inventory Data System
IDSU	Inventory Data System Utility
MLRA	Major Land Resource Area
MOU	Memorandum of Understanding
MUUF	Map Unit Use File
NBM	National Biology Manual
NCM	National Cartographic Manual
NCSS	National Cooperative Soil Survey
NFM	National Forestry Manual
NRH	National Range Handbook
NSH	National Soil Handbook
PNC	Potential Natural Community
PRIA	Public Rangeland Improvement Act
RAIDS	Riparian Aquatic Information Data Summary
RAWS	Remote Automatic Weather Station
RMP	Resource Management Plan
RUSLE	Revised Universal Soil Loss Equation
SNTC	South National Technical Center
SMSS	Soil Management Support Services
SRM	Society of Range Management
SSM	Soil Survey Manual
SSQA	Soil Survey Quality Assurance
SWA	Site Writeup Area
WEG	Wind Erodibility Group
WEP	Wind Erosion Prediction
WEPP	Water Erosion Prediction Project

Appendix I

Taxonomic Class Phases

Common kinds of phases for components of map units. Additional information in Part. 602 of the National Soils Handbook.

1. Surface texture phases, e.g., Alpha silt loam.
2. Organic surface layers, e.g., Alpha peat.
3. Texture phases of soils with rock fragments, e.g., Alpha gravelly loam.
4. Surface phases of soils having stones and boulders, e.g., Alpha stony loam.
5. Surface phases of soils having stones or boulders on the soil surface, e.g., Alpha silt loam, 10 to 20 percent slopes, bouldery.
6. Slope phases, e.g., Alpha silt loam, 4 to 8 percent slopes.
7. Eroded soils, e.g., Alpha loam, 8 to 15 percent slopes, eroded.
8. Depositional phases, e.g., Alpha sandy loam, 2 to 8 percent slopes, overwashed.
9. Depth phases, e.g., Alpha silt loam, shallow, 4 to 8 percent slopes.
10. Substratum phases, e.g., Alpha silt loam, gravelly substratum.
11. Phases related to soil water, e.g., Alpha silt loam, drained.
12. Saline phases, e.g., Alpha loam, slightly saline.
13. Sodic phases, e.g., Alpha loam, slightly saline-alkali.
14. Physiographic phases, e.g., Alpha gravelly loam, fan, 0 to 8 percent slopes.
15. Climatic phases, e.g., Alpha sandy loam, cool.
16. Other phases, e.g., frequently flooded, occasionally flooded, rarely flooded, burned, calcareous, or leached surface.

Appendix II

Draft
Technical Note
Riparian-Wetland
Soil Map Unit Delineations

04/21/92
Prepared by George J. Staidl, NSRT

Background

Soil survey techniques and procedures guiding soil surveys, soil scientists, and SCS SSQA staff, have generally concentrated on the major soil components and map unit delineations with substantial acreage. These procedures, in conjunction with cartographic policy, only allow for a closed line delineation or general spot symbols to identify unique areas. Use of delineations or spot symbols is highly dependent upon the scale of the photobase maps. Many unique areas are comprised of riparian zones and wetlands of minor acreage. These unique areas contain contrasting soils and are usually the most vegetatively productive soils within any survey area. The typical field mapping process identifies these areas with a broadly defined spot symbol or as contrasting soil inclusions within map units. This is a result of not identifying the riparian-wetland mapping objectives in the soil survey area MOU and the emphasis put upon the soil scientist to increase their production of acres mapped. The result is a tradeoff in detail of mapping and reduced ability to provide soil information concerning riparian and wetland areas.

The present farm bill and other congressional legislation have emphasized preservation and management of these unique riparian-wetland areas. They are, for the most part, the more productive and fragile parts of the ecosystem. The soil survey and cartographic procedures presently in use are not conducive to identifying and delineating many of these smaller areas as soil map units. These areas need to be part of a permanent soil database. Without this data, quality information cannot be disseminated to the user to meet the legislative needs. New techniques need to be explored, tested, and implemented within the soil survey process to give the soil scientist the tools to incorporate past, present, and future data into soil survey activities.

Statement of Needs

As noted previously, congressional legislation has pointed out a need for additional soil survey information applicable to riparian and wetland areas. Availability of this information for total resource planning and conservation practice application is also vitally important in the decision making process. It is recognized that data collection should be initiated in many areas thought to be of less importance, or at least unmappable, using the policy and techniques available to the soil scientist at the time. Implementation would require that the resulting soil and plant data obtained be incorporated into a permanent database. This would maximize its utility for present and future data dissemination. This can be accomplished by developing a mechanism to identify these unique areas on field sheets, orthophoto quads, and in a GIS database where available. To maintain a permanent database, some modification of procedures will be needed. This should include modification of requirements using innovative cartographic techniques, map unit design, map unit descriptions, correlation to the series and phase level, and data entry to the soil survey database. Field applications would take into account only that which is normally expected for delineation and documentation common to other map units. Addressing the inequities of the present procedures will minimize the need for continued onsite investigation where soil and vegetation data is presently maintained in a nonpermanent form. Positive changes to the present system will maximize soil data availability for use by managers and others.

Requirements

A. Any modifications to the existing soil survey procedures will be applicable to a soil survey where:

1. GIS capability may or may not be available.

2. Targeted areas will include:

   a. New SSA(s)
   b. Ongoing SSA(s)
   c. Newly completed SSA(s)
   d. SSA(s) undergoing update

3. The need exists for information on unique lands (riparian-wetland areas and others) and is presently unavailable.

B. Development and expansion of procedures for implementation will:

1. Be incorporated into any existing GIS database where the potential exists.

2. Allow for the correlation of minimal acreage unique soils to the series level. This will initiate data entry into the soil survey database.

3. Allow for the correlation of minimal acreage unique soil mapping units. This will initiate data entry into the soil survey database.

4. Provide techniques for unique delineations and spot symbols that will represent map units, but do not meet the present cartographic requirements.

5. Provide procedures to use the unique delineations and spot symbol map units to represent spatial area and allow for acreage determination.

6. Allow for the description of spatial area concepts for the unique delineation and spot symbol map units as a component in map unit descriptions.

C. Proposed methods for use in soil survey areas:

1. Line segment (e.g., dot to dot or line break to line break) vector format.

   a. Determine and designate the representative delineations line segment width for each map unit (e.g., the map unit line segment represents an average width of 120 feet). This information, along with the line length and scale of map, will determine map unit acreage.

b. Suggested line width groupings are 1-50, 50-100, 100-150, and 150-200 feet. Areas that are greater than 200 feet wide will typically be located by an enclosed line polygon.

c. Assign a map unit symbol to each line segment using a leader technique. A unique Alpha or Numeric code, representing an average width within a line segment group, will be assigned as the last character in the map unit symbol. An example of a symbol is 103X, where "103" is the map unit name and "X" indicates an average width of 75 feet in the 50-100 feet group.

d. Utilize the existing drainage spot symbols as line segment breaks to minimize map clutter.

2. Spot symbols.

a. Use ad hoc symbols or a dot to represent a map unit.

b. Determine the acreage that each spot symbol or dot represents for the map unit (e.g., averages 2.5 acres). Suggested spot symbol grouping are <1, 1-2, 2-3, 3-4, and 4-5 acres. Those areas that are greater than 5 acres will typically be located by an enclosed line polygon.

c. Assign a map unit symbol to each spot symbol or dot using the leader technique. A unique Alpha or Numeric code representing an average acreage for the spot symbol group will be assigned as the last character in the map unit symbol. An example of a symbol is 103P, where "103" is the map unit name and "P" indicates an average acreage of .5 acres for the <1 acre group.

