Vegetation Dynamics Development Tool

User Guide

Version 6.0

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May 2007

Citation: **ESSA Technologies Ltd.** 2007. Vegetation Dynamics Development Tool User Guide, Version 6.0. Prepared by ESSA Technologies Ltd., Vancouver, BC. 196 pp.

Funding assistance by the US Forest Service does not imply endorsement of any statements or information contained herein.

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ACKNOWLEDGEMENTS

We thank Paul Hessburg, Wendel Hann, Jim Byler, and Al Harvey for supporting the initial idea for VDDT. We also thank the many users and participants of various workshops who patiently worked with earlier versions of VDDT and who provided suggestions and feedback that helped us to improve the tool. We especially thank Don Long, Kathy Schon, and the members of the Insect and Pathogens Working Group for their contributions to the success of this initiative.

We thank Kelly Pohl, Don Long, Jim Merzenich, Jim Smith, Sue Hagle, Jim Byler, Andy Taylor, Susan Schilling, and Wendel Hann for ideas and suggestions that led to new features implemented in Versions 3, 4, 5 and 6.

This project has been funded by many sources. The main part of the development initially came from the Interior Columbia River Basin Assessment Project. Additional funds have been supplied by the LANDFIRE Project, the US Forest Service, The Nature Conservancy, the Canadian Forest Service, Forest Renewal BC and ESSA Technologies Ltd.

INTRODUCTION TO VDDT

What is VDDT?

Projecting changes in vegetation structure and composition over time is an important part of landscape-level analyses. Vegetation can change for a variety of reasons such as human activity, fires, insects, pathogens, mammals, weather, or growth and competition. The interaction of these factors can be quite complex and it can be difficult to project the combined effects over long periods of time.

The Vegetation Dynamics Development Tool (VDDT) is a user-friendly, Windows-based computer tool that provides a modeling framework for examining the role of various transition agents and management actions in vegetation change.

Terminology Used in VDDT

Different areas within a landscape can be summarized as being covered by vegetation that is predominantly of some type (i.e., the dominant species) and structure. Each of these areas can be called a ***class***. VDDT operates on a series of these classes. Each class is a unique combination of cover type and structural stage, where ***cover type*** is the dominant type of vegetation, and the ***structural stage*** relates to the vegetation structure of the class (e.g., high or low grasses, single or multi-storied tree cover, etc.). VDDT moves ***cells*** (a unit of area) from class to class based on a set of ***pathways***. These pathways define how the vegetation changes based on ***deterministic transitions*** (i.e., aging in the absence of any probabilistic transitions), and ***probabilistic transitions*** (anything that changes the pathway of the cell such as insects, diseases, grazing, harvesting, severe weather events, etc.). Movement along pathways can be a deterministic (time dependent event) or a stochastic event, the likelihood of which is defined by probabilities.

Regions are areas in which the basic scenario assumption is the same (for example – transition type *i*, in class *j*, moves the cell to class *x*), but the probabilities (P(*i*)) of some transitions differ.

Probabilistic transitions belong to one or more ***transition groups***. These groups are broad categories containing probabilistic transitions that are of similar type. The grouping allows users to more easily select pathways for drawing, view the effect of the transitions, disable types of transitions for a particular simulation, or use multipliers to change the probabilities associated with types of transitions. Users can define up to 30 groups, and can assign each probabilistic transition to up to three groups.

How the Model Works

Users of VDDT create descriptions of vegetation dynamics using state and transition models. For each state and transition model vegetation states are defined as combinations of the predominant cover type and structural stage, called classes. Two types of pathways between classes are possible in a pathway diagram: probabilistic transitions and deterministic transitions. Probabilistic transitions specify the type of transition event, its probability (or return frequency) and its impact on vegetation. Probabilistic transitions are typically used to represent natural disturbances (e.g. fire, wind, insects) or probabilistic succession. Deterministic transitions specify, for each class, the maximum time until a transition must occur, and the class it will move to after this time has passed (e.g., to represent deterministic succession).

