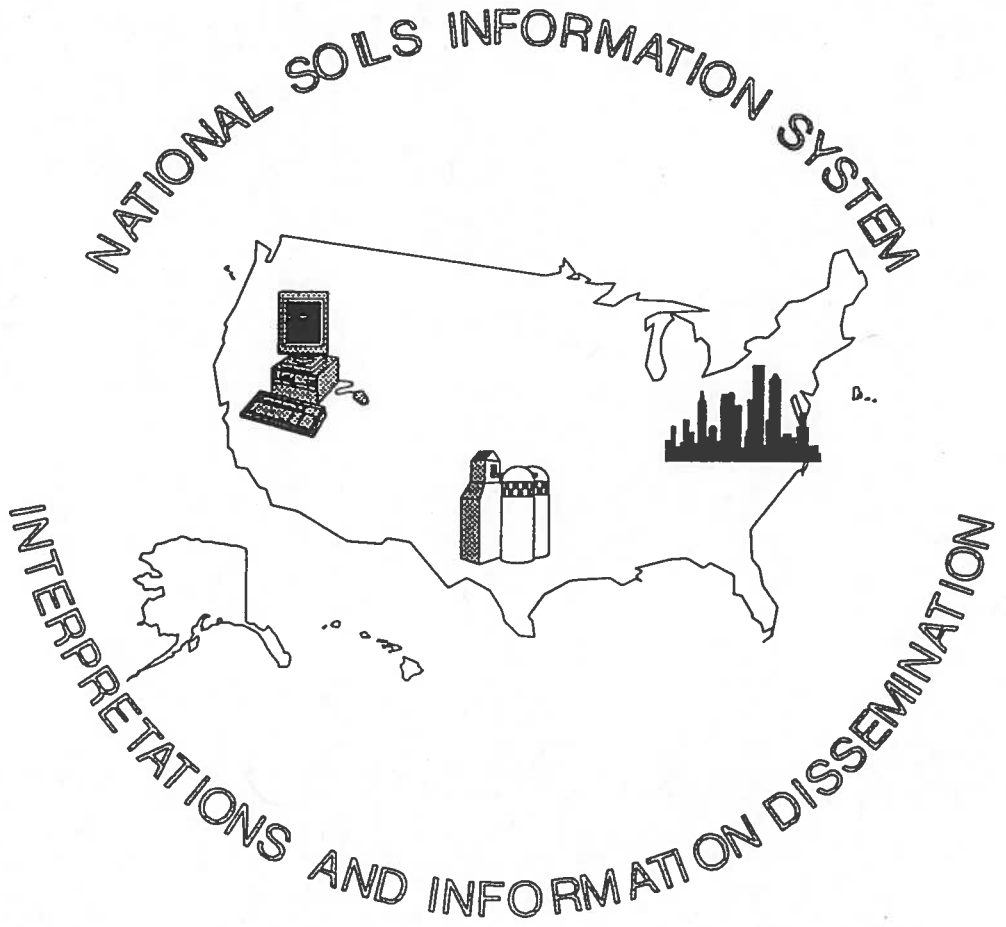
DRAFT REQUIREMENTS STATEMENT

USDA SOIL CONSERVATION SERVICE



DRAFT REQUIREMENTS STATEMENT

USDA-SOIL CONSERVATION SERVICE

NATIONAL SOILS INFORMATION SYSTEM
SOIL INTERPRETATION AND INFORMATION DISSEMINATION SUBSYSTEM

DRAFT REQUIREMENTS STATEMENT

January 25, 1991
Revised August 19, 1991

Chris Smith DRS
Jon Vrana DRS

SPECIAL STUDY TASK FORCES

Soil Series

Henry Mount, Chair
Berman Hudson
Dennis Nettleton
Bob Engle
Daniel Ernstrom

Data Reliability

Benny Brasher, Chair
Richard Fenwick
Berman Hudson
H. Raymond Sinclair, Jr.
Christopher W. Smith
Daniel Ernstrom

Additional invaluable help was received from a number of end users of soils information who assisted in determining the user requirements for the soils information to be provided by the proposed system. This included people from other disciplines within the Soil Conservation Service as well as users in other agencies and the private sector.

Acknowledgments

This report is the result of the cumulative effort of the following principal contributors who include those participating in the earlier phases of the project including the Initial Study Report (ISR), the Detailed Study Report (DSR) and the Draft Requirements Statement (DRS). The participants are listed by the main roles they performed.

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Table of Contents

Table of Contents (cont.)

1.0 Perspective

1.1 Purpose of the Draft Requirements Statement

The purpose of the Draft Requirements Statement (DRS) is to state the known logical requirements for the National Soils Information System. These requirements are presented in terms of an outline of the new logical model, updated objectives, and constraints on the physical design. The DRS states the requirements to the point that an Outline Physical Design (OPD) can be developed. Physical implementation of a system designed to meet these requirements may take considerable time and is dependent on physical constraints such as hardware and other resources. It is also dependent on policy as well as impacts to various user communities.

The DRS provides information to the NASIS Steering Body, NHQ Soil Survey management, Technology Division managers, and the Information Resources Board so that they may provide informed direction for the system development effort.

1.2 System Purpose

The fundamental purpose of the National Soils Information System (NASIS) is to accommodate collection, storage, manipulation and dissemination of soil survey information to clients in a manner that is most suitable for making informed decisions about natural resources.

1.3 Phasing of Analysis

The project intent is to identify, develop, and implement subsystems that are suitable for modular implementation and that have the potential for high return at the earliest practicable time.

Soil Interpretations and Information Dissemination (SIID) is a subsystem within NASIS that is likely to produce significant benefits if implemented before the remainder of the system. Consequently, analysis of this subsystem is being expedited. In addition to this DRS, the expedited analysis will consist of the following items:

- the Outline Physical Design (OPD)
- Total Requirements Statement (TRS)
- analysis of conversion requirements for the current data bases that will be displaced by the proposed information system.
- the practicality of an interim data collection/recording function.

Based on the expedited analysis, the NASIS Steering Body, NHQ Soils management, Technology Division management, and the Information Resources Board will make a decision whether to implement the SIID subsystem prior to completing work on the remainder of the system.

1.4 Scope of Document

This document addresses only the SIID functions. Information related to Data Collection/Recording and Aggregation, which are other functions of the system, is included only to clarify the context.

Data Collection/Recording and Aggregation will be the subject of a subsequent Draft Requirements Statement. Its preparation will be a secondary effort that can proceed concurrently with the higher-priority efforts being given the SIID subsystem.

2.0 Background Summary

The focus of the National Cooperative Soil Survey is shifting from producing static, printed soil survey reports to providing a dynamic resource of soils information that can service diverse, individualized needs. The National Soils Information System will be required to support the shift in concept in three important areas:

- support of field operations to gather new information in compliance with standards
- application of expert knowledge to make information usable for an increasing variety of purposes, and
- making the information readily available to a wide variety of users

Advances in automation and information processing technology relieve many of the prior constraints on the management, organization, and usability of the large and complex sets of data that are characteristic of soils information. Current automation continues to use concepts and techniques imposed by earlier manual systems.

The goal of the NASIS project analysis is to determine the requirements for a system that will meet the change of emphasis, recognize opportunities that are opened through advanced technology, and determine the means to accomplish the transition.

2.1 System integration perspective

The proposed system encompasses data collection and recording, data organization and management, classification, interpretations, and soils information dissemination. The functions of the system must implement management policy, concepts, and operating principles accurately and uniformly.

2.1.1 Analysis considerations

Each function must be analyzed in the context of the entire system to assure integrity of the overall system and to determine where automation would be appropriate and beneficial. Exclusion of any of the functions from the analysis could lead to a fragmented outcome with incompatibilities. There is some risk in not including analysis for the data collection and aggregation portion of NASIS with this DRS. However, because of the logical separation of the two identified phases it is considered to be minimal.

2.1.2 Management considerations

Management policy, concepts, technical standards, and operating principles are the central organizing factors for the system.

2.1.2.1 Data collection and recording

Data collection/recording practices and mechanisms must be sufficiently rigorous and unambiguous to ensure a consistent recording of the same kinds of occurrences.

2.1.2.2 Data organization, storage and management

Soils data organization, storage, and management must preserve the integrity, continuity, and entirety of the soils information.

2.1.2.3 Information dissemination

The dissemination of the information must convey to the user accurate soils information that is consistent with the observations and scientific judgement of the collector/recorder.

2.2 Fundamental concepts subject to reevaluation

The kinds of soil information provided to users and the methods used to collect, store, and deliver the information are open to reevaluation.

2.2.1 User requirements.

The NASIS analysis has attempted to identify the ideal, essential requirements that are not limited by previous operational constraints. In subsequent phases, implementation design constraints may cause limitations to be imposed, but only as the result of a documentable design trade-off.

Currently, requests for soils information are constrained by the way soils information has been provided to users. These requests are conditioned by the various principles and practices in soil survey that were adopted to facilitate the use of large, complex sets of data without the advantages of current computer technology. One such practice is grouping data into structured units that are difficult to regroup at different levels of generalization or for different purposes. These groups may not always meet users needs.

NASIS must meet the needs of a diverse, but defined, user community. A complete analysis of the essential requirements of users is necessary to be able to best meet their needs. This requires an understanding of their actual purpose for soils data in order to define the information content and access that will satisfy the purpose. Without a clear understanding of the eventual purpose, requirements are apt to be mis-stated.

It is recognized that not all user needs and specific applications will be known or understood prior to design of NASIS. It is also recognized that NASIS will not be able to meet all possible user desires for soils information. However, if essential kinds of access and information are defined then specific requests for information can be accommodated. Generic data structures and generalized access to data that are based on an understanding of user requirements will make the system more flexible and extend its useful life.