D. Field procedures for soil survey areas:

1. Field check the area to be mapped in terms of the normal map unit concept.

2. Design a map unit using accepted soil survey procedures.

3. Determine if the map unit is a consociation, association, complex, or undifferentiated group.

4. Identify each major and minor component soil within the proposed map unit, preferably at the soil series level, and assign phases as needed.

5. Obtain all necessary documentation for soils, vegetation, hydrology, etc.

6. Using the documentation collected, correlate each major soil component of the map unit to the series level.

7. Assign each new map unit its own unique map unit symbol and display with representative line segments or spot symbols on the soil map.

8. Designate the representative line segment width and spot symbol acreage in each applicable map unit description.

9. Determine acreage for each line segment or spot symbol on each completed soil map.

10. Continue using accepted National Cooperative Soil Survey procedures throughout the survey.

E. Delineation and map symbol application will be as follows:

1. Line segments or spot symbols will be on original field sheets and orthophotoquad soil maps.

2. Line segments or spot symbols will be on registered mylar overlays with a stable base map.

3. Line segments or spot symbols will be transferred to scribe coat of orthophotoquad for publication processes.

4. Line segments and spot symbols will be digitized as part of the GIS database.

F. Data permanence procedure within the soil survey area:

1. Identify and implement the soil mapping options noted in (E) above that are applicable to the soil survey area status.

2. Undergo the review and final correlation process common in any soil survey as outlined in the National Soils Handbook.

3. Prepare and process all necessary soil series and map unit information into the National Soil Survey Database for future access of output data.

Appendix III

Exhibit 302.7A

Plant Association Tables

Plant Association Table (First Assemblage) /T means trace; blanks mean did not occur/

Species	Production at Location No.						
	1	2	3	4	5	6	7
	Pounds per acre (air-dry)						
bluebunch wheatgrass	910	1,190	1,690	960	1,380	1,260	1,620
Sanberg bluegrass	110	120	260	95	185	70	375
Thurber needlegrass	15	T		15		10	
needle-and-thread	10			10		T	
cheatgrass	10		T			T	T
Pacific fescue		15	T		T		T
squirreltail			T			T	
Idaho fescue			400		460		250
lineleaf fleabane	15	15		20		15	25
snow eriogonum	15	15	50	15	50	T	25
cluster phlox	15	25		30		15	
longleaf phlox	10		50	25	50	T	25
yarrow	20	15	50	20	50	15	30
pussytoes	T	15				T	
arrowleaf balsamroot			50		25		50
hangingpod milkvetch			25		25		25
silky lupine			25		25		25
specklepod loco			T		25		25
indianwheat		10					
tarweed				T		T	
tapertip hawksbread			50		50		25
filaree						T	
gray rabbitbush	10	T	T	5	T	15	T
gray horsebrush			T		T		T
Total	1,140	1,420	2,650	1,195	2,325	1,400	2,500
Soil Taxonomic Unit No.	1	2	3	1	4	1	3

NRN-1, July 13, 1976

Plant Association Tables

Plant Association Table (Final Assemblage)
/T means trace; blanks mean did not occur/

Species	Production at Location No.						
	1	2	4	6	3	5	7
	Pounds per acre (air-dry)						
bluebunch wheatgrass	910	1,190	960	1,260	1,690	1,380	1,620
Sanberg bluegrass	110	120	95	70	260	185	375
Thurber needlegrass	15	T	15	10			
needle-and-thread	10		10	T			
cheatgrass	10		T		T		T
Pacific fescue		15			T	T	T
squirreltail				T	T		
Idaho fescue					400	460	250
lineleaf fleabane	15	15	20	15			25
snow eriogonum	15	15	15	T	50	50	25
cluster phlox	15	25	30	15			
longleaf phlox	10		25	T	50	50	25
yarrow	20	15		T			
pussytoes	T	15		T			
indianwheat		10					
tarweed			T	T			
filaree				T			
arrowleaf balsamroot					50	25	50
hangingpod milkvetch					25	25	25
silky lupine					25	25	25
specklepod loco					50	50	25
tapertip hawksbread					50	25	25
gray rabbitbush	10	T	5	15	T	T	T
gray horsebrush					T	T	T
Total	1,140	1,420	1,195	1,400	2,650	2,325	2,500
	Site No. 1				Site No.		
Soil Taxonomic Unit No.	1	2	1	1	3	4	3

NRH-1, July 13, 1976

Appendix IV

Site Correlation Procedures

The formal site correlation procedures are designed to standardize and supplement part of Section 302.8 *Naming and Correlating Range Sites* of the National Range Handbook (NRH).

This procedure will also supplement the applicable sections of the National Biology Manual (NBM), National Forestry Manual (NFM) and National Soil Handbook (NSH) as appropriate.

The “Site Correlation Procedures” will establish compatibility with current soil correlation standards as set forth in the NSH. This is accomplished by providing site correlation with soil correlation from the start of field work through the formal correlation process. (See NSH Section 602.00-4).

Site correlation is a process for consistently relating ecosystem components within and between ecosystems perceived as having the same climax or potential natural vegetation. The site correlation process also provides quality control for consistent description and documentation of the ecosystem components as well as subsequent interpretations associated within the site.

Wildland (grassland, woodland, wetland, etc.) resource inventories are basically “ecosystem inventories.” These ecosystems include not only vegetation and soil, but also the associated climate, water, and animal life. Ecosystem components, including vegetation, soil, water, air, fire, animals, topography, temperature, solar energy, and man, are closely and completely interrelated. Any influences exerted on one affects the others.

In order for any site correlation process to proceed in an orderly manner, the following items need to be understood and addressed by all participants.

1. Responsibility

    a. The Director, Ecological Sciences Staff, National Office, SCS, through the National Technical Centers (NTCs) has the responsibility for the correlation and establishment of sites.

       The NTC Director will be responsible for correlating sites within his region and will maintain a file of all correlated sites by using a numbering system and retaining copies of all correlated site descriptions.

    b. State Conservationists will be responsible for maintaining a record of all sites within their state according to their status and for proposing sites to the NTC. State Conservationists in consultation with administrators of cooperating agencies will also be responsible for correlating all sites within their state. When a site occurs in more than one state, the NTC Director will designate the state responsible for maintaining and updating the site.

c. Field personnel of all cooperating agencies will be responsible for collecting the necessary documentation for each site used and will propose draft descriptions as needed for further consideration and approval by the SCS State Conservationist.

2. Timing

a. Site correlation is a continuous process initiated at the beginning of any soil or vegetation survey and progressing through a final correlation (which may also include an interstate correlation).

b. Site correlation is normally done in conjunction with soil survey correlation. However, site correlation may also be necessary because of updates or revisions to site descriptions.

c. Preparation for intrastate and interstate site correlation should include:

(1) Six months prior to correlation:

(a) The states involved should communicate as the soil survey(s) progress to correlate common site descriptions. If there is disagreement on some sites, than a formal interstate correlation will be arranged.

(b) States involved will have exchanged proposed and/or established site descriptions for the area to be correlated.

(c) States will coordinate with field staff to jointly select locations to be correlated (it is not necessary to visit every site if there are no disagreements).

(d) States involved will document which sites can be correlated and those that cannot at this time.

(2) Three months prior to correlation:

(a) States will make an initial grouping or separation of sites based on the criteria in Part 3.B. of the site correlation procedures.

(b) States will submit a proposal to NTC for correlating comparable sites and/or resolving issues that remain.

(3) One month prior to correlation:

(a) States will have available all necessary documentation as outlined in Part 3.C., including soil pits at the review sites.

3. Procedures

A. Internal consistency - site forming factors should be checked to insure compatibility within each factor and between individual factors.

(1) Entries for each individual factor should::

(a) be representative of the site throughout its normal area of occurrence. e.g. Minor occurrence of the site in odd areas (landscapes, slopes, etc.) are not considered to be representative.