The basic VDDT simulation algorithm is described with detail in Appendix A. Here is a brief description. For each simulation, the landscape is partitioned into a number of cells or simulation units; each initially assigned a class (i.e., cover type and structural stage) and age. For each time step the model simulates the probability of each cell being affected by one of probabilistic transition types, and if a transition does occur, moves the cell to the class defined in the pathway diagram. Transition probabilities are dependent on the current state of the cell, defined by its class. They are independent of the state of the neighboring cells. Thus, the model is not spatially-explicit, and so does not simulate contagion in space (e.g., wildfire) or time (e.g., insect outbreaks).

VDDT can be used to test the assumptions of transition probabilities and pathways. The model simulates changes in landscape-level indicators, such as changes in the frequency distribution of classes or structural stages and the area affected by each transition type. Results are presented at user-specified time intervals or as average statistics for certain time periods. Detailed results can also be exported to text files. Because of the stochastic nature of the model, results are not deterministic, but follow probability distributions described in more detail in Appendix B.

The pathway diagrams depict scenarios of vegetation dynamics. Landscape-level vegetation changes can thus be simulated for one or more scenarios and the impacts of changes in transition frequency can be assessed. Scenarios can define different assumptions about fire suppression, land management, or the introduction of exotics by assigning different probabilities to the applicable pathways.

This modeling framework provides a common platform for specialists of different disciplines (entomology, pathology, fire ecology, silviculture, wildlife biology and ecology) to collectively define the roles of various processes and agents of transition on landscape-level vegetation dynamics.

Moreover, the development tool allows for rapid gaming and testing of the sensitivity of the system to alternative assumptions. It thus provides a tool for learning and communication.

Using this Manual

The User's Guide has been organized by menu option, and covers the major steps involved in setting up the model, carrying out runs, and analyzing results. Please consult the Table of Contents and the Index to help you find specific information.

The User's Guide uses the following typographical conventions.

Example	Description
Number of simulations	Italic type indicates names/text appearing on a dialog box, such as the names of fields and tab names.
Results	Bold type indicates text you must type exactly as shown; it also emphasizes menu names, menu options and buttons you can choose.

New VDDT Features

VDDT version 6 has been upgraded to include a number of new features. These include:

1. a reorganization of VDDT's menus and screens to make using the system more intuitive; in particular, the options for graphing and exporting output, and for controlling advanced features (such as multipliers, attributes and area limits), have now been streamlined;
2. storage of all key user inputs within the VDDT Access database, making it easier to track and share models; new features added to the VDDT model database since version 5 include attributes, area limits and multipliers;
3. the simplification and streamlining of options for exporting model output, making it easier to export model output for use in other applications (such as Excel and Access);
4. improved options for importing and exporting model parameters, including the ability to import and export transition pathways and probabilities to/from Excel;
5. the addition of batch run capabilities, allowing multiple projects in a database to be run at one time; this feature is particularly useful when running VDDT over landscapes with multiple models; and
6. the ability to invoke batch runs of VDDT models from other applications.

Details of these and other changes are explained throughout this manual. See about *Working with Version 4 Projects*, and *Importing Projects and Files* for specifics on how to use VDDT files from VDDT version 4.4c and earlier.

GETTING STARTED

System Requirements

We recommend the following system specifications:

- Microsoft Windows 2000 or later; and
- 512 MB memory.

Installing VDDT

VDDT is installed using an MSI program in the downloaded zip file. You will need a password to extract the VDDT installation program from the ZIP file (contact vddt@essa.com to request the password).

To install VDDT for the first time:

1. From the **Start** menu, select **Run**.
2. Click on the **Browse** button and navigate to the temporary directory. From the **Files of Type** drop-down list, select **All Files**.
3. Choose **VDDT-Setup-60-xxx.msi**, where "xxx" denotes the last three digits of the version number. Click **Open**.
4. Click **OK** on the **Run** window, and follow the instructions on the screen.

The install program will ask you where you wish to put the program files (i.e., the directory in which VDDT should be placed). The default directory is C:\Program Files\VDDT but users can change this to a directory of their choice. The installation will place files in the chosen directory and in the \WINDOWS\SYSTEM32 directory. It will also create items on the **Programs** menu.

