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# NED-2 User's Guide

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## Abstract

This is the user's guide for NED-2, which is the latest version of NED, a forest ecosystem management decision support system. This software is part of a family of software products intended to help resource managers develop goals, assess current and future conditions, and produce sustainable management plans for forest properties. Designed for stand-alone Windows-based personal computers, NED-2 integrates a variety of forest management tools into a single environment. These tools include databases, growth and yield models, wildlife models, geographic information systems (GIS), visualization tools, and others. The software is distributed with an online help system and a printed user's guide. This user's guide provides guidance for use of the software and a basic introduction to the principles and calculations used in NED-2. A reference guide with more detailed explanations of the models, equations, and rules that underlie the software is available separately. The NED-2 software and related documentation is included on the CD-ROM and also may be downloaded from <http://nrs.fs.fed.us/tools/ned/products/ned2/>.

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**Cover photo:** Loon on Arbutus Pond, Essex County, New York. Photo by Mark J. Twery, U.S. Forest Service.

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### **NED Contributors**

The list of contributors for NED-2 is large and includes members from state and federal agencies, universities, and private industry. The list includes practicing foresters, wildlife biologists, landscape architects, hydrologists, and more. Development of NED-2 began with the formation of the following core team that consisted of representatives from each of several resource committees, as well as, several software developers. The original core team met two to three times annually to work out the details of NED-2.

Original NED core team members included the following:

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Early contributors to the NED development project included the following:

David A. Marquis, Research Silviculturist, Northeastern Research Station, Retired. We are most indebted for his vision and energy that conceived the project and sustained its early development.  
 Clay Smith, Research Silviculturist, Northeastern Research Station, Deceased  
 Laura Alban, Forester, SUNY College of Environmental Sciences and Forestry  
 Tom Schuler, Research Forester, Northern Research Station  
 Brian Simpson, Forester, Northern Research Station  
 Max McFadden, Assistant Director, Northeastern Research Station, Retired

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NED-2 was programmed by Scott Thomsma and Pete Kollasch, along with support from the University of Georgia in Athens, GA under the direction of Donald Nute and Donald Potter. Additional programming support was provided by Julian Bishop, David Boucugnani, Yousong Chang, Ningyu Chen, Zhiyuan Cheng, Deepak Chinthamalla, Mayukh Dass, John Dewey, Astrid Glende, Christopher Henderson, Geneho Kim, Rajesh Kommineni, Shanyin Liu, Arlo Lyle, Fred Maier, Joe Procopio, Xia Qu, Cy Routh, Karan Sharma, Shulei Sun, Hajime Uchiyama, Jin Wang, Yong Wei, Sarah Witzig, Mingguang Xu, Huasong Yin, Xin Zhang, Guo-jun Zhu, and others.

## **NED-2 Resource Committees**

Early in the development of NED-2, many scientific and managerial concepts were incorporated into NED-2 as a result of input from several resource committees. Prior to 1998, committees provided guidance on desired resource conditions, rules and regulations, operational procedures, definitions, and other concepts based on scientific research and professional practice.

### **Ecology**

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### **Economics**

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### **Forest health**

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**Visual**

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Present committee members: Skip Echelberger, Paul Gobster, Steve Hollenhorst, Gary Kell, William Kerr, Tom Kokx, Tom More, Peggy Pings, and Bruce Reid

Previous committee members: Mary Anna Harrilchak and John Kuhr

**Water**

Committee chair: Jim Hornbeck

Committee members: Mary Beth Adams, Edward Corbett, Tony Federer, Donald Hair, James Kochenderfer, Harry Parrott, Doug Ryan, Robert Smith, and James Vose

**Wildlife**

Committee chair: Dave deCalesta (Linda Thomasma 1992 to 1995)

Committee members: Doug Blodgett, Robert Brooks, Alan Boss, Richard DeGraaf, Clayton Grove, William Healy, John Lanier, Brad Nelson, Ralph Nyland, Steve Pelletier, William Porter, Robert Szaro, and Mariko Yamasaki

# Chapter 1 - Introduction

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## ABOUT NED SOFTWARE

NED-2 is the latest version of NED, a forest ecosystem management decision support system. This software is part of a family of software products intended to help resource managers develop goals, assess current and future conditions, and produce sustainable management plans for forest properties. NED originally was an acronym for the Northeast Decision Model, but as the geographical scope of the project expanded, the software lost the regional reference in its name and became known as NED.

The NED concept uses an original prescription design system to incorporate management goals for multiple objectives, analyze current forest conditions, recommend management alternatives, and predict future conditions under different alternatives. NED is designed to include a long-term, landscape-level view of the forest as an interconnected ecosystem that is too complex to understand at every level but which still must be managed. Recommendations for potential treatments involve information on all resources affected and provide options from which a manager may choose. The technique involves defining a management area of interest, defining goals for the area, identifying conditions necessary to meet each goal, and identifying conditions that may be met in conjunction with other conditions, from most restrictive to least restrictive (Twery et al. 2005).

The process begins with the selection of management objectives, or goals, for any or all of the following five resources: visual quality, wildlife, water, wood production, and general ecological objectives. These goals are defined for a management unit at a scale from one to many stands, generally within the range of 10 to 10,000 acres. Committees of experts in each of the specific resources defined the conditions necessary to meet the specified goals and determined common variables to allow consistent evaluation of the conditions across goals. This integrated evaluation is a key element to the process of determining acceptable prescriptions and evaluating whether different alternative actions across the entire area will meet the desired conditions.

Previously, a number of products were developed and distributed to meet different aspects of the project's original goals. The previous products are as follows:

**NED/SIPS** - This was the initial NED product, released in 1995 as a disk operating system (DOS) program and subtitled Stand Inventory Processor and Simulator (SIPS). NED/SIPS provided an effective means of creating, managing, and analyzing forest inventory records at the stand level. The user-friendly interface relieved the pain of entering and editing stand inventory data, and once data was entered, a host of analytical tools were available to help understand the data. A variety of reports could be generated describing the vegetation structure, timber value, and economics of the stand. You could apply a set of standard treatments to the stand or design a customized cutting scheme, and utilize one of the four incorporated stand growth simulators to show what the stand may look like in the future.

**Forest Stewardship Planning Guide (FSPG)** - Published in 1995, this program provides users with exposure to and explanations of a wide range of forest practices that produce a variety of benefits from forests. This Windows program guides you through a process of selecting forest stewardship goals. The program offers a great deal of basic information about forests and their management, along with menus of possible stewardship goals. FSPG makes limited recommendations on how to manage a forest for specific goals and describes the conditions that must be created or enhanced to accomplish them.

**NEWILD** - Published in 1998, NEWILD presents expert knowledge about wildlife habitat requirements in the northeastern United States. NEWILD is based on information presented in the Species/Habitat matrices developed by DeGraaf and Rudis (1986) and DeGraaf et al. (1992).

**NED-1** - Completed in 1999, NED-1 partially extended the functionality of NED/SIPS. In NED-1, the forest simulation functionality included in NED/SIPS was dropped, but a migration into the Windows programming environment was accomplished. NED-1 emphasized the analysis of forest inventory data from the perspective of the various forest resources. The resources addressed included aesthetics, ecology, forest health, timber, water, and wildlife. NED-1 evaluated to what degree individual stands, or the management unit as a whole, would provide the conditions required to accomplish specific goals. An extensive hypertext system provided information about the resource goals, the desired conditions that support achieving those goals, and the related data used to analyze the actual condition of the forest.

**Stewplan** - Published in 2003, Stewplan helps create standard forest management plans (stewardship plans) to facilitate participation in the Forest Stewardship Program. The software, which has been approved by a number of states, is currently used by a number of consulting and service foresters to organize and present information on forest ownership and boundaries, stand inventory characteristics, landowner goals, harvest schedules, and other features necessary for stewardship plans. Stewplan produces a written plan that may be submitted to the Forest Stewardship Program, or a hypertext file that may be modified in a separate word processor.

## The NED Decision Process

Decision support systems (DSSs), such as NED-2, are combinations of tools designed to facilitate operation of the decision process (Oliver and Twery 1999). In the context of forest management, a DSS helps to organize information and analyses to enable a decision maker to make a better-informed decision. (Rauscher 1999; Reynolds 2005) Recommendations from computer systems, such as a DSS, are likely to be better than those of a novice, but are not always able to account for as many specific conditions as a live expert. The software's purpose is to support decision making; a DSS is not meant to replace the decision maker.

Typically in natural resource management, choosing the appropriate detail of analyses is a compromise between the complexity of ecological systems on one hand, and the need to solve a problem with limited data and in a reasonable amount of time on the other. A user may make good decisions, but good outcomes are never guaranteed. In many instances, further research or information is required.

NED-2 integrates a variety of forest management tools into a single environment. These tools include databases, growth and yield models, wildlife models, geographic information systems (GIS), visualization tools, and others. More than a collection of components, NED-2 is designed around the NED Decision Process – a goal-driven process that helps improve project-level planning and decision-making processes by providing useful and scientifically sound information to natural resource managers.

The NED Decision Process involves the following steps:

1. Establish goals and ways to measure them (measurement criteria).
2. Analyze inventory and current conditions.
3. Design alternative management strategies.
4. Simulate management strategies into the future.
5. Assign values to the simulated results.
6. Determine goal satisfaction levels.
7. If not satisfactory, go back and repeat the process.

## **What's New in NED-2**

The following features were added in NED-2 under the respective categories as follows:

### **Goals**

- Creation and maintenance of goal sets that may be repeatedly reused.

### **Inventory**

- Introduction of height classes as an alternative to measuring stem height.
- New plot type – the ground plot, used for herbaceous plants and small woody stems.
- Customizable plot cluster design that permits a variable number of plots per cluster.
- Expanded user-defined field variables that are now available for understory and ground cover, with user-defined labels.
- Buildings and structures as new inventory items for stands.
- Total (actual) tree height for overstory observations.
- Ability to inventory and grade multiple logs in the merchantable portion of each tree.

### **Timber pricing**

- Enhanced ability to specify timber pricing.
- Creation and maintenance of pricing sets that may be reused and shared among several NED-2 files.

### **Plant species**

- Expanded capability for modifying, storing, and retrieving custom plant species lists and plant species info.
- Enhanced interface allows sorting display by any plant attribute.

### **Treatment plans**

- Ability to define treatment plans.
- Ability to simulate prescribed treatments using the Forest Vegetation Simulator (FVS).

### Growth and yield

- Under treatment plans, the ability to simulate growth and yield using FVS.

### Analysis

- Ability to import stand data into Environmental Systems Research Institute, Inc. (ESRI) Geographic Information Systems (GIS) ArcMap software.
- Improved and expanded reports.
- Creation and maintenance of report sets that may be repeatedly reused.
- Expanded ability to display data in customizable tables.
- Generation of realistic stand images using the Stand Visualization System (SVS).

### The NED-2 Look

NED-2 uses a Windows graphical interface with a top-level menu, toolbar, and a status bar. The application is displayed in a fixed, full-screen window, with a working area divided into three panes. Two left panes provide navigation and control through each of the NED-2 activities. The large pane on the right is used for displaying and editing information.

Figure 1 illustrates the typical appearance of NED-2. Specifically, the top pane in the upper-left corner is named the “Navigation Pane” which represents an outline of the NED decision process. From this pane, you select an activity to run in NED-2. The pane in the lower-left corner that often contains additional options and items based on the current selection in the Navigation Pane is named the “Options Pane”. The large pane on the right is named the “Work Pane”. You interact with items on each of the panes while working in NED-2.

Each of the items mentioned above is used throughout NED-2. These items are described as follows:

**Top-level menu** - In NED-2, the menu provides additional options not necessarily shown in the main work area. Items in the main work area—in each of the three panes—are not typically repeated as items on the menu.

**Tool Bar** - Click the icons shown in the tool bar. Tool bar items typically have a counterpart on the top-level menu, and exist solely for convenience by providing quick access to common menu items.

**Status Bar** - The status bar normally contains text describing your location within NED-2, what action is currently running, and other status information.

**Navigation Pane** - The Navigation Pane items represent all activities that are performed in NED-2. The items occur approximately in the order that a user would commonly proceed through the NED decision process. It is important to realize that these items may appear to be independent of each other. In some cases they are, while in other cases they are not. For example, because goals act as a major organizing framework for inventory design and analysis and treatment plan development and evaluation, it is impossible to determine what actions to take or how to evaluate the success of an activity without first identifying goals. Therefore, the first activity listed is goal

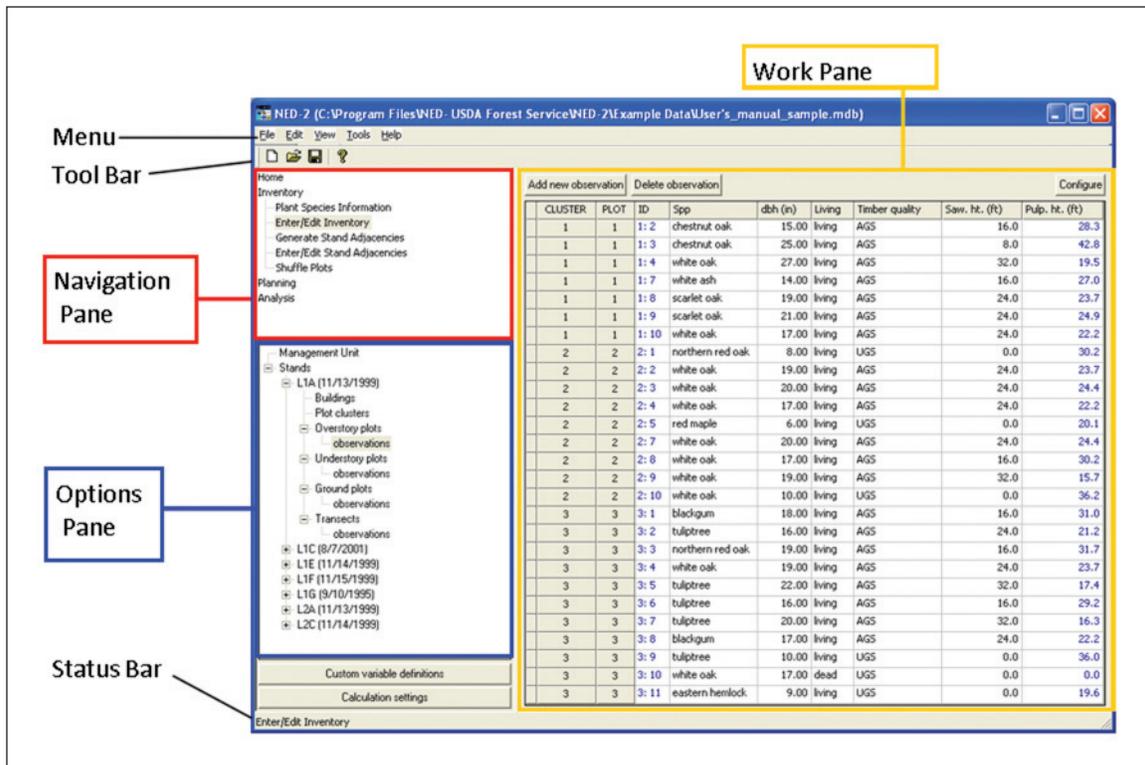


Figure 1. Typical appearance of NED-2 interface.

selection. On the other hand, you might already have a completed inventory when you launch NED-2, and you may wish to enter your data and then specify goals. This action order may be acceptable if the inventory already contains sufficient information required by the goals selected. In this way, you may jump between the activities to suit your needs.

Some items in the Navigation Pane are not independent of each other. These items cannot be performed until other steps have been completed. For example, a treatment plan cannot be simulated if a baseline was not established first, and so on. NED-2 informs you of missing data, and if necessary, does not proceed until all the necessary steps are completed satisfactorily.

**Options Pane** - The Options Pane displays additional options and choices based on the current activity selected in the Navigation Pane. Whenever you switch to another activity, the appearance of the Options Pane also changes. Occasionally, when performing actions in the Work Pane, those actions are identified and made available for modification in the Options Pane.

**Work Pane** - The Work Pane is used to display, create, delete, or modify various components of the forest ecosystem analysis. You interact with the Work Pane for inventory data, simulated data, treatment plans, and various analysis tables. Often the appearance of the Work Pane may be modified by configuring which items to display. This pane occasionally is referred to as the Edit Pane, as this is where you edit data.

## System Requirements

NED-2 installs on any version of Windows XP, as well as Windows 2000 Service Pack 3 or later. Some users have installed and run NED-2 on Windows Vista and Windows 7 with success, though extensive testing on these operating systems has not been performed.

The installation and setup of NED-2 requires the Microsoft Windows Installer engine, version 3.1 or later. Installer 3.1 is included with Windows XP Service Pack 2 or later.

Administrative privileges are required because of increased security restrictions on Windows Vista as well as on earlier Windows versions.

It is strongly recommended that NED-2 be installed on a local hard drive, and *not* installed on a network drive.

Once NED-2 is installed, more than one session of NED-2 cannot run on a single computer at one time. In other words, NED-2 cannot be launched multiple times, resulting in concurrent NED-2 applications running at the same time.

### Hardware requirements

- Computer running Windows 2000 or later.
- A minimum hard disk space of 40 MB.
- A minimum screen resolution setting of 800x600 or higher (recommended).
- A minimum amount of random access memory (RAM) of 128 MB (recommended).

## Installing NED-2

Administrative access is required to perform the NED-2 installation.

Follow the prompts to complete the installation.

**Installing from the web**— The NED-2 software and related documentation may be downloaded from <http://nrs.fs.fed.us/tools/ned/products/ned2/>. Do not choose **Run** from the pop-up window. Instead, click **Save** to download the NED-2 setup file, then run it manually after it has finished downloading. The NED-2 setup file name is ned2install.exe.

**Installing from a CD**—To begin the installation, insert the NED-2 CD into the computer's CD-ROM drive. If auto-play is enabled on the computer, the installation program launches automatically. If the CD does not start within 5 to 10 seconds, click **Run** in the Start menu to begin setup. In the Run dialog box that appears, type in: d:\ned2install.exe, where "d:" is the name of the computer's CD-ROM drive. Click **OK** to launch the installation. Alternatively, you may browse the contents of the CD and double-click on the ned2install.exe file to proceed. Please check the web site, <http://nrs.fs.fed.us/tools/ned/products/ned2/>, for the latest software updates.

**Installing on Windows Vista and Windows 7**—A limited amount of testing of NED-2 has been performed on Windows Vista and Windows 7. At the time of publication, NED-2 runs on both 32- and 64-bit editions of Windows 7. Beta versions of NED-2 were reported to have problems

running on these operating systems if the default installation folder was chosen while running the setup. If this problem occurs, uninstall NED-2 and rerun the installation, but do NOT accept the default Program Files installation folder. Install NED-2 to the root-level folder (for example, C:\). Thus, when finished with the installation, NED-2 is located at C:\NED-2. This step should only be necessary if NED-2 did not run properly after the first installation into the default Program Files folder location.

**Installing on Windows 2000 and early XP versions**—On older computers running Windows 2000, or Windows XP Service Pack 1 (or older versions of XP), the NED-2 installation may need to upgrade the Microsoft Windows Installer to version 3.1 before proceeding with the installation. The NED-2 installation will not commence until the Windows Installer upgrade is completed. Once the Windows Installer upgrade is finished, the computer may need to reboot. After rebooting, the installation continues.

**Installing the Stand Visualization System (SVS)**—In addition to NED-2, the installation includes SVS software that allows for viewing images of stands. As a default, the complete installation includes NED-2 and SVS. You may choose not to install the SVS setup files, and may rerun the NED-2 installation to install the SVS setup files at a later time, if desired. If NED-2 installs the SVS setup files, select the option to run the SVS installation on the last page of the NED-2 installation wizard. The SVS installation commences immediately after the NED-2 installation is completed. If the SVS installation is not selected to run, it can be run manually. The setup files for SVS are located in the NED-2 folder, SVSSetupFiles folder. To run the SVS setup manually, double-click the **setup.exe** file in the SVSSetupFiles folder.

## Getting Help with NED-2

Online help is available for many NED-2 features.

To obtain quick access to help within NED-2, choose from the following actions:

- On the keyboard, press the **F1** key for information on the active NED-2 window or dialog box.
- Double-click a column or row header for help with a particular variable.
- In the Work Pane, double-click a goal or report name for a description.

To open the help system within NED-2, in the **Help menu**, click **Help with NED-2**. To open the help system outside of NED, in the **Start menu**, select **Programs > NED Programs > NED-2 Tools > Help**.

In the help system, click the **Index** tab and scroll through the list to find topics of interest. Click the **Search** tab and enter a keyword in the search field to find all topics that reference a word or phrase. When a topic is displayed in the help system, click the **Contents** tab to see where the given topic fits within the help system organization.

## User's Guide Organization

NED-2 provides many features. How you interact with NED-2, and what features you use, depends on your needs and objectives.

**Goals and objectives**—Prior to inventory data collection, during your assessment of objectives it may be worthwhile to review the applicable resource goals that are evaluated in NED-2. The *NED-2 Reference Guide*, Appendix A (Twery et al. 2011), lists the desired future conditions for each goal. These descriptions ultimately point to specific NED-2 variables, and thus may be helpful in determining what data to collect.

**Inventory data**—For information on how NED-2 variables are tallied in the field, see the “Data Entry and Manipulation” section in the Inventory chapter for inventory field procedures.

If data are already collected and ready to enter into NED-2, see the “Data Entry and Manipulation” section in the Inventory chapter for tips on getting started.

See the “Plant Species Attributes” section in the Inventory chapter for information about plant species identification codes, biological characteristics, and timber values.

**Analysis**—Adjustments may be made to specific calculations. For additional details, see the “Calculation Settings” section of the Calculations chapter.

To learn about analyzing data, see the “Vegetation Tables” and “Reports” sections in the Examining the Data chapter.

To explore the options for graphically displaying data, see the Examining the Data chapter which includes topics on “Generating GIS Displays” and the “Stand Visualization System.”

**Forest simulation**—For information on simulation of stand growth and mortality, as well as designing and simulating treatments, see the Management Planning chapter.

## GENERAL SETTINGS

### Choosing English or Metric Units

In NED-2, either English or metric units are accepted. However, NED-2 stores data in English units only. When using metric units, NED-2 converts from English to metric and displays metric values where appropriate.

To switch between English and metric units:

1. From the **Tools** menu, click **User Settings**.
2. Click **Display Settings**.
3. Under Units, choose **English** or **metric**.
4. Click **OK**.

## Using Color to Denote Data Sources

NED-2 uses colors to reflect how data was entered (i.e., by you, calculated from other variables, or imported).

The following colors define the origin of the data:

- Green** - Default value
- Blue** - Calculated value
- Cyan** - Imported value
- Black** - Value you entered
- Brown** - Generated by another program external to NED

The following instructions turn the color feature on or off:

1. From the **Tools menu**, click **User Settings**.
2. Click **Display Settings**.
3. Check or uncheck the box for **Use color to indicate value sources in entry/edit tables**.
4. Click **OK**.

## Displaying Plant Species Names

The following instructions show how to display species throughout NED-2. Each plant species has five codes or identifiers associated with it, and all species may be viewed throughout NED-2 by using any of the codes. Tree species have a sixth identifier, the Forest Inventory and Analysis (FIA) code, but these codes are not available for all species and therefore cannot be selected here. FIA codes may be viewed when entered as user codes. Whenever viewing inventory data or simulated forest data, as well as non-customizable reports, this setting affects how NED-2 displays the species. Regardless of this setting, any valid code or identifier may be entered for a species, but NED-2 displays the species according to the setting described here.

This setting does not apply to vegetation tables and reports in which the option exists for choosing how to display species.

Using sugar maple (*Acer saccharum*) as an example, the possible displays of the species include the following:

USDA Plants Symbol: ACSA3

Latin name: *Acer saccharum*

Common name: sugar maple

User code: sm (the default is the old FIA survey code of 318)

User label: hard maple

The following instructions specify how to display the species throughout NED-2:

1. From the **Tools menu**, click **User Settings**.
2. Click **Display Settings**.
3. In the **Species Display** pick list, click the identifier you want NED-2 to use to display species.
4. Click **OK**.

## Browsed Folder History

For convenience, NED-2 remembers your browsed folder history for certain input/output operations such as importing stands and opening data files. These settings are stored on the computer and not within the NED-2 file.

The following list describes the history of browsed folders (or paths) that NED-2 retains on your computer:

**Last I/O Path** - The last folder used when a file was opened or saved. Essentially this folder is used for any of the “file” dialogs, unless otherwise listed below.

**Last Stand Import Path** - Used when importing a stand.

**Last Stand Import Ext** - Used when importing a stand. The extension is saved because NED-2 imports several data types.

**Last Report Export I/O Path** - Used when storing or retrieving reports from another data file. The files are always stored as \*.NEDreports files. Reports can be retrieved from a \*.NEDreports file or another \*.mdb NED-2 database.

**Last Report I/O Path** - Used when the Generate All button is selected to generate a series of reports all at the same time.

**Last Species I/O Path** - Used when storing or retrieving species from another data file.

**Last Species I/O Ext** - Used when storing or retrieving species from another data file. The extension is saved only when retrieving species because NED-2 imports several data types. When storing species, they are saved to a \*.spp2 file.

Normally, you will not need to worry about these settings. However, if the need arises, the settings may be cleared and NED-2 refills them the next time they are used.

### Clearing out the browsed folder history

1. From the **Tools** menu, click **NEDcheckup** to run an external program that examines the NED-2 setup. If NED-2 is not active, access this program from the Start menu, under NED-2 Programs > NED2 Tools. Click **Check NED Setup**. A series of wizard-style dialogs appears.
2. Click **Next** until the **User Registry Settings** page opens.
3. Double-click the row that displays **Settings** in the header column.
4. Click the **Clear all registry entries** button in the top right corner. NOTE: All entries will be cleared at once—specific entries cannot be cleared separately.
5. Click **Yes** to clear all entries.
6. Click **OK** when finished.
7. If you want to clear out the species paths as described above, double-click the row entitled **Screen** in the header column, then repeat steps 4-6.
8. Click **Quit** to end the NEDcheckup program.

# Chapter 2 - Forest Management Goals

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## ABOUT GOALS

A critical step in any management endeavor is identifying goals and objectives and clearly articulating them into a cohesive management strategy. Therefore, it is important to establish goals with well-designed, measurable criteria so that current conditions may be assessed, and appropriate management actions identified that help create conditions that can satisfy the objectives.

NED-2 aims to improve decision making by providing useful and scientifically sound information regarding the management of natural resources. The resources to address in NED-2 were determined through a process using focus groups and interviews of potential users. The scientific information on which the goal analyses are based was derived from the use of committees of experts in each of the disciplines, who provided suggestions for goals that might be affected through silvicultural treatments. The experts then also delineated conditions (desired future conditions [DFCs]) that could be evaluated from forest inventories to indicate whether the selected goals were likely to be met. Resources currently addressed include visual quality, ecology, forest health, timber, water, and wildlife. The appropriate DFCs were chosen by experts in their respective natural resource disciplines and are based on empirical evidence, field experience, or both.

The goals evaluated by NED-2 are predefined. If you have other goals that are not listed, NED-2 cannot analyze them directly. The process of analyzing goals in NED-2 follows three major steps:

1. **Select goals** – Goal selection is the process of selecting goals that match the identified objectives.
2. **Establish a common baseline of data** – Goal analysis in NED-2 evaluates conditions across space (stands) at a given time (year). Because inventories may be taken on different stands in different years, NED-2 requires that a common baseline be identified before it evaluates DFCs. Nevertheless, NED-2 requires data in a special format for goal analysis, and even if stands were inventoried in the same year, generation of a baseline is required.
3. **Analyze your goals** – At your request, NED-2 analyzes one or more goals and presents a full explanation of the results. You may obtain a goal analysis report, and can view the results of the goal analysis in ArcMap GIS if an associated GIS shapefile exists of the management unit.

## Management Unit and Stand-Level Goals

NED-2 defines a management unit as a group of forest stands to be managed under one set of resource goals. Many ecological phenomena are the result of broader, landscape-level processes. Thus, properties in any given stand may depend on or act on other stands in the area. Many additional goals exist to pick from at the management unit level—compared to the stand level—because at this level it is generally more feasible to establish and maintain a desired set of physical conditions over a group of stands than for a single stand.

When working with multiple goals, it is difficult, if not impossible, to consistently satisfy all goals in a single stand at all times. However, it may be possible on a management unit to meet several goals over several stands over time.

### Resource Goals Available in NED-2

**Timber goals**—Forest users and landowners differ greatly in their view of timber production. For some, the land may be owned primarily as an investment, with the financial returns from timber production being the dominant management objective. In other cases, the land may be owned for a variety of reasons, of which income from timber production is but one. Still other landowners and forest users may prefer not to have any commercial timber cutting of any kind on their property or on particular portions of public forest lands in their region.

Considering the variety of attitudes on timber production, four timber management goals are available, described in the *NED-2 Reference Guide* (Twery et al. 2011), Appendix A, as follows:

- Focus on Cubic-Foot Production
- Focus on Board-Foot Production
- Focus on Periodic Income
- Focus on Net Present Value

You must specify which of these four approaches to use to evaluate timber returns. If you prefer not to harvest timber at all, not selecting any timber goal is appropriate.

Timber production is often important for reasons other than the financial returns themselves. For example, providing a stable supply of timber products to support local economies and meeting the public's wood product needs may be important on public lands. On industry lands, ensuring a supply of raw material for company mills may likewise share importance with timber income. And on private tracts where the landowner does not care about maximum financial returns, timber income may still be desired to cover the costs of managing or holding the land for other purposes.

Sustainable timber production depends on a balance of size classes maintained throughout the stands of the management unit. Each timber goal requires balanced size classes, as defined below.

**Balanced size classes** are defined according to the percentage of the total management unit area represented by each size class as follows:

- 5-10 percent in regeneration (< 1 inch diameter at breast height [dbh])
- 35-45 percent in sapling and pole combined ( $1 \leq \text{dbh} \leq 10.5$  inches )
- 25-35 percent in small sawtimber ( $10.5 < \text{dbh} \leq 16.5$  inches)
- 10-15 percent in large sawtimber (> 16.5 inches dbh)

NOTE: The above size classes reflect stand and plot size classes in NED-2, which are different from tree size classes. See the "Stand, Plot, and Tree Size Classes" topic in the Inventory chapter for further information.

**Visual goals**—Most landowners and forest visitors like to see and experience a natural-appearing forest. Within this general goal, people differ in their specific aesthetic objectives and tastes. Some may want to experience an unbroken “wilderness” of mature trees that shows little sign of disturbance or deviation from the mature forest appearance. Others want to see a greater variety or diversity of views, with natural-appearing openings containing trees and shrubs of differing heights, species, and colors interspersed among areas of mature trees. This desire for variety might occur at a “micro” level, maximizing the visual variety that is seen from a fixed point or points within a stand, or it might occur at more “macro” levels, where one experiences a sequence of changes over time, or as he or she passes through the landscape or views the landscape from a distance. In addition, landowners may wish to enhance the visual appearance of particular stands, to accomplish such objectives as creating a large tree appearance, screening out undesirable views or sounds, or featuring certain plant species that have attractive foliage, bark, or shape. Considering the variation in people’s tastes and how they view or experience the forest, aesthetic goals that affect both the general forest canopy and specific visual elements are available, described in the *NED-2 Reference Guide* (Twery et al. 2011), Appendix A, as follows:

- Create or Enhance Continuous Overhead Canopy
- Large Scale Canopy Variety
- Small Scale Canopy Variety
- Large and Small Scale Canopy Variety
- Open Understory under a Closed Canopy
- Open Understory under an Open Canopy
- Dense Understory under a Closed Canopy
- Dense Understory under an Open Canopy
- Allow Visual Access to Specified Features
- Screen Specified Features from Sight
- Create or Preserve a Permanent Visual Upland Opening
- Enhance Big Tree Appearance
- Minimize Visual Disturbance and Slash
- Feature Fall Color of Trees, Shrubs, and Ground Covers
- Feature Flowers on Trees, Shrubs, and Ground Covers
- Feature Nuts, Fruits, and Berries on Trees, Shrubs, and Ground Covers
- Feature Contrasting Foliage on Trees
- Feature Contrasting Forms of Trees

**Water goals**—Forests play an important role in the quantity and quality of streams, lakes, wetlands, and groundwater. The Clean Water Act of 1987 and its amendments require that all forest management activities comply with regulations developed at state levels to protect the high quality of forest streams, lakes, and wetlands. Beyond the legal mandate to protect quality and biological integrity of surface waters, some landowners may have more specific objectives for water resources. For example, managers of municipal watersheds may want to increase low flow volumes by reducing vegetative cover, or forest managers in flood prone areas may want to minimize peak flows. Others may want to give special consideration to managing wetlands and riparian areas or enhancing fish habitat. NED-2 provides several water quantity and water quality objectives to address these and other water goals, described in the *NED-2 Reference Guide* (Twery et al. 2011), Appendix A, as follows:

### ***Water Quality Goals***

- Meet Best Management Practices
- Provide Intensive Protection of Water Resources
- Provide Intensive Protection of Wetlands
- Provide Protection of Riparian Areas
- Enhance Habitat for Warm Water Fish
- Enhance Habitat for Cold Water Fish

### ***Water Quantity Goals***

- Limit Peak Flows
- Maintain or Exceed Existing Flows
- Increase Water Yields

NOTE: NED-2 assesses goal conditions based on existing aquatic features. However, lacking aquatic features, NED-2 assumes that a given water goal would be satisfied because there are no “negative conditions” due to the absence of aquatic features. Therefore, use caution when interpreting the results of water goals in situations where aquatic features are absent in one or more stands or absent from the management unit.

**Wildlife goals**—Forest users and landowners enjoy seeing wildlife in their visits to the woods. Some pursue hobbies that involve observation of wildlife (such as bird watching) while some are interested in wildlife for hunting. Most people feel that preservation of habitat for a variety of wildlife species is an important goal to be sought in all forested areas, and especially in public forests. Specific wildlife goals, described in the *NED-2 Reference Guide*, Appendix A, are as follows:

- Increase Wildlife Species Richness
- Enhance Habitat for Specific Species:
  - Amphibians
  - Reptiles
  - Birds
  - Mammals

**Ecology goals**—NED-2 recommends that all forest operations conform to best management practices (BMPs). These management practices incorporate protection of surface streams and ground water and control of erosion and sedimentation by complying with the Federal Water Pollution Control Act of 1972 (section 208) and the Clean Water Act (section 313). Most states have regulations that prescribe compliance with BMPs. In addition to these water quality BMPs, some states have adopted voluntary silvicultural BMPs.

Experts built the NED-2 program's internal rule and prescription bases to ensure the practice of sustainable forestry, given the current state of knowledge. That is, timber products are harvested at a rate equal to or less than their natural growth rate or replacement rate. Harvests are scheduled and regulated under a framework of silvicultural systems designed to achieve this objective, and to ensure successful renewal of forests managed using NED-2 prescriptions. All silvicultural

practices are designed to comply with the National Forest Management Act of 1976. All silvicultural systems incorporate protection of riparian zones, provide for special care on wet or otherwise sensitive sites, and ensure regeneration after harvest.

The NED-2 program does not provide management prescriptions for sensitive, endangered, or threatened species, because such prescriptions (or constraints) are so specialized. Where sensitive, threatened, or endangered species occur, the guidelines for these species should take precedence over the model recommendations in all areas of conflict. In addition to baseline environmental protection, you may incorporate a variety of specific ecological goals. Several of these encourage you to manage forest properties in the context of regional and local biological diversity. Others allow you to specify your desires relative to the existing forest types in the management unit. You may select from a few other specific ecological goals, described in the *NED-2 Reference Guide*, Appendix A, as follows:

- Enhance Regional Biological Diversity
- Enhance Local Biological Diversity
- Promote a Variety of Forest Types in This Management Unit
- Discourage Exotic Elements
- Protect Riparian and Wetland Habitats

**Forest health**—A number of factors contribute to the general health and productivity of plants and ecosystems. The general appearance of a plant may be the result of a complex history of multiple events and processes. Nevertheless, individual factors often are cited as the main cause of stress that results in decline or mortality. Currently, the NED-2 program evaluates potential fire risk. In particular, the potential risk of wildland fire in individual stands, and risk to buildings and structures at the wildland-urban interface (WUI).

## GOAL SELECTION

### Selecting Management Unit Goals

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Work Pane, open up or expand (click the plus [+] symbol) one of the resource categories (i.e., timber, wildlife).
4. Open up or expand the **Management Unit goals** item underneath the desired resource category.
5. After locating a goal of interest, single-click to select (double-click to display a detailed description).
6. In the top-left corner of the Work Pane, click the **left-pointing arrow** to select the goal for your management unit.

Goals must be selected one at a time, using the steps outlined above. Each selected management unit goal appears in the Options Pane in the lower-left corner of the screen, under the Management Unit Goals heading.

## Removing Management Unit Goals

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane, open up or expand (click the plus [+] symbol) the Management Unit Goals heading to locate the current management unit goals.
4. Single-click to select the goal to remove.
5. In the top-left corner of the Work Pane, click the **right-pointing arrow** to remove the goal.

## Selecting Stand Goals

A stand goal applies to a specific stand, rather than an entire management unit. Currently, only visual goals may be applied to specific stands.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Work Pane, open up or expand (click the plus [+] symbol) one of the resource categories (i.e., timber, wildlife).
4. Open up or expand the **Stand goals** item underneath the desired resource category.
5. After locating a goal of interest, single-click to select (double-click to display a detailed description).
6. In the top-left corner of the Work Pane, click the **left-pointing arrow** to select the specific stand to apply the goal.
7. From the Add Stand Goal dialog, select the stand(s). One or more stands may be selected at a time.
8. Click **OK**.

Goals must be selected one at a time, using the steps outlined above. Each selected stand goal appears in the Options Pane in the lower-left corner of the screen, under the name of the selected stands where the goal was added.

## Removing Stand Goals:

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane, locate the goal to remove under the listed stands.
4. Click on the goal to remove.
5. In the top-left corner of the Work Pane, click the **right-pointing arrow** to remove the goal.
6. From the Delete Stand Goal dialog, select one or more stands from which the goal should be deleted.
7. Click **OK**.

## Storing Goals in an External File

To facilitate sharing or reapplying the same goals among several ownerships or properties, goals may be exported to external files. This task saves time later by allowing a set of goals to be

imported into new NED-2 data files instead of selecting the same goals repeatedly.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane of the lower-left corner of the NED-2 window, click **Store**.
4. In the pop-up dialog that appears, select the goals to store. Only the goals in the current (active) goal set are available.
5. From the box on the left, select the management goals to store.
6. From the box on the right, select the stand-level goals to store.
7. At the upper-left corner of the dialog, click **Pick File** to specify a file name and location. If an existing file is chosen, it cannot be appended, and a prompt will ask to overwrite the file.

External NED-2 goal files have a name ending with the following extension: NEDgoals.

## Importing Goals

Rather than selecting goals repeatedly, goals may be imported from existing NED-2 data files and from external NED-2 goal files. Through the process of importing goals, goals may be combined from multiple goal sets.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane of the lower-left corner of the NED-2 window, click **Retrieve**.
4. From the Pick Goals dialog that appears, click the **Open file** button.
5. Select the appropriate file from which to import goals. To import goals from an existing NED-2 data file, select NED-2 data file (\*.mdb) using the **Files of type** pick list at the bottom of the Open file dialog. Available goals appear in the first column of the dialog, with management unit goals appearing before stand-level goals.
6. Select management unit goals to import in the second column—grayed out cells in the second column indicate stand-level goals. Remaining columns contain the names of the stands into which stand-level goals may be imported.
7. Double-click a cell to toggle the selection of a goal on or off.
8. To import all management unit goals and all stand-level goals for each of the stands, click the **Pick all** button.
9. Click **OK**.

All goals are imported into the current (active) goal set.

## Searching for Goals

NED-2 provides a search capability to help determine whether a goal exists, as well as under what natural resource discipline category a particular goal has been placed in NED-2.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the upper-right corner of the Work Pane, click the **Search for a goal** button.
4. Enter a search string in the box provided, and click the **Search** button.

## GOAL ANALYSIS

Goal analysis is the process of evaluating each of your stands individually and collectively as a management unit according to the goal's DFCs. Once the evaluation has been performed, NED-2 produces a report indicating whether or not a goal has succeeded or failed, including details on each of the conditions in the analysis.

### How To Analyze Goals

You may analyze selected goals at any time after a baseline is generated (refer to the Management Planning chapter for a description of the baseline). Data beginning with the baseline year or any other succeeding year on the planning grid for any management plan may be analyzed.

The following steps explain how to analyze one goal at a time:

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Analyze goals**.
3. In the Goal Analysis dialog, review the following choices:
  - If using goals defined within a previously stored goal set, select the goal set at the top of the dialog. Otherwise, First Goal Set can be left alone.
  - Select ONE of the goals from the list of available goals. These are the goals selected previously.
  - From the list of possible "views" of your data, select the plan and year in which to evaluate your goal.
4. At the bottom of the dialog, click the **Analyze Goal** button. NED-2 sends an alert saying that a report will be generated, and displays the folder where the report is stored for off-line viewing and manipulation, if desired.
5. Click **OK** when ready to continue.
6. After the Goal Analysis is complete, NED-2 launches the Internet Explorer web browser and displays the report.

NOTE: Goal analysis and its subsequent generation of goal analysis reports are handled separately from other types of reports in NED. Thus, the Analysis option called Generate Reports is used for other reports and is not used for goal analysis.

### Goal Analysis Results

Goal analysis can be a complex process resulting in somewhat complex reports, depending on the requirements of the goal. NED-2 produces separate reports for each goal. The reports are written in HTML and are opened in the Internet Explorer web browser. Active links may appear in a report, indicating subsections exist that make up a complete report. Generally, the reports present the results of the goal analysis according to the DFCs to illustrate how the goals are being evaluated and to help you understand why a goal passed or failed, according to the DFCs.

In addition, the goal analysis reports are intended to be instructive, providing as much information on the results of goal analysis as possible, indicating the degree of success, such as whether a goal barely passed or failed. That is, they present how well the management unit (or individual stand) satisfied the goal as well as each of the conditions underlying the goal. This information is

intended to help you understand the important ecological and practical aspects of the goal that are likely to be affected by management actions.

The goal analysis reports do not offer treatment recommendations, as such. However, many of the goal descriptions list possible treatment implications associated with meeting the objectives of the goal.

**Viewing goal analysis reports outside of NED-2**—Goal analysis reports are generated and stored as separate files to be viewed and/or modified later, even if NED-2 is not running. The reports are stored under the “My Documents” folder on the computer’s local hard drive. For instance, if the NED-2 file had a management unit name such as “Eastern Game Lands,” and the goal analysis requested was for a baseline year of 2004 using goals selected in the “first goal set,” then all reports may be found under these circumstances stored under the following location on the hard drive: “C:\Documents and Settings\UserID\My Documents\My NED-2 Files\Reports\Eastern Game Lands\Baseline - 2004 - first goal set.”

If you have not specified a management unit name, the reports are filed under “...\My NED-2 Files\Reports\Unknown Management Unit\Baseline - 2004 - first goal set.” Reports are given a name that matches the name of the goal, such as “timber\_1.htm,” “redback\_salamander.htm,” etc.

## GOAL SETS

Goals are stored in one or more goal sets within a NED-2 data file to allow goals to be organized according to a variety of purposes. NED-2 uses only one goal set a time, which allows for separating complex analyses from one another.

By default, NED-2 starts with a “first goal set.” Goal sets are not required, but even if not used, the goals will be stored this way. If goal sets are not used, no further steps are required in defining management unit or individual stand-level goals because the default (i.e., “first”) goal set is always used.

A primary purpose for having goal sets is to enable dialogue among a variety of stakeholders in determining management approaches. Using multiple goal sets, a forest manager can design one or more management plan(s) (alternative scenarios) and evaluate them individually against the management priorities (goal sets) of different interested parties without needing to repeat the plan development process.

### Creating New Goal Sets

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. From the Options Pane in the lower-left corner of the NED-2 window, click the **Manage Goal Sets** button.
4. On the Goal sets dialog, click **Add**.
5. Enter the name of the goal set, along with a description if desired.

6. Specify whether to create an empty goal set or to copy the goals from an existing goal set. If copy is selected, choose the goal set from the list of goal sets in the current NED-2 data file.
7. Click **OK**.
8. Click **Done**.

Each time a management unit or stand-level goal is specified, it will be added to the current (active) goal set. Once a goal set is created, goals may be retrieved from external goal sets that are stored in other NED-2 data files (\*.mdb) or NED-2 goals files (\*.NEDgoals) by using the Import Goals feature.

### Deleting Goal Sets

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane in the lower-left corner of the NED-2 window, click the **Manage Goal Sets** button.
4. From the Goal sets dialog, select a goal set.
5. Click **Delete**.
6. Click **Yes** to confirm the deletion.
7. Click **Done**.

When a goal set is deleted, all management unit and stand-level goal selections associated with that goal set are removed from the NED-2 data file.

### Modifying Goal Set Properties

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Select Goals**.
3. In the Options Pane in the lower-left corner of the NED-2 window, click the **Manage Goal Sets** button.
4. From the Goal sets dialog, select a goal set.
5. Click **Edit**.
6. Modify the name of the goal set and/or the description of the goal set as desired.
7. Click **OK**.
8. Click **Done**.

# Chapter 3 - Inventory

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## INTERACTING WITH DATA GRIDS

Tabular data, such as overstory and understory data, as well as plant species characteristics, are entered or modified on a grid table, sometimes called a data table, grid table, and hereafter referred to as a data grid. It resembles other spreadsheet software and has some similarities. A series of rows and columns appears in the Work Pane, each with appropriate labels for guidance. Any cell that appears with a gray background color cannot be edited.

Typically, data is entered in rows, with each column representing a particular field or variable such as species or diameter. Each row is a separate observation.

A grid is also used in setting plant species codes and default parameters.

Data cannot be copied *into* the grid. However, data may be copied *from* the grid and pasted into another application for other purposes.

When viewing inventory data, simulated forest growth data, and plant species information, often more variables exist than you may want to view in each row or column. To show only specific variables and rearrange their order, click the **Configure** button when it appears in the upper-right corner of the Work Pane.

For some tables, the variables appear in rows and are listed along the left side of the table. In other tables, the variables are displayed in columns and are listed along the top of the table.

### Adding Variables to the Data Grid

1. In the Work Pane, click the **Configure** button to modify the display of variables.
2. From the left box that lists non-displayed variables, select the desired variable to display.
3. Click the **single right-pointing arrow** to move a variable to the box of displayed variables on the right.
4. To view ALL variables, click the **double right-pointing arrows** to move all variables to the box of displayed variables on the right.
5. Variables in the box on the right are displayed in the order they are listed.
6. Click **OK** when finished.

To add more than one variable at a time from the box of non-displayed variables on the left, click consecutive variables by selecting one variable and then pressing and holding down the **Shift** key while selecting the next desired variable. To skip around and select non-consecutive variables, press and hold down the **Ctrl** key while selecting additional variables. Use the single right-pointing arrow to move multiple variables to the box on the right.

## Searching for a Variable to Add to the Data Grid

You may search for variables. The search only pertains to variables associated with the current data level. For instance, if entering data on overstory observations, only those variables are searchable, and variables from other levels (i.e., stands, plots) are excluded.

1. In the Work Pane, click the **Configure** button to modify the display of variables.
2. At the top of the Select variables dialog, click the **Search for a variable** button. A second pop-up dialog opens to perform a search.
3. In the box provided (next to the Search button), enter any part of the variable name to search. For instance, if looking for merchantable height, enter both words, “merchantable height” or a substring such as “merch.”
4. Click the **Search** button.
5. From the list of matches found, select the desired variable and click OK.
6. If the variable was selected from the list of matches, it will be highlighted on the left side if it is not currently displayed, or on the right side if it is already displayed in the data grid.

## Modifying the Order of Data Grid Variables

1. In the Work Pane, click the **Configure** button to modify the display of variables.
2. Select a variable in the box on the right (the list of displayed variables). One variable at a time can be moved.
3. Hold down the left button on the mouse and drag the variable up or down to the desired position.
4. Click **OK** when finished.

To move a variable to the end of the list, drag it to the next-to-last position, then move the very last variable above it.

## Removing Variables from the Data Grid

1. In the Work Pane, click the **Configure** button to modify the display of variables.
2. Select the variable in the box on the right.
3. Click the single left-pointing arrow button.
4. To remove additional variables, repeat steps 2 and 3 as needed.
5. Click **OK** when finished.

## Copying Data from the Grid

Data may be copied from most of the grid tables displayed throughout the data entry program. Copying the information in the grid may be useful when obtaining a printout of the data for proofreading or to perform additional analyses outside of NED-2. Remember that data *cannot* be pasted into any of the grids.

1. Click anywhere in the data entry grid.
2. Select cells by clicking and dragging the mouse across the desired range of cells or by holding down the **Ctrl** key while clicking in multiple cells.
3. Press **Ctrl+C** to copy to the clipboard, or select **Copy** from the Edit menu. Then paste contents of the clipboard into other software (e.g., Microsoft Word, Excel) as desired.

Two settings may affect how data is copied from the grid. You may control whether NED-2 includes column and row headers, and whether NED-2 copies rounded values (carried to 1-2 digits) versus actual, non-rounded values carried out to several digits.

**To include (or not) the column and row headings that appear in the grid:**

1. From the Tools menu, select **User Settings**.
2. Select **Display settings**.
3. Check or uncheck the **Include column and row headings when copying to clipboard** box.
4. Click **OK**.

**To use rounded values (or not) when copying data from the grid—Recommendation:**

For research and/or statistical analyses outside of NED-2, be sure to uncheck the setting for using rounded values, otherwise the values may not be what are expected. For general reports or other purposes, rounded numbers may be appropriate.

1. From the Tools menu, click **User Settings**.
2. Click **Display settings**.
3. Check/uncheck the **Use rounded values when copying data to clipboard** box.
4. Click **OK**.

## ESTABLISHING DEFAULTS

A default is a pre-defined value that is automatically assigned to a given variable. You may establish defaults that are applied whenever new records are created that include the specified settings. Default values appear in green during data entry. Existing records are *not* affected by changes to default settings. Establishing defaults may save some effort by eliminating the need to enter repetitive values. Defaults exist for each of the primary data levels including stands, plots, observations, and inventory settings.

Default settings are stored with the NED-2 program on the computer, and not in the NED-2 data. This allows the defaults to be applied to any active NED-2 data file.

### Establishing Default Values

A “user-set default” is possible for many variables, which allows for the establishment of personal default values that replace or supersede NED-2 defaults.

1. From the Tools menu, click **User Settings**.
2. Select **User-set default values**. The User default values dialog launches as shown in Figure 2.
3. Double-click a row to change the default value and click **OK** when finished.
4. Click **OK** when finished modifying default values.