2.2.2 Soil survey operations

All facets of soil survey information including information collection, storage, and dissemination have been open to analysis to ensure system compatibility with user requirements and to support policy, concepts, and practices.

2.2.3 Implementation of new ideas

An integrated approach to analysis has provided an opportunity to collect, review and assimilate suggestions, ideas and user requirements from many different sources. When considered in isolation, many of the ideas appear impractical to implement. However, within the framework of a complete analysis of all aspects of NASIS as an integral system, the ideas may become practical.

3.0 Definition of Terms

Component data record: A set of property or attribute values that represents a portion of all delineations of each map unit on a soil map. The soil or miscellaneous area represented by the component data record is referred to as a "Component". The Component is not delineated but its extent within the delineations of each map unit is defined. It is recorded as a percent of area that it occupies within the map unit. The actual location can usually be defined in relation to landscape features. A component is defined by a set of known or estimated soil profile characteristics and a corresponding set of attributes which define the setting.

Delineation: An area on a map that is bounded by a line.

Map Unit: A grouping of one or more delineations defined and named the same in terms of its components. Each map unit differs in some respect from all others in a survey area and is uniquely identified on a soil map (Soil Survey Manual, Draft, March 1989 modified).

Interpretation: A general use for a soil interpretation; such as agriculture, septic tank filter fields, or housing subdivisions.

Interpretation Aspect: An interpretation can be subdivided into aspects. Each aspect is a different part of an overall interpretation. An example would be construction, maintenance and environmental aspects for the use *septic tank filter fields*. Each aspect may have different criteria that may or may not apply to the other aspects for the use.

Essential vs. Implementation: In data analysis there is a major difference between the concept of what is meant by "implementation " and what is meant by "essential " data.
The term "essential " is used to represent necessary data for the purpose of the business. It does not take into consideration:

- Means of Storage: as a paper document, or in a computer data base.

- Where it is stored: distributed among various locations or a central location.

- Physical means of access: computer terminal, printed report, or pulling a file folder from a drawer.
- State of automation: manual calculation or computer calculation.

The term "physical" refers to the form in which data or systems are implemented.

Essential refers to "what"
Implementation refers to "how"

The essential aspect of data and systems is not directly impacted by technological change (new computer systems or improved software); the

implementation aspect of data and systems can be drastically impacted by technological change.

Observation: Any examination or recognition of resource property values. Examples would be field measured soil characteristics or, vegetation or land forms.

Primary Soil Characteristics : Actual data values for soil characteristics made from site specific observations.

Primary Component Data Record Data: Non-classed component data record data. That is component data records which have not been grouped into other classes or aggregations.

4.0 Fundamental NASIS Concepts

A review of the more significant proposed fundamental concepts of NASIS is necessary to be able to grasp the extent and nature of the impacts and potential benefits. Comprehension of these concepts is necessary to understand the essential data model. Although most of these concepts are incorporated in the statements of Objectives, Current Limitations, and Enabling Tasks, it will aid comprehension if they are summarized here.

4.1 The component data record is the basic data building block

A component data record (Fig. 1) is the information stored within the information system that represents the most elementary, relatively homogeneous identifiable soil entity or miscellaneous area within a map unit. It represents a soil or miscellaneous area which has spatial extent and a set of property values which define its range in characteristics. The component data record is the basic building block for interpretation and information aggregation. All interpretations and geographic generalizations of data will draw upon the component data record.

4.2 Availability of detailed primary soil property data

One user requirement for NASIS is to have access to the most detailed information available. Although detailed information is collected in the form of pedon descriptions, transects and field notes, most of the detail is not available to users in the soil survey report. Historically the soil survey report has been the primary mechanism for providing soils information to users. In the future NASIS will be a dynamic soils information system that will enable many different output formats and levels of detail. A conventional soil survey report would be only one of these output formats. It is an objective of NASIS to be able to provide as much detailed information as has been collected and recorded. The level of information provided (either detailed or generalized) should be determined by the users need, based on the availability of data and the detail appropriate for the intended use.

4.3 Utilization of a representative or expected value

Many new uses of soils data, such as models, require a single value for a soil property rather than a range in values. NASIS needs to have the ability to portray a representative or expected value (RV) for each property where appropriate) of a component data record (Fig. 2).

Components are formed from observations

Observations have:

- sets of properties
- known location

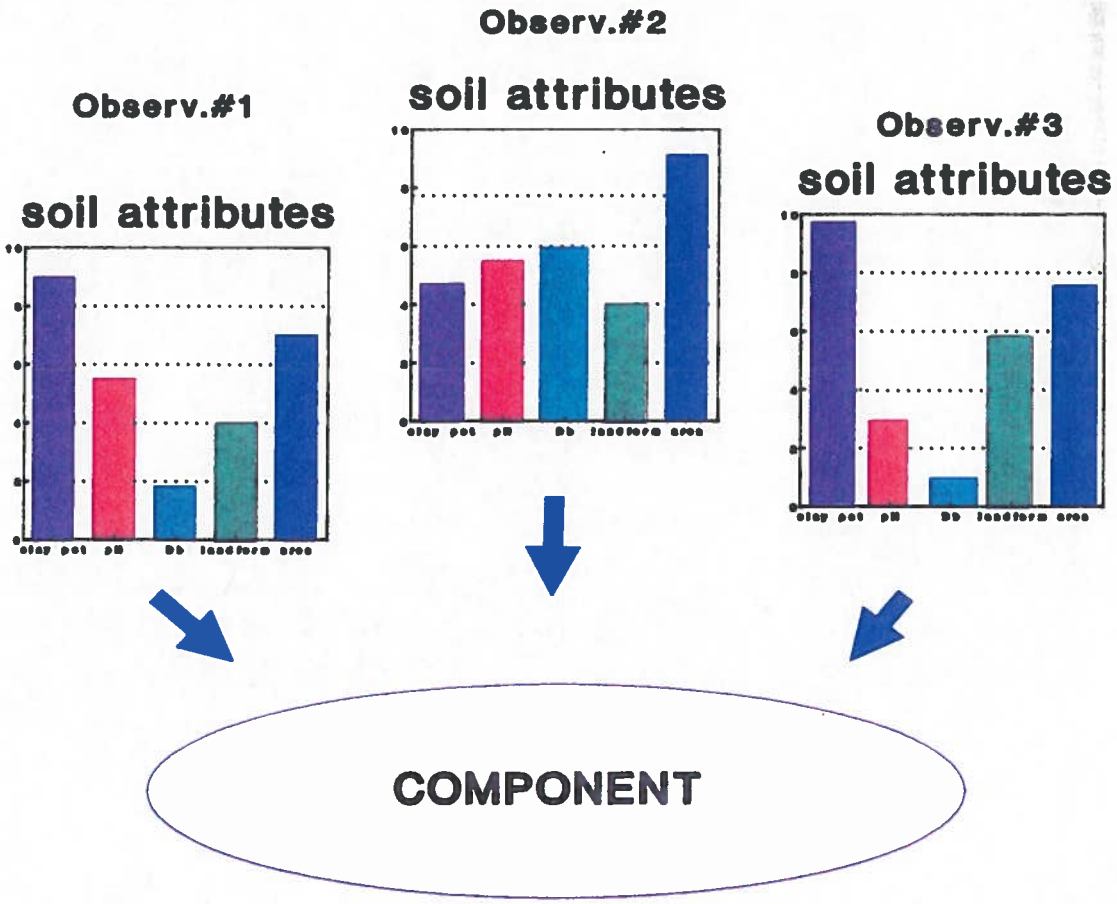


Figure 1

SOIL ATTRIBUTES

VARIANCE FOR A COMPONENT DATA RECORD

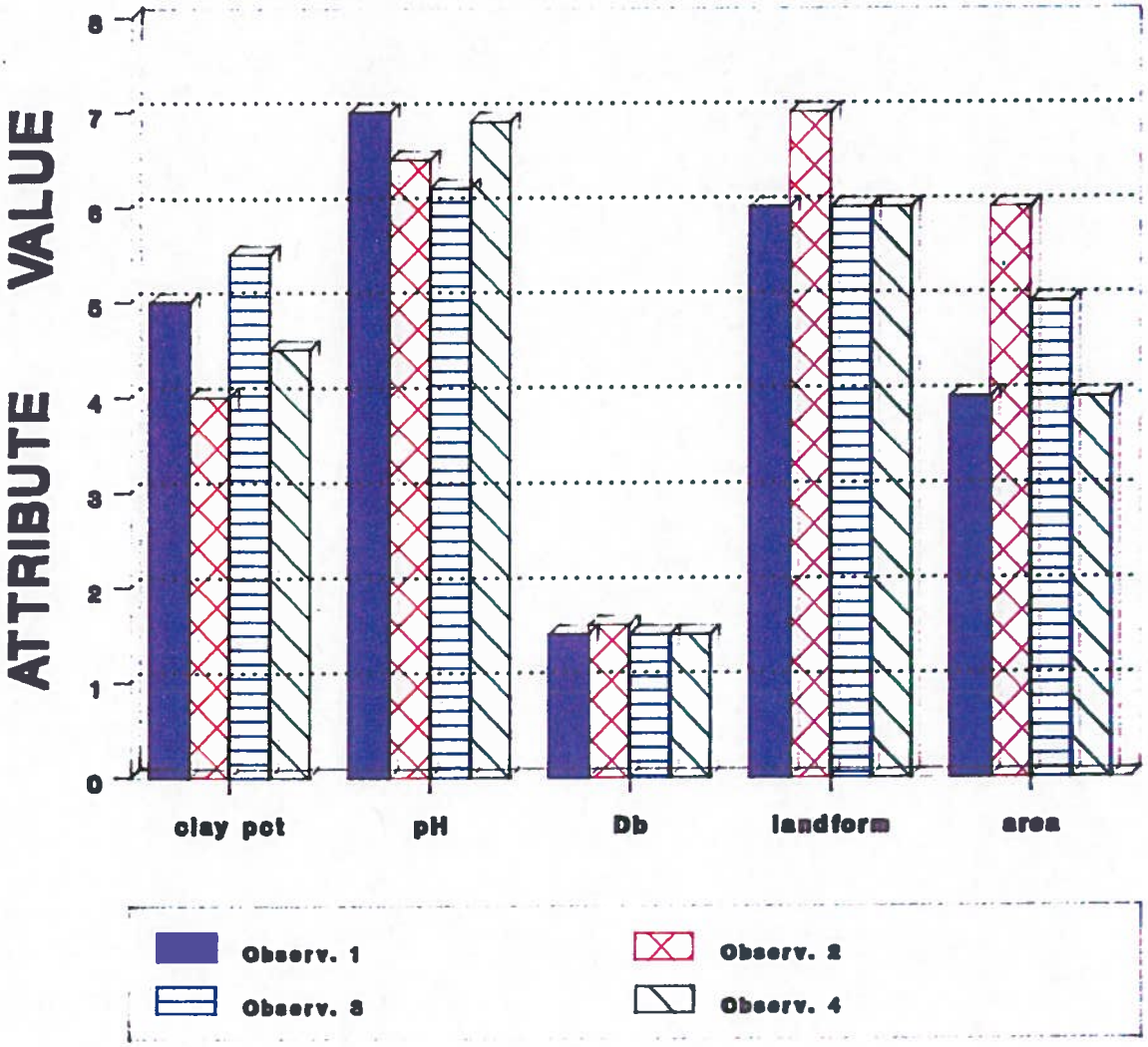


Figure 2

The representative value may be generated by default (by taking an average for the range of values where no better information exists), or, it may be desirable to select a reference profile as an expression of a single value for each property. The data collector may also choose to set the value based on unrecorded observations. In this case the user needs to be provided with the knowledge of how the representative value was determined. (See 4.6.4) The representative value may be determined based on a statistical sampling of collected data provided there is sufficient data available to be statistically valid. The method for selecting the representative value will vary based on availability of data and purpose for which the data will be used. NASIS should provide for all the above possibilities in setting the value.

4.4 Aggregations of data from component data records

NASIS information must be consistent at all levels of aggregation. More detail will be added to soil survey information through the update process and the definition and proliferation of component data records will change. As this happens, any data aggregated and stored at a level more general than the component data record may become outdated. Therefore, NASIS must be able to aggregate as often as needed from primary component data records . This will result in information that will be consistent at all levels of aggregation.

4.5 Use of primary component data record soil properties for soil interpretations

NASIS must provide for the use of primary component data record data values for making soil interpretations.

4.6 Recognition of data quality

4.6.1 Soil attributes of component data records.

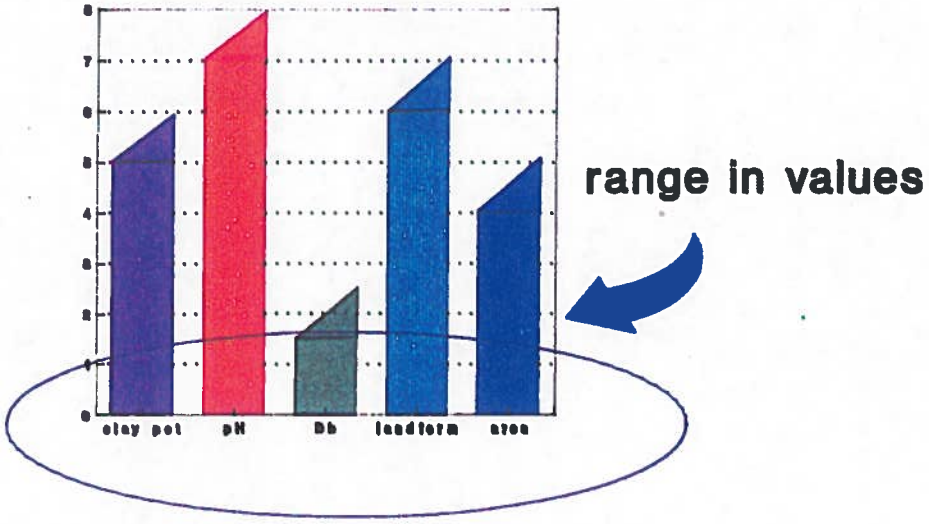
Component data records have sets of soil attributes originating from primary soil attributes (Fig. 3). As profile, pedon, and setting data become available, grouping and summerization of these soil attributes can provide the ranges, means, RV's and modal characteristics for component data records. Evaluation of the quality of these and other kinds of statistical descriptions of component data record characteristics will require that the reliability as well as the quantity of the observations of the soil properties be known and communicated to users.

4.6.2 Component data records of delineations/map units.

Map units are characterized by sets of component data records (Fig. 4). As transect and field note data become available,

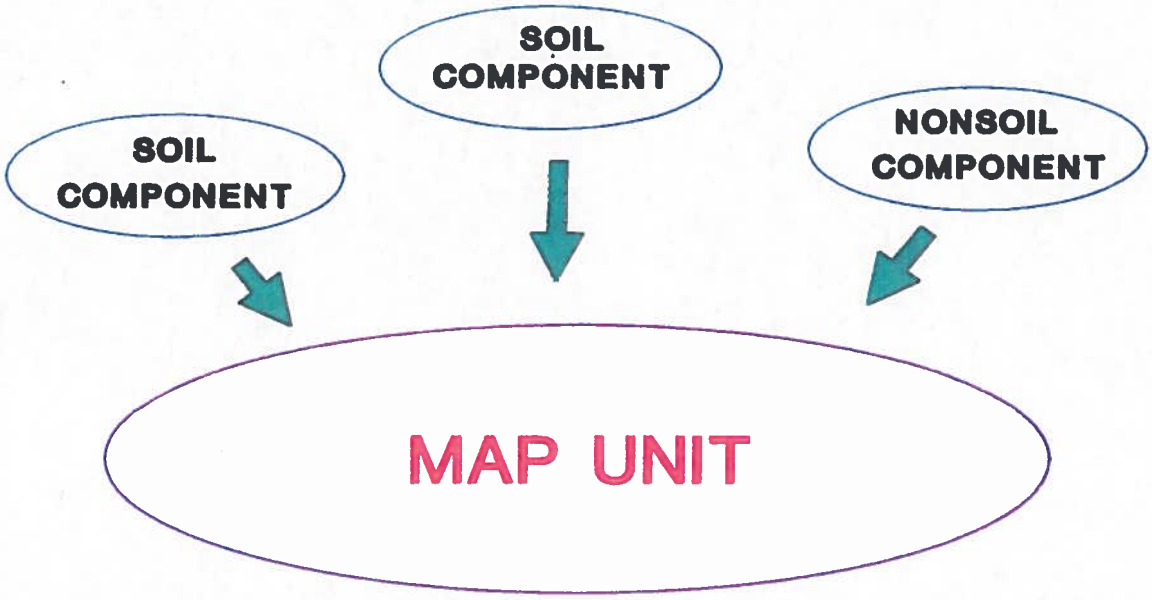
COMPONENT

soil attributes



- set of attributes
- determined extent
- unknown location except by relative landscape position

Figure 3



- map units have sets of components
- each component has a "Component Data Record"
- each component has defined:
  - attributes
  - pattern
  - extent

Figure 4

summarization of these primary soil properties of component data records will provide the ranges, means, RV's and confidence levels of component data record composition and extent in delineations. Evaluation of the reliability of the composition of delineations will require that the reliability of the observations be known.

4.6.3 Extension of observations.

In some cases, soil properties of components and their distribution in delineations will have been measured. However, in most cases, component delineation characteristics will be projected from similar component data records or delineations.

4.6.4 Describing reliability.

A committee was established by the Steering Body for this project to resolve the issue of communicating a better understanding of the meaning of data supplied by the system. The need for describing reliability is recognized by the Steering Body. NASIS will accommodate a yet-to-be determined method, based on the conclusions of the committee's work.

4.6.5 Using reliability in the delivery of soil interpretations.

Reliability of primary soil property values and primary component data record data values should be known, and users should be able to specify minimum levels of data reliability, quality, and limitations to be used in reporting soil data and preparing interpretations.

4.7 Soil interpretations that provide more specificity and flexibility in meeting user needs

4.7.1 Interpret all components in a map unit.

NASIS, should provide the capability for interpreting the component data record for each soil identified (Fig. 5) in a map unit, and aggregating the interpreted component data records according to user selected criteria. In addition to providing interpretations for the dominant named component, the user should be able to select aggregated interpretations for all components in the map unit. Interpretations made in this manner have the flexibility to duplicate the current methods of interpretation as well as produce interpretations that reflect the entire composition of each map unit.

It is the intent to account for the local generation of soil potentials, either wholly or in part from NASIS. It may be necessary to develop soil potentials through the use of NASIS in concert with other information systems.