VDDT is distributed with a set of existing files that can be used as a starting point or as examples. These files include an example Project in a database (VDDT.mdb), and text definition files containing lists of probabilistic transitions (DISTCODE.TXT), probabilistic transition groups (DISTGRP.TXT), cover types (COVER.TXT, COVERC.TXT), and structural stages (STRUCTUR.TXT).

To install an upgraded version of VDDT:

> **Note:**
> VDDT version 6 can read files from all previous versions of VDDT.

If you try to install VDDT 6 without uninstalling a previous version, the installation program will detect the older version and offer you the opportunity to remove it. The removal process will archive the *.TXT definition files found in the VDDT folder, and will remove all program files, including the default VDDT.mdb file. Files and folders that you created while working with the earlier version of VDDT, e.g., customized folders containing databases and other project-related files, will not be removed by the de-installation process.

> **Note:**
> If you have made manual changes to the location of VDDT program files, VDDT may be unable to complete the uninstall. If this happens, please contact us at vddt@essa.com for assistance.

If you have projects in the default VDDT database (VDDT.mdb) that you wish to keep, be sure to make a back-up copy of VDDT.mdb before proceeding. The uninstall process will remove the VDDT.mdb file in the VDDT folder, and the installation process will replace that file with a fresh one containing only the Ponderosa Pine Demonstration Project. After the installation is complete, you can either copy your backed up VDDT.mdb into the VDDT folder (overwriting the newly installed VDDT.mdb), or you can import your customized projects from the back-up into the newly installed VDDT.mdb. Alternatively, you can export your projects from the back-up database into a new database with a different name of your choosing.

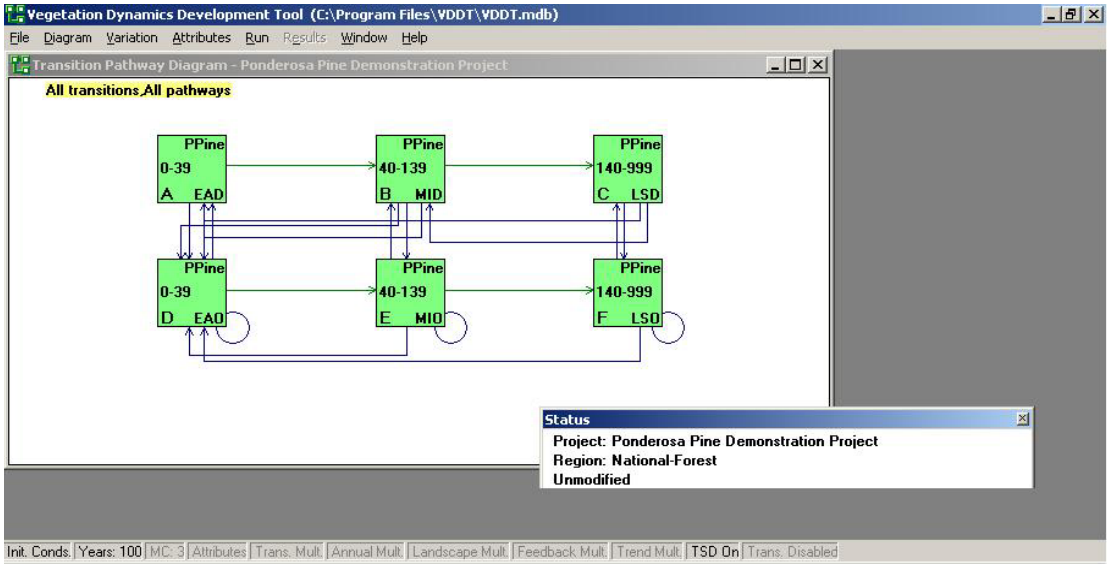
After uninstalling, re-start the installation process by following the steps above for installing VDDT for the first time.

Running the Model

To assist beginning users, a basic database (VDDT.mdb) and an example Project called "Ponderosa Pine Demonstration Project" are distributed with VDDT . Using the example Project, or any other Project in the database, the model can be run in just nine steps.