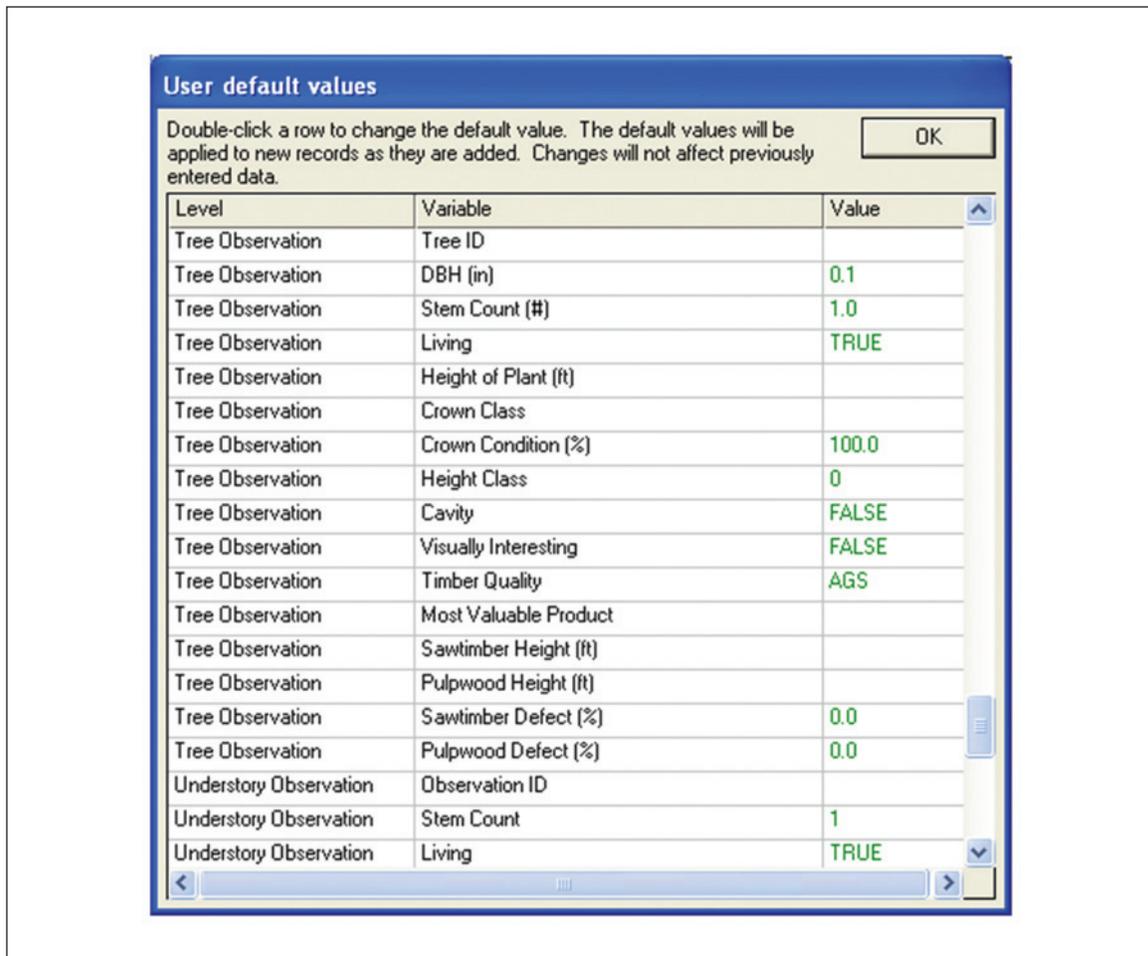


Figure 2. User default values dialog.

Default values supplied by NED-2 appear in green. If a value is modified, values appear in black.

If desired, values can be sorted by any of the column headings. Click once in the column header to sort in ascending order, and again to sort in descending order.

## DATA ENTRY AND MANIPULATION

### Getting Started With an Inventory

Every time the NED-2 program starts, NED-2 is ready for data entry. If an existing NED-2 file was opened and you want to start with an empty or new file, establish a new file by selecting New from the File menu.

To get started with data entry, the following steps should occur in the order listed as follows:

1. **Choose units** - NED-2 allows you to record and display data in English or metric units. Nearly everything entered for stands, plots, and observations is affected by this setting.
2. **Define plant species** - Each new, empty NED-2 file includes an empty list of known plant species. NED-2 must “learn” species before it recognizes them. Known species are referred to as the “short list” of species. It is recommended that all of the specific woody and herbaceous plants are defined ahead of time in order to speed up data entry. Use the Plant Species Module for this purpose. This module is where all of the plant characteristics are defined, such as pricing, form class, and custom user species codes. It is possible to define plant species as needed during data entry, but this method causes numerous interruptions and is generally slower than defining species ahead of time. Once species and characteristics are defined, they can be saved and reused in other NED-2 files.
3. **Establish forest stands** - Analysis in NED-2 is based on inventories of forest stands. Therefore, establishment of one or more stands must occur before entering any data.
4. **Define your inventory procedure** - When a stand is created, it will inherit default inventory settings. It is important to establish appropriate inventory settings or the data may be analyzed incorrectly. If most or all of the stands follow the same inventory settings, default inventory settings may be established so that each new stand inherits the proper settings. Plot sizes and other inventory criteria are established in the default settings. This is also an appropriate time to define custom data variables, if the collected data was not predefined in NED. If using height classes to approximate total stem height, these must be established under inventory settings.
5. **Add plots** - Once a stand is established, plots may be added. Plots are associated with clusters, and are typically included when clusters are added. Clusters represent each point in the inventory. All of the clusters may be established at one time, or they may be added as needed. Each time a new cluster is established, the associated plots are automatically created according to the number of plots per cluster under the inventory settings for the stand. Another way to begin adding plot data is to try adding a plot instead of adding a cluster. By convention NED-2 will first create a new cluster and then add the associated plots. NED-2 allows for the choice of adding the plot to a new cluster, or adding the plot to an existing cluster. Typically the cluster/plot layout will be followed throughout an inventory of a stand.
6. **Add observations** - Individual observations are added to plots—not clusters.
7. **Configure tables** - NED-2 may be configured to display only the variables that are collected in the field, along with values calculated by NED, such as volume and basal area if desired. This helps eliminate clutter as data is entered. However, tables may be configured at any time—even before data entry.

## PLOT TYPES

### About Clusters and Plots

A number of plot types exist in which data may be entered in NED-2. Depending on the objectives, an inventory may require data on the overstory, understory, ground cover, and coarse woody debris components of the forest. Inventory data in NED-2 may be collected or summarized at the levels of forest stands, clusters, plots, observations, and log products for tree observations.

For each stand, data are stored as a collection of clusters. Plot-clusters maintain an association among plot types at respective data collection locations from the inventory. For example, a standard inventory may include sampling with all the types of plots NED-2 recognizes: overstory, understory, ground, and coarse woody debris, which is collected in associated groups such that at each overstory plot location two of each of the other plots may be taken. The NED-2 terminology of clusters and plots is analogous to plots and sub-plots. The terms “cluster” and “plot-cluster” are synonymous throughout NED.

NED maintains clusters and plots because for some analyses it is important to know which plots belong together. Each plot-cluster maintains a list of its plots, and each plot maintains a collection of observations. Each overstory observation can maintain a collection of log products.

NED-2 generally allows you to establish clusters and plots according to your own sampling scheme. For most statistical analyses, NED-2 analyzes variability between clusters and not within clusters. Plot data is averaged together in a given cluster.

### NED-2 Plot Types

Several plot types are available in NED-2. Collectively, these plot types approximate the vertical layering that develops in forest ecosystems. NED-2 stores its data in plot-clusters which are collections of these plot types.

**Overstory plot** - The overstory plot should be comprised of woody stems of a minimum diameter at breast height (dbh)—stems that have reached or are likely to reach the upper canopy layer. In some situations, the overstory plot has traditionally been used for all stems one inch and larger, but this need not be the case in NED-2. To exclude stems larger than one inch, check the understory dbh threshold under calculation settings. NED-2 requires one overstory plot per cluster.

**Understory plot** - The understory plot should contain intermediate woody stems found above the ground layer and below the overstory canopy as established by a dbh range. The maximum dbh threshold for understory marks the difference between overstory and understory stems. NED-2 requires a minimum height of 4.5 feet for all understory observations, and a minimum dbh of 0.1 inches.

**Ground plot** - Regardless of condition, all forests have something going on at the ground layer—organic matter accumulation/decomposition, regeneration processes, and so on. For NED-2, the ground plot is used to record cover of rocks, mosses, and litter. The ground plot will contain all herbaceous flora (regardless of height) and smaller woody stems (trees and shrubs) that generally

are under a minimum dbh or are less than 4.5 feet tall. Ground plot observations may be recorded as a count of the number of stems, percent cover, or both.

**Woody debris transects**—Coarse woody debris (CWD) data is collected along a linear transect—typically between successive plots along a line plot cruise.

### Plot Characteristics

Plots are generally characterized according to the observations they contain. However, NED-2 offers additional plot details that can be recorded, such as global positioning system (GPS) location, riparian status, and other information. Many of the NED-2 goals can be addressed using information recorded at the plot level (about the plot itself) in the absence of detailed observations.

Before heading into the field, review the list of NED-2 plot variables to determine which ones may be calculated versus those that must be observed directly.

### Plot Layout

The diagram in Figure 3 is one example of how plots may be established for the NED-2 inventory.

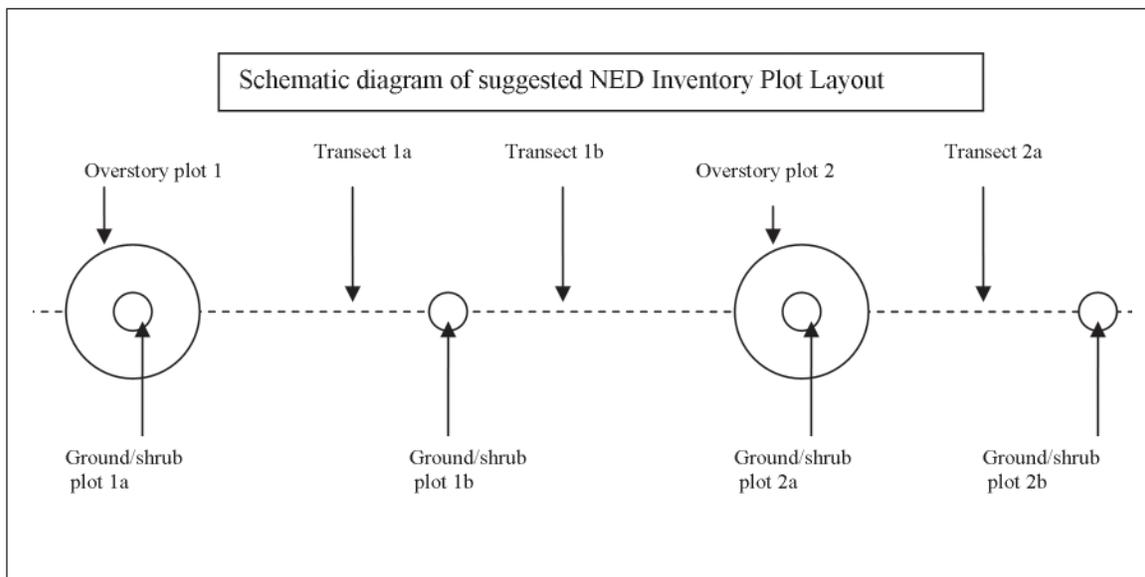


Figure 3. Example inventory plot layout for NED-2.

## INVENTORY SETTINGS

Inventory settings describe portions of your field inventory, including tally date, plot sizes, overstory sampling method (fixed area vs. variable radius or prism), number of plots per cluster, and stem height classes.

Each stand maintains its own set of inventory settings. Adjustments made to one stand will not affect other stands. Plot sizes established for each plot type must remain the same within a stand. However, plot sizes can differ between stands.

**Defaults**—To apply the current inventory parameters to all *future* stands, click the **Make these the default settings** button. New stands will inherit the default parameters.

### Plot Sizes

You can use any desired plot size for a given plot type. NED-2 applies default plot-size values if one is not specified. Be sure to check that the correct plot sizes have been entered.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand from the list of stands.
3. In the Work Pane, click the **Inventory Settings** button.
4. For each plot type, enter the desired plot size as the total area covered by a single plot. Note the units that appear next to each field.
5. Click **OK**.

Plot sizes apply only to the current stand. The contents of the edit box for overstory plot size depends on the inventory method. If prism points (equivalent to variable radius plots) were selected for the overstory plot type, a basal area factor (BAF) must be entered in the box for overstory plot size.

### Overstory Cruise Type

Overstory data can be collected using fixed-area plots or a variable-radius (prism) cruise.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand from the list of stands.
3. In the Work Pane, click the **Inventory Settings** button.
4. In the **Overstory plot type** pick list, select **prism points** or **fixed area**.
5. For the overstory plot size, enter either the BAF or the fixed plot area depending on cruise type.

## Inventory Date and Tally Person

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand from the list of stands.
3. In the Work Pane, click the **Inventory Settings** button.
4. In the **Tallied by** box, enter the name of the person who collected the inventory data (optional).
5. By default, NED-2 supplies an inventory date using the date that the stand was created in the data file. To modify the date, click in the **Inventory date** box and enter the date the inventory was collected.
6. Click **OK**.

## Number of Plots Per Cluster

NED-2 provides flexibility in your plot-cluster design. That is, you get to specify how many plots to take at each point along your inventory. There is only one exception—you cannot change the number of overstory plots. NED-2 currently requires one and only one overstory plot in each plot-cluster.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand from the list of stands.
3. In the Work Pane, click the **Inventory Settings** button.
4. Enter the desired number of plots for each plot type in the **Number of plots per cluster** field.
5. Click **OK**.

## HEIGHT MEASUREMENT

### Forms of Height Measurement

To describe the vertical structure of a forest, you must know something about the height of the plants. NED-2 offers several alternatives for indicating height.

**Total height** - The height of the stem from the ground to the top of the crown.

**Height classes** - Provide a way to approximate stem height by assigning a numeric code as a means of applying a height range to a stem.

**Height layer** - A non-editable characteristic that is calculated and assigned by NED-2 when some indication of stem height (total height or height class) is entered. Layer is used by NED-2 to determine whether a plant occupies the ground layer (0-3 feet) or the shrub layer (3-10 feet).

**Sawtimber height** - The total merchantable sawtimber portion of a tree. It is entered as a total length in feet or meters, and NOT in logs or bolts. If no height is entered, NED-2 will calculate a sawtimber height based on the diameter and species of the tree.

**Pulpwood height** - The merchantable portion of the tree above sawtimber height. If the tree does not contain any sawtimber, the total merchantable height may be recorded as pulpwood height. If no pulpwood height is entered, the program will calculate a height based on the tree diameter and effective age of the stand.

## About Height Classes

It is difficult and time consuming to measure heights above 20 to 30 feet. By conceiving a forest's vertical structure as a series of horizontal layers from the forest floor to the top of the canopy, one can stratify plants according to their relative position among the layers in the forest. However, measurement of actual stem heights is not an efficient, convenient, accurate, or precise way to characterize a forest with multiple layers.

Height classes provide a way to approximate the relative height of a stem without the problems of height measurement. A height class represents a single layer. When each layer has been identified and described with a height class, height classes provide a convenient way to approximate total stem height. The set of observed height class values, together with the relative abundances in each height class, may be useful in characterizing vertical forest structure. You can run reports and vegetation tables to view the number of stems per unit area, basal area, and more by species and by height class, for example.

To apply height classes during inventory, first decide how to conceive the layers in a forest. Five or six layers are sufficient for most uses, including ecological studies, wildlife habitat assessment, and evaluation of visual/aesthetic forest properties.

Each height class is represented by a range with a minimum and maximum height for a given layer in the forest. For instance, a range from 0-1 feet may represent height class "1." Height class is recorded in the field as a numeric code. In this example, a tiny seedling < 1 feet tall would be assigned a height class value of "1" (an integer value). NED-2 provides a default label based on the range, but this label can be modified to suit your needs. However, in the field, you should not use the label—only the code is recorded.

NED-2 goal analyses require a minimum of three height classes with fixed endpoints at 0, 3, and 10 feet. This allows NED-2 to identify plants in a ground layer from 0-3 feet, and a shrub layer from 3-10 feet. These endpoints are grayed out so they cannot be modified. If desired, eliminate this feature by unchecking **Height classes conform to NED standards**. If this choice is made, analysis of certain goals in NED-2 cannot be completed. Nevertheless, layers can always be split by adding new height classes. For instance, the 0-3 foot ground layer can be split into two height classes as follows: 0-1 feet and 1-3 feet. Figure 4 shows an example of six height classes with modified labels. The last range represents anything higher than the minimum value for the range—anything taller than 25 feet.

Changes apply only to the current stand. To apply the current height classes (as well as all inventory parameters) to future stands in the NED-2 file, click the **Make these the default settings** button. When adding new stands, they are established with the same height classes.

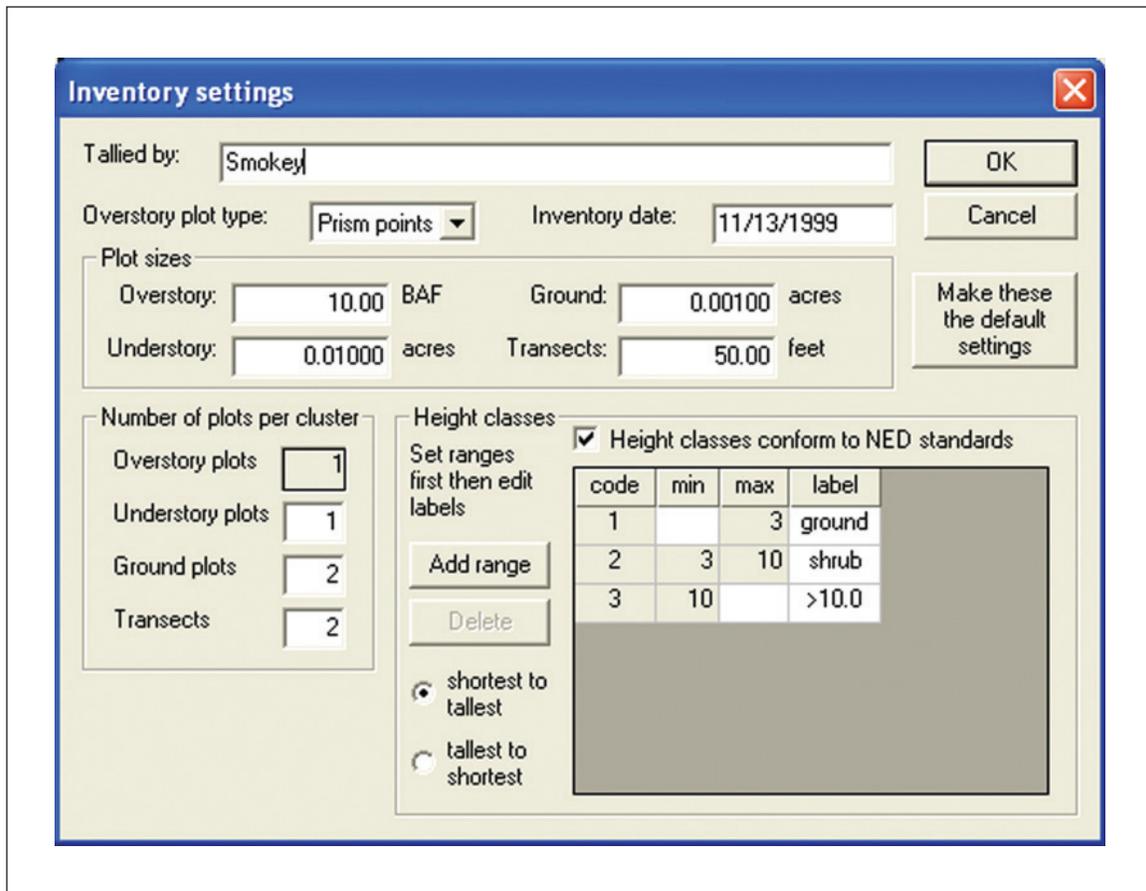


Figure 4. Establishing height classes.

## Adding a Height Class

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand.
3. In the Work Pane, click the **Inventory Settings** button.
4. Click the **Add range** button.
5. Click **Add a single range** (selected by default).
6. Enter the threshold value that will define where the new height class starts/ends. For instance, if starting with single range from 3 to 10 feet, and you want to split that range into two height classes, 3-5 and 5-10 feet, enter "5" as the new threshold value. NED-2 evaluates the existing ranges and inserts the height class in the proper place.
7. To enter a range of successive height classes instead of just one, click **Add a series of ranges**. Enter the sequence information to define the range of height classes. This option can be used to insert a range within the existing height classes or to replace all of the height classes with a new series.
8. Click **OK**.

## Deleting a Height Class

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand.
3. In the Work Pane, click the **Inventory Settings** button.
4. Click in a cell that contains a user-entered breakpoint to delete. No confirmation is given, so be sure you want to delete the height class.
5. Click the **Delete** button. If a height class is deleted that contains one of the fixed endpoints, NED-2 will realign the height classes to preserve all endpoints at 0, 3, and 10 feet. If there was a height class from 0-1 feet and from 1-3 feet with the 1-3 feet range being deleted, NED-2 also deletes the 0-1 range and produces a 0-3 feet range.
6. Click **OK**.

## Reordering Height Classes

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane in the lower-left corner of the NED-2 window, select a stand.
3. In the Work Pane, click the **Inventory Settings** button.
4. Click **smallest to tallest** for lower height class codes (1, 2, ...) to apply to shorter stems. Similarly, click **tallest to smallest** for lower height class codes (1, 2, ...) to apply to taller stems.
5. Click **OK**.

## INVENTORY FIELD PROCEDURES

The inventory field procedures contain a consolidated list of all of the NED-2 variables that can be recorded in the field. Further information is available on each variable under each data section (i.e., Stands, Overstory Data) covered in the *NED-2 Reference Guide*, Appendix B (Twery et al. 2011). It is not necessary to record all possible variables in the field. The variables you choose to omit could affect subsequent analysis. For example, if you choose not to record data on ground cover, of the ability to perform some wildlife habitat analyses would be affected. Some variables (i.e., stand elevation, management unit name) may be recorded in the office either before or after the field inventory. Others will require being on site to collect. Data may be collected in either English or metric units, but must not be mixed—a single setting exists in NED-2 that identifies whether you want to use English or metric units. While the setting can be changed, it cannot adapt to some of each at the same time.

Paper tally sheets are available on the NED-2 website. On some of the tally sheet pages, not all NED-2 variables are shown due to space limitations. If desired, an Excel version of the tally sheets may be downloaded to substitute variables or make other modifications. A companion PDF version is available that handles most inventory situations (see the following link: <http://nrs.fs.fed.us/tools/ned/products/ned2/>).

NED-2 uses Boolean variables for many items. Boolean variables can be recorded as Yes or No, True or False, Present or Absent, and so on. NED-2 will interpret any string beginning with “T,” “Y,” or “P,” or any non-zero number as True. Other strings and numbers are interpreted as False.

## Management Unit

**County** - Enter the county in which the management unit occurs. If the unit crosses a county line, enter the county containing the largest portion of the property.

**Deer impact** - Enter an estimate of the amount of browsing pressure that deer are having, or likely to have, on tree seedlings in the management area. Codes are as follows: 0 = unknown; 1 = low, 2 = low/medium; 3 = medium; 4 = medium/high; and 5 = high. Enter either the number or the text.

**District** - For public forests, enter the district name or number. For private forests, leave it blank or create a code.

**Forest name** - For public forests, enter the forest name. For private forests, leave it blank or create a code.

**Land type association** - Enter the U.S. Forest Service land type association(s) according to Bailey's ecological classification system (Bailey 1995).

**Name** - Enter the name of the management unit or property.

**Owner** - Enter the owner's name.

**State** - Enter the state in which the management unit occurs. If the unit crosses a state line, enter the state containing the largest portion of the property.

**Streams** - If streams are present within or immediately adjacent to the management unit, enter "present"; otherwise enter "absent".

## Inventory Settings

**Date inventory was taken** - Enter the date the inventory was collected.

**Ground plot size** - Enter the size (area) of the ground-cover plot.

**Number of ground plots in cluster** - Enter the expected number of ground-cover plots that are established in each plot cluster.

**Number of overstory plots in cluster** - Enter the expected number of overstory plots that are established in each plot cluster. Currently required to have one and only one overstory plot per cluster.

**Number of transects in cluster** - Enter the expected number of transects that are established in each plot cluster to collect volumes of coarse woody debris (CWD; also known as down woody material).

**Number of understory plots in cluster** - Enter the expected number of understory plots that are established in each plot cluster.

**Overstory prism BAF** - If prism points were used to tally overstory trees, enter the basal area prism factor (BAF).

**Overstory plot size** - If fixed area plots were used to tally overstory trees, enter the individual plot size (area). If a 100-percent tally was done, this number should be the stand area, and the inventory type should be "fixed area".

**Overstory inventory type** - Enter the type of overstory inventory procedure used (i.e., whether using fixed area plots or prism points).

**Tallied By** - Enter the name of the person, agency, or company that conducted the inventory.

**Transect length** - Enter the length of the CWD transect on which dead and down log data was collected (e.g., 200 feet or 75 meters). The length must be no less than 50 feet.

**Understory plot size** - Enter the size (area) of the understory plot.

## Stand

**Accessibility** - Enter the type of vehicle access to the stand. Enter the number of one of the following codes: 1 = two-wheel drive; 2 = four-wheel drive; 3 = within a mile of a road; 4 = none (no road access).

**Adjacent to water** - Enter "yes" if the stand is adjacent to or contains a perennial stream, permanent pond, or lake.

**Aspect** - Enter the aspect of the stand either from a topographic map or while in the field. Enter as an azimuth reading from 0 to 360 degrees.

**Average haul distance** - Enter the average distance from the stand to the nearest mill.

**Caves** - Enter "present" if there are any caves or larger rock openings that lead below the frost line.

**Coarse woody debris in water** - Enter "present" if any down logs within a minimum diameter of 6 inches are partially or wholly in a permanent water source.

**Compartment** - Enter the compartment number and/or property name if applicable.

**Dead cavity tree** - Enter "present" if at least one tree with a dead cavity occurs within the stand.

**Elevation** - Enter the average elevation in feet or meters for the stand from a topographic map.

**Ecological land type** - Enter Bailey's ecological land type(s) in the stand (Bailey 1995).

**Feature to screen** - List any features to screen or hide such as a residence, a cut along a main road, a junk yard, etc.

**Feature to show** - List any features to show off such as a potential vista, a waterfall, an unusual looking tree, etc.

**Forest type** - Enter the appropriate code for the forest type that most closely matches the current overstory species composition of the stand.

**Height to bottom of canopy** - Enter the distance from the ground to the bottom of the overstory canopy.

**High perch** - Enter "present" if any high exposed perches occur in the stand. A high perch is any live or dead tree that clearly towers above the canopy such as a supercanopy white pine, or a single tree or group of trees standing above ground vegetation such as a lone elm in a pasture or a snag in a clearcut.

**Land-cover type** - Enter the proper Level 1 or Level 2 Anderson (1976) land-cover type. Level 1 codes are as follows: 1 = urban; 2 = agriculture; 3 = rangeland; 4 = forest; 5 = water; 6 = wetland; 7 = barren; 8 = tundra; 9 = perennial snow. If the stand is a wetland forest, enter it as wetland (5).

**Live cavity tree** - Enter "present" if at least one tree with a live cavity occurs within the stand.

**Loose soils** - Enter "present" if there is soil that can be easily burrowed into.

**Low perch** - Enter "present" if any low exposed perches occur in the stand. Low perches are exposed perches less than 10 feet high. Examples include fences, isolated shrubs, clumps of woody sprouts, tree tops remaining after harvesting, and short tree stubs.

**Operability** - An estimate of the stand's environmental or economic limitations such as unmarketable timber or wet soils, steep slopes, or rockiness which limit the use of mechanical equipment. Enter 2 if steep slope, rockiness, or poor drainage limit the use of mechanical equipment. Enter 1 if no such limitations exist.

**Percent area riparian** - Enter the percent of the stand area that falls within a riparian area, include buffer strips along water sources. Riparian areas include stream channels, lakes, wetlands, floodplains, and immediately adjacent terrestrial ecosystems.

**Percent area wetland** - Enter the percent of the stand area that falls within a wetland. Wetlands include areas with shallow standing water or seasonal to year-long saturated soils (including bogs, marshes, and wet meadows).

**Permanent ponds** - Enter "present" if any permanent ponds or lakes are within or adjacent to the stand. Permanent ponds are any size or depth, but larger is generally better; water must be present year-round, although the top layer can freeze.

**Pre-inventory treatment year** - Enter the year of last treatment prior to the inventory year.

**Roaded** - Enter "yes" if there is a truck road in or adjacent to the stand.

**Rock crevices** - Enter "present" if there are openings in the rocks that lead below the frost line.

**Rock piles** - Enter "present" if there are any natural or man-made piles (rock walls), as long as they provide hiding places for small mammals, amphibians, or reptiles.

**Seeps** - Enter "present" or "absent" as to the presence of seeps or springs within or adjacent to the stand. A seep is a source of surface ground water without a well defined point of origin. A spring has a well defined point of origin. Seeps and springs may or may not have vegetation around them.

**Site index** - Enter the site index number as determined from appropriate charts; record to the nearest index, and do not round the numbers. Site index should be calculated from age and height measurements of 3 to 10 dominant or codominant trees of the site species. Do not bore veneer quality trees. Site index affects growth potential of trees, and in NED-2 is used to affect growth rates when running simulations. In the eastern United States site index is typically estimated as the expected height of a dominant tree at age 50.

**Site index species** - Enter the tree species for which the site index was determined. Use any of the accepted codes for species identification, including the U.S. Department of Agriculture (USDA) PLANTS symbol, the 3-digit Forest Inventory and Analysis (FIA) code, or the user code. See the topic on "Recording Plant Species" in the Plant Species Attributes section for more information.

**Slope** - Enter the average percent slope for the stand.

**Slope shape** - Enter the most applicable slope shape from the following codes: 1 = convex; 2 = linear; or 3 = concave.

**Stand area** - Enter the total acres and/or hectares in the stand.

**Stand ID** - Enter the stand identification name or number.

**Stream** - Enter "present" if perennial streams are within the stand or immediately adjacent to the stand.

**Temporary ponds** - Enter "present" if any temporary or vernal ponds are within or adjacent to the stand. Temporary ponds must be greater than 6 inches deep and greater than 1 square yard; water must be present for at least two months during the growing season. The exact month differs for each species that uses temporary ponds. Areas covered by a fine layer of silt and depressions filled with blackened leaves may serve as dry season indicators of temporary ponds.

**Topographic position** - Enter the topographic position of the stand from the following codes: 1 = upland plateau; 2 = upland bottom; 3 = ridge top; 4 = upper slope or shoulder; 5 = midslope; 6 = bench; 7 = lower slope; and 8 = bottomland, flatland.

**Unique features** - Enter a description of the unique feature.

**Year of origin** - If the stand is even-aged, enter the year the stand originated. This year is determined either from historical records, by coring representative site index trees, or using the program's calculated effective age to determine year of origin.

## Buildings

Information on buildings is used in the fire risk analysis module.

**Adjacent building** - Enter the distance to the nearest building.

**Building ID** - Enter the building identification name or number.

**Comments** - Enter any additional comments about the building.

**Defensible space** - Enter the amount of space (distance) next to a building that would allow room for firefighters.

**Open Foundation** - Enter "present" if the building has an open foundation type.

**Map X-coordinate** - This variable is used to record GPS coordinates of the building.

**Map Y-coordinate** - This variable is used to record GPS coordinates of the building.

**Open soffits** - Enter "present" if the building has open soffits.

**Single paned, non-tempered glass windows** - Enter "present" if the building has single-paned, non-tempered glass windows.

**Slopes >30%** - If the building is on a steep slope (>30%), enter the average slope immediately around the building.

**Stacked firewood** - Enter "present" if stacked firewood is present near the building.

**Vinyl siding** - Enter "present" if the building has vinyl siding or vinyl soffits.

**Wood deck** - Enter "present" if a wood deck is connected to the building.

**Wood fence** - Enter "present" if a wood fence is connected to the building.

**Wood shingles** - Enter "present" if the building has wood shingles or shakes (Class C or not rated).

**Wood siding** - Enter "present" if the building has wood siding.

## Plot Cluster

**Cluster ID** - Enter the cluster identification name or number.

**Map X-coordinate** - Used to record GPS coordinates of the cluster center point.

**Map Y-coordinate** - Used to record GPS coordinates of the cluster center point.

## Overstory Plot

**Canopy closure** - Enter the percent cover of the overstory trees (trees greater than 30 feet in height).

**Hard mast present** - Enter "present" if any tree present in the plot produces hard mast. The variable will default to absent but is calculated by NED-2 if species known to produce hard mast are present in the inventory.

**Map X-coordinate** - Used to record GPS coordinates of the overstory plot.

**Map Y-coordinate** - Used to record GPS coordinates of the overstory plot.

**Midstory closure** - Enter the percent cover of the midstory trees (trees between 10 and 30 feet high).

**Midstory type** - If at least 25 percent midstory cover exists, enter one of the following: 1 = D (deciduous); 2 = C (coniferous); or 3 = M (mix of coniferous and deciduous species; at least 1 coniferous and at least 1 deciduous).

**Overstory Plot ID** - Enter the overstory plot name or number.

**Riparian plot** - Enter "yes" if any portion of the plot is in a riparian zone.

**Soft mast** - Enter "present" if any tree produces soft mast. The variable will default to absent but is calculated by NED-2 if species known to produce soft mast are present in the inventory.

**User comments** - Enter any additional comments about the overstory plot.

## Overstory Observation

**Cavity** - Enter "present" if the tree contains a cavity.

**Crown class** - Determine the position of the tree crown using the following codes: 1 = open grown (a tree that is free of competition and receives light on top and on all sides of the crown as a result of a very heavy thinning or being in an isolated, open-grown position); 2 = dominant (a tree with the crown extending above the general level of the main crown canopy and receiving full light from above and partly from the sides); 3 = codominant (a tree with a crown forming the general level of the main canopy, receiving full light from above but little from the sides); 4 = intermediate (a tree with a crown extending into the lower portions of the main crown canopy, but shorter than the codominants and receiving little direct light from above and none from the sides); or 5 = suppressed (a tree whose crown is entirely below the general level of the canopy and receives no direct light from either above or the sides).

**Crown condition** - An estimate of the tree crown's condition based upon the percent of crown that appears healthy (alive). Trees are in poor condition if more than 50 percent of their branches are dead; in fair condition if 25 to 50 percent of their branches are dead; and in good condition if less than 25 percent of their branches are dead.

**dbh** - Enter the diameter at breast height for each tallied tree. Diameter can be entered in 1- or 2-inch classes or actual measurement down to a 1/10 inch. Do not mix diameter classes.

**Height of plant** - Enter the height of the tree from the ground to the tip of the leader or top of the crown. NOTE: This is a total height variable. If you want to record merchantable height, use the sawlog height and pulpwood height variables.

**Height class** - Enter the user-defined height class code that best represents the approximate height of the overstory observation.

**Living** - Enter "yes" or "living" if the tree is alive.

**Log ID** - Enter the identification name or number of the merchantable log section. Log ID, Log length, and Log product are variables to record if the product and quality of each log within the tree are itemized. These variables are used in place of sawlog height and pulpwood height.

**Log length** - Enter the log length.

**Log product** - An estimate of the highest product or grade obtained in the log. Enter one of the following codes: 1 = veneer (contains at least an 8-foot section that qualifies for veneer); 2 = sawlog (contains at least a 12-foot section that qualifies for grade 1 through 4 sawlog). If interested in the grade of the tree, enter the following: 21 = grade 1 sawlog; 22 = grade 2 sawlog; 23 = grade 3 sawlog; or 24 = subfactory sawlog (grade 4 sawlog); 3 = pulpwood (contains at least two contiguous 4-foot bolts with a minimum top diameter of 4 inches and at least 50 percent sound). Also, if desired, enter either of the following grades: 31 = chipped pulpwood; 32 = whole pulpwood; 4 = boltwood (has the same specification as pulpwood, but of species and quality that meets requirements of local boltwood producers); 5 = poles (meets specifications for local cabin log or pole markets); 6 = firewood (same specifications as pulpwood, except minimum top diameter inside bark is 1.0 inch); 7 = local use (a product used locally that does not meet any of the other products/grade, a local user definition); or 8 = cull (tree less than 50 percent sound, or does not qualify for any of the products listed, a log classified as cull is omitted from any volume calculations).

**Overstory observation ID** - Enter the identification name or number of the overstory observation.

**Most valuable product** - An estimate of the highest product or grade obtained in the tree. Enter one of the following codes: 1 = veneer (contains at least an 8-foot section that qualifies for veneer); 2 = sawlog (contains at least a 12-foot section that qualifies for grade 1 through 4 sawlog). If interested in the grade of the tree, the following may be entered: 21 = grade 1 sawlog; 22 = grade 2 sawlog; 23 = grade 3 sawlog; 24 = subfactory sawlog (grade 4 sawlog); 3 = pulpwood (contains at least two contiguous 4-foot bolts with a minimum top diameter of 4 inches and at least 50 percent sound). Also enter, if desired, either of the following grades: 31 = chipped pulpwood; 32 = whole pulpwood; 4 = boltwood (has the same specification as pulpwood, but of species and quality that meets requirements of local boltwood producers); 5 = poles (meets specifications for local cabin log or pole markets); 6 = firewood (same specifications as pulpwood, except minimum top diameter inside bark is 1.0 inch); 7 = local use (a product used locally that does not meet any of the other products/grade, a local user definition) or ; 8 = cull (tree less than 50 percent sound, or does not qualify for any of the products listed, a tree classified as cull is omitted from any volume calculations).

**Pulpwood defect** - Enter the amount of defect in the pulpwood portion of the tree in percent. If data for pulp defect is not collected, then the default will set the variable at 0.0 and net volume will be 80 percent of gross volume in pulpwood.

**Pulpwood height** - Enter the portion of the tree above sawtimber height. For example, if the tree contains 32 feet of sawtimber, enter the portion above 32 feet that contains pulpwood products. If the tree does not contain any sawtimber, enter the merchantable pulpwood height. If no height is entered, the program calculates an average height based on the diameter of the tree and effective age of the stand.

**Sawtimber defect** - Enter the amount of defect in the sawtimber portion in percent. If data for sawlog defect is not collected, the default is set at 0.0 and gross board-foot volume and net board-foot volume is equal.

**Sawtimber height** - Enter the total height of sawtimber products in the tree in feet or meters; do not enter a count of logs or bolts. If no height is entered, the program calculates an average height based on the diameter of the tree.

**Species** - For every tallied tree, enter the tree species using either USDA PLANTS Database symbol (such as ACSA3 for sugar maple), the 3-digit Forest Inventory code (such as 318 for sugar maple), or a user-defined code such as SM for sugar maple).

**Stem count** - Enter the total number of identical trees of the same species, dbh, quality, etc. on the plot and described in a single observation. It is not necessary to combine similar observations.

**Timber quality** - A determination of whether the tallied tree will produce a sawtimber product. Enter one of the following: AGS = Acceptable Growing Stock for timber (capable of producing sawtimber when it reaches appropriate size, and expected to live at least 15 years); UGS = Unacceptable Growing Stock for timber (not capable of producing sawtimber at any time in future and/or not expected to survive for 15 years); or Crop tree (an extremely desirable acceptable growing stock tree).

**Custom variable 1** - Enter the appropriate value or code according to first pre-established user-defined variable.

**Custom variable 2** - Enter the appropriate value or code according to second pre-established user-defined variable.

**Custom variable 3** - Enter the appropriate value or code according to third pre-established user-defined variable.

**Custom variable 4** - Enter the appropriate value or code according to fourth pre-established user-defined variable.

**Custom variable 5** - Enter the appropriate value or code according to fifth pre-established user-defined variable.

**Custom variable 6** - Enter the appropriate value or code according to sixth pre-established user-defined variable.

**Visually interesting** - If the tree is of visual interest, enter "yes".

## Understory Plot

**Average shrub layer height** - Enter an ocular estimate of the average height of plants in the shrub layer (3 to 10 feet high).

**Coniferous shrub layer** - Enter "present" if the understory plot contains coniferous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any coniferous species are present in the inventory.

**Cover of foliage in shrub layer** - An ocular estimate of the percent cover of all herbaceous and woody plants in the shrub layer (3 to 10 feet high); using 10 percent increments is adequate.

**Deciduous shrub layer** - Enter "present" if the understory plot contains deciduous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any deciduous species are present in the inventory.

**Ericaceous shrub layer** - Enter "present" if the understory plot contains ericaceous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any ericaceous species are present in the inventory.

**Flowery shrub layer** - Enter "present" if any plant in the shrub layer (3 to 10 feet high) produces showy flowers. The variable defaults to absent but will be calculated by NED-2 if species known to have showy flowers are present in the inventory.

**Hard mast** - Enter “present” if any ground or shrub observation produces hard mast. The variable defaults to absent but will be calculated by NED-2 if species known to produce hard mast are present in the inventory.

**Map X-coordinate** - Used to record GPS coordinates of the understory plot.

**Map Y-coordinate** - Used to record GPS coordinates of the understory plot.

**Percent regeneration sprout** - Enter the percent of seedlings and saplings that are of sprout origin (root sprouts, sucker sprouts, etc.).

**Potential residual tree** - Enter “yes” if the plot contains at least one acceptable tree between 5 and 10 inches dbh that will meet your management goal and survive to occupy the site after a final harvest. Acceptable commercial trees have at least moderately good crowns and clear straight boles free of branches, epicormic branches, or other defects for at least the first 17 feet. Commercial species with more than one or two epicormic branches on the butt log should not be considered acceptable residual trees.

**Riparian plot** - Enter “yes” if any portion of the plot falls within a riparian area.

**Soft mast** - Enter “present” if any ground or shrub observation produces soft mast. The variable defaults to absent but will be calculated by NED-2 if species known to produce soft mast are present in the inventory.

**Stocked with commercial regeneration** - Enter “yes” if the plot is stocked with commercial tree seedlings (any commercial species, but not necessarily high value species).

**Stocked with high value regeneration** - Enter “yes” if the plot is stocked with desirable seedlings of high value species.

**Understory Plot ID** - Enter the identification name or number of the understory plot.

**User comments** - Enter any additional comments about the understory plot.

**Wetland vegetation** - Enter “present” if the shrub layer (3 to 10 feet high) contains any wetland species. The variable is automatically calculated if you enter wetland plants in the understory plot. If this variable is left empty, and detailed plant species list exists, the variable will default to absent.

## Understory Observation

**Living** - Enter “yes” or “living” if the plant is alive.

**dbh** - Enter the diameter at breast height for the understory observation. Diameter can be entered in 1- or 2-inch classes or actual measurement down to a 1/10 inch. Do not mix diameter classes.

**Height class** - Enter the user-defined height class code that best represents the approximate height of the understory observation.

**Height of plant** - Enter the height of the plant from the ground to the tip of the leader or top of the crown.

**Origin of plant** - Enter the code (1-5) that reflects the establishment origin of the understory observation.

**Percent cover** - Enter the percent of the fixed area plot that is covered by the species. This is used for both herbaceous and woody species. Depending on the desired analysis, the percent cover of each woody understory observation in addition to dbh may be entered.

**Species** - For every tallied observation, enter the species using either USDA PLANTS Database symbol (such as ACSA3 for sugar maple), the 3-digit Forest Inventory code (such as 318 for sugar maple), or a user-defined code (such as SM for sugar maple).

**Stem count** - Enter the number of stems of the species. This is used for both woody and herbaceous species.

**Understory Observation ID** - Enter the identification name or number of the understory observation.

**Custom variable 1** - Enter the appropriate value or code according to first pre-established user-defined variable.

**Custom variable 2** - Enter the appropriate value or code according to second pre-established user-defined variable.

**Custom variable 3** - Enter the appropriate value or code according to third pre-established user-defined variable.

**Custom variable 4** - Enter the appropriate value or code according to fourth pre-established user-defined variable.

**Custom variable 5** - Enter the appropriate value or code according to fifth pre-established user-defined variable.

**Custom variable 6** - Enter the appropriate value or code according to sixth pre-established user-defined variable.

## Ground-cover Plot

**Average shrub layer height** - Enter an ocular estimate of the average heights of plants in the shrub layer (3 to 10 feet high).

**Coniferous shrub layer** - Enter "present" if the ground plot contains coniferous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any coniferous species are present in the inventory.

**Cover of foliage in ground layer** - Enter an ocular estimate of the percent cover of all herbaceous and woody plants in the ground layer (0 to 3 feet high); using 10 percent increments is adequate.

**Cover of foliage in shrub layer** - Enter an ocular estimate of the percent cover of all herbaceous and woody plants in the shrub layer (3 to 10 feet high); using 10 percent increments is adequate.

**Deciduous shrub layer** - Enter "present" if the ground plot contains deciduous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any deciduous species are present in the inventory.

**Ericaceous shrub layer** - Enter "present" if the ground plot contains ericaceous species in the shrub layer (3 to 10 feet high). The variable defaults to absent but will be calculated by NED-2 if any ericaceous species are present in the inventory.

**Flowery ground layer** - Enter "present" if any ground plant produces showy flowers that are 0 to 3 feet high. The variable defaults to absent but will be calculated by NED-2 if species known to produce showy flowers are present in the inventory.

**Flowery shrub layer** - Enter "present" if any ground plant produces showy flowers are 3 to 10 feet high. The variable defaults to absent but will be calculated by NED-2 if species known to produce showy flowers are present in the inventory.

**Hard mast** - Enter “present” if the species in any ground or shrub observation produces hard mast. The variable defaults to absent but will be calculated by NED-2 if species known to produce hard mast are present in the inventory.

**Ground-cover Plot ID** - Enter the ground-cover plot identification name or number.

**Litter depth** - Enter the depth of undecomposed leaf litter and organic matter on top of the mineral soil.

**Map X-coordinate** - Used to record GPS coordinates of the ground-cover plot.

**Map Y-coordinate** - Used to record GPS coordinates of the ground-cover plot.

**Percent grass and sedge** - Enter the percent of the ground-cover plot that is covered by grass and sedge that inhibits seedling establishment and growth.

**Percent inhibiting fern** - Enter the percent of the plot that is covered by any ferns that inhibit seedling establishment and growth, for example either hay-scented or New York fern. If identity is uncertain, count any fern that grows as individual fronds from the ground level and ignore any ferns that grow in clumps.

**Percent litter** - Enter the percent of the ground-cover plot that is covered by forest litter (leaves, small twigs, etc.).

**Percent moss** - Enter the percent of the ground-cover plot that is covered by moss.

**Percent other fern** - Enter the percent of the plot that is covered by any fern that does not inhibit seedling establishment and growth.

**Percent regeneration sprout** - Enter the percent of seedlings and saplings that are of sprout origin (root sprouts, sucker sprouts, etc.).

**Percent rock** - Enter the percent of the ground-cover plot that is covered by surface rocks. Surface rocks are those that can easily be turned over using your hand or with a rake.

**Riparian plot** - Enter “yes” if any portion of the plot falls within a riparian area.

**Rockiness barrier to regeneration** - Enter “yes” if rocks or stones will inhibit seedling regeneration.

**Soft mast** - Enter “present” if any ground or shrub observation produces soft mast. The variable defaults to absent but will be calculated by NED-2 if species known to produce soft mast are present in the inventory.

**Stocked with commercial regeneration** - Enter “yes” if the plot is stocked with commercial tree seedlings (any commercial species, but not necessarily high value species).

**Stocked with high value regeneration** - Enter “yes” if the plot is stocked with desirable seedlings of high value species.

**User comments** - Enter any additional comments about the ground-cover plot.

**Wetness barrier to regeneration** - Enter “yes” if wetness or poorly drained soils inhibit seedling regeneration. Look for areas covered by a fine layer of silt and depressions filled with blackened leaves during the dry season.

**Wetland vegetation** - Enter “present” if wetland ground species are present. This variable is automatically calculated in the program if wetland plants are entered in the ground-cover plot.

## Ground-cover Observation

**Height class** - Enter the user-defined height class code that best represents the approximate height of the plant.

**Height of plant** - Enter the total height of the plant from the ground to the tip of the leader or top of the plant.

**Ground-cover Observation ID** - Enter the identification name or number of the ground-cover observation.

**Origin of plant** - Enter the code (1-5) that reflects the establishment origin of the ground-cover observation.

**Percent cover** - Enter the percent of the fixed area plot that is covered by the species. This is used for both herbaceous and woody species.

**Species** - For every plant observed, enter the species using either USDA PLANTS Database symbol (such as ACSA3 for sugar maple), the 3-digit Forest Inventory code (such as 318 for sugar maple), or a user-defined code (such as SM for sugar maple).

**Stem count** - Enter the number of stems of the species. This is used for both woody and herbaceous species.

**Custom variable 1** - Enter the appropriate value or code according to first pre-established user-defined variable.

**Custom variable 2** - Enter the appropriate value or code according to second pre-established user-defined variable.

**Custom variable 3** - Enter the appropriate value or code according to third pre-established user-defined variable.

**Custom variable 4** - Enter the appropriate value or code according to fourth pre-established user-defined variable.

**Custom variable 5** - Enter the appropriate value or code according to fifth pre-established user-defined variable.

**Custom variable 6** - Enter the appropriate value or code according to sixth pre-established user-defined variable.

## Transect

**High slash** - Enter "yes" if any high slash piles are seen along the transect. Slash piles are considered high if any part of the pile is more than 3 feet high.

**Interesting tree** - Enter "yes" if an interesting tree along the transect is seen.

**Low slash** - Enter "yes" if any low slash piles along the transect are seen. Slash piles are considered low if the pile is less than 3 feet high.

**Transect ID** - Enter the identification name or number of the transect.

**Transect length** - Enter the distance of the transect on which dead and down log data was collected; for example, 200 feet or 75 meters. The distance should be no less than 50 feet.

**User comments** - Enter any additional comments about the transect.

## Transect Observation

**Bark** - Enter yes if the bark on the log is loose.

**Condition** - Enter the condition of the down logs. Codes include: 1 = hard/sound; 2 = soft/decayed.

**Count** - Enter the number of logs of the same diameter, condition, and bark.

**Diameter** - Enter the diameter of each down log walked over along the compass bearing between plot centers. Measure only down logs with a diameter of at least 3 inches and a length of at least 3 feet long.

**Species** - For every tallied log, enter the tree species using either USDA PLANTS Database symbol (such as ACSA3 for sugar maple), the 3-digit Forest Inventory code (such as 318 for sugar maple), or a user-defined code (such as SM for sugar maple).

**Transect Observation ID** - Enter the identification name or number of the transect observation.

## MANAGEMENT UNIT

### About the Management Unit

A management unit represents forest stands that are managed collectively, and may contain from one to many stands which may or may not be contiguous. A single management unit could range in size from 10 to 10,000 or more acres. A typical management unit was conceived as a forest property belonging to a non-industrial private landowner. Extensive land holdings managed by public agencies may include multiple management units, which would require multiple NED-2 files. Large land holdings may be split into distinct management units if the management goals differ between units.

Management unit details include information about the property such as the owner, location, size, and stand count as well as information about size class distribution, overstory, understory and rare plant species, and wetland status. Note that not all of these variables are calculated at the same time and some management unit variables are used internally and are not visible to you.