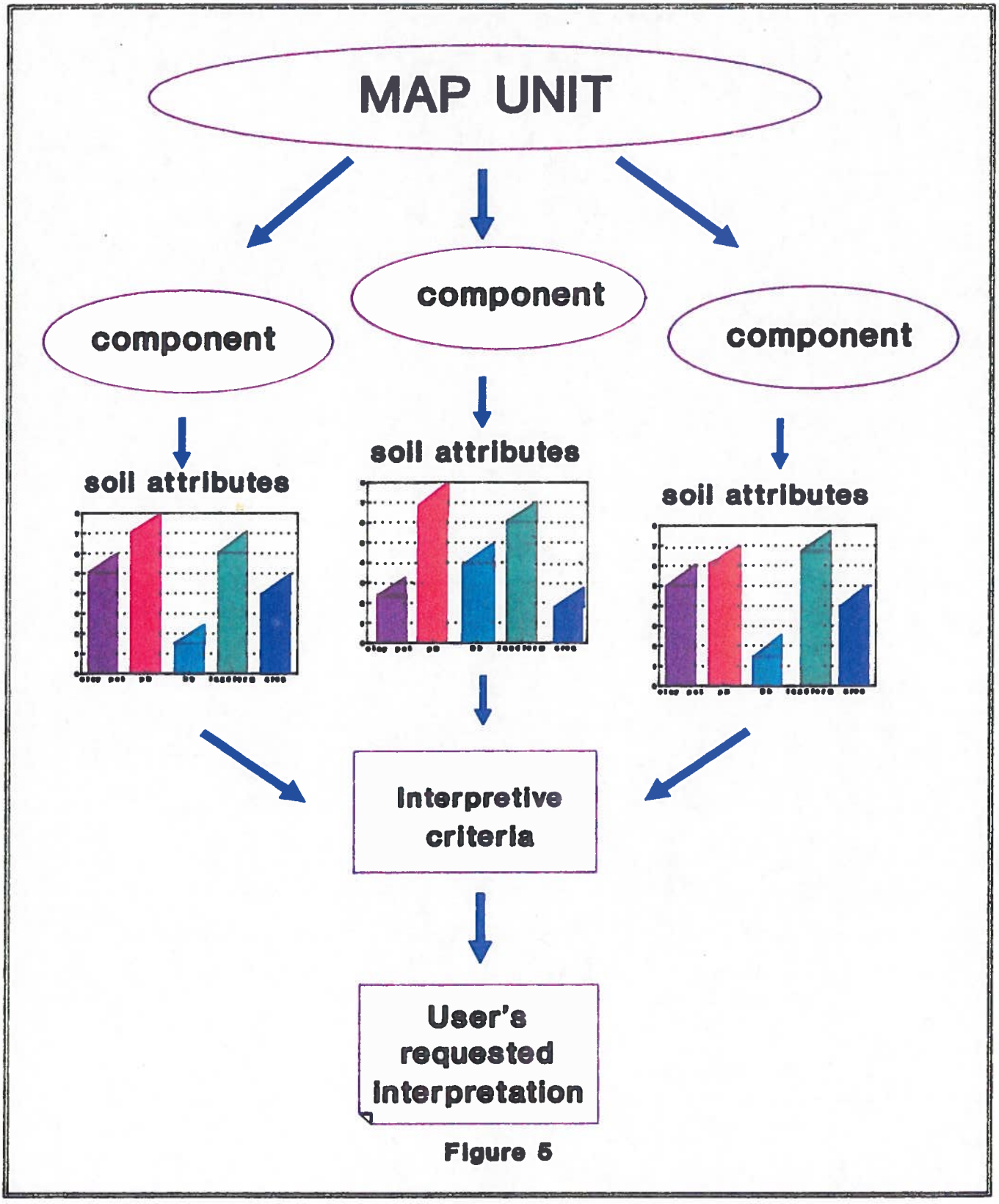

MAP UNIT
component
component
component
soil attributes
soil attributes
soil attributes
Interpretive criteria
User's requested interpretation

Figure 5

4.7.2 Produce interpretations for aspects of a use.

Many standard interpretations consider properties in the rating criteria that affect two or more aspects of a use. For example, the interpretation for *lawns, landscaping, and golf fairways* considers properties that affect plant growth and trafficability. Plant growth and trafficability could be defined as separate aspects of the interpretation for *lawns, landscaping, and golf fairways*.

4.7.3 Produce interpretations coincident with other features.

Soil information users should be able to request interpretations that are coincident with specified characteristics. Some of the characteristics internal to NASIS include classification, vegetative cover, and aspect. Some of the characteristics external to NASIS include land use, climate, and population density. This function serves as a method to discover relationships in behavior and occurrence of soils. Those relationships that require data not stored within NASIS are external to the scope of NASIS. A requirement for NASIS is that it be able to provide data or interpretations to be used at a broader level than what is contained within NASIS.

4.7.4 Provide interpretations based on user specified criteria.

Some users have a need for specific, but nonstandard, soil interpretations and have well defined interpretation criteria for the interpretation. The capability should be provided to generate nonstandard interpretations that are based on rating criteria defined by the user. Users should be able to select the soil properties and critical limits appropriate to their interpretation.

4.7.5 Provide support for interpretations that consider proximity and adjacency.

Individual soils exist in a universe of other soils and features. Although soils represented by component data records have determined characteristics, extent, and patterns, they have unknown location except by relative landscape position or feature within the delineation. Delineations have a known location and can be related to other delineations and features. Where feasible and logical, NASIS should provide information that supports the capability by systems and applications external to NASIS to analyze individual soils or delineations relative to surrounding soils , delineations or other features.

4.8 Enable routine addition or modification of approved interpretations criteria

Soil interpretations will change or be refined as more is learned about soil properties and expected soil behavior. New interpretations are likely to be added to the standard soil interpretations that are already available. A requirement for NASIS is that the system provide for routine addition or revision of standard soil interpretation criteria as part of an integrated system.

4.9 Enable routine addition of new approved soil attributes

As research continues in all aspects of soil science, it is likely that new soil attributes will be necessary to completely describe soils and provide interpretations. It will be a requirement to provide for the routine addition and management of new soil attributes as part of an integrated system. This includes use of derivation logic and algorithms for generation of new data elements.

4.10 Updating capability

Soil data collection is a continuous process of evaluating and responding to user needs. In areas of existing mapping, users may need verification of soil maps and associated data or they may need more site intensive data. These needs provide opportunities for soil scientists to examine soils at specific sites and provide additional information about soil characteristics. NASIS should provide the capability to incorporate additional information as it is collected. This may include the need for an audit trail of changes/updates to the data.

4.11 Integration of all data

Soil information is available from several sources within the National Cooperative Soil Survey (Fig. 6). These sources include soil survey field operations, National Soil Survey Laboratory, university laboratories, and research projects. The kinds of information expected from these sources include, but are not limited to, soil delineations, pedon and profile descriptions, laboratory characterization data, field notes, forest site indices, and crop yields.

Data are also available from sources outside the National Cooperative Soil Survey. These sources include state highway departments, the Environmental Protection Agency, and other agencies. The kinds of data expected from these sources include field descriptions, engineering laboratory analyses, and other physical and chemical analyses. Where appropriate this information can be stored in NASIS.

For those data which are not stored within NASIS, the system should provide a capability to reference the additional sources of information.

4.12 Geographic location

The ability to observe, record, interpret, and report spatially referenced soil properties is essential for soil survey. Many of the requirements specified in other parts of this document include an ability to utilize the spatial relationships of data, both internal and external to NASIS. NASIS must support the recording and reporting of soil data by geographic location and should support the utilization of spatial relationships identified in other parts of this document.

Data Integration

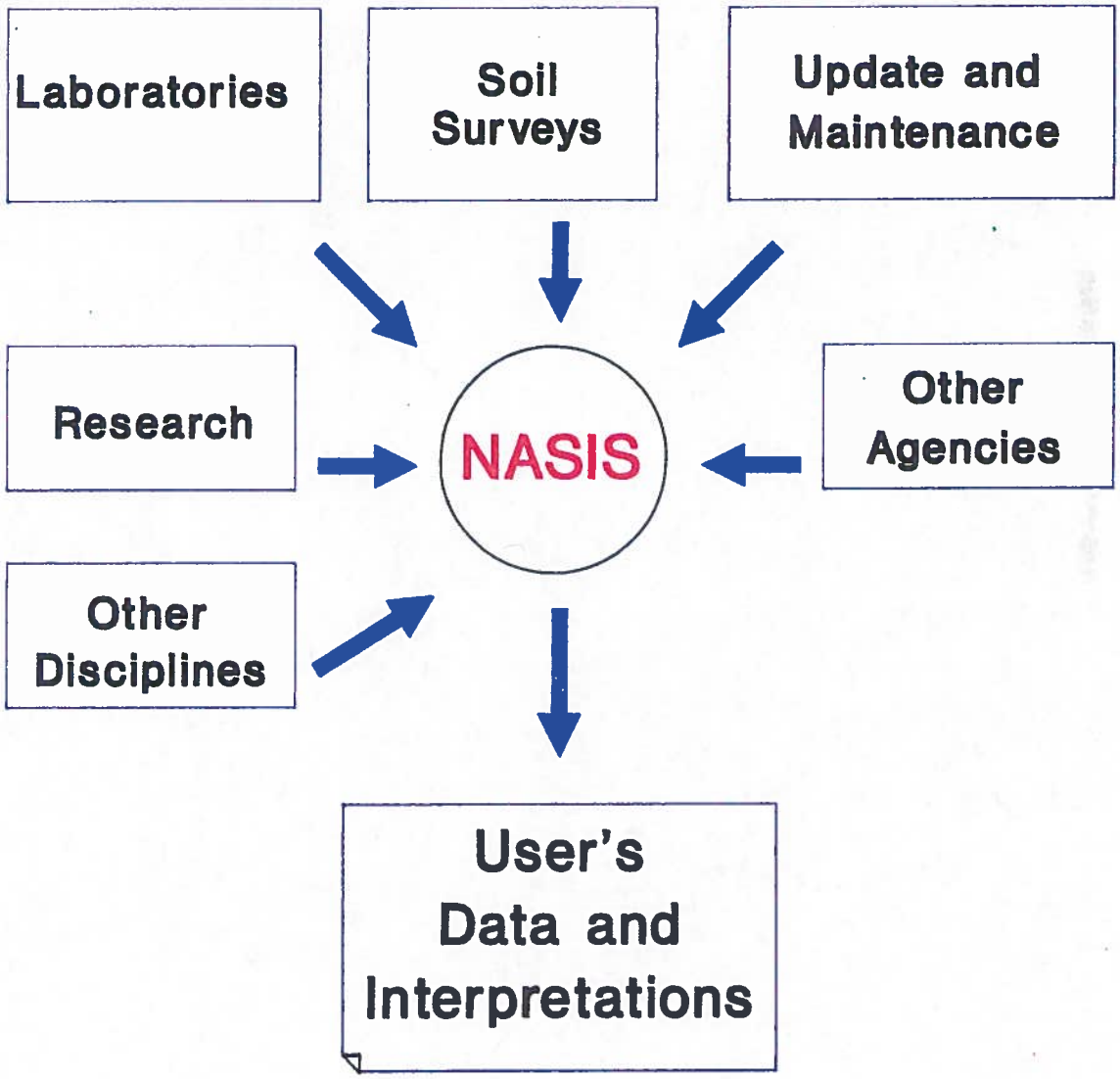


Figure 6

5.0 Essential Model of Current System

SOILS INFORMATION SYSTEM DATA FLOW DIAGRAM - EXISTING/PLANNED (SSSD/ISU/NSSC)

SYSTEM NARRATIVE

The essential model of the current system includes a system-level Data Flow Diagram (Plate 1) and a general system narrative.

