United States Department of Agriculture

NRCS Natural Resources Conservation Service

Ecological Site Inventory System
Business Requirements

Ecological Site Inventory Business Analysis Team

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Executive Summary

The Ecological Site Inventory Business Analysis team organized by memo from Micheal Golden, Director Soil Survey Division, and Mike Hubbs, then Director of Ecological Sciences Division, has completed their assigned task to identify the business requirements of a proposed information system to collect, store, manage and deliver point data collected in the field to support the development and enhancement of Ecological Site Descriptions.

The team has deliberated during numerous teleconferences and one face-to-face meeting. The current systems, procedures, databases and applications were identified and described. Deficiencies in the existing ecological site information system were identified. The following are key features identified as being needed to make a successful operational information system:

- First and foremost, a national database(s) needs to be available to store all data collected at a specific geographic location that can be used to support a given ESD. If multiple databases are used, they need to be configured and linked in such a fashion that to the user they appear as a single database. Data to be included are vegetative plant community clippings or other compositional data, soil pedon descriptions, soil analytical data, animal usage of the site, digital photos, sketches, drawings, land use and management history of the site, and other disturbances that might influence the soil and/or vegetative community to be what it is at the time of sampling.
- All data collected from the same geographic location need to be able to be organized and linked so that there is no question that they all were collected at the same location.
- Existing point data in the ESIS-ESI database needs to be incorporated into the system.
- Standardized field data collection protocols need to be identified where they are missing to ensure that the necessary point data are being collected.
- Standardized field data forms need to be developed using common terminology and data entry guidelines are essential in order for data to be entered into the national database.
- A common data field data collection tool is needed in order to increase data collection efficiency and reduce redundant data collection. Currently there is a considerable amount of redundant data collection between soils data collection and vegetation data collection.
- Electronic field data collection tools are preferred to improve efficiency and to reduce the need for rekeying the data into electronic format which also introduces the potential for data entry errors.
- Most, if not all, functionalities currently available in the Ecological Site Information System (ESIS) in regards to point data need to be available in the new system.
- Quality control/quality assurance processes and checks need to be built into system to improve data quality, completeness, and integrity.
- All data needs to be available to internal NRCS personnel and partner agency personnel in order for them to perform their assigned duties.
- Certified data needs to be accessible by the general public via a web interface.
- A mechanism needs to be in place to restrict access and edit permissions to the appropriate data records.
- The national database(s) must be able to be queried in order for users to get the data they need.
- Standard reports need to be able to be run against the national database.
- Subsets of the data need to be able to be exported to the user in format suitable for importing into external software packages – e.g. Excel, Access, statistical packages, etc.

- Data must be able to be aggregated or summarized in order to define ranges of characteristics at various levels – e.g. ecological sites, ecological site states, community phases, soil map unit components.
- Data must be geospatially referenced so that data collection points can be displayed in a GIS along with selected attributes for each collection point.
- Some data may be of a sensitive nature and needs to be able to be shielded from some user groups – e.g. rare and endangered species, cultural artifacts, etc.

The sections that follow explain these identified functionalities in more detail.

Ecological Site Inventory System Business Requirements

Background

The Natural Resources Conservation Service (NRCS) and its partners routinely collect point data for the various resource themes (soils, range, forest, cropland, dynamic soil properties, NRI, etc.) as part of the national soil survey program effort, the development of ecological site descriptions, NRI, and other agency programs. The various themes of data are often collected from the same geographic location either at or near the same point in time, or at various time intervals. Data collected from the same geographic location do or should have a direct relationship and share various attributes. Data from the same location collected at different times share some or all these same attributes other than the date on which the data were collected.

Current data collection methods and data storage protocols are disjointed and often totally independent of each other. Data cannot be easily shared between systems resulting in data redundancy and duplication of data collection efforts. These issues have been discussed by different groups at various times during the last 10+ years, but no progress has been able to be made in regards to resolving the issues for a variety of reasons. With the recent increased emphasis being placed on the development of ecological site descriptions there is an associated desire to provide a more integrated system to collect, store, manage and publish these data.

Terms and Concepts

1. **Inventory** – the systematic acquisition and analysis of information needed to describe, characterize, or quantify the resource in question. As used in this document, inventory refers to the collection of data about one or more resource themes (soils, vegetation, etc.) at a particular geographic location or point on the landscape. As might be expected, data for many different attributes or characteristics can be collected. Inventories can be used not only for characterizing or describing ecological sites, but also for determining ecological status, assessing the distribution and abundance of species, and establishing baseline data for monitoring studies.
    a. From National Forestry Handbook - (ftp://ftp-.sc.egov.usda.gov/NSSC/National_Forestry_Handbook/nfh_2004.pdf) - An inventory is defined as the collection, assemblage, interpretation, and analysis of natural resource data. The data are used to monitor ecological change, develop ecological site descriptions, determine soil productivity and species adaptability, and predict height growth and species survival rates. In the Natural Resources Conservation Service (NRCS), ecological site inventories are always correlated to a specific soil component. The National Forestry Manual, Part 537 defines policies and standards for collection of the data associated with forest ecological site inventories.
    b. From National Range and Pasture Handbook – (http://www.glti.nrcs.usda.gov/technical/publications/nrph.html) - An inventory is defined as the collection, assemblage, interpretation, and analysis of natural resource data for planning or other purposes. Inventories are regularly completed to determine the present status of variables important to NRCS and decision makers. These inventories include physical structures, hydrologic features, rangeland ecological

sites, animal resources, and other variables pertinent to the planning process. Biomass data collection, production, and composition by species are the standard techniques used by NRCS in characterizing rangeland ecological sites during the inventory process.

2. **Vegetation attributes** – the quantitative features or characteristics of vegetation that describe how many, and/or what kind of plant species are present. Commonly used attributes describe frequency, cover, density, production, structure, and species composition at a particular geographic location or within an ecological site.
3. **Plot** – the relatively small geographic area on the landscape, 20-30 meter square or similar sized area of a different shape, where the resource inventory occurred. Actual data observation or collection points exist within the plot boundaries. Some attributes collected refer to the plot as a whole. Example plot configurations used in ecological site inventories are shown in Appendix 2 of this document.
4. **Point** – the actual point (x,y coordinate) on the landscape where data from a resource attribute observation or measurement is collected, such as where a vegetation clipping occurred or a soil profile is described.

Description of Current System

Field Data Collection

1. Soil Pedon Descriptions, field notes, and transects
    a. Pedon descriptions are routinely collected at specific geographic locations and georeferenced using GPS technology. Lat/long coordinates in decimal degrees and WGS84 datum have been designated as the standard.
        i. For older pedon descriptions, geographic coordinates have been recorded as latitude/longitude, UTM, state plane, Public Land Survey System (PLSS), or as metes and bounds format. Different horizontal datums can be recorded. Many of these were estimated from USGS topo quads or Orthophoto imagery.
    b. Data collected include not only below surface soil profile characteristics, but also above ground 'site' data and geographic location data. Various site/soil classification and correlation data are also recorded. Some vegetation data is recorded – primarily the presence of a particular plant species.
    c. Pedon descriptions can be captured in electronic format either by inputting them into Pedon PC and then uploading to the national NASIS database, or input directly through the NASIS application interface.
    d. In some instances, field data are recorded on a variety of paper field forms, and then later manually keyed into either Pedon PC or NASIS. Electronic versions of some field forms (e.g. Soi-232) also exist. Many older descriptions only exist in hardcopy paper form.
    e. At the current time, such point data only resides in NASIS. It is not routinely published publically except as noted in the Soil Characterization Data section below. Some pedon descriptions are published as 'typical' pedons in Official Soil Series Descriptions, or as 'representative' pedons in map unit descriptions in published soil survey reports.
    f. At the current time, there are about 344,000 pedon records in NASIS.

2. Soil Characterization Data
    a. Soil characterization data are created during the soil analytical process in the NSSC Soil Survey Laboratory (SSL) and stored in the LIMS (Laboratory Information System) database.
    b. Such data are also being generated from the MLRA Soil Survey Office mini-labs. These data have no routine storage place at this time other than being maintained locally. Plans are to provide a place for these data in the NASIS database.
    c. Data has in the past, and in some instances still is, been generated by laboratories at state universities. The SSL is actively working with these labs to accumulate these data into the LIMS database so as much data as possible is in one central database.
    d. Regardless of the source of the analytical data, they can be virtually linked to the corresponding pedon description in NASIS by inserting a lab pedon number and individual soil lab sample numbers in the appropriate pedon description record in NASIS.

e. Characterization data from the SSL is periodically posted to a public facing repository and web site. Users can view and/or download the data to their local computer. Associated pedon description data from NASIS is also available through the web site.
f. Currently, there are about 34,000 pedons that have been analyzed by the SSL, and another 4000 that have been accumulated and imported from various state laboratories. It is anticipated that about another 25,000 to 30,000 pedons will be accumulated from other state labs.

3. Soil Monitoring data
    a. Soil moisture and temperature data are being collected using various methods in the field
        i. Piesometers which are read on a periodic basis, but over relatively long-term
        ii. Piesometers with data recorders attached to them
        iii. Buried moisture and temperature sensors with data loggers/recorders attached to them
    b. Frequency of data readings vary from a single reading on periodic days, to multiple readings per day (sometimes many times per day).

4. Rangeland inventory data
    a. Historically, and in many cases today, range clipping data have been recorded on paper copies of the Range-417, or similar form.
        i. The inventory efforts have primarily been aimed at documenting vegetation species composition on representative sites and annual production estimates.
        ii. Data collected not only include kinds and amounts of vegetation by species, but also geographic coordinate/location data, soil type, date, and ecological site info if known at the time. Data from individual sampling units are summarized to the plot level to predict production and plant community composition.
    b. Data from Range-417 forms that were available prior to mid-1990s exist within the Ecological Site Inventory (ESI) portion of the Ecological Site Information System (ESIS) database. Data from about 9200 plots are included in the database. The data have not been validated for data-entry accuracy compared to what was on the original paper form.
    c. Data on more recent forms have not been routinely entered into the ESI database as no mechanism is available for doing so other than manually keying the data in through the user interface. It is unknown how many such paper forms exist. These forms are held locally at the state offices.
    d. Some states have adapted these forms to an Excel or other spreadsheet format. It is unknown how or where these data files reside. Some may have been keyed into the ESI database. Others are likely stored locally.
    e. Some states have begun using the Jornada Database for Inventory Monitoring and Assessment (DIMA) tool to collect field inventory data. This is a MS Access tool designed by the Jornada ARS team in collaboration with NRCS and other Federal agency personnel. The individual Access databases are being maintained locally by those using the tool. Data from some may have been keyed into the national ESI database.
        i. No mechanism currently exists to move these datasets into the national ESI database.
        ii. General consensus of this analysis group is that the Jornada tool is not adequate as it exists today, even for range inventories
        iii. The tool has no capability to collect forest inventory data.
        iv. Montana has worked with the Jornada group to develop a modified version of the tool to better fit their needs. This version needs to be evaluated to determine its capabilities and adequacy.
    f. The NRI staff has developed a CASI application on a handheld computer to collect rangeland health data as part of the NRI data collection process.
    g. A recent query of the states by Curtis Talbot reveals that the states are using a variety of field forms to collect range inventory data. Types of data being collected include
        i. species composition to arrive at plant community composition and production estimates,

1. different levels of resolution are being collected using different collection protocols and methods.

ii. rangeland health
iii. several forms are available from ARS Jornada on their website
iv. forms being used are posted on our SharePoint site.