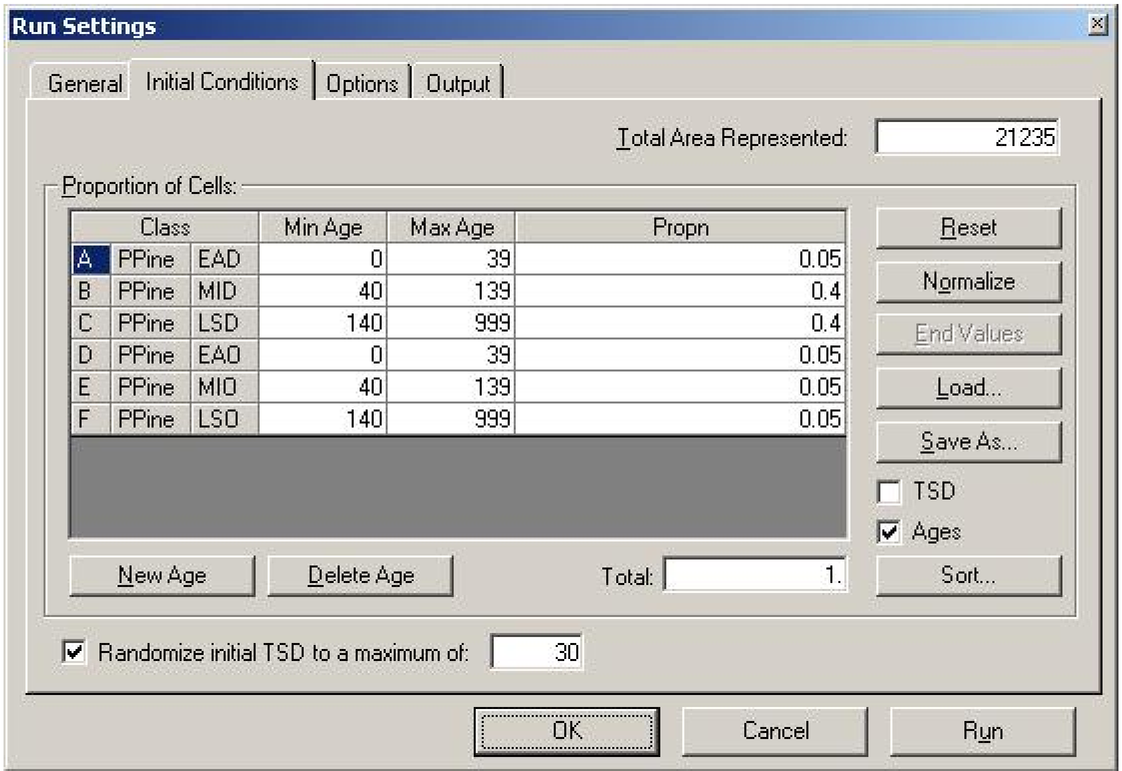
To run the model using an existing Project:

1. Start VDDT by selecting **VDDT** from the **Programs** menu under the **Start** button.
2. Select **Open** from the **File** menu.
3. Choose an existing Project (such as Ponderosa Pine Demonstration Project) from the list in the **Open Project** dialog; VDDT will display the associated Transition Pathway Diagram (TPD).



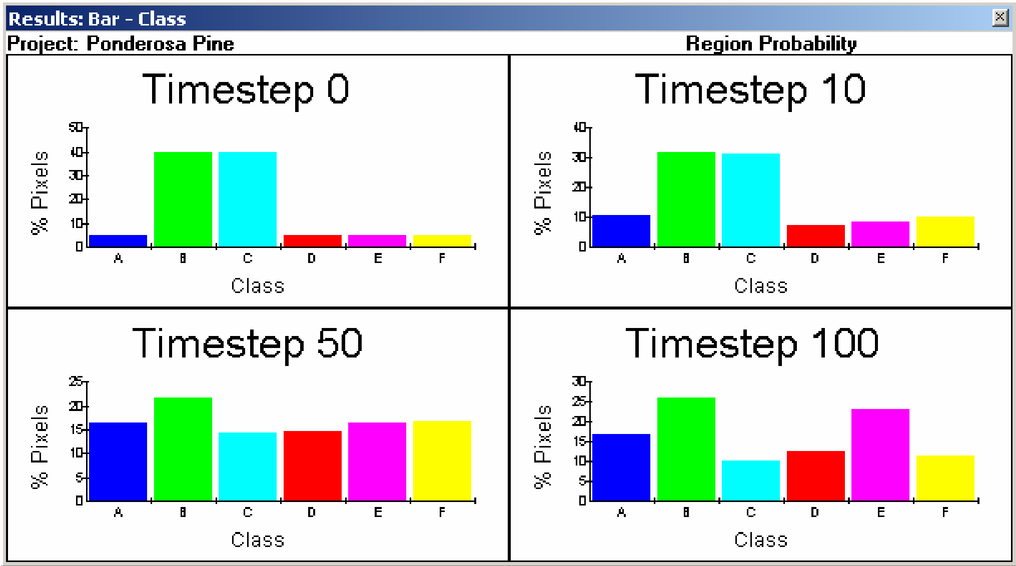
4. Select **Run|Settings** and define your general run conditions on the *General* tab. Set the *Number of timesteps*, the *Number of cells*, and the *Number of simulations*. In the example below, the model is set to simulate 1000 cells for 100 years, repeated for 3 Monte Carlo simulations.