The existing and planned soils information system is a soils data system of the USDA-Soil Conservation Service. It is composed of the State Soil Survey Database (SSSD), Iowa State University Statistical Laboratory Databases (AMES), and the National Soil Survey Center (NSSC).

The State Soil Survey Database (SSSD) is composed of several subsystems that interface with field, state, and national databases. This Data Flow Diagram (DFD) defines the scope of the State Soil Survey Database and its interactions with AMES, NSSC, and other SCS State Offices.

SSSD provides county-tailored Map Unit Interpretation Record (MUIR) databases to Field Offices in support of CAMPS and the Field Office Technical Guide. SSSD contains a state-level subset of the National Official Soil Series Description (OSED), Soil Interpretation Record (SIR), and Map Unit Interpretation Record (MUIR) databases.

There are six different functionalities of this system.
They are:

-- Official Soil Series Descriptions Management
-- Soil Interpretation Records Management
-- SOI-6 and MUIR Database Management
-- Table, Report, and List Production
-- National Map Unit Use File (MUUF) Updating
-- Soil Classification Database Management

Official Soil Series Descriptions Management involves entry and edit of the OSED, requesting changes to the OSED database, updating and maintaining OSED at AMES and NSSC, and downloading and printing print files upon request by users.

Soil Interpretation Records Management incorporates all aspects of SIR data management (similar to OSED management) including entry and edit, change requests, updating and maintaining at AMES, and downloading and printing.

SOI-6 and MUIR Database Management encompasses the multiple processes of MUIR database development. This includes SOI-6 development and editing, MUIR database creation (in AMES or in SSSD), tailoring of area-specific MUIR datasets, and creation and downloading of Official CAMPS Soils datasets.

Table, Report, and List Production enables the user to create and print a number of tables, lists, and reports, such as Manuscript tables, Field Office Technical Guide tables, Hydric Soils and Highly Erodible Soils Lists, Nontechnical Descriptions, Soil Interpretation Records, and Official Soil Series Descriptions.

National Map Unit Use File (MUUF) Updating is a system that enables the State Office user to add to, delete from, or edit the Map Unit Use File, currently stored at AMES.

Soil Classification Database Management is an system not directly within SSSD, but handled at the National Level between the National Soil Survey Center and AMES. In the process of adding to or editing the OSED, the Soil Classification (SC) Database is automatically updated if changes are made to the soil classification of a soil series (based on Soil Taxonomy).

6.0 Objectives, Current Limitations, and Enabling Tasks

Introduction

The analysis of SIID subsystem functions of NASIS is presented in terms of Soil Conservation Service, Soils Division objectives, current limitations, NASIS system objectives, and enabling tasks.

SCS Objectives focus on improved services to users and are stated in terms of quality, availability, efficiency, and flexibility. These objectives contribute to the overall objective of communicating soils information to clients in a manner that is suitable for making informed natural resource decisions.

Current Limitations describe some of the existing situations that interfere with the ability to satisfy objectives.

NASIS Objectives are system capabilities that are necessary to overcome the current limitations and fully achieve SCS objectives.

Enabling Tasks are the steps that must be completed to make the proposed system work.

The four segments are displayed in the following form:

6.x SCS Objectives
Current Limitations
NASIS Objectives
Enabling Tasks

6.1 Integrate and make all recorded soils information available to soil survey staffs and other users

Current Limitations

Valuable information collected as a part of the soil survey, but not published in soil survey reports, generally becomes unavailable for use. During a project soil survey, soil scientists collect profile descriptions, transect data, special study data such as soil temperatures and depth to water tables, and field notes that describe delineations. In some cases, laboratory data is available as a result of characterization or reference sampling (Fig. 6). These field and lab data are analyzed and used for writing taxonomic unit descriptions, map unit descriptions, adjusting interpretation tables, and making correlation decisions. At completion of the survey, the field records are archived. This detailed soil survey data is difficult to retrieve in response to requests for specific information about the survey area.

Often as soil scientists conduct a soil survey they are aware of valuable data in the form of engineering studies, research reports, and special studies that are collected by other agencies. Graduate students conduct research in soil genesis and classification, but the soil descriptions, lab data, and results are generally not available as soil survey documentation. State highway department labs conduct engineering tests on soil samples, but the results are generally inaccessible for use. Laboratory analyses conducted by other agencies, such as EPA acid deposition investigations that were conducted in cooperation with soil survey, are generally inaccessible as soil survey information. All of this data could contribute to soil survey and help to satisfy requests for soils information.

Although some automation is taking place with the Pedon Description Program, most detailed soil survey observations are generally stored on paper forms and are difficult to retrieve and analyze. In many cases the profile descriptions, field notes, transect data, and special studies are recorded on paper forms of unique design and filed in a manner that is convenient for use by the local soil survey staff. However, filing of these paper records by name or number precludes their accessibility by geographic area or other methods. Moreover, the volume of data collected is difficult to manage by hand effectively making these data unavailable for other than the original designed use.

Soil data collected in a survey area after completion of the soil survey is mostly unavailable for general use. This kind of data includes profile descriptions, refinements of the distribution of soils in delineations and refinement of delineation boundaries. On site investigations, for example, are generally conducted at the request of users who need specific additional data that is not currently available. Without a mechanism to incorporate the new information in soil survey, it continues to be unavailable to users.

Soil data is not completely integrated, preventing retrieval of related information. Soil survey data that is collected in adjacent survey areas,

states or regions is difficult to access. Laboratory data, although available, is inconvenient to access.

Subsequent soil surveys generally do not have access to field records from the previous survey. Profile descriptions and field notes that contributed to the old published soil survey could provide additional information for the soil survey staff. In most cases however, these records are no longer available.

NASIS Objectives

Photos/Diagrams

Retain in electronic form all detailed soils information including observations of primary soil properties and associated observations made during soil survey operations.

Enable continual updating and addition of soils information.

Allow for the integration of all soils information that meets the standards and requirements of NASIS.

Provide the capability to reference soils and other resource information collected and retained by non NCSS sources.

Enable access of soils data by georeference, using digitized delineations and site locations.

Provide a routine means of user access to the particular, complete and integrated information that is needed.

Enabling Tasks

Refine policy and procedures for retaining all soil properties (data elements) and associated characteristics and information.

Develop a standard system to conveniently store, integrate, and provide access to all soil properties (data elements) and associated characteristics and information.

Refine policy and procedures for data dissemination.

6.2 Make interpretations that accurately reflect variable conditions that are known in the field

Current Limitations

Interpretations made for named taxa are applied to entire delineations of map units, and may not consider minor soils within the delineations. The resulting interpretation represents the major part of the delineation and ignores the minor parts . The Soils-6 form that is currently used is limited to three soils or miscellaneous areas per map unit.

Interpretations for multi-taxa delineations are typically assigned the most restrictive rating of any of the named soils , regardless of extent. The resulting interpretation is likely to be unnecessarily restrictive for the delineation for those interpretations which are not spatially extensive.

Interpretations made for delineations are currently based on the generalized composition of the map unit, not the composition of the delineation. Similar delineations are grouped as map units throughout a soil survey, and the quality of the grouping is assured by the correlation process. Although it is recognized that different delineations may have varying percent composition, we are not able to record and provide this information with current systems.

NASIS Objectives

Retain the percent composition of soils and miscellaneous areas within delineations where this is known.

Provide the capability to interpret component data records for all soils or miscellaneous areas within the delineation.

Provide users with options for accumulating the area extent of soils having common interpretive results (ratings) to create an interpretation for the delineation or map unit.

Enabling Tasks

Refine procedures for collecting percent composition of soils or miscellaneous areas as it relates to delineations of map units, and for storing this information where known and desirable.

Develop a standard system for retaining percent composition of all soils or miscellaneous areas within each delineation where this is known.

Improve methods for combining interpretations of component data records to produce interpretations for delineations.

Develop procedures and conduct training in the use of the flexibilities provided by SIID.

6.3 Allow interpretations to be generated that are current with the data and interpretation criteria, and that meet individual user needs

Current Limitations

Typically, interpretation ratings are assigned by the soil scientist responsible for the soil interpretation records. This task is accomplished by running the ratings program and accepting the ratings provided by the program or by substituting ratings in place of the ratings provided by the program. In either case, the interpretation ratings are fixed in time relative to the rating criteria and physical properties known about the soil. If the ratings criteria change or the data which describe the soil are refined, an update of the interpretations must be initiated manually.