Each NED-2 data file contains one and only one management unit. Therefore, when a new NED-2 file is created, the management unit already exists. However, stands and forms of data such as tree observations require some user action in order to be added or imported for subsequent analysis.

**Management Unit Name:** It is recommended that you provide a name for the management unit because it is used in a variety of ways by NED-2, particularly as a label in many reports and tables.

## STANDS

### Adding Stands

NED-2 is organized around forest stands, as are most of the growth and yield and prescription models used by NED-2. Hence, establishing or adding stands is one of the simplest and most necessary steps in creating data in NED-2.

To add a stand:

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click **Stands**.
3. In the Work Pane, click the **Add new stand** button.
4. For each new stand, NED-2 automatically provides a stand name for you, but any name can be entered.

### Deleting Stands

1. When deleting a stand, NED-2 removes all data associated with that stand, but species information is retained. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select the stand to delete.
3. In the Work Pane, click the **Delete stand** button.
4. Click **Yes** when prompted to confirm the deletion.

### Importing stands

Importing stands allows you to obtain a copy of an existing stand from several file types or from within the same file. Use this feature to make a copy of a stand from the current file (be sure that the data file has been saved, otherwise the stand will not be available for copying).

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click **Stands**.
3. In the Work Pane, click the **Import Stands** button.
4. From the dialog box, click the **File** button.
5. Stands may be copied from the following file types:
  - NED/SIPS
  - NED-1
  - NED-2
  - SILVAH
  - Forest Vegetation Simulator (FVS)
6. From the **Files of Type** list at the bottom of the Open dialog, choose a file type. If the data is in a format other than listed above, refer to the topics on "Importing Data from Other Sources" in the Importing Data section.
7. Browse to a desired folder and select a file that contains the stands to import.
8. Select one or more stands from the list that is displayed on the dialog.
9. Click **OK**.

NED-2 retains the name of the imported stands. Of course, the stands may be renamed after importing.

## Creating New Stands from Existing Clusters

Occasionally, inventories are collected without specifying which plots (clusters) belong to which stands. Clusters can be “moved” around by copying them into new stands and deleting them from the source stands once the clusters have been copied successfully.

Clusters can be copied from an existing stand into a *new* stand, but clusters cannot be copied into an *existing* stand. Individual plots that belong to a given cluster cannot be selected and copied. Instead, make sure to copy a cluster and get all of the existing plots and observations that belong to that cluster.

Clusters from different stands must have identical characteristics, such as matching plot sizes. If the characteristics of all clusters do not match up, the clusters cannot be copied into the new stand.

1. In the Navigation Pane, click **Inventory**, and then click **Shuffle Plots**.
2. To import clusters from another NED-2 file, near the top of the Options pane, click the **Pick file** button. Otherwise, skip to step 6 to use stands and clusters from the current NED-2 file.
3. From the Pick file dialog, click **Import stands and clusters from another file**.
4. Browse to and select the NED-2 file that contains the clusters to import.
5. From the Open dialog, click the **Open** button. Skip to step 7.
6. If stands/clusters from another NED-2 file were selected previously, click the **Pick file** button. From the Pick file dialog, click **Use stands and clusters from this file**, then click **OK**. If you have not been working with stands from other files, proceed to Step 7.
7. In the Options Pane, select a stand from the **Stands** list.
8. Select one or more clusters from the **Cluster** list box.
9. In the Work Pane, click the **Add cluster** button.
10. Continue selecting clusters from other stands as desired, by repeating steps 7-9, as necessary.
11. For each selected cluster, NED-2 provides a new name for the cluster as it will appear in the new stand. It is recommended that this name be modified here before creating the new stand.
12. When satisfied with the collection of clusters to copy, proceed to the next step.
13. Click the **Create new stand** button. A Stand values dialog opens. Describe the stand now or later, if desired.
14. Click **OK** to create the new stand. The new stand contains all the clusters selected in steps 7-9.
15. To view the new stands with copied plot-clusters, in the Navigation Pane, switch to **Enter/Edit Inventory**.
16. If clusters were copied from stands within the same file, remember to delete the original copy of any “moved” clusters, if appropriate.

## About Stand Adjacency

In NED-2, you may indicate which stands are adjacent to each other within a management unit. NED-2 uses stand adjacency information to create spatial (patch analysis) reports. Studies in landscape ecology have shown that significant relationships often exist between the spatial arrangement of vegetation and the response of ecological processes and animal populations that use that habitat.

## Viewing and Editing Stand Adjacency

To view and/or manually edit the adjacency of your stands:

1. In the Navigation Pane, click **Inventory**.
2. In the Work Pane, click **Enter/Edit Stand Adjacencies**. Stand adjacency is shown on the grid in the Work Pane.
3. Double-click any cell at the intersection of two different stand names to turn on or off a leaf symbol to indicate adjacency. Blank cells indicate no adjacency. NOTE: A leaf symbol indicates a given pair of stands is adjacent (for the stand listed in the current row and the stand listed in the current column of a given cell).
4. NED randomly applies a leaf symbol to each cell. The different leaf symbols have no implied meaning, other than indicating adjacency between two stands. If a large number of stands and/or adjacencies exist, the leaf symbols repeat.

## Calculating Stand Adjacency with Environmental Systems Research Institute, Inc. (ESRI) Geographic Information Systems (GIS)

In order for NED-2 to calculate stand adjacencies, ArcMap software version 8.x or 9.x, and a valid shapefile must be installed. The shapefile must have a column (i.e., a database field) that identifies each stand in the management unit, and the name of this field must be "stand\_id." Then, the name of each stand in the shapefile must match the stand name that occurs in the corresponding NED-2 data.

1. Open a NED-2 file that has a corresponding ArcMap shapefile.
2. In the Navigation Pane, click **Inventory**.
3. Click **Generate Stand Adjacencies**. An Open shape file dialog opens.
4. Select an existing shapefile (.shp). Click **Open**.
5. NED launches ArcMap automatically. It may take a few minutes to load ArcMap and calculate the adjacency information.
6. Click **OK** on the ArcMap dialog that says stand adjacencies are successfully generated.
7. To view the adjacencies, under Inventory, click **Enter/Edit Stand Adjacencies**. Icons of leaves appear where stands are adjacent. NED-2 randomly applies a leaf symbol to each cell. The different leaf symbols have no implied meaning, other than indicating adjacency between two stands. If a large number of stands and/or adjacencies exist, the leaf symbols repeat.

## CLUSTERS

### Adding Clusters

Each time a new cluster is added, NED-2 creates one overstory plot and however many understory and ground-cover plots and CWD transects are specified in the inventory settings. If running a simulation, the maximum number of clusters that can be simulated in any single stand is 99.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Plot clusters** under the stand.
4. In the Work Pane, click the **Add new cluster** button.

## Deleting Clusters

When deleting a cluster, NED-2 deletes ALL of the plots and observations belonging to that cluster.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Plot clusters** under the stand.
4. In the Work Pane, click the row of the cluster to delete.
5. In the Work Pane, click the **Delete cluster** button.
6. Click **Yes** to confirm the deletion when prompted.

## CUSTOM DATA VARIABLES

### About Custom Data Variables

NED-2 provides several dozen site and vegetation variables that can be tallied in the field for specific analyses across several natural resource disciplines. If the inventory includes other variables that do not have a counterpart in NED-2, there is an option of defining them as custom, user-defined variables.

Up to six custom variables may be defined per NED-2 file. Custom variable definitions apply to all stands and do not correlate with plot types. The following are examples of three custom variables that could be established: 1) a rating scale for ice storm damage; 2) an index for beech bark disease progression; 3) a rating on the competitive ability of oak seedlings in the ground cover. The first two examples might only be tallied for overstory observations, while the third example would be tallied for ground-cover observations.

Custom data values are not validated. Custom variables may contain alphabetic and numeric characters, which allows for any coding scheme that makes sense for your application. Custom variables can be used only for observations in the overstory, understory, and ground cover, and are *not* available for CWD observations. NED-2 does not provide custom variables at the level of stands, plot-clusters, and plots.

Reports and vegetation tables may be generated on one custom variable at a time, where each value tallied in the field is identified in separate columns or rows. For example, if developing a rating of beech bark disease progression on a scale from 1-5, and the only values observed were 2 and 3, the 2 columns or rows labeled "2" and "3" will appear, representing the unique values for that particular custom variable. NED-2 provides a sum total of the number of stems, percent cover, basal area, volume, etc. for each unique value across diameters or species (but not both at the same time). However, beware that the vegetation table footers (e.g., sum, mean) may or may not make sense, depending on the intended use of each custom variable.

## How to Set Up Custom Data Variables

By default, NED-2 identifies custom variables as “custom 1,” “custom 2,” etc. To improve the readability of reports and vegetation tables, specify a short label (column heading) that appears for each custom variable.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. At the bottom of the Options Pane, click the **Custom variable definitions** button.
3. On the Custom variables dialog, enter a description in the description field for each variable. Use this description as a reminder of the variable's use. The description is not used by NED-2. If custom 1 was being used to indicate ice storm damage, the description might be “extent of ice storm damage.”
4. Enter a label intended for use in reports. This is the column heading. For ice storm damage, an appropriate column heading might be “ice.”
5. Be sure to configure the appropriate observation table(s) to display the custom variables along with other variables such as species, dbh, etc. The list of variables on the configuration dialog displays the assigned label(s) from step 4.

## TIPS FOR EDITING INVENTORY DATA

### Dialog-based Versus Spreadsheet-style Editing

Inventory data is always displayed in the Work Pane in columns and rows, in a spreadsheet style. Displaying data this way is convenient. However, if displaying numerous variables that cannot all fit in the space allotted, you must scroll to see the cell that contains the value to edit.

You must use the dialog-based data entry to grade separate log products in a single tree, because you cannot view the logs in the spreadsheet display.

NED-2 provides a dialog-based alternative that allows you to see the entire set of variables for a single record—including logs when editing overstory observations. Variables are organized on the dialog in a context appropriate for the items you are editing.

To edit data using a dialog instead of the spreadsheet:

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. View the inventory data to edit. Almost any level will support dialog-based entry, including the list of stands (see Stands in the Options Pane) but not when editing a single stand.
3. Where data is displayed in the normal spreadsheet view, double-click any of the non-header rows in the first or second gray (darker shaded) columns in the far left of the row to edit. See Figure 5.
4. Edit values as necessary; use the tab key to move between fields.
5. Click **OK** to dismiss the dialog.
6. Repeat this process for other rows.

**Overstory observation**

ID: 1.4      Crown class: [dropdown]  
 Stem count: 1      Crown condition: 100  
 dbh: 7.28      Height class: [dropdown]  
 Species: sugar maple      Total height: [input]  
 Timber quality: AGS       Alive  
 M.V. Product: pulpwood       Interesting tree  
 Sawlog defect: 0      Pulpwood defect: 0       Cavity

Custom variables:  
 ice: 1  
 bear sign: [input]  
 Custom 3: [input]  
 Custom 4: [input]  
 Custom 5: [input]  
 Custom 6: [input]

**Logs**

	Height	Cubic Vol.
Sawlog	0.0	0.00
Pulpwood	25.2	4.90
<b>Total</b>	<b>25.2</b>	<b>4.90</b>

You can either enter the sawlog and pulpwood heights, or you can enter individual logs. If you enter the heights, logs will automatically be added to the log table below. If you enter individual logs, the heights will be calculated.

Buttons: Add log, Delete log, Reset logs and heights, Configure

ID	Length (ft)	Prd. / grd.
bult	25.2	pulpwood

Comments: [text area]

Buttons: Cancel, OK

Figure 5. Editing an overstory observation using a dialog instead of the spreadsheet view.

## Data Entry Shortcuts

Several shortcuts exist to make it easier to enter data in NED-2.

**Duplicate cell above (Ctrl+D).** Press and hold down the **Ctrl** key and then press the **D** key.

This action copies the contents of the cell immediately above the current cell in the active row.

For example, if you add a new observation and click in the species column of that new row, this shortcut copies the species from the row above into the new row.

**Delete a record (row) (Ctrl+Delete).** Press and hold down the **Ctrl** key and then press the **Delete** key. Click **Yes** to confirm the deletion.

**Insert new record (row) (Ctrl+Enter).** Press and hold down the **Ctrl** key and then press the **Enter** key. Anywhere NED-2 shows a group of similar items in the display, you can quickly add another of the same kind of item with this shortcut. This shortcut inserts a new item below the current row when viewing a table of stands, plots, or observations.

**Insert new record (row) in next plot (Ctrl+Shift+Enter).** Press and hold down the **Ctrl** key, the **Shift** key, and finally press the **Enter** key. This action inserts a new observation in the next plot.

**Query codes (Ctrl+Q).** Press and hold down the **Ctrl** key and then press the **Q** key. If you are in a cell that requires a coded value, this shortcut opens a dialog that presents all of the possible choices appropriate for the data item.

## OVERSTORY DATA

### What Belongs in the Overstory?

In many applications, an inventory of the overstory includes stems at least 1.0 inch dbh and larger. Similarly, for prescriptions involving a complete overstory removal (e.g., clear-cutting), stems as small as 1 inch are often included in the removal. Depending on your conception of forest vegetation, you may prefer to think of such small stems as occupying the understory layer. Perhaps you might not want to include anything smaller than 3 or 4 inches in your overstory tally. NED-2 provides a way to establish your own threshold of just exactly what is overstory and understory.

Recommendation: NED-2 incorporates several previously-published stocking guides for analysis of your stand data. If adopting a threshold greater than 1.0 inch dbh, you should consider recording the dbh of stems under this threshold (but larger than 1.0 inch) in your understory tally, and including understory stems with overstory calculations. The reason for this is that some stocking guides include tree sizes down to 1.0 or 2.0 inches dbh (Frank and Bjorkbom 1973, Roach 1977, Schlesinger and Funk 1977, and Ernst and Knapp 1985). If not including such trees in your inventory, you may overestimate stand diameter and underestimate stocking (Roach 1977). In applying a stocking chart, the B line will then be too high and volume available for cutting will be reduced. This may result in a residual stocking that is higher than intended.

### Stand, Plot, and Tree Size Classes

In the NED-2 program, a difference in break points exists for the Stand and Plot Size Class and the Tree Size Class:

#### Stand and plot size classes:

- Regeneration medial diameter < 1.0 inch
- Sapling 1.0 inch  $\leq$  medial diameter  $\leq$  4.5 inches
- Pole 4.5 inch < medial diameter  $\leq$  10.5 inches
- Small Sawtimber 10.5 inch < medial diameter  $\leq$  16.5 inches
- Large Sawtimber 16.5 inch < medial diameter

#### Tree size classes:

- Seedlings < 1 inch
- Saplings  $\geq$  1 inch and  $\leq$  5.5 inches
- Poles > 5.5 inches and  $\leq$  11.5 inches
- Small Sawtimber > 11.5 inches and  $\leq$  17.5 inches
- Medium Sawtimber > 17.5 inches and  $\leq$  23.5 inches
- Large Sawtimber > 23.5 inches

The stand level classification of whether a stand is a sapling, pole, or sawtimber stand is based on medial diameter, and the break points between them are 1 inch lower than for individual trees. For example, if a stand has a medial diameter of 10.6 inches, that means that half the basal area in the stand is in trees  $\geq 10.6$  inches, so a person walking through the stand would probably experience it as a “small sawtimber” stand. One reason for the difference in break points is that many small trees pull the medial and mean diameters down, so the stand size class break points are a little (1 inch) lower than the tree size class break points.

No “medium sawtimber” size class exists for stands and plots because medium and large sawtimber have been merged into one stand size class. This merge occurred because while distinguishing structural differences among the size classes in order to establish “balanced size classes” on a management unit, a big enough difference was not discovered between a stand with an average diameter of 19 inches and one of 25 inches. So the size classes were combined.

### Adding Overstory Plots

An overstory plot can be added only when establishing a new cluster. NED-2 requires one overstory plot per cluster, and this cannot be changed. Therefore, at the time the cluster is created, NED-2 automatically creates one overstory plot.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand.
4. In the Work Pane, click the **Add new plot** button.
5. Click **Create a new cluster** on the new plot dialog.
6. Specify a cluster ID, if desired. NED-2 provides a default ID, thus this step is optional.
7. Click **OK**.

### Deleting Overstory Plots

An overstory plot cannot be deleted from an existing cluster. NED-2 requires one and only one overstory plot per cluster.

The only way to delete an overstory plot in NED-2 is to delete the plot-cluster that contains that plot. When you delete a cluster, NED-2 also removes all of the other plot types, including understory, ground, and CWD transects in that cluster.

### Adding Overstory Observations

When starting out with an empty plot, you will need to specify to which plot the observation belongs.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand, and then click **observations**.
4. In the Work Pane, click the **Add new observation** button.
5. If you have established only one cluster (and hence, one overstory plot), each time you click **Add new observation** a new row is inserted in the observations table. No further action is required.

6. On the other hand, if you have already established more than one cluster, NED-2 asks you to choose a plot where the new observation belongs. From the Choose plot for new observation dialog, select a plot.
7. Click **OK**.

**Shortcut recommendation:** Once you have an observation in a plot, you can quickly add another observation by using the Insert New Record shortcut (**Ctrl+Enter**) described in the “Data Entry Shortcuts” topic. When you apply this shortcut, NED-2 automatically inserts a new observation *below* the current row. Thus, you can select a given observation in any plot and quickly add a new observation. As you hold down the Ctrl key, if you press the Enter key more than once, NED-2 continues to add new observations until you stop. If desired and the number of observations in a plot is known, you can create all of the new observations first, and then go back and enter data in each row.

### Deleting Overstory Observations

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand, and then click **observations**.
4. Click the row that contains the observation to delete.
5. Click the **Delete observation** button.
6. Click **Yes** to confirm the deletion.

### About Product Grading

If a tree contains merchantable volume, two general approaches for determining the volume and value of products in that tree exist.

The first approach is more traditional, in which you enter only the species and tree's dbh and record the most valuable product likely to be obtained in the tree.

Of course, with the traditional approach, you may also record sawtimber and pulpwood height to obtain product volume based on your own measurements of merchantable height. This is more time consuming in the field but may lead to a more accurate assessment of standing timber value.

The second approach is intended to provide more control over the breakdown of products within a tree. NED-2 allows you to split the merchantable portion of a tree into several distinct products and log lengths. Instead of splitting merchantable height into sawtimber and/or pulpwood height, you can divide a tree into several merchantable sections or logs, and specify a separate product and length for each log.

Regardless of which approach you use, NED-2 always maintains logs that match the total sawtimber and pulpwood height. It may appear that total sawtimber and pulpwood height and logs are editable at the same time. But they are not—you can only edit one or the other, unless you choose to reset and start over. That is, total sawtimber height can be entered and then individual logs, which are created automatically by NED-2, can be modified. Conversely, if you create or modify individual logs, total sawtimber and pulpwood height cannot be modified. If you need to start over, thus allowing either merchantable heights or individual logs to be re-entered, follow the instructions in the following section on Logs.

## Recording Sawtimber and Pulp Height

Sawtimber height is the total merchantable sawtimber portion of a tree and is entered as a total length in feet or meters. Pulpwood height is the merchantable portion of the tree above sawtimber height. If the tree does not contain any sawtimber, the total merchantable height should be entered under pulpwood.

Sawtimber and pulpwood defect is always entered as a percentage of the total sawtimber and pulpwood, respectively.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand, and then click **observations**.
4. Select the row of the observation where you wish to enter or modify the product/grade information.
5. Find the columns for sawlog and pulpwood height, and product/grade if you wish to specify a most valuable product likely to be obtained in the tree. If you do not see these items, click **Configure** in the top-right corner of the Work Pane to display them.

If you prefer to work from the data-entry dialog instead of individual rows, double-click in the gray columns to the far-left side of the Work pane. Locate total sawlog height and/or pulpwood height and enter the values as desired. Refer to the following section on Logs for information on entering multiple products and heights (separate log lengths) for a single tree.

## Assigning Multiple Products to a Tree

NED-2 allows you to split the merchantable portion of tree into several distinct products and log lengths.

Using this approach, you can cull out defective portions of the tree, and thereby reduce the amount of defect otherwise present in the sawtimber and/or pulpwood portion. Sawtimber defect and pulpwood defect, if entered for the entire tree, apply to each log, depending on whether the log is assigned a sawtimber product or a pulpwood product. Both kinds of defect cannot be applied to one log at the same time.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand, and then click **observations**.
4. Select the row of the observation where you wish to enter or modify the product/grade information.
5. Double-click in any of the gray columns in the left of the row. This action opens a dialog that displays all pertinent information for a given overstory observation. You must call up this dialog to split a tree into separate log products.

Refer to the following section on Logs for further information.

## LOGS

### About Logs

Traditionally the merchantable portions of a tree are split between sawtimber and pulpwood and are typically entered as sawtimber height and pulpwood height, respectively. NED-2 provides a feature that allows you to go one step further and split the merchantable portion of a tree into several products or sections, each receiving its own grade, and the result is a series of sections referred to as logs in NED-2.

When you enter a tree with a merchantable dbh, NED-2 automatically calculates sawtimber and pulpwood height and generates corresponding logs, one for the sawtimber portion and a second one for pulpwood. Thus, if you decide to accept the calculated merchantable heights, or enter your own, NED-2 maintains a table of logs for the tree even though you are not specifically entering the logs. If you do not assign a most valuable product, NED-2 assigns default products for the sawtimber and pulpwood portion of the tree, namely, "sawlog" (grade 2 sawtimber) and "pulpwood."

If you want to record multiple products from the tree, other than one grade each for the sawtimber and pulpwood portion, log lengths must be entered for each separate product. When you modify log lengths using the logs table, NED-2 subtotals the logs and re-calculates sawtimber and pulpwood height.

As a general rule, you may enter sawtimber and pulpwood heights or individual logs, but not both. It is possible to go back and forth after you have entered one or the other, but doing so requires extra steps. Refer to the topic on "Resetting Heights and Logs" in this section.

### Viewing Logs

Logs are viewed and modified in a logs table that is maintained for each overstory observation. In order to view or edit the logs, you must open the Overstory observation dialog that displays logs as well as all pertinent information for the overstory observation. If you are already in the list of overstory observations, skip to step 4, otherwise start from step 1.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Overstory plots** under the stand, and then click **observations**.
4. Select the row of the observation where you wish to enter or modify the logs and log products.
5. Double-click in either the first or second gray column in the far left of the row. This will open a dialog (see Figure 6) that displays all pertinent information for a given overstory observation.
6. Refer to the topics on "Adding Logs" and "Deleting Logs" in this section.

To view additional volume and value characteristics for any log in the logs table, click the Configure button.

The screenshot shows the 'Overstory observation' dialog box. The 'Logs' section is highlighted, showing a table with the following data:

ID	Length (ft)	Prod. / grd.
butt	23.1	sawlog
log 2	21.1	pulpwood

The 'Logs' section also includes a summary table with the following data:

	Height	Cubic Vol.
Sawlog	23.1	34.10
Pulpwood	21.1	22.13
Total	44.2	56.22

Figure 6. Viewing the logs table for an overstory observation.

## Adding Logs

1. Double-click in either the first or second gray column in the far left of the row that contains the pertinent overstory observation. The Overstory observation dialog launches.
2. Click the **Add log** button.
3. From the Add new log dialog, identify one of the existing logs (if present) and choose whether to insert the new log before or after it.
4. Specify a simple name for the log for easy identification.
5. Enter a log length.
6. Select a product for the log.
7. Click **OK**.

The Add log button may be disabled if you have entered a tree that does not meet the preferences under calculation settings. For instance, you may have entered a tree with a diameter that is too small or one that results in a calculated log length that does not meet the minimum length specified. On the other hand, the button may be disabled because you have already entered sawtimber and/or pulpwood heights. In this case, your merchantable heights override the log-editing mechanism. Click the **Reset logs and heights** button in order to edit individual logs.

## Deleting Logs

1. Double-click in either the first or second gray column in the far left of the row that contains the pertinent overstory observation. The Overstory observation dialog launches.
2. Select the row that contains the log you wish to delete.
3. Click the **Delete log** button.
4. Click **Yes** to confirm deletion of the log.

The Delete log button may be disabled if you have entered a tree that does not meet the preferences under calculation settings. For instance, you may have entered a tree with a diameter that is too small or one that results in a calculated log length that does not meet the minimum length specified. On the other hand, the button may be disabled because you have already entered sawtimber and/or pulpwood heights. In this case, your merchantable heights override the log-editing mechanism. Click the **Reset logs and heights** button in order to edit individual logs.

## Resetting Heights and Logs

If you have entered logs, you are prevented from entering (editing) merchantable heights. The converse is also true. If you have entered merchantable heights, you are prevented from modifying the logs table.

Occasionally you may need to reset and start over for a given overstory observation. When doing this, NED-2 erases the logs table, re-calculates sawtimber and pulpwood merchantable height, and then re-populates the logs table. At this point, you can choose whether to modify merchantable heights or logs, as necessary.

1. Double-click in either the first or second gray column in the far left of the row that contains the pertinent overstory observation. The Overstory observation dialog launches.
2. Near the center of the dialog, click the **Reset logs and heights** button.
3. Click **Yes** when prompted to continue.

## UNDERSTORY DATA

### What Belongs in the Understory?

In NED-2, the understory plot is intended for woody stems meeting size criteria based on dbh and/or stem height. In forestry practice, a common convention for defining the understory is any woody stem that is tall enough to have a dbh less than 1.0 inch. Depending on your conception of forest vegetation layers or strata, you may establish criteria to suit your needs. For instance, you may want to include anything up to 3 or 4 inches in your understory tally. Whichever is decided, NED-2 provides a way to establish your own threshold of just exactly what is understory and overstory.

The dbh of understory stems can be recorded in NED-2. Should you decide to use a dbh threshold larger than 1.0 inch, recall that you should include understory stems with overstory calculations in order to properly estimate stand stocking and average stand diameter.

## Adding Understory Plots

An understory plot may be added to an existing cluster, thereby altering the predefined cluster: plot ratio, or an understory plot may be added when you establish a new cluster. At the time the cluster is created, NED-2 automatically creates the number of understory plots as designated in your inventory settings.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Understory plots** under the stand.
4. In the Work Pane, click the **Add new plot** button.
5. On the New Plot dialog, click **Create a new cluster** if you want NED-2 to establish a new cluster with all of its associated plots, or click **Create a single plot in an existing cluster** if you want to put an additional understory plot in an existing cluster.
6. Click **OK**.

## Deleting Understory Plots

You may delete one or even all understory plots in any given cluster. When you delete a plot, all of its observations are also deleted. If you have observations in the plot, NED-2 prompts you for confirmation. Otherwise, no prompt is given and the plot is deleted immediately.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Understory plots** under the stand.
4. In the Work Pane, select the row of the plot to delete.
5. In the Work Pane, click the **Delete plot** button.
6. Click **Yes** if prompted to confirm the deletion.

## Adding Understory Observations

When starting out with an empty plot, you will need to specify to which plot the observation belongs.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Understory plots** under the stand, and then click **observations**.
4. In the Work Pane, click the **Add new observation** button.
5. If you have established only one understory plot in a given cluster, each time you click **Add new observation**, a new row is inserted in the observations table. No further action is required.
6. Typically more than one understory plot per cluster exists, and NED-2 asks you to choose a plot where the new observation belongs. Select a plot from the Choose plot for new observation dialog.
7. Click **OK**.

**Shortcut recommendation:** Once you have an observation in a plot, you can quickly add another observation by using the Insert New Record shortcut (Ctrl+Enter) described in the “Data Entry Shortcuts” topic. When you apply this shortcut, NED-2 automatically inserts a new observation *below* the current row. Thus, you can select a given observation in any plot and quickly add a new observation. As you hold down the Ctrl key, if you press the Enter key more than once, NED-2 continues to add new observations until you stop. If desired and the number of observations in a plot is known, you can create all of the new observations first, and then go back and enter data in each row.

## Deleting Understory Observations

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Understory plots** under the stand, and then click **observations**.
4. Select the row that contains the observation to delete.
5. Click the **Delete observation** button.
6. Click **Yes** to confirm the deletion.

## GROUND-COVER DATA

### What Belongs in the Ground Cover?

The ground cover or ground flora may include plants in the shrub, herb layer, and moss-lichen layers—plants that are relatively close to the soil surface. Generally, a woody stem should be recorded in the ground-cover plot if it is less than breast height (4.5 feet). By convention, NED-2 does not use a dbh threshold between understory and ground-cover. If you want to record stems taller than 4.5 feet in the ground cover (e.g., stems with a small dbh approximately 0.5 inch or less), you cannot record the dbh but you can record the count or percent cover. Stems of this size are generally less than 6.5-9.5 feet tall. All herbaceous stems, regardless of size, should be recorded in the NED-2 ground-cover plot.

### Adding Ground-cover Plots

A ground-cover plot can be added to an existing cluster, thereby altering the predefined cluster: plot ratio, or you can add a ground-cover plot when you establish a new cluster. At the time the cluster is created, NED-2 automatically creates the number of ground-cover plots as designated in your inventory settings.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Ground plots** under the stand.
4. In the Work Pane, click the **Add new plot** button.
5. Click **Create a new cluster** on the new plot dialog if you want NED-2 to establish a new cluster with all of its associated plots, or click **Create a single plot in an existing cluster** if you want to put an additional ground-cover plot in an existing cluster.
6. Click **OK**.

## Deleting Ground-cover Plots

You may delete one or even all ground-cover plots in any given cluster. When a plot is deleted, all of its observations are also deleted. If you have observations in the plot, NED-2 prompts you for confirmation. Otherwise, no prompt is given and the plot is deleted immediately.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Ground plots** under the stand.
4. In the Work Pane, select the row of the plot to delete.
5. In the Work Pane, click the **Delete plot** button.
6. Click **Yes** if prompted to confirm the deletion.

## Adding Ground-cover Observations

When starting out with an empty plot, you will need to specify to which plot the observation belongs.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Ground plots** under the stand, and then click **observations**.
4. In the Work Pane, click the **Add new observation** button.
5. If you have established only one ground-cover plot in a given cluster, each time you click **Add new observation** a new row will be inserted in the observations table. No further action is required.
6. Typically more than one ground-cover plot per cluster exists, and NED-2 asks you to choose a plot where the new observation belongs. Select a plot from the Choose plot for new observation dialog.
7. Click **OK**.

**Shortcut recommendation:** Once you have an observation in a plot, you can quickly add another observation by using the Insert New Record shortcut (Ctrl+Enter) described in the “Data Entry Shortcuts” topic. When you apply this shortcut, NED-2 automatically inserts a new observation *below* the current row. Thus, you can select a given observation in any plot and quickly add a new observation. As you hold down the Ctrl key, if you press the Enter key more than once, NED-2 continues to add new observations until you stop. If desired and the number of observations in a plot is known, you can create all of the new observations first, and then go back and enter data in each row.

## Deleting Ground-cover Observations

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Ground plots** under the stand, and then click **observations**.
4. Select the row that contains the observation to delete.
5. Click the **Delete observation** button.
6. Click **Yes** to confirm the deletion.

## WOODY DEBRIS TRANSECTS

### What Is Coarse Woody Debris?

Coarse woody debris (CWD) is comprised of large woody material on the forest floor. Large, fallen trees in various stages of decay contribute much-needed diversity to terrestrial and aquatic habitats (Maser and Trappe 1984). Snags—standing dead trees—also are important components of forests. Snags are recorded separately from CWD in NED-2. To evaluate the abundance of snags, you should record standing dead trees in your overstory tally and obtain reports on the contribution of standing dead trees in your inventory.

You record CWD data along a linear transect, typically in between successive plots along your cruise. The CWD transect allows you to record data on slash piles as well as individual fallen trees. CWD includes downed logs with a diameter of at least 3 inches and a length of at least 3 feet. NED-2 uses CWD observations to calculate volume per acre of down woody debris (Howard and Ward 1972).

### Adding Transects

A transect can be added to an existing cluster, thereby altering the predefined cluster:transect ratio, or you can add a transect when establishing a new cluster. At the time the cluster is created, NED-2 automatically creates the number of transects as designated in your inventory settings.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Transects** under the stand.
4. In the Work Pane, click the **Add new transect** button.
5. Click **Create a new cluster** on the New Plot dialog if you want NED-2 to establish a new cluster with all of its associated plots, or click **Create a single transect in an existing cluster** if you want to put an additional transect in an existing cluster.
6. Click **OK**.

### Deleting Transects

You may delete one or even all transects in any given cluster. When deleting a transect, all of its observations are also deleted. If you have observations in the transect, NED-2 prompts you for confirmation. Otherwise, no prompt is given and the transect is deleted immediately.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Transects** under the stand.
4. In the Work Pane, select the row of the plot to delete.
5. In the Work Pane, click the **Delete transect** button.
6. Click **Yes** if prompted to confirm the deletion.

## Adding Transect Observations

When starting out with an empty transect, you need to specify to which transect the observation belongs.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Transects** under the stand, and then click **observations**.
4. In the Work Pane, click the **Add new observation** button.
5. If you have established only one transect in a given cluster, each time you click **Add new observation** a new row is inserted in the observations table. No further action is required.
6. Typically more than one transect per cluster exists, and NED-2 asks you to choose a transect where the new observation belongs. Select a transect from the Choose transect for new observation dialog.
7. Click **OK**.

**Shortcut recommendation:** Once you have an observation in a transect, you can quickly add another observation by using the Insert New Record shortcut (Ctrl+Enter) described in the “Data Entry Shortcuts” topic. When you apply this shortcut, NED-2 automatically inserts a new observation *below* the current row. Thus, you can select a given observation in any transect and quickly add a new observation. As you hold down the Ctrl key, if you press the Enter key more than once, NED-2 continues to add new observations until you stop. If desired and the number of observations in a transect is known, you can create all of the new observations first, and then go back and enter data in each row.

## Deleting Transect Observations

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Transects** under the stand, and then click **observations**.
4. Select the row that contains the observation to delete.
5. Click the **Delete observation** button.
6. Click **Yes** to confirm the deletion.

## BUILDINGS IN THE WILDLAND URBAN INTERFACE (FIRE RISK)

### Adding Buildings

It is becoming increasingly important to understand the risks associated with fire in the wildland-urban interface (WUI). Along with your forest inventory data, NED-2 uses the data on buildings to evaluate the potential risk to buildings from forest fires. You can record information on the site layout and general construction of existing buildings within a stand.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Buildings** under the stand.
4. In the Work Pane, click the **Add new building** button.

## Deleting Buildings

Deleting a building is straightforward in NED-2.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Click **Buildings** under the stand.
4. In the Work Pane, select the row of the building to delete.
5. Click the **Delete building** button.
6. Click **Yes** to confirm the deletion.

## Estimating Average Shrub Height

The height of the understory plants is, in part, a measure of fuel load and how fires behave and spread. If you want to evaluate fire risk to buildings in a given stand, NED-2 requires information on the height of the understory vegetation. A quick way to do this is to indicate the average shrub height in your understory plots.

Average shrub height is an ocular estimate of the average height of all plants (woody and herbaceous) between 3-10 feet tall. The value entered must be a number between 3 and 10 feet. You can record this value in either the understory or the ground-cover plots. However, if these plot types are nested in your cruise design, you do not need to record average shrub height in both plot types. If you are collecting actual stem heights in the understory and/or ground cover, NED-2 can calculate average shrub height.

## PLANT SPECIES ATTRIBUTES

### About Species Management in NED-2

NED-2 provides several features for the management of plant species information. From approximately 29,000 species (including mosses and lichens), one or more lists of plants may be established for your local sites. Each species has several characteristics that can be modified as necessary. NED-2 uses many of these characteristics in evaluating goals and in producing reports. Species identified as trees (growth form = "tree") can also have timber pricing information. You can record species using any of six possible identifiers such as species codes and names.

When you begin with a new, empty file, it may appear that NED-2 does not know any plant species. A single, master list of 29,000 species is stored in an external database installed with the software, and NED-2 uses this database to locate species that are not already defined in the current NED-2 file. Known species comprise what NED-2 defines as the "short list" of species. Unlike the master list of species, species on the short list are kept with (stored in) the NED-2 data file.

NOTE: A species *must* be in the short list in order to use it in your inventory, or to view or modify any plant characteristics.

The short list of species can be established ahead of time—prior to data entry, either by manually adding them one by one, by selecting all the species in one or more states, or by importing an

existing list from other NED-2 files. It is worthwhile to define a set of species that you expect to include, and it is acceptable to include additional species than may occur within the current inventory data. By defining a comprehensive set of species before entering data, you can speed up data entry by reducing interruptions associated with unknown species. The short list also can be built while entering data from an inventory.

Each time you start out with a new, empty data file, NED-2 starts with an empty list of species, and they will need to be redefined in the short list again. However, as an alternative to defining a short list over and over again, you can store and retrieve as well as import species information, and thus quickly re-establish a short list.

## Recording Plant Species

NED-2 provides several ways to record or identify species through a set of codes, labels, and names. Thus, six ways exist to identify a species in the inventory data. Only the user code and the user label are editable.

Any of these identifiers except the FIA survey code can be selected as the preferred way for displaying species throughout NED-2. For example, you might prefer to display the common name for readability, but you could enter the species using a simpler (shorter) user code.

NED-2 automatically interprets or “knows” a species by the USDA PLANTS code, FIA survey code, Latin name, and common name. No requirement for defining custom codes exists unless you intend to use them (recommended).

Regardless of the identifier that you enter for a species during data entry, NED-2 stores the USDA PLANTS code for the observation. NED-2 uses this code to minimize errors in species interpretations and to ensure compatibility with future versions of NED.

In addition to the following four codes, NED-2 supplies the Latin name and common name from the PLANTS database for each species:

**USDA PLANTS code** - Often called the “PLANTS” symbol, this code contains the first two letters of the genus and the first two letters of the species, followed by a number if there are other plants that have similar genus and species abbreviations. This code is not editable because it is maintained in the PLANTS database developed by the USDA Natural Resources Conservation Service for every species found in North America (native or exotic). Even though NED-2 readily interprets these codes, NED-2 treats these codes as unknown species and prompts you to add the given species to the short list if it is “new” to the file. You may note that the common name used by NED-2 is not necessarily the one you use, but it is the preferred name from the PLANTS database.

**FIA code** - This code was formerly used by the Forest Inventory and Analysis (FIA) group of the U.S. Forest Service for various inventory efforts. Most of these codes were applied to woody species, and therefore you may not find many FIA codes for herbaceous species. Even though NED-2 readily interprets these codes, NED-2 treats these codes as unknown species and prompts you to add the given species to the short list if it is “new” to the file. Not all

regions applied identical FIA codes for all species. Please check that the FIA codes you intend to use are the same as those in the list. You cannot display the FIA code when viewing plant species information. However, the FIA code may be seen in the user code, where it may serve as substitute whenever a user code has not been defined.

**User code** - This is a custom user-defined code that can be any combination of alphanumeric characters. Establishing your user codes before collecting or entering data makes it easier to apply them consistently in the field and during data entry. If you were to apply a user code for a given species throughout data entry, and if it were necessary to change that user code later, none of the previous entries for species in the data would be lost because NED-2 only stores the USDA PLANTS code for a given species. Furthermore, within the inventory data, NED-2 only displays the current user code and not any previously used codes for a given species. User codes must be unique—that is, no two species can share a user code. User codes are associated with species in the current data file only.

**User label** - This is essentially a custom user-defined label that is free from any of the restrictions placed on the other codes described above. Use this label if you want to apply the same code to more than one species. By default, the user label matches the common name. If you want to apply a common name that is different from the built-in NED-2 common name, the user label is an appropriate way to establish a substitute. For example, for the species *Liriodendron tulipifera*, the NED-2 common name is “tuliptree.” If you prefer to use “yellow poplar,” enter that for the user label, and if desired, set the species display to user label. User labels are associated with species in the current data file only.

## Modifying Species Characteristics

Species characteristics play a key role in the outcome of goal analyses and reports. The entire set of attributes is split into general plant characteristics and tree-only or timber-oriented characteristics. Species characteristics are maintained in the plant species module.

1. In the Navigation Pane, click **Inventory**.
  2. Click **Plant Species Information**.
- To display biological, taxonomic, and ecological properties, in the Options Pane click **General information**. The entire short list is displayed in the Work Pane.
  - To display timber-oriented information, in the Options Pane, click **Tree species**. Only the tree species are displayed in the Work Pane. Click the **Configure** button, and on the Select variables dialog, click the **Timber prices** button if you only want to display timber price variables for the species. As an alternative, you can use the Quick Set feature to set timber prices for multiple species simultaneously.

When you are working with a particular species, you can jump back and forth between the “General” and “Timber-oriented” set of characteristics. NED-2 scrolls up or down to bring the species into view and highlight it for you. Since NED-2 allows you to display different characteristics in each of these views, and to sort them differently as well, this “auto-find” makes it easy to jump back and forth without having to relocate the species each time.

**Dialog-based species modification**—If you prefer to view and modify *all characteristics* (general and timber-oriented) for a given species at once, double-click in any of the gray-colored columns to bring up the Plant Species dialog. Through this dialog, you can view the entire set of attributes and modify them as desired. You can do this from either the General or the Tree species views of species.

## THE PLANT SPECIES SHORT-LIST

### Viewing Current Species Short List

A short list is the set of species known within the active (open) file. All of your custom species codes and characteristics are stored in the short list. When you create a new, empty data file, the short list is always empty.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane, click **General information**, if not already selected. The short list is displayed in the Work Pane in the right side of the NED-2 window. In the top-right corner of the Work Pane, next to the Configure button, the total number of species in the short list is displayed.

To display only those species that have been used in the inventory, in the upper-left corner of the Work Pane, check the **Inventoried species only** box.

### Sorting Species in the Short-List Display

The short list can be sorted by any of the characteristics being displayed. To sort, right-click in the header cell of the characteristic by which you wish to sort. Select ascending or descending order.

In the top-right corner of the NED-2 window, click the **Configure** button to choose the items and their order to display.

### Adding Species to the Short List Manually

You may search manually for one or more species and add them to the short list as needed. These instructions apply when you may already have a large short list, but realize that you need to add one more.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane in the left side of the NED-2 window, click the **Modify species list** button.
4. In the search string box, enter any number of characters that match the desired species. You can search by Latin or common name, regardless of how the list is sorted or displayed.
5. Select the species on the left-hand side of the Select species dialog, and click the **single right-pointing arrow**. You can add multiple species simultaneously using this approach.

## Adding Short-List Species During Data Entry

If you are starting out with a new, empty NED-2 data file, you may begin recording data without defining a short list of species beforehand. This process is sometimes referred to as “defining species on-the-fly.”

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, select a stand.
3. Choose the plot type that contains the type of observation you are using.
4. Add a new observation, if necessary.
5. To record the species of a given observation, find the species field and enter a species code or other form of identification that you wish to use to identify the given species.
6. Regardless of what you enter, if the species is not already in your short list, NED-2 tells you that it is not listed, and then it attempts to guess the species. If NED-2 makes the correct guess, click **Add above species to the short list** and continue entering your data. No further action is required. You can continue to use the same code throughout your inventory and NED-2 will know the species.
7. If the species is unknown, or if NED-2 guessed the wrong species, click Search the master list to find the correct species.
8. Notice the value you entered in the species field is shown under Code at the top of the Select species dialog.
9. Select whether you want to search by Latin or common name.
10. Enter search criteria in the Search string box and click **Search**. View the list of species for a possible match. Repeat this process as necessary.
11. Place a check mark next to the species that is the best match.
12. Click **OK** when finished.

Within a given file, NED-2 only attempts to prompt you with a new species once—the first time you try to record it from an inventory.

If you build the short list by defining species as you encounter them during data entry, the short list should match all of the species found in the overstory, understory, ground-cover, and CWD data of the current NED-2 file.

## Removing Species from the Short List

The following steps describe how to remove one or more species from the short list of a given NED-2 file.

NOTE: You cannot remove a species from the short list if it has been used anywhere in the data. Therefore, you must either replace the species of the affected observations, or delete those observations.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane in the left side of the NED-2 window, click the **Modify species list** button.
4. Select the species on the right-hand side of the Select species dialog, and click the **single left-pointing arrow**. Only one species can be removed at a time with this method. To remove all species at once, click the **double left-pointing arrows**.
5. Click **OK**.

## Importing Species from Other Files

You may establish a short list of plant species by importing species from existing NED-2 files. The instructions are essentially the same for all file sources or types. However, NED-1 species follow a different format and may require user intervention to import properly. Refer to the next topic on “Matching NED-1 Species in NED-2” for further instructions.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane of the lower-left corner of the NED-2 window, click the **Retrieve** button. The Retrieve species information dialog opens.
4. Click **File** to pick a file for retrieving species.
5. From the Open dialog, choose from one of the following sources under **Files of type**: NED-2 data files, SILVAH data files, NED-1 data files, NED/SIPS user data files, NED-2 plant species files, or NED-1 plant species files.
6. Browse and select the desired file, and click **Open**.
7. In the left-side box in the Retrieve species information dialog, select the species to import.
8. In the right-side box in the Retrieve Species Information dialog, select plant characteristics and/or pricing information to retrieve for each species.
9. Click **OK** when finished.
10. When you import species, you must choose from one of the import options as shown in the Import options dialog. For instance, you can completely replace the existing list with the incoming species, or you can replace existing species if certain conditions are met, and so on. If you are working with a new, empty NED-2 file, then no further action is necessary when you import species.
11. Select an option and click **OK** to import the species.

If desired, you can import species from more than one NED-2 file. When doing so, be sure to review the import options in the instructions referred to in step 10.

## Matching NED-1 Species in NED-2

If you are importing NED-1 data files, individual NED-1 stands, or NED-1 plant species information, you will need to carefully review incoming NED-1 species to ensure that they are interpreted correctly. NED-1 species follow a different format and may require user intervention to import properly. Duplicate species entries are permitted in NED-1 files, which adds to the difficulty of correctly identifying species.

When you are importing anything from NED-1, the process stops until you confirm the incoming NED-1 species as described here.

You are presented with a dialog that displays how well NED-2 was able to match your old NED-1 species, as shown in Figure 7.

On the dialog that appears, you can change the order of the species by clicking once in any of the column headers in the table. For instance, to group all species together by strength of match, click the unlabeled center column. The dialog lists the plant species found in the selected NED-1 file on the left, and the counterparts from the current NED-2 master list of species on the right.

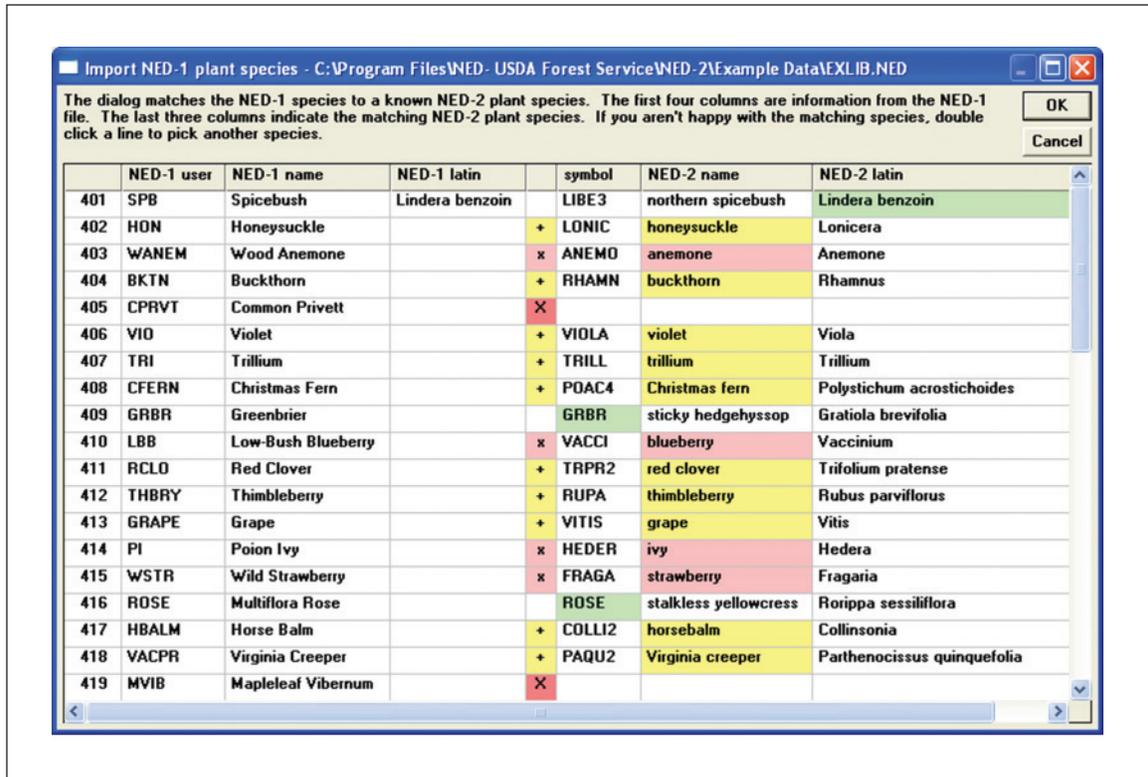


Figure 7. NED-1 species matches in NED-2.

If a good match was found, one of the last three columns on the right is shaded green to indicate how the match was made. For instance, if the Latin name is highlighted, the program successfully found a matching Latin name. The program checks Latin names first and if no match exists, the common name is checked. The center column indicates the strength or degree of confidence in each match, as follows:

X	No match could be found
x	A match was found, but not a very good one
+	A match was found that was pretty close.
•	A synonym of the Latin name was found. This can usually be left alone.
	(empty) A very good match was found.

Exact spelling is required for a match. Any line that has a red center cell (with either a lower or upper case “X”) should be corrected if possible. Anything with yellow or green (with a “+” or “•”) is probably okay and can be left alone. A blank cell indicates a good match was found. Typically, problems may occur when importing NED-1 species, even if it looks like perfect matches have been made. Be sure to check the validity of each match, regardless of color or strength of match. Despite the indication of a “very good” match for a species, it may be incorrect. Note that a misspelled entry in NED-1 usually cannot be matched automatically by NED-2.

Matches with a dark red center column, indicated with an upper case “X”, will *not* be imported. All other matches, including pink cells indicated with a lower case “x”, *will* be imported. For all matches, only the NED-1 user code (shown as “NED-1 user” in the first column) is retained—the program applies the current (NED-2) Latin and common name shown in the columns to the right.

The column on the far left displays the NED-1 species index. This code is *not* an FIA code or any other kind of species code—it is a plain, numerical index used by NED-1 to isolate individual entries in the file.

**Correcting or changing a NED-1 species match:** You may change any of the matches if they are not what you desire.

1. Double-click a row of any species (see Figure 7) and the Plant species identification dialog appears, allowing you to correct the identity of a NED-1 species using the species codes program. The top of the dialog displays the species information from the NED-1 file, and the bottom of the dialog displays the suggested or current matching information. An explanation in the top-left corner of the dialog describes how the match was made.
2. Click the **Pick a new species** button to change a match. The Select species dialog opens, allowing you to search for the correct species. The top of the dialog displays the information from the NED-1 file. The list box contains all of the current species in the NED-2 master list. Search by Latin or common names.
3. Place a check by the desired species.
4. Click **OK** to return to the dialog showing all species matches, as shown in Figure 7.
5. Repeat this process until you are finished correcting all matches. At this point, ideally the dialog has mostly green or white matches, and possibly some yellow matches.
6. Click **OK** when satisfied with all the matches. Continue importing NED-1 data.