(b) Accurately describe the site by portraying the narrowest range of characteristics feasible. e.g. In mountainous areas, elevation-aspect relationships may be important. Original entries may show the site on all aspects at elevations of 5,200 to 6,800'. The actual intent was for the site to be on north aspects at elevations of 5,200 to 6,400' and on south aspects at elevations of 6,400 to 6,800'. The original entries should be changed to reflect the elevation-aspect differences.

(2) Entries for combinations of factors should:

(a) Be compatible between the range of characteristics described for each individual factor with other related individual factors. e.g. A common inconsistency is between the soil classification criteria and the climate factors.

(b) Be compatible between the plant species listed and soil landscape or climate factors. e.g. The presence of obligate wetland plant species are not common where the soil properties listed under the soil factors indicate the absence of a water table or other wetness characteristics.

B. Comparison between sites - Comparisons of site descriptions are made and documented when 1) new sites are proposed or 2) correlations are made between survey areas, MLRA's or states. The criteria used for making comparisons between sites are:

(1) Compare all sites that have two or more major species in common (10% or more composition by weight each) and/or that have the same soil family, groups of similar families or other taxons.

(2) For correlation purposes, initial guidelines for determining significant differences between sites will be:

(a) The presence (or absence) of one or more species that make up 10% or more of the potential natural plant community, as defined in the NRH, by air dry weight, or equivalent forest composition, by production (Site Index and volume) or cover.

(b) 20% (absolute) change in composition air dry weight between any two species in the potential natural plant community as defined in the NRH.

(c) Culmination of mean annual growth increment difference of 15 or mor for tree species in forest or woodland sites.

(d) A difference in average annual herbaceous production of:

50% @ 200 - 500 #/Acre
30% @ 500 - 1000 #/Acre
20% @ >1000 #/Acre

(e) Any differences in criteria (a, b, c, or d), either singly or in combination, great enough to indicate a different use potential or to require different management are basis for establishing (or differentiating) a site (NRH Sec. 302.6).

(f) Upon correlation of the kind, proportion and production of plants within or between sites, the landscape, soils and climate characteristics should be reviewed to insure they reflect the range of characteristics representative of the plant community.

The above criteria are merely guidelines for initiating comparison during the correlation process and would not necessitate site differentiation or combination. The breaks between sites may be finer or broader than the above guidelines, if supported by rationale *and* the differences can be readily and consistently distinguished by the site factors listed in the respective descriptions. Notable exceptions might include sites where one species makes up more that 70% of the production or the occurrence of highly site-specific, minor indicator species.

C. Documentation required

(1) Acreage requirement

(a) A minimum of 200 acres must be identified to propose a site.

(b) A minimum of 2000 acres must be mapped to become an established site.

(c) An exception might be for highly unique or important sites, such as in riparian areas.

(2) Physiographic factors - Copies of field sheets and any supporting maps (geology, topographic, slope, etc.).

(3) Climate - Data from nearest representative weather station(s), research or field study.

(4) Soils - Copies of SCS official series descriptions, SOI-5's and supporting 232's used to describe the range of soil properties typifying the known range of the site.

(5) Vegetation

(a) Sufficient SCS Range 417(s), Range Condition Worksheets or equivalent woodland data, (e.g., SCS-WOOD-5(s), should be completed per soil taxa listed in each site description. If documentation cannot be provided for each soil correlated to the site, soils without such documentation must be designated.

(b) A plant association table (NRH Exhibit 302.7A, or equivalent display) for each site.

(6) Wildlife - Historical accounts, special studies, field observations, species list, etc.

(7) General - Field notes, photographs, etc.

D. Preparation of Reports

(1) Field Review Checklist (Exhibit 1)

(a) To be completed by the responsible range conservationist or the designated representative as a supplement to soil survey area initial, progress and final field review reports. It is also applicable to internal site review processes.

(b) Intended to document the overall status and applicability of the site descriptions, vegetation support data and related actions within the soil survey area on an ongoing basis.

(2) Site correlation checklist (Exhibit 2) - to be completed by the responsible range conservationist or the designated representative to document formal site correlation activities.

4. Records of Site Descriptions

A. Site description files containing complete site descriptions will be maintained by *Proposed*, *Established* and *Inactive* status. The file contents will include:

(1) Site Number

(2) Site Name

(3) Responsible State (As designated by the first two letters FIPS code for state abbreviations used in the standard site description number system)

(4) Status in the following format:

(a) *Proposed* site descriptions to be field tested for at least one year prior to consideration for acceptance. Files will be maintained by the responsible State Offices and NTC's. Proposed site descriptions will be identified with a (P) following the site name indicating its present status.

(b) *Established* site descriptions will be maintained by the responsible State Offices and NTC's. State Offices will maintain supporting documentation of the site descriptions.

(c) *Inactive* site descriptions will be maintained by responsible states.

B. *Site record card files* will be maintained by the responsible NTC for tracking site status and actions.

(1) *Contents* will include:

Site Number ________________

	Author	State Approval	NTC Approval	Date
Proposed	_______	____________	____________	_______
Established	_______	____________	____________	_______
Revised	_______	____________	____________	_______
	_______	____________	____________	_______
	_______	____________	____________	_______
	_______	____________	____________	_______

Inactive		Site #	Name
	Combined with	____________	________________
		____________	________________
		____________	________________

dropping because: ____________________________
____

(2) All users will be notified of any change in status upon approval by NTC.

5. Updating or Revising Site Descriptions

Site descriptions will be updated or revised according to procedures estab lished in the National Range Handbook Section 302.10 (NRH-5, Feb., 1985)

Appendix V

Standard Site Description

Site Number:______________________
Site Name:________________________
Plant Name:_______________________
Date:_____________________________
Initials (Author's/Agency):__________

Part A: Description of Site

1. Landscape Factors

   a. Geographic Location:

      (1) MLRA Name:____
      (2) Local Area:_________________________, __________________________, _________________________
      (3) Typical Location:

      Legal:____1/4;____1\4;____1\4; Sec._____ T.____ R._____ Meridian_____
      Latitude: Deg.____ Min.____ Sec.____
      Longitude: Deg.____ Min.____ Sec.____
      UTM Coordinate: ______________________

   b. Physiography:

      (1) Landform:
      (a) Broad:____
      (b) Specific:________________________, _______________________,
      (c) Microrelief:_____________________, _______________________,
      (2) Elevation/Aspect:
      Low______________/______ ______ High_____________/________ ________
      (3) Slope: Low: _______% High _______%

   c. Landscape Narrative:

   d. Associated Water Features:

      (1) Non-stream Characteristics:

      (a) Non-stream Type(s): (Indicate the appropriate designation(s). If associated with a stream, go to "stream".)
      ________________ ________________ ________________
      ________________ ________________ ________________

      Enter: Lake, Reservoir, Pool, Pond, Spring, Seep, Marsh, Bog, Potholes, Irrigation Conveyance or Other (Specify).