Some of the standard rating criteria use interpreted or classed data as well as primary soil data in making interpretations. For example, the interpretation for roadfill includes AASHTO and shrink-swell, which are classed data, and fraction greater than 3 inches, which is primary component data. Interpretations made from classed data may be affected when criteria used to create the classed data change. In addition, interpretations made from classed data do not specify the soil property contributing to the limitation, potentially obscuring corrective measures that could overcome the limiting property or feature.

Values of soil attributes are generally expressed as ranges of values. In some cases, the range given for the value of a soil attribute includes values that are both above and below the critical limit of an interpretation criterion. This situation requires a selection of values in one part of the range for that soil property. The more restrictive values are generally selected, but this is an arbitrary selection that may not make adequate use of actual observations or conditions that are representative for a local area.

Nearly all interpretations are made using standard rating criteria that have been developed within the agency and documented in part 603 of the National Soils Handbook. These interpretations are distributed to users in published soil survey reports, handout information, and through CAMPS. These standard interpretations meet the needs of many users of soil survey information. However, some users need non-standard interpretations to meet local needs. These users must know the requirements for the non-standard interpretation and provide specific limits on values of soil attributes for their interpretation. Although many of the requests for non-standard interpretations are accommodated by soil scientists, a computer facility for handling non-standard interpretations does not exist.

Standard interpretations are made for major uses. However, within a major use there are generally several undescribed subdivisions or "aspects" of the use. For example construction, health considerations and system maintenance could be considered aspects of "suitability for septic tank systems". Certain of these "aspects" are repeated in a number of major uses. Currently interpretations made for major uses do not provide information about the individual "aspects" of the major use.

It is also possible that similar "aspect" criteria that are in a number of major uses might cause inconsistency in the rating criteria.

NASIS Objectives

Generate interpretations on demand that use data from the current primary component data records.

Retain the current interpretive criteria in a standard system.

Provide a capability to select either the most restrictive value of a range, least restrictive value of a range, representative value, or user specified values of primary data to be used in interpretations.

Enable authorized users to specify soil attributes and limits to be used in making non-standard interpretations.

Enable authorized users to routinely enact new standard interpretations or to modify interpretive criteria in standard interpretations.

Enable interpretations for "aspects" of each standard use.

Enabling Tasks

Design a system to store and retrieve primary soil data and interpretive criteria.

Develop methods and design a system that interprets soils data on demand.

Develop guidelines and methods for assigning representative values to properties of component data records.

Develop methods and design a system that facilitates non-standard interpretations.

Determine the "aspects" of interpretations in Part 603 of the National Soil Handbook that can be handled individually, and develop a system to interpret them.

Develop policy and procedure that ensures consistent application of interpretive criteria.

Develop policy and procedure that ensures coordinated development or modification of interpretive criteria.

6.4 Provide statements as to the reliability and variability of soil data and interpretations to users

Current Limitations

The current soils information systems do not provide for storing and communicating reliability distinctions between individual data within the system.

Although the reliability, methods, and limitations of soils information is understood by the data collectors, the current systems do not provide for communicating facts such as:
- whether data values are obtained actual measurements or are estimated.
- whether the description is made from a typical or atypical site
- whether the field notes are collected for typical or atypical delineations
- whether the data are from direct observations or inferred
- appropriateness of the data collection method for the landscape.

Map units have a proportion of soils or miscellaneous areas that is portrayed to users as constant for all delineations of a given map unit. Individual delineations may have field notes or transect data, but other delineations have a proportion of soils or miscellaneous areas that is projected from the measured delineations. Users of soil information generally are not informed whether the composition of delineations have been measured or estimated. Currently there is no information provided to the users which describe the mapper's confidence in being able to depict the actual occurrence of soils within delineations or map units.

Interpretations may be made from soil data without regard for the reliability of the soil data. Interpretations made in this way have undocumented reliability.

NASIS Objectives

Provide capability to assign a reliability designation for an observation of each primary soil characteristic consistent with the soils data reliability policy, procedures, and techniques.

Provide capability to assign a reliability designation for the percent composition of soils or miscellaneous areas in each map unit.

Provide interpretations from primary soil attributes for each component data record.

Enable manual assignment of interpretation ratings where stored data is inadequate or it requires personal assignment, such as "Prime Farm Land".

Routinely add new soil attributes and associated characteristics.

Enable users to specify minimum levels of reliability to be used in creating interpretations or reporting soil information.

Enabling Tasks

Develop appropriate methods to assess reliability of primary soil data.

Develop appropriate methods to assess reliability of soil and miscellaneous area distribution in delineations.

Develop a system for recording and reporting reliability.

Refine methods to communicate data meaning and reliability to users.

Develop policy and procedure for recording and reporting data reliability.

6.5 Make consistent soils information and interpretations available at all levels of generalization in a timely manner

Current Limitations

Generalized soil maps are prepared manually for a survey area during the soil survey process. These maps have broader, less detailed delineations than detailed maps and are better suited to broad land use planning. Other kinds of generalized maps, such as STATSGO and NATSGO, are also produced manually to suit broad land use planning needs. Because manual preparation of these kinds of maps is costly and time consuming, generalized maps are prepared only once at the completion of a project soil survey. This situation results in generalized maps that may become outdated as future updates are made to detailed soil maps. Generalized maps are not made for specific interpretations or at a scale designed for specific uses. Therefore, users must adapt a generalized map to their purpose. These adapted maps may be inappropriate for the users purpose.

NASIS Objectives

Develop Generalized soil maps from detailed soils information.

Develop generalized interpretations from the interpretation of all included component data records.

Interpret component data records or provide soil information from current primary soil data.

Derive generalized soil data from the most detailed soil data available (Fig. 7).

Data Aggregation

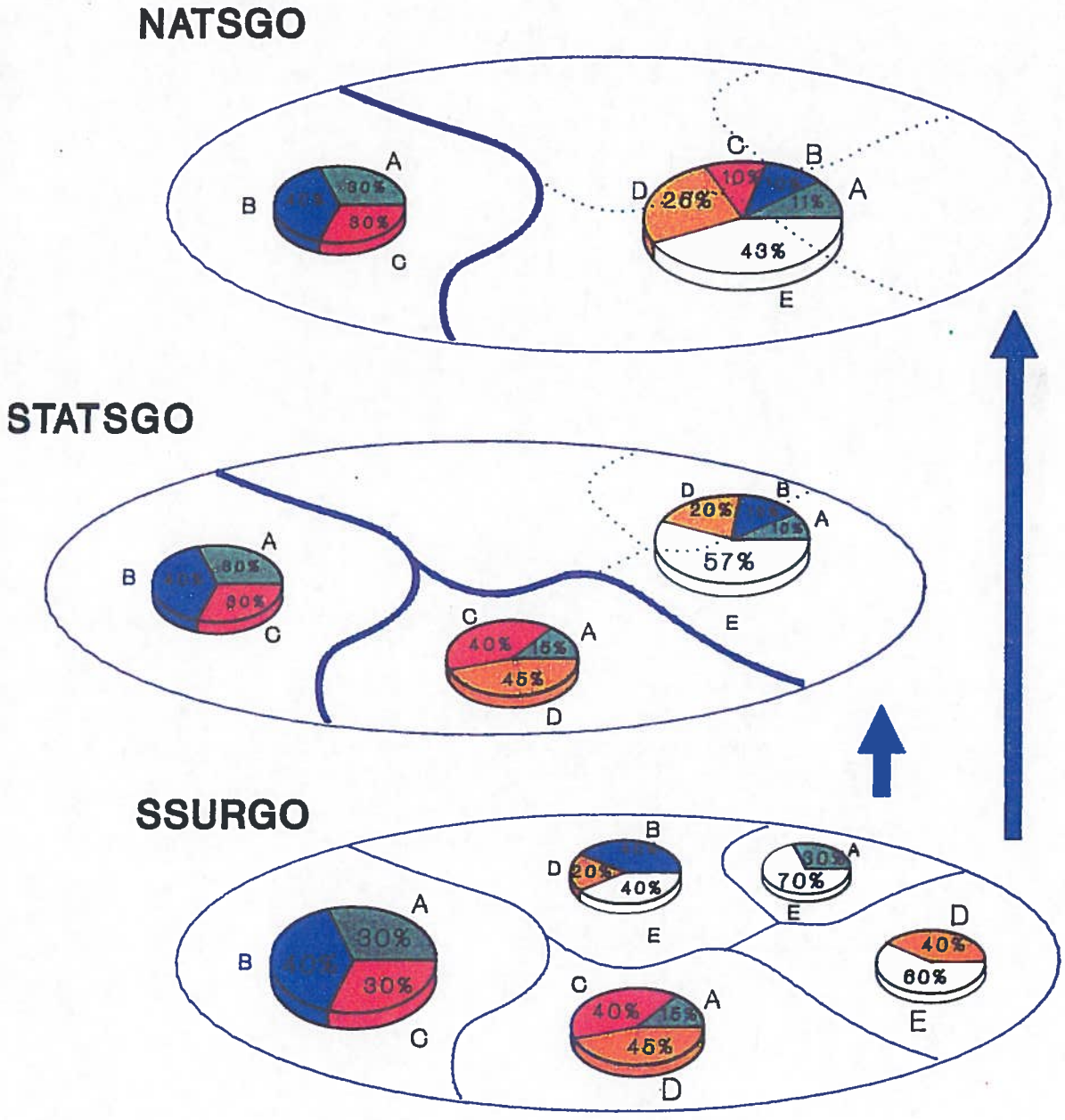


Figure 7

Enabling Tasks

Develop methods for aggregating soil data and interpretations to any level of generalization.

Design an automated system to handle generalized map boundaries and aggregate soil data and interpretations on demand.
Initial phases may require physical processing until maps are digitized.

Develop methods and design an automated system that interprets soils data on demand.

Develop policy and procedure that ensures consistent dissemination of soil data and interpretations across all levels of generalization.