5. Forestland and Windbreak Inventory data
    a. Forest inventory data collection efforts basically parallel those for rangeland.
    b. Forestland inventory data have historically been recorded on Wood-5 forms, generally paper copies.
        i. Question of spatial extent of the sample area – need to record something
    c. Windbreak inventory data are recorded on Wood-4 form.
    d. Data from Wood-5 and Wood-4 forms that were available prior to mid-1990s exist within the Ecological Site Inventory portion of the Ecological Site Information System (ESIS) database. Data from about 33,000 plots are included in the database. Data from about 2300 windbreak plots are in the database. Data from other plots only exist in paper format. The data in the database have not been validated for data-entry accuracy compared to what was on the original paper form.
    e. Some states have likely adapted these forms to an Excel or other spreadsheet format.
    f. No mechanism exists to upload data from field forms or Excel forms to the ESI database other than manual entry through the ESI user interface. Data from some plots may have been keyed into the ESI database since the mid-1990s.
    g. Data collected not only include kinds and amounts of vegetation by species, but also geographic coordinate/location data, soil type, and date. Data from individual tree samples are summarized to the plot level.
    h. Recently, updated forms have been developed to record this type of data, along with additional important inventory data. See **Appendix 1** of this document. As these are new forms, no mechanism is in place to import data from these forms into the ESI database other than manual entry through the ESI user interface. The ESI database does not have fields defined for the newer supplemental inventory forms.

6. Cropland performance data
    a. In earlier years of the soil survey program there was an effort to collect crop yield data by different soil types for inclusion in published soil survey reports.
    b. Field data were recorded on SOI-1 forms.
    c. Data from some earlier years were entered into a national database.
    d. As late as the mid-1990's, this database was maintained by personnel in Ft Collins, CO.
    e. Today, it appears this database is no longer being maintained, and may not even be available for recovery.
    f. Some such data are likely still being collected, but it is unknown how frequently this occurs, what forms are being used, or how they are being maintained.

7. Pastureland inventory data
    a. Clipping study
    b. Hay & grazing records

8. Wildlife
    a. Currently, very little if any data related to wildlife habitat and wildlife use of ecological sites is being collected.

9. NRI (Natural Resource Inventory) data
    a. The NRI has different data collection protocols.
    b. Location of the data collection points is intended to be protected data and not publically available, and not even readily available to others within the agency.
    c. Rangeland Health is currently one of the data collection protocols.

d. Data collectors are using a handheld CASI tool for field data collection of data in rangeland and pastureland settings.
e. Rangeland health protocols are incorporated into the CASI.
f. A data upload procedure is available to move data from the CASI to a central database at Iowa State University.
g. A variety of data collection protocols are being used
    i. Range Data Collection
        1. Line Point Transects for Cover Composition
        2. Line Intercept transects: Basal and Canopy Gaps
        3. Soil Stability
        4. Plant Height
        5. Dry Weight Rank
        6. Species Composition by Weight
        7. Plant Census
        8. Rangeland Health

    ii. Pastureland Data Collection
        1. Line Point Transects for Cover Composition
        2. Line Intercept transects: Basal and Canopy Gaps
        3. Soil Stability
        4. Plant Height
        5. Dry Weight Rank
        6. Standing Biomass
        7. Plant Census
        8. Pasture Condition

10. Dynamic Soil Properties (Soil Change)
    a. Data are being collected to document changes in selected soil properties under different landuse and management systems, and to document characteristics (soil and vegetation) of different ecological sites, and states and community phases of a particular ecological site.
    b. Data collection protocols for Dynamic Soil Properties are outlined in the Soil Change Guide. The current version of the guide is posted at http://soils.usda.gov/technical/soil_change/ .
    c. Data being collected include standard soil profile descriptions, specialized field measurements of soil properties, analytical data from samples analyzed in a soils lab, and a variety of vegetation related data for rangeland, forestland, cropland, and hayland/pastureland.
        i. Some of the protocols outlined for these resource disciplines are the same as being used for standard vegetation inventories; others are not.
    d. Field data collection forms have been designed as Excel spreadsheets to record soils data and minimal vegetation data.
        i. The spreadsheets could be adapted for use with digital pen technology.
    e. With the release of NASIS 6.1, soil related data recorded on these spreadsheets is able to be imported into the NASIS database and merged with the respective pedon descriptions collected at the same data collection points.
    f. The extensive vegetation inventory data to be collected as part of DSP projects await the outcome of this business analysis project. For now, vegetation data will be recorded on appropriate field data collection forms which will be placed on a SharePoint site for temporary storage until a national database is available for storage of these data.

11. Rapid Carbon Assessment
    a. Data are being collected to document selected soil properties under different landuse and management systems primarily for the purpose of estimating soil organic carbon content on a national scale.

b. Data being collected include standard soil profile descriptions, specialized field measurements of soil property data, analytical data from samples analyzed in a soils lab, and a minimal vegetation related data.
c. Field data collection forms have been designed as Excel spreadsheets to record soils data and minimal vegetation data.
    i. The spreadsheets could be adapted for use with digital pen technology.
d. With the release of NASIS 6.1, data recorded on these spreadsheets is able to be imported into the NASIS database and merged with the respective pedon descriptions collected at the same data collection points.

Data Storage

1. Soil Pedon Descriptions, field notes, and transects
    a. Data collected using Pedon PC can be uploaded to NASIS database.
    b. Data are stored in the centralized NASIS database at the Kansas City Enterprise Data Center.
    c. Data on paper forms or other electronic formats are mostly retained in local or state offices.
2. Soil Characterization Data
    a. Data are stored in the LIMS database at the National Soil Survey Center
    b. When projects are completed and certified, the data are copied to the Soil Characterization Database located in Ft Collins, CO. The Soil Characterization Database is scheduled to be moved to the KC Data Center in FY 2011.
    c. Data generated by state university labs is being accumulated by the SSL and merged into the LIMS database and posted to the Soil Characterization Database.
    d. Data from the mini-labs in the MLRA Soil Survey Offices currently has no centralized storage space. Plans are underway to provide space for them in an upcoming release of NASIS.
3. Soil Monitoring Data
    a. For sites that are monitored for soil moisture and soil temperature with on a single reading per day, the readings can be inserted into the Site/Pedon data structure in NASIS.
    b. Some monitoring data are stored at the National Water and Climate Center in Portland.
    c. Other data with multiple readings per day are only stored in files in local and/or state offices. No mechanism is in place to accumulate such data into a national database.
4. Rangeland inventory Data
    a. Data collected prior to mid-1990s were entered into the national ESIS-ESI database located in Ft Collins, CO.
    b. More recently collected data has been entered into the national database in some cases, but most likely still exists on data collection forms or in copies of the Jornada Rangeland Database (recently renamed as Database for Inventory, Monitoring, and Assessment (DIMA)) which are only retained in local or state offices.
5. Pastureland inventory Data
    a. Currently there is no national data base to store this data.
6. Forestland and Windbreak Inventory Data
    a. Data collected prior to mid-1990s were entered into the national ESIS-ESI database located in Ft Collins, CO.
    b. More recently collected data has been entered into the national database in some cases, but most likely still exists on data collection forms in the states.
7. USFS point data
    a. USFS has many point data records of vegetation and soils data collection.
    b. Stored in USFS-NRIS database at the KC Data Center.
    c. There have been some preliminary discussions with FS about possibly bringing soil profile descriptions from NRIS into NASIS, but no definite work has been done. We have made accommodations for importing aggregated map unit data from NRIS to NASIS, and the data migration process is being tested at this time.
8. Cropland performance data
    a. No national database exists for these data
    b. Data that existed in a previous national database may not be recoverable.

    c. More recently collected data likely still exists on data collection forms held in the states.
9. NRI (Natural Resource Inventory) data
    a. Data are stored in a national database at Iowa State University, Ames, IA
10. Dynamic Soil Properties & Rapid Carbon Assessment
    a. Soils data collected as part of these projects will be uploaded and stored in the national NASIS database after the release of NASIS 6.1. In the meantime, some data will be stored on Excel spreadsheets and placed on a SharePoint site.
    b. The minimal vegetation data from Rapid Carbon Assessment project will also be stored in the NASIS database.
    c. Vegetation data collected in DSP projects have no national database location at this time. Data will be stored on field data collection forms for the time being, awaiting the outcome of this business analysis effort and development of a national database.
        i. Field forms to be used to collect this data are still in development stages. The general recommendation is to use existing range and forest inventory forms.

Data Usage

1. Soil property and vegetation point data are aggregated to document and provide ranges of characteristics for soil series, soil map units, map unit components, wetland classification, and ecological sites, states and community phases.
    a. Soil map units and map unit components
        i. ranges of characteristics are documented by soil pedon descriptions, soil characterization data
        ii. plant community and productivity data for individual map unit components are documented by vegetation inventory data and production data collected in vegetation inventories
    b. Ecological sites, states, and community phases
        i. Soil characteristics of ESDs, including states and community phases, are documented by soil pedon descriptions and soil characterization data
        ii. plant community and productivity data for individual ESDs, including states and community phases, are documented by vegetation inventory data and production data collected in vegetation inventories
        iii. ESDs also contain descriptive information about the presence of various wildlife species and their use of the areas. Inventory data should provide the basis for this information.
    c. Pasture scoring, rangeland health, similarity indexes, trend analysis
2. Data collected during the various resource inventories are used to document changes in soil properties and vegetation communities and production levels resulting from differing land use management systems.
3. Resource inventory data are used during conservation planning activities on the particular tract of land where the data are collected.
4. Resource inventory data could be used to provide more site-specific interpretations of the immediate area around the data collection point.

Interaction between the various data stores and the various information management systems

1. NASIS and ESIS
    a. Currently, the only true connection between these databases/applications is that on a nightly basis valid ecological site IDs and names are passed from ESIS to NASIS. Users in NASIS use these as look-up lists for linking or correlating soil map unit components and site descriptions with the appropriate ecological site(s).
        i. This linkage is later used in Web Soil Survey to display ESD information from ESIS to the WSS user for their defined area of interest (AOI).

b. No data are passed directly from NASIS to ESIS. However, there are report scripts in NASIS that will output a variety of soil properties and characteristics of the soils that are linked to a particular Ecological Site. The summarized data is used by the developers of ESDs to define ranges of soil properties and characteristics to be described in the particular ESD.