5. Set the initial run conditions on the *Initial Conditions* tab of the **Settings** screen under the **Run** menu (see about *Initial Condition Run Settings* for more information). In the example below, we've set the total area to be simulated as 21,235 hectares. The model is set to start with 5% of this area as Class A, 40% as Class B, etc. Click **OK** to close the screen.



6. Run the model by selecting **Start Model** from the **Run** menu.

7. When the run is complete, you can view your results using the various options under the **Results** menu. For example, selecting **Results|Graph Options** and then **Class** and **Bar** will display the distribution of area by class at up to four different time steps.



8. To save any changes you've made to your VDDT Project, select **File|Save As** and enter a new name for it. If you now go to the **File|Open** menu, you should see your newly-named Project, alongside the original demonstration project used to start this exercise.

9. When your VDDT session is concluded, select **Exit** from the **File** menu to close the application.

The VDDT Database

VDDT stores all key model inputs in an Microsoft Access database, i.e., definitions, potential vegetation type and scenario information, information about the location of classes in the pathways diagram, initial conditions, attributes, area limits, multipliers and general project information. Advanced information created using the optional **Variation** menu, e.g., trend multipliers and landscape feedback (see about the **Variation** menu in Appendix G), is stored in a series of text files external to the VDDT database. The physical location of these files is stored in the database as part of the Project, so VDDT can find them when the Project that references them is opened; the database only stores information about the physical location of these advanced files, not the information itself.

VDDT is distributed with a sample database (VDDT.mdb) to assist beginning users. Other VDDT databases of Project information can also be created and loaded. For example, users might keep all Projects from a certain geographic location in one database and those from another in a separate database. To load a different VDDT database, choose **Database** from the **File** menu and select the MDB file with which you wish to work. To create a new VDDT database, copy the one in the installation directory

(Default C:\Program Files\VDDT), move it into the directory you want to use, and rename it.

Once you have chosen the database with which you wish to work, any Project in that database can be opened using the **Open** option under the **File** menu. After making changes to your Projects, you must explicitly save them to the database using the **Save** option under the **File** menu. If you wish to save your changes to a new Project, choose **Save As** from the **File** menu and rename the Project.

Working with Version 4 Projects

Definition Files

In early versions of VDDT (4.x and earlier), definition files constituted the foundation of all Projects. These files define the meaning of many numerical codes used in VDDT (e.g., they relate a cover type code to a name), and contain information about the valid cover types, structural stages, and probabilistic transitions that are used throughout the model. In later versions of VDDT, all definition information is stored within the VDDT database; however definition files can still be used to create new Projects (using the **File|New** menu). Alternatively, definition files can be imported into an existing VDDT 5.x or later project using the **File|Import|Definitions** menu.

A set of five text definition files is included with the VDDT installation as a starting point for new Projects. They are:

- DISTCODE.TXT,
- DISTGRP.TXT,
- COVER.TXT,
- COVERC.TXT, and
- STRUCTUR.TXT.

New cover types, probabilistic transitions, transition groups, and structural stages can be defined by creating a new set of definition files or editing the existing ones in any editor capable of reading and writing ASCII files. When customizing these files, be sure the file format conforms to the descriptions provided in Appendix D.