6.6 Respond to changing user needs, legislative direction, research findings, and technological development

Current Limitations

Interpretations are made and stored with soil attributes , but changes in interpretive criteria or soil attributes are not reflected in the stored interpretations unless the interpretation records are specifically modified.

Soil attributes have been grouped as map units, taxonomic classes, and interpretive classes to accommodate an otherwise unmanageable volume of data. These groups are relatively inflexible and modification of grouping criteria as well as assignment of soil properties to groups requires significant staff time. Moreover, changes in a class may affect interpretations or other classes in ways that are difficult to predict. In cases where the soil data handling is automated, the data is not integrated and some of the data are redundant. Changes in interpretive criteria, addition of new data elements and new interpretive criteria, or changes in data or interpretations require that programs be rewritten, new datasets be downloaded, and access routines be redesigned.

Published soil surveys are designed to meet specific needs and the interpretations supplied with published soil surveys are fixed in time. New soils data, new interpretations, new interpretive criteria, and changing user needs are not adequately accommodated by traditional published soil surveys.

Soil attributes are observed and described at geographic locations, but most locations are recorded and stored in a manner that is inaccessable for use with geographic information systems.

NASIS Objectives

Provide a routine means to add new soils attributes

Retain in electronic form all detailed soils information including observations of primary soil attributes and associated observations made during soil survey operations.

Provide facility for making global changes to stored data based on new findings

Enable continual updating and addition of soils information.

Enable authorized users to routinely enact new standard interpretations or to modify interpretive criteria in standard interpretations.

Enable users to specify soil properties and limits to be used in making non-standard interpretations.

Produce soils data and interpretations on demand using current data and interpretation criteria.

Enabling Tasks

Develop policy and procedure to implement a dynamic, automated soil information system.

Develop communication and training necessary to enhance usefulness of SIID.

Design a standard system to store, retrieve, modify, and interpret primary soil data.

Design a standard system to store, retrieve, and modify interpretive criteria.

Identify primary soil data elements and interpretive data elements. Provide a standard definition for each element.

7.0 Constraints

The constraints that are stated in the following section reflect those that are currently known. Since several aspects of the constraints are being actively worked on, they will be updated as necessary during the next project phases.

7.1 Computer environment

Some or all of the NASIS functions, and access to the NASIS data base, will be required at the following SCS organizational locations:

- Field offices
- Area offices
- State offices
- National Technical Centers
- Soil Survey offices
- National Soil Survey Center
- National Headquarters
- National Cartographic Center

In addition to these SCS locations, access to NASIS may potentially be required by National Cooperative Soil Survey cooperators, such as universities, and other government agencies. Because of the diversity of computing environments that may exist at the non-SCS locations, the constraints are limited to the SCS computing environments. Adherence to SCS portability guide lines will hopefully minimize the effort required to port NASIS to other operating environments.

Computing environments at the various SCS organizational locations are constrained as follows.

7.1.1 Field and Area offices

The computer environment constraints are specified by National Instruction No. 270-303, Second Edition, Part 303 - FOCAS Implementation Policy, which defines the "platform for which national software, targeted for use at the field and area office level, will be developed." In summary, the principal constraints are as follows:

General:

All national software is to be developed for use in the UNIX environment and designed to be portable across the UNIX platforms defined in Part 303 that constitute the field office architecture. Program structure and code is to be "optimized to run most efficiently on AT&T's 6386 UNIX-based computer environment". Portability to DOS platforms may be included in program design when computing efficiency is not impacted and specific functions require operation in the DOS environment.

The full NASIS will operate within the UNIX environment. However, some NASIS applications, such as data collection, need to operate on a portable platform or need to function on existing DOS computers. There is also a need to share software with members of the National Cooperative Soil Survey and other members of the scientific community. DOS is the most common computing environment in these situations. DOS compatibility will be provided for these specific NASIS applications where it is required.

Hardware:

Part 303.4 specifies that software will be developed to operate on either AT&T 6386WGS, with a minimum of four megabytes of RAM, or AT&T 3B2 computers, with a minimum of two megabytes RAM for a one-user system and four megabytes for a multi-user system.

Part 303.4(f) adds that portable computers available through the laptop contract may be used for "applications and data" for field use.

Operating System:

Part 303.5 specifies AT&T's UNIX System V, version 3.2 for all FOCAS UNIX computers. Portability to DOS may be accommodated when computing efficiency is not impacted.

Data Base Management System:

The Data Base Management System for use in Field and Area offices will be determined by a National SCS study that is currently in progress.

7.1.2 State offices
National Technical Centers
Soil Survey offices

There are no specific, published guidelines for computer environments for these organizational locations as with the Field and Area offices. Subject to further specification, NASIS will plan that the following constraints, previously stated for the Field and Area offices, will also apply for these locations.

Hardware:

Software will be developed to operate on AT&T 6386WGS as the minimum level of hardware.

Operating System:

AT&T's UNIX System V, version 3.2.

Data Base Management System:

The Data Base Management System that is to be selected for Field and Area offices.

7.1.3 National Soil Survey Center

NSSC currently operates an AT&T 3B2/600. RAM and disk configuration may require further evaluation with consideration for the entire planned requirements for all the applications.

7.2 Development tools

7.2.1 Common User Interface (CUI)

NASIS will adhere to the evolving user interface standards defined in the SCS document titled "Standard for a Common User Interface in Computer Software

Applications". The Vermont Views libraries along with custom functions developed by SCS will be used to implement the CUI standards.

7.2.2 Programming language

The C programming language will be used in accordance with the draft proposed American National Standard X3J11, subject to any modifications in the FIPS adoption of the proposed draft standard. In addition, NASIS will adhere as closely as possible to the evolving SCS C language programming standards defined in the document titled "Programming Standards for the C Language" (July 26, 1990).

NATIONAL SOFTWARE DEVELOPMENT STANDARDS HANDBOOK, Part 601.21 (f) encourages the use of a 4GL language in conjunction with the use of a DBMS when it can be shown to be more economical and efficient compared to the use of one of the Departmental general purpose programming languages.

However, there is no plan to use 4GL for NASIS beyond its potential use for discovery and behavioral prototyping.

7.3 Telecommunications

The geographic dispersion and different types of locations of NASIS users raises the potential impact of telecommunications on decisions for data base dispersion. National Instruction No. 270 - 303, Part. 303.8 specifies the use of DEPNET for telecommunications whenever possible.

A study is being initiated to develop an SCS Telecommunications Plan. It is highly desirable that the plan include the decision factors for the potential use of telecommunications for NASIS, and for other systems and data bases, for deciding on dispersion of data bases and processing. It is anticipated that the study will particularly address factors that are based on FTS 2000.

7.4 Data and system interfaces

7.4.1 GIS interface

The Geographic Resources Analysis Support System (GRASS) software system will be the means of a GIS mode of dissemination of soils information from NASIS at locations where GRASS is available.. GRASS modules will be used when appropriate for NASIS processes that require GIS functionality, such as determining the area of geographic delineations or the proximity of geographic locations.

7.4.2 CAMPS

Various modules in CAMPS need access to soils data. The soils data base for CAMPS will be replaced by all or part of the NASIS data base. All or part of the NASIS system functionality will be integrated into CAMPS. Integration issues need to be clarified.

7.4.3 Other systems needing access to Soils data.

NASIS will replace the existing Soils Data Bases of a number of application systems (such as CAMPS and FOES) and models (such as WEPP and EPIC). There is the potential to more effectively serve the needs of National Resource Inventory (NRI),

STATSGO, and NATSGO and to relieve a significant amount of the data storage and management in their current operations. A plan will need to be developed to help these systems transition from a customized soils data source to the use of the NASIS Data Base Management System.

7.4.4 Sources of soils data

There are potentially a number of systems that record soils data that might be appropriate to include in NASIS. Before this can take place it is necessary to determine to what extent the data in these systems are consistent with the concepts and information contained in NASIS. Procedures will need to be developed to convert the data in these systems for inclusion into NASIS on a case by case basis.

7.4.5 Soils data users external to SCS

Currently, there are numerous soils data users external to SCS, who may potentially desire to make the transition to NASIS and to its new concepts

7.4.6 Conversion of current Soils Data Bases

The current Soils Data Bases will require conversion to accommodate the new data model and Data Base Management System. A transition plan will need to be developed to minimize the effort required to move from the current soils data systems to NASIS.

8.0 Essential Model of the Proposed System

The logical model of the proposed system includes a system-level Data Flow Diagram (Plate 2), an Entity-Relationship Model (Plate 3), and a general system narrative (Section 8.1), supported by the detail contents of the data dictionary (Appendix 1). The Data Flow Diagram defines the scope and identifies the normal processing functions of SIID. The System Narrative briefly describes each of the principal functional groupings in SIID.

8.1 System Narrative

SIID is a subsystem of NASIS. SIID includes six principal functions. Five functions will continue as on-going functions of NASIS. The sixth function - Add and revise soils and spatial data - is an extension of the Interim Data Collection/Update System. The interim system must enable all the essential data collection and update functions until NASIS Phase 2 is completed, which will provide a fully functional Data Collection and Aggregation subsystem.

The interim system will encompass the functions and data of the current Pedon Description Program and provide for retention of Laboratory Characterization data where the data satisfies the NASIS purposes.

SIID includes the following six functions:

- Add and revise soils attribute and spatial data
- Define and modify soil attributes and their characteristics
- Develop and revise interpretations and their rating criteria
- Define and revise queries for soils data and interpretations
- Select soils data and perform interpretations
- Disseminate soils information to users

The applicable Data Flow Diagram processes are referenced for each function.

8.1.1 Add and revise soils attribute and spatial data (Processes 106 and 107).

Soils and spatial data will be received from the External Entity "INTERIM DATA COLLECTION/UPDATE SYSTEM" shown on the Data Flow Diagram.