2. Soil Data Warehouse/Mart, Web Soil Survey, and NASIS
    a. Snapshots of aggregated soil survey map unit data for individual soil survey areas are periodically certified and exported from NASIS to the Soil Data Warehouse and Mart. These data are by NRCS policy designated as the 'official' soils data for use in eFOTG and delivery to the public.
    b. These datasets include the correlated linkage between soil map unit components and the appropriate ecological site.
    c. Data in the Soil Data Mart are displayed through the Web Soil Survey application.
3. Web Soil Survey and ESIS
    a. In WSS, the user can define an AOI for a particular tract of land that they are interested in and get the official soil survey data and information for that AOI.
    b. By using the linkage between soil map unit components and ecological sites described above, the WSS user can also view and/or print various data coming from the respective ESD stored in ESIS including tables, charts, state and transition model diagrams, and stored digital images. Additional ESD content will be able to be displayed with the release of WSS 3.0 in early 2012.
4. PLANTS and ESIS
    a. When an ESIS user enters vegetation point data, they enter a list of plants found at the observation point/plot. To do so they enter the national plant symbol and ESIS validates that symbol against those in PLANTS. If it is found to be a valid symbol the scientific name, national vernacular name and plant symbol are populated in ESIS-ESI database. This process is repeated for each plant needing to be recorded.
    b. When ESIS users develop an Ecological Site Description they provide a list of plants that occur on that ecological site. To do so they enter the national plant symbol and ESIS validates that symbol against those in PLANTS. If it is found to be a valid symbol the scientific name, national vernacular name and plant symbol are populated in ESIS-ESD database. This process is repeated for each plant needing to be recorded.
    c. In the ESD report output, there is a live link from each plant in the list to the corresponding plant record in PLANTS. If a user clicks on the link, the information in PLANTS for the particular plant is displayed.
5. PLANTS and NASIS
    a. A copy of the plant species list from PLANTS with plant symbol, national vernacular name, and scientific name is stored in the Plants table in NASIS. The list is periodically captured from PLANTS and placed in NASIS db. No live linkage exists.
    b. The list of plants in NASIS serves as a look-up list to the Local Plants table where selected NASIS data managers can assign a 'local' common plant name to an official plant record. Local Plants serve as look-ups to populate plant names in various tables in the NASIS soils database.
6. GSAT – Grazing Land Spatial Analysis Tool
    a. Standalone application that utilizes soils data through Customer Service Toolkit and gets at ESD data
7. Erosion models such as Rangeland Hydrology Erosion Model (RHEM) and Wind Erosion Prediction Program (WEPP) are utilizing soil map unit component data to summarize by ecological sites. They would really prefer to get at vegetation point data if they could get at it.

Deficiencies of the Current System

1. Field data collection of the various types of inventories is done using disconnected methods and tools. This results in
    a. a significant amount of redundant and overlapping data collection such as
        i. geographic location information and coordinates are recorded on various forms
        ii. Physical characteristics of the collection point are recorded on multiple forms.

iii. Selected soil identifiers and properties are records on the vegetation forms as well as in the associated soil pedon description, and

b. the likelihood of data entry errors that can make it nearly impossible to later associate data from the various data collection efforts that comes from the same location and logically is intended to fit together. For example, the geographic coordinates of the data collection point are stored in both the soil pedon description and the vegetation inventory data. If a typo is made while entering the geographic coordinates in one of the databases, that data cannot readily be recognized as coming from the same location.

2. Data are not only being collected for basic resource inventory purposes, but also as part of on-farm conservation planning activities. Such data are generally not being accumulated into any national resource inventory database.
    a. These data need to be evaluated to see if they are applicable for use in the basic resource inventory process.
3. Most data collection tools are not in electronic format making it difficult to input the data into any national database.
    a. No automated mechanism is available for uploading vegetation point data to ESIS
    b. Manually rekeying the data into a national database is inefficient and provides another chance for data entry errors.
4. The national data stores that are in existence for resource inventory data are basically stove piped databases that cannot easily share data. This makes it very difficult for users to get at the various data needed from the different databases to meet their particular needs.
    a. Range, forest, and windbreak inventory data are stored in the ESI database within ESIS. However, each type of inventory is stored in own respective set of separate data tables. No linkage between them is evident.
    b. Soil pedon description, DSP and RaCA data are stored in NASIS. No direct linkage exists to associated vegetation data.
    c. Soil Characterization data are stored in the Soil Characterization database. No direct linkage exists to other data stores. A logical linkage to the associated soil pedon description exists by way of manually entering the lab pedon ID and individual soil sample numbers into the soil description data in NASIS.
5. The ESI database in ESIS has no mechanism to import data from any field data collection tool, even if such a tool did exist.
    a. Manual data entry via the keyboard is the only option available. This method is inefficient and provides the opportunity for data entry errors.
    b. Vegetation inventory data for both rangeland and forestland are being collected using a variety of forms and tools. Standard data collection forms need to be developed and adopted and preferably in electronic format so the data can be imported into a national database.
6. Pastureland inventory data
    a. Currently there is no national database to store the data.
7. Wildlife and Wildlife Habitat
    a. Currently, there is little if any data related to wildlife habitat and wildlife use of ecological sites being collected
    b. There is no national database to store such data if it is collected
    c. Part 612, National Biology Handbook, titled “Fish and Wildlife Habitat in Ecological Site Descriptions” is blank. No guidance is provided.
8. Riparian data collection is not accommodated in the current system. Standardized forms to collect field data on nor a national database to store the data are available.
9. The Pedon PC application and associated database have not been updated since 2002. Many new attributes have been included in the national NASIS database since 2002, especially as related to the current Dynamic Soil Property and Rapid Carbon Assessment projects. If Pedon PC is to continue to be used, it and its database need to be brought up to date with the NASIS data structure as well as the data upload routine to NASIS.
10. Data collection related to soil moisture and soil temperature are being collected with repeated readings on a daily basis. These protocols result in large datasets with many, many readings. Currently, the NASIS point data

structure can only accommodate one reading per day each for soil moisture and soil temperature. Provisions are needed to store this soil monitoring data in a national database.

11. Data other than what is currently being collected have been identified as needing to be collected to fully document ecological sites, states and community phases – e.g. range health assessments, wildlife species data, woody debris data, growth curve data for pastureland and hayland (Forage Suitability Groups), etc.
12. Climate data is needed by both the soils and vegetation disciplines. Currently, such data is not easily integrated with the various information systems.
13. Limited quality control/quality assurance procedures related to some point data are in existence today. Users of inventory data in ESIS are particularly concerned about the quality and correctness of data currently in the ESI database. It is unknown what percentage of the 340,000+ pedon descriptions currently in NASIS have been reviewed for correctness. Some states have recently undertaken the task of checking those that they have responsibility for.
    a. The geographic coordinates of existing data points is of variable reliability. Some points only have section, township, and range. Others have metes and bounds type location descriptions. Some locations were estimated from aerial photos or USGS topo sheets; others were recorded using GPS in standards formats.
    b. This variability makes it nearly impossible to display the data collection points in a GIS.
    c. All data points need to be able to be located in a standard coordinate system.
14. Photographs and sketches are often part of the inventory process and provide valuable knowledge. No organized national storage facility exists to store such files, nor a mechanism to process them beyond the originator of the files. No standardized metadata structure is in place. This issue is being studied by others too.
15. Data about the use and management history of the site or geographic location where inventory data are being collected is not routinely collected today. Current databases do not have the needed data structure to store such data. These data are essential to being able to properly summarize the data for use in documenting the state and transition models of ecological sites and to help explain how the various characteristics of the location came to be what they are today.
16. Currently, the NRCS national databases for soils and vegetation point data do not provide the ability to include data from other agencies, unless it is entered using our normal data input methods. If it is entered, we do not have a mechanism to indicate the source of the data.
    a. The NRCS characterization database can accept data from other laboratories, and the data is tagged as coming from a particular lab – e.g. the University of Illinois.
17. Point data describe the conditions at a particular point on the landscape at the time the observation was made. Collections of point data records need to be able to summarized/aggregated to document ranges of characteristics for the ecological site as a whole, or states or community phases within the ecological site. Very few standard tools are available to help with the summarization process.

Description of the Desired System

Overall system requirements

An integrated, coordinated information system is needed to store and manage the national collection of ecological site inventory data describing the geographic location, properties and characteristics found at the location, associated site information, plot properties, and metadata collected from specific points or plots on the landscape.

1. Such a system would include soil profile descriptions, site/landscape characteristics, documentation of the different vegetation species and their proportional amounts found at the location, information about wildlife use of the area, land use and management history, etc. Analytical soil data from various soil laboratories is also available from some sites and should be a part of the system.
    a. The data collected document the characteristics found at the observation site at the time of observation
    b. The data need to be able to be summarized to describe ranges of characteristics of the ecological site, state, and/or community phase to which the site is correlated, as well as ranges in characteristics for soil map units, map unit components, and soil taxonomic units (soil series, etc.).

2. The system would include a transactional database(s) where the data are stored and managed, as well as a public portal(s) where selected and approved data are made available to the general public. Selected authorized personnel would have full access to the data through possible a different portal/interface.
    a. Even though the feeling is that having all the data in a single database would be advantageous to usage of the data and efficiency of data storage, there is no absolute requirement of a single database.
    b. If the data are ultimately stored in multiple databases, they MUST be able to communicate with each other to the point that from a user standpoint the data appears to be in a single database.
    c. All data collected at the same location need to be able to be linked in such a way that they can be readily summarized and that it is obvious that they come from the same location.
3. The overall information system would also include one or more field data collection tools for recording data in the field. Automated data upload mechanism(s) are needed to move data from the field data collection tool(s) to the national database.

Field data collection

1. Tools used for the various resource inventories should be available to any agency employee, technical service provider, contractor, employees of partner agencies, consultants, and others as deemed appropriate. Any of these individuals should be allowed to use the tools and submit data for review to be included in the national database(s) of inventory data.
2. Data collected during standard resource inventory activities (soil survey, range, forest, etc.) and data collected during dynamic soil property assessment or on-site during conservation planning activities should be in a common format so that all data has the potential of being housed in a common database.
3. Data collection tool
    a. It is desirable that we have a single/common field tool to collect soils, range, forest, cropland, dynamic soil property, rapid carbon assessment, and other types of resource inventory data. Having a single tool would facilitate familiarity with the tool for the various field personnel collecting the data as many individuals will likely be collecting various themes of inventory data.
    b. It may be unrealistic to assume that a one-size-fits-all field tool will work in all data collection situations. Multiple formats – e.g. handheld computer, tablet computer, spreadsheets with digital pens, etc. may be needed.
    c. A common tool (hardware and software) would also reduce the redundancy and duplication of some data that is needed to be able to connect the various themes of data that come from the same location either at the same point in time, or different times.
    d. It is desirable to have a field tool where data can be collected in electronic format to avoid having to later transcribe from paper forms to electronic format in order to upload the data to the national database. Having to transcribe from paper to electronic form introduces the chance of data entry error.
    e. Any field data collection tool (hardware) should be easily carried and used in field data collection operations. It needs to be ruggedized and protected from climatic elements and the working environment including water, mud and dust.
        i. The overall size and weight of the tool are issues for use in a field setting
        ii. Screen readability and size, and battery life are issues.
        iii. Overheating of the unit is a concern.
    f. Integrated GPS technology is desirable to capture geographic coordinates of the observation points and auto-populating the coordinates into the database.
        i. Recording the coordinates in a standardized format is essential to being able to easily use the data points in a GIS application.
    g. Any field tool used needs to enforce data standards and integrity of the national database – e.g. limiting input into any given data field to the defined data type, allowable numeric ranges, choice lists, etc.
    h. As new ecological site attributes are identified to be collected, new data collection protocols are identified, or new choices are added to choice lists, the tool, its database, and any data entry forms need to be able to be updated as needed to reflect such changes as they are made to the national database.

i. An automated mechanism is needed to upload data from the field data collection tool(s) to the appropriate national database(s). As field tool data model changes are made, the upload routine must be able to be kept in sync with these changes.
j. Integration with digital cameras is needed in order to associate images with other inventory data from the same location on the landscape.
k. Need the capability to calculate some database values based on other existing data values. This might include similarity indices, difference indices, etc.