## Establishing Species from One or More States

You can build a short list of species quickly by establishing the list using all species known to occur in one or more states.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane in the left side of the NED-2 window, click **General information**, if it is not already selected, to make sure all species in the current short list are displayed.
4. In the Options Pane, click the **Modify species list** button.
5. On the Select species dialog, click the **Get state list** button.
6. From the map of the United States, double-click one or more states of interest. More options are available if you click the **select states by name** button. Your selected states are highlighted on the map. Click **OK** on the map of states to return to the Modify species dialog.
7. To include moss or lichen species, check the appropriate box next to **Include**. Mosses and lichens currently are *not* associated with any geographic area. Therefore, you will get all North American species if you select these.
8. From the list of species in the left box, select one or more entries. Then click the **single right-pointing arrow** to add them to the display. If you want to display every species on the left, click the **double right-pointing arrows**. You can also double-click a species on the left to add it to the display.
9. Click **OK**.

## Exporting Species for Sharing and Re-Use

It is useful to store one or more short lists of species into separate files for future use. These exported lists contain only plant species information (identification, plant characteristics, timber prices, and volume parameters), and can be directly imported into NED-2, as needed. Thus, once you export a species list, a short list can be quickly defined in NED-2 by importing species from an existing species file.

If you need to share your species information with other users, but do not wish to share the inventory data, exporting is the best option.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. From the lower-left corner of the NED-2 window, click **Store** to bring up the Store species info dialog.
4. To choose the species that you wish to store, in the box on the left side of the Store species info dialog, place a check mark next to each species to store. Click **select all** to store *all* species.
5. To choose the information about each species that you wish to store, in the box on the right in the Store species info dialog, place a check mark next to each value to store. Click **select all** to store *all* values.
6. To specify a file name, click the **File** button to choose a file. From the Save As dialog, specify a location and file to save your species information. If you select an existing file, you are asked if you want to overwrite (replace) the contents. If you click **Yes**, the file is overwritten. Thus, you cannot combine species and characteristics with a set of species that were exported earlier.

The resulting file has an .spp2 extension. This file can be imported into NED-2 at any time when needed, such as when you want to quickly establish a short list of species, import timber prices, and so on.

## Using a Template NED-2 File

A template NED-2 file is a file that typically would contain no real inventory data but has a short list of plant species, timber prices, and other characteristics. The idea of establishing a template file is to re-use or re-apply information repeatedly to save time whenever you want to start a new file.

1. Open or create a NED-2 file. Once you have a species short list, timber prices, and so on, you are ready to establish a template file.
2. From the File menu, click **Save As**.
3. From the Save As dialog, specify a location and name of your template file.
4. If you have inventory data in the file, after you are sure you have saved a copy of the file and are working with the template file, delete stands or other definitions that you do not wish to retain in the template file.
5. Save the file.
6. When you are ready to start a new NED-2 file, instead of creating a new file from scratch, open your template file.
7. From the File menu, click **Save As** to create a file with a new name. Before entering new data, the new file contains all the same information that exists in the template file. Then, you can enter your data in the new file and leave the original template unchanged. Be sure not to skip this step to ensure that the template file is preserved.

## DEFINING YOUR OWN SPECIES CODES

### Species User Codes

This is a custom user-defined code that can be any combination of alphanumeric characters to identify a species. Establishing user codes before collecting and entering data makes it easier to apply them consistently in the field and during data entry. You may use custom user-defined codes for any species that is in the master list of 29,000 species known to NED-2.

If you were to apply a user code for a given species throughout data entry, and later you needed to change it to something else, the previous species entries in the data would automatically be changed to the new user code. Thus, you can change a user code in the future and lose no species identifications because NED-2 stores the USDA PLANTS code for a given species. Furthermore, NED-2 only displays the current user code and not any previously used codes for a given species.

User codes must be unique—that is, no two species can share a user code. Empty (null) values are accepted and not treated as duplicates.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane of the NED-2 window, click **General information**, if it is not already selected, to display the short list of species in the Work Pane.
4. Find the column titled User code. If it is not displayed, click the **Configure** button to display the User code column.
5. Enter a desired user code in the user code column for a given species.

### Species Labels

This is essentially a custom user-defined label that is free from any of the restrictions placed on the other codes described in the previous section. Use this label to apply the same identifier to more than one species.

By default, the initial user label for any species is the same as the common name.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane of the NED-2 window, click **General information**, if it is not already selected, to display the short list of species in the Work Pane.
4. Find the column titled **Label**. If it is not displayed, click the **Configure** button to display the user label column.
5. Enter a desired user label in the **Label** column for a given species.

If you want to apply a common name that is different from the built-in NED-2 common name, the user label is an appropriate way to establish a substitute. For example, for the species *Liriodendron tulipifera*, the NED-2 common name is “tuliptree.” If you prefer to use “yellow-poplar,” enter it for the user label, and if desired, set the species display to User Label. User labels are associated with species in the current data file only.

## ENTERING TIMBER INFORMATION

### About Quick-Set Prices

The purpose of the Quick-set Prices feature is to provide an efficient way to establish timber prices for your species. While you can directly modify timber prices for any species in the Work Pane (if you select Tree species in the Options Pane), with the quick-set feature you can establish pricing information for one or more species at a time, and you can also copy pricing information from one species to another.

You may choose to set prices for only specific products while leaving other products alone.

Even if you have specific prices for separate species, you can use the quick-set feature to establish “base” or common prices that most species share. Then modify the prices for individual species as desired.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane, click **Tree species** to view all timber-oriented species in the current short list.
4. In the Work Pane, click the **Quick-set Prices** button near the top.

### Establishing Prices for a Specific Product

You may set prices for a given product for one, several, or all species at once. For instance, you may want to specify prices for grade 2 sawtimber, pulpwood, and so on.

1. In the Navigation Pane, click **Inventory** to access the Quick-set Prices feature.
2. Click **Plant Species Information**.
3. In the Options Pane, click **Tree species** to view all timber-oriented species in the current short list.
4. In the Work Pane, click the **Quick-set Prices** button near the top.
5. In the box on the left side, enter the price for the specific product.
6. In the box on the right side, select which species to apply the price(s) entered in step 5.
7. Click **Apply** to accept the changes and continue working on other prices or species.
8. When finished, click **OK**.

### Copying Pricing Information to Another Species

You may use the Quick-set Prices feature to copy pricing information from one species to another, or to several species at a time.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options Pane, click **Tree species** to view all timber-oriented species in the current short list.
4. Establish pricing information for a given species that you wish to copy from. If you already have pricing information that you want to copy, skip to step 5.

5. In the Work Pane, click the **Quick-set Prices** button near the top.
6. In the Set Timber Prices dialog, locate the species you wish to copy pricing information *from*. Place a check mark next to that species.
7. Click the **retrieve prices from highlighted species** button. The price information appears in the top-left corner of the Set Timber Prices dialog.
8. Check all species on the right side of the dialog into which you wish to copy pricing information.
9. Click **Apply** to accept the changes and continue.
10. Click **OK** to close the Set Timber Prices dialog. When you close the Set Timber Prices dialog, pricing information is copied to the selected species.

## Pulpwood Price Units

There are several ways you can work with pulpwood values in NED-2.

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options pane, click **Tree species** to view all timber-oriented species in the current short list.
4. In the Work Pane, click the **Pulpwood price settings** button near the top. You can also set these values when using the Quick-set Prices feature.
5. Choose from dollars per ton, dollars per cord, dollars per cubic foot, or dollars per cunit (100 cubic feet).
6. Click **OK**.

## Cubic Feet Per Cord

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options pane, click **Tree species** to view all timber-oriented species in the current short list.
4. In the Work Pane, click the **Pulpwood price settings** button near the top. You can also set this value when using the Quick-set Prices feature.
5. Enter the conversion factor for cubic feet per cord. All species inherit this value.
6. Click **OK**.

You may modify the conversion factor for any single species, if desired. However, this must be done in the Tree Species displayed in the Work Pane in the right side of the NED-2 window.

## Tons Per Cord

1. In the Navigation Pane, click **Inventory**.
2. Click **Plant Species Information**.
3. In the Options pane, click **Tree species** to view all timber-oriented species in the current short list.
4. In the Work Pane, click the **Pulpwood price settings** button near the top. You can also set this value when using the Quick-set Prices feature.
5. Enter the conversion factor for tons per cord. All species inherit this value.
6. Click **OK**.

You may modify the conversion factor for any single species, if desired. However, this must be done in the Tree Species displayed in the Work Pane.

## IMPORTING DATA

### About Importing Data

Data from almost any source can be imported into NED-2. NED-2 can directly import data in a few simple steps from SILVAH, NED-1, NED/SIPS, and the Forest Vegetation Simulator (FVS). For instructions on how to import from these sources, refer to the topic on “Importing Stands into NED-2” in the Data Entry and Manipulation section. Special considerations that apply to these sources are covered in this section.

For other data sources, such as Microsoft Excel, an initial data mapping and conversion process is required before importing the data into NED-2. This process may require considerable user intervention and is discussed under the “Importing Data from Other Sources” section.

NEDLite data can also be imported into NED-2. NEDLite users should consult the *NEDLite User's Manual* (Knopp and Twery 2006) for an explanation of this process.

### Converting NED-1 Files

1. On the Tools menu, click **Convert NED-1 File**.
2. Click the **Input file** button. Browse and select the desired file, and click **Open**.
3. Click the **Output file** button. Enter the name of the NED-2 file to create from a NED-1 file, or browse and select the desired file, and click **Open**.
4. Click **Start**. The program tries to load information on goals, variables, and plant species from the NED-1 file. Then it attempts to match NED-1 plant species with those in NED-2.
5. Review the matches for plant species. NED-1 maintained a list of mostly tree species, while NED-2 maintains a complete list of vascular plant species. If your NED-1 data contained only the NED-1 standard species, the screen is nearly blank and the matches may be fine. Refer to the topic on “Matching NED-1 Species in NED-2” in the Plant Species Attributes section for further instructions.
6. If you are satisfied with the species matches, click **OK**.
7. Check for possible errors. Occasionally errors may occur in the process, and these are listed in the main window of the dialog. Most likely the errors involve unknown species. Click **Store errors in a log file** to output errors into a plain text file readable by Notepad or other word processors.
8. Click **Save data** to start the import process. If you do not want to proceed, click **Stop now**. You may want to stop the process to fix any reported errors.
9. When the process is finished, click **Quit** to close the ned2mdb dialog.
10. To view the results, open the resulting output file in NED-2.

### Importing SILVAH Data

SILVAH data can be imported into NED-2 as long as it is accompanied by the appropriate SILVAH defaults file (.def) that contains species identification codes and pricing information, among other species details. Without a SILVAH .def file, you are not able to import SILVAH data into NED-2.

SILVAH data is imported one stand at a time. Refer to the topic on “Importing Stands in NED-2” in the Data Entry and Manipulation section for instructions.

Most of the SILVAH stand information is imported, with the exception of the following:

**Stand-level variables in SILVAH that will not be imported into NED-2:**

- Site class
- Silvicultural system
- Management value
- Prescription charts to follow
- Intend to regenerate
- Increase oak
- Residuals desired
- Aquatic features in the stand
- Clearcut acreage
- Open acreage
- Cultivated acreage
- Aquatic features within one mile

Overstory data from SILVAH is imported directly into NED-2 without any alterations. However, the following few exceptions exist:

**Merchantable Height** - If the SILVAH tree data contains estimates of merchantable height for each tree, the incoming number of 8-foot bolts is multiplied by 8.0 to produce the sawtimber height for the tree in NED-2. SILVAH does not provide space for you to enter pulpwood height nor does it store it in the data file—instead SILVAH calculates pulp height, so pulpwood height is not an issue. NED-2 calculates pulpwood height above the sawtimber portion of the tree.

**Live/Dead** - In SILVAH, a dead tree is recorded under timber quality (DEAD), and the tree is recorded as dead in the “live/dead” variable in NED, otherwise the tree is assumed to be alive.

**Timber Product** - The timber product assigned in SILVAH is recorded in NED-2 as the Most Valuable Product of a given tree.

**Timber Quality of Borderline Trees Observed Using a Prism** - In SILVAH, trees recorded with a prism occasionally appear as borderline trees when they have a diameter that places them almost out of reach of the prism. Such trees occur when the distance from the sampling point to the tree center is exactly equal to tree diameter at breast height times the plot radius factor (Avery and Burkhart 1994). In SILVAH, borderline trees are recorded by adding 5 to the timber quality rating, and are counted as half when the data is analyzed. These trees are imported into NED-2 as whole trees because NED-2 does not have a provision for handling borderline trees.

**Timber Defect** - In SILVAH, if defect is 20 percent, it is recorded as a “2.” In NED-2, this value is multiplied times 10. SILVAH only records defect for the entire tree, so the SILVAH value is duplicated in NED-2 for both sawtimber and pulpwood defect. Thus, the value of “20” derived from SILVAH defect is recorded as 20 in NED-2 sawtimber defect and 20 in NED-2 pulpwood defect.

**Crown Condition** - SILVAH uses four codes for crown condition, which are converted into Percent of Crown Living in NED-2, using the midpoint of each range:

- Category 1 – Healthy - Living Crown  $\geq$  90%
- Category 2 – Good - Living Crown  $\geq$  75% and  $<$  90%
- Category 3 – Fair - Living Crown  $\geq$  50% and  $<$  75%
- Category 4 – Poor - Living Crown  $<$  50%

**Wildlife Tree Codes** - If wildlife information has been recorded for at least one tree, then NED-2 automatically creates a user-defined custom variable called “wildlife” if it does not already exist. This becomes Custom Variable 3 if no other custom variables have been already established. The potential wildlife values of a tree were coded in SILVAH as follows:

- Category 1 – Potential den tree
- Category 2 – Existing den tree
- Category 3 – Snag with potential cavities
- Category 4 – Snag tree with existing den

All SILVAH understory data is imported into the NED-2 ground-cover plot. The understory plot of NED-2 is unused.

When importing SILVAH understory data, NED-2 automatically establishes user-defined custom variables for SILVAH-specific variables such as residuals and saplings, and creates several height classes (see Tables 1 and 2).

**Table 1. Oak regeneration height classes.**

SILVAH Oak Seedling Size	NED-2 Height Class	Definition
New oak	Tiny seedlings	0-6 in.
Established oak	Med seedlings	6 in. - 3 ft
Competitive oak	Large seedlings	3-10 ft <sup>a</sup>

<sup>a</sup> Competitive oak is potentially taller in the field but within this range in NED-2.

**Table 2. Woody interference height classes.**

Type of Woody Interference	NED-2 Height Class	Definition
Tall woody seedlings and saplings	Tall woody	$>$ 10 ft <sup>a</sup>
Low woody seedlings and shrubs	Med seedlings	6 in. - 3 ft <sup>b</sup>

<sup>a</sup> The height of the dominant woody interfering species in the 6-foot regeneration plot, consisting of woody plants taller than 10 feet (approximately the height of the observer in the field, but 10 feet in NED-2).

<sup>b</sup> The percent cover of woody interfering species  $<$  10 feet in the 26-foot interference plot (less than the height of the observer in the field, but  $<$  10 feet in NED-2). NED-2 uses “med seedlings” as an approximation of height for low woody interference.

For each understory plot in SILVAH, the following regeneration tally variables are handled as follows:

**Black Cherry Regeneration** - Where black cherry seedlings are present ( $> 0$ ), the count of black cherry seedlings is entered into a single observation in a corresponding NED-2 ground plot, using black cherry as the species. Black cherry seedlings are placed into the “tiny seedlings” height class established for SILVAH data in NED-2.

**Yellow-poplar Regeneration** - Where yellow-poplar seedlings are present ( $> 0$ ), the count of yellow-poplar seedlings is entered into a single observation in a corresponding NED-2 ground plot, using yellow-poplar as the species. Yellow-poplar seedlings are placed into the “tiny seedlings” height class established for SILVAH data in NED-2.

**Conifer Regeneration** - Where conifer seedlings are present ( $> 0$ ), the count of conifer seedlings is entered into a single observation in a corresponding NED-2 ground plot, using “unidentified Tree - needleleaf coniferous” as the species. Conifer seedlings are placed into the “tiny seedlings” height class established for SILVAH data in NED-2.

**Other Desirable Regeneration** - Where other desirable seedlings are present ( $> 0$ ), the count of other desirable seedlings is entered into a single observation in a corresponding NED-2 ground plot, using “unidentified high value” as the species. Other desirable seedlings are placed into the “tiny seedlings” height class established for SILVAH data in NED-2.

**Residuals** - Where a residual species has been identified, an observation is created in a corresponding NED-2 ground plot, with the same species as identified in SILVAH, and a count of 1.0. No height class is applied. If it does not already exist, a custom variable is created (Custom Variable 1, if it is available) called “Residual,” with a value of “yes” applied to the observation.

**Saplings** - Where a sapling species has been identified, an observation is created in a corresponding NED-2 ground plot, with the same species as identified in SILVAH, and a count of 1.0. No height class is applied. If it does not already exist, a custom variable is created (Custom Variable 2, if it is available) called “sapling,” with a value of “yes” applied to the observation.

**Tall Woody Interference** - Where tall woody interference has been identified, an observation is created in a corresponding NED-2 ground plot, with the same species as identified in SILVAH, and a count of 1.0. The height class is set to “tall woody” as identified in Table 2.

**Low Woody Interference** - Where low woody interference has been identified, an observation is created in a corresponding NED-2 ground plot, with the same species as identified in SILVAH, and a count of 1.0. The height class is set to “med seedling” as identified in Table 2. The percent cover is entered as the same value from SILVAH.

**Percent Grass and Sedge** - Where grass and sedge cover is  $> 0$ , the cover value is imported into a matching ground plot variable in NED-2, associated at the ground plot level and not with any observation.

**Percent Fern** - Where fern cover is  $> 0$ , the cover value is imported into the “inhibiting fern” plot variable in NED-2, associated at the ground plot level and not with any observation.

**Thick Duff** - This variable is not imported into NED-2.

**Rocky Surface** - Where a rocky surface is present, a value of “yes” is imported into the “Rockiness barrier to regen” (too rocky) variable of NED-2, associated at the ground plot level and not with any observation.

**Poor Drainage** - Where poor drainage is present, a value of “yes” is imported into the “Wetness barrier to regen” (too wet) variable of NED-2, associated at the ground plot level and not with any observation.

## Importing NED/SIPS Data

NED/SIPS data can be imported directly into NED-2. Refer to the topic on “Importing Stands” in the Data Entry and Manipulation section for instructions.

If you have NED/SIPS plant species mnemonic codes or volume and value specifications, such as timber pricing, refer to the topic “Importing Species from Other Files” in the Plant Species Attributes section.

## IMPORTING DATA FROM OTHER SOURCES

### About Other Data Sources

NED-2 provides a single approach by which data from almost any source can be imported—relying on an open, standard, text (ASCII) file format. Through this approach, NED-2 can import data from a variety of programs—provided that these programs have a mechanism for converting or exporting their data into text format.

The process of importing data from other sources involves several steps, divided into two major parts. Part 1 involves the most time and effort. If you carefully consider all of the steps in Part 1, you significantly increase your chance of success. This part provides tips on how to get your data ready for the conversion process. This part teaches you about **txt2mdbSetup**, an auxiliary program for describing your data to NED-2 by matching your variables with appropriate NED-2 variables. The result of Part 1 is a definitions file (ending with **.ini**), that “describes” each of your variables for NED-2. The **.ini** file must be used when importing your data into NED-2, as described in Part 2. Part 2 teaches you about **txt2mdb**, a second auxiliary program that uses the **.ini** file from Part 1 to import your text data into NED-2.

When importing data from other sources, a new NED-2 file is created. Data from other sources cannot be imported into an *existing* NED-2 file. It is possible to merge two NED-2 files in a later step, once the data has been converted into a NED-2 file.

The following outline provides an overview of the general steps involved in the process of importing other data into NED-2:

1. Organize your data.
2. Choose your data files.
3. View your data.
4. Match your variables with NED-2 variables.
5. Save your definitions.
6. Import your data.

To get familiar with the variables defined in NED-2, see the *NED-2 Reference Guide* (Twery et al. 2011), Appendix B, which may be helpful in determining the NED-2 variables that are the best match for your variables.

## Part 1 - Define Your Data

### Tips for Organizing Your Data

Incoming data must be organized according to a few simple rules. For instance, data from one portion of your inventory must be separated from data in other portions (e.g., overstory data must be separated from regeneration data in the ground layer). The general idea is that if you do not intend to analyze relatively dissimilar portions of your inventory together, then those portions must be identified and separated. Thus, separating different portions is imperative if you wish to get valid results from NED-2.

Dissimilar portions of an inventory should be split into separate text files. Thus, overstory data are placed in one text file, and regeneration data goes in a different file. In a spreadsheet program such as Microsoft Excel, such data may occur in a series of worksheets.

Ultimately, data must be organized into a series of rows and columns. Each row represents a unique observation—a single item among many items, such as one tree observation out of many. Columns represent information collected about each item, such as species, dbh, timber quality, etc. In addition, each row must contain identification detail. For overstory data, such information includes the stand and plot. Thus, each row should repeat information for the stand ID and plot number. It is also helpful if each observation in a plot is provided with a unique ID or number though not required.

Above each column, an appropriate title or heading should be created. The first row in your data must only contain “header” information that describes the columns (i.e., field variables) for each observation. Additionally, data between (across) columns should be separated by a tab, comma, semicolon, or other symbol. Choose only one symbol and use it consistently throughout all of your text files. Tabs are automatically inserted by Excel when exporting into plain text format.

Be on the lookout for inventory data that does not provide a perfect match with a variable in NED-2. A good example is tree quality. In some systems, whether a tree is alive or dead is recorded under timber quality, along with acceptable/unacceptable growing stock. However, in NED-2, whether a tree is alive or dead is recorded separately in its own variable, and timber quality is recorded in another variable. In this example, without splitting out this information

into separate variables beforehand, you are forced to choose whether you wanted this variable to indicate either alive/dead or timber quality, but not both, since two pieces of information are included under one variable in the incoming data, and NED-2 wants to store this information in two variables.

### Instructions using Microsoft Excel:

When you are satisfied that your data is ready for import into NED-2, follow these instructions if you want to convert Excel data into plain text format.

1. Select the appropriate **worksheet**.
2. From the File menu, select **Save As**.
3. At the bottom of the Save As dialog, specify a file type of **Text (tab delimited) (.txt)**.
4. Enter the name of the file.
5. Click **Save**.

### Using the txt2mdbSetup Program

#### About the txt2mdbSetup Program

Txt2mdbSetup is an auxiliary program that reads your text data and provides tools for mapping your variables to NED-2 variables—a crucial first step in importing Excel or other data into NED-2. The mapping of your ASCII text variables to NED2 variables is stored in an .ini file (*anyfilename.ini*). The .ini file provides the interpretation of your data during the conversion process that ultimately imports your data into NED-2. On the File menu, this file is referred to as a definitions file.

It is reasonable to define a single .ini file for your overstory, understory, ground-cover, and CWD data. If you have other kinds of data that may be different, perhaps because of how it was recorded, or it contains entirely different information, then you might define that data in a separate .ini file, though this is optional.

The process of mapping your variables to NED-2 variables may take some effort. However, once the \*.ini file is created, it can be re-used repeatedly each time additional data is collected. As long as the field data is collected and organized in the same way (i.e., it follows the definitions in the .ini file), then you do *not* have to modify the .ini file, and you are able to import the data quickly into NED-2 using the original .ini file.

#### Starting txt2mdbSetup

To get started mapping your data to NED-2 variables, run the txt2mdbSetup program, by locating the shortcut titled **Setup Text File Import**, on the Start menu.

1. Open the Windows Start menu.
2. Click Programs > NED Programs > NED2 Tools.
3. Click Setup Text File Import.

### Starting a New INI File

A new .ini file is created automatically when you start the txt2mdbSetup program. The mapping process begins after you open the text files that contain your data.

If you have already begun the process of opening text files and mapping your variables, and you are ready to start a new .ini file, follow these steps:

1. At the top of the program, open the File menu.
2. Click **Create a new definitions file (ini file)**.
3. If you had unsaved changes to the current .ini file, you are prompted to save them. Click **Yes** if you want to save the changes to the current .ini file.

After you have created a new .ini file, the next step is to open your text data.

### Opening an Existing INI File

When you open an existing .ini file, the txt2mdbSetup program attempts to load your text data if you previously opened text data for the .ini file. If so, the names of your text file(s) appear as tabs in the middle of the txt2mdbSetup dialog.

1. At the top of the program, open the File menu.
2. Click **Open definitions file (ini file)**.
3. Locate the .ini file.
4. Click **Open**.
5. As an alternative, you can open the file if it appears in the recent files history. Recent files are numbered and displayed in the middle portion of the File menu. If you see the .ini file displayed in the recent history, click it to open.

Click on any of the tabs to view your text data to verify that it was loaded correctly.

### Saving the INI File

1. At the top of the program, open the File menu.
2. To save the current .ini file, click **Save the definitions file (ini file)** and proceed to step 4.
3. To save the current .ini file under a different name, click **Save the definitions in a new definitions file (ini file)**.
4. Select a file or enter a file name.
5. Click **Save**.

### Adding Notes to the INI File

You may add your own notes (comments) to the .ini file, if desired. Notes may be helpful in documenting how variables were described or how you handled exceptions. Notes do not interfere with processing and are ignored when importing data into NED-2.

To add your own note:

1. At the top of the program, open the File menu.
2. Click **Edit Notes**.
3. In the upper edit box, enter your text.
4. Click the **Add Note** button. The text appears at the bottom of the existing notes in the large box that comprises most of the notes dialog.

To delete a note:

1. To remove a note, click the line that displays the text you wish to remove from the notes.
2. Click the **Delete selected line** button.

### Viewing the INI file in a report

If you wish to view the contents of the .ini file, you can obtain a report that displays the mapping between your variables and NED-2 variables, plant species codes, and notes in an easy-to-read format.

To view the .ini file in a report:

1. At the top of the program, open the File menu.
2. Click **Generate HTML Report**.
3. Select a file or enter a file name.
4. Click **Save**. The txt2mdbSetup program creates the file and automatically displays it in your web browser.

### Opening Your Text Data

This is the first step in getting started with mapping your variables to NED-2 variables. At this point, you should have already established one or more text files that are sufficiently organized into discrete portions of your field data.

To open your text data in txt2mdbSetup:

1. Start the txt2mdbSetup program.
2. Click the **Open txt files and start a new INI file** button.
3. From the dialog, browse to the location of your data. You can select multiple text files.
4. Click **Open** when finished selecting text files.
5. Txt2mdbSetup displays each text file in a separate tab. Select any tab to begin mapping the data in the corresponding text file.

If you have already opened one or more text files, click the **File** button near the left center of the tab of any text file (do *not* click the File menu at the top, and do *not* click **File information** button beneath the **File** button). Then browse and select additional text files as in step 3 above.

When opening additional text files, if they have different data formats than those already defined in the current .ini file, txt2mdbSetup, detects the differences and then asks if you want to create a new "file type" based on these new text files. This is optional and allows you to define and map several different kinds of text files and store those definitions together in the *same* .ini file. Thus, you might only need one .ini file to import a variety of data into NED-2, even though you have several different kinds of data sets.

### Choosing How to View Your Text Data

There are three ways to view your data. The default is the **raw contents** display, where your data is simply displayed as if it were opened in Notepad or some other word processor. No attempt is made to display the data in any organized format. **Raw columns** displays your data as it would

appear in a spreadsheet as shown in Figure 8. Column headings are provided above each column, showing an improved organization. Notice in Figure 8 that specific column headers appear in green, indicating which variables you have successfully mapped to NED-2. However, the header text is *not* NED-2 names, but is the text found in the header row of the text file. To view the NED-2 variable names, select **NED values** to see the NED-2 variables appear in the column headers.

Initially, none (or very few) of your variables match any of the NED-2 variables. In this case, a bunch of tiny empty squares appear all scrunched up. This appearance changes after the first time you successfully match one of your variables.

### Identifying Delimiters in Your Data

Once you open a text file, you may need to specify which kind of character was used to distinguish one column from another. Excel uses the tab character by default, but your data may use other characters. Each text file may use a different delimiter.

1. Open your text file(s), if not open already.
2. Click the tab that displays the name of the text file for which you need to identify a delimiter.
3. Click the **File information** button.
4. From the File information dialog, select the appropriate delimiter.
5. Click **OK**.

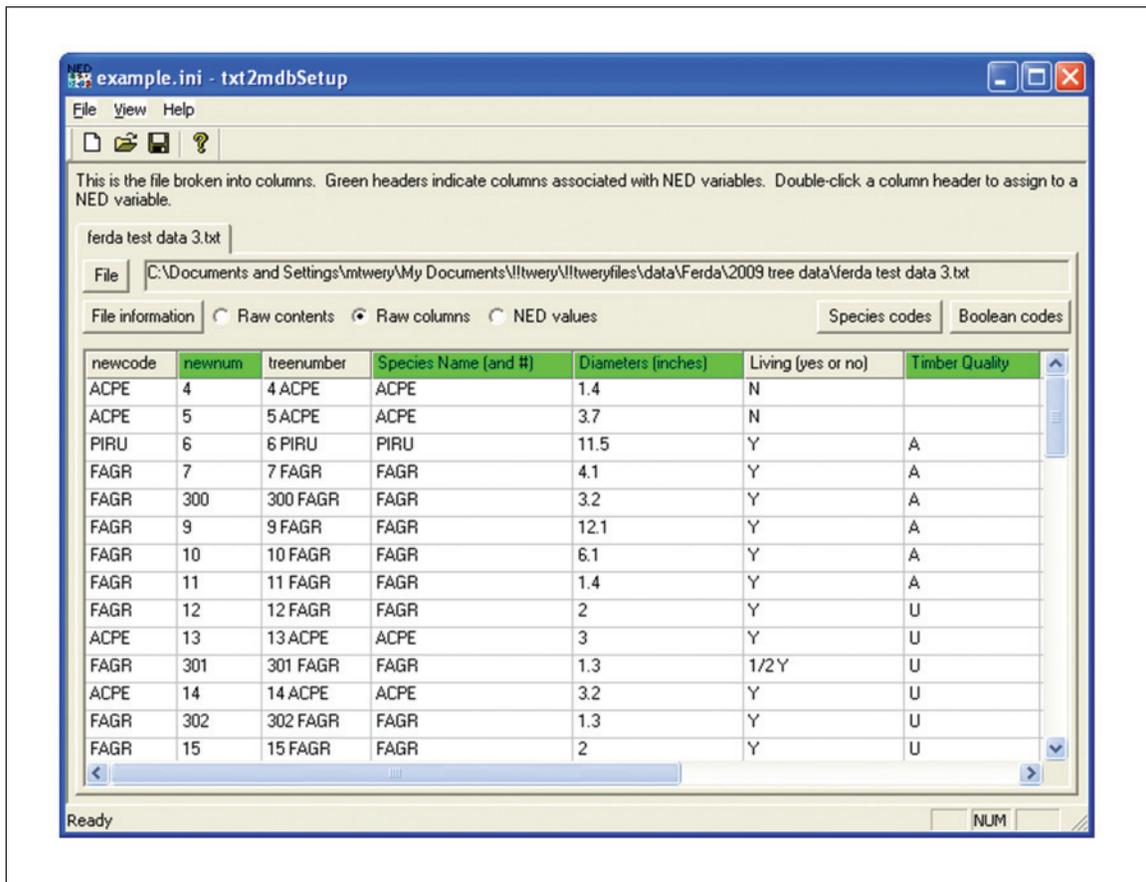


Figure 8. Viewing your data in the auxiliary program txt2mdbSetup.

## Changing the Order of Tabs

If you have opened multiple text files, they appear across the top in the order they were added. To modify the order:

1. Click any tab.
2. Click the **File information** button.
3. Under **Re-order files**, click and drag a file name to the desired location in the list. Files are displayed in the order as shown in the list.
4. Click **OK**.

## Removing Definitions from the INI File

You can remove text files (remove a tab) if you opened one just to peek inside it, or if you opened one by mistake. You can also remove a text file in order to eliminate all definitions associated with that file.

When you remove a text file, the .ini file no longer includes the definitions based on your variables in that text file. Thus, if you do not want that file type to be a part of your .ini file, you may remove it.

1. Click the tab that displays the name of the text file to remove.
2. Click the **File information** button.
3. From the File information dialog, click the **Delete this file type** button.
4. Txt2mdbSetup warns you about not being able to import data that contains variable definitions associated with this file type. When you are ready to remove the definitions, click **Yes** to confirm. Immediately the text file is removed.

If you remove a text file accidentally, or you want to retain the definitions you already created, your only option is to close the .ini file or exit txt2mdbSetup *without* saving the .ini file. When you re-open the .ini file, the text file is still associated with the .ini file because changes were not saved. If you did not save the definitions beforehand, you need to start over.

## Describing Your Data

### About Describing Data

Describing your data allows NED-2 to interpret it correctly. This is the process of finding (mapping) NED-2 variables to go with your inventory data. NED-2 has many variables. You do *not* need to find matches to all of them. You only need to map variables that you are interested in, and not necessarily all of the variables in your data.

You may have data that does not quite fit or match up well with available NED-2 variables, and you might not find matches 100 percent of the time.

It is very difficult, if not impossible, to successfully describe your data unless it is organized properly. Be sure you review how to organize your data before starting.

To describe your data, you will use the txt2mdbSetup program. Refer to the topics under the "Using the txt2mdbSetup Program" in the Part 1: Define Your Data section for instructions on starting the program, opening your text data, defining delimiters, etc.

## How to Map Your Variables

Generally, the process of mapping your variables is the same, regardless of variable type. You map one variable at a time, going back and forth between the main txt2mdbSetup window and the Field Information dialog shown in Figure 9. The Field Information dialog allows you to browse through NED-2 tables to find the best match for a given variable.

To map one of your variables to a single NED-2 variable, follow these steps:

1. In the **raw columns** or **NED values** view on the txt2mdbSetup window, double-click the name of your variable that appears in the column heading. The Field information dialog (see Figure 9) opens allowing you to pick the NED-2 variable that is the best match.
2. In the Field information dialog, *remove the check mark* next to **Ignore field** at the top-left corner.
3. Under **NED tables** in the large box to the far left, click the table that most likely matches the location you believe your variable might belong inside NED-2. For example, if you have a variable named “diam” (tree diameter), it is probably the diameter at breast height, which is located in the table called “overstory observation tree variables.”
4. As you select different tables on the left, the NED-2 variables that go in each table appear in the middle box of the dialog. Here is where you see inventory items that may look familiar, even if they have slightly different names than your names. In the middle box, two columns appear with one labeled **NED Variable** and the other labeled **user variable**. NED variable is the name of the variable in NED-2, and user variable is the name of your variable that was mapped to the NED-2 variable.
5. From the middle box, click the row that contains the name of the NED-2 variable to map to your variable. If you double-click instead, a question appears that asks if you want to map the variable. If you do, click **Yes**. Then the Field information dialog closes. Otherwise, proceed to step 6.
6. When you click a row in the middle box, the representative values from your data are displayed in the third box to the far right side of the dialog.
7. Specify a **conversion value** (metric to English) if your data contains metric values. This is done above the third box to the far-right side of the dialog as shown in Figure 9. If you accept the default conversion factor supplied by txt2mdbSetup, be sure it is appropriate for the values in your data. Refer to the “English-Metric Conversion” topic later in this section for more information.
8. If you are dealing with a coded variable, such as timber quality, check that your values match up with NED-2. To map your coded values to the proper values in NED-2, double-click one example from each of your possible codes and select one of the coded values in the Translation dialog. The choices depend on the NED-2 variable you selected in the middle box.
9. If no further modification is required, double check the NED-2 variable you selected along with any codes and metric conversion factors.
10. When you are finished, click **OK** to return to the main txt2mdbSetup window that displays all of your data columns (see Figure 8).

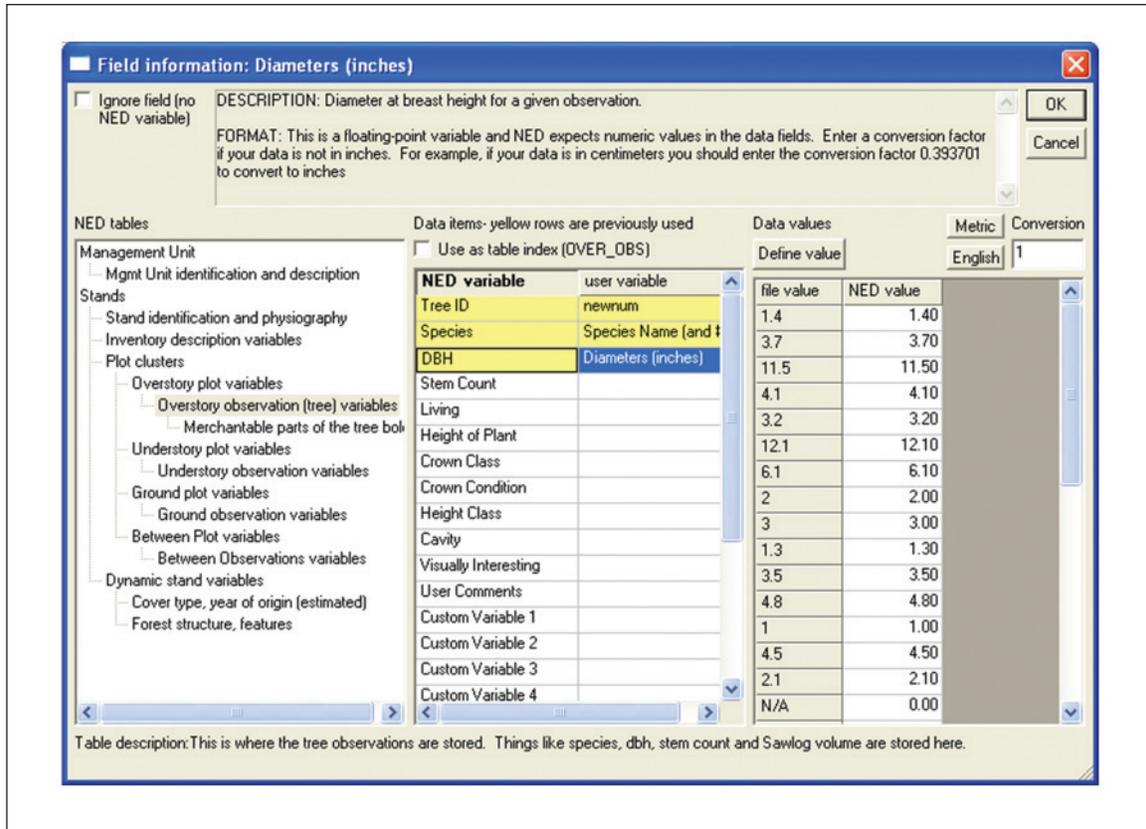


Figure 9. Mapping a variable in the auxiliary program txt2mdbSetup.

## Table Indexes

NED-2 organizes data in tables in a Microsoft Access database. Each table must have an index that uniquely identifies each row in the table. Txt2mdbSetup automatically establishes an index for you, so you do not need to worry about providing an index for any table. However, in the event you have already set up some kind of special index in your data, you have the option of applying your index in a given NED-2 table.

Specifying an index is optional and not likely to be necessary. If you wish to specify your own index, follow these steps:

1. From the **raw columns** or **NED values** view in the txt2mdbSetup window, double-click the name of your variable that appears in the column heading. This opens the Field information dialog (see Figure 9) where you can pick the NED-2 variable that is the best match.
2. In the Field information dialog, *remove the check* next to **Ignore field** at the top-left corner.
3. Under **NED tables** in the large box to the far left, click the table that most likely matches where you think your variable might belong inside NED-2. For example, if you had a variable called "tree index," *and you are sure there are no duplicate values*, then you could

probably use it as the index for a table. In this case, you select the table named, “overstory observation tree variables.”

4. Above the middle box, click the check box for **Use as table index**.
5. When you are finished, click **OK** to return to the view of your data columns (see Figure 8).

### Coded Variables

If your data contains coded variables (e.g., timber quality, crown position), you must check that your values match up with NED-2. In most cases, differences are likely to occur. For instance, NED-2 translates numeric codes and stores them as string values (e.g., “1= open grown,” “2 = dominant”). If you were manually entering data inside NED-2, for the crown position (crown class) of a given tree it is valid to enter “open grown” or simply “1,” since NED-2 knows that “open grown” is coded as 1. What gets stored for the tree in NED-2 is the value, “open grown.” However, even if your data has numeric codes, they might not be in the same order as the list of possible values in NED-2. Therefore, you must carefully match the codes used in your data with codes that are accepted by NED-2.

Using timber quality as another example, assume your data contains the code “a” to imply acceptable growing stock. NED-2 does not know what “a” means. You have to specify that your “a” really means “acceptable growing stock” or, more correctly, “AGS.”

Follow the steps below to describe your codes in txt2mdbSetup:

1. Once you have found a matching NED-2 variable in the middle box of Figure 9, representative values from your data are displayed in the first column (labeled **file value**) of the third box in the far-right side of the dialog. If the set of file values represents codes (categories) and they do not precisely match up with NED-2 values, proceed to the next step.
2. In the third box on the right of the dialog, notice that your coded values appear in the left column labeled **file value**. NED-2 values are in the right column labeled **NED value**. If no match exists, the NED value is shaded pink. To provide or modify a match, double-click the cell in the file value column.
3. In the Translation dialog, click the appropriate row from the list of coded values. The choices depend on the NED-2 variable you selected in the middle box.
4. Click **OK**.

To define values that may not exist in your data, possibly in anticipation of future data sets:

1. Click the **Define value** button above the third box to the right in Figure 9.
2. In the Translation dialog, in the edit box at the top, enter an input value that you expect to encounter in your data.
3. In the Translation dialog, click the appropriate row from the list of coded values.
4. Click **OK**.

### Boolean Variables

Boolean variables include variables that are typically answered yes or no, true or false, present or absent, and so on. When mapping variables, define your own codes as described in this section for coded variables.

By default, txt2mdbSetup interprets any string beginning with “T,” “Y,” or “P” as “true.” Any numeric value other than zero is also imported as “true.” Everything else is set to “false.”

If desired, you can define your own list of Boolean values all at once, prior to mapping variables, in order to make them available as valid codes when you begin mapping coded variables.

1. In the main txt2mdbSetup dialog, click the tab that displays the name of the text file for which you wish to establish boolean codes.
2. Click **Boolean codes**.
3. Click the **Set value** button.
4. Enter the string used in your data, like “present,” or “alive,” “2,” and so on. Then, indicate whether the entered string is supposed to represent a “true” or “false” condition.
5. If you enter a string by mistake, or if you have other strings you want ignored, enter the string in the top of the Boolean values dialog and then click **code doesn't map to a NED string**. This action removes the string from both lists. The string is removed.
6. Click **OK**.

### English-Metric Conversion

NED-2 stores data in English, but can display values in metric, if desired. Therefore, if your data contains metric values, you must specify an English conversion value (metric to English) for *each* of your variables in order for NED-2 to properly store values so that they can be displayed with accurate metric values.

1. Find a match for your variable by looking in the third box to the far right in the Field information dialog (see Figure 9). Your values appear under the column labeled **file value**.
2. Above the box showing the values found in the text file, click the **Metric** button to automatically generate a conversion factor in this field. Metric values are displayed in the right column labeled **NED value**. To view the values in English, click the **English** button.
3. If the metric values are incorrect, enter a conversion factor in the conversion box. Then click any row below to display the values that are recorded in NED-2 when the data is imported. NOTE: If you click the English or metric button after you have entered your own conversion factor, your factor is replaced with an automatically generated conversion factor.
4. Click **OK**.

### Plant Species

If you recorded plant species using a method of identification other than USDA PLANTS database symbols or FIA codes, then you must provide definitions for each species in your data. Txt2mdbSetup maintains one list of species definitions in each .ini file. Species definitions must be unique. Your data must use the same identifier for a species throughout the overstory, understory, and groundcover plots, and CWD transects. If your data contains multiple codes for the same species, some records will be imported into NED-2 as unknown species.

If you have data from multiple inventories and species were not recorded using the same identifiers across inventories, you must create separate .ini files for each inventory.

Access to plant species definitions in txt2mdbSetup is available in the following two locations:

If you are mapping a plant species variable to a NED-2 species variable on the Field information dialog, once you select the NED-2 variable, all of your species codes are shown in the third box to the right. Your codes are shown under the **file value** column. Next to each code, a guess of the species appears under the **NED value** column. If it says "Plant species not loaded" for each species, the Master Species List needs to be loaded. To load the Master Species List, click the **Species Codes** button. If the Master Species List was already loaded, and the guesses for your species are incorrect, follow the instructions below for defining a species code.

Species definitions can be accessed from the main txt2mdbSetup window at any time, regardless of whether you have mapped your species variable to a NED-2 species variable. Click the tab for which you want to define species. Click the **Species codes** button.

To add or remove species:

1. Click the **Species codes** button from either location described above.
2. Click **Yes** to load the **Master Plant Species List** if prompted to do so.
3. Click the **Select species** button.
4. To add one species at a time, in the Select species dialog, enter a species name and search for that species. To add many species at once, click the **Get state list** button and select a state to add an entire list of species from that state. Species on the left are those that matched your criteria.
5. In the box on the left, click one or more species, then click the **single right-pointing arrow** to move the species to the box on the right. Species on the right are in the current list. Use the double arrows to move all species on the left to the box on the right.
6. To remove a species from the current list, click a species in the box on the right, then click the **single left-pointing arrow**.

To define a species code:

1. Click the **Species codes** button from either location described above.
2. Click **Yes** to load the Master Plant Species List if prompted to do so.
3. If no species are listed, you need to add them as described above.
4. Click in the **user code** column of the row of the species for which you wish to define a species code.
5. Enter a code exactly as it appears in the text data. The code must be less than eight characters long, and must not contain spaces, commas, apostrophes, colons, or semicolons.
6. Repeat steps 4, 5, as necessary. When you are finished, click **OK**.

To import plant species codes from other files:

To save time, you can import plant species codes from NED-2 data files (.mdb), NED-2 plant species files (.spp2), NED-1 data files (.ned), NED-1 species files (.spp), and other txt2mdbSetup .ini files (.ini).

1. Click the **Species codes** button from either location described above.
2. Click **Yes** to load the **Master Plant Species List** if prompted.
3. Click the **Import codes** button.
4. At the bottom of the **Open** dialog, choose a file type in the **Files of type** list.
5. Browse to and select the desired file.
6. Click **Open**.
7. When prompted, select how you wish to incorporate the incoming list of species from the choices given (i.e., “delete the existing list and replace it with the imported species list”). Read the choices carefully.
8. Click **OK**.

To validate your list of plant species codes:

To check for any remaining unidentified species from your data, txt2mdbSetup can search for unmatched species codes and report them to you.

1. Before you can validate your species codes, you must have already mapped a species variable from your data to a species variable in NED-2.
2. Click the **Species codes** button from either location described above.
3. Click **Yes** to load the **Master Plant Species List** if prompted.
4. Click the **Check data** button. Txt2mdbSetup presents a list of all unknown (undefined) species codes in your data, and also reports when none are found.
5. For each unknown species code, you need to define the species code as described above. If the species is not shown in the current txt2mdbSetup plant species list, you also need to add them as described above.

### Finish and Save Your Definitions

If you are finished matching your variables and defining them as necessary, you should see mostly green column headers when using the **Raw Contents** or **NED values** views of your data (see Figure 8). NOTE: Figure 8 does not necessarily show all columns as having matches and is used for illustrative purposes only.

1. When you are finished and ready to exit, from the File menu, click **Exit**, or click the **X** in the top-right corner of the txt2mdbSetup window.
2. If there are any unsaved changes, click **Yes** to save your work.
3. In the Save As dialog, browse to a folder and enter a filename.
4. Click **Save**.

After your work is saved, you now have an .ini file. This file is used to interpret your data. You are required to identify this file when you are ready to import your data into NED-2.

## Part 2 - Build a NED-2 File

### About the txt2mdb Program

Txt2mdb is an auxiliary program that imports text data into NED-2. It uses .ini files, generated from the txt2mdbSetup program, to interpret your data correctly.

The output of txt2mdb is a new NED-2 file (.mdb) containing all of the data for which definitions were available in the accompanying .ini file.

Txt2mdb does not append data to an existing NED-2 file.

### Starting txt2mdb

To import your text data into NED-2, run the txt2mdb program, by locating the shortcut titled **Import Text Data** on the Start menu.

1. Open the Windows Start menu.
2. Click **Programs > NED Programs > NED2 Tools**.
3. Click **Import Text Data**.

### Import Text Data into NED-2

To import your data into NED-2, these steps can be performed in any order, as long as you *do not* click **Start** until after completing all other steps.

You must have a valid definitions (.ini) file for the text data you wish to import. This file is created by the txt2mdbSetup program.

1. Start the txt2mdb program.
2. Click the **Add input file to list** button to select the text files that contain the data you wish to import.
3. From the Open dialog, browse to the location of your text files. Use the Ctrl and/or Shift keys to select multiple text files concurrently.
4. Click the **Open** button when you are finished selecting files. If you have multiple text files in separate folders, repeat steps 2-4 for text files in each folder.
5. Click the **Output file** button to enter the name of the NED-2 file you wish to create.
6. Browse to a desired folder.
7. Use the keyboard to enter a file in the **file name** box. If desired, you can click an existing NED-2 file in the browse window. If specifying a file name that already exists, you are asked if you wish to replace the file. You cannot import data into an existing NED-2 file. Click **Yes** if you want to replace the file.
8. Click the **Code file** button to select the definitions (.ini) file that contains interpretations of the text data you wish to import. Only one .ini file can be used at a time.
9. From the Open dialog, browse to the location of your .ini file.
10. Click the **Open** button when you have selected your .ini file.
11. Review the selections you made above. When you are ready to import the data, click the **Start** button. Normally this button remains deactivated until you have completed the steps above.
12. When the process has completed, a Finish button appears over the top of the Start button. Click **Finish** to end the txt2mdb program.

If there were errors during the import, you are asked whether you wish to save the error messages in a log file for further review.

The txt2mdb program generates a NED-2 file, which is a Microsoft Access database. You can open the file in Access, but Access is *not* required in order to view the data in NED-2. It is recommended that you open the file in NED-2. Any accidental changes made when you open the file in Access may make the file unreadable in NED-2.

# Chapter 4 - Calculations

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## CALCULATION SETTINGS

Calculation settings offer some control over how NED-2 estimates many stand-level values. Most of the settings apply to overstory data, and generally affect inventory data as well as simulated data. Whenever you make changes to calculation settings, you are prompted to confirm this change. This prompt occurs because it means that NED-2 has to completely redo all calculations, and all simulated treatment plan data are deleted, which means that you need to re-simulate your treatment plans, if applicable.

Calculation settings apply to all stands within the management unit.

You may store calculation settings into an external file for re-use in other NED-2 files.