106: After appropriate review and approval, soils attributes are added or existing attributes are modified for sites or component data records. Soils attributes for component data records are identified as either high, low, or representative values.

107: After appropriate review and approval, sites, delineations, and map units are identified, and their geographic location or delineation data are added or revised. The proportionality of soils and miscellaneous areas within a delineation or map unit is added or revised.

8.1.2 Define and modify soil attributes and their characteristics (Process 109).

New approved soil attributes are routinely added to enable their use in the system. Characteristics that are required for normal use and processing are specified, including such data as validity specifications, and acceptable methods or procedures for obtaining or recording the data values. Modification of existing soil attributes is also permitted when they meet conditions that assure consistency with soils data that were recorded prior to the modification.

New soils attributes that fit within the proposed data model can be routinely added.

8.1.3 Develop and revise interpretations and their rating criteria (Processes 103 and 104).

103: Interpretations and their rating criteria can be routinely added for system use. Those that currently exist can be reviewed and modified, including the terminology for ratings or aspect descriptions. The interpretations criteria can be permanent or limited to a particular query to continue only during the retention period of the query. Interpretations criteria are identifiable as to their extent of use, either national or for a particular regional or limited use. In some uses, the criteria can be modified to satisfy "what if" analyses.

Where appropriate the criteria must be able to be expressed in terms of interpretation variables, such as a depth, to enable the criteria to be routinely adjusted to meet a specific user need.

8.1.4 Define and revise queries for soils data and interpretations (Processes 100 and 108).

100: Basic query templates are originated or modified for interpretations, Soil Survey manuscript tables, or data accesses that can be applied, in an executable query, to an area or site location. Query templates can also be originated or modified to determine the existence of soils data with the specified characteristics.

108: Executable queries are reviewed to determine their applicability for a specific user need. Executable queries are originated or modified to apply a basic query template to a specific delineated area, site location, or an area that is defined by proximity to a reference delineated area or site location.

The parameters to be available for users to prepare basic query templates and executable queries are listed in Section 8.2, "Parameters for Interpretations and Data Access".

8.1.5 Select soils data and perform interpretations (Processes 101, 102, and 110).

101: The data are selected as specified by the selection parameters for the query, either through direct specification of properties to be reported or through reference to properties required by the applicable interpretation criteria.

102: Each set of data for the components of an area or a pedon or site is interpreted. Each set of data is processed against the interpretation criteria for the specified interpretation use(s) to determine its interpretation result.

110: An interpretation rating is added, modified, or deleted for a particular component data record or site location, interpretation use and aspect phase, and data mode. The action is enabled if the component data record lacks a property value that is required by the interpretation criteria. The assigned rating remains in effect until the data is updated to remove the deficiency.

8.1.6 Disseminate soils information to users (Processes 105 and 111).

111: Component data records are combined into generalized composite report categories based on user parameters. The parameters specify unique combinations of use ratings, classification, presence of external features, selective property values, and management use that occur for each component data record.

105: The data is organized and the response formatted for any of the following types of queries:

- Interpretation information
- Soil Survey Manuscript Tables
- Soil data access
- Determination of the existence of data that meets specified characteristics

User report parameters, listed in Section 8.2, "Parameters for Interpretations and Data Access", control the report organization and formatting.

8.2 Parameters for Interpretations and Data Access

Access to data from NASIS is necessary for performing interpretations based on the data, and for providing uninterpreted data to users. This section describes the known kinds of access the system should provide as well as various possibilities of reporting the data and/or interpretations. It should also be possible to access the information system to determine if data is available within the system to meet the users need.

Queries can be one or a combination of the following categories:

- Interpretation
- Soil data access
- Determination of the existence of data that meets specified criteria

The following parameters express the options available to a user of NASIS.

Data Selection Parameters

I. Area or Site Locations To Be Included in Query

Identification of one or more of the following site or area location selection options is mandatory for all categories of queries.

A. Pre Defined Areas or Locations

1. Political Boundaries

For example
   a. National
   b. State
   c. County
   d. Soil Survey Area

2. Spatial Boundaries/Locations

For example
   a. Map Unit
   b. Delineation
   c. MLRA
   d. Site

B. User-defined areas (ad hoc; georeferenced)

For example:
   a. Quad
   b. Hydrologic Unit
   c. NRI primary sampling unit
   d. Farm Boundary
   e. Watershed Boundary
   f. Township
   g. Proximity to a site
   h. Proximity to a Pre-defined area

II. Primary Selection Parameters

One or more of the following Primary Selection Parameters can be specified as the basis for selection of data for a query for the identified area or site locations.

A. Interpretation use, phase, and rating(s).

B. Taxonomic Classification

C. External Features

1. Vegetation
2. Landscape feature
3. Climate
4. Geologic feature

D. Soil property(ies) (to be included in a soil data access)

III. Limiting Parameters

The following Limiting Parameters can be specified, as desired, to modify or further restrict the data that would be qualified under the Primary Selection Parameters:

A. Applicable for all Primary Selection Parameters:

1. Data mode

a. Options available for interpretations:

(1) Most restrictive of a range
(2) Least restrictive of a range
(3) Representative value
(4) Both extremes of restrictiveness of a range
(5) Single profile

b. Options available for data access:

(1) Lowest value of a range
(2) Highest value of a range
(3) Representative value
(4) Both extremes of a range
(5) Single profile

2. Specification of a limitation of the extent of the profile from which data is selected.

3. Predominance, in percent composition, of the delineated area that must be occupied by a unique combination of selected data for the data to be included (e.g., a unique occurrence of a particular Taxonomic Classification together with a particular rating for an aspect of an interpretation use):

a. Minimum percentage of area.

b. Specification that an interpretation rating or other feature must be dominant (i.e., its area => the area of any other rating for the same interpretation rating or other feature) in the area for analysis.

B. Applicable for Interpretations Parameters:

a. Specification of exclusions from interpretation criteria, including:
- Soil property data element
- Restrictive Feature

b. Relative restrictiveness of rating in a delineation

(1) Limit to delineations that have no more restrictive rating than the rating specified in the Primary Selection Parameter.

(2) Limit to delineations that have no less restrictive rating than the rating specified in the Primary Selection Parameter.

c. Interpretation limitation based on a specified cause

(1). Limit to data for which a specified *Restrictive Feature* is the cause of (or contributes to) its interpretation rating.

(2). Limit to data for which a specified *Property* is the cause of (or contributes to) its interpretation rating.

Report Organization Parameters

A. Specification for grouping selected data into a single, summary report item.

1. Group basic delineations into common groups based on their having the same *most*-restrictive rating (for any of the specified uses). No grouping effect of specified classifications or external features.

2. Same as 1., but for the same *least*-restrictive rating.

3. Group.....same most dominant rating.(using the most restricting if 2 or more components have the same proportion of the delineation.

4. .....same combination of extreme ratings.

5. .....same unique combination of all ratings.

6. User assigned grouping, based on rating and

its associated % of the delineation.

7-12. Same as 1-6, except subdivide groups by identical combinations of the (occurrence of) classifications specified as a selection parameter.

13-18. Same as 1-6, except subdivide groups by external features.

19-24. Same as 1-6, except classifications and external features.

Report Detail Parameters

A. Interpretation Report Levels

Report at the following level(s) within the total area that was selected to be included in the query:

(a) Complete area included in query
(b) National
(c) State(s)
(d) County(s)
(e) Soil Survey Area(s)
etc.

B. Interpretation Details To Be Reported

1. For each combination of component data record and use-rating, and for all soil attributes that contributed to the rating.
   a. Attributes only
   b. Attributes with the value(s) that actually were used to determine the rating.
   c. Attributes with the attributes' values (i.e., extreme ranges and RV).

2. Report the remaining attributes that pertained to interpretation criteria, but did not contribute to the rating.

3. Report rating criteria.

4. Report Data Selection Mode.

5. Report a user-defined interpretation explanation.

9.0 Fully Attributed Data Model For Proposed System

The Entity Relationship Model (Plate 3) represents only the Soil Interpretation and Information Dissemination subsystem portion of NASIS. It is segmented into two sub-models: Natural Resources and Operational Features. The two diagrams have the following common data entities: DN101, SITE and DN102, COMPONENT DATA RECORD. The data model is not yet normalized.

The Entity Relationship Model has two cases in which generalized data entities and data elements are portrayed in the diagram in a non-generalized form by including their detail occurrences (domains). The detail occurrences are included to aid understanding of the data model. Both cases occur in the Natural Resources Subsystem (Part 1).

In one case, the data entities that are subordinate to Data Entity DN107, SOILS INFORMATION, are attributed with specific Soils Information attribute names. Each attribute that is listed is actually an occurrence in the domain of a generalized data element, ATTRIBUTE , which has four associated data elements , ATTRIBUTE NAME, ATTRIBUTE VALUE, ATTRIBUTE UOM (Unit of measure for the attribute value), and ATTRIBUTE METHOD CODE, and one data structure, ATTRIBUTE VALUE QUALITY. The specific occurrences of the properties are included as a convenient means to clarify the placement of each attribute among the data entities that characterize Soils Information, which shows it in context.

In the second case, the Entity Relationship Model includes the following six entities that are delineated areas, each with its unique identifier: MLRA, COUNTY, LAND OWNER, SURVEY AREA, MAP UNIT, and DELINEATION. The six entities can be generalized into one DELINEATED AREA entity. The keys for the DELINEATED AREA data entity are a SPATIAL TYPE data element that differentiates the type of area and a SPATIAL ID, which is a generalization of all six identifiers.

The generalized (generic) terminology is used in the Data Flow Diagram, Data Flows, Data Stores, and System Narrative.

10.0 Essential Data Dictionary For Proposed System

The following information from the Essential Data Dictionary is included in the Appendix:

1. Data Element Names and Definitions
2. Data Flow Contents
3. Data Store Contents