4. Data entry forms
    a. If forms, either paper or electronic, are used they should be standardized and constructed in such a fashion as to reduce redundant and duplicate data collection/data entry as much as possible.
    b. Electronic forms are preferred in order reduce duplicate data entry and data entry errors, and to facilitate uploading data to the national database.
    c. For rangeland inventories, a number of different protocols have been identified as being appropriate for use. Each protocol has a specific set of site and vegetation attributes that are to be collected and recorded that may be unique to that particular protocol. There are some attributes that apply to multiple protocols. It is desirable for any data collection tool to have the ability to have data entry forms or screens that are appropriate for a specific protocol. The same may be applicable to other resource inventories besides just rangeland inventories. The data recorded through the various data entry forms should ultimately be stored in a common underlying data structure.
    d. More recently proposed/adopted protocols recommend collecting data following a 3-tiered approach. (ref. paper by Bestelmeyer et.al. "State-and-Transition models for heterogeneous landscapes: A strategy for development and application", 2009.)
        i. Tier 1 – "Initial Site Concept Data Collection" is a reconnaissance level inventory where ocular estimates are collected to determine general range of variability.
        ii. Tier 2 – "Refining Site Concept Data Collection" is a mid-level data collection effort used to verify site concepts.
        iii. Tier 3 – "Full Site Characterization" is the most detailed data collection at a number of representative locations involving all states and community phases within an ecological site.
    e. We need the ability to record Riparian Complex Inventory data using the 3-tiered data collection approach.
        i. Tier I Completing Tier 1 (reconnaissance) provides the necessary information to determine or develop the following necessary information for proceeding to Tier 2:
            1. Available research, articles, historic accounts and/or photographs stream gauge and other hydrologic information, aerial photo and topographic base maps, and other accessible information
            2. Anthropomorphic alterations and other disturbances to the stream (locations, types, magnitude of disruption, etc.)
            3. Valley types and stream types (potential natural channel and other present stages of channel evolution)
            4. Stream successional scenarios (channel evolution)
            5. Dominant plant community components (identified to plant associations) and their correlated fluvial surfaces and relative locations
            6. Relative boundaries of the site (upper and lower boundaries and lateral extents; this may include a stream, a segment of a stream, or several streams in an area with the same stream order and other characteristics)
            7. Potential reference areas for potential natural channels and vegetation (and perhaps other stable analogues or degraded channels)
            8. Draft state and transition model (states, phases, and plant community components)
            9. Historical and current accounts of riparian and aquatic bird, mammal, fish, amphibian, reptile, and invertebrate species distributions

ii. Tier 2 involves collecting data on the stream types, plant communities and aquatic and terrestrial animals integral to the site. In general, the more sites inventoried the better: sites may be inventoried by laying out tapes and using laser survey equipment or by using step transects of the metrics and getting cross-sections (when possible) with a hand level and portable rod.

1. Completing Tier 2 (inventory & analysis) provides the necessary information to determine or develop the following necessary information for proceeding to Tier 3:
2. Detailed analysis of stream and valley morphology (stream and valley cross-sections).
3. Descriptions of plant community components (plant community composition, cover, production, arrangement and extent of components).
4. Soil transects describing soil properties on each fluvial surface across the complex.
5. Descriptions of aquatic and terrestrial animals including species, habitats, and temporal and spatial use patterns. Species that may be indicators of a particular phase or state (or serve as triggers of transitions and pathways) should be noted and further investigated.
6. Identifying one or more type locations (for tier 3 inventory) that express the potential natural channel, soils, aquatic and terrestrial animal communities, and reference plant community components. In the absence of a potential natural channel, the current stable analogue can be used as the diagnostic phase/state.

iii. Tier 3 involves collecting specific point data on the stream types, plant communities and aquatic and terrestrial animals of the reference reach of the potential natural channel or current stable analogue. In general, if there is more than one good reference site it should be inventoried. Sites should be inventoried by laying out tapes and using laser survey equipment.

1. Completing Tier 3 (inventory & analysis of type location) provides the necessary information to complete a final draft of the riparian complex ESD.
2. Detailed analysis of stream and valley morphology (stream and valley cross-sections). Some sites may need surveys of longitudinal profile of thalweg, bankfull, and water surface, meander geometry, and hydraulic geometry.
3. Data collection is the same as Tier 2 except that all methods are performed with the best precision and accuracy (no ocular estimates or step transects).
4. Additional vegetation metrics may be needed (depending on the site) and include Basal Gaps, Canopy Gaps, Soil Aggregate Stability, and Production (Double Sampling).
5. Deeper investigations for fish and wildlife, including bird surveys, macroinvertebrate surveys, fish assemblages, etc.
6. Information is collected to develop reference sheets for Stream Visual Assessment Protocol version 2 and Proper Functioning Condition of Lotic Riparian Areas.
7. Detailed soil transects across the valley cross-section to determine range of characteristics for fluvial surfaces (incorporating any existing soil survey and/or descriptions from the riparian area).

f. Excel spreadsheet forms can be made compatible with digital pen technology that looks promising to be integrated into agency business flows. Such forms could minimize or eliminate the need to take a tablet or laptop computer to the field. Data collected with the digital pens is uploaded into Excel spreadsheet files when the pen is docked upon returning to the office.

g. With the release of NASIS 6.1, we have the ability to import data from Excel spreadsheets directly into the local NASIS database. The data can then be uploaded to the national NASIS database. This technology could be applied to other databases as well.
h. Any form used needs to enforce data standards and integrity of the national database – e.g. limiting input into any given data field to the defined data type, numeric ranges, choice lists, etc.
i. As changes are made to the national database, and new attributes are identified to be collected the respective forms need to be able to be updated to reflect such changes.

5. Photographs and other digital images
    a. A central national storage facility is needed for digital photographs, sketches, block diagrams, drawings, and other image files that may be acquired during resource inventory activities.
    b. Standardized guidelines are needed for file format, quality, resolution, required metadata, etc. as related to these data files.
    c. A mechanism is needed to move such files from the field data collection point to the central repository.
    d. Adequate metadata must be associated with each file in order to make appropriate use of the image.
        i. Standardized georeferencing is a must.
        ii. Captions are needed.
        iii. The Soil Survey Division has sponsored a business analysis of a proposed Content Management system that includes handling of such image files. Metadata requirements are outlined in that document. These business requirements are planned to be considered by ITC during FY 2011 for possible development. The CDSI teams are also looking at agency needs for storing and managing digital images related to conservation planning activities. These requirements need to be evaluated to see if they might meet ESI needs.
    e. Image files need to be available for querying and linkage into various publication work flows including Ecological Site Descriptions (ESDs) and Web Soil Survey.
6. Data model
    a. The data model content and structure needs to accommodate all the data that are identified as being needed to be collected to meet the various needs of those collecting and using the data. This would include soil profile descriptions, site/landscape characteristics, documentation of the different vegetation species and their proportional amounts found at the location, information about wildlife use of the area, land use and management history, etc. Analytical soil data from various soil laboratories is also available from some sites and should be a part of the system.
        i. Need the ability to record data and information collected that describe the geographic location of the data collection site or plot, as well as general information describing the characteristics of the site or plot. The use of standardized geographic coordinates is desired and encouraged.
        ii. Need the ability to record data collected at the actual observation point(s) within the site or plot – e.g. soil and hydrologic characteristics, plant species present and their respective numbers or amounts, wildlife presence and/or use of the site, etc.
        iii. Need the ability to document where each point exists within the plot.
            (1) Recording x,y coordinates from GPS at each point is one option.
            (2) Data structure added to NASIS for RaCA and DSP data locate each point by distance and azimuth from a single reference x,y coordinate assigned to the plot.
        iv. As changes are approved to collect and record additional or different resource attributes, the data model must be designed in such a way that it can be altered as needed to accommodate these changes without major programming effort. A system such as is used with NASIS would be desirable.
        v. Various plot configurations have been developed and identified as being appropriate for gathering ecological site inventory data. The different configurations vary is overall shape and arrangement of individual soil and vegetation observation points within the plot. The plot configuration for each sampling event needs to be identified and recorded. Some of these are shown in **Appendix 2** of this document.

vi. Considerable data have been identified as being needed that is not currently being collected on a routine basis – e.g. dynamic soil property data collection protocols. Such data must be accommodated.

vii. Data collected by the different resource disciplines must be accommodated.

(1) The soils discipline has a data model being used to collect pedon and site descriptive data. Data from RaCA and DSP projects are also included with NASIS 6.1 release.

(2) The forestry discipline has developed new inventory data collection forms.

(3) The range discipline has the 417 form and others.

(4) Nothing currently exists related to Wildlife and Wildlife Habitat. There is a need to collect data related to

(i) Bird count per state for each community phase

(ii) Downed wood density for wooded sites

(iii) Dead snags per acre for wooded sites

(iv) Stream visual assessment (SVAP2) for perennial streams

(v) Wetland classification using Cowardin Classification and HGM (hydro-geomorphic) wetland class

(vi) Ecological site descriptions should contain a discussion of ecological dynamics of the site. This discussion should include known animal drivers/engineers and the resultant vegetative trajectory. Animal drivers/engineers/architects include beaver, prairie dogs, anadromous (ascending rivers from the sea for breeding) fish, bark beetles, etc. Data related to the use of the area being inventoried by such species should be collected and recorded in the database.

(vii) Need to record the presence of soil features/inclusions important to wildlife such as mineral licks, bank swallow cliffs, etc.