      (b) Drawdown Characteristics (reserved)
      (c) Turnover (reserved)

(2) Stream Characteristics:

(a) Major Stream Type Characteristics

	Stream Type	Gradient Low	Gradient High	Sinuosity Low	Sinuosity High	W/D Ratio Low	W/D Ratio High
1.	____________	____.____	____.____	____.____	____.____	____.____	____.____
2.	____________	____.____	____.____	____.____	____.____	____.____	____.____
3.	____________	____.____	____.____	____.____	____.____	____.____	____.____
4.	____________	____.____	____.____	____.____	____.____	____.____	____.____
5.	____________	____.____	____.____	____.____	____.____	____.____	____.____

	Materials		Confinement Ratio of Floodplain width/bankfull width
	Channel Bed	Bank	
1.	____ ____ ____	____ ____ ____	____ A) Confined (1.0 - 1.5)
2.	____ ____ ____	____ ____ ____	____ B) Moderately Confined (1.5 - 2.5)
3.	____ ____ ____	____ ____ ____	____ C) Unconfined (2.5+)
4.	____ ____ ____	____ ____ ____	____ D) Not Determined
5.	____ ____ ____	____ ____ ____	

(b) Flow Regime (Discharge and channel capacity)

[1] General

Kind: ____________________, ______________________
(Enter: ephemeral, Perennial, Intermittent or Subterranean)

[2] Specific

[a] Position of the Water Column (Channel capacity)

Stage	Season			
	Winter	Spring	Summer	Fall
Low	_______	_______	_______	_______
High	_______	_______	_______	_______

[b] Average Annual Discharge: _________._ to __________ ._

[c] Ratio of 7-day duration high and low flows to the average annual discharge

Stage	Recurrence Interval					
	1.25 Year	2 Year	5 Year	10 Year	25 Year	50 Year
Low High	0.000 0.000	0.000 0.000	0.000 0.000	0.000 0.00	0.000 0.0	0.000 0.0

(c) Drainage Area and Stream Size For Multiple Systems

Extremes of Condition					
Stream Width (Ft)		Stream Depth (Ft)		Watershed Area (Acres)	
Low	High	Low	High	Low	High
___.___	___.___	___.___	___.___	______	______

(d) Special Modifiers

[1] Organic Debris, Channel Blockages, Controls (3 Entries Maxi mum)

_________________________, _________________________,
____

[2] Depositional Features (3 Entries Maximum)

_________________, _________________, _________________

[3] Stream Adjustment Features (3 Entries Maximum)

_________________, _________________, _________________

[4] Other Special Modifiers (3 Entries Maximum)

_________________, _________________, _________________

(e) Ground Water Factors

[1] System Extent: _______________

[2] Source Type: __________________

[3] Source Dependence: ___________ D = Dependent
I = Independent

Note: The following questions can only be answered when source dependence is answered D (Dependent).

Floodplain Recharge: _____ A = Active, I = Inactive
Adjacent Pond Water Recharge: _____ Y = Yes or N = No
Bank Recharge: _____ Y = Yes or N = No
Channel Bed Loss: _____ L = Low, M = Moderate or H = High

(3) Associated Water Features Narrative:

2. Climate Factors

a. Soil Moisture Regime: ______________________, _______________________
b. Soil Temperature Regime: ______________________, ____________________
c. Mean Annual Soil Temperature: _______________ to ________________ (°F)
d. Mean Summer Soil Temperature: _______________ to ________________ (°F)
e. Mean Annual Air Temperature: _______________ to ________________ (°F)
f. Mean Annual Precipitation: _______________ to _______________ (inches)
g. Frost-Free Period: __________________ to _______________ (days)
h Moisture and Temperature Distribution:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
PPT HI	___	___	___	___	___	___	___	___	___	___	___	___	(in.)
MEAN	___	___	___	___	___	___	___	___	___	___	___	___	
LOW	___	___	___	___	___	___	___	___	___	___	___	___	
TEMP HI	___	___	___	___	___	___	___	___	___	___	___	___	(°F)
MEAN	___	___	___	___	___	___	___	___	___	___	___	___	
LOW	___	___	___	___	___	___	___	___	___	___	___	___	

i. Climatic Weather Station:

(1) Location: _____________________________
(2) Station Number: _______________

j. Climate Narrative:

3. Soil Factors

a. Major Soil Family(s) and Classification Typical for the Site:

	Subgroup	Family Adjectives
(1)	______________________________	________________________________
(2)	______________________________	________________________________
(3)	______________________________	________________________________

b. Geologic Formation:
(1) Formation(s): ____________________________, ____________________
(2) Parent material: ________________, ____________________

c. Features of Soil Surface:
(1) "O" Horizon:
(a) Thickness Minimum ________(inches) Maximum _____(inches)
(b) Type _______

(2) Rock Fragments (% cover):

Pebbles Low	_____	High	_____	Boulders Low	_____	High	_____
Cobbles Low	_____	High	_____	Channers Low	_____	High	_____
Stones Low	_____	High	_____	Flagstone Low	_____	High	_____

d. Surface Horizon:
(1) Diagnostic Surface Horizon: __________ Epipedon
(2) Thickness: Minimum ______(inches) Maximum _______(inches)

e. Surface Texture: ____________, ___________, ___________, ___________

f. Soil Depth; (not to exceed 2 classes)
Minimum ___________(inches) Maximum ___________(inches)

g. Major Root Zone Thickness: (for common and many roots)
Minimum ___________(inches) Maximum ___________(inches)

h. AWC for Effective Plant Root Zone: Low _____ High _____(inches/inch)

i. Accumulation (clay $CaCO_3$, etc.):

Depth Minimum (Inches)	Depth Maximum (Inches)	Type	Amount Low	Amount High	Measurement (%, PPM, meq/100gm)
________ to	________	__________	____ to	____	____________________
________ to	________	__________	____ to	____	____________________
________ to	________	__________	____ to	____	____________________
________ to	________	__________	____ to	____	____________________

j. 35% to 50% (vol) Rock Fragments:
(1) Depth: Minimum _____ (inches) Maximum _____ (inches)
(2) Average Thickness: ______(inches)

k. 50% (vol) Rock Fragments:
(1) Depth: Minimum _____(inches) Maximum ______(inches)
(2) Average Thickness ______(inches)

l. Reaction:

	Depth Range (Inches)		Amount (Ph)	
	Minimum	Maximum	Low	High
Surface Layers:	________	________	____	_____
Layers:	________	________	____	_____
All Other Layers:	________	________	____	_____

m. Salinity:

	Depth Range (Inches)		Amount (mmhos/cm)	
	Minimum	Maximum	Low	High
Surface Layers:	________	________	_____	_____
Layers:	________	________	_____	_____
All Other Layers:	________	________	_____	_____

n. Sodicity:

	Depth Range (Inches)		Amount (SAR)	
	Minimum	Maximum	Low	High
Surface Layers:	________	________	_____	_____
Layers:	________	________	_____	_____
All Other Layers:	________	________	_____	_____

o. Annual Pattern of Soil-Water States:

Depth	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0- 4"	___	___	___	___	___	___	___	___	___	___	___	___
4-10"	___	___	___	___	___	___	___	___	___	___	___	___
10-20"	___	___	___	___	___	___	___	___	___	___	___	___
20-40"	___	___	___	___	___	___	___	___	___	___	___	___
40-60"	___	___	___	___	___	___	___	___	___	___	___	___

F: Frozen more than half of the month
W: Wet more than half of the month
M: Moist more than half of the month
D: Dry More than half of the month

p. Water Table (During Growing Season):
(1) Depth: Minimum _____(Ft) Maximum ______(Ft)
(2) Kind: ________________
(3) Month(s): ____________ to ____________

q. Flooding:
   (1) Frequency: _______________
   (2) Duration: _______________
   (3) Months: __________ to __________

r. Ponding
   (1) Depth: Minimum ____ Maximum ____(ft)
   (2) Duration: __________
   (3) Month(s): ___ to ___

s. Soil Narrative:

4. Vegetation Factors

a. Cover:

(1) Canopy Cover and Structure:

	% Cover (Vertical View)	Height (ft)
Trees	_____ - ______	____ - ____
Shrubs	_____ - ______	____ - ____
Grasses, Grass Like, & Forbs	_____ - ______	____ - ____
Cryptogams	_____ - ______	____ - ____

(2) Basal Cover: ________% total

(3) Litter/Residue:

Kind[1]	% Cover	lbs./Acre (ADW)
__________________	___ - ___	_______ - _______
__________________	___ - ___	_______ - _______
__________________	___ - ___	_______ - _______

[1] N = non-persistent
P = persistent
R = residue

b. Vascular Plant Community Composition and Production:

(1) Overstory Trees:

Basal Area (all Trees) ________ - ________ ft²

Symbol	Common Name	Site Index	Ft³/Acre/Yr	% Canopy Cover	% Composition Canopy	Av. Density (No./Acre)
_______	_________________	___-___	_____-_____	___-___	___-___	_________
_______	_________________	___-___	_____-_____	___-___	___-___	_________
_______	_________________	___-___	_____-_____	___-___	___-___	_________
_______	_________________	___-___	_____-_____	___-___	___-___	_________
_______	_________________	___-___	_____-_____	___-___	___-___	_________

Site Index References: ____

____

____

(2) Understory:

(a) Shrubs (and understory trees, if applicable) - - _____ - _____ Total

Symbol	Common Name	Group	% Canopy Cover	% Comosition Air Dry Wt	Group % Allowable	
_______	________________	______	____-____	____-____	____-____	________
_______	________________	______	____-____	____-____	____-____	________
_______	________________	______	____-____	____-____	____-____	________
_______	________________	______	____-____	____-____	____-____	________
_______	________________	______	____-____	____-____	____-____	________

Other .... ____-____NTE____ea

__________ _________________________

__________ _________________________

__________ _________________________

__________ _________________________

(b) Grasses and Grass Like .... ____-____ Total

Symbol	Common Name	Group	% Canopy Cover	% Composition Air Dry Wt	Group % Allowable	
_______	________________	_______	____-____	____-____	____-____	________
_______	________________	_______	____-____	____-____	____-____	________
_______	________________	_______	____-____	____-____	____-____	________
_______	________________	_______	____-____	____-____	____-____	________
_______	________________	_______	____-____	____-____	____-____	________

Other .... ____-____NTE____ea

__________ _________________________

__________ _________________________

__________ _________________________

__________ _________________________

(c) Forbs .... ____-____ Total

Symbol	Common Name	Group	% Canopy Cover	% Composition Air Dry Wt	Group % Allowable	
_______	________________	_______	____-____	____-____	____-____	_________
_______	________________	_______	____-____	____-____	____-____	_________
_______	________________	_______	____-____	____-____	____-____	_________
_______	________________	_______	____-____	____-____	____-____	_________
_______	________________	_______	____-____	____-____	____-____	_________

Other .... ____-____NTE____ea

__________ _________________________

__________ _________________________

__________ _________________________

__________ _________________________

(d) Total Annual Production - Vascular Vegetation

Favorable _________lbs/acre   Average _________ lbs/acre

Unfavorable ___________lbs/acre

c. Cryptogamic Community Production and Composition (for tundra and similar ecosystems):

(1) Lichen Biomass (100%)

Symbol	Common Name	% Canopy Cover	% Composition Air Dry Wt.	Group % Allowable
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____

Other .... ____-____NTE____ea

__________ _________________________

__________ _________________________

__________ _________________________

__________ _________________________

(2) Moss/Clubmoss Biomass (100%)

Symbol	Common Name	% Canopy Cover	% Composition Air Dry Wt.	Group % Allowable
_______	_________________	______-______	_____-_____	_____-____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____
_______	_________________	______-______	_____-_____	_____-_____

Other .... ____-____NTE____ea

__________ ______________________

__________ ______________________

__________ ______________________

__________ ______________________

(3) Cryptogamic Community Production

(a) Total Lichen Biomass:

Range: Low ______ High ______ lbs/acres

Average: __________ lbs/acres

(b) Total Moss/Clubmoss Biomass:

Range: Low ______ High _____ lbs/acres

Average: __________ lbs/acre

d. Documentation:

Seral Stage (Condition)	# Transects	# Data Sheets
Potential (Climax)	____________	____________
Late (Good)	____________	____________
Mid (Fair)	____________	____________
Early (Poor)	____________	____________

e. Vegetation Narrative:

5. Wildlife

a. Species List:

____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________
____________	___________	____________	____________	____________

b. Wildlife Narrative:

6. Community Dynamics (Fire, etc.):

7. List of Commonly Associated Sites (number and names):
   a. Upland:

   b. Riparian or Wetland:

8. List of Competing Sites (number and name):

9. List of Soils Grouped Into the Site By:

Soil Survey Area	Map Unit Symbol	Soil Name and Phase
________	________	________________________________
________	________	________________________________
________	________	________________________________
________	________	________________________________
________	________	________________________________
________	________	________________________________
________	________	________________________________

Standard Site Description

Site Number:

Date:

PART B: Major Vegetation Interpretations for Use and Management of the Site

1. General Interpretations (narrative) for use and management of the site.

    a. Plant Community Characteristics:

    b. Riparian or Wetland Site Progressions (Riparian Area Only)

        (1) Aggradation:

        (2) Degradation:

    c. Grazing:

    d. Forestry

        (1) General Description:

        (2) Managed Stands:

            (a) Possible Management Regimes:

(b) Expected Increases in Cumulative Yields:

(c) Growth Predictions for Onsite Conditions: (Based on on-site inventory data, the model(s) that can be used to predict the effects of management on associated yields at various time intervals.)

(3) Silviculture:

e. Insects and Disease Pests and Animal Damage:

f. Wildlife:

g. Recreation and Natural Beauty:

h. Fire:

i. Range and Forest Understory Rehabilitation:

j. Other Interpretations:

k. Applicable Field Offices:

Appendix VI

Example Riparian-Wetland Site Description

Standard Site Description

Site Number: 048BY001CORTEST

Site Name: MOUNTAIN STREAM MEADOW

Plant Name: DECAS-AGTR

Date: 08/90

PART A: DESCRIPTION OF SITE

1. Landscape Factors

    a. Geographic Location:

        (1) MLRA Name:

        SOUTHERN ROCKY MOUNTAIN PARKS

        (2) Local Area:

        LONG GULCH

        (3) Typical Location:

Legal:	1/4;	1\4;	1\4; Sec. 30 T. 49N R. 2E Meridian
Latitude: Deg	Min.	Sec.	
Longitude: Deg.	Min.	Sec.	
UTM Coordinate:			

    b. Physiography:

        (1) Landform:

            (a) Broad: MOUNTAIN VALLEY STREAMS

            (b) Specific: FLOODPLAIN TERRACES, ALLUVIAL FAN SIDE SLOPES

            (c) Microrelief: SMOOTH-TERRACES, CONCAVE-ALLUVIAL FANS

        (2) Elevation/Aspect:

        Low 7000 / ALL High 11500 / ALL

        (3) Slope: Low: 0 % High 4 %

c. Landscape Narrative:

This site occurs in the SOUTHERN ROCKY MOUNTAIN PARKS Major Land Resource Area (MLRA 48B). It occurs on level to gently sloping soils in smooth floodplain terraces of small stream valleys and high mountain streams, and concave outer margins of seeps or springs at the base of alluvial fans. Slope has no significant influence on plant growth.

Elevation range from 7000 to 11500 feet.

d. Associated Water Features:

(1) Non-stream Characteristics:

(a) SEEP SPRING

(b) Drawdown Characteristics

(c) Turnover

(2) Stream Characteristics:

(a) Major Stream Type Characteristics

	Stream Type	Gradient		Sinuosity		W/D Ratio	
		Low	High	Low	High	Low	High
1.	B3	0.9	1.4	1.0	1.2	8.0	12.0
2.	B4	0.0	0.0	0.0	0.0	0.0	0.0
3.							
4.							
5.							