### Minimum Top Diameter for Volume Estimation

You may specify a minimum top diameter for calculating sawlog volume. NED-2 calculates volume for logs only if the diameter of the top portion of the log is greater than or equal to the threshold.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Enter the appropriate minimum top diameter threshold for board-foot volume estimation.
4. Click **OK** to accept the change.

This variable is only used in estimating the board-foot volume of larger logs (i.e.,  $\geq 16$  feet). It is not used for smaller logs in the logs table (i.e.,  $< 16$  feet in length).

### Minimum Dbh for Height Estimation

If you do not record merchantable height, NED-2 can estimate merchantable height for sawtimber and pulpwood in hardwoods and softwoods. If the diameter at breast height (dbh) is less than the minimum dbh you specify, sawtimber and/or pulpwood height is set to zero.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Enter the appropriate values for minimum diameters for height estimation.
4. Click **OK** to accept the changes.

### Choosing a Log Rule

You can specify which equation you want NED-2 to use in estimating board-foot volume. NED-2 provides the following three most commonly used equations or log rules: International 1/4 Inch, Doyle, and Scribner.

The Doyle rule is generally the least consistent of the three equations. Scribner is intermediate, and International 1/4 Inch is the most consistent (Avery and Burkhart 1994).

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Make a selection in the board-foot volume equation pick list.
4. Click **OK** to accept the changes.

### Establishing Minimum Sawlog and Pulpwood Log Lengths

When NED-2 is estimating sawlog and/or pulpwood height, it returns zero for any value that is less than the minimum log lengths you specify.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Enter the appropriate minimum sawtimber and pulpwood log length.
4. Click **OK** to accept the changes.

### Defining a Big Tree Threshold

The big tree threshold is a specific dbh that indicates whether a tree is considered large or “big.” Perhaps you want to create or hasten the development of an old-growth or large tree appearance. If so, NED-2 uses the big tree threshold to report on big trees in your forests.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Enter the desired big tree threshold.
4. Click **OK** to accept the changes.

### Overstory/Understory Dbh Threshold

NED-2 uses dbh to distinguish between overstory and understory stems, with a default threshold value of one inch. This means that any woody stem with a dbh greater than or equal to one inch is inventoried as overstory and is included in any subsequent analysis of the overstory.

This setting may affect the default dbh when you enter a new overstory observation. If this threshold is greater than your default dbh value, NED-2 applies the overstory/understory dbh threshold as the initial dbh value for the new observation.

This threshold does not affect calculations on stand metrics such as basal area, relative density, biomass, etc. However, during treatment plan simulation, stems less than the current dbh threshold are considered understory. Once these stems grow to a dbh that is greater than or equal to the current threshold, they are considered overstory.

If you elect to use a threshold larger than one inch, timber volume is only calculated for the overstory trees.

To change the threshold:

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation Settings** button at the bottom of the window.
3. Enter your desired threshold in the box labeled, Overstory/Understory dbh threshold.
4. Click **OK**. You are prompted to confirm this change. This prompt occurs because it means that NED-2 has to completely redo all calculations, and all simulated treatment plan data are deleted, which means that you need to re-simulate your treatment plans, if applicable. This threshold applies to all stands within the management unit.

### Including Dead Trees

You can choose to include dead trees in NED-2's calculations. If this box is checked, all computations for timber values include dead trees. When configuring vegetation tables and reports, you are again given the option to include dead trees in those calculations as well as the ability to calculate values for dead trees only.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Check/uncheck the box include dead trees in timber values.
4. Click **OK** to accept the change.

### Q-factor Size-class Interval

In calculating the q-factor for a stand, NED-2 uses 1- or 2-inch diameter size-class intervals.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. Make a selection from the pick list labeled Q-factor size class interval.
4. Click **OK** to accept the change.

### Storing Calculation Settings in a Separate File

NED-2 calculation settings are saved and retained with the current NED-2 file. However, you may store your calculation settings in a separate file to be reused in another NED-2 file in the future. This allows for sharing calculation settings between NED-2 files.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. On the Calculation settings dialog, click the **Store calculation** settings button.
4. If desired, browse to the desired folder or location where you wish to keep the file.
5. Enter an appropriate file name in the File Name field.
6. Make sure the save-as type reads **NED-2 calculation files (.NEDcalcs)** at the bottom of the dialog.
7. Click the **Save** button to store your settings to a file.

## Retrieving Calculation Settings from a Separate File

NED-2 calculation settings are saved and retained with the current NED-2 file. However, you may retrieve calculation settings from a separate file so that you do not have to retype and/or rethink the settings you have previously used in other NED-2 files.

1. In the Navigation Pane, click **Inventory**, and then click **Enter/Edit Inventory**.
2. In the Options Pane, click the **Calculation settings** button at the bottom of the window.
3. In the Calculation settings dialog, click the **Retrieve calculation settings** button.
4. At **Files of type**, choose whether to retrieve settings from another NED-2 data file or from an external calculation file (.NEDcalcs) at the bottom of the dialog.
5. If desired, browse to the desired folder or location where you wish to retrieve the file.
6. Select the file that contains your desired calculation settings.
7. Click the **Open** button to retrieve the settings stored in the file. These settings are saved with the current NED-2 file.

## TIMBER VOLUME

### Calculating Logs from Merchantable Height

If you have *not* entered your own logs in the logs table, NED-2 calculates logs automatically. For example, in the scenario where you record only species and diameter, NED-2 first calculates sawtimber and pulpwood height for the tree, and then logs are calculated. The scenarios for calculating logs are explained below:

Scenario 1—When you have *not* entered sawtimber and pulpwood heights:

1. The sawtimber height is calculated.
  - a. If the tree's most valuable product is not a sawtimber product, then sawtimber height is zero.
  - b. If the dbh < minimum dbh for sawtimber height estimates, the sawtimber height is zero.
  - c. If the calculation comes out less than the minimum sawtimber length, sawtimber height is zero.
  - d. If the sawtimber height is greater than zero, a log is added to the log table with a length equal to the sawtimber height, and the product is the same as the tree's most valuable product.
2. The pulpwood height is calculated. This is the log above the sawtimber portion of the tree.
  - a. If the tree's most valuable product is "cull," the pulpwood height is zero.
  - b. If the dbh < minimum dbh for pulpwood height estimates, the pulpwood height is zero.
  - c. If the calculation comes out below the minimum pulpwood length, the pulpwood height is zero.
  - d. If the pulpwood height is greater than zero, a log is added to the log table with a length equal to the pulpwood height, and the product is either the tree's most valuable product (if the tree's most valuable product is a pulpwood product), or "Pulpwood."

Scenario 2—When you have entered sawtimber height only (but *not* pulpwood height):

1. A log is added to the log table with a length equal to the sawtimber height, and the product is the same as the tree's most valuable product, unless one of the following occurs:
  - a. The tree's most valuable product is not a sawtimber product.
  - b. The sawtimber height is less than the minimum sawtimber length.
2. The pulpwood height is calculated. This is the log above the sawtimber portion of the tree.
  - a. If the tree's most valuable product is "cull," the pulpwood height is zero.
  - b. If the dbh < minimum dbh for pulpwood height estimates, the pulpwood height is zero.
  - c. If the calculation comes out below the minimum pulpwood length, the pulpwood height is zero.
  - d. If the pulpwood height is greater than zero, a log is added to the log table with a length equal to the pulpwood height, and the product is either the tree's most valuable product (if the tree's most valuable product is a pulpwood product), or "Pulpwood."

Scenario 3—When you have entered pulpwood height only (but *not* sawtimber height):

**Caution:** If you wish to enter the entire merchantable height as pulpwood, you must also select one of the non-sawtimber products (e.g., pulpwood, firewood) as the most valuable product, or NED-2 calculates a sawtimber height if the tree is large enough.

1. The sawtimber height is calculated.
  - a. If the tree's most valuable product is not a sawtimber product, then sawtimber height is zero.
  - b. If the dbh < minimum dbh for sawtimber height estimates, the sawtimber height is zero.
  - c. If the calculation comes out less than the minimum sawtimber length, sawtimber height is zero.
  - d. If the sawtimber height is greater than zero, a log is added to the log table with a length equal to the sawtimber height, and the product is the same as the tree's most valuable product.
2. A log is added to the log table with a length equal to the pulpwood height, and the product is either the tree's most valuable product (if the tree's most valuable product is a pulpwood product), or "Pulpwood," unless one of the following occurs:
  - a. If the tree's most valuable product is "cull," the pulpwood height is zero.
  - b. If the calculation comes out below the minimum pulpwood length, the pulpwood height is zero.

Scenario 4—When you have entered *both* sawtimber and pulpwood height:

1. A log is added to the log table with a length equal to the sawtimber height, and the product is the same as the tree's most valuable product, unless one of the following occurs:
  - a. The tree's most valuable product is not a sawtimber product.
  - b. The sawtimber height is less than the minimum sawtimber length.
2. A log is added to the log table with a length equal to the pulpwood height, and the product is either the tree's most valuable product (if the tree's most valuable product is a pulpwood product), or "Pulpwood," unless one of the following occurs:
  - a. If the tree's most valuable product is "cull," the pulpwood height is zero.
  - b. If the calculation comes out below the minimum pulpwood length, the pulpwood height is zero.

## Using Logs to Calculate Merchantable Height

If you do not record merchantable heights, NED-2 uses logs to determine merchantable heights. To do this, NED-2 first estimates sawtimber and pulpwood merchantable height of a tree, and then calculates logs according to estimated merchantable heights. If you change a log length or a log product, NED-2 recalculates merchantable heights according to the logs in the logs table, according to the following descriptions. NOTE: If you do not record merchantable heights, and you do not record logs in the logs table, if you modify the species or dbh of a tree, NED-2 restarts this procedure, by recalculating merchantable heights and then resetting the logs table.

If you record logs in the logs table, NED-2 calculates merchantable heights as follows:

When the last log you enter is a pulpwood product:

1. No additional calculated logs will be added.
2. The tree's sawlog height and pulpwood height are calculated by summing the appropriate logs in the log table.

When the last log you enter is a sawtimber product:

1. The pulpwood height is calculated. This is the log above the sawtimber portion of the tree.
  - a. If the calculation comes out below the minimum pulpwood length, the pulpwood height is zero.
  - b. If the pulpwood height is greater than zero, a log is added to the log table with a length equal to the pulpwood height, and the product is "Pulpwood."
2. The tree's sawlog height and pulpwood height are calculated by summing the appropriate logs in the log table.

## Cubic Volume

Cubic volume is calculated using a U.S. Forest Service, Region 9, composite volume equation (Marquis 1977). Cubic volume is only calculated for trees in the overstory plot.

Cubic volume is reported for the whole tree, sawtimber, and pulpwood portions, and is calculated at the following levels in NED-2:

**Individual log** - Lowest level; where actual formula is applied and defect and utilization loss occur.

**Tree** - Based on total of sawtimber and pulpwood cubic volume in all of the logs of a given tree.

**Overstory plot** - Per unit area; based on the sum of all trees in single plot.

**Stand** - Per unit area; based on simple arithmetic average of all plots.

Related measures such as cord volume and tonnage, are indirectly derived from cubic volume using conversions from cubic volume to cordwood (i.e., units of cubic volume per cord), and from cubic volume to tons (i.e., tons per cord).

The following description illustrates how gross and net cubic volumes are calculated through each level. All levels contain variables that store the results of the following calculations, and the variables are described under each level in the *NED-2 Reference Guide*, Appendix B.

Before volume is calculated, sawtimber and pulpwood height are calculated and/or edited and corresponding logs are generated in the logs table.

1. The calculation begins at the **log level**. Cubic volume is calculated individually for each log in a tree.
  - a. If the product is “cull,” gross cubic volume is zero.
  - b. Gross cubic volume of a log is calculated.
  - c. The cubic volume correction factor is applied to the calculated gross cubic volume.
  - d. Net cubic volume of a log is determined by applying the appropriate defect (sawtimber or pulpwood—depending on the product assigned to the individual log), and after defect has been accounted for, an additional 20 percent is removed to account for utilization loss.
2. At the **whole tree level**, cubic volume is first calculated for the sawtimber portion, and then the pulpwood portion.
  - a. Gross tree cubic volume of sawtimber is the sum total of gross sawtimber for all logs that have sawtimber products.
  - b. Net tree cubic volume of sawtimber is the sum total of net sawtimber for all logs that have sawtimber products.
  - c. Gross tree cubic volume of pulpwood is the sum total of gross pulpwood for all logs that have pulpwood products.
  - d. Net tree cubic volume of pulpwood is the sum total of net pulpwood for all logs that have pulpwood products.
  - e. Total (whole-tree) gross cubic volume is the sum of gross cubic volume of sawtimber and gross cubic volume of pulpwood.
  - f. Total (whole-tree) net cubic volume is the sum of net cubic volume of sawtimber and net cubic volume of pulpwood.
3. At the **overstory plot level**, cubic volume is determined on a per-unit area basis.
  - a. Gross tree cubic volume of sawtimber is multiplied by the stems per unit area represented by that tree, and similarly for all trees in the plot, resulting in gross plot cubic volume of sawtimber.
  - b. Net tree cubic volume of sawtimber is multiplied by the stems per unit area represented by that tree; and similarly for all trees in the plot, resulting in net plot cubic volume of sawtimber.
  - c. Gross tree cubic volume of pulpwood is multiplied by the stems per unit area represented by that tree; and similarly for all trees in the plot, resulting in gross plot cubic volume of pulpwood.
  - d. Net tree cubic volume of pulpwood is multiplied by the stems per unit area represented by that tree; and similarly for all trees in the plot, resulting in net plot cubic volume of pulpwood.
  - e. Total plot gross cubic volume is the sum of gross cubic volume of sawtimber per unit area and the gross cubic volume of pulpwood per unit area.
  - f. Total plot net cubic volume is the sum of net cubic volume of sawtimber per unit area and net cubic volume of pulpwood per unit area.

4. At the **stand level**, cubic volume is based on the average of all plot-clusters in the stand.
  - a. Gross stand cubic volume of sawtimber is the average gross cubic sawtimber of all plot-clusters in the stand.
  - b. Net stand cubic volume of sawtimber is the average net cubic sawtimber of all plot-clusters in the stand.
  - c. Gross stand cubic volume of pulpwood is the average gross cubic pulpwood of all plot-clusters in the stand.
  - d. Net stand cubic volume of pulpwood is the average net cubic pulpwood of all plot-clusters in the stand.
  - e. Total stand gross cubic volume is the sum of gross cubic volume of sawtimber per unit area and gross cubic volume of pulpwood per unit area.
  - f. Total stand net cubic volume is the sum of net cubic volume of sawtimber per unit area and net cubic volume of pulpwood per unit area.

### Board-foot Volume

Board-foot volume is reported for the sawtimber portion of a tree and is calculated at the following levels in NED-2:

**Individual log** - Lowest level; where actual formula is applied and defect is also applied.

**Tree** - Based on total of board-foot volume in all of the sawtimber logs of a given tree.

**Overstory plot** - Per unit area; based on total of all trees in single plot.

**Stand** - Per unit area; based on simple arithmetic average of all plots.

The following description illustrates how gross and net board-foot volumes are calculated at each level. All levels contain variables that store the results of the following calculations, and the variables are described under each level in the *NED-2 Reference Guide*, Appendix B (Twery et al. 2011).

Before board-foot volume is calculated, sawtimber height is calculated and/or edited and corresponding logs are generated in the logs table.

1. The calculation begins at the log level. Board-foot volume is calculated individually for each log in a tree that has a sawtimber product.
  - a. If the log product is not a sawtimber product, gross board-foot volume is zero.
  - b. If the calculated minimum top diameter is less than the user-specified (default = 8 inches) minimum top diameter for board-foot (sawlogs), gross-board foot volume is zero.
  - c. Gross board-foot volume of a log is calculated depending on the log length. If log length is less than 16 feet, the smaller log formula is used. If the log length is at least 16 feet, the larger log formula is used.
  - d. The board-foot volume correction factor is applied to the calculated gross board-foot volume.
  - e. Net board-foot volume of a log is determined by multiplying gross board-foot volume times the sawtimber defect recorded for the tree.

2. At the tree level, board-foot volume is calculated for the sawtimber portion only.
  - a. Gross tree board-foot volume is the sum total of gross sawtimber for all logs that have sawtimber products.
  - b. Net tree board-foot volume is the sum total of net sawtimber for all logs that have sawtimber products.
  
3. At the overstory plot level, board-foot volume is determined on a per-unit area basis.
  - a. Gross tree board-foot volume of sawtimber is multiplied by the stems per unit area represented by that tree, then summed for all trees in the plot, resulting in gross plot board-foot volume.
  - b. Net tree board-foot volume of sawtimber is multiplied by the stems per unit area represented by that tree, then summed for all trees in the plot, resulting in net plot board-foot volume.
  
4. At the stand level, board-foot volume is based on the average of all plot-clusters in the stand.
  - a. Gross stand board-foot volume is the average gross board-foot volume of all plot-clusters in the stand.
  - b. Net stand board-foot volume is the average net board-foot volume of all plot-clusters in the stand.

### Formula for Board-foot Volume of Smaller Logs

The following formula (Wiant and Castaneda 1977) is used to determine the board-foot volume of a single log in the logs table that is less than 16 feet in length. This formula is less involved than the procedure used for larger logs, and is sometimes referred as the “simple” formula in NED-2. Larger log lengths (i.e.,  $\geq 16$  feet) use a more complex formula (Scrivani 1989).

First, the log length is divided by 16 to represent it as a proportion of a 16-foot log, as follows:

$$\text{Length} = \text{Log length} / 16.0$$

Board-foot volume is calculated as follows:

$$\begin{aligned} \text{Board-foot volume} &= F_1 + (F_2 \times \text{Length}) + (F_3 \times \text{Length}^2) \\ &+ (((F_4 + (F_5 \times \text{Length}) + (F_6 \times \text{Length}^2)) \times \text{dbh}) \\ &+ (((F_7 + (F_8 \times \text{Length}) + (F_9 \times \text{Length}^2)) \times \text{dbh}^2) \\ &\times ((\text{Girard form class} - 78.0) \times 0.03 + 1.0). \end{aligned}$$

The values for  $F_1$  to  $F_9$  are located in Table 3.

**Table 3. Values of coefficients (F<sub>1</sub> through F<sub>9</sub>) used for the board-foot volume calculation (Wiant and Castaneda 1977).**

	Doyle	Scribner	International 1/4-inch
F <sub>1</sub>	-29.37337	-22.50365	-13.35212
F <sub>2</sub>	41.51275	17.53508	9.58615
F <sub>3</sub>	0.55743	-0.59242	1.52968
F <sub>4</sub>	2.78043	3.02980	1.79620
F <sub>5</sub>	-8.77272	-4.34381	-2.59995
F <sub>6</sub>	-0.04516	-0.02302	-0.27465
F <sub>7</sub>	0.04177	-0.01969	0.04482
F <sub>8</sub>	0.59042	0.51593	0.45997
F <sub>9</sub>	-0.01578	-0.02035	-0.00961

### Formula for Board-foot Volume of Larger Logs

For any log in the logs table that is at least 16 feet in length, NED-2 calculates board-foot volume using the method of Scrivani (1989) as follows. This formula is more involved than the procedure used for smaller logs, and is sometimes referred to as the “complex” formula in NED-2. Smaller log lengths (i.e., < 16 feet) use a simpler formula (Wiant and Castaneda 1977).

- First, test the dbh as follows:
  - If the dbh < 10 then board-foot volume = 0.0, and processing stops.
  - If the dbh > 40 then dbh is set to 40, and processing continues.
- Second, convert log length (from the logs table) to the number of 16-foot log-sections, to the nearest 1/2 section, using the following equation:  
 Log-sections = (int (log length/8.0)) / 2.0, where “int” truncates the value to an integer.
  - If Log-sections < 1 then board-foot volume = 0.0, and processing stops.
  - If Log-sections > 6 then the number of sections in the log is set to 6, and processing continues.
- The top diameter of the first log is determined by the following:  
 Top diameter = dbh × (Girard form class /100.0)
- Calculate the board-foot volume of the first log-section, as follows:  
 Choose *one* of the following formulas to calculate volume:
  - If using the **International 1/4-inch** log rule:  
 Board-foot volume = (0.796 × Top diameter<sup>2</sup>) – (1.375 × Top diameter) – 1.23
  - If using the **Doyle** log rule:  
 Board-foot volume = (Top diameter – 4)<sup>2</sup>
  - If using the **Scribner** log rule:  
 Board-foot volume = (0.79 × Top diameter<sup>2</sup>) – (2 × Top diameter) – 4

5. Calculate board-foot volume of subsequent log-sections remaining in the log.
  - a. If the tree has two or more 16-foot log-sections, the top diameters for the subsequent log-sections are determined by the following:

Top diameter = Previous top diameter – taper

- Previous top diameter = the top diameter from the previous log-section (for example, for the second log-section, this would be the top diameter from the first log).
  - Taper is found in Table 4:
- b. If the taper is zero, the volume cannot be calculated because it is outside the limits of the table. Thus, board-foot volume for this log-section is set to zero.
  - c. If the top diameter is less than the minimum top diameter for board-foot volume (sawlogs), board-foot volume for this log-section is set to zero. Otherwise, one of the following formulas is used to calculate volume:
    - If using the **International 1/4-inch** log rule:  
board-foot volume =  $(0.796 \times \text{Top diameter}^2) - (1.375 \times \text{Top diameter}) - 1.23$
    - If using the **Doyle** log rule:  
board-foot volume =  $(\text{Top diameter} - 4)^2$
    - If using the **Scribner** log rule:  
board-foot volume =  $(0.79 \times \text{Top diameter}^2) - (2 \times \text{Top diameter}) - 4$
6. The board-foot volumes for all the log-sections are added together to find the volume for the given log in the logs table.

### Working with Half Log-sections

1. If there is an extra half log-section, the volume determined using whole log-sections (as described above) is saved.
2. A second volume is calculated as if the tree had an additional 16-foot log-section. These two volumes are averaged to get the final board-foot volume.

### Example

Find the volume of a tree where:

- Dbh = 34.0 inches.
- Sawlog height = 45.0 feet.
- Girard form class = 80.

Assume that Bdft volume equation to use = 1 (International 1/4 inch), and that the minimum top diameter for board-foot volume (sawlogs) = 8.0 inches.

**Table 4. Taper values used in determining the top diameter of upper log sections (Scrivani 1989).**

Number of 16-ft log-sections	Log-sections	DBH							
		≥ 10 < 12	≥ 12 < 14	≥ 14 < 16	≥ 16 < 18	≥ 18 < 20	≥ 20 < 22	≥ 22 < 24	≥ 24 < 26
2	second log	1.4	1.6	1.7	1.9	2.0	2.1	2.2	2.3
3	second log	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.8
	third log	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.2
4	second log	0.0	1.1	1.2	1.2	1.3	1.4	1.4	1.5
	third log	0.0	1.4	1.5	1.6	1.7	2.0	2.0	2.2
	fourth log	0.0	1.9	2.0	2.1	2.2	2.5	2.5	2.6
5	second log	0.0	0.0	0.0	0.0	0.0	1.1	1.1	1.1
	third log	0.0	0.0	0.0	0.0	0.0	1.7	1.7	1.8
	fourth log	0.0	0.0	0.0	0.0	0.0	2.3	2.3	2.4
	fifth log	0.0	0.0	0.0	0.0	0.0	2.9	2.9	3.1
6	second log	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	third log	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	fourth log	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	fifth log	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	sixth log	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

Number of 16-ft log-sections	Log-sections	DBH							
		≥ 26 < 28	≥ 28 < 30	≥ 30 < 32	≥ 32 < 34	≥ 34 < 36	≥ 36 < 38	≥ 38 < 40	≥ 40 < 42
2	second log	2.4	2.5	2.6	2.7	2.8	2.8	2.9	2.9
3	second log	1.9	1.9	2.0	2.0	2.1	2.1	2.1	2.2
	third log	2.3	2.5	2.6	2.7	2.8	2.8	2.8	2.8
4	second log	1.5	1.6	1.7	1.7	1.8	1.9	1.9	1.9
	third log	2.3	2.4	2.5	2.5	2.5	2.6	2.6	2.7
	fourth log	2.7	2.8	3.0	3.1	3.3	3.4	3.4	3.4
5	second log	1.1	1.2	1.2	1.2	1.3	1.3	1.3	1.4
	third log	1.9	1.9	2.0	2.1	2.1	2.2	2.2	2.3
	fourth log	2.5	2.6	2.7	2.9	3.0	3.0	3.1	3.2
	fifth log	3.2	3.3	3.5	3.7	3.8	3.9	3.9	4.0
6	second log	0.0	0.9	0.9	1.0	1.0	1.1	1.1	1.2
	third log	0.0	1.4	1.4	1.4	1.4	1.5	1.5	1.5
	fourth log	0.0	2.1	2.1	2.1	2.2	2.2	2.3	2.4
	fifth log	0.0	3.2	3.2	3.2	3.3	3.3	3.4	3.5
	sixth log	0.0	4.4	4.5	4.6	4.7	4.9	5.1	5.3

**The number of 16-foot logs is:**

$$\begin{aligned}
 \text{Logs} &= (\text{int}(\text{height}/8.0)) / 2.0 \\
 &= (\text{int}(45.0/8.0)) / 2.0 \\
 &= (\text{int}(5.625)) / 2.0 \quad (\text{remember int}( ) \text{ rounds down}) \\
 &= 2.5
 \end{aligned}$$

**The volume of the first log (starting at the bottom) is calculated:**

$$\begin{aligned}
 d &= \text{top diameter of log} \\
 d &= \text{dbh} \times (\text{Girard form class} / 100.0) \\
 &= 34.0 \times (80/100.0) \\
 &= 27.2 \\
 \text{Volume} &= (0.796 \times d^2) - (1.375 \times d) - 1.23 \\
 &= (0.796 \times 27.2^2) - (1.375 \times 27.2) - 1.23 \\
 &= 550.28
 \end{aligned}$$

**The volume of the second whole log is calculated:**

$$\begin{aligned}
 dp &= \text{top diameter of previous log} \\
 dp &= 27.2 \\
 \text{taper} &= 2.8 \quad (\text{there are 2 logs, this is the second log, the dbh} = 34) \\
 d &= dp - \text{taper} \\
 &= 27.2 - 2.8 \\
 &= 24.4 \\
 \text{Volume} &= (0.796 \times d^2) - (1.375 \times d) - 1.23 \\
 &= (0.796 \times 24.4^2) - (1.375 \times 24.4) - 1.23 \\
 &= 439.13
 \end{aligned}$$

**The total volume of whole logs:**

$$\text{Board-foot volume} = 550.28 + 439.13 = 989.41$$

But, there is the extra half log, so the entire routine is re-run, and the number of 16-foot logs is set to 3.0

The volume of the first log (starting at the bottom) is calculated the same as above: 550.28

The volume of the second whole log is calculated:

$$\begin{aligned}
 dp &= 27.2 \\
 \text{taper} &= 2.1 \quad (\text{there are 3 logs, this is the second log, the dbh} = 34) \\
 d &= dp - \text{taper} \\
 &= 27.2 - 2.1 \\
 &= 25.1
 \end{aligned}$$

$$\begin{aligned}\text{Volume} &= (0.796 \times d^2) - (1.375 \times d) - 1.23 \\ &= (0.796 \times 25.1^2) - (1.375 \times 25.1) - 1.23 \\ &= 465.75\end{aligned}$$

The volume of the third whole log is calculated:

$$\begin{aligned}dp &= 25.1 \\ \text{taper} &= 2.8 \text{ (there are 3 logs, this is the third log, the dbh= 34)} \\ d &= dp - \text{taper} \\ &= 25.1 - 2.8 \\ &= 22.3 \\ \text{Volume} &= (0.796 \times d^2) - (1.375 \times d) - 1.23 \\ &= (0.796 \times 22.3^2) - (1.375 \times 22.3) - 1.23 \\ &= 363.95\end{aligned}$$

So, the total volume, if there are 3 whole 16-foot logs would be:

$$\begin{aligned}\text{Board-foot volume} &= 550.28 + 465.75 + 363.95 \\ &= 1379.98\end{aligned}$$

**The final board-foot volume is the average of the two:**

$$\begin{aligned}\text{Board-foot volume} &= (989.41 + 1379.98) / 2 \\ &= 1184.7\end{aligned}$$

## PLANT SPECIES DIVERSITY

### Similarity Measures

NED-2 includes measures of similarity (beta-diversity) that are calculated between plots and stands in your management unit. An option is available for the choice of stems per unit area or basal area for the variable used in the following Renkonen's Index of Similarity Percentage (Renkonen 1938) and Morisita-Horn Similarity Index (Morisita 1959, Horn 1966) calculations.

Five measures are reported as follows:

**Sorensen's Similarity Coefficient** - Sorensen's coefficient (1948) is based on presence-absence of species. Values range from 0-1, where low values indicate little or no similarity, and higher values indicate stronger similarity. This measure gives more weight to species that occur in both samples.

Based on presence/absence of species throughout all plots in the stand, Sørensen's index is computed for all the possible pairs of plots. The final index is the mean value of the pair indices.

Formula for Sørensen's SI:

$$S = 2a/(2a+b+c)$$

Where

- a = number of species occurring on both plots
- b = number of species occurring only in first plot
- c = number of species occurring only in second plot

**Jaccard's Similarity Coefficient** - Jaccard's coefficient (1901) is based on presence-absence of species. Values range from 0-1, where low values indicate little or no similarity, and higher values indicate stronger similarity. This measure gives more weight to species that are unique to each sample.

Based on presence/absence of species throughout all plots in the stand, Jaccard's index is computed for all the possible pairs of plots. The final index is the mean value of the pair indices.

Formula for Jaccard's SI:

$$J = a/(a+b+c)$$

Where

- a = number of species occurring on both plots
- b = number of species occurring only in first plot
- c = number of species occurring only in second plot

**Whittaker's Similarity Coefficient** - Whittaker's coefficient (1960) is based on presence-absence of species. Low values indicate stronger similarity, and higher values indicate little or no similarity. The fewer species that samples share, the higher the value of Whittaker's measure (higher diversity or conversely, lower similarity).

Based on presence/absence of species throughout all plots in the stand,

Formula for Whittaker's SI:

$$W = (S/a) - 1$$

Where

S = total number of species occurring in all plots

a = average number of species found on each plot.

**Renkonen's Index (Percent Similarity)** - Renkonen's index (1938) is based on abundance data, specifically, the relative abundance of species. Values range from 0-100, where low values indicate little or no similarity, and higher values indicate stronger similarity. In NED-2, you can specify the measure of abundance (i.e., basal area, stems per unit area, percent cover) that best matches the data source (i.e., overstory, understory, ground cover).

Renkonen's index is computed for all the possible pairs of plots.

The final index is the mean value of the pair indices.

Formula for Renkonen's P:

$$\sum_{\text{species}} (\text{minimum of } P_{1i} \text{ or } P_{2i})$$

Where

$P_{1i}$  = relative value of species  $i$  in plot 1

$P_{2i}$  = relative value of species  $i$  in plot 2

**Morisita-Horn Similarity Index** - The Morisita-Horn index (Morisita 1959, Horn 1966) is based on abundance data and is somewhat sensitive to the most highly abundant species (Magurran 1988). Values range from 0-1, where low values indicate little or no similarity, and higher values indicate stronger similarity. In NED-2, you can specify the measure of abundance (i.e., basal area, stems per unit area, percent cover) that best matches the data source (i.e., overstory, understory, ground cover).

The Formula for the Morisita-Horn index is:

$$\frac{2 \times \sum_{species} (N_{1i} \times N_{2i})}{d_1 + d_2 + N_1 + N_2}$$

Where:

$N_1$  = the total number of individuals in plot 1

$N_2$  = the total number of individuals in plot 2

$N_{1i}$  = the total number of individuals of species i in plot 1

$N_{2i}$  = the total number of individuals of species i in plot 2

And

$$\frac{\sum_{species} N_{1i}^2}{N_1^2} \quad \text{and} \quad \frac{\sum_{species} N_{2i}^2}{N_2^2}$$

## Diversity Program

In addition to the internal diversity calculations available in NED-2, a separate, external program is installed with NED-2 that allows you to calculate any of the NED-2 diversity measures described in this section. Currently, you can calculate measures of similarity for any stand for any time period including the year of inventory, baseline, or any year in a management plan.

1. Launch NED-2.
2. From the Tools menu, click **NED Diversity**.
3. From the Diversity indices dialog, click the **Snapshots** button to pick the file and stand to use in the calculations.
4. From the Choose a snapshot dialog, click the **File** button to pick the NED-2 data file that contains the stands you wish to use.
5. Browse to and select the desired file, and click the **Open** button.
6. From the list of stands, select the stand and the time period (e.g., inventory, baseline).
7. Click **OK**.
8. The Diversity indexes dialog displays values for Sorensen's measure of similarity as shown in Figure 10. Plot-cluster IDs are identified in the first column and along the top of each column.

9. In the left-most pick list in the top-left corner, select the diversity measure you wish to calculate.
10. In the pick list to the right, select a forest layer (overstory, understory, or ground).
11. Check **Include dead** if you wish to include dead observations in the calculation.
12. If you select a quantitative measure (Renkonen's or Morista-Horn), you need to select a measure of abundance (stems per unit area, basal area, or percent cover).
13. As you make selections, NED-2 automatically displays the results of the calculation on the dialog.
14. NED-2 displays the diversity measure for each possible combination of plot-cluster pairs in the stand. In Figure 10, plot-clusters are numbered sequentially in the order they were added during data entry. Also displayed is an overall average based on all of the possible combinations of plot-cluster pairs, as well as a range of values for the stand.
15. If you wish to see a breakdown of abundance values for each plot-cluster by species, click the **Species X Cluster** button. NED-2 displays either stems per unit area, basal area, or percent cover, by plot-cluster and species, depending on the current abundance value selected for the quantitative similarity measure.

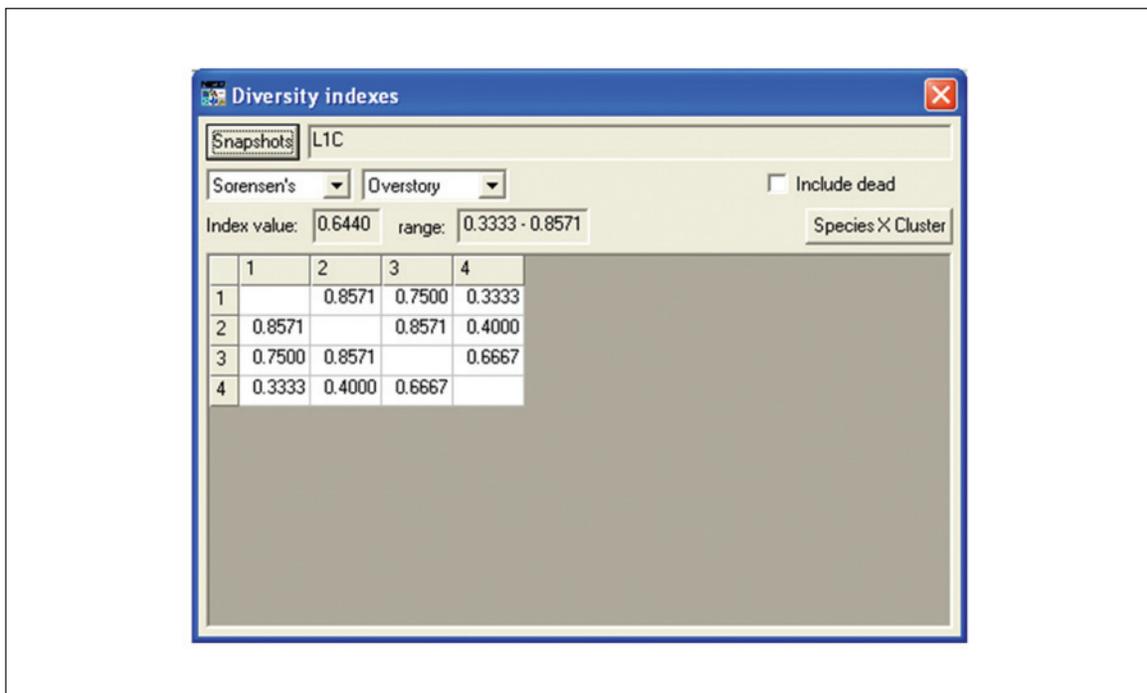


Figure 10. The NED-2 Diversity Measures Program.

## FOREST TYPES

The forest type is based on the species composition of the overstory, and species composition is based on the proportion of total stand basal area represented by each species in the stand.

In calculating the forest type, NED-2 uses the following definitions:

1. **Stands** – Forest types are applied to stands, which are forested areas of reasonably homogeneous species composition and structure. Stand size may vary widely, but is usually in the range of 5 to 100 acres. Large forested areas may therefore contain stands of several forest types.
2. **Characteristic species** – Those species that characterize a given forest type, as shown in the forest type descriptions. Characteristic species usually dictate forest management.
3. **Associated species** – Those species commonly found in a forest type in addition to the characteristic species. A species may be listed as an associated species in any number of forest types.
4. **Pure types** – Those types in which the title species represents at least 80 percent of the stand basal area. Stands that qualify for both a pure and multiple species type will be assigned to the pure type.
5. **Base types** – Typically, those types in which species of a single genus constitute the characteristic species (with some exceptions, such as beech-birch), and they represent at least 50 percent of the stand basal area; these species plus the associated species together represent at least 65 percent of the basal area. This category may include a mixture of species in which a single species or genus dictates management, even though it does not meet the definition (80 percent of the basal area) of a pure stand. Note that base forest types have a more general name than a pure stand of the same species (i.e., “cedar” and “maple” are base types, while “northern white cedar” and “sugar maple” are pure types).
6. **Mixed types** – Do not qualify for either pure or base types as described above, but are comprised of species that characterize pure, base, or other mixed types. At least two or more “characteristic forest types” are represented in a mixed forest type, and at least 50 percent of the stand basal area must be represented by species from these types; these species plus the associated species together represent at least 65 percent of the basal area. Species from any single characteristic forest type must represent at least 10 percent of the stand basal area.

### Pure Forest Types

Any species that represents at least 80 percent of the stand basal area are recognized as a pure type; the type name is the full species common name. Thus, a stand with at least 80 percent of its basal area in eastern white pine is defined as an Eastern White Pine type.

### Base Forest Types

In base forest types, the characteristic species must represent at least 50 percent of total stand basal area; characteristic species plus associated species must represent at least 65 percent of total stand basal area.

Base forest types include the following:

**aspen**

The characteristic species are: balsam poplar, big-tooth aspen, and quaking aspen.

The associated species are: American beech, black cherry, eastern hemlock, gray birch, paper birch, pin cherry, red maple, sugar maple, sweet birch, and yellow birch.

**bay-swamp pocosin**

The characteristic species are: American elm, American holly, Atlantic white cedar, black-gum, cabbage palmetto, Carolina ash, flowering dogwood, laurel oak, loblolly bay, pond cypress, pond pine, red maple, redbay, slash pine, southern magnolia, swamp bay, swamp tupelo, sweetbay, sweetgum, tuliptree, and water oak.

The associated species are: American snowbell, buckwheat tree, dahoon, live oak, loblolly pine, longleaf pine, myrtle dahoon, poison sumac, possumhaw, sand live oak, saw palmetto, scentless bayberry, southern bayberry, southern redcedar, stiff dogwood, swamp titi, titi, wax myrtle, and yaupon.

**beech-birch**

The characteristic species are: American beech and yellow birch.

The associated species are: None.

**beech magnolia**

The characteristic species are: American beech and southern magnolia.

The associated species are: American elm, American sycamore, black ash, black willow, eastern cottonwood, green ash, pin oak, plains cottonwood, red maple, river birch, silver maple, sugarberry, swamp cottonwood, sweetgum, sycamore, tuliptree, and willow.

**beech maple**

The characteristic species are: American beech and sugar maple.

The associated species are: American elm, bitternut hickory, black walnut, common hackberry, hophornbeam, northern red oak, Ohio buckeye, shagbark hickory, slippery elm, white ash, white oak.

**birch**

The characteristic species are: gray birch and paper birch.

The associated species are: American beech, big-tooth aspen, black cherry, eastern hemlock, pin cherry, quaking aspen, red maple, sugar maple, sweet birch, and yellow birch.

**bottomland conifer**

The characteristic species are: balsam fir, Atlantic white cedar, tamarack, black spruce, red pine, eastern white pine, eastern hemlock, and Carolina hemlock.

The associated species are: boxelder, red maple, silver maple, black ash, green ash, balsam poplar, eastern cottonwood, peachleaf willow, pussy willow, river willow, black willow, American elm, and slippery elm.

**bottomland hardwoods**

The characteristic species are: American elm, American sycamore, bald cypress, balsam poplar, black ash, black walnut, black willow, boxelder, eastern cottonwood, green ash, pawpaw, pin oak, plains cottonwood, red maple, river birch, silver maple, sugarberry, swamp cottonwood, sweetgum, sycamore, tuliptree, and willow.

The associated species are: alternate-leaf dogwood, American basswood, American beech, American bladdernut, American holly, American hornbeam, northern white cedar, arroyo willow, balsam fir, Barclay's willow, Bebb willow, big-tooth aspen, black cherry, black spruce, black-gum, bur oak, butternut, chestnut oak, chokecherry, Coastal Plain willow, common hackberry, common persimmon, cottonwood, diamondleaf willow, dune willow, eastern hemlock, eastern white pine, feltleaf willow, flowering dogwood, Geyer's willow, Goodding's willow, gray birch, hazel alder, hickory, honeylocust, larch, laurel willow, loblolly pine, maple, Missouri River willow, narrowleaf willow, northern red oak, northwest sandbar willow, oak, overcup oak, paper birch, peachleaf willow, pecan, pin cherry, planertree, poison sumac, possumhaw, purpleosier willow, pussy willow, quaking aspen, red spruce, river willow, rock elm, roughleaf dogwood, Scouler's willow, serviceberry, shagbark hickory, shellbark hickory, shining willow, silky willow, Sitka willow, slippery elm, southwestern white pine, strapleaf willow, sugar maple, swamp chestnut oak, swamp tupelo, swamp white oak, sweet birch, tamarack, Texas red oak, Virginia pine, walnut, water hickory, water locust, water oak, white ash, white spruce, white willow, willow oak, winged elm, yellow birch, and yellow willow.

**cedar**

The characteristic species are: Northern white cedar and Atlantic white cedar.

The associated species are: balsam fir, red maple, yellow birch, paper birch, tamarack, white spruce, black spruce, red spruce, eastern white pine, balsam poplar, big-tooth aspen, and quaking aspen.

**cherry**

The characteristic species is: black cherry.

The associated species are: American basswood, American beech, big-tooth aspen, cucumber-tree, eastern hemlock, northern red oak, paper birch, pin cherry, quaking aspen, red maple, sugar maple, sweet birch, and yellow birch.

**Douglas-fir**

The characteristic species are: Douglas-fir, grand fir, and lodgepole pine.

The associated species are: incense cedar, ponderosa pine, quaking aspen, western hemlock, western larch, and western white pine.

**Engelmann spruce subalpine fir**

The characteristic species are: Engelmann spruce and subalpine fir.

The associated species are: Douglas-fir, lodgepole pine, mountain hemlock, and western white pine.

**fir**

The characteristic species are: balsam fir and Fraser fir.

The associated species are: red maple, yellow birch, paper birch, Atlantic white cedar, tamarack, white spruce, black spruce, red spruce, eastern white pine, northern white cedar, hemlock, eastern hemlock, and Carolina hemlock.

**grand fir**

The characteristic species are: Douglas-fir and grand fir.

The associated species are: Engelmann spruce, incense cedar, lodgepole pine, ponderosa pine, quaking aspen, subalpine fir, western hemlock, western larch and western white pine.

**hemlock**

The characteristic species are: hemlock, eastern hemlock and Carolina hemlock.

The associated species are: red maple, sugar maple, yellow birch, American beech, tuliptree, red spruce, eastern white pine, black cherry, northern red oak, and American basswood.

**hickory**

The characteristic species are: hickory, mockernut hickory, water hickory, southern shagbark hickory, bitternut hickory, pignut hickory, pecan, shellbark hickory, nutmeg hickory, red hickory, shagbark hickory, sand hickory, and black hickory.

The associated species are: maple, black maple, red maple, buckeye, Ohio buckeye, horse chestnut, ailanthus, American hornbeam, American chestnut, chinkapin, Ozark chinkapin, catalpa, southern catalpa, northern catalpa, hackberry, and eastern redbud.

**live oak maritime**

The characteristic species is: live oak.

The associated species are: cabbage palmetto and southern redcedar.

**loblolly pine-shortleaf pine**

The characteristic species are: eastern redcedar, shortleaf pine and loblolly pine.

The associated species are: red maple, hickory, mockernut hickory, bitternut hickory, pignut hickory, eastern redbud, white fringetree, flowering dogwood, common persimmon, American beech, Carolina buckthorn, white ash, Carolina ash, American witchhazel, American holly, southern redcedar, sweetgum, tuliptree, sweetbay, wax myrtle, swamp tupelo, black-gum, sourwood, redbay, slash pine, longleaf pine, Table Mountain pine, pitch pine, pond pine, Virginia pine, black cherry, white oak, scarlet oak, southern red oak, laurel oak, blackjack oak, water oak, cherrybark oak, willow oak, northern red oak, post oak, black oak, sassafras, common sweetleaf, western red cedar, winged elm, farkleberry, and rusty blackhaw.

**lodgepole pine**

The characteristic species is: lodgepole pine.

The associated species are: Engelmann spruce, ponderosa pine and white fir.

**longleaf pine**

The longleaf pine forest type is a base forest type. The characteristic species is: longleaf pine.

The associated species are: blackgum, blackjack oak, common persimmon, dogwood, loblolly pine, sassafras, shortleaf pine, slash pine, southern red oak, swamp tupelo, sweetgum, and water oak.

**mangroves**

The characteristic species are: American mangrove, black mangrove, and white mangrove.

The associated species are: button mangrove, cabbage palmetto, and West Indian mahogany.

**maple**

The characteristic species are: red maple and sugar maple.

The associated species are: American basswood, American beech, big-tooth aspen, black cherry, cucumber-tree, eastern hemlock, northern red oak, paper birch, pin cherry, quaking aspen, striped maple, sweet birch, yellow-poplar, and white ash.

**maple basswood**

The characteristic species are: American basswood, sugar maple, and black maple.

The associated species are: American elm, bitternut hickory, bur oak, butternut, green ash, hophornbeam, northern red oak, shagbark hickory, shellbark hickory, slippery elm, white ash, and white oak.

**mesic mixed southern pine**

The characteristic species are: American elm, Atlantic white cedar, Carolina ash, loblolly bay, loblolly pine, longleaf pine, pond cypress, pond pine, red maple, slash pine, swamp bay, swamp tupelo, sweetbay, sweetgum, and water oak.

The associated species are: bald cypress, black-gum, blackjack oak, bluejack oak, buckwheat tree, cabbage palmetto, common persimmon, dogwood, flowering dogwood, hickory, laurel oak, live oak, myrtle dahoon, myrtle oak, post oak, sand live oak, sand pine, sassafras, scentless bayberry, shortleaf pine, southern bayberry, southern red oak, southern redcedar, swamp titi, titi, turkey oak, water tupelo, and yaupon.

**oak**

The characteristic species are: oak, white oak, scarlet oak, northern pin oak, Emory oak, southern red oak, bear oak, overcup oak, bur oak, blackjack oak, chinkapin oak, cherrybark oak, pin oak, willow oak, chestnut oak, northern red oak, post oak, black oak, and live oak.

The associated species are: maple, red maple, tree of heaven, hickory, mockernut hickory, water hickory, bitternut hickory, pignut hickory, pecan, shellbark hickory, nutmeg hickory, shagbark hickory, sand hickory, black hickory, American chestnut, hackberry, common hackberry, flowering dogwood, common persimmon, butternut, black walnut, sweetgum, tuliptree, blackgum, pitch pine, black locust, and sassafras.

**pine**

The characteristic species are: jack pine, Table Mountain pine, red pine, pitch pine, and eastern white pine.

The associated species are: red maple, sugar maple, gray birch, hickory, mockernut hickory, bitternut hickory, pignut hickory, pecan, shellbark hickory, shagbark hickory, white ash, yellow-poplar, red spruce, shortleaf pine, loblolly pine, Virginia pine, big-tooth aspen, quaking aspen, chestnut oak, and eastern hemlock.

**plantation fir**

The characteristic species are: Pacific silver fir, balsam fir, white fir, Fraser fir, and grand fir.

The associated species are: None.

**plantation larch**

The characteristic species are: European larch, Japanese larch, tamarack, and western larch.

The associated species are: None.

**plantation pine**

The characteristic species are: jack pine, sand pine, lodgepole pine, shortleaf pine, slash pine, western white pine, longleaf pine, Table Mountain pine, red pine, pitch pine, pond pine, eastern white pine, Scotch pine, loblolly pine and Virginia pine.

The associated species are: None.

**plantation spruce**

The characteristic species are: Norway spruce, white spruce, black spruce, blue spruce, red spruce and Sitka spruce.

The associated species are: None.

**pond pine**

The characteristic species are: Atlantic white cedar and pond pine.

The associated species are: bald cypress, blackgum, eastern white pine, gray birch, hemlock, loblolly bay, loblolly pine, pitch pine, pond cypress, red maple, redbay, slash pine, southern bayberry, southwestern white pine, swamp titi, swamp tupelo, sweetbay, sweetgum, wax myrtle, western white pine, and yellow birch.

**pond pine pocosin**

The characteristic species is: pond pine.

The associated species are: red maple, swamp titi, loblolly bay, sweetgum, sweetbay, southern bayberry, wax myrtle, swamp tupelo, redbay, slash pine, loblolly pine, pond cypress, and bald cypress.

**ponderosa pine**

The characteristic species is: ponderosa pine.

The associated species are: Douglas-fir and grand fir.

**sand pine**

The characteristic species is: sand pine.

The associated species are: Boynton sand post oak, Chapman oak, common persimmon, dwarf live oak, longleaf pine, myrtle oak, and turkey oak.

**southern bottomland hardwoods**

The characteristic species are: boxelder, red maple, silver maple, pawpaw, black mangrove, water hickory, bitternut hickory, cypress, sweetgum, yellow-poplar, southern magnolia, sweetbay, water tupelo, swamp tupelo, blackgum, redbay, slash pine, pond pine, loblolly pine, laurel oak, swamp chestnut oak, cherrybark oak, willow oak, pond cypress, bald cypress, and American elm.

The associated species are: painted buckeye, American hornbeam, mockernut hickory, pignut hickory, shellbark hickory, shagbark hickory, sugarberry, eastern redbud, Atlantic white cedar, buckwheat tree, roughleaf dogwood, stiff dogwood, common persimmon, American beech, Carolina ash, green ash, pumpkin ash, water locust, honeylocust, dahoon, possumhaw, American holly, yellow-poplar, wax myrtle, red mulberry, Ogeechee tupelo, sourwood, spruce pine, longleaf pine, planertree, eastern cottonwood, swamp cottonwood, white oak, southern red oak, overcup oak, water oak, northern red oak, Shumard oak, bottomland post oak, post oak, Texas red oak, Coastal Plain willow, black willow, American snowbell, poison sumac, and winged elm.