(5) Other disciplines may have forms that they use.

viii. If multiple data entry forms are developed for a given resource theme, e.g. rangeland, the data being recorded should all ultimately be stored in a common underlying data structure.

ix. Data about the land use and management history of the site or geographic location of data collection need to be collected and stored in the database. The actual information that needs to be collected remains to be identified. Some possibilities are included in **Appendix 4** of this document.

x. Need the ability to flag data elements as calculated, estimated, or measured

b. **A detailed data model will need to be developed**. However, the actual data model cannot be defined until each resource discipline identifies the actual data they will be collecting and what needs to be stored in the database.

i. Point data currently in the ESIS-ESI database needs to be accommodated in the new data model. The data should be migrated from ESIS into whatever national database is built. The source of the data must be identified.

ii. Appropriate data that currently exists in the ARS Jornada Database for Inventory Monitoring and Assessment (DIMA) database should be accommodated in the new data model and the actual data would need to be converted into whatever national database is developed.

iii. In 1996, an interagency Sampling Vegetation Attributes document was agreed to and published by BLM. NRCS participated in this effort. The document provides attributes and definitions associated with different rangeland data collection protocols. About a dozen protocols or methods are documented. This document should be used as a starting point, as well as the current ESIS-ESI data model, for any national database that is developed. Curtis Talbot has a hardcopy of this document.

iv. In the late 1990's, an interdisciplinary team of NRCS employees met if a series of meetings to discuss the need for an integrated resource inventory system. One result was a draft data model that might be used. This data model should be evaluated as a possible starting point for any data model that is ultimately developed.

v. **Appendix 3** includes an excerpt from the recently signed Rangeland Interagency Ecological Site Manual. It provides some insight into the data that should be collected during the inventory process on rangeland.
vi. We need the ability to store project plans and milestones that outline data collection projects at the MLRA Soil Survey Office (MLRA-SSO) and/or MLRA Regional Soil Survey Office (MO) level (similar to Project tables in NASIS). The use of standardized templates for project plans and storage of the information is pieces and parts would facilitate querying the information.

c. The data model needs to be managed and built in such a way that it can be adjusted and expanded as additional data requirements are identified in the future. We know it will change with time.
d. The data must be georeferenced using a standardized coordinate system and horizontal datum. The data collection points need to be able to be readily displayed using GIS technology without a lot of data manipulation.
    i. Data points could be recorded using different coordinate systems (lat/long, UTM, etc.) but the all should be able to be converted to a standard system to facilitate display in GIS.
    ii. Existing older data will likely be an issue due to the fact that precise coordinates may not be available.
    iii. A mechanism needs to be included to indicate the accuracy/reliability of the geographic coordinates included. Should include a 'method' column to indicate how the coordinates were determined – e.g. estimated from USGS topo or aerial photo, auto-populated from GPS, manually entered from GPS, etc. NASIS has a list that might be used.
    iv. For newly collected data, it is recommended that GPS technology be used to collect coordinates in the defined standard coordinate system in the field.
e. It is desirable for the various resource inventories to share as much data as possible (or maybe more preferably be in a common data structure and physical database) to reduce data redundancy and facilitate linkages of inventory data taken from the same geographic location – e.g. site descriptive and geographic location data.
f. Data collected for a specific plant species must reference official plant symbols and scientific names in the PLANTS database.
    i. The ability to use local common/vernacular names is desired.
    ii. Choice lists used in the integrated resource inventory database need to either be populated by a live link to PLANTS or be able to be periodically refreshed with an updated list from PLANTS.
g. The data model needs to be structured in such a way that data gathered within a plot can be aggregated or summarized for that plot.
h. The data needs to be able to be summarized across plots that represent an ecological site, a state of an ecological site, or a community phase within a state. Such summarization is needed to document the characteristics of ecological sites, states, and community phases, as well as the transitions/pathways between them – documenting the state and transition model of an ecological site description.
i. Summarization of data across soil map units and map unit components is also needed.
j. Different groups of users need access to their data for data entry, edit, and QC/QA purposes. There is a need to be able to record and maintain edit permissions to their appropriate list of data records in the national database.
k. A mechanism is needed to identify which data records are approved for public viewing.

Quality Control and Quality Assurance

1. Procedures need to be implemented by the various disciplines to ensure that all resource inventory data is reviewed for accuracy and completeness. The information system that these data are stored need to facilitate these procedures.
    a. Another team has developed QC/QA guidance and work flow recommendations.
    b. Those recommendations are currently being routed for review and acceptance.
2. At a minimum, the following QC/QA checks should be able to be made on the data
    a. Quality Control

i. Completeness and accuracy of data transferred from paper to electronic media
ii. Verifying completion of minimum dataset (100% check)
iii. Review the correlation of ecological sites to soil map unit components (100% check)
iv. Ensure type locations are representative of modal concept
v. Ensure all data is organized and archived appropriately

b. Quality Assurance
i. Verification that proper data collection protocols were followed. Training of field personnel will be needed to ensure they are aware of and following the proper protocols and standards for gathering the respective inventory data
ii. Verification that appropriate data from a specific protocol is being collected and being collected appropriately
iii. Verifying completion of minimum dataset (partial check)
iv. Ensure adequacy of the number of sampling points, considering size and extent of the ecological site
v. Review the correlation of ecological sites to soil map unit components (partial check)

3. Need the capability to validate the data including simple statistics, verification of data types, and verification of data values within an approved numeric range or choice list, data inter-relationships, and mathematical correlations. Validations can be a mix of system imposed and user invoked on demand.
4. Need to be able to develop validation rules about what is valid data –
    a. Is the soil identified mapped in the area?
    b. Were enough trees measured on a given plot for it to be valid data?
5. QC/QA reviews should be restricted to those individuals with the proper training and authority to conduct the reviews.
6. A mechanism should be implemented so that all inventory data can be labeled as having been through the QC/QA review process. Could consider developing a workflow status concept to indicate level of certification process that would be stored with each dataset. Categories might include draft, ready for review, rejected, accepted, etc.
7. Data collected during on-site conservation planning activities should be reviewed by qualified individuals to determine its appropriateness for inclusion in the national resource inventory database.

Data Storage

1. All resource inventory data needs to be housed in a centralized transactional national database(s). This will allow for the long-term preservation of the data and make more of the data available more readily available to those who need access to it.
2. It is assumed that any national database(s) would be located within one of the USDA Enterprise Data Centers, presumably in Kansas City with other NRCS resource data.
3. The national database(s) must be secure and backed up on a regularly scheduled frequency to ensure protection and availability of the data.
4. The system needs to be secure from unauthorized access to protect against:
    a. Malevolent code such as viruses, worms, Trojan horses
    b. Theft of private information (email addresses, phone numbers, names, URLs, etc.)
    c. Unauthorized users accessing and potentially harming data
    d. Data loss due to systems failure (i.e., needs a robust backup system)
5. Staff must be available to maintain the system and provide enhancements as needed
6. The database(s) must have business specialists assigned as data stewards for the data.
7. Database(s) need an operational and technical support system (e.g., hotline staff) for users, both internal and external users.
8. It is felt that having the various types of inventory data in a single national database would make the data easiest to manage and use. This would also make it much easier to keep the various data from a single location linked together.
    a. Would facilitate querying data across the different resource data themes.

    b. Would facilitate generation of reports containing data from different data themes that were collected from the same geographic location and are intended to be associated.
9. If the various types of inventory data are ultimately stored in separate national databases, a common, coordinated data dictionary is essential to efficient data linkage, use of data, and access to the data.
10. If the data are in separate physical databases, to the user the data need to be able to be presented as if coming from a single database.
11. Automated upload mechanisms are essential for moving data from any field data collection tool(s) to the national database(s). Functionality similar to how data are imported from Pedon PC to NASIS and the import of Excel spreadsheet content into NASIS are possibilities.
12. Need the ability to import/enter existing or new data from various current sources (electronic and paper sources).
13. Need the ability to include data currently in the ESIS-ESI database and the Jornada Database for Inventory Monitoring and Assessment (DIMA). Conversion of these data to a new data model will likely be needed.
14. The National Resource Inventory (NRI) database at Iowa State University contains data collected as part of the Rangeland Health initiative. It would be desirable if these data could be included, or at least accessed in some fashion so that they could be included in data aggregation/summarization activities.
15. Data collected for a specific plant species need to be able to reference official plant symbols and scientific names in the PLANTS database.
    a. Locally used common/vernacular name usage is desired.
    b. Choice lists used in the integrated resource inventory database need to either be populated by a live link to PLANTS or be able to be periodically refreshed with an updated list from PLANTS.
    c. Need hot link between this database and PLANTS so the user can view information from PLANTS in the interface.

Data Access

1. The database(s) need to be accessible nationally to authorized users for data integrity checks and maintenance
2. Access permissions need to be granted and controlled by login privileges (e.g., eAuth login)
    a. All data should be visible to all authorized system users for querying and reporting purposes, regardless of their edit permissions to the data.
    b. Need the ability to restrict data editing access to only those individuals that have a need to edit particular data records
    c. Need the ability to edit existing data post import to correct any conversion errors or omissions in data
    d. Some group of individuals will need to have global access to the data (i.e., administrators)
3. The national collection of all ecological site inventory data must be accessible by NRCS and partner agency personnel who need the data in order perform the duties of their job. This includes those individuals that:
    a. Collect/Input new data
    b. Are responsible for performing QC/QA tasks on the data.
    c. Will use the data to develop Ecological Site Descriptions.
    d. Will use the data to develop soil map unit and component ranges of characteristics.
    e. Will use the data in conservation planning activities.
    f. Overall database admin
    g. Data stewardship
4. Access to the data by internal users must be available during normal working hours of these users at a minimum.
    a. If public access is deemed appropriate, access to the data must be available 7 days a week. Scheduled downtimes for maintenance are permissible.
    b. If unscheduled downtime is needed, the interface to the data needs the ability to display a message saying the system is down for unscheduled maintenance.
5. Access for editing of the data must be restricted to authenticated users who have a appropriate edit permissions assigned to them.

6. Access to the national database(s) must be through some mechanism that restricts each person to only the data to which they need access based on the function they are performing – eAuthentication is a possibility.
    a. Different people or groups of people need different levels of access to the data. Some users will have a need to enter new data or edit existing data. Others will only need read-only access.
        i. **Currently** in ESIS, privileges to can granted to enter new data, edit data, query data, and delete data. Also can grant permissions to certify or approve ESDs and FSGs. Site administrators can grant these privileges.
            1. Privileges are granted on a political state by state basis meaning any user assigned to a state can edit any data associated with that state.
        ii. In the future, something along MLRA lines (possibly by MLRA or groups of MLRAs – e.g. MLRA-SSO of MO responsibility) might be more appropriate.
            1. Could consider QA responsibility areas.
        iii. Some designated small group of folks (data stewards) will need to be able to view and even edit any of the data in the national database – overall database administration and overall QC/QA responsibilities.
        iv. Field personnel need the ability to enter new data into the national database(s).
            1. FSG description data can currently be uploaded from Access db to ESIS – species, production potential
            2. CTSGs
            3. National db needs a user interface that will allow users to manually key in inventory data
            4. Also need an automated mechanism to upload data from field data collection tool(s) and/or forms
        v. Other users need the ability to perform QC/QA functions on the portion of the database that they have responsibility for
    b. **Currently** in ESIS, users with additional privileges can see raw data from individual sampling points within a plot, including lat/long coordinates.
    c. Some inventory sites may contain 'sensitive' data and therefore some data for those sites, such as geographic coordinates, may need to be shielded from certain groups of users.
    d. In the NASIS security model anyone with a need to have read-only access to the system can be given a NASIS login if they have a level-2 eAUTH account. Read-only access allows them to run any existing query or report scripts or interpretation and view the resulting subset of the data.
        i. Users that have a need to create data, whether it be actual soil data, query scripts, or report scripts have to be assigned to a 'group' that has some data editing privileges.
            1. An individual user can be a member of one or more groups as deemed necessary
            2. The NASIS Site Administrator (MO data manager) is responsible to assigning individual users to the groups.
            3. An individual user can be assigned to a group that will allow them to create new query or report scripts, but still not be able to edit any existing soil data.
        ii. The various data objects in the database are assigned to different groups based on who needs to be able to edit those data records.
7. The national collection of inventory data needs to be able to be queried for data that meet user specified criteria to meet their needs. Needs will vary depending on who the user is and the question(s) to be answered.
    a. Data needs to be able to be aggregated/summarized in order to develop ranges of characteristics for ESDs, soil map units, map unit components, etc.
    b. Results of queries need to be able to be exported in delimited files that can be imported into external applications such as MS Excel and Access, statistical applications, PC Ord, etc.
    c. Need to be able to write custom queries and save the script for later use.
        i. Could query for any subset of the data elements(columns)
        ii. Any authenticated user could write a new script
        iii. Users with read-only access to the database can run pre-written queries