Materials			**Confinement Ratio Of Floodplain width/bankfull width**
	Channel Bed	**Bank**	
1. 2. 3. 4. 5.	CB GR S	SI C	Confined

(b) Flow Regime (Discharge and channel capacity)

[1] General

Kind: Intermittent

[2] Specific

[a] Position of the Water Column (Channel capacity)

Stage	**Season**			
	Winter	**Spring**	**Summer**	**Fall**
Low High	None Low		Moderate Low	

[b] Average Annual Discharge: 0.0 to 0.9 CFS/Sq. Mi.

[c] Ratio of 7-day average annual discharge

Stage	1.25 Year	2 Year	5 Year	10 Year	25 Year	50 Year
Low	0.000	0.000	0.000	0.000	0.000	0.000
High	6.600	0.000	0.000	81.11	0.0	172.2

The 7-day duration low and high flows are to expressed relative to the average annual discharge (i.e., 1.5, 0.55, 10.0, etc. times the average annual discharge).

[redacted]

(c) Drainage Area and Stream Size For Multiple Systems

Stream Width (Ft)		Stream Depth (Ft)		Watershed Area (Acres)	
Low	High	Low	High	Low	High
5.9	0.0	0.6	0.0	12000	

(d) Special Modifiers

[1] Organic Debris, Channel Blockages, Controls (3 Entries Maximum)

MAN-MADE DAMS, INFREQUENT DEBRIS

[2] Depositional Features (3 Entries Maximum)

[3] Stream Adjustment Features (3 Entries Maximum)

[4] Other Special Modifiers (3 Entries Maximum)

(e) Ground Water Factors

[1] System Extent: LOCAL

[2] Source Type: LATERAL

[3] Source Dependence: DEPENDENT

Floodplain Recharge: Inactive
Adjacent Pond Water Recharge: No
Bank Recharge: Yes
Channel Bed Loss: Low

(3) Associated Water Features Narrative:

This site is associated with B3 and B4 stream types (Rosgen, 1989), and localized lateral flow from up slope seeps or springs, B3 stream types are described as moderate gradients, unstable, with cobble/gravel streambeds. Width/depth rations run 8 to 20, with the mean being 12. These systems are generally well confined.

Landforms/soils are usually depositional, coarse unconsolidated material, steep to moderate rejuvenated slopes with unstable banks.

B4's are moderate gradients, unstable, with sand/gravel channels. Landforms/soils are fine textured noncohesive depositional soils and unstable banks. Width/depth ratios have a mean of 10. These systems are generally well confined.

For associated sites, riparian vegetation is dependent upon streamflow to recharge the groundwater except in localized areas of lateral flow from adjacent seeps or springs. Bank recharge is usually active with channel bed loss being low. Floodplain recharge is usually inactive when the site is in an degraded condition and usually active in an aggraded condition.

2. Climate Factors

a. Soil Moisture Regime: AQUIC
b. Soil Temperature Regime: FRIGID, CRYIC
c. Mean Annual Soil Temperature: 42 to 47 (°F)
d. Mean Summer Soil Temperature: 50 to 60 (°F)
e. Mean Annual Air Temperature: 30 to 44 (°F)
f. Mean Annual Precipitation: 12 to 40 (inches)
g. Frost-Free Period: 40 to 70 (days)
h. Moisture and Temperature Distribution:

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
PPT HI	1.2	1.2	1.0	1.0	1.2	1.1	2.2	2.1	1.4	1.3	0.9	1.2
MEAN	0.8	0.8	0.7	0.7	0.8	0.7	1.5	1.5	0.9	0.7	O.5	0.8
LOW	0.3	0.3	0.3	0.2	0.3	0.2	0.8	0.7	0.4	0.2	0.2	0.3
TEMP HI	26	31	41	55	66	76	80	79	73	62	46	30

MEAN	9	15	26	39	48	56	62	59	52	42	28	14
LOW	-8	-2	11	22	29	36	42	41	32	21	11	-2

(PPT is in inches and TEMP is in deg F.)

i. Climatic Weather Station:

(1) Location: GUNNISON

(2) Station Number: 3662

j. Climate Narrative:

The climate of this site is characterized by cool summers and cold winters. The site has a Snow cover through the winter and early spring and often into late spring at some locations. The average annual precipitation for this site ranges from 12 to 40 inches with the major portion in the form of snow. Maintenance of the site is dependent on natural subirrigation in a cool mountain climate, rather than the amount of precipitation or flooding. The average annual temperatures range from 30 to 44 degrees F. and the frost free period is 40 to 70 days.

Optimum plant growth occurs from mid-May to early June and continues through mid-July or August, although the growing season varies because of the wide range in elevation where the site occurs. Some plants start growth under the snow and develop rapidly following snowmelt. Due to the influence of the ground water table, there is a low or non-existing moisture deficit that seems to favor certain characteristic plants that are scarce or absent on similarly wet soils in drier climates.

3. Soil Factors

a. Major Soil Family(s) and Classification Typical for the Site:

Subgroup
Family Adjectives

(1) FLUVAQUENTIC HAPLAQUOLLS
FINE-LOAMY, MIXED, FRIGID

b. Geologic Formation:

(1) Formation(s):
(2) Parent
MIXED ALLUVIUM

c. Features of Soil Surface:

(1) "O" Horizon:

(a) Thickness Minimum 0.0 (inches) Maximum 0.0 (inches)
(b) Type

(2) Rock Fragments (% cover):

Pebbles	Low _____	High _____	Boulders	Low _____	High _____
Cobbles	Low _____	High _____	Channers	Low _____	High _____
Stones	Low _____	High _____	Flagstone	Low _____	High _____

d. Surface Horizon:

(1) Diagnostic Surface Horizon: MOLLIC Epipedon
(2) Thickness: Minimum 10 (inches) Maximum 15 (inches)

e. Surface Texture: SIL, L

f. Soil Depth; (not to exceed 2 classes)

Minimum 60 (inches) Maximum 75 (inches)

g. Major Root Zone Thickness: (for common and many roots)

Minimum 10 (inches) Maximum 14 (inches)

h. AWC for Effective Plant Root Zone: Low 1.60 High 2.90 (inches/inch)

i. Accumulation (clay $CaCO_3$, etc.):

Depth Minimum (Inches)	Depth Maximum (Inches)	Type	Amount Low	Amount High	Measurement (%, PPM, meq/100gm)
________ to	________	__________	_____ to	_____	____________________

j. 35% to 50% (vol) Rock Fragments:

(1) Depth: Minimum 0 (inches) Maximum 0 (inches)
(2) Average Thickness: 0 (inches)

k. 50% (vol) Rock Fragments:

(1) Depth: Minimum 0 (inches) Maximum 0 (inches)
(2) Average Thickness 0 (inches)

l. Reaction:

Depth Range (Inches) Minimum	Depth Range (Inches) Maximum	Amount (Ph) Low	Amount (Ph) High

Surface Layers:	0	6	7.9	8.4
Layers:	6	14	7.4	7.8
All Other Layers:	14	60	6.6	7.3

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m. Salinity:

	Depth Range (Inches)		Amount (mmhos/cm)	
	Minimum	Maximum	Low	High
Surface Layers:	________	________	_____	_____
Layers:	________	________	_____	_____
All Other Layers:	________	________	_____	_____

n. Sodicity:

	Depth Range (Inches)		Amount (SAR)	
	Minimum	Maximum	Low	High
Surface Layers:	________	________	_____	_____
Layers:	________	________	_____	_____
All Other Layers:	________	________	_____	_____

o. Annual Pattern of Soil-Water States:

Depth	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
0- 4"	F	F	F	M	M	M	M	M	D	D	M	F
4-10"	F	F	F	M	M	M	M	M	M	M	M	F
10-20"	M	M	M	W	W	W	W	M	M	M	M	M
20-40"	W	W	W	W	W	W	W	W	W	W	W	W
40-60"	W	W	W	W	W	W	W	W	W	W	W	W

F: Frozen more than half of the month
W: Wet more than half of the month
M: Moist more than half of the month
D: Dry More than half of the month

p. Water Table (During Growing Season):

(1) Depth: Minimum 1.0 (Ft) Maximum 1.5 (Ft)
(2) Kind: APPARENT
(3) Month(s): APR to JUL

q. Flooding:

(1) Frequency: NONE, OCCASIONAL
(2) Duration: V BRIEF-BRIEF
(3) Months: MAY to SEP

r. Ponding

(1) Depth: Minimum ____ Maximum ____(ft)
(2) Duration: __________
(3) Month(s): ___ to ___

s. Soil Narrative:

The soils of this site have dark-colored (mollic) surface layers with loam and silt loam textures. Typical subsoils are stratified loam, silt loam, silty clay loam and clay loam with thin strata of extremely gravelly sand common at any depth below 14 inches.