**southern pine**

The characteristic species are: loblolly pine, shortleaf pine, and Virginia pine.

The associated species are: bitternut hickory, black hickory, black oak, blackgum, chestnut oak, common persimmon, flowering dogwood, hickory, mockernut hickory, northern red oak, nutmeg hickory, pecan, pignut hickory, pitch pine, red maple, sand hickory, scarlet oak, shagbark hickory, shellbark hickory, sweetgum, water hickory, and white oak.

**southern scrub oak**

The characteristic species are: sand live oak, bluejack oak, turkey oak, runner oak, blackjack oak, myrtle oak, and live oak.

The associated species are: common persimmon and saw palmetto.

**spruce**

The characteristic species are: black spruce, red spruce, and white spruce.

The associated species are: Atlantic white cedar, northern white cedar, eastern hemlock, eastern white pine, Fraser fir, Pacific silver fir, paper birch, red maple, and yellow birch.

**tropical hardwoods**

The characteristic species are: false mastic, false tamarind, Florida poisontree, gumbo limbo, lancewood, leadwood, live oak, redbay, sea torchwood, tietongue, and white bully.

The associated species are: None.

**xeric mixed southern pine**

The characteristic species are: shortleaf pine, Table Mountain pine, pitch pine, and Virginia pine.

The associated species are: red maple, gray birch, hickory, Atlantic white cedar, flowering dogwood, American holly, eastern redcedar, sweetgum, yellow-poplar, sweetbay, swamp tupelo, blackgum, sourwood, eastern white pine, loblolly pine, black cherry, white oak, scarlet oak, southern red oak, blackjack oak, chinkapin oak, willow oak, chestnut oak, northern red oak, post oak, black oak, and sassafras.

**yellow poplar**

The characteristic species is: yellow-poplar.

The associated species are: red maple, sugar maple, yellow birch, sweet birch, paper birch, American beech, cucumber-tree, big-tooth aspen, quaking aspen, pin cherry, northern red oak, American basswood, and eastern hemlock.

**Mixed Forest Types**

Mixed forest types are comprised of species from two or more characteristic forest types, which may be pure, base, or other mixed types.

Mixed forest types include the following:

**Allegheny hardwoods**

The characteristic types are: cherry and northern hardwoods.

The associated species are: American basswood, bigtooth aspen, cucumber-tree, eastern hemlock, northern red oak, paper birch, pin cherry, quaking aspen, striped maple, sweet birch, yellow-poplar, and white ash.

**Appalachian hardwoods**

The characteristic types are: northern hardwoods and yellow-poplar.

The associated species are: balsam fir, striped maple, buckeye, serviceberry, pawpaw, sweet birch, paper birch, American hornbeam, hickory, bitternut hickory, common hackberry, eastern redbud, flowering dogwood, white ash, black ash, green ash, American witchhazel, butternut, black walnut, sweetgum, tuliptree, cucumber-tree, mountain magnolia, southern magnolia, umbrella-tree, sweetbay, swamp tupelo, blackgum, hophornbeam, red spruce, shortleaf pine, eastern white pine, loblolly pine, Virginia pine, cottonwood, bigtooth aspen, quaking aspen, pin cherry, black cherry, oak, white oak, southern red oak, chestnut oak, northern red oak, black locust, sassafras, bald cypress, northern white cedar, basswood, American basswood, hemlock, eastern hemlock, Carolina hemlock, and American elm.

**aspen northern hardwoods**

The characteristic types are: aspen and northern hardwoods.

The associated species are: None.

**aspen pine**

The characteristic types are: aspen and pine.

The associated species are: None.

**aspen spruce-fir**

The characteristic types are: aspen and spruce-fir.

The associated species are: None.

**aspen-birch**

The characteristic types are: aspen and birch.

The associated species are: American beech, black cherry, eastern hemlock, red maple, sugar maple, sweet birch, and yellow birch.

**bottomland mixed**

The characteristic types are: bottomland conifer and bottomland hardwoods.

The associated species are: None.

**hemlock hardwoods**

The characteristic types are: hemlock and northern hardwoods.

The associated species are: striped maple, sweet birch, paper birch, white ash, yellow-poplar, cucumbertree, red spruce, eastern white pine, bigtooth aspen, quaking aspen, pin cherry, black cherry, northern red oak, and American basswood.

**longleaf pine-scrub oak**

The characteristic types are: longleaf pine and southern scrub oak.

The associated species are: southern bayberry, swamp titi, and wax myrtle.

**mesic mixed pine-hardwoods**

The characteristic types are: mesic mixed southern pine and southern mixed mesic hardwoods.

The associated species are: American holly, buckwheat tree, cherrybark oak, farkleberry, flowering dogwood, hawthorn, littleleaf titi, mockernut hickory, myrtle dahoon, northern red oak, pignut hickory, possumhaw, post oak, redbay, rusty blackhaw, scarlet oak, scentless bayberry, shagbark hickory, shortleaf pine, sourwood, southern bayberry, southern red oak, spruce pine, swamp chestnut oak, yellow-poplar, Virginia pine, wax myrtle, white ash, white oak, and yaupon.

**northern hardwoods**

The characteristic types are: beech-birch and maple.

The associated species are: balsam fir, Fraser fir, striped maple, mountain maple, yellow buckeye, serviceberry, pawpaw, sweet birch, paper birch, American hornbeam, hickory, bitternut hickory, common hackberry, flowering dogwood, white ash, black ash, green ash, American witchhazel, butternut, black walnut, yellow-poplar, cucumber-tree, hophornbeam, white spruce, red spruce, eastern white pine, bigtooth aspen, quaking aspen, pin cherry, black cherry, chokecherry, white oak, southern red oak, northern red oak, black oak, mountain ash, northern white cedar, basswood, American basswood, American basswood, hemlock, eastern hemlock, elm, American elm, and rock elm.

**oak bottomland hardwoods**

The characteristic types are: bottomland hardwoods and oak.

The associated species are: None.

**oak northern hardwoods**

The characteristic types are: northern hardwoods and oak-hickory.

The associated species are: American basswood, bigtooth aspen, black cherry, black locust, black walnut, blackgum, butternut, common persimmon, cucumber-tree, eastern hemlock, flowering dogwood, paper birch, pin cherry, pitch pine, quaking aspen, sassafras, striped maple, sweet birch, sweetgum, tree of heaven, yellow-poplar, and white ash.

**oak northern pine**

The characteristic types are: oak-hickory and pine.

The associated species are: None.

**oak southern pine**

The characteristic types are: oak-hickory and southern pine.

The associated species are: black locust, black walnut, blackgum, butternut, common persimmon, flowering dogwood, oak, pin oak, pitch pine, red maple, sassafras, swamp white oak, sweetgum, tree-of-heaven, and yellow-poplar.

**oak yellow poplar**

The characteristic types are: oak and yellow-poplar.

The associated species are: American basswood, American beech, bigtooth aspen, cucumbertree, eastern hemlock, paper birch, pin cherry, quaking aspen, red maple, sugar maple, sweet birch, and yellow birch.

**oak-hickory**

The characteristic types are: hickory and oak.

The associated species are: striped maple, red maple, sugar maple, buckeye, tree of heaven, serviceberry, pawpaw, yellow birch, sweet birch, paper birch, American hornbeam, chinkapin, eastern redbud, alternate-leaf dogwood, roughleaf dogwood, flowering dogwood, common persimmon, American beech, white ash, green ash, American witchhazel, butternut, black walnut, eastern redcedar, mountain laurel, sweetgum, tuliptree, cucumber-tree, blackgum, hophornbeam, sourwood, shortleaf pine, longleaf pine, Table Mountain pine, red pine, pitch pine, eastern white pine, loblolly pine, Virginia pine, bigtooth aspen, quaking aspen, American plum, black cherry, shingle oak, bluejack oak, turkey oak, chinkapin oak, great laurel, black locust, sassafras, gum bully, basswood, eastern hemlock, winged elm, and American elm.

**pine hardwoods**

The characteristic types are: northern hardwoods and pine.

The associated species are: American basswood, bigtooth aspen, bitternut hickory, black cherry, black hickory, chestnut oak, cucumber-tree, eastern hemlock, gray birch, hickory, loblolly pine, mockernut hickory, northern red oak, nutmeg hickory, paper birch, pecan, pignut hickory, pin cherry, quaking aspen, red spruce, sand hickory, shagbark hickory, shellbark hickory, shortleaf pine, striped maple, sweet birch, tuliptree, Virginia pine, water hickory, and white ash.

**pine hemlock**

The characteristic types are: hemlock and pine.

The associated species are: American basswood, American beech, bigtooth aspen, bitternut hickory, black cherry, black hickory, chestnut oak, gray birch, hickory, loblolly pine, mockernut hickory, northern red oak, nutmeg hickory, pecan, pignut hickory, quaking aspen, red maple, red spruce, sand hickory, shagbark hickory, shellbark hickory, shortleaf pine, sugar maple, yellow-poplar, Virginia pine, water hickory, white ash, and yellow birch.

**sand pine-southern scrub oak**

The characteristic types are: sand pine and southern scrub oak.

The associated species are: Chapman oak, common persimmon, dwarf live oak, longleaf pine, and saw palmetto.

**southern mixed mesic hardwoods**

The characteristic types are: Appalachian hardwoods and beech magnolia.

The associated species are: None.

**spruce-fir**

The characteristic types are: fir and spruce.

The associated species are: American beech, northern white cedar, Atlantic white cedar, black cherry, cottonwood, eastern hemlock, eastern white pine, gray birch, hemlock, mountain ash, mountain maple, northern red oak, paper birch, pin cherry, red maple, red pine, southwestern white pine, striped maple, sugar maple, tamarack, western white pine, yellow birch, and yellow buckeye.

**spruce-northern hardwoods**

The characteristic types are: northern hardwoods and spruce-fir.

The associated species are: American basswood, Atlantic white cedar, bigtooth aspen, black cherry, cucumber-tree, northern white cedar, eastern hemlock, eastern white pine, northern red oak, paper birch, pin cherry, quaking aspen, striped maple, sweet birch, tamarack, yellow-poplar, and white ash.

**white pine-hemlock**

The characteristic types are: hemlock and pine.

The associated species are: alternate-leaf dogwood, American basswood, American beech, American elm, American witchhazel, northern white cedar, balsam fir, basswood, bigtooth aspen, black ash, black cherry, black locust, black oak, blackgum, chestnut oak, flowering dogwood, gray birch, hemlock, hickory, hophornbeam, mountain laurel, mountain maple, northern red oak, paper birch, pin cherry, post oak, quaking aspen, red maple, red spruce, scarlet oak, shortleaf pine, sourwood, striped maple, sugar maple, swamp tupelo, sweet birch, Table Mountain pine, yellow-poplar, Virginia pine, white ash, white oak, white spruce, and yellow birch.

**xeric mixed pine-hardwoods**

The characteristic types are: oak-hickory and xeric mixed southern pine.

The associated species are: red maple, eastern redbud, flowering dogwood, common persimmon, yellow-poplar, swamp tupelo, blackgum, sourwood, Table Mountain pine, and winged elm.

**yellow-poplar bottomland hardwoods**

The characteristic types are: bottomland hardwoods and yellow poplar.

The associated species are: maple, boxelder, black maple, red maple, silver maple, buckeye, Ohio buckeye, serviceberry, Saskatoon serviceberry, common serviceberry, Allegheny serviceberry, pawpaw, birch, yellow birch, sweet birch, river birch, hackberry, sugarberry, common hackberry, eastern redbud, Kentucky yellowwood, alternate-leaf dogwood, flowering dogwood, American beech, ash, white ash, Carolina ash, black ash, green ash, silverbell, Carolina silverbell, magnolia, cucumber-tree, mountain magnolia, bigleaf magnolia, umbrella-tree, sweetbay, tupelo, blackgum, hophornbeam, sourwood, sycamore, American sycamore, eastern cottonwood, black cherry, southern red oak, northern red oak, American basswood, poison sumac, elm, American elm, slippery elm, and rock elm.

## Prescription Forest Type

Prescription forest types are a subset of forest types that occur in nature. Published silvicultural studies have mostly been limited to the more common, widespread, and commercially valuable forest types. Therefore, NED-2 has established a set of goals based on desired future conditions (DFCs) of several well-known forest types, and these are collectively referred to as prescription forest types.

The analysis of specific timber goals is governed by the same logic regardless of prescription forest type, but there are slight differences in some conditions depending on the forest type.

NED-2 attempts to map your forest type into one of the prescription forest types as shown in Table 5.

NOTE: Single-species forest types are pure stands with at least 80 percent of the stand basal area comprised by that species.

## Wildlife Forest Type (HAM)

This is the forest type used for wildlife analysis in NED-2. In evaluating wildlife goals, NED-2 attempts to map your forest type into one of the Habitat Assessment Model (HAM) (Cleveland and Finney 1998) forest types as shown in Table 5. If a forest type is not listed in the table, then NED-2 cannot evaluate the wildlife goals for that type.

**Table 5. Prescription and wildlife forest types in NED-2.**

NED forest type	Prescription type	HAM type
cherry	Allegheny hardwoods	NORTHERN HARDWOOD
Allegheny hardwoods	Allegheny hardwoods	NORTHERN RED OAK
yellow poplar	Appalachian hardwoods	NORTHERN RED OAK
Appalachian hardwoods	Appalachian hardwoods	NORTHERN HARDWOOD
oak yellow poplar	Appalachian hardwoods	NORTHERN RED OAK
southern mixed mesic hardwoods	Appalachian hardwoods	WHITE PINE/RED OAK/RED MAPLE
yellow poplar bottomland hardwoods	Appalachian hardwoods	RED MAPLE (WET SITES)
aspen	aspen-birch	ASPEN
birch	aspen-birch	BIRCH
aspen northern hardwoods	aspen-birch	NORTHERN HARDWOOD
aspen pine	aspen-birch	ASPEN
aspen spruce-fir	aspen-birch	SPRUCE-FIR
aspen-birch	aspen-birch	ASPEN
hemlock	hemlock-hardwoods	EASTERN HEMLOCK
bottomland mixed	hemlock-hardwoods	RED MAPLE (WET SITES)
hemlock hardwoods	hemlock-hardwoods	EASTERN HEMLOCK
beech magnolia	northern hardwoods	NORTHERN HARDWOOD
beech-birch	northern hardwoods	BIRCH
maple	northern hardwoods	RED MAPLE (WET SITES)
northern hardwoods	northern hardwoods	NORTHERN HARDWOOD
bay-swamp pocosin	oak-hickory	RED MAPLE (WET SITES)
hickory	oak-hickory	NORTHERN RED OAK
live oak maritime	oak-hickory	NORTHERN RED OAK
oak	oak-hickory	NORTHERN RED OAK
southern bottomland hardwoods	oak-hickory	RED MAPLE (WET SITES)
southern scrub oak	oak-hickory	NORTHERN RED OAK
oak bottomland hardwoods	oak-hickory	RED MAPLE (WET SITES)
oak northern pine	oak-hickory	WHITE PINE/RED OAK/RED MAPLE
oak southern pine	oak-hickory	WHITE PINE
oak-hickory	oak-hickory	NORTHERN RED OAK
other hardwoods	oak-northern hardwoods	NORTHERN HARDWOOD

(Table 5 continued on next page)

**Table 5 (continued). Prescription and wildlife forest types in NED-2.**

NED forest type	Prescription type	HAM type
bottomland hardwoods	oak-northern hardwoods	RED MAPLE (WET SITES)
oak northern hardwoods	oak-northern hardwoods	NORTHERN RED OAK
Douglas-fir	spruce-fir	SPRUCE-FIR
Engelmann spruce - subalpine fir	spruce-fir	SPRUCE-FIR
fir	spruce-fir	BALSAM FIR
grand fir	spruce-fir	BALSAM FIR
plantation fir	spruce-fir	BALSAM FIR
plantation larch	spruce-fir	BALSAM FIR
plantation spruce	spruce-fir	SPRUCE-FIR
spruce	spruce-fir	RED SPRUCE
spruce-fir	spruce-fir	SPRUCE-FIR
other mixedwoods	spruce-hardwoods	WHITE PINE/RED OAK/RED MAPLE
spruce-northern hardwoods	spruce-hardwoods	NORTHERN HARDWOOD
other softwoods	white pine	WHITE PINE
bottomland conifer	white pine	BALSAM FIR
cedar	white pine	BALSAM FIR
loblolly pine-shortleaf pine	white pine	WHITE PINE
lodgepole pine	white pine	WHITE PINE
longleaf pine	white pine	WHITE PINE
mesic mixed southern pine	white pine	WHITE PINE
pine	white pine	WHITE PINE
plantation pine	white pine	WHITE PINE
pond pine	white pine	WHITE PINE
pond pine pocosin	white pine	WHITE PINE
ponderosa pine	white pine	WHITE PINE
sand pine	white pine	WHITE PINE
southern pine	white pine	WHITE PINE
xeric mixed southern pine	white pine	WHITE PINE
longleaf pine-scrub oak	white pine	WHITE PINE
mesic mixed pine-hardwoods	white pine	WHITE PINE/RED OAK/RED MAPLE
pine hardwoods	white pine	WHITE PINE/RED OAK/RED MAPLE
pine hemlock	white pine	EASTERN HEMLOCK
sand pine-southern scrub oak	white pine	WHITE PINE
white pine-hemlock	white pine	WHITE PINE
xeric mixed pine-hardwoods	white pine	WHITE PINE/RED OAK/RED MAPLE

## Forest Type Program

If you want to examine how NED-2 calculates a forest type, you may run an external program that calculates forest type using the NED-2 algorithms. Through this program, you may evaluate the species composition that resulted in the forest type classification. This program is installed with NED-2 and is accessed from the Tools menu.

1. Launch NED-2.
2. From the Tools menu, click **NED Forest Type**.
3. From the NED Forest Type program, select the **Data** tab.
4. Find your species and enter basal area values manually. Or, if you prefer, load a stand from an existing NED-2 file instead of entering basal area values by hand.
5. Click on the other tabs (i.e., **Pure**, **Base**) to look for the calculated forest type. The answer appears on one of the tabs, depending on the mixture of species entered.
6. On the Base and Mixed tabs, double-click the row of any of the plausible forest types to determine the characteristic and associated species for that type. If your stand contains one of the characteristic or associated species, it is displayed with the basal area value you provided in step 4.

# Chapter 5 - Management Planning

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## DEFINING MANAGEMENT PLANS

Forest planning involves a cycle of events, starting with establishing goals and measurement criteria, analyzing current conditions, testing alternative action plans, possibly refining goals, and continuing with additional analyses as necessary. The cycle moves into management action with the selection of the most appropriate set of treatments and conditions that most nearly satisfy landowner objectives. Ideally, the chosen management scenario reflects the most desirable trade-offs in outcomes. Through this process you determine what are the most appropriate actions and conditions. Eventually, after monitoring and evaluation of management actions, the planning cycle starts again. This chapter describes planning as it relates to developing a baseline and developing and comparing management plans, also called treatment plans.

Baseline and treatment plan development involve simulation of forest growth and treatment (cuttings). Therefore, planning within NED-2 also involves the selection of forest simulation models and the design of treatments that can be applied in treatment plans.

The baseline establishes a starting point from which all management plans begin. Typically, the forest stands under management have not been inventoried in the same year. In order to get the most realistic assessment of current conditions, NED-2 requires that all stands be brought up to date in a common year—a baseline, in which one or more stands are simulated up to the baseline year that you have specified. The baseline year is the year in which a NED-2 plan starts.

The baseline and all treatment plans are developed on a planning grid, with a series of rows representing stands, and columns representing years. You will interact with the planning grid to select models and treatments and to adjust the number of years in your planning cycle.

The planning grid also displays the results of simulated data for any year specified in your management plan. If you have simulated treatments, you may view data before and after treatments have been applied, allowing you to adjust treatment parameters where necessary. Using the on-screen display, you monitor stand conditions over time (e.g., stems per unit area, basal area, volume, biomass, stand diameter). You may want to design treatments to optimize the development of conditions within a pre-determined time frame, or you may want to know when your objectives are reached by utilizing a minimum number of treatments. For some objectives, you may want to know how long a given set of conditions may exist over time.

In addition to analyzing stand conditions in the planning grid, NED-2 supplies several pre-defined goals that can be analyzed at various points in time under any simulated management alternative; vegetation tables and reports are also available for analysis of simulated forest conditions.

## About Simulation

Simulation is of paramount importance in forest planning, because it allows for testing and evaluation of alternative management scenarios (plans) without requiring an investment in actual treatments, or needing to wait for the forest to grow.

NED-2 does not complete the actual forest simulation per se, but it controls the flow of data to and from external forest simulation models that are installed with NED-2.

If your inventory design included multiple plots per cluster, NED-2 establishes one “pseudoplot” for each plot type (i.e., overstory, understory, ground cover). A pseudoplot is a single plot, generated by NED-2, that represents all the data in a given cluster within a given plot type. During the generation of a pseudoplot, NED-2 converts the original subplot data into per-unit area values and obtains the average over all subplots. For example, if a given stand has 20 plot-clusters (sample points), each with 3 understory plots (subplots) per cluster, NED-2 generates 20 pseudoplots for the understory data. This is necessary to simplify the data provided to the simulator in baseline and treatment plan development.

Some limitations exist that you should be aware of, mostly pertaining to the use of the Forest Vegetation Simulator (FVS) and its model variants. NED-2 may prompt you in the event that any of the following conditions occur in your data. It is possible that other limitations may exist that have not been uncovered, for which the effect in NED-2 may be unpredictable.

The following are known limitations regarding simulation of the baseline and treatment plans:

1. You cannot have more than 99 plots in any stand.
2. You cannot have more than 999 records in one cluster.
3. You cannot have more than 1,350 records for stems  $\geq 1$  inch diameter at breast height (dbh) in the overstory and understory combined.
4. Only records with growth form = “tree” are simulated by FVS. Records of species with growth forms other than “tree” are maintained from year to year without changing size or other attributes.
5. Records with growth form = “tree” but of unknown species are simulated as “other commercial hardwoods,” to match the requirements of the selected FVS variant. Different variants have different species substitutions. For example, NED-2 may substitute unknown tree species as “Other hardwood,” “Other softwood,” “Non-commercial,” or even “Other juniper” depending on the selected FVS variant.
6. If NED-2 does not know the species at all, such as when the species remains unknown or is an “unknown species,” it is left out of simulation entirely.

## Defining Treatments

Treatments are mostly comprised of cutting specifications designed to alter forest structure and development as part of an overall management strategy based on predefined goals. In order to apply treatments within a management plan, you must first establish one or more treatments for each simulation model used in your plans. The kinds of treatments available depend on the forest simulation model. Establishing a treatment involves selecting one from the list of pre-supplied standard treatments and accepting the default parameters or modifying the parameters as necessary. Inside your NED-2 file, NED-2 maintains lists of your treatments according to the forest simulation models you have associated with your stands. Once you have established one or more treatments, you may apply them in your management plans.

If desired, you may reuse or share treatments between NED-2 files, by exporting your treatment definitions into external files for future access. This saves time and provides for consistent simulation of treatment designs across management units.

## Getting More Information on Treatment Simulators

The implementation of treatments is controlled by the simulator under which the treatments have been selected. The following steps describe how to view a list of plant species (and codes) recognized by a simulator, and to obtain more detailed information through web links (subject to availability).

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under **Planning**, click **Define Treatments**.
3. In the Options Pane, select a forest simulation model under the list of simulation models shown to the far left.
4. In the Work Pane, click the **Simulator information** tab.
5. Click **Visit web site** to obtain information about the simulator. If you do not have access to the Internet, refer to Dixon (2002).
6. If desired, click **Set as default** to establish a default simulator for treatment definition. If the simulator you are viewing is already set as the default, the **Set as default** button is disabled. NED-2 automatically starts with your default simulation model whenever you click **Define Treatments** in the Navigation Pane. This setting does not affect the selection of simulators in baseline generation or planning.

## Treatments and Implementation of the Cut

It may be easier to design a treatment with some knowledge of how the cut is implemented by the simulator. A variety of silvicultural manipulations may be simulated in NED-2, using the FVS in the background. Treatments that involve cutting operate under two general approaches for the removal of trees. In one approach, referred to as the priority-weighting scheme, FVS assigns individual removal priorities to each tree record. In the other approach, which is based on the establishment of a group or class of tree records, FVS essentially distributes the removals evenly among all trees within the class (Dixon 2002). The latter approach is referred to as a diameter-limit thinning in FVS, as classes of trees are often established for a specific segment of diameter distribution (Dixon 2002). The FVS diameter-limit thinning is not to be confused with the logging practice of diameter-limit cutting.

By understanding the rules by which trees will be removed according to the various treatment names, you can decide which approach best approximates the kind of cut you are trying to design.

**Treatments using the priority-weighting of individual trees**—Under the priority-weighting tree removal model, you may modify stand density by selecting a treatment that involves thinning from above or below, or using Stand Density Index (Reineke 1933). Generally, each tree record is assigned a removal priority according to its diameter and species. Additionally, when thinning from below, smaller diameters are given more priority for removal, and when thinning from above, larger diameters are given more priority for removal. Trees may be removed until a user-set residual has been met, or they may be removed according to a user-set proportion of each tree record (cutting efficiency). Residual targets apply to the defined range of tree diameters and species and do not necessarily reflect residual stand conditions. NED-2 treatments and templates that follow the individual tree removal model include the following:

- Custom cut 1
- Seed tree
- Shelterwood seed cut
- Thin from below/thin from above
- Thin using stand density index if thinning from above or below

**Treatments using classes of trees under the diameter-limit model**—This approach distributes cutting evenly among a group or class of trees, such as a specific segment of the diameter distribution, or by limiting the cut to a single species, species group, or all species. Instead of assigning a removal priority to each tree as above, cutting occurs uniformly throughout the class of trees that meet the diameter and/or species criteria, and cutting is regulated according to a user-set residual or a user-set proportion of each tree record (cutting efficiency). NED-2 treatments and templates that allow you to treat classes of trees collectively for removal include the following:

- Custom cut 2
- Clearcut
- Row thinning
- Shelterwood removal cut
- Thin using stand density index if thinning throughout diameter range

For further reading on the simulation of stand manipulations and tree removals, refer to the FVS documentation (Dixon 2002).

### **Treatment Parameters**

Once you have selected a treatment, you may customize the treatment according to your needs. Treatments are customized according to one or more parameters described as follows. These parameters are used by the FVS and have the same meaning regardless of treatment type or category, but subtle differences exist in how they are used depending on the treatment type.

**Cutting efficiency** - This is the proportion of trees per unit area represented by a tree record that is to be removed in any treatment (Dixon 2002). In NED-2, the default cutting efficiency is 100 percent, meaning all the trees represented by a tree record are removed. Cutting

efficiency must range between 0 and 100 and can be changed to suit your needs. In some cases, where residual targets are specified, the simulation model ignores the user-specified cutting efficiency and dynamically calculates a cutting efficiency necessary to achieve the target. For the following treatments, the simulation model does not dynamically adjust the cutting efficiency: thin from above or below, seed tree, custom cut 1, and shelterwood seed cut. If the cutting efficiency is set too low, the simulation model may not be able to obtain the user-set residual for these treatments.

**Residual basal area (BA)** - The target residual basal area per acre/hectare for a given treatment.

**Residual trees per acre (TPA)** - The target residual number of trees per acre/hectare for a given treatment.

**Species Preference** - A numeric value that affects the removal priority for a given species. The default value is zero for all species, and values may be positive or negative. The species preference influences the removal priority of a tree, for those treatments that remove trees based on individual tree priorities (custom cut 1, thin from above or below, etc. as described in the topic, "Treatments and Implementation of the Cut"). For these treatments only, the tree with the largest removal priority is removed first (for example, a tree with a removal priority of 10 is removed before a tree with priority 2, and a tree of priority 2 is removed before a tree with priority -5, and so on). Thereafter, trees are selected for removal, in descending order of removal priority, until the residual density objective is achieved. If a user does not alter this parameter, the dbh is used to determine order of removal. If more than one species is being assigned a preference value, different preference values may be assigned to each species.

**Minimum dbh** - The lower boundary of the range of diameters intended for treatment.

**Maximum dbh** - The upper boundary of the range of diameters intended for treatment.

**Stand Density Index (SDI)** - The target SDI for a given treatment. SDI is a measure of stocking which describes density. Treatments that specify SDI are used in conjunction with a cutting control flag (see next description). Note that SDI is not to be confused with stand relative density as described by Ernst and Knapp (1985). See Stout and Nyland (1986) for a comparison of the two measures in Allegheny Hardwood stands.

**Cutting Control** - A value that is used only with SDI. It determines which approach to follow for removing trees to a desired residual SDI. If the target SDI is nonzero and the cutting control value is set to "thin throughout the diameter range" in NED-2, Dixon (2002) explains that "...cutting occurs uniformly throughout the specified dbh range until the target is met (the cutting efficiency parameter is ignored and the cutting efficiency needed to complete the thinning is automatically computed by the simulation model)." If the target SDI is not zero and the cutting control flag is set to "thin from above or below" in NED-2, then the cutting efficiency parameter is used, and trees are removed according to individual tree priorities as described in the topic on treatments and implementation of the cut. Dixon (2002) further explains that "...if the cutting efficiency parameter is set so low that the target cannot be reached, the cutting efficiency is recalculated so that the target is met."

## Adding Standard Treatments

Standard treatments have built-in, pre-defined parameters, but these parameters can be adjusted to suit your needs.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Define Treatments**.
3. In the Options Pane, select a forest simulation model under the list of simulators shown to the far left.
4. Click the **Add treatment** button above the list of simulators.
5. From the template pick list, select one of the pre-defined treatments.
6. Review the settings (parameters) of the treatment and modify them as needed.
7. Change the treatment name to one that helps you remember the specifics of the treatment (optional).
8. Supply a treatment description (optional).
9. Double-click on the treatment symbol in the upper right-hand corner to select a different image that you wish to use to represent the treatment in the planning grid (optional).
10. Click **OK** to accept the treatment. This adds the treatment to the list of available treatments under the current forest simulator. Click **Cancel** if you do not want to accept the treatment and wish to exit. Click **Reset** if you want to continue working on the treatment by starting over with the initial treatment parameters.

## Adding Custom Treatments

You may customize any of the standard treatments by modifying parameters. Thus, any standard treatment can become a custom treatment. However, NED-2 provides a couple of custom treatment templates that allow you to adjust parameters to match your desired conditions. These custom templates are referred to as custom cut 1 and custom cut 2.

## Editing Existing Treatments in a Treatment Set

Once you have added a treatment to a treatment set, you may modify it at any time. However, if you have previously simulated a plan, you will lose all simulated data by modifying the treatment parameters.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Define Treatments**.
3. Select the forest simulation model that contains the treatment to modify. In the Options Pane, the forest simulators are displayed to the far left. Your existing treatments are displayed under the simulator.
4. Under the forest simulator, click once on the name of the treatment to modify.
5. In the Work Pane, from the **Treatment information** tab, click the **Edit Settings** button.
6. Adjust the parameters as necessary.
7. Click **OK** when you are finished modifying parameters. Click **Cancel** if you do not want to accept the treatment and wish to exit. Click **Reset** if you want to continue working on the treatment by starting over with the initial treatment parameters.

## Deleting Existing Treatments from a Treatment Set

Once you have added a treatment to a treatment set, you may remove it at any time. However, if you have previously simulated a plan that contains the treatment you intend to remove, you will lose all simulated data in the stands that contain the treatment.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Define Treatments**.
3. Select the forest simulation model that contains the treatment to modify. In the Options Pane, the forest simulators are displayed to the far left. Your existing treatments are displayed under the simulator.
4. Under the forest simulator, click once on the name of the treatment to delete.
5. Click the **Delete treatment** button above the list of simulators.
6. If you have simulated plans that contain your treatment, NED-2 warns you that it will delete the associated plan data. Click **Yes** if you wish to delete the treatment.

## Storing Treatment Definitions in an External File

To facilitate sharing or reapplying the same treatment definitions among several ownerships, properties, or users, you may export treatments to external files. This saves time later by allowing treatments to be imported into new NED-2 data files instead of defining the same treatments repeatedly.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Define Treatments**.
3. In the Options Pane of the lower-left corner of the NED-2 window, click **Store**. The Export Treatments dialog opens. Only the treatments in the current (active) NED-2 file are available.
4. Choose which treatments to store.
5. At the top of the dialog, click **File** to specify a file name and location. If you pick an existing file, you cannot append to it, and you are prompted to overwrite the file.

External NED-2 treatment files have the extension **.tkb2**.

## Importing Treatments

Rather than defining treatments repeatedly, you may import treatments from existing NED-2 data files and from external NED-2 treatment definition files.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Define Treatments**.
3. In the Options Pane of the lower-left corner of the NED-2 window, click **Retrieve**. The Import Treatments dialog opens.
4. Click **File**.
5. At the bottom of the Open file dialog, in **Files of type**, choose whether to import treatments from a NED-2 data file (.mdb) or a NED-2 treatment definitions file (.tkb2).
6. Browse to and select the file containing the treatments to import.
7. Choose the treatments to import.
8. Click **Add to existing treatments** if you want the incoming treatments to be added to your existing treatments, or click **Replace current treatments** if you want to replace all existing treatments with the ones you are importing.
9. Click **OK**.

## Choosing Simulation Models

### About Growth Models

The processes of forest growth and mortality have been carefully studied in a variety of forest types across the continental United States. Researchers have incorporated site information, species composition, density, and other factors into models that allow us to simulate forest growth and mortality over time.

A growth model, also called a forest growth and yield simulator, is used to simulate forest growth and mortality, and the model you decide to use depends on the forest type and the geographic area of a given stand.

Currently, NED-2 provides the following growth models, which are a subset of the variants in the FVS:

- Northeast Variant
- Southern Variant
- Central States Variant
- Lake States Variant
- Blue Mountain Variant
- East Cascades Variant
- Inland Empire Variant
- Pacific Northwest Variant

You should select the most suitable growth model for each of your stands. For any stand, it is recommended (though not required) that you use the same growth model in management plans as you used to develop the baseline.

### About Regeneration Models

Few practical forest regeneration models are available for simulation. Modeling forest regeneration is not a simple task and there are many variables involved. Currently, NED-2 provides for regeneration of tree seedlings using the Forest Vegetation Simulator (FVS). You have a choice of using FVS (the default selection) or not using any regeneration model.

### Selecting Models

Models are used to simulate forest growth and mortality, and tree regeneration.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Baseline** if you are just starting the planning process. New management plans inherit the same models for all stands as used for the baseline. If desired, you may change models in any management plan, so that different plans use different models which also may be different from models used in the baseline. To change models in management plans, click **Develop treatment plans** and select the plan to modify.

3. From either baseline or plan development, double-click in the **model** column of any given stand. This launches the Simulation models dialog. A warning appears stating that if you change models, all existing simulated data is erased. NED-2 requires that changes to models in the baseline and in management plans require data to be re-simulated. Changing models in management plans does not result in changes to the baseline. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with model selection. Otherwise, click **Yes** to continue.
4. From the Simulation models dialog, make a selection from the **Growth simulators** list.
5. If you wish to apply tree regeneration during growth simulation, check **Apply regeneration**.
6. If you want to reflect the current model selection for other stands at the same time, check **Set models for other stands**.
7. From the Simulation models dialog, click **OK** to accept the changes.

### Establishing Default Simulation Models

NED-2 maintains default simulation models that are automatically applied to new stands. The only way to review the current default model settings is to examine the simulation models of any given stand after you have begun baseline development and before you change any model selections.

Changes to the defaults do not affect existing stands.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Baseline**.
3. Double-click in the model column of any given stand. A warning appears stating that if you change models, all existing simulated data is erased. Establishing default simulation models results in a loss of simulated data. Click **Yes** to continue.
4. From the Simulation models dialog, check **Make these the default settings for future stands**.

### Establishing a Common Baseline of Data

If a management unit is comprised of several forest stands, and those stands are inventoried over a range of years, it is necessary to establish a common point in time—a baseline—from which to analyze conditions across the landscape. Having a baseline is critical to be reasonably sure that you are working with the most relevant information without having to re-inventory all forest stands in your management unit in the same year.

A baseline can be elaborate or quite simple in design. At a minimum, you must establish a baseline year.

After the baseline has been developed (designed), you must generate a baseline in order to complete the baseline establishment process. A baseline is required for analyzing management unit goals and simulating treatment plans.

Even if all your stands were tallied in the same year, a baseline is still required as part of the steps in the NED-2 simulation process.

## Choosing a Baseline Year

A baseline year is a designated point in time to which all stands will have been brought forward, through simulation, in order to establish a common starting point in the planning process. This year must be equal to or later than the most recent inventory year among all of your stands.

In baseline development, a grid of cells (the baseline grid) in the Work Pane shows each stand in a separate row. Time in years is represented in columns. NED-2 initializes the baseline grid with all the years corresponding to the time when your stands were inventoried. Years are displayed as headings at the top of the columns.

The cells preceding the date when a given stand was inventoried are shaded in dark gray. You cannot establish a baseline in any column that has a dark gray cell.

NED-2 automatically establishes a baseline year using the most recent (last) year when any of your stands were inventoried. If you are satisfied with this year, no further steps are required, and you may proceed to baseline generation.

The baseline year is highlighted in yellow at the top of the designated column.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Baseline**.
3. If you want to add time beyond the year that NED-2 automatically designated as the baseline, click **Add Year** to add one or more years to the baseline grid.
4. Enter or select a year from the list box that pops up next to the Add Year button. Only the latest (most recent) year can be the baseline year.
5. If desired, any year on the grid can be deleted except years with inventory. To delete a year, select the column for that year and click the **Delete Year** button.

If you have previously generated a baseline, altering the baseline design requires the baseline and any plans to be re-simulated.

## Historical Treatments in the Baseline

On occasion it may be necessary to reflect treatments that have occurred in a stand since it was last inventoried. As with the development of treatment plans, you also may implement treatments in the development of the baseline.

Treatments can be added to any stand in any year after the inventory and before the baseline year.

The choice of treatments available depends on whether you have defined any treatments for the growth model selected for a stand.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Baseline**.
3. Double-click in the cell where you want to apply a treatment to launch the Treatment list dialog. If you have already generated (simulated) the baseline, a warning appears stating that if you make changes to the baseline design, you need to re-simulate the baseline,

and all treatment plans will also have to be simulated. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with treatment selection. Otherwise, click **Yes** to continue.

4. To add a treatment, from the bottom list of available treatments on the Treatment list dialog, double-click on the name of the treatment to add.
5. To remove an existing treatment from the baseline, from the upper list of scheduled treatments, double-click on the name of the treatment to remove.
6. Click **OK** when you are finished.

### Generating Baseline Data for All Stands

Generating the baseline requires simulating forest growth and mortality for all stands up to the baseline year.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Generate Baseline**. NED-2 presents an estimation of the time required to generate the baseline.
3. Click **Yes** to proceed with baseline generation.

When the baseline is successfully generated, the Options Pane in the left side of the NED-2 window under baseline development displays the following message: Baseline data has been generated. If you attempt to click Generate Baseline after it has already been generated, NED-2 alerts you that the baseline has already been generated.

### Deleting the Baseline

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Baseline**.
3. In the bottom of the Options Pane of the lower-left corner of the NED-2 window, click **Delete baseline**.
4. You are given a warning about invalidating your existing plans, which may be lost and/or altered as a result of deleting the baseline. Most assuredly, all simulated planning data is erased. If you click **Yes**, the Baseline deletion options dialog opens. Select one of the following options:

**Delete everything** - Choose this option if you want to completely erase the entire baseline and start over. All forest simulation model selections are removed along with treatments, non-inventory years, etc. (inventory data *will* be preserved).

**Delete non-inventory years and treatments** - Choose this option if you want to keep the simulation models, and to reset the baseline year as the most recent year that any of the stands were inventoried.

**Delete simulation models and treatments** - Choose this option if you wish to retain all years established on the grid. All forest simulation models and associated treatments are removed.

**Delete treatments only** - Choose this option if you only wish to remove treatments. All other baseline design elements remain. (Alternatively, you remove individual treatments from the baseline grid as follows: Double-click on the treatment cell, then select the treatment name on the Treatment List dialog and click **Delete**).

5. Click **OK** to proceed. You need to re-simulate the baseline and all treatment plans once the baseline is altered.

## Building Treatment Plans

A treatment plan represents the series of intended or desired treatments that you wish to apply to all of the stands in your management unit into the foreseeable future, perhaps the next 10 to 25 years or longer. It is one of several possible management scenarios you are considering in the management of your stands. You may establish several plans as a way to compare alternative management scenarios. Therefore, the purpose of setting up treatment plans is to test silvicultural treatments and evaluate forest growth over time to determine which scenario is most likely to create conditions that satisfy your management goals and objectives.

## Adding New Plans

Treatment plans may be added at any time. You may start with an empty plan or copy an existing plan and use it as a starting point for a new plan.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. At the top of the Options Pane, click the **Add New Plan** button. The Plan information dialog opens.
4. If desired, enter a plan name, or accept the default.
5. If desired, enter the plan author and a description of the plan.

To start with a new, empty plan:

6. Make sure the choice at the bottom of the Plan information dialog says **Empty plan** (default).
7. Click **OK**.

To copy an existing plan:

6. Make sure the choice at the bottom of the Plan information dialog says **Copied from another plan**.
7. From the pick list on the right, select one of the existing plans in the current NED-2 file.
8. Click **OK**.

Once the plan is added, you may want to examine the baseline data before developing the plan. Click the **View Data** button in the top-right corner of the Work Pane to proceed. The View Data button is relabeled as **View Treatments** while viewing data. Be sure to click the **View Treatments** button to return to plan development mode.

## Plan Author and Description

You may enter a plan author and description to help you remember the specific details of the plan, perhaps to describe the overall strategy, or to explain the schedule of treatments. A little information about the plan may be helpful in the future if you need to recall why certain decisions were made in the planning process.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan from the list of plans.
4. Near the top of the Work Pane in the upper portion of the NED-2 window, click the **Edit plan info** button. The Plan information dialog opens.
5. Change the plan name if desired.
6. Enter the plan author and a description of the plan.
7. Click **OK**.

### Establishing a Time Frame

A time frame represents the years in your plan—the planning cycle. If you have more than one plan, all plans follow the same time frame, which makes sense because you would not be able to compare plans adequately if each plan did not occur within the same time frame.

The time frame is managed within the planning grid. Each column represents a different year. A time frame may include years in the past (historical data and/or treatments), as well as years beyond the present. The first year of your plan is automatically assigned to the baseline year that you established when you generated a common baseline of data among your stands. This year is highlighted in yellow at the top of the column.

The smallest time increment allowed on the planning grid is one year. You may have successive years, or you may skip years and only show time in 5- or 10-year increments or other lengths to suit your needs.

For example, if your baseline year was set at the year 2000, and you were working within a 20-year planning cycle, you could establish time in 5-year increments. Thus, your planning grid would have 5 columns, starting with the year 2000 (automatically provided since that would be the baseline year), and including the years 2005, 2010, 2015, and 2020.

Adding and removing years from the planning grid results in a loss of previously simulated data.

To add years to your time frame:

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select any plan from the list of plans.
4. Near the top of the Work Pane, click the **Add Year** button. NED-2 displays a warning explaining that adding a year will result in the loss of simulated data in your plans.
5. Click **Yes** to proceed.
6. From the Add a year dialog, you can enter a single year, or a series of years at a specified increment (10 years is the default).
7. Click **OK**.

To remove years from your time frame:

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select any plan from the list of plans.
4. Near the top of the Work Pane, click the **Delete Years** button. If you have already simulated your plan, NED-2 displays a warning explaining that deleting a year results in a loss of data which requires you to re-simulate the plan.
5. Click **Yes** to proceed.
6. From the Delete years dialog, select the year(s) you wish to remove from the time frame.
7. Click **OK**.

### Deleting Plans

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan from the list of plans.
4. Near the top of the Work Pane, click the **Edit plan info** button. The Plan information dialog opens.
5. Select the **Delete Plan** button in the lower-right corner of the dialog.
6. Click **Yes** if you are sure you want to delete the plan.

### Scheduling Treatments

#### Adding Treatments to a Plan

Treatments may be scheduled in your plans and then simulated and evaluated to determine the effect of those treatments on forest conditions and management goals. You may schedule any of the existing treatments that you have defined for the simulation models that are associated with the stands in your plan.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan from the list of plans.
4. Double-click in the cell where you want to work with a treatment to launch the Treatment List dialog. If you have already simulated the plan, a warning opens stating that if you make changes to the plan design, you have to re-simulate the plan. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with treatment selection. Otherwise, click **Yes** to continue.
5. To add a treatment, from the bottom list of available treatments on the Treatment List dialog, double-click on the name of the treatment to add. If you aren't sure about the details of a treatment, click once on an available treatment and then click the **Parameters** button to review the details of the treatment.
6. Click **OK** when finished.

### Deleting Treatments from a Plan

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan from the list of plans.
4. Double-click in the cell of the treatment to launch the Treatment List dialog. If you have already simulated the plan, a warning appears stating that if you make changes to the plan design, you have to re-simulate the plan. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with treatment deletion. Otherwise, click **Yes** to continue.
5. From the top list of scheduled treatments on the Treatment List dialog, double-click on the name of the treatment you wish to delete.
6. Click OK when finished.

### Scheduling Multiple Treatments in the Same Stand and Year

On some occasions, it may be desirable to schedule more than one treatment in a stand in a given year. For example, a clearcut may be followed by tree planting. Other treatments may coincide with cuttings, such as herbiciding or trail maintenance, but NED-2 only schedules treatments that have been defined for the simulation models that are associated with the stands in your plan.

NED typically displays a treatment symbol in the cell where you schedule a treatment in the planning grid. However, when multiple treatments are scheduled, NED-2 displays a count of the treatments (e.g., "2 treatments").

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan from the list of plans.
4. Double-click in the cell where you want to work with a treatment to launch the Treatment List dialog. If you have already simulated the plan, a warning appears stating that if you make changes to the plan design, you have to re-simulate the plan. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with treatment selection. Otherwise, click **Yes** to continue.
5. From the bottom list of available treatments on the Treatment List dialog, double-click on the name of the treatment you wish to add.
6. Click **OK** when finished.

### Reviewing Treatment Parameters

While you are analyzing a plan, at any time you can quickly review the parameters of any scheduled treatments.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, if you are not already viewing a plan, select the plan from the list of plans.

4. Right-click in the cell where you want to view the parameters of a scheduled treatment. If you have multiple treatments scheduled in the same stand and year, select a treatment in list provided. Treatment Parameters are listed at the bottom of the Treatment parameters dialog.
5. If you wish to replace or switch to another treatment, click the **Change treatments** button. If you have already simulated the plan, a warning appears stating that if you make changes to the plan design, you have to re-simulate the plan. If you do not wish to lose your simulated data, click **No**, then save a copy of the file and then resume with treatment selection. Otherwise, click **Yes** to continue.
6. Click on the **X** in the upper-right corner to close the Treatment parameters dialog.

## SIMULATING MANAGEMENT PLANS

You may simulate plans only after you have successfully generated a baseline.

Simulation is organized by plans and stands. Within a given plan, you may ask NED-2 to simulate a single stand, or select several stands to simulate. From the list of stands that you have selected, NED-2 simulates one stand at a time until all simulation is complete. NED-2 uses the simulation model that you have specified for each stand in your plans.

When you enter the planning function of NED, under Develop Treatment Plans, NED-2 displays the current simulation status of your plans together with the plan descriptions. This allows you to see which plans have been simulated, as well as how many stands have been simulated in each plan.

Simulation always proceeds from the earliest year on the planning grid to the last year. Thus, you cannot select years or range of years to simulate.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Simulate Treatment Plans**. The Plan Selection dialog opens.
3. The Plan Selection dialog is split into two halves. On the left, there is a list of all of your current plans that have *not* yet been simulated. For each plan, an adjacent list of stands yet to be simulated also appears.
4. Select a plan on the left side.
5. Select the appropriate stands to be simulated (all stands are selected by default).
6. Click the **double right-pointing arrows**.
7. Your selected unsimulated plan appears on the right side of the dialog, under the list of selected plans. In this case, none of the stands appear highlighted, but that does not affect the simulation.
8. Repeat this process as necessary if you wish to simulate multiple plans in one operation.
9. To change your selected plans or stands, on the right side of the dialog, under the list of selected plans, highlight the plans or stands you do *not* want to simulate and click **delete**.
10. After you have selected your plans and stands within each plan, click **OK**.
11. NED presents an estimate of the time required for simulation.
12. Click **Yes** if you wish to continue with the simulation after reviewing the estimated simulation time.

## Simulating Single Stands

It may be advantageous to simulate one stand a time, if you are designing treatments and wish to see how they are implemented by the simulator, or if you want to evaluate volume other metrics over time in a single stand. Such information may be useful in designing other treatments or in deciding a treatment schedule overall.

The steps for simulating one stand are very similar to the ones described for simulating plans.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Simulate Treatment Plans**. The Plan selection dialog opens.
3. Select a plan on the left side.
4. Select the appropriate stand to be simulated.
5. Click the **double right-point arrows**.
6. Your selected unsimulated plan appears on the right side of the dialog, under the list of selected plans.
7. Click **OK**.
8. NED presents an estimation of the time required for simulation.
9. Click **Yes** if you wish to continue with the simulation after reviewing the estimated simulation time.

## Reviewing the Status of Your Plans

You may use this feature to review the history of your plans, and to quickly determine whether all of the stands in one or more plans have been simulated

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**. A list of all your plans along with their status is presented in the Work Pane.
3. If you are in the middle of plan development, in the Navigation Pane, click **Plans** to view the list of all of your plans and their status.

## EXAMINING SIMULATED PLANS

### Viewing Plan Data

Once you have simulated a plan, you can examine the effects of treatments using any desired metric, such as board-foot volume, stems per unit area, basal area, etc.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. In the Options Pane, select the plan that contains the treatment you wish to view.
4. In the top-right corner of the Work Pane, in the upper-right corner of the NED-2 window, click the **View Data** button.
5. In the top-left corner of the Work Pane, choose a value from the list, such as relative density, net cord volume, average dbh, etc. Units appear in the upper-left corner of the data grid.

6. Select how you wish to view the data. You may view the data in one of the following three ways :
  - a. **Pre-treatment** - This option displays the stand as it would appear “untreated” up through the year the treatment was implemented. Succeeding years would show the effects of the treatment, since those years occur after the treatment has actually occurred. In years without treatments, there is no difference between “pre” and “post” treatment views.
  - b. **Post-treatment** - This option displays the stand as it appears after the treatment has been implemented. The main difference with this option is that treatment effects are shown in the year that a treatment has been scheduled.
  - c. **Removal** - This option shows what quantity was removed by the treatment in a year, for any value, such as basal area, relative density, or volume.
7. You can switch to another variable at any time. Recall that you can copy the contents of the plan data grid into another program.
8. Click the **View Treatments** button to return to the plan development view.

## Comparing Plans

You may generate a plan-comparison table that allows you to compare all stands in all plans, for a single year in any of your plans. This is a useful way to compare the effects of treatments in one plan against a “grow-only” or “do nothing” plan.