8. The database(s) holding the site/point data needs to be able to be linked at some level with ESDs, NASIS, PLANTS, and possibly other applications.
9. By using the geographic coordinates of the sample points, the data should be able to interact with GIS. Displaying the sample points in a GIS would be a minimal level of interaction.
    a. Standardized coordinate format and datum is desirable.
    b. Ability to define an AOI (similar to WSS) and see sample points that exist within the AOI. Possibly display some data for each point.
    c. There is interest in being able to display data point/plot locations over the geographic extent of an ecological site. Boundaries of ecological sites are not digitized as such, but can be generated by use of the spatial soil map unit boundaries and linkages between ecological sites and soil map unit components.
10. Report generation requirements
    a. The system must provide users with the ability to generate reports from data records of their choosing. Report output format should include formatted table-type reports and delimited file formats.
    b. Output/download the results of queries run against the database in delimited file format that can be imported into external applications such as MS Excel, Access, statistical applications, etc. Applies to raw observation data as well as plot summary data.
    b. Generate reports with observation data summarized within a single plot and across multiple plots for a given ecological site, state, community phase, soil component, etc. This output might be in formatted reports or as delimited file format.
    c. Formatted form output to simulate various field data collection forms, a Range 417 for example.
        i. Used to validate data entry
        ii. Used when revisiting a plot at a later date to look at trends or changes.
    d. Users need to be able to write new or modified report scripts within the application, and save for later use.
    e. Need to be able to generate reports itemizing project plan milestones. Summarizing this information at the MLRA-SSO and/or MO level is needed.
    f. Need to be able to generate reports showing progress made toward project plan milestones. Summarizing this information at the MLRA-SSO and/or MO level is needed.
    g. **Currently** in ESIS, any user can run canned report scripts to get data – no login is needed
        i. The user can click on individual attributes to include in the output. Need to continue such capability across all data themes
        ii. Precise geographic location coordinates are hidden from general user view. Could consider generalizing to lower precision – e.g. NRI generalizes to Township; could consider nearest Lat/long minute or something similar, maybe 5 or 7.5 minutes of lat/long.
        iii. Observation data are summarized at the plot level
    h. **Currently** in NASIS, authenticated users can run existing report scripts, whether or not they have any data editing privileges to existing data.
        i. Users that are members of at least on edit group can write new report scripts.
        ii. Report scripts can be saved for later use.
        iii. Any user can run any report script saved to the system.
11. Public access to and publication of the data
    a. Selected, approved inventory data records need to be available to the general public.
        i. A web interface is needed for users to interact with the data
        ii. Need a mechanism for them to select that data they need – either by designating an area of interest (AOI) spatially, or querying by various data attributes
            1. Plots with presence of a particular plant species
            2. Plots linked to a specific ecological site(s)
            3. Upload AOI boundary similar to WSS

b. Could consider the concept of a data mart type database to house data approved for public viewing. If such a set up is included, a mechanism would be needed for migrating the 'approved' data records from the transactional database to the data mart database.
    i. The data mart database must be protected by regular backups
    ii. The system must be protected from malevolent code and unauthorized access to nonpublic areas of the system
    iii. Staff must be available to maintain the site and provide enhancements as needed
c. Precise geographic locations data should be hidden from general user view. Could consider generalizing to lower precision – NRI generalizes to Township (what do they use for areas without PLSS?); could consider nearest Lat/long minute or something similar; maybe 5 or 7.5 minutes of lat/long
d. Users with the appropriate level of access or permissions could see complete location data.
e. Data that are deemed 'sensitive' will be shielded from public viewing.
f. Issues – endangered species, noxious species, cultural resources, etc. data content is sensitive to some landowners. Some landowners will not allow us to inventory their land for fear of the information becoming available to the public.
    i. Previous discussions by other groups indicated that endangered species might not even be recorded in the database
    ii. Same with cultural resources
    iii. Need the ability to flag data from a particular plot/observation points as containing 'sensitive' data. Geographic location data from those points would not be included in outputs to general users.
    iv.
    v. Could consider flagging a particular species (vegetation and animal species) on a plot to hide it from general users. Lump it with a functional group or other higher category.
    vi. Generalizing or fuzzifying the geographic location coordinates may be an alternative to providing precise locations of sensitive species.
g. Any public access portal needs the capability to generate reports in user defined formats (e.g., XML, comma delimited, HTML, etc.)
h. Any public access portal must have export capabilities to provide customers with user defined subsets for use on client systems. Exports must be in a useable form for users

Potential Data Flow

Appendix 5 includes a diagram showing potential data flow through the proposed Ecological Site Information System.

Appendix 1 – ESI Forest Plot field Worksheet

ESI Forest Plot Field Worksheet

August 2000 - March 2009

Collected by:					Date:	
Soil Component Name, Map Unit Symbol:						
Ecological Site Name:			Community Phase #:		Ecological Site #:	

Forest Site Plot Number				Location Description (include latitude and longitude)
ID	Year	State	County	Pedon ID #

Location Data

Cover Type	MLRA Number	State Plane Coordinates / Township, Range, Section			Elevation
		Zone/Section	East(X) / Township	North(Y) / Range	

Physical Data

Precipitation (inches)		Landform	Slope						Position on Slope
Annual	Summer		Percent	Kind	Shape	Micro Relief	Aspect (Azimuth)	Length (feet)	

Soil Data

Detailed Profile	Detailed Understory	Mensur. Info	Soil Series/Component Name	Texture		Terms in-lieu of Texture	Past Eros.	Drainage Class	Altered Water Relations
				Modifier (e.g., Cobbly)	Type (e.g., SIL)				

Density Data

Understory Abundance				Stand Density		Basal Area (Sq. Ft. per Acre)		Crown Competition Factor (CCF)	
Reprod.	All Woody	Grasses, Forbs	Mosses, Lichens	M or E	Percent	M or E	Sq. Ft.	CCF (Applies only to Lodgepole pine)	Average Stand DBH"

Tree Data

NSPNS	Crown Class	Tree Origin	Tree Dia.	In. Rad. Last 10 Yr.	Age Estimation				
					Ht. Ring Ct.	No. of Rings	Mea. Pt. Age	Total Age	Total Height

Site Index Data

NSPNS	Number of Trees	Curve Number	Average Site Index

Canopy Cover Data

NSPNS	Canopy%	NSPNS	Canopy%	NSPNS	Canopy%	NSPNS	Canopy%

Ground Cover Data (for all species typically below 13 feet in height including tree seedlings and saplings)

NSPNS	Rating*	NSPNS	Rating*	NSPNS	Rating*	NSPNS	Rating*	NSPNS	Rating*	NSPNS	Rating*

Remarks

After February 2009, entries are optional; if used, coordinate with covers on the* **Supplemental 1 *worksheet, i.e., Rating 1 = 0-1% cover, 2 = 2-9%, 3 = 10-19%, 4 = 20-29%, 5 ≥ 30% cover.*

ESI Forest Plot Field Worksheet Instructions

August 2000 - March 2009

Header

Collected by - Enter full name of data collectors.

Date - Enter date plot was taken.

Soil Component Name, Map Unit Symbol - Enter name and symbol.

Ecological Site Name - Enter name if known (continue in remarks).

Community Phase # - Enter number if known (can be entered later).

Ecological Site # - Enter number if known (can be entered later).

Forest Site Plot Number

ID - Enter a number from 01 to 999. The ID# must be unique for the year, state, and county in which the plot data is recorded, i.e. duplicate ID#'s are not allowed for plots located in the same state and county for the same calendar year.

Year - Enter the last two digits of the calendar year the plot was recorded.

State - Enter the FIPS 2-digit numerical code for the state in which the plot is located.

County - Enter the FIPS 3-digit numerical code for the county in which the plot is located.

Pedon ID # - Enter number, e.g. 09OR667001.

Location Description - Enter information and latitude and longitude.

Location Data

Cover Type - Enter the code for appropriate forest cover type.

MLRA Number - Enter the major land resource area number in which the site is located.

State Plane Coordinates or Section – Either system may be used. If coordinates are used, round to show probable accuracy. If section, township, and range is used, enter in this fashion: 29 T14N R7W

Elevation - Enter the elevation in feet. In mountainous country, elevation to the nearest 100 feet is adequate.

Physical Data

Precipitation - Enter to the nearest whole inch.

Landform - Enter the appropriate code.

Slope -

Percent - Enter percent of slope in whole numbers, 0 to 99. Use 99 for slopes steeper than 99.

Kind - Enter the appropriate code.

Shape - Leave blank if slope has a Kind code of "P". If slope has a Kind code of "I", enter the appropriate code.

Microrelief - Enter the appropriate code.

Aspect - Enter the direction the slope faces in degrees of azimuth from true north.

Length - Enter the approximate length of slope to the nearest whole foot.

Position on Slope - Enter the appropriate code.

Soil Data

Detailed Profile Description - Enter Y if a complete and suitable soil description has been made, otherwise enter N.

Detailed Understory - Enter Y if detailed understory information has been recorded, otherwise enter N.

Mensurational Information - Enter Y if detailed mensurational information has been recorded for the trees in the plot, otherwise enter N.

Soil Series/Component Name - Enter the full soil series or component name. If a series name has not been established for the soil, enter the soil series name of the family to which the soil belongs, followed by the letter (F). Example: Holden (F)

Texture -

Modifier - Enter the appropriate texture modifier code or leave blank if none apply.

Type - Enter the appropriate texture type code or leave blank if none apply.

Term In Lieu of Texture - Enter the appropriate or leave blank if none apply.

Past Erosion - Enter the appropriate code.

Drainage Class - Enter the appropriate code.

Altered Water Relations - Enter the appropriate or leave blank if there has been no change in the water regime:

Density Data

Understory Abundance - Enter the code number that represents the relative understory abundance of each of the following items:

Reproduction

All Woody Plants

Grasses and Forbs

Mosses and Lichens

Stand Density (Canopy) -

M. or E. - Enter the code that indicates if the crown canopy closure was measured (M) or estimated (E).

Percent - Enter the percent of crown canopy closure in whole numbers.

Basal Area -

M. or E. - Enter the code that indicates if the basal area was measured (M) or estimated (E).

Sq. Ft. - Enter basal area in square feet.

Crown Competition Factor

- Enter CCF (lodgepole pine only).

- Enter Average Stand DBH" used to derive CCF.