These soils are very deep and very poorly drained. The root zone is shallow due to depths ranging from 12 to 18 inches at some time during the months of April through July. Therefore the available water capacity for the soil profile is high and for the root zone is low. Soils that occur on floodplain terraces are occasionally flooded for very brief to Brief periods at some time during the months of May through September and soils outside the floodplain, but along the outer margins of springs and seeps are not subject to flooding. Ground water seems to have the most influence on the vegetation.

Reaction is moderately alkaline in the surface layer, mildly alkaline in the underlying layer, and neutral throughout the remainder of the soil profile.

4. Vegetation Factors

a. Cover:

(1) Canopy Cover and Structure

	% Cover (Vertical View)	Height (ft)
Trees	0 -0	0.0 - 0.0
Shrubs	0 - 5	2.0 - 8.0
Grasses, Grass Like, & Forbs	70 - 90	1.2 - 2.0
Cryptogams	0 - 0	0.00 - 0.00

(2) Basal Cover: 40 % total

(3) Litter/Residue:

Kind[1]	% Cover	lbs./Acre (ADW)
	0 - 0	0 - 0

[1] N = non-persistent

P = persistent
R = residue

b. Vascular Plant Community Composition and Production:

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(2) Understory:
(a) Shrubs
(and understory trees, if applicable) Total 0 - 10

Symbol	Common Name	Group	% Canopy Cover	% Composition Air Dry Wt	Group % Allowable
SABE	BEBB WILLOW	1	0 - 0	0 - 3	0 - 5
SABO	BOOTH WILLOW	1	0 - 0	0 - 3	0 - 5
SADR	DRUMMOND WILLOW	1	0 - 0	0 - 3	0 - 5
POFR4	SHRUBBY CINQUEFOIL	0	0 - 0	0 - 2	0 - 5
	Other 0 - 5 NTE 2 ea				

Symbol	Common Name
ROWO	WOODS ROSE
ARCA13	SILVER SAGEBRUSH
CHRYS	RABBITBRUSH

(b) Grasses and Grass Like Total 75 - 90

Symbol	Common Name	Group	% Canopy Cover	% Composition Air Dry Wt	Group % Allowable
DECA5	RUFTED HAIRGRASS	0	0 - 0	40 - 50	0 - 0
AGTR	SLENDER WHEATGRASS	0	0 - 0	10 - 20	0 - 0
AGRI	STREAMBANK WHEATGRASS	0	0 - 0	2 - 10	0 - 0
AGSM	WESTERN WHEATGRASS	0	0 - 0	2 - 5	0 - 0
CAREX	SEDGES	0	0 - 0	2 - 10	0 - 0
JUBA	BALTIC RUSH	0	0 - 0	3 - 5	0 - 0
JUNCU	RUSHES	0	0 - 0	3 - 5	0 - 0
	Other 3 - 5 NTE 2 ea				

Symbol	Common Name
FEOV	SHEEP FESCUE
FETH	THURBER FESCUE
POPR	KENTUCKY BLUEGRASS
AGAL3	REDTOP BENTGRASS

(c) Forbs Total 10 - 20

Symbol	Common Name	Group	% Canopy Cover	% Composition Air Dry Wt	Group % Allowable
POTEN	CINQUEFOIL	0	0 - 0	3 - 5	0 - 0
ACM12	COMMON YARROW	0	0 - 0	3 - 5	0 - 0

ASTER	ASTER	0	0 - 0	3 - 5	0 - 0
TRIFO	CLOVER	0	0 - 0	3 - 5	0 - 0
IRMI	ROCKY MOUNTAIN IRIS	0	0 - 0	2 - 3	0 - 0
	Other 5 - 10 NTE 2 ea				

Symbol	Common Name
SENEC	GROUNDSEL
VICIA	VETCHES
CIRSI	THISTLES
EPAN2	COMMON FIREWEED
THERM	GOLDENPEA
MENTHA	MINT
LIGUS	LICORICEROOT

(d) Total Annual Production - Vascular Vegetation

Favorable	3000	lbs/acre
Average	2500	lbs/acre
Unfavorable	2000	lbs/acre

d. Documentation:

Seral Stage (Condition)	# Transects	# Data Sheets
Potential (Climax)	____________	____________
Late (Good)	____________	____________
Mid (Fair)	____________	____________
Early (Poor)	____________	____________

e. Vegetation Narrative:

Grasses and sedges give this site its characteristic meadow appearance and comprise 75 to 90 percent of the annual yield. A great variety of forbs are showy when in bloom and may comprise up to 20 percent of the annual yield. Tufted hairgrass is dominant in potential. Slender wheatgrass, streambank Wheatgrass, sedges, and rushes are other common grasses. Kentucky bluegrass and redtop may also be conspicuous introduced grasses. Common forbs include herbaceous cinquefoils, yarrow, asters, mints clovers, and iris. Goldenpea, groundsels, licoriceroot, and fireweed may also be present. Shrubs when present, may include shrubby cinquefoil, and Bebb, Booth and/or Drummond Willow. Some rabbitbrush, rose, or silver sagebrush may also be present in small amounts.

The vegetation of this site is influenced by a seasonally high water table that usually recedes to deeper than 20 inches late in the growing season.

5. Wildlife

    a. Species List:

MULE DEER	ELK
PRONGHORN	MALLARD DUCK
SAGE GROUSE	GOLDEN EAGLE
COTTONTAIL RABBIT	JACKRABBIT
GROUND SQUIRREL	COYOTE
HUMMINGBIRD	GARTER SNAKE
TOADS	REDTAIL HAWK
KILLDEER	OWLS
FLICKERS	FLYCATCHER
ROBINS	WRENS
THRUSHES	WARBLERS
MEADOWLARK	GROSBEAK
FINCHES	SPARROWS
BATS	BOBCAT
VOLES	JUMPING MICE
BEAVER	

    b. Wildlife Narrative:

This site can provide habitat for a wide array of wildlife species as noted in the species list. The number of species and size of populations is related to the number of acres of habitat.

Systems that are degraded (incised gullies) provide little or no habitat for wildlife. Most species would only use the site for watering when and if it was available.

In aggrading systems (gully healing), most species present with potential become common. As the site aggrades channel types, vegetation succession can advance to higher ecological stages and the extent of the site will approximate historic positions. This will allow for significant increases in numbers of wildlife. Species that will show significant increases include waterfowl, mule deer, rabbits, shorebirds, song-birds, beaver, jumping mice, bats, bobcats, raptors, and sage grouse.