1. In the Navigation Pane, click **Planning**.
2. From the list of choices under Planning, click **Develop Treatment Plans**.
3. At the bottom of the Options Pane in the lower-left corner of the NED-2 window, click the **Plan Comparison** button.
4. In the top-left corner of the Plan comparison table dialog, choose a metric from the list, such as relative density, net cord volume, basal area, etc.
5. In the top-right corner of the Plan comparison table dialog, select the year that you wish to use for comparison.
6. Select how you wish to view the data, such as **Pre-treatment**, **Post-treatment**, or **Removal**. For unsimulated stands, the words “no data” appear beyond the baseline.
7. Repeat steps 4-6 as needed.
8. When you are finished viewing the comparison, close the dialog by clicking on the **X** in the top-right corner of the dialog.

## Chapter 6 - Examining the Data

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### VEGETATION TABLES

Vegetation tables are an alternative to pre-formatted reports. Unlike many reports, vegetation tables do not offer an interpretation of your data and no descriptive text appears. Instead, vegetation tables provide you with total control in examining your data from a variety of points of view.

You may use tables to analyze conditions within a management unit (e.g., evaluate basal area by species for all stands) and within stands (e.g., evaluate the diameter distribution among species). If you have simulated data, you may also use tables to compare management plans. Within each of these levels (plan, management unit, and stand) several standard table types exist to choose from, as well as a custom type for which you completely define all elements of the table.

Vegetation tables are created by following a series of steps through a table-generation wizard. In constructing tables, generally the first step involves filtering the kind of data you wish to use, such as overstory, understory, live or dead stems, and so on. In succeeding steps, you choose from a list of possible values to fill the table, which may include inventory variables as well as calculated summary variables such as basal area, volume, and stems per unit area, and you decide how you want the data organized or presented by choosing values for rows and columns, using variables such as plot, species, live/dead, timber quality, product, height class, and so on.

Many NED-2 reports and vegetation tables share the same interface—they are driven by the same wizards. If you generated a vegetation table and then immediately selected a report that matched the current vegetation table type, the same settings appear in the report settings wizard (though they may be changed if desired).

Descriptions of vegetation tables are provided in the *NED-2 Reference Guide*, Appendix C: Vegetation Tables and Reports (Twery et al. 2011).

### How to Launch a Vegetation Table

You can identify a vegetation table by its name, as all tables are listed with a brief title that is suggestive of the contents and format of the table.

**Custom tables**—If you want to generate a table of your own design, a custom table, those are generally listed with the word “wizard” in their title.

**Standard tables**—Many vegetation tables may be generated from standard tables that come with pre-selected row and column variables. Standard tables are typically listed as “variable A × variable B,” and should be interpreted such that variable A appears across the top of the table, in a series of column headers, and variable B appears as row headers, in the first column off to the left. Therefore, a table such as “Product × Species” would have products (e.g., veneer, grade2

sawtimber, firewood, pulpwood) across the top, and species down the left side of the table. Standard tables follow this convention, and none of them have “wizard” in their title, even though all tables are generated by a wizard.

**Table families**—In the list of vegetation tables to choose from, a custom table wizard and one or more related standard tables often occur as a “family” of tables. To reflect this relationship, standard tables that follow the custom table wizards are indented. A custom table can generate any of the standard tables that are in the same family of tables.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **View Vegetation Tables**.
3. From the Options Pane in the lower-left corner of the NED-2 window, decide whether to base your tables on inventory or simulated data. You may choose from inventory, baseline, plans, or a plan comparison.
4. Select a level that matches the analysis you require. Click **Management unit** to analyze a condition across multiple stands, or select a stand if you want to analyze the properties of a single stand.
5. If you have selected a **plan**, you also need to select a **year** and a **treatment view** (i.e., pre- or post-treatment results). Otherwise, this step is not required.
6. Choose a table type in the upper portion of the Work Pane, by clicking inside the list labeled as **Table type**.
7. After you have selected a table type, follow the steps on the data table wizard. For further information, refer to the following topic, “How to Run the Vegetation Table Wizards.”

## How to Run the Vegetation Table Wizards

Most tables are generated by following the same general pattern as described below. With the exception of plan comparison tables, these instructions generally apply to all tables though individual steps will vary. Refer to the individual table descriptions for specific details.

When you launch a table wizard, a dialog appears and presents the first of several pages that comprise all the necessary steps in building your particular vegetation table. Each page contains one or more choices that affect the appearance of your table. Collectively these choices are referred to as table settings, or just settings.

### Wizard example

The following example illustrates how to navigate through a vegetation table wizard, with a species X plot table (read as “species by plot”) using basal area per acre. The table shows how much basal area occurs, by species, for each plot in a given stand. There are a total of three plots in the stand, and the plot IDs appear as row headers, in the very first column off to the left side of the table. Species appear as column headers across the top of the table. Because this is a custom table, if desired, you could have the species in columns and the plot IDs in rows—the choice is yours.

This table is generated by using the **Table wizard for single stand tables**, a custom table type, for a given stand.

**First wizard page:** Selecting the data source to use to build your vegetation table.

1. NED-2 refers to the vegetation table that you want to build as a matrix, and in the first step you are asked to specify which tables to include in the **matrix** (see Figure 11). Tables refer to the actual database tables in your NED-2 file. Thus, in the Data Tables dialog, you need to select whether you want to build your table based on the overstory data table, or understory (or both), or ground-cover data. You can choose more than one data table to use for your vegetation table, but obviously NED-2 does not let you combine tables that do not contain similar data.
2. When you click **Overstory observations (trees)**, specify the kind of trees to include, by timber quality, and whether or not you wish to include dead trees. If you want to include all live trees, click **AGS and Crop** and **UGS**. In this example, dead trees are included.
3. Click **Next** to continue.

**Second wizard page:** Choosing a matrix variable.

4. Specify a variable to use to fill the cells of the matrix (see Figure 12). This is the value on which you want to base your vegetation table. Note that the wizard page displays a table diagram, highlighting the relevant area in red to illustrate which portion of the vegetation table is being affected by your selection. When you select a variable from the

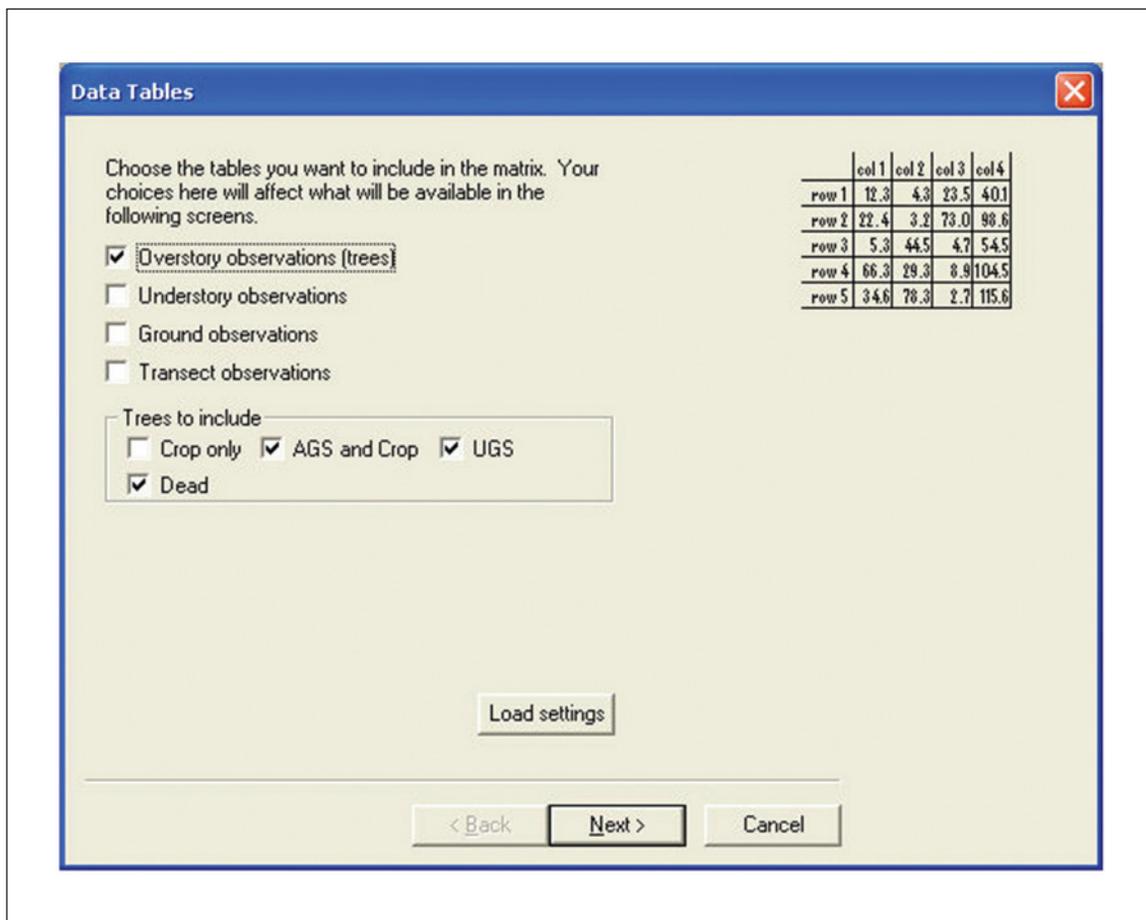


Figure 11. Selecting the data source on the first wizard page.

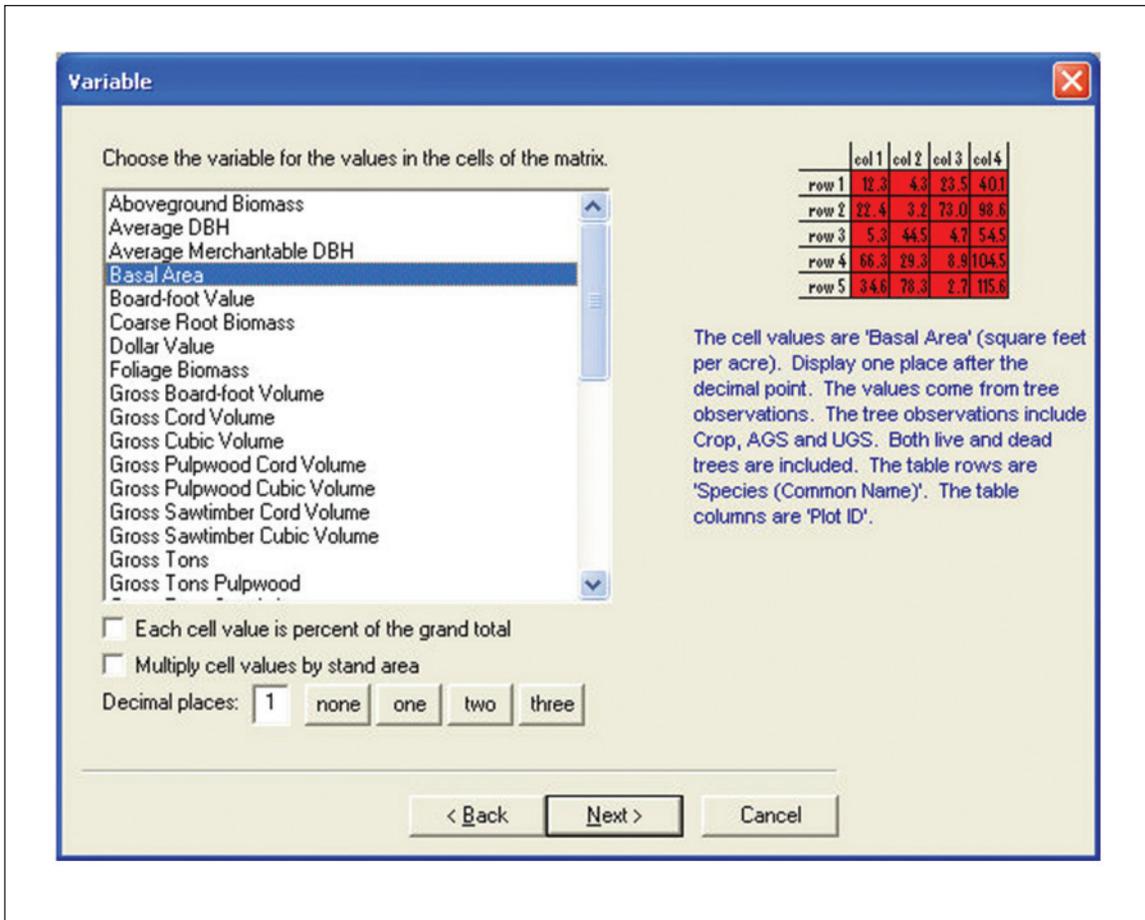


Figure 12. Choosing a variable for the cells of the table on the second wizard page.

list on the left side of the wizard page, NED-2 produces a narrative on the right side of the page under the table diagram. This narrative describes your variable and the kinds of observations to be included in the table.

- By default, cell values are displayed per unit area. You may choose whether you want your table values to reflect total values (**Multiply cell values by stand area**) or percentages (**Each cell value is percent of the grand total**). NOTE: If you select percentages, these are based on the percentage of the entire stand, and *not* by plot-clusters or other divisions, and the grand total of all rows and columns adds up to 100.
- Specify the number of desired decimal places for the cell values. You can enter a value in the box provided, or click the button that matches your desired precision.
- Click **Next** to continue or click **Back** if you need to change a setting on a previous page.

### Third wizard page: Choosing a column variable.

- Specify a variable for the columns of the vegetation table (see Figure 13). The table diagram in the upper-right corner of the wizard page now highlights the column headers. Your table values are separated into columns based on the variable you select here. Additional choices are possible for some variables. For species, you could choose any of the species codes or names, as well as any of the species attributes. In this example, the

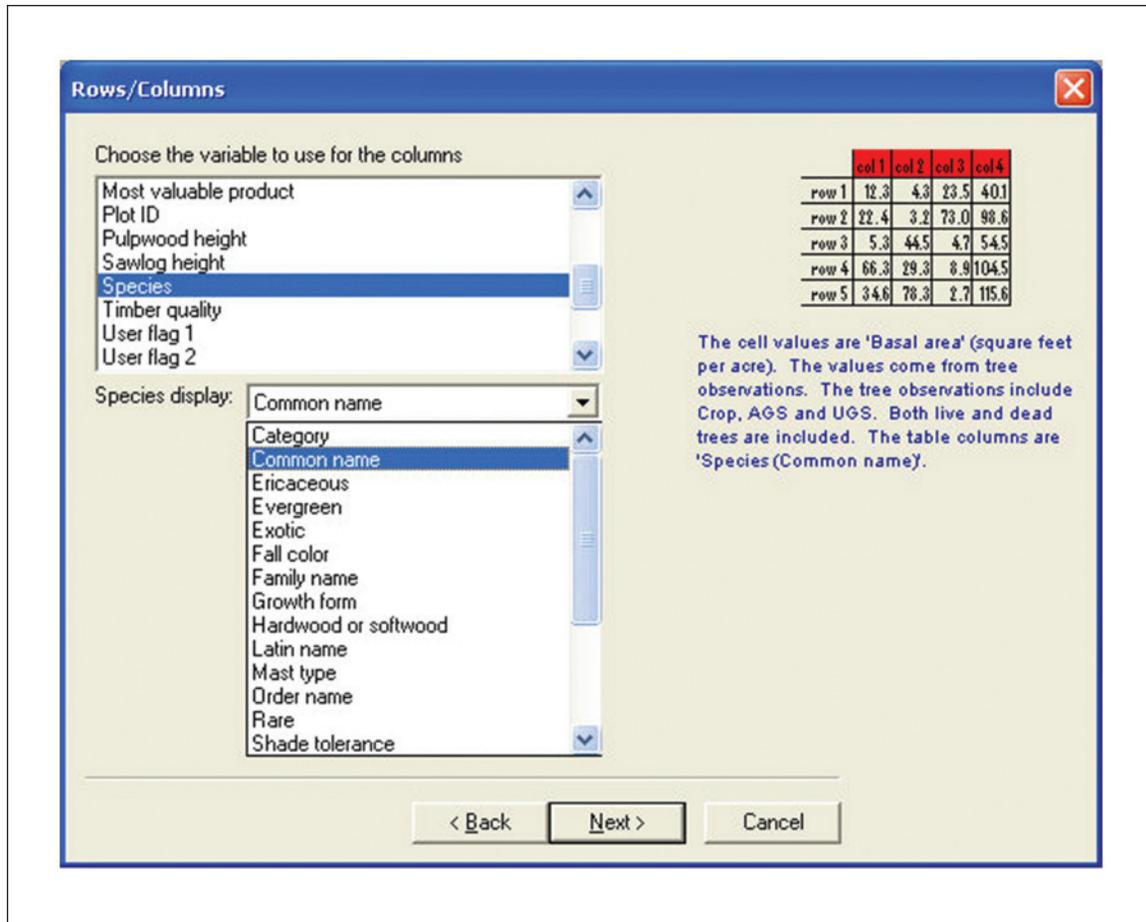


Figure 13. Choosing a column variable on the third wizard page.

species common name is selected. The description under the table diagram now includes information on the table columns.

NOTE: If you were to choose diameter at breast height (dbh), instead of species, there are three choices in which to display data by dbh, as follows: **Midpoint of Range**, or **Entire Range**, which allow you to specify your own diameter ranges on the table, or **Size Class**, which automatically establishes columns based on the stand size class. When defining your own diameter ranges, you must enter the first dbh breakpoint, such as 1 inch. You must also enter an interval between size class breakpoints, such as 2 inches. Then you must also enter the largest dbh breakpoint you want to include, or check the box **Adjust last size class to fit largest dbh**, and NED-2 assigns the largest dbh breakpoint for you. NED-2 includes all stems that are larger than the largest dbh breakpoint, regardless of how you defined it. If you specify your own diameter ranges using either Midpoint of Range or Entire Range, the number of diameter columns in the table is the same. However, the column headings differ. The Midpoint of Range displays in each column the calculated diameter midpoints based on the range and interval that you specify. The Entire Range displays the minimum and maximum dbh breakpoints based on the range and interval that you specify.

9. Click **Next** to continue or click **Back** if you need to change a setting on a previous page.

**Fourth wizard page:** Choosing a row variable.

10. Specify a variable for the rows of the vegetation table (see Figure 14). Note that the table diagram in the upper-right corner of the wizard page now highlights the row headers. Your table values are further separated based on the variable you select here. In this example, the Plot ID is chosen. The description under the table diagram now includes information on the table rows.
11. Click **Next** to continue or click **Back** if you need to change a setting on a previous page.

**Fifth wizard page:** Finishing up.

12. Your vegetation table is ready to build (see Figure 15). If you want to save these settings, click on the **Save settings** button. Click **Finish** to build your table.

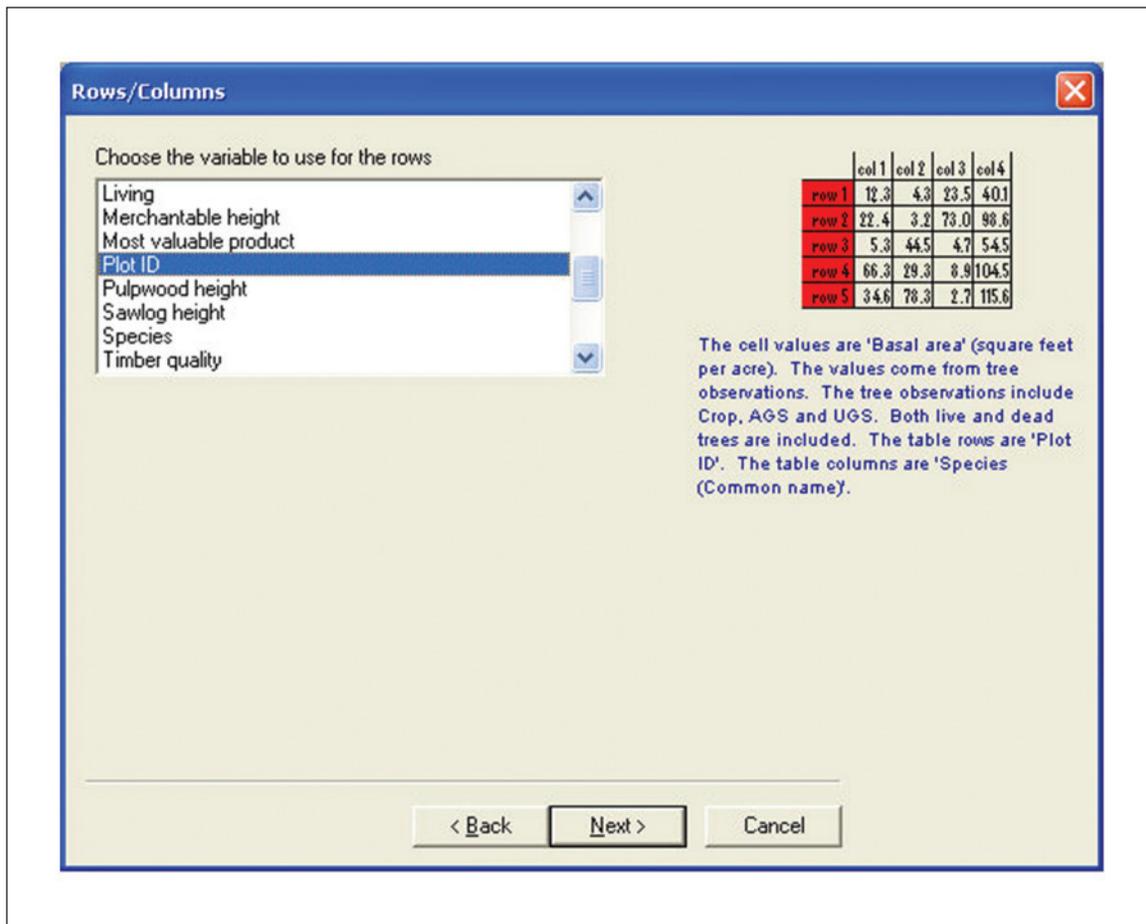


Figure 14. Choosing a row variable on the fourth wizard page.

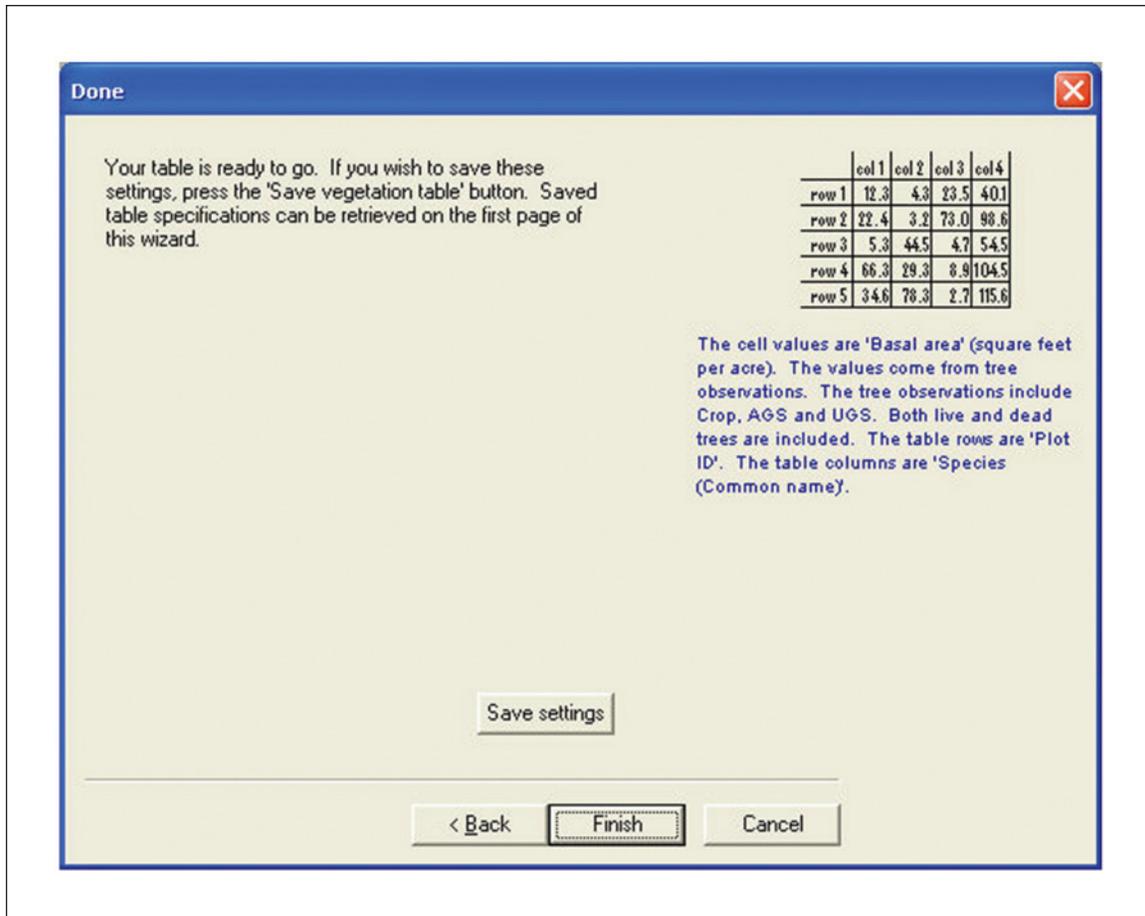


Figure 15. The last page of the vegetation table wizard.

## How to Run the Table Wizard for Plan Comparisons

This is the general table wizard that allows you to create a custom plan comparison table of your own design. You can also use it to build the standard plan comparison tables.

Plan comparison tables are not available unless you have simulated at least one management plan.

### Step 1 - Decide what you want to compare

On the first page of this wizard, two pick lists are available that contain the same choices—this is to allow you to decide whether you want items across the top of the table (columns) or along the side (rows). Directly under these lists, a caption appears that is updated whenever you change your selection for columns and rows; it provides tips on what you will need to pick once you have decided on what you want for columns and rows.

**Compare plans**

If you want to display all of your plans in a table, then be sure to select plans for either rows or columns. After that, you may choose one of the following:

- If you also select stands, you may choose one variable and one year and then view that variable in all of your stands in each of your plans in the same year.
- If you also select variables, you may choose one stand and one year and then view all the variables you want in one stand in each of your plans in the same year.
- If you also select years, you may choose one variable and one stand and then view that variable in one stand in each of your plans over all years.

**Compare stands**

If you want to display all of your stands in a table, then be sure to select stands for either rows or columns. After that, you may choose one of the following:

- If you also select plans, you may choose one variable and one year and then view that variable in all of your stands in each of your plans in the same year.
- If you also select variables = you may choose one year and one plan and then view all the variables you want in each of your stands in one plan in the same year.
- If you also select years, you can choose one variable and one plan and then view that variable in each of your stands for all years in the plan.

**Compare variables**

If you want to display multiple variables in a table, then be sure to select variables for either rows or columns. After that, you may choose one of the following:

- If you also select plans, you may choose one stand and one year and then view all the variables you want in one stand in each of your plans in the same year.
- If you also select stands, you may choose one year and one plan and then view all the variables you want in each of your stands in one plan in the same year.
- If you also select years, you may choose one stand and one plan and then view all the variables you want for one stand in each of the years in the same plan.

**Compare years**

If you want to display all years in a table, then be sure to select years for either rows or columns. After that, you may choose one of the following:

- If you also select plans, you may choose one variable and one stand and then view that variable in one stand in each of your plans over all years.
- If you also select stands, you may choose one variable and one plan and then view that variable in each of your stands for all years in the plan.
- If you also select variables, you may choose one stand and one plan and then view all the variables you want for one stand in each of the years in the same plan.

## Step 2 - Select variables

- On the second page of the wizard, if you selected variables for either rows or columns in step 1, you will be able to pick as many variables as you want. Otherwise, you may only select one variable.
- For any given year, decide whether you want to show data prior to any treatments, or after all treatments have been applied in that year.

## Step 3 - Arrange the order of variables

- This step only occurs if you were allowed to select multiple variables. If desired, drag-and-drop variables within the list shown on third wizard page in order to establish a desired order. Top-to-bottom translates into left-to-right.

## Step 4 - Finish the wizard

- Click Finish to complete the wizard. NOTE: There is one final step in completing the table definition that occurs after you have finished the wizard. This is explained in the next (final) step.

## Step 5 - Complete the table definition (choose a single plan, stand, or year)

- Immediately after you click Finish in the previous step, a plan table settings dialog appears. Complete the table definition by choosing a single plan, stand, or year. The choices in the final step depend on what you selected for columns and rows in step 1. Click OK when you are finished, and NED-2 displays the table.

## Table Output

Vegetation tables include several additional attributes. Above the table, a descriptive title appears that includes the units. To the right of each row, and below of each column, simple statistics (sum, mean, minimum, maximum, average, standard deviation, etc.) may be shown as footers. You may turn the footer statistics on or off as necessary.

NOTE: A word of caution is advised regarding table footers. The statistics presented in the footers are calculated for the number of rows and/or columns assembled for the table. Sometimes the statistics make sense. However, the statistics may not agree with similar values calculated using other procedures, and they may even be invalid. This is a side-effect of the manner in which a standard format is applied to all table output.

Several options are available after you have built a table.

**Table summary**—Once you have a table displayed, you can always view a summary of the table. The summary describes the table values, units, format, and what kind of data was used to populate the table.

To view the table summary, in the Work Pane, click the **Summary** button in the top-right corner, above the vegetation table.

**Footers**—Often a table is displayed with additional statistics that summarize each row and column. These values are collectively known as table footers. You may select which values to display by clicking the **Footers** button in the top-right corner of the Work pane, above the vegetation table. The Set Row and Column Footings dialog opens.

To display the footers, you must select the **Include table-cell statistics (if available)** box, for both rows and columns in the Set Row and Column Footings dialog. The available footers appear in the list boxes at the bottom of the dialog.

For most tables, the choices of row and column footers are often the same, but not always. You may select the following options for controlling the display of footers:

- **Always show all available** - Displays all available footer statistics at the end of a row or column.
- **Never show any** - Prevents the display any of the footer statistics.
- **Try to show the following** - Allows you to select which footer statistics to display. You must place a check by the desired values.

NED-2 retains the selected footers for each table that appears in the pick list in the upper portion of the Work Pane. Thus, when you use the pick list to jump from one table to another, NED-2 remembers the footers that you selected. However, within a given table, if you rerun the same table with a different variable, NED-2 reapplies the same footer choices repeatedly. For instance, if you run the table wizard for comparing stands, and you select net cubic volume, the footers you select for this table are retained if you rerun the table a second time and select above-ground biomass. This may result in footers left over from another table, which in some cases might not make sense. See the cautionary note on footers in the introductory paragraph of this topic for more information.

You may also run vegetation tables as reports instead of screen output. If you elect to generate vegetation tables as reports, footer choices are not customizable, and footers are sometimes excluded from some reports.

**Settings**—To review your settings, or to make adjustments to how the table was built, click the Settings button in the top-right corner of the Work Pane, above the vegetation table. This button re-launches the table wizard for the same table type, where you are able to review or modify settings as desired.

**Copy the table**—You may copy the entire table, including footers, onto the clipboard for use in another program such as Microsoft Excel.

1. From the Edit menu, click **Select All**, or click inside the table and press the **Ctrl** key and the letter **A** simultaneously (**Ctrl+A**).
2. From the Edit menu, click **Copy**, or press the **Ctrl** key and the letter **C** simultaneously (**Ctrl+C**).
3. Switch to another program, and paste the table using Edit-Paste, or press the **Ctrl** key and the letter **V** simultaneously (**Ctrl+V**). If you intend to paste the table into a word processor, it is recommended that you first paste the table into a spreadsheet program and then copy the table from the spreadsheet into the word processor.

## Fast Data Switching When Viewing a Table

NED automatically stores your vegetation table settings when you finish building a table, and maintains a record of all the most recent table settings for each table type. When you switch from one table type to the next, the table wizard retrieves your most recent settings from the last time you built a table of that type.

**Fast data switching**—While you are viewing an existing vegetation table within a given data level (i.e., the management unit level in inventory, baseline, and in your plans; or a stand within a single management unit, within the baseline, or among plans), if you jump within that data level in the Options Pane you can instantly view the vegetation table for any similar item without proceeding through the table wizard again. For example, assume you have 10 stands in your inventory, and you wish to examine all of them using the same table design, such as “basal area per acre by diameter and species.” After you build the table for one stand, you are able to switch from one stand to the next without re-running the table wizard each time. In another example, you could examine “net cubic volume by species in each stand” and examine how volume changes over time among all of your plans. As long as you stay within the same data level, NED-2 displays the results automatically—you can see the contents of the vegetation table change just as quickly as you switch from one item to the next. However, if you try switching levels, such as going from management unit to stand data, the wizard loads the settings from the previous table design but NED-2 does not automatically display the vegetation table, and the fast data switching halts. In this case, you will have to rerun the wizard.

## Storing and Retrieving Table Settings

If you have invested a considerable amount of effort in designing a table and you do not want to forget your settings, you can store your table settings for future use. Table settings are associated with a specific table type. Thus, in order to reload your previously stored table settings, you need to remember the table type under which your favorite table settings are stored. Table settings can be retrieved when you re-launch the wizard that corresponds to your table type.

You may store your settings when you are on the last page of a vegetation table wizard, and the saved table specifications can be retrieved on the first page of the table wizard of the same table type.

### Storing table settings

1. On the last page of the table wizard, click the **Save settings** button.
2. From the Table specifications dialog, in the **New name** field, enter a brief name that adequately describes your table settings.
3. Click **OK**.

If you have previously stored any table settings, they also appear in the table specifications dialog.

### Retrieving table settings

1. On the first page of the table wizard, click the **Load settings** button.
2. From the Table specifications dialog, in the list under Settings from Last Wizard Use, click on the name that identifies the settings that you wish to reapply in the current table wizard.
3. Click **OK**.

Reports provide a way for you to summarize your data and determine current conditions of inventory data as well as future conditions of simulated data. The format of NED-2 reports is fixed and unchangeable, but often the *content* of reports is not fixed. Such reports are denoted with an asterisk (\*) in the report name when you are reviewing the list of available reports in the Work Pane.

NED-2 reports should not be confused with the NED-2 vegetation tables. NED-2 reports typically offer explanations or interpretations of results, and may contain multiple tables, whereas NED-2 vegetation tables do not provide interpretation and generate one table at a time.

The content of reports generally falls into two categories: summaries and analyses. Most summaries are condensed tables that allow you to evaluate conditions for a variety of purposes, but usually no interpretation of the data is provided. Examples of reports that fall under this category are listed under the headings, **General Information** and **Vegetation Tables** (reports that generate tables). NED-2 offers a variety of analyses that are designed to provide guidance or interpretation of the data. Such interpretation is based on the general opinion of subject matter experts for typical situations. Your personal evaluations may sometimes differ. Examples of reports that analyze and offer interpretation are listed under the headings **Resource Narratives**, **Spatial Reports**, and **Goal Analysis**.

Reports are available at three levels: Plans or Plan Comparisons, Management Unit, and Individual Stand. A few report names may be duplicated across levels, but the organization and the amount of detail are different.

Generating reports requires at least two steps. The first step is to select which reports you wish to create. Technically, no limit exists to the number of reports that can be selected at any given level. In reality there may be only a few reports that you need. During the first step you build a list of reports that you wish to generate. The second step involves the generation of one or more selected reports. You generate a report from the list of your selected reports in order to create output and view the report.

The output of reports is in HTML format, which can be opened in any commercially available web browser. If desired, you may copy the contents of reports from the browser and paste them into a word processor if you would like to rearrange the structure and provide your own formatting.

## List of Reports Available

The following list represents the reports available in NED-2, as described in the *NED-2 Reference Guide*, Appendix C: Vegetation Tables and Reports (Twery et al. 2011).

### Plan reports

- Plan summary
- Predicted timber product yield
- Predicted stand development
- Plan comparison of variables

### Management unit reports

#### General Information

- Identification Data
- Species List
- Variable List
- Stand Comparison Table
- Stand Adjacency List
- User Preferences
- Plant Species Values

#### Vegetation Tables

- Table Wizard for Comparing Stands (Select Contents)
- Table Wizard for Management Unit Totals (Select Contents)
- Species X Stand (Select Contents)
- Species X Size Class (Select Contents)
- Size Class X Stand (Select Contents)
- Overstory Vegetation Summary
- Understory Vegetation Summary
- Ground Vegetation Summary
- Biomass Tables
- Carbon Storage

#### Resource Narratives

- Ecology Narrative
- Timber Narrative
- Visual Quality Narrative
- Water Narrative
- Wildlife Narrative

#### Goal Analysis

- Selected Goal List

#### Spatial Reports

- Forest Type Patch Analysis
- Size Class Patch Analysis
- Forest Type and Size Class Patch Analysis
- Canopy Closure Patch Analysis

**Stand reports**

Overstory Statistics

General Information

Identification Data

Species List

Stand Variable List

Overstory Plot Variable List

Overstory Observation (Tree) List

Overstory Tree Log List

Understory Plot Variable List

Understory Observation Variable List

Ground Plot Variable List

Ground Observation Variable List

Transect Variable List

Transect Observation Variable List

Vegetation Tables

Vegetation Table Wizard (Select Contents)

Species X Diameter (Select Contents)

Product X Species (Select Contents)

User Code X Species (Select Contents)

Product X Diameter (Select Contents)

User Code X Diameter (Select Contents)

Height Classes X Species (Select Contents)

Plot Cluster X Species (Select Contents)

Timber Tables (Select Contents)

Dead/Down Summary

Ground Vegetation Summary

Overstory Species Composition and Diversity

Understory Species Composition and Diversity

Ground Species Composition and Diversity

Biomass Tables

Carbon Storage

Resource Narratives

Ecology Narrative

Timber Narrative

Visual Quality Narrative

Water Narrative

Wildlife Narrative

## Selecting Reports

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. In the Work Pane, open up or expand (click “+” symbol) the desired level for which you wish to generate a report (Plans, Management Unit, or Stands).
4. Open up or expand the general report heading to view the list of available reports under that heading. For instance, under Management Unit Reports, open up **General Information**.
5. When you find a desired report, select it with a single mouse click. For instance, select the report **Stand Comparison Table** in order to compare similar data across stands in the management unit.
6. In the Work Pane, click the **left-pointing arrow** in the top-left corner of the window to select the report.
7. If the report is marked with an asterisk (\*) then you are able to customize at least some of the report contents. If this occurs, you are immediately presented with a dialog of choices, suitable for the chosen report, when you select the report using the green arrow in step 6. If there is no asterisk for the report, this step is skipped.
8. If you have simulated data (projected forest growth beyond the most recent inventory year of any of your stands) you are given an opportunity to specify for which years you want to generate the report. An example of the available choices for simulated data is shown in Figure 16.
9. Check the boxes in each year for which you want to view your report. For all years in a plan, two boxes are available for before and after effects of treatments (if any) in the given year. The box on the left side of each pair indicates pre-treatment (“pre”) data, and the box on the right side indicates post treatment (“post”) data. Even if you have implemented multiple treatments in a given year, “pre” and “post” refers to the condition of the data before or after all treatments collectively.
10. When you have specified all of the points in time as desired, click **OK** to finish.

## Unselecting Reports

To remove a report from the list of reports that has already been selected:

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. In the Options Pane, open up or expand (click “+” symbol) the desired data (e.g., Inventory, Baseline) and then open up the desired level (Plans, Management Unit, or Stands) that contains the report you wish to unselect.
4. When you find the report, select it with a single-mouse click.
5. In the Work Pane, click the **right-pointing arrow** in the top-left corner of the window to unselect the report.
6. In some cases, you are presented with a series of check boxes for each stand as well as for simulated data in which you have selected the report previously. You must uncheck the appropriate boxes in order to unselect the report for those items. Click the **Clear all** button to unselect all boxes in one step. After unchecking the boxes, click **OK**.
7. In the Options Pane, the report disappears from the list of selected reports.

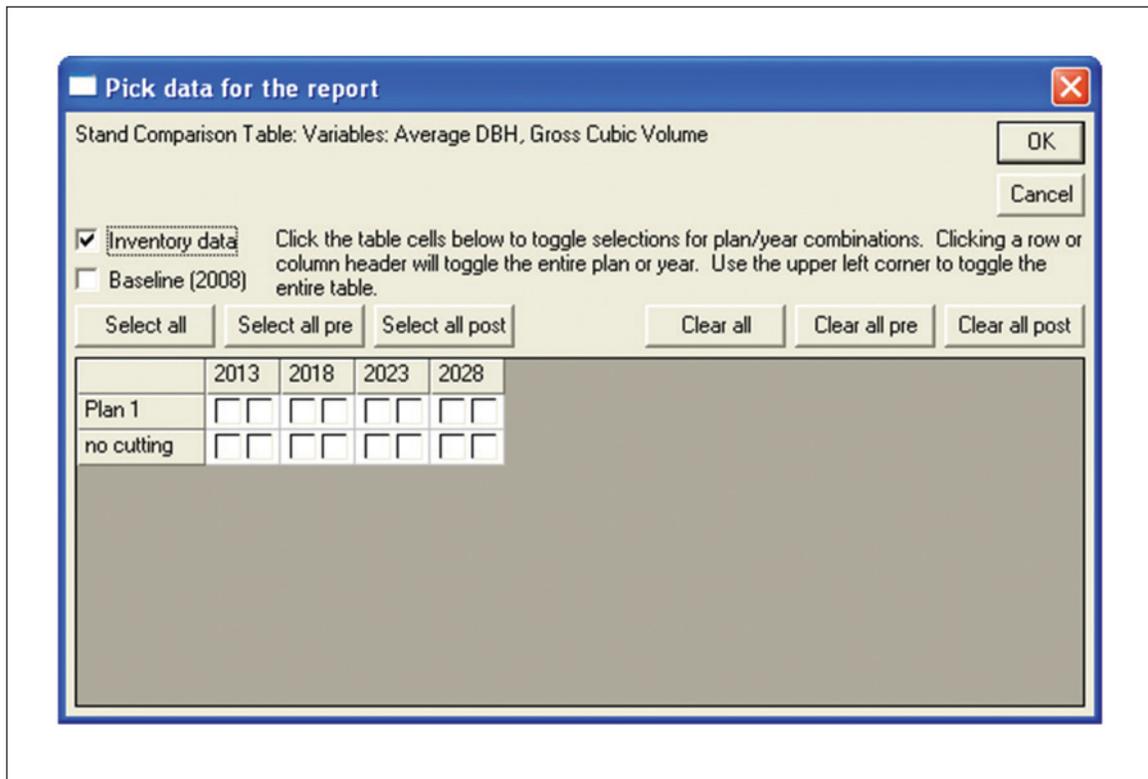


Figure 16. Choosing the years in which to generate a report.

## Generating One Report at a Time

Generating reports in this manner allows you to view one report at a time.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. A report cannot be generated until it has been selected. You may see which reports have been selected by viewing the Options Pane. Reports that you have previously selected will appear in boldface type. If necessary, expand the levels in the Options Pane to see the selected reports.
4. To generate a report, double-click on the name of the report in the Options Pane. NED-2 builds the report and displays it in your default web browser.

## Generating Multiple Reports at Once

After selecting several reports, you may generate them all at the same time, or you may generate two, three, or as many reports as desired.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. At the top of the Options Pane, click the **Generate All** button. All of your selected reports are displayed in a table.

4. To generate any specific report, you must enter a file name for the report. You can enter your own names in the File name column provided for each report in the table, or click the **Generate names for all reports button** to have NED-2 generate report file names automatically for you. Reports without file names are not generated.
5. All reports are created in the same output folder as shown on the dialog. To change this location, click the **Output folder** button and specify the desired folder.
6. If desired, check the **Delete existing files in the output folder** box to have NED-2 delete all existing report files in the output folder. This does not delete other kinds of files—only those ending with an .html extension. Even if this box is unchecked, NED-2 overwrites any file with the same name as newly generated reports.
7. To review the specifications of any of the reports, double-click in the Specifications column of the desired report.
8. When you are ready to generate all of the reports for which you have provided file names, click **OK**.
9. NED generates the reports and provides an index page in your default web browser with links to all of the requested reports. Click the links to view the desired reports.

### Adjusting Table Sizes on Reports

NED-2 reports are formatted to fit on a standard 8.5 × 11-inch (216 × 280-mm) sheet of paper. As a result, the tables generated for reports are generated with a default of six columns in order to fit on the printed page. If a table requires more than six columns, additional columns are written in the space below (six columns per section) until all columns have been displayed.

For many uses, the default setting of six columns per table is appropriate. However, you can change this setting to suit your needs.

To adjust the table sizes on reports:

1. From the Tools menu, click **User Settings**.
2. Click **Display Settings**.
3. If you want the NED-2 report writer to limit the number of columns, check the box **Limit tables in reports...** and enter the maximum number of columns you desire. For an unlimited number of columns in the reports, uncheck the box **Limit tables in reports...**
4. Click **OK**.

### Working with Report Sets

You may store a set of reports for re-use in other NED-2 files. This saves effort by reducing the amount of time it might take to redefine the same reports repeatedly. Also, this allows you to set aside groups of reports suited for special projects or analyses.

Report sets are stored in an external file ending with a **.NEDReports** extension. Report settings are intended to be stored in a generic manner so that they can be re-applied to any file regardless of the number or content of plans and stands.

## Creating Report Sets

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. At the bottom of the Options Pane, click the **Store** button. This launches the Select reports dialog. If you do not have any reports selected currently, the dialog does not open. You must first select some reports.
4. Specify a file name for your report set, by clicking the **Pick File** button. Browse to the desired folder, and enter an appropriate file name.
5. In the table of reports, place a check mark in the box next to the desired reports. If you want to include all reports, click the **Select all** button.
6. You may review the report settings for customizable reports by clicking a report name and then clicking on the **Report settings** button. For non-customizable reports, the **Report settings** button remains disabled.
7. Click **OK** when you are ready to build the report set, which is created in a file ending with a **.NEDreports** extension.

## Retrieving Report Sets

You may retrieve reports from a report set file (.NEDreports) or from any existing NED-2 (.mdb) file.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate Reports**.
3. At the bottom of the Options Pane, click the **Retrieve** button. This launches the Select reports dialog.
4. At the top of the Select reports dialog, click the **Pick file** button.
5. Under **Files of type** at the bottom of the dialog, select **NED report files** to retrieve reports from external report-set files, or select **NED-2 data file** to retrieve reports from an existing NED-2 file.
6. In the table of reports, place a check mark in the box next to the reports you wish to retrieve. If you want to include all reports, click the **Select all** button.
7. You may review the report settings for customizable reports by clicking a report name and then clicking on the **Report settings** button. For non-customizable reports, the **Report settings** button remains disabled.
8. Click **OK** when you are ready to retrieve the reports into your NED-2 file.

## GENERATING GEOGRAPHIC INFORMATION SYSTEM (GIS) DISPLAYS

NED-2 uses Environmental Systems Research Institute, Inc.'s (ESRI's) ArcGIS (ArcMap) to display a map of your selected goals and stand-level values. The creation of the GIS map (shapefile) is handled separately and *is not* performed by NED-2. The role of NED-2 is to join your selected goals and values with the stands identified in your shapefile, to provide color-coding of the values, and to launch the display.

Generally, GIS map data is represented on one or more layers, where each layer provides detail that can be viewed separately or in conjunction with information from other layers. Thus, each value (e.g., basal area, board-foot volume, relative density) and each goal (e.g., “focus on board-foot production,” “provide habitat for eastern screech owl”) that you select are displayed on separate layers. As described in ArcMap, within the **Display Tab** of the **Data Frame** in the far-left side of the ArcMap window, existing layers are listed in the order they are drawn from top to bottom. The layers at the top of the list draws over those listed below them.

In addition to inventory data, a GIS display can be created for any plan and year that has been simulated—where each layer encapsulates the data in a different view of the management unit. The GIS display can include layers for either all of the years in a single plan or all of the plans in a single year. For years that include treatments, layers for both the pre- and post-treatment views are included. You can easily switch between different layers in the GIS display to see the effects of treatments or to compare the values of variables across different years or plans.

### What is required?

1. You must have an existing shapefile (.shp) with geographic data for your management unit.
2. Your shapefile must have a column (i.e., a database field) that identifies each stand in the management unit, and the name of this field *must* be “stand\_id.” Then, each stand name in the shapefile must match the stand name that occurs in the corresponding NED-2 data.
3. NED-2 supports ArcGIS-ArcMap, version 8.x or 9.x. ArcGIS-ArcMap is available as a commercial product and is not distributed as part of NED-2.

### How to Generate a GIS Display

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate GIS Display**. When you request a GIS display, NED-2 verifies that ArcMap is installed on your system. You must already have ArcMap installed and tested (all license issues resolved, etc.) in order to generate a GIS display through NED-2. If a proper version of ArcMap is not found, NED-2 notifies you with a warning and stops.
3. If successful in finding ArcMap, NED-2 asks if another ArcMap session is already running. Answer **No** if ArcMap is *not* already running and you are ready to proceed. Attempting to generate a GIS display while ArcMap is already running may cause problems in NED-2. Thus, only one ArcMap session can be open at a time. When prompted, if you answer **Yes**, NED-2 does not generate a GIS display and it stops.
4. If you answered No and are ready to proceed, NED-2 opens the GIS selection dialog as shown in Figure 17.

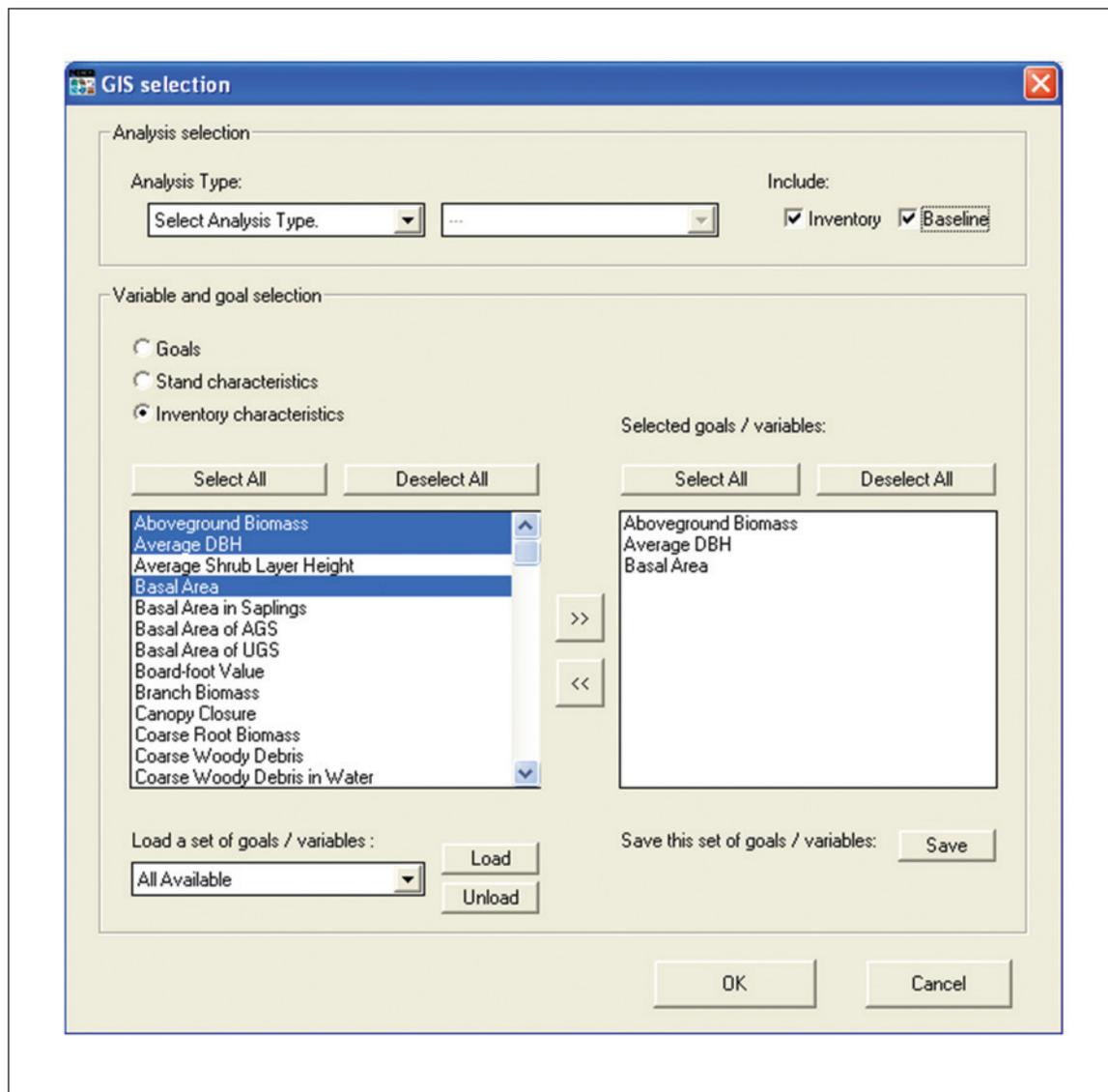


Figure 17. NED-2 GIS selection dialog.