Tree Data

Scientific Plant Name Symbol - Enter the scientific plant name symbol as listed in the Plants database (http://plants.usda.gov).

Crown Class - Enter the crown class code.

Tree Origin - Enter the tree origin code.

Tree Diameter - Enter the diameter at breast height of the measured tree to nearest 0.1 inch.

In. Rad. Last 10 Yr. - Enter the radius of the last 10 rings of the measured tree to the nearest 0.1 inch

Age Estimation - *Ht. Ring Ct.* - Enter the height, in feet, of the measured tree, at which the growth rings were counted. For standing trees this is normally at 4.5 feet above normal ground level. If ring count is from stumps, the center pith of the tree should be clearly discernable in the core sample to insure an accurate age count.

No. of Rings - Enter the number of growth rings counted.

Mea. Pt. Age -Enter the number of years it took for the measured tree to reach the height at which the ring count is made. For age correction factors, refer to the National Register of Site Index Curves in the National Forestry Manual.

Total Age -The total age is the sum of the number of rings plus the age correction factor.

Total Height -Enter the total height of the tree to the nearest foot.

Canopy Cover Data

NSPNS - Enter the scientific plant name symbol as listed in the Plants database (http://plants.usda.gov). ~~If there are more than twelve species, combine the least important species using the code "OTHER".~~ If additional spaces are needed, place data in the REMARKS section.

Percent - Enter the percent, in whole numbers, that each species occupies of the total canopy (done on a spatial basis). The percentages must total 100. ~~Use the code "OTHER" (see "NSPNS", above) if more than 12 species occur in the canopy, then record the percentage needed to sum to 100.~~ If additional spaces are needed, place data in the REMARKS section.

Ground Cover Data

NSPNS - Enter the scientific plant name symbol, as listed in the Plants database (http://plants.usda.gov), for the species that make up the ground cover below the canopy (mostly under 13 feet). Thirty spaces are provided.

Rating - Enter the code that represents the relative abundance of each listed species. Rating 1 = 0-1% cover, 2 = 2-9%, 3 = 10-19%, 4 = 20-29%, 5 > 30% cover. After February 2009, entries are optional.

ESI Forest Plot Field Worksheet - Supplemental 1

March 2009

ESI Forest Plot Field Worksheet - ID, Year, State, County:		Date:	
Forest Overstory Cover % (all trees typically > 13' height):		Other Note:	

Forest Overstory (data is for overstory trees typically above 13 feet in height)

	Forest Overstory Species Common Name (repeat species if in 2 or more height strata; arrange in descending order by top height)	NSPNS	Plant Type (nativity) *	Representative Live Canopy Height (bottom-in feet)	Representative Live Canopy Height (top-in feet)	Estimated Cover** %	Tree Diameter Range - (in.)	Basal Area (ft2)
1								
2								
3								
4								
5								
6								
7								
8								
9								
10								

Forest Understory (data is for understory species including trees typically below 13 feet in height)

	Forest Understory Species Common Name (repeat species if in 2 or more strata; arrange in descending order by top height)	NSPNS	Plant Type (nativity) *	Representative Live Canopy Height (bottom-in feet)	Representative Live Canopy Height (top-in feet)	Estimated Cover** %	Notes (vegetation vigor/health, snags, downed wood, pests, fire history, other -- continue on back):
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							
13							
14							
15							
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

*

T = Tree; TF = Tree Fern; V = Vine/Liana -- these three plant types can used in both "overstory" and "understory"; S = Shrub/Subshrub; G = Grass/grass-like or Graminoids; FH = Forb/Herb; FA = Fern/fern Ally; BC = Biological Crusts, e.g., algae, cyanobacte

** *For amounts less 0.1% cover, enter "0" in the Estimated Cover column, i.e., the plant is present in very limited amounts.*

ESI Forest Plot Field Worksheet - Supplemental 2

March 2009

ESI Forest Plot Field Worksheet - ID, Year, State, County:		Date:	

Percent Canopy Cover by Height Class and Plant Type

Height above ground*	Grass-Grasslike (graminoid)	Forb-herb-fern-fern ally	Shrub-tree-fern-vine-liana (typical potential height < 13')	Tree-tree-fern-vine-liana (typical potential height > 13')
<=0.5 ft				
>0.5 - <=1 ft				
>1 - <=2 ft				
>2 - <=4.5 ft				
>4.5 - <=13 ft				
>13 - <=40 ft				
>40 - <=80 ft				
>80 - <=120 ft				
>120 ft				

Percent Cover by Material Type

	% Surface cover (basal cover for grass, forb, shrub, and tree types)		% Ground cover (canopy)**	
Material Type	Minimum	Maximum	Minimum	Maximum
Grass/grass-like/ (graminoid)				
Forb/herb/fern/fern ally				
Shrub/tree-fern/vine/liana (typical potential height < 13')				
Tree/tree-fern/vine/liana (typically > 13' height)				
Biological Crusts (e.g., algae, cyanobacteria, lichens; may occur on soil surface or aerial parts of other plants)				
Nonvascular (e.g., mosses, liverworts, hornworts, stemmed lichens; may occur on soil surface or aerial parts of other plants)				
Litter (leaves, needles, fruits, cones, and bark on the surface)				
Downed wood, fine-small (< 0.40" diameter; 1-hour fuels)				
Downed wood, fine-medium (0.40 - 0.99" diameter; 10-hour fuels)				
Downed wood, fine-large (1.00 - 2.99" diameter; 100-hour fuels)				
Downed wood, coarse-small (3.00 - 8.99" diameter; 1,000-hour fuels;)				
Downed wood, coarse-large (> 9.00" diameter; 10,000-hour fuels;)				
Surface Fragments > 0.25" and <= 3"				
Surface Fragments > 3"				
Bedrock				
Water				
Tree snag-hard (>4" diameter at 4.5' above ground and >6' height with bark intact -- if less diameter OR height use downed wood codes)			Low (number/acre)	High (number/acre)
Tree snag-soft (>4" diameter at 4.5' above ground and >6' height with bark intact -- if less diameter OR height use downed wood codes)			Low (number/acre)	High (number/acre)
Bare Ground				

the top height determines height class, e.g., a stratum of 90 to 100' tall trees is placed only in the 80-120' height class even if crowns extend below 80'.

****hierarchy of ground cover from high to low; count highest intercepted material first with materials directly beneath not counted.***

ESI Forest Plot Field Supplemental 1 and Supplemental 2 Worksheet Instructions

March 2009

Supplemental 1

ESI Forest Plot Field Worksheet - ID, Year, State, County - Enter numbers from the correlated ESI Forest Plot Field Worksheet.

Date - Enter date plot was taken.

Forest Overstory Cover - Enter cover percentage for all trees typically above 13' in height.

Other Note - Enter any short note related to overstory cover.

Forest Overstory

(Data are for overstory trees typically above 13' in height; repeat species if in 2 or more height strata; arrange in descending order by top height)

Forest Overstory Species Common Name - Enter common name.

NSPNS - Enter the scientific plant name symbol as listed in the Plants database (http://plants.usda.gov).

Plant Type (nativity) - For plant type, enter T= Tree; TF = Tree Fern; V = Vine/Liana. Enter Nativity in parentheses: (N)=Native, (I)=Introduced, (U)=Unknown.

Representative Live Canopy Height (bottom-in feet) - Enter the representative bottom height of the live canopy of the particular overstory species as it occurs in a unique overstory stratum for the community phase.

Representative Live Canopy Height (top-in feet) - Enter the representative top height of the live canopy of the particular overstory species as it occurs in a unique overstory stratum for the community phase.

Estimated Cover % - Enter the representative canopy cover percentage value of the particular overstory species as related to the plant community phase. For amounts less than 0.1% cover, enter a value of "0" (zero) signifying a "trace" amount of cover.

Tree Diameter Range (in.) - Enter the representative minimum to maximum range of diameters in inches of the boles/trunks of trees > 13 feet in height encountered for the particular tree species in the correlated overstory stratum at a reference height (typically 4.5 feet above the average ground line) as related to the plant community phase.

Basal Area (ft2) - Enter the representative basal area for a tree species in the correlated overstory stratum at a reference height (typically 4.5 feet above the average ground line) as related to the plant community phase.

Forest Understory

(Data are for understory species including trees typically below 13' in height; repeat species if in 2 or more height strata; arrange in descending order by top height)

Forest Understory Species Common Name - Enter common name.

NSPNS - Enter the scientific plant name symbol as listed in the Plants database (http://plants.usda.gov).

Plant Type (nativity) - For plant type, enter T= Tree; TF = Tree Fern; V = Vine/Liana; S = Shrub/Subshrub; G = Grass/grass-like or Graminoids; FH = Forb/Herb; FA = Fern/fern Ally; BC = Biological Crusts, e.g., algae, cyanobacteria, lichens; N = Nonvascular, e.g., mosses, liverworts, hornworts, stemmed lichens. Enter Nativity in parentheses: (N)=Native, (I)=Introduced, (U)=Unknown.

Representative Live Canopy Height (bottom-in feet) - Enter the representative bottom height of the live canopy of the particular understory species as it occurs in a unique understory stratum for the community phase.

Representative Live Canopy Height (top-in feet) - Enter the representative top height of the live canopy of the particular understory species as it occurs in a unique understory stratum for the community phase.

Estimated Cover % - Enter the representative canopy cover percentage value of the particular understory species as related to the plant community phase. For amounts less than 0.1%, enter a value of "0" (zero) signifying a "trace" amount of cover.

Notes - Enter comments about vegetation vigor/health, fire history, condition of snags, etc.

Supplemental 2

ESI Forest Plot Field Worksheet - ID, Year, State, County - Enter numbers from the correlated ESI Forest Plot Field Worksheet.

Date - Enter date plot was taken.

Percent Canopy Cover by Height Class and Plant Type

Enter canopy covers of plant types falling within each height class. The top height determines height class, e.g., the entire cover percent of a stratum of 90 to 100' tall trees is placed only in the 80-120' height class even if crowns extend below 80'. The cover of a grass stratum of 1.5’ in height is placed only in the 1-2’ height class even though stems originate at ground level.

Percent Cover by Material Type

% Surface Cover

Soil surface cover is the percentage of the soil surface actually occupied by vegetative basal cover, biological crusts, litter, surface fragments, water, and bare ground. The cumulative total of the averages of low-high (min-max) values for the applicable material types will equal 100 percent. *Continuous line intercepts* of 100’ lengths are recommended, i.e., each material type is tallied by its length along the intercept line (down to tenths of a foot). If only one intercept line is completed or estimated ocularly, enter values in the “Minimum” column. If two or more are completed, enter the minimum to maximum values. Even though each downed wood size class is measured along the intercept line, the size class diameter is estimated perpendicular to the material’s longest dimension where the intercept line passes over the midpoint of the material. A line that intercepts a snag can be so noted and the snag “length” measured along the line, but offset “around” the snag to continue the line to its end.