6. Community Dynamics (Fire, etc.):

7. List of Commonly Associated Sites (number and names):

    a. Upland:

048XY245CO Mountain Swale - The Mountain Swale range site is located on adjacent rarely or non-flooded valley bottom positions. Vegetation is a basin or mountain big sagebrush/basin wildrye-rhizomatous wheatgrass potential.

b. Riparian or Wetland:

048BY002CORTEST Mountain Stream Bank - The Mountain Stream Bank site is usually located adjacent to the stream channel or concave positions that remain moist to the surface throughout the growing season and maintain a higher water table. Vegetation is dominantly willow/carex in potential.

8. List of Competing Sites (number and name):

9. List of Soils Grouped Into the Site By:

Soil Survey Area   Map Unit Symbol

Soil Name and Phase

CO000   1
FLUVAQUENTIC HAPLAQUOLLS, FINE-LOAMY, MIXED, FRIGID, OCCASIONALLY FLOODED, 0 TO 2 PERCENT SLOPES

PART B: Major Vegetation Interpretations for Use and Management of the Site

1. General Interpretations (narrative) for use and management of the site.

   a. Plant Community Characteristics:

      On relatively undisturbed sites, tufted hairgrass is dominant over other graminoids and forbs. Litter is dense on drier extremes of the site but may be absent on moist extremes. Willows may be present in small amounts where this site occurs as a result of site progression from the Mountain Stream Bank site.

      Moderate grazing reduces the reproductive potential and vigor of tufted hairgrass through reduced seedhead production and depletion of carbohydrate reserves. Under heavy grazing, tufted hairgrass vigor is further reduced and other graminoids and forbs dominate the site. Species most likely to invade the site are dandelion and introduced forage grasses, especially timothy, redtop, and Kentucky bluegrass. Canada thistle is a troublesome invader in some places. Annual forbs such as owl clover may also come in. Several plants natural to the site in small amounts also tend to increase at the expense of the major climax grasses. Typical plants in this category are Baltic rush, iris, yarrow, herbaceous cinquefoils, false hellebore, rose, and shrubby cinquefoil. Sheep fescue and silver sagebrush also tend to increase but are not consistently on the site. Shrubby cinquefoil gives the dominant aspect to many deteriorated spots.

      Successional Communities:

CLIMAX/PNC	GOOD/LATEF	AIR/MID	POOR/EARLY
CT 1.1	CT 2.1	CT 3.1	CT 4.1
DECA5-AGTR	JUBA-DECA5-AGTR	AGAL3-JUBA-AGTR	AGAL3(PHPR3)-JUBA
	CT 2.2	CT 3.2	CT 4.2
	SALIX/AGTR-DECA5	SALIX/CAREX-JUNCUS	POPR-AAFF-PPFF
		CT 3.3	CT 4.3
		POFR4-CAREX-JUNCUS	POFR4-AAFF-PPFF

b. Riparian or Wetland Site Progressions (Riparian Area Only)

(1) Aggradation:

With aggradation of the stream channel or blockages such as beaver dams to raise the water table, this site can progress to a willow/carex potential of the Mountain Stream Bank site.

(2) Degradation:

Lowering of the water table by stream incision, bank widening, or loss of blockages can result in site progression to the upland site potential of big sagebrush/ basin wildrye-rhizomatous wheatgrass of the Mountain Swale range site.

c. Grazing:

Tufted hairgrass is preferred as mid to late season pasture by livestock following forage depletion on adjacent uplands. However, earlier use may occur when in complex with willow dominated sites used for shade and when near available water sources. Grazing has limited impact on tufted hairgrass meadows when done in moderation. Grazing should be deferred until surface soils are dry. Proper levels of grazing should range from light to moderate. When in complex with willow or aspen dominated sites, grazing should also be keyed to browse utilization on those sites.

Sustained close grazing reduces the reproductive potential and vigor of tufted hairgrass through reduced seedhead production and depletion of carbohydrates reserves. With continued overuse, tufted hairgrass becomes subordinate to other graminoids and forbs.

This site in mid seral or better ecological status will respond rapidly to improved grazing strategies. Time season of use to both the drying of the soil surface and to maturation of seedheads of tufted hairgrass. Livestock should be removed when 40 percent or less utilization is obtained.

Sheep have light impact on this site when herded. Bed sheep in adjacent uplands.

Reference: Hansen et al. 1989. Classification and management of riparian sites in southwestern Montana. Draft version 2, University of Montana.

Kinch, Gene. 1989. Grazing management in riparian areas. TR 1737-4, BLM.

Kovalchick, B. L. 1987. Riparian zone associations Deshutes, Ochoco, Fremont, and Winema National Forests. R6 ECOL TP-279-87, FS.

d. Forestry

(1) General Description:

There are no forest or wood product values associated with this site.

(2) Managed Stands:

(a) Possible Management Regimes:

(b) Expected Increases in Cumulative Yields:

(c) Growth Predictions for Onsite Conditions: (Based on on-site inventory data, the model(s) that can be used to predict the effects of management on associated yields at various time intervals.)

(3) Silviculture:

e. Insects and Disease Pests and Animal Damage:

f. Wildlife:

g. Recreation and Natural Beauty:

This site provides opportunities for viewing big game during the summer and fall, especially at higher elevations, and winter at lower elevations. Those sites near streams provide access for fishing. Roads, trails, and campgrounds should not be located on this site.

h. Fire:

Tufted hairgrass is resistant to damage from fire. Root crowns are rarely damaged, even by hot, intense fires. However, repeated burning of this site can favor rhizomatous species such as Kentucky bluegrass and the wheatgrasses. Burning should be postponed if livestock are present to avoid attracting animals to young, palatable regrowth of tufted hairgrass (Hansen et al., 1989).

i. Range and Forest Understory Rehabilitation:

This site in mid seral or better ecological status will respond rapidly to improved grazing strategies.

On stands in early seral status the density of tufted hairgrass is too low to achieve rapid response, so more intensive rehabilitation strategies will be required. Domestic species such as Kentucky bluegrass, timothy, and meadow foxtail may be seeded but tufted hairgrass is preferable (Kovalchick, 1987).

Where this site borders a stream, tufted hairgrass shows little potential for use in streambank rehabilitation because of its thin fibrous root system. Baltic rush produces a deep fibrous root system, with a mass of coarse and creeping rhizomes, and once established, rapidly spreads. These soil holding characteristics may make it valuable for stabilizing streambanks.

j. Other Interpretations:

k. Applicable Field Offices:

Appendix VII

Other Suggested Technical References

A. Rosgen, D. and B. Fittante. 1986. Fish habitat structures: A selection guide using stream classification. Fifth Trout Stream Habitat Improvement Workshop. Lock Haven University, Lock Haven, Pennsylvania, August 11-14, 1986. 18 pp.

B. Part 602 - Soil Classification

Exhibit 602-4 Reference materials that may be helpful to increase accuracy and efficiency of soil surveys

1. Older soil surveys of survey area
2. Soil surveys of adjoining counties
3. Soil surveys for conservation planning
4. Major land resource maps
5. General soil maps
6. All available airphoto coverage
7. Topographic and slope maps
8. Maps and texts on geology and geography
9. Maps and texts on water resources
10. Maps and text on vegetation and land use
11. Climatic maps and data
12. Census reports
13. Crop reporting service reports
14. Multispectral data
15. River basin reports
16. State, regional, or county land use plans and regulations
17. RC&D work plans
18. Public lands management reports and inventories
19. Bulletins and reports of state agricultural experiment stations
20. Thesis of college or university students
21. Soil Survey Investigations Reports
22. Scientific and technical journal articles
23. Well logs from local or state agencies
24. SCS drainage, irrigation, and erosion control guides
25. Percolation test results from local agencies
26. Highway soil tests
27. Forest inventories
28. First draft interpretive tables by computer printout generated from Forms SCS-SOI-5

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