5. At the top of the dialog, in the Analysis selection area, choose what point in time on which to base your display. You may select more than one. For instance, under the Include: area, you may check **Inventory** and **Baseline** to view your variable(s) in the year of your tally and in the baseline year. If you have simulated one or more plans, the **Select analysis type** pick lists are also available. In the list on the left, pick **Single plan with multiple years** to compare your variable(s) in all years of a given plan, and select a plan in the second list. Or, if you wish to compare data across your plans within a single year, pick **Single year with multiple plans** in the first list, and choose a year in the second list.
6. In Variable and goal selection area, variables and goals are selected by moving them from the lists of available goals and variables located on the left to the list of selected items located on the right. Items are moved between the two boxes by using the **double right-pointing** and **left-pointing arrows**. To aid in finding the desired item, the items available

for display are divided into three categories: goals, stand characteristics, and inventory characteristics. Inventory characteristics include the variables describing the vegetation on a stand, whereas stand characteristics cover the non-vegetative variables such as physiography and site information. Only the goals that have already been selected in planning are available for GIS analysis selection. You may switch between categories by using radio buttons. Changing categories does not affect items already selected.

7. Click **OK** when you have finished selecting variables and goals for display.
8. The next step is to specify the shapefile (.shp file) on which you wish to base the display. NED-2 launches the Open shape file dialog to allow you to browse to and select the shapefile.
9. Once you have specified the shapefile, NED-2 performs a goal analysis if any goals have been selected, and starts up ArcMap and then launch a dialog where you must specify which goal or variable to view first. You can only view one variable or goal at a time.
10. Click **OK** after you have selected the initial goal or variable to view, and ArcMap produces the display.
11. If you want to save your ArcMap project (.mxd file), be sure to save it with a name that you will easily remember. NED-2 always creates each ArcMap project with the same name and will overwrite any existing file with that name.

### Establishing GIS Data Ranges for Numeric Values

Whenever you choose a NED-2 goal or variable to display in ArcMap, the dialog as shown in Figure 18 appears. If your variable is of the NUMERIC type, you have some control over the establishment of data ranges.

At present, only equal interval partitioning of data is supported. This is a classification scheme whereby the range of attribute values is divided into equal-sized subranges. You select the number of classes into which the data is partitioned. In Figure 18, the number of classes is set to “5,” and you can select any whole number greater than one.

If you attempt to select the range for the partitions, using your own custom minimum and maximum values, the custom ranges cannot be implemented in ArcMap because this functionality is not working properly. It is strongly recommended that you retain the default data minimum and maximum.

To modify the data ranges at any time:

1. During a current NED-2 - ArcMap session while a given variable or goal is already in display, locate a small toolbar window with the caption **NED Renderers** as shown below:



2. Select the third icon from the left (the square with a blue triangle covering half of the icon). If you mouse over this icon, a tooltip bubble displays “Select Field (NED).” This launches the Choose stand variable to show dialog, as shown in Figure 18.

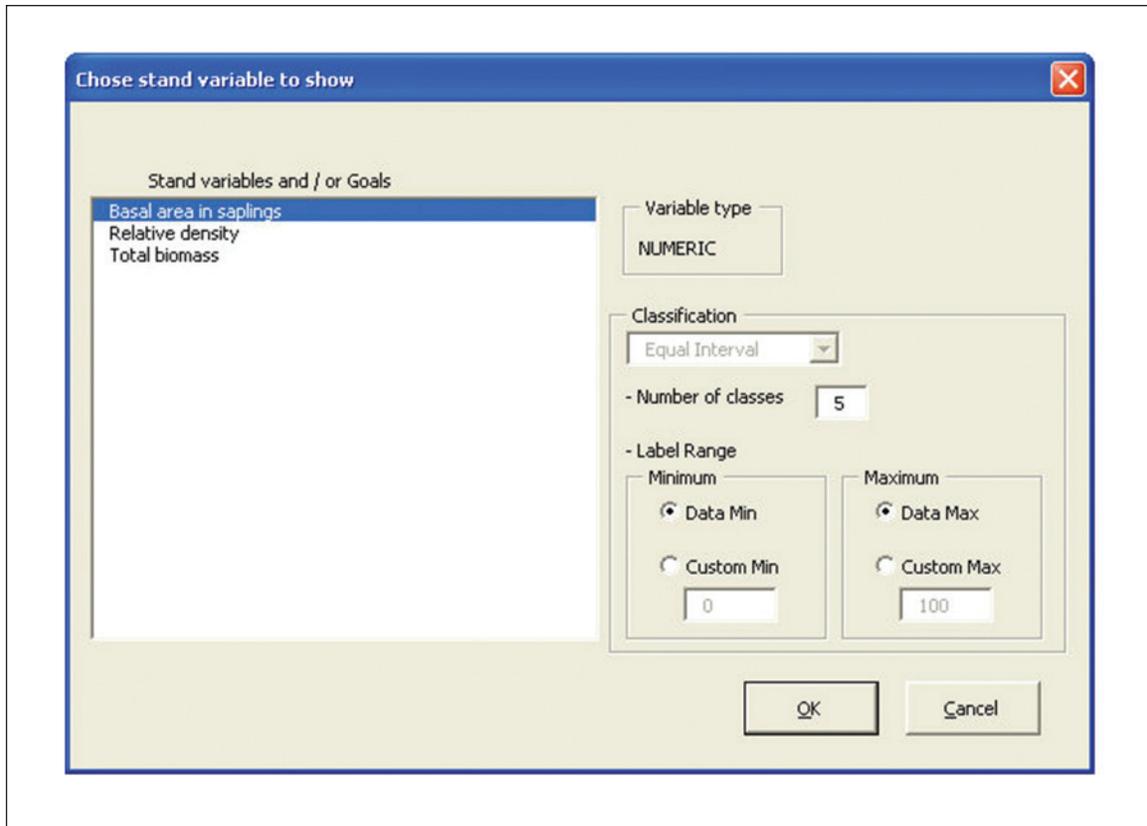


Figure 18. NED-2 GIS variable selection dialog.

3. Enter a different number of classes if desired.
4. Do not attempt to change the label range, using custom min or max; the functionality for making changes to the label range is not working properly. You should retain the default data min and max for label ranges.
5. Click **OK**.

### Switching Layers in the ArcMap Display

If you have other (non-NED) layers associated with the same shapefile in ArcMap, you may switch between layers by using the checkboxes in the layer headings within the **Display Tab** of the **Data Frame** on the far-left side of the ArcMap window. Multiple layers can be selected, but only the top layer is visible. To avoid confusion, it is advisable to select only one layer at a time.

Changing layers can cause a problem updating the legend, and the *legend may disappear*. If this occurs, locate a small toolbar window with the caption, NED Renderers, as shown below:



Select the second icon from the left (resembling a pen) to redraw the legend. If you mouse over this icon, the tooltip bubble displays “Modify Legend (NED).”

### Switching Variables During a GIS Session

After you have generated a GIS display in ArcMap, if you had started the session with multiple variables and goals, you need to follow these instructions to switch from one variable or goal to another. If you need to view a variable or goal that you did not already select, then your only alternative is to close ArcMap and start another GIS session with the variables you need.

1. During a current NED-ArcMap session while a given variable or goal is already in display, locate a small toolbar window with the caption **NED Renderers** as shown below:



2. Select the third icon from the left (the square with a blue triangle covering half of the icon). If you mouse over this icon, the tooltip bubble displays, “Select Field (NED).” This launches the Choose stand variable to show dialog (see Figure 18).
3. Choose the desired variable from the list on the left.
4. Click **OK**. ArcMap redisplay the map using the new variable.

### Labeling Features in ArcMap

Features such as stands, roads, rivers and ponds can be labeled in the ArcMap display. For example, if you do not see stand labels, you can add them to any layer as follows:

1. Right-click on the layer heading within the Display Tab of the Data Frame in the far-left side of the ArcMap window.
2. Click **Label Features** from the pop-up menu to turn on the display of the labels.

If different labels are desired:

1. Right-click on the layer heading within the Display Tab of the Data Frame in the far-left side of the ArcMap window.
2. Click **Properties** from the pop-up menu.
3. Click the **Labels** tab.
4. In the **Label** field, choose a desired label, such as “INVENTORY.STAND\_ID” to label each stand with the stand name.

## STAND VISUALIZATION SYSTEM (SVS)

The Stand Visualization System (SVS) (McGaughey 1997) is used to generate images depicting stand conditions represented by a list of individual stand components such as trees, shrubs, and down material, using detailed geometric models. SVS is optional software that is distributed with NED-2. During the installation of NED-2, you may choose whether you wish to install SVS.

The images generated by SVS provide useful, visual representations of current stand conditions as well as the effects of various management alternatives.

SVS uses two types of data: a tree list and plant form definitions. The tree list describes the species, size and location of each component (tree, snag, plant, log, or special object) in a stand. Typically, the location of stand components is generated from the model, unless you supply coordinates for each component and input the data directly into SVS. NED-2 generates the tree list in the format of Forest Vegetation Simulator (FVS) output, which is converted by SVS into a tree list for display. Plant form definitions describe the appearance of each species and, optionally, the appearance of individuals exhibiting different growth forms within a species. Users can change plant form definitions using the SVS tree designer to better adapt SVS to their stand conditions.

The minimum data required in a tree list includes a simple stand table containing species, dbh, height, and the number of plants per unit area.

In order to generate an image in SVS, NED-2 requires simulated data (i.e., a baseline and any plans). The SVS feature in NED-2 does not work for inventory data and the image will look like cut stumps; similarly, if the baseline year is the same as the inventory year for a stand, the image will look like cut stumps for the baseline year. This is because no height and crown data can be computed for a stand until growth has been simulated.

SVS provides the following capabilities:

- Displays individual plant and log components realistically;
- Displays stand characteristics to communicate the overall structural diversity present within a stand;
- Differentiates between stand components using different plant forms, colors, or other types of marking;
- Displays overhead, profile and perspective views of a stand;
- Provides a mechanism to define plant forms and colors based on species, growth form, and plant position within the canopy; and
- Provides tabular and graphical summaries of stand information.

### Generating a Stand Display

You must have SVS installed on your computer before you can generate a display. If you did not install SVS when you installed NED-2, try re-running the NED-2 installation, and select SVS only. If you are not sure, try looking for the **SVSSetupFiles** folder under the NED-2 folder in the location where you installed NED-2. In the SVSSetupFiles folder you may run the **setup.exe** file to install SVS.

Currently, NED-2 generates an SVS display only for simulated data. That is, you must at least establish a baseline prior to running SVS. The baseline must be at least one year later than the most recent year of inventory in any of your stands.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **Generate SVS Display**.
3. Choose a stand from the list of choices.
4. For a display method, select **by plan** to view your stand in all years within a single plan, or select **by year** to compare your stand among different plans in the same year.
5. For **choose a plan or year**, select a plan if your display method is by plan, or select a year if your display method is by year.
6. Click the **Display** button.
7. Some SVS windows appear:
  - The first window displays the source tree list files that your display is based upon. Click **OK** to continue.
  - The second window is a temporary splash screen that displays the SVS version and author, and then goes away automatically. Click **OK** to dismiss this window before it automatically disappears.
  - The third window is the SVS display window, where you can view image(s) of your stand (see Figure 19) according to the criteria chosen above. This is the active SVS window where you can adjust the view, modify the appearance of the trees, and other picture-oriented settings.
8. If there are multiple views of data, click the navigation buttons (**First**, **Previous**, **Next**, and **Last**) to move between the views. Brief descriptions of the stand, plan and year are provided immediately to the left of the navigation buttons at the bottom of the image display window.

Once SVS is running, you may keep the SVS window(s) open even if you quit NED-2.

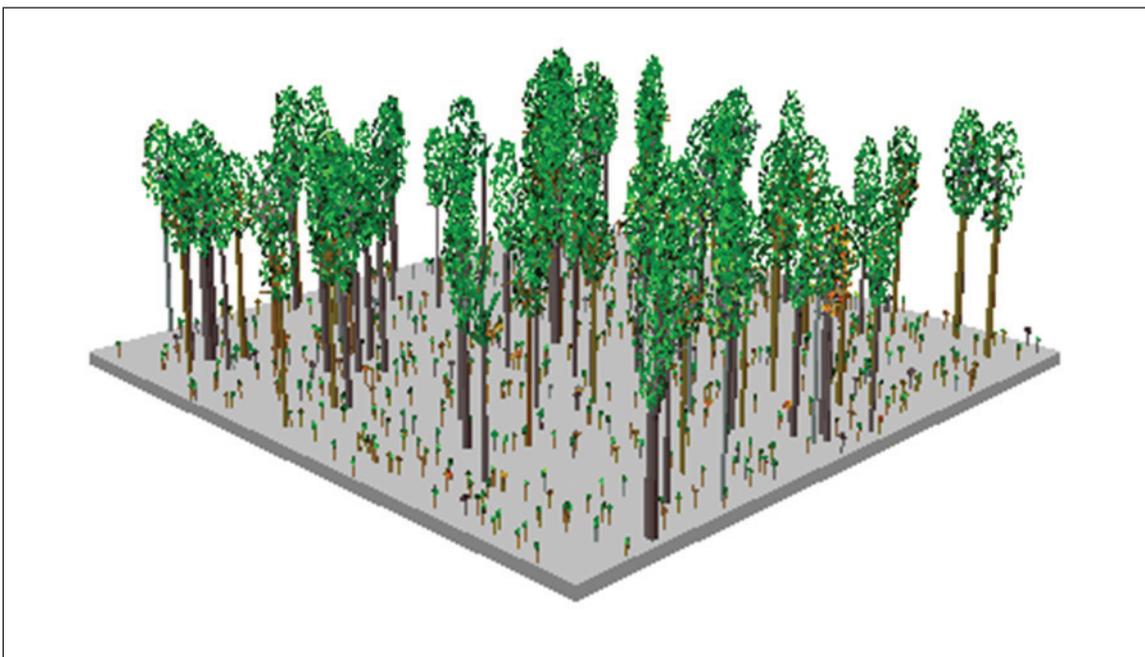


Figure 19. Viewing a stand in SVS.

## VIEWING STAND SNAPSHOTS

At any time, you may view your data in “read-only” mode, by viewing what is referred to as “stand snapshots.” A snapshot is a view of your data at various points in time during the planning cycle. For any given stand, you may view a snapshot of your original inventory data or simulated data such as the baseline or any year on the planning grid.

This feature is most useful when you need to view multiple variables of simulated data concurrently. If you only need to view one variable at a time, and you wish to compare plans side by side, refer to the Management Planning chapter, specifically the section, “Examining Simulated Plans,” where it describes how you can compare plans as well as view the results of simulation in all years of a single plan.

### Viewing Data along the Planning Cycle

Simulated snapshot data is presented as a series of discrete simulation actions (or simulation steps) that were applied to each stand, under each plan, according to the years on the planning grid. Simulation steps are identified by a brief name (such as a treatment ID) along with the year in which they occurred. For each year on the planning grid, all stands contain a growth and mortality simulation step, identified as a growth treatment (e.g., “2010 grow”). Any treatments you prescribed follow the growth step, and are identified separately according to the name of your treatment preceded by the year (e.g., “2010 shelterwood seed cut”). This reflects the manner in which simulation occurs—stand growth from the preceding year on the planning grid is accumulated prior to the implementation of your treatments in the current year.

When viewing snapshots of your implemented treatments (those involving cutting), you may see which trees have been removed during a simulated cut by checking the stems per unit area. For trees that have been removed in the year of the cut, the stems per unit area are zero.

Stand snapshots are viewed in the same manner as you would view your data during inventory entry/edit. The only difference is that this view is read only—you cannot edit the data.

1. In the Navigation Pane, click **Analysis**.
2. From the list of choices under Analysis, click **View Stand Snapshots**.
3. If you wish to organize your data by stands, in the bottom of the Options Pane, click **Stands at root**, or, if you wish to organize your data by plans, click **Plans at root**.
4. In the Options Pane, select the stand and the year in which you wish to view the data, such as inventory, baseline, or another year.
5. In the Options Pane, select the level (i.e., overstory, understory).
6. To view specific variables in the table, in the Work Pane, click the **Configure** button in the upper-right corner of the window.

# Glossary

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**abiotic factors**—The non-living components that make up or interact with a community or ecosystem.

**acre**—A unit of measure describing surface area. One acre contains 43,560 square feet. A football field (without the end zones) is 45,000 square feet—slightly larger than an acre. The inside of a professional baseball diamond is about 1/4 of an acre.

**advance regeneration**—Young trees that have become established naturally in a forest before regeneration methods are applied. In other words, the regeneration is present in advance of any treatment.

**aesthetics**—The science or study of beauty, as well as the theory or understanding of the perception of the environment by all the senses.

**age class**—The trees in a stand that became established at, or about, the same time. The range of tree ages in a single age class is usually less than 20 percent of the expected age of that class.

**air pollution**—The chemical compounds and emissions in the air that may damage the foliage of some trees.

**association**—A naturally occurring collection of plants and animals with similar needs for sunlight, warmth, moisture, shelter, and nutrients growing together. They function together to cycle energy, nutrients, and water; also called a community.

**average annual income**—The amount of money received over the course of a rotation divided by the number of years in that rotation; also called periodic income. For example, there is an even-aged stand that will be regenerated when it is 110 years old. The sale of wood products from a thinning at 65 years yields \$5,000, a thinning at 85 years yields \$6,500, and a regeneration cut yields \$30,000. The income from each sale is added and then the total is divided by the length of the rotation:  $\$5,000 + 6,500 + 30,000 = \$41,500$ ;  $\$41,500/110 \text{ years} = \$377.27$  each year. Therefore, the average annual income would be \$377.27.

**average diameter**—Average stand diameter; The average diameter at breast height (dbh) of stems among samples in a stand. Based on the simple average (arithmetic mean) dbh of all stems > 1 inch. Other measures of stand diameter in NED-2 include merchantable diameter, medial diameter, and quadratic mean diameter.

**basal area (BA)**—The area of the cross section of a tree's stem at 4 1/2 feet above ground, or breast height, in square feet. Basal area of a forest stand is the sum of the basal area's of the individual trees in the stand. It is usually reported in square feet of BA per acre and is used as a measure of stand stocking, stand density, and stand volume.

**Best Management Practices**—Procedures and treatments that lessen soil erosion, sedimentation, stream warming, movement of nutrients, and visual quality during or following activities that alter the land.  
**biological diversity**—The variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur. Also, the variety of ecological structures and functions at any one of these levels.

**biological diversity**—The variety and abundance of species, their genetic composition, and the communities, ecosystems, and landscapes in which they occur. Also, the variety of ecological structures and functions at any one of these levels.

**biotic factors**—The living components of a community or ecosystem.

**board-foot volume**—The amount of wood products expressed as the number of boards 1 foot wide by 1 foot long and 1 inch thick that are sawn from logs.

**breeding cover**—The cover required by animals to successfully produce offspring.

**broad-leaved plant**—A tree or shrub of the botanical group *Angiospermae*. This term is often applied literally to trees and shrubs with wide leaves as opposed to those with needle-like leaves.

**buffer strip**—An area of land that is left relatively undisturbed to lessen impacts of treatments next to it. Common examples include visual buffers used to screen the view from roads, and stream side buffers used to protect water quality.

**bulk wood product**—A product made of wood chips or wood fiber, as opposed to boards or lumber. Bulk wood products are most often measured in cubic feet or tons.

**canopy**—The continuous cover of branches and foliage formed collectively by the crowns of trees.

**canopy closure**—The degree of depth and closeness of branches and leaves of individual crowns to other crowns. It is expressed as a percentage of the maximum depth and closeness possible.

**canopy density**—The amount, compactness, and depth of branches and leaves of the crowns of trees.

**catastrophic event**—The occurrence of damaging agents such as insect outbreaks, drought and ice storms that appear suddenly and without warning. Events can be extensive and severe, but usually last for a short period of time.

**Clean Water Act**—A Federal law passed in 1972 and since amended, designating forests and silvicultural activities such as logging as nonpoint sources of water pollution. To comply with the Act, most states have established best management practices to control erosion and sedimentation, stream warming, and movement of nutrients into forest streams.

**clearcutting**—An even-aged silvicultural technique involving the removal of all stems in the stand. Strip cutting is a form of clearcutting.

**cold-water fish**—Fish that are very sensitive to and intolerant of warm water. They include salmonids such as brook trout.

**commercial treatment**—Any activity producing forest products that have at least enough value to cover the direct costs of the activity.

**conifer**—Trees, mostly evergreens, bearing cones and needle-shaped or scale-like leaves.

**corridors**—Corridors are usually linear patches or connections between similar patches, that differ from the elements on either side. Corridors can function as habitat for some species (especially species that live in edge habitats), serve as conduits or routes of movement between patches, or act as barriers to movement across the matrix.

**crop tree**—Any tree selected to provide a specific benefit such as mast, dens, veneer, or sawtimber. Crop trees are usually selected when they are young.

**crow**n—The part of a tree or woody plant bearing living branches and foliage.

**cubic-foot volume**—The amount of wood products expressed as the number of cubes 1 foot wide by 1 foot long and 1 foot high that are in a log or stem.

**cumulative effects**—An effect initiated by an event that was tied in time or space to other events (e.g., one straw broke the proverbial camel's back, but only because many straws had already been piled on). Cumulative events can be additive (e.g., straws on the camel's back) or compounded (involving more than one process). For example, increased frequencies of high flood events, debris torrents, and dam-break floods can adversely affect aquatic habitats and bury low-gradient stream reaches in debris. The occurrence of such events are not only due to severe storm conditions but to the effects of land management activities such as timber harvesting practices, road density, construction and maintenance standards, and conversion of land cover from forests to other land uses.

**cutting cycle**—The planned interval between treatments in forest stands.

**damaging agent**—Any one of various factors that injure trees. They include some insects, diseases, wildlife, abiotic factors, and human activities.

**dead and down material**—Any dead branches, tree trunks, or stumps that are on the ground.

**deformity**—The abnormal development of a tree's shape, caused by damaging agents or too much shading. Tree trunks can be crooked or swollen, branches can be unusually forked or bent, and wood can be of inferior quality.

**den tree**—A living tree that has holes in the trunk, or stem, from broken branches and decay, or hollow trunks; a cavity tree.

**diameter at breast height (dbh)**—Diameter at breast height; the diameter of the trunk of a tree measured at 4 1/2 feet above ground level. It is measured on the uphill side of the tree.

**diameter class**—An interval of sizes of trees or logs; or the trees and logs themselves that fall into such an interval.

**dieback**—The death of branch tips and loss of foliage in the upper and outer areas of tree crowns. Trees usually recover in several years by producing new branches. Various damaging agents can cause tree crowns to die back.

**disease**—Any departure from the normal functioning of a plant caused by some type of persistent damaging agent.

**drought**—A period of dryness that is associated with low soil moisture and inability of plant roots to obtain adequate water for growth. Droughty conditions often predispose trees to other problems that also cause damage.

**ecosystem**—A spatially explicit unit of the Earth that includes all organisms along with abiotic components (Christensen et al. 1996). Ecosystems are volumetric segments of the Earth, large and small, nested within one another in a hierarchy of spatial sizes (Barnes et al. 1998).

**escape cover**—The cover used to avoid a predator or other danger.

**evapotranspiration**—The conversion of water into water vapor which is then released into the air. The water can pass from plants (usually leaves) into the air or be evaporated from open water or the soil. Plants convert water to vapor to cool the surface of leaves.

**even-aged stand**—A stand containing trees in the main canopy that are within 20 years of being the same age. Even-aged stands sometimes are designated by age-class (10-year-old stand, 40-year-old stand) or broad size-class: seedling stand (most trees are < 1 inch dbh); sapling stand (trees 1-4 inches dbh); poletimber stand (trees 5-10 inches dbh); and sawtimber stand (trees > 10 inches dbh).

**even-aged system**—A planned sequence of treatments designed to maintain and regenerate a stand with one age class.

**felling**—Cutting or uprooting standing trees, causing them to fall to the ground.

**fishery**—A fish habitat maintained or created for sport or commercial fishing. Some examples of habitat criteria include ample food sources, favorable temperature, shelter such as woody debris and rocks, and optimal levels of dissolved oxygen and chemicals.

**forest**—A plant association characterized by trees and other woody vegetation, growing more or less closely together. Also, a group of stands under single ownership or manager. Forest management includes silviculture, and also involves activities such as road construction, fire protection, pest management, regulating the cut of timber products, maintenance of wildlife habitat conditions, inventory, boundary maintenance, and recreational and aesthetic planning.

**forest benefit**—Any of the things that you receive from a plant community dominated by trees that increase the community's value to you. These things may include beauty, solitude, biological diversity, habitats for species of special concern, water quality or quantity, wildlife, wood products, and income.

**forest community**—A naturally occurring collection of plants dominated by trees, and the animals associated with them, that have similar needs for sunlight, warmth, moisture, shelter, and nutrients growing together. They function together to cycle energy, nutrients, and water.

**forest condition**—Generally, the current characteristics of forested land including but not limited to cover type, age arrangement, stand density, understory density, canopy density, and forest health.

**forest cover type**—A category of forests based on the kind of trees growing there, particularly the composition of tree species. Forest cover types are often referred to as forest types, cover types, stand types, or types.

**forest developmental stage**—The age, condition, and degree of maturity of a forest community. For example, even-aged stands develop from seedlings to saplings to poles to large diameter trees, and the community changes as the trees grow. Uneven-aged stands have at least three different developmental stages in each stand.

**forest health**—The condition of a community of trees in relation to past, present and potential effects of damaging insects, diseases, abiotic factors, wildlife and human activities.

**forest opening**—An area where trees have been or will be absent from the plant community.

**fungi**—Organisms that reproduce by spores, and are not able to produce their own food. Fungi obtain nutrients from other living or dead organisms.

**geographic range**—The area, or region, where a native species occurs naturally.

**groundwater**—Water found in unblocked pores and fractures in bedrock and other geologic material. Groundwater can occur in soils that are permanently saturated. Groundwater may be held in place for long periods of time or move slowly down slope by gravity. Groundwater is usually obtained from wells and may contribute to streamflow by surfacing at lower elevations.

**group selection**—An uneven-aged silvicultural technique involving the removal of trees in groups usually 1/10 to 2/3 acre in size, but sometimes up to 1 to 2 acres on large properties. Group selection can be applied in combination with single-tree selection between groups.

**growth loss**—A reduction in expected height and/or diameter increase. Many factors influence tree growth including available growing space, water, nutrients, amount of shading, and effects from damaging agents.

**hardwoods**—Woody angiosperms, broadleaf trees, that are distinguished from softwoods (gymnosperms) by the presence of vessels in the wood and broad leaves; hardwood is the wood of broad-leaved trees.

**herbaceous plants**—Plants with non-woody stems that normally live only one growing season. Herbaceous perennials have persisting root systems or other underground structures such as bulbs. These plants can sprout stems each growing season for several years. In forest understories, these include wildflowers and ferns.

**herbicide**—Any chemical preparation used to kill or inhibit the growth of certain plants, particularly herbs, or their spores or seeds. This term generally includes arboricides which are specific for trees and other woody plants.

**home range**—The area in which an individual animal normally confines itself to obtain food and cover.

**horizontal diversity**—The degree of complexity of the arrangement of plant and animal communities, and other habitats across a large area of land.

**hydrologic function**—The ability of vegetation, soils, and bedrock to accept rain water and snowmelt and convert it to soil water, runoff, groundwater, or evaporation. The hydrologic function in well-established forest communities is excellent and provides a maximum opportunity for storing moisture and minimal overland flow.

**hydrology**—The study of the movement and storage of water in the natural and disturbed environment. Also, the condition of the water resource at some specified point in time.

**importance value**—A value that indicates the influence of a species in a community. It is computed by adding together the values for relative abundance, relative frequency, and relative dominance and dividing by three to obtain an importance percentage. Although often used, it has the disadvantage of giving similar results for species that have different combinations of the independent measures of influence.

**improvement cut**—A cut in an uneven-aged stand, designed to upgrade the quality or species composition. No rotation age is specified for uneven-aged stands. Instead, a very general maximum tree size is chosen, and residual stands after cutting are defined by maximum tree size, stand density, and stand structure—diameter distribution, proportion of sawtimber, etc.

**insect**—Insects associated with forests are represented by numerous species, and have a wide range of ecological roles. Most insects do not damage trees, but some do. They eat leaves, suck sap, bore through bark and wood, and introduce microorganisms that cause diseases.

**interior species**—Species found only or primarily away from the perimeter of a landscape element. Species commonly requiring or associated with interior habitat conditions.

**intermediate cuttings**—Silvicultural cuttings applied in the culture of even-aged stands and are normally noncommercial (no products sold) or commercial thinnings (timber sold), designed to favor certain species, sizes, and qualities of trees by removal of competitors. Thinnings designed to grow quality timber commonly maintain a closed canopy; however, low-density thinning (50-70 percent residual crown cover) can be used to hasten diameter growth and stimulate understory development for wildlife purposes. At rotation age, the stand is considered to be mature, and a regeneration cutting is applied to produce a new stand.

**intermediate product**—Any wood product recovered from intermediate treatments.

**intermediate treatment**—Any treatment or “tending” designed to enhance growth, quality, vigor, and composition of the stand after seedlings are established and before mature trees are regenerated. For example, thinning is an intermediate treatment.

**landing**—A cleared area in the woods where logs are gathered to load onto trucks for shipment to a processing plant. Usually, it is along a road.

**landscape elements**—The basic, relatively homogeneous ecological elements or units, whether they are of natural or human origin. Examples include forests, rivers, fields, roads, wetlands, hedgerows, lakes, and farmyards.

**leaf litter**—Fallen organic matter including recognizable leaves, needles, branches, bark, and stems, that accumulate on the forest floor. Leaf litter protects the underlying organic and mineral soils against the impacts of raindrops. It prevents erosion and promotes rapid infiltration of rain and snowmelt into the soils.

**logging**—The felling and removal of logs and other wood products from forest stands.

**lop**—Cutting branches of trees that are standing, felled, or fallen.

**maintenance costs**—Costs that are associated with owning and caring for a piece of land. They include taxes, and upkeep of other resources such as roads.

**management unit**—A group of forest stands managed as a unit to provide a single package of benefits.

**mast tree**—A tree that produces nutlike fruits such as acorns, beechnuts, hickory nuts, seeds of certain pines, cherries, apples, samaras. Hard mast trees include acorns, beechnuts, and hickory nuts. Soft mast trees include cherries, apples, and samaras (on maple and ash trees). Mast trees are an important food source for wildlife.

**matrix**—The matrix is the dominant landscape element on a landscape in which smaller differentiated elements (patches) are embedded. It is commonly highly connected throughout the landscape.

**mature tree**—A tree that has reached the age where its growth declines or decay begins to increase. Also, a tree is mature when the benefits begin to decline, as in its ability to produce mast or the value of its wood.

**medial diameter**—The average of the diameter or size-class midpoints of a stand, weighted by the proportion of basal area in each size class or diameter. Approximately the same as the diameter at the midpoint of the basal area distribution. Medial diameter is favored by some (over both simple average and quadratic mean diameters) because it better reflects the size of the crop trees and is less influenced by small understory trees. See average diameter for more information.

**merchantable diameter**—The average stand diameter (arithmetic mean) of the merchantable-sized trees (> 5.5 inch dbh) in a stand. See average diameter for more information.

**mortality**—The death of trees. In forests, it is a normal process that occurs when trees are old, crowded, or when they have been severely damaged by some agent. Mortality of some trees offer benefits to remaining trees and to wildlife. However, extensive mortality in a forest interferes with its expected development and desired uses.

**native plant**—A species that naturally occurs in a given location where its requirement for light, warmth, moisture, shelter, and nutrients are met.

**natural forces**—The factors that influence the development of a forest, including the soil, climate, and damaging agents.

**NED**—A computerized decision support model developed by the U.S. Forest Service for forest managers to provide assistance on integrated resource management. NED-2 is a tool to incorporate wildlife habitats, visual and scenic qualities, wood production, water quality and quantity, and ecological aspects in forest planning and development of silvicultural treatments. In early versions of the software, including NED/SIPS and NED-1, the NED-2 acronym was rooted in the concept of a “Northeastern Decision Model.” As the geographic scope as well as our set of collaborators expanded, the name has remained but with expanded applicability that includes the temperate forest zone of the eastern United States.

**NED/SIPS**—NED/SIPS was the initial product of the development of NED. The computer program, subtitled Stand Inventory Processor and Simulator (SIPS), provided an effective means of creating, managing, and analyzing forest inventory records at the stand level. Its user-friendly interface relieved the pain of entering and editing stand inventory data, and once data are entered, a host of analytical tools were available to help understand the data. A variety of reports could be generated describing the vegetation structure, timber value, and economics of the stand. The user could apply any of a set of standard treatments to the stand or design a customized cutting scheme, and utilize one of the four incorporated stand growth simulators to show what the stand may look like in the future. Major SIPS features included access to four growth and yield simulators using the same data file format (NE TWIGS, SILVAH, OAKSIM, and FIBER), overstory summary tables for common measures of stand characteristics (i.e., density, species composition, volume), and economic analyses of incomes and expenses over the planning horizon.

**net present value**—The gross value minus costs at one point in time, generally the present.

**non-commercial treatment**—Any activity that does not produce at least enough value to cover the direct costs of that treatments.

**nonpoint source pollution**—Pollution that stems from a source that is spread out over the land. Nonpoint sources include runoff from silvicultural treatments, agricultural activities, waste water management and some construction activities. The actual pollutants may vary considerably.

**nutrient**—Elements, and other chemical substances, that enhance biological activity. Nitrogen, phosphorus, potassium, and sulfur are some of the nutrients necessary for plants to grow.

**old growth**—A forest community that is very old, generally with several age classes older than 80 years.

**outbreak**—Unusually large populations of insects or diseases that cause damage. Outbreaks vary in size, frequency and duration depending on the particular insect or disease and environmental conditions.

**overland flow**—The portion of rain or snowmelt that flows over the surface until it reaches a stream channel. It is not absorbed by the soil. Overland flow in forests is rare unless leaf litter and organic horizons of the soil have been severely disturbed or mineral soils have been compacted.

**overmature**—A stage in a tree's life when it has declined in vigor and is no longer growing due to old age.

**overtopped**—A condition or position where a tree's crown is completely covered by the crowns of one or more of its neighboring trees. An overtopped tree's crown is entirely below the general level of the canopy and does not receive any direct sunlight either from above or from the sides.

**patch**—A patch is a relatively homogeneous area that differs in some way from its surroundings (e.g., woodlot in a corn field, conifer plantation in a mixed-deciduous forest).

**peak water flow**—The instantaneous maximum flow of water, often occurring as the result of an intense storm, snowmelt, or a combination of both.

**pest suppression program**—A collection of methods used by forest managers to control outbreaks of damaging insects and diseases. These methods usually involve aerial spraying of pesticides or biological materials to reduce pest populations and minimize damage to the forest resources.

**photosynthesis**—The formation of starches and other carbohydrates from carbon dioxide, water, and sunlight in cells containing chlorophyll, or green colored cells in plants.

**plantation**—A forest stand in which most trees are planted or established from seed sown by people. Typically, planted trees are in rows, with equal spacing between each tree in a row and between rows.

**pole**—A tree, usually young, with a dbh that is larger than 4 inches and smaller than 8 to 11 inches.

**pollutant**—A resource out of place.

**prescribed burn**—The application of fire in forested or other areas, usually under specific conditions of weather and fuel moisture, to control vegetation for silvicultural purposes or to reduce hazards.

**prescription**—The specific instructions for controlled applications of silvicultural treatments based on information about the stands to which they apply.

**province**—Provinces cover areas on the order of ten-thousands of square miles. Provinces are characterized by broad vegetation regions and soil orders, which conform to climatic subzones controlled primarily by continental weather patterns such as length of dry season and duration of cold temperatures. The climatic subzones are extensive areas of similar potential natural communities as mapped by Kuchler (1964).

**q-factor**—Also called q-ratio. Represents a geometric progression of increasing numbers of trees with decreasing diameters (Smith 1986). For example, using 2-inch diameter classes, if the q-ratio is 1.2, the number of trees in the 6-inch diameter class will be 1.2 times the number of trees in the 8-inch diameter class.

**quadratic mean diameter**—The average stand diameter based on the tree of (arithmetic) mean basal area for all stems with a dbh > 1 inch. Weighted upward by the contribution of trees of larger diameter. Has historical significance because foresters were interested in the tree of “average volume” (arithmetic mean volume per tree). If a forester knew what the average tree volume was, then they could count the number of trees in a stand, and multiply that number by the average tree volume to compute stand volume. According to Curtis and Marshall (2000), in regular even-aged stands the average volume per tree is closely related to the average basal area per tree, which is the same as the quadratic mean diameter. Stocking charts also use quadratic mean diameter because of the direct relationship between number of trees, basal area, and quadratic mean diameter. See average diameter for more information.

**quarantine regulation**—Federal, state and local laws that restrict the movement of plants or their products that may contain or promote damaging insects and diseases. These restrictions are intended to limit the spread of pests outside their current range.

**regeneration**—The seedlings and/or saplings in a new forest stand or age class. Natural regeneration originated from seeds, sprouts, or root suckers.

**regeneration cuttings**—Silvicultural cuttings designed to naturally regenerate the stand by providing for seedling (or vegetative stems) establishment or development, or both. Two even-aged techniques include; clearcutting and shelterwood, and two uneven-aged techniques include: single-tree selection and group selection.

**regeneration method**—A cutting method by which a new age class is created. These methods include clearcutting, seed tree, shelterwood, single-tree selection, and group selection; also called reproduction method.

**relative abundance**—The amount (abundance) of a given species, using any kind of measure, divided by the total abundance of all species. The sum of all species' relative abundances must equal unity (1.0). Relative abundance can also be expressed as a percentage, in which the total relative abundance of all species adds up to 100. If basal area is the measure of abundance, relative abundance is often termed “relative dominance” and is calculated by dividing the total basal area of a species by the total basal area of all species. The relative number of stems is another measure, commonly referred to as “relative density” among ecologists. In the practice of forestry, a separate concept of relative density has evolved. See “relative density” for further information.

**relative density**—An index of crowding for forest stands, also called the tree-area ratio; a measure of the absolute stand density expressed as a ratio to the density of some reference level. The reference level is usually the stand density of a fully stocked stand for a particular species composition, site, and method of treatment.

**residual spacing**—The distance between trees that remain in the forest after a silvicultural treatment.

**resting cover**—The cover used when animals are roosting or sleeping.

**riparian area**—The area where the transition between streams, or other bodies of water, and forest vegetation occurs. Riparian areas usually have unique plants, animals, and soil characteristics. The boundaries of riparian areas are not always clearly defined. Riparian areas require special care to protect the quality and habitats of streams.

**roost**—To sit, rest, or sleep on a pole, tree, or protected place on the ground. Roosting is a term used mostly in reference to birds.

**rotation**—The planned interval of time between treatments that regenerate a stand.

**runoff**—Surface streamflow leaving a watershed. Sources of runoff are precipitation falling in the channel, overland flow (rare in forested areas), and subsurface water exiting from soils and bedrock. In this user's guide, runoff is synonymous with streamflow.

**sapling**—A tree, usually young, that is larger than a seedling but smaller than a pole-sized tree. Size varies by region, but a sapling is usually taller than 6 feet and with a dbh between 1 and 4 inches.

**sawlog**—A log suitable in size and quality to be milled in to lumber of any size. Usually sawlogs are at least 8 inches in diameter after the bark is removed.

**sawtimber**—Trees large enough to be cut into sawlogs.

**scale**—A reference to the relative size of things. Or, size in comparison with its environment, a human figure, or the landscape. The human scale, or the size of people, is a standard reference for the size of all things in our culture.

**scenic quality**—The positive and negative visual characteristics of the natural landscape.

**section**—Sections are broad areas of similar geomorphic processes, stratigraphy, geologic origin, drainage networks, topography, and regional climate. Sections cover areas on the order of thousands of square miles; also used to denote a portion of a township in a public land survey, where an individual section measures one mile on a side (80 chains), forming a square, equaling approximately one square mile or 640 acres.

**sedimentation**—The accumulation of organic and mineral soil particles and rocks in streams and water bodies due to erosion. Sedimentation often accompanies flooding. The application of best management practices will usually protect against sedimentation during and after treatments.

**seed tree**—A tree that produces seed. Seed trees are usually mature and high in quality.

**seedling**—A tree grown from a seed. Usually the term is restricted to trees smaller than saplings, or less than 6 feet tall or with a dbh smaller than 1 inch.

**semi-woody plant**—Plants with stems that reach nearly full size and become somewhat woody in one growing season; subshrubs. They commonly grow additional shoots but not additional layers of wood in following years. Such stems normally live only a few years, and are replaced by new stems growing from a persistent root system. These include brambles.

**shade intolerance**—The relative inability of a plant to become established and grow in the shade.

**shade tolerance**—The relative capacity of a plant to become established and grow in the shade.

**shelterwood**—An even-aged silvicultural technique involving the removal of the understory and lower crown canopy trees to allow the new stand to regenerate under shade. Subsequent removal of the overstory in one or several cuts.

**silvicultural system**—A planned process whereby a stand is tended, and re-established. The system's name is based on the number of age classes (for example even-aged or two-aged), and/or the regeneration method used (for example, shelterwood, crop-tree, or selection).

**silvicultural treatment**—A process or action that can be applied in a controlled manor according to the requirements of a prescription or plan to a forest community to improve real or potential benefits.

**silviculture**—The art, science, and practice of establishing, tending, and reproducing forest stands with desired characteristics.

**single-tree selection**—An uneven-aged silvicultural technique involving the removal of trees singly or in groups of two or three, which maintains a continuous canopy and an uneven-aged or uneven-sized mixture.

**site**—The combination of biotic, climatic, topographic, and soil conditions of an area; the environment at a location.

**site conditions**—The site conditions representative of a stand are sometimes designated by soil factors (parent material, texture, drainage, or soil series), or by direct measurements such as site index—the height of the dominant/codominant trees at a base age of usually 50 years.

**skid trail**—A path or minor road in the woods that is followed when skidding logs from the stump to the landing.

**skidding**—The act of moving felled logs from their stumps to a landing by dragging or sliding.

**slash**—Branches, twigs, and leaves of trees left on the ground after a treatment.

**snag**—A standing dead tree without branches, or the standing portion of a broken-off tree. Snags may provide feeding and/or nesting sites for wildlife.

**softwoods**—A term describing both the wood and the trees themselves that in most cases have needles or scale-like leaves (the conifers); gymnosperms.

**soil properties**—The combination of chemical and physical factors which influence the movement of moisture into, through, and out of soils. Examples include infiltration capacity, porosity, bulk density, soil depth, and water-holding capacity.

**soil water**—Water held between soil mineral and organic particles. This water is susceptible to evaporation, plant uptake, lateral flow into streams, and downward flow into groundwater.

**species composition**—The collection of plant species found in an area. Composition is expressed as a cover type, or a percentage of either the total number or the density, or volume of all species in that area.

**species diversity**—The number of different plants and animals, and other life forms, coexisting in a community.

**species richness**—The number of different species present in an area.

**stand**—An area of trees of a certain species composition (cover type), age class or size class distribution and condition (quality, vigor, risk), usually growing on a fairly homogeneous site. The trees are sufficiently uniform in spacing, condition, age arrangement and/or forest type to be distinguished from neighboring stands. The conditions of the site are relatively uniform, including soil properties, water drainage, slope, exposure to weather, and productivity. Stands of five acres and larger commonly are recognized, though minimum stand size depends upon size of ownership and intensity of management.

**stand composition**—The collection of plants, particularly trees, that are found in a stand.

**stand condition**—The number, size, species, quality, and vigor of trees in a forest stand.

**stand density**—A quantitative measure of the proportion of area in a stand actually occupied by trees. This is an absolute measure rather than a relative measure, or percentage.

**stand structure**—The arrangement of trees of different sizes and ages in a stand.

**stewardship**—The wise management and use of forest resources to ensure their health and productivity for the future with regard for generations to come.

**stocking**—A subjective indication of the number of trees present on a stand compared to the optimum number for your desired outcomes expressed as a percentage.

**stream flow**—Flowing surface water formed by a combination of precipitation intercepted by the stream channel, and moisture passing over or through soils and bedrock. Stream flow is generally confined to a well-defined channel, except during flooding or in exceptionally flat topography.

**stream warming**—The heating of stream water by sunlight. The forest canopy covering streams can be managed to either protect against or encourage stream warming.

**succession**—A gradual and continuous replacement of one kind of plant and animal community by a more complex community. The environment is modified by the life activities of the plants and animals present thereby making it unfavorable for themselves. They are gradually replaced by a different group of plants and animals better adapted to the new environment.

**sustainable**—The indefinite and steady supply of something.

**terrestrial**—Of or pertaining to the land as distinct from air or water.

**territory**—A defended area in the home range of an animal, particularly during the breeding season.

**thinning**—The removal of some trees to improve and enhance the vigor and growth of other trees. Thinning enhances forest health and allows you to recover any excess of potential mortality.

**thinning interval**—The period of time between successive thinning treatments, usually used in connection with even-aged stands.

**threatened and endangered species**—Plant or animal species with limited abundance and distribution and in danger of disappearing due to lack of suitable habitat and/or other factors.

**travel cover**—The cover that allows animals to move from one area to another without being detected.

**understory**—The small trees, shrubs, and other vegetation growing beneath the canopy of forest trees and above the herbaceous plants on the forest floor.

**uneven-aged stand**—A stand with trees in three or more distinct age classes, either intermixed or in small groups, growing on a uniform site; a stand containing trees of several 20-year-age classes. These stands generally contain trees of many sizes (seedling through sawtimber) due to the range in age as well as differences in growth rate among species.

**uneven-aged system**—A planned sequence of treatments designed to maintain and regenerate a stand with three or more age classes.

**veneer**—A thin sheet of wood of uniform thickness, produced by rotary cutting, slicing or sawing.

**vertical diversity**—The extent to which plants are layered within an area. The degree of layering is determined by three factors: 1) the arrangement of different growth forms (trees, shrubs, vines, herbs, mosses and lichens); 2) the distribution of different tree and shrub species having different heights and crown characteristics; and 3) the number of trees of different ages.

**virus**—Microorganisms that are not able to produce their own food. They obtain nutrients from other living or dead organisms. The study of tree viruses is relatively new, but several have been identified. They infect leaves or roots, and may contribute to tree death.

**visual and scenic qualities**—A category of aesthetic factors associated with forests that includes qualities like big tree appearance, plants with special characteristics, permanent openings, and concern for the visual effects of disturbance and slash after treatments.

**visual quality**—The positive and negative visual characteristics of anything you see.

**warm-water fish**—Fish are tolerant of high water temperatures often found in larger bodies of water, such as rivers and lakes. An example is large-mouth bass.

**water quality and quantity**—A category of factors associated with forests that includes intensive protection of water quality, riparian areas, wetlands, and fisheries; and the amount of water that flows from the forest.

**water yield**—The distribution and total quantity of runoff, usually considered over some specified period of time. Water yield may be characterized by total volume of runoff and flow duration curves.

**watershed**—An area of land through which precipitation is redistributed into components of the hydrologic cycle, including evaporation, groundwater, and streamflow. A watershed is all the land giving rise to streamflow at a selected point in a stream channel; the area drained by a river or stream and its tributaries.

**wetland**—In the absence of a single, universally recognized definition, a wetland is a land/water ecosystem characterized by periodic inundation. The soils developed under the influence of saturation. It supports plants and animals adapted to these conditions.

**wildlife cover**—Hiding places that provide animals with protection from weather, predators, or other dangers. Specialized types of cover include breeding cover, escape cover, resting cover, and travel cover.

**wildlife habitat**—The combination of environmental factors, such as food, water, cover, and their spatial distribution that a given species needs to survive and reproduce in a given area. Each species has unique habitat requirements.

**wildlife pest**—Animals that cause excessive damage to trees by eating leaves, twigs, buds, bark, or roots.

**woody debris**—The larger woody branch and stem wood (greater than 1 inch in diameter) that has fallen either naturally or as a result of logging. Woody debris in water is an important layer for aquatic organisms and a source of shelter for fish.

**woody plants**—Plant species with persistent stems capable of growing an additional sheath, or layer, of wood and bark each year for the life of the plant. These include trees, shrubs, and woody vines (grapevines).

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For definitions of additional terms not found in the index, see the Glossary.

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**NED-2 User's Guide.** Gen. Tech. Rep. NRS-85. Newtown Square, PA: U.S.  
Department of Agriculture, Forest Service, Northern Research Station. 193 p.  
[CD-ROM]

This is the user's guide for NED-2, which is the latest version of NED, a forest ecosystem management decision support system. This software is part of a family of software products intended to help resource managers develop goals, assess current and future conditions, and produce sustainable management plans for forest properties. Designed for stand-alone Windows-based personal computers, NED-2 integrates a variety of forest management tools into a single environment. These tools include databases, growth and yield models, wildlife models, geographic information systems (GIS), visualization tools, and others. The software is distributed with an online help system and a printed user's guide. This user's guide provides guidance for use of the software and a basic introduction to the principles and calculations used in NED-2. A reference guide with more detailed explanations of the models, equations, and rules that underlie the software is available separately. The NED-2 software and related documentation is included on the CD-ROM and also may be downloaded from <http://nrs.fs.fed.us/tools/ned/products/ned2/>.

**KEY WORDS:** decision support, forest management, multiple objectives, ecosystem management, growth simulation, desired future conditions, alternative comparisons, goal evaluation, eastern North America.

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