% Ground Cover

Ground cover (vertical view) is the percentage of material, other than bare ground, that protects the soil surface from being hit directly by a raindrop. This would include first contact with plant canopy cover, biological crust, litter (including downed wood and snags), surface fragments, bedrock, and water. Canopy cover is the percentage of ground covered by a vertical projection of the outermost perimeter of the natural spread of foliage of plants. The cumulative total of the averages of low-high (min-max) values for the applicable material types will equal 100 percent. Various techniques may be used to estimate ground cover/canopy of material types, e.g., line-point intercept for ground cover and continuous-line intercept for canopy. If only one tally is completed or estimated ocularly, enter values in the “Minimum” column. If two or more tallies are completed, enter the minimum to maximum values. The hierarchy of ground cover is estimated by material type from high to low; count highest intercepted material first with materials directly beneath not counted.

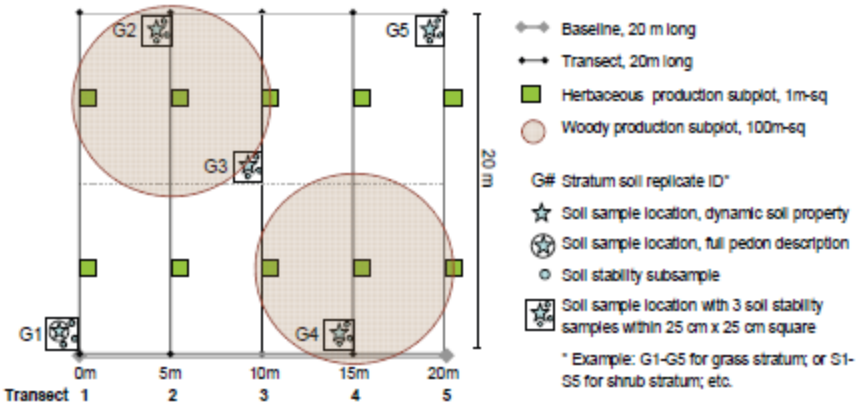
Tree Snag-Hard (number/acre) - Enter the low to high range of snag numbers per acre. “Hard” snags have bark largely intact and are >4" diameter at 4.5' above ground and >6' height with no evidence of decay; if less diameter OR height use downed wood codes and do not count as a snag.

Tree Snag-Soft (number/acre) - Enter the low to high range of snag numbers per acre. “Soft” snags have bark that has sloughed off (or no bark) and are >4" diameter at 4.5' above ground and >6' height with no evidence of decay; if less diameter OR height use downed wood codes and do not count as a snag.

Appendix 2 – Ecological Site Inventory Plot configurations

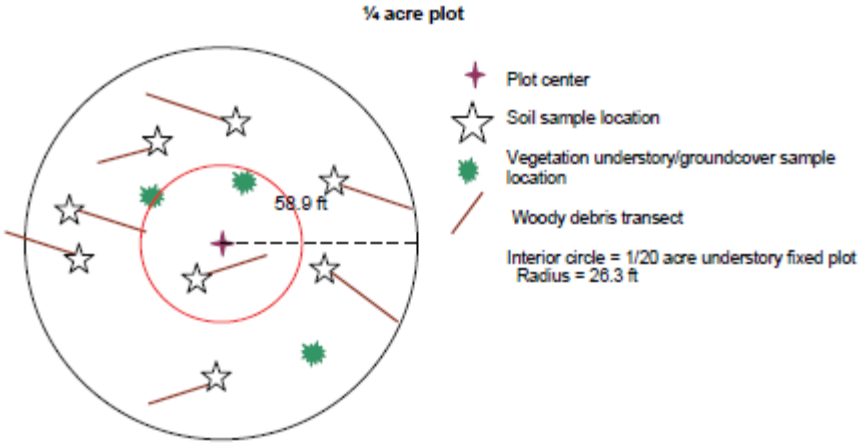
Rectangular Plot

Figure A3-1. Standard Plot Layout for Grassland, Shrubland, and Savanna Ecosystems. Example is a primary sampling unit (plot) for sampling one stratum with five soil sample locations.

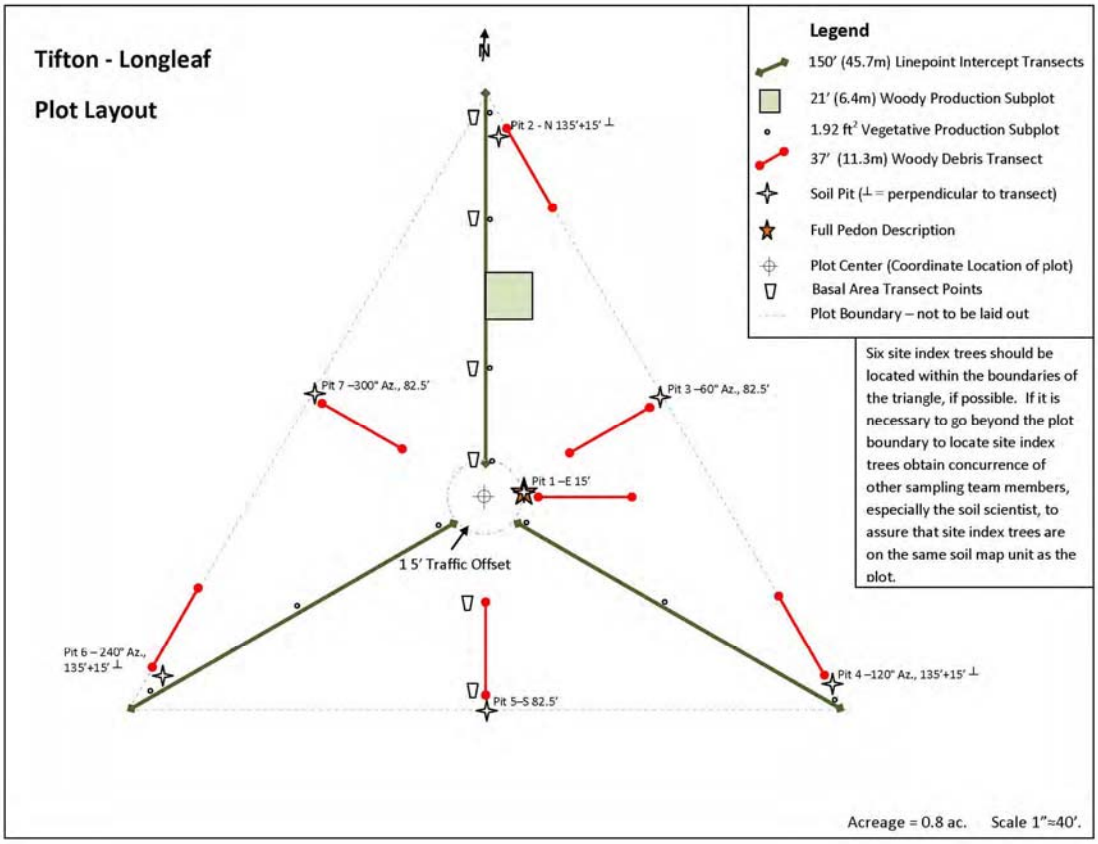


Circular Plot

Figure A3-3. Standard Plot Layout for Forest Land Ecosystems. Example is a primary sampling unit for a plot with a radius of 58.9 feet. This radius was selected to accommodate the variable radius plot required for site index in the western hemlock plant community in north-central Idaho. The site index sampling requirements of the plant communities included in a project dictate the radius for the plot. It may be necessary to vary the plot radius from project to project, but it is important to use the same plot radius for all plots within a single project.



Triangular Plot



Appendix 3 - An excerpt from the Rangeland Interagency Ecological Site Manual.

The following are minimum requirements to be included in the contents of the rangeland ecological site description:

1. General Information including ecological site name, ecological site number, and a map identifying approximate geographic extent of the ecological site.
2. Physiographic Features including landform, geology, aspect, elevation, slope, water table, flooding, and ponding.
3. Climatic Features including frost-free period (length and dates), freeze-free period (length and dates), mean annual precipitation, monthly moisture and temperature distribution, and name of approved climate stations.
4. Influencing Water Features existing on the site or adjacent wetland/riparian ecological sites that influence vegetation and/or management of the site. Use Cowardin Wetland Classification and/or Rosgen Stream Classification terminology.
5. Representative Soil Features including those that differentiate from other ecological sites, affect plant adaptation, establishment, growth, and response to disturbance.
    a. Use standard terminology and definitions in National Soil Survey Handbook and Soil Survey Manual.
    b. Identify properties that affect plant-soil-water relationships and hydrology.
6. Ecological Dynamics of the Site including: states, transitions, thresholds, restoration pathways, community phases, community pathways, animal species, wildlife habitat elements, hydrology, and changes to soil properties that are expected to occur as a result of disturbances and/or stresses.
    a. Include information related to landscape scale processes such as runoff, erosion, fire behavior, wildlife use, etc.
    b. Discussion of temporal scale associated with transitions, community pathways, restoration pathways, and thresholds. Where information exists about response to disturbance or management actions, probabilities of occurrence can be included (drought occurrence, fire frequency intervals).
7. Vegetation
    a. Describe the most common, predominant, or ecologically significant states and community phases. Include description of transitions, restoration pathways, and community pathways. Include a state and transition diagram.
    b. Describe ecologically significant associations of plant species that indicate important environmental gradients used to differentiate sites, state, or plant community phases.
    c. Use standardized plant names from the Integrated Taxonomic Information System as presented in the NRCS PLANTS database.
    d. For the reference state include a narrative description, detailed listing of plant species (includes scientific and common name, normal annual production in pounds air dry weight (ADW) per acre, and either canopy, foliar, or basal cover depending on life form), total annual production by growth form (median ADW pounds per acre per year in favorable, normal, and unfavorable years), and growth curve (monthly growth by plant species or communities).
    e. For all other states/community phases include, at a minimum, a narrative description.
    f. Productivity of Major Tree Species –annual productivity and site index for forested plant communities occurring on rangeland ecological sites, if applicable.

8. Supporting Information
    a. Record information about the relationship of the ecological site to other ecological sites and the documentation and references used to develop the rangeland ecological site description.
    b. Identify relationships to other classification systems such as National Vegetation Classification System (NVCS).

Appendix 4 – Land Use and Management History options

Below is a listing of various categories of data that have been identified as a being needed or would be useful in documenting the land use and management history of sites where data is being collected. To get a 'history' of the site, there would be a need to be the ability to record information back through time – repeating fields.

- Land use category
- Length of time in each land use – could be actual number of years or begin/end dates
- Historic land use
- Length of deferment
- Management/tillage system used and duration of each – should be related to land use category recorded.
- Grazing history – frequency, type of animal, and primary season of use for each type of animal
- Burning history – frequency, burn type, and season of burn
- Brush management history – date and method
- Crop history – crop and years
- Forest thinning/harvest – method, date, type of equipment used, season of harvest
- Forest stand competition control – method, date
- Forest rotation – length and cycle
- Hydrology changes
- Natural disturbances – type and distance from sample site
- Non-organic inputs
- Other disturbances affection production or plant community composition

There is ongoing discussion concerning the inclusion of 'cropland' in ESDs. If it is determined that cropland is not to be a component of ESDs, there may not be a need to include cropland related items in the land use/management history section. However, it is believed that this database will have multiple uses, not just ESDs.

Appendix 5 – Conceptual Diagram of Data Flow through the proposed future system.