> **Note:**
> If you wish to create multiple customized sets of definition files while retaining the original TXT files as templates, you can either rename the new ones by changing the extension (do not change the filenames), or you can move the new sets into different file folders.

PVT and Scenario Files

Potential Vegetation Type files (*.PVT) and Scenario files (*.SC) are integral to Project files created in early versions of VDDT. In version 6, the information contained in these files is stored in the database, and users only handle these files when importing or exporting Projects (using the

File|Import|PVT and **File|Import|Scenario** menus). For a detailed description of these files and how they were used in VDDT version 4.4c, see Appendices D and E.

Location Files

In early versions of VDDT, location files (*.LOC) contained information about the placement of the classes in the Transition Pathway Diagram. This information is optional, as VDDT can organize classes using an internal rule-base. As with PVT and Scenario files, the information contained in the location file is now stored directly in the database. Users only handle this file when importing or exporting Projects (using the **File|Import|Scenario** menu). After the scenario file is read, the model will look to see if there is a location file with the same name as the PVT file. If so, the user will be prompted to load the location file as well. The information in the location file will overwrite the default information produced by VDDT. Once a location file is being used for a VDDT session, all new classes must be placed in the desired location.

Clicking on the **Cancel** button when VDDT asks for the location file name will cause VDDT to ignore the location file, and to use the default locations for the classes.

Note:
If the location file has a different name than the PVT file, the model will not find the file and will not prompt the user to load it. You can open a location file with a different name by navigating to the directory containing the file, and selecting it.

Project Files

In early versions of VDDT, project files (*.PRJ) contained a roadmap to all component files that comprised a Project. These component files included core information (Definitions, PVT, SCN, LOC, IC) which is now stored in the database, as well as advanced information (attributes, temporal variation, landscape feedback…), some of which is still stored in files. Additionally, Project files contained various parameter values (such as the number of time steps, or whether multipliers are turned on, etc.).

Users only handle this file when importing or exporting Projects (using the **File** menu). A complete description of the file formats is given in Appendix D.

Building Projects from Component Files

For users of VDDT version 4.4c and earlier, Projects can be created in version 6 from component files using the **Import** option under the **File** menu. **Import** opens the selected files into memory; nothing is saved to the database until the user explicitly saves a Project by selecting **Save** or **Save As** from the **File** menu.

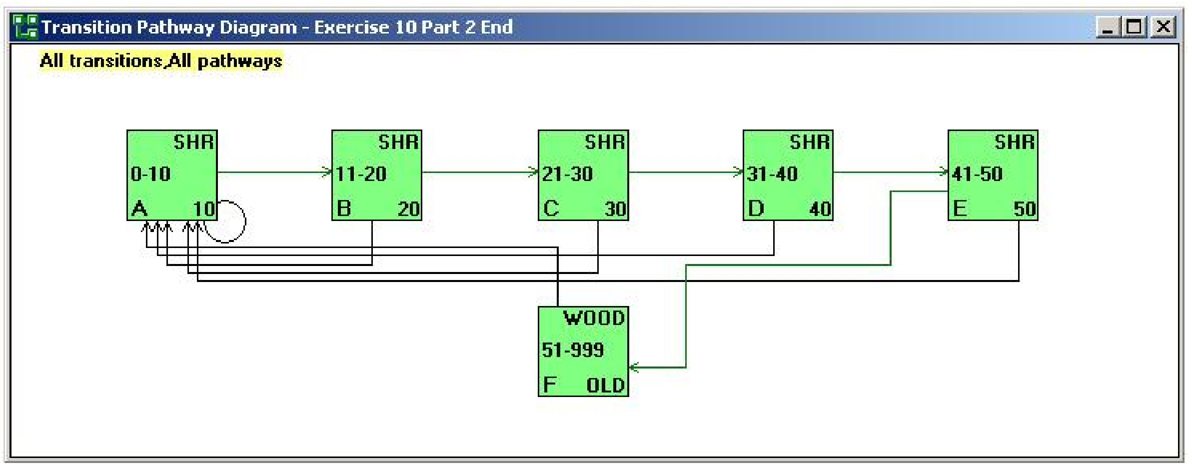
To import component files for a Project:

1. Start VDDT by selecting **VDDT** from the **Program** menu under the **Start** button.
2. Select **Import|Definitions** and **PVT** in turn from the **File** menu. With these menu options, you will import all definition files, the PVT, scenario and location files. When done, the Project defined by the selected files will open into memory, displaying the pathway diagram.
3. Select **Save** from the **File** menu and name the Project; this action will integrate the Project information into the database.
4. Use the various menus and submenus of VDDT to read in the information contained in all associated files related to the Project, e.g., attributes, transition and temporal multipliers, area limits, etc. How to do this will be addressed in subsequent chapters of this User Guide.

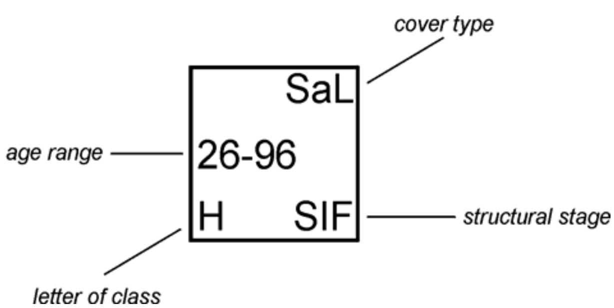
TRANSITION PATHWAY DIAGRAMS

Transition Pathway Diagrams

A Transition Pathway Diagram (TPD) defines the classes (boxes) and the pathways (lines and circles) between these classes for each potential vegetation type. TPDs illustrate all possible ways in which a cell could travel to move from one class to another.



Each box is one class, and is described by a unique combination of cover type (upper right corner) and structural stage (lower right corner). Each box is also labeled with a letter (assigned automatically by VDDT).



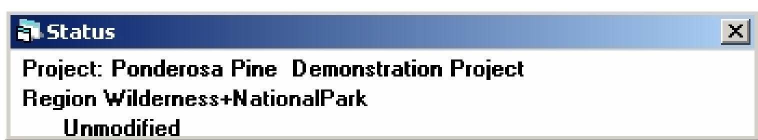
The cover type is a short code for the predominant vegetation in the class, and the structural stage is a letter or number code for the structure of the vegetation in the class. The letter of the class is an identifier used within VDDT as a reference for the class. The age range shows the minimum and maximum ages for the class, as determined by the deterministic transitions. The arrows show the pathways between classes, as described in the Project. Deterministic transition pathways start and end on the vertical sides of boxes while probabilistic transition pathways start and end on the top or bottom of boxes.

By default, all defined pathways are shown (see About *Class Properties* for more information). Arrows are drawn in a variety of colors to help users identify the type of transition agent. The colors used are:

Color	Green	Yellow	Red	Black	Blue
Transition	Deterministic	7	10	1-3	All others
Group	9	8			More than 1 agent

The numbers in the table correspond to the Code for the pathway's Transition Group (as defined under **File|Properties|Definitions**). Note that in many pathway diagrams, pathways for multiple agents overlap and will be drawn in blue (last column).

The window header for the TPD contains the words **Transition Pathway Diagram** and then the name of the Project. This information is also displayed in the **Status** window in the lower right corner of the main window. The status window displays **Unmodified** until any information about the classes, pathways, probabilities, or attributes has been edited. The top left of the TPD also lists the transitions currently being displayed (see the next section for more details).



About Class Properties

All of the information contained within a Transition Pathway Diagram may be viewed and edited through the Class Properties dialog box.

To open the class properties dialog:

1. Right click on the box representing the class of interest, then select **Class Properties**.

OR

2. Select **Class Properties** from the **Diagram** menu, and enter the letter of the class of interest.

The **Class Properties** dialog box will appear, showing all the pathways going away from the class. In the top right corner of the dialog, the class identifier is shown along with the cover type and structural stage of the class. Below this is the *Display Pathways* section of the dialog, with which users can view/edit information about pathways going from the class (*From Class*), or view information about pathways going to the class (*To Class*).

The information in the dialog is divided into two main sections. The top section contains the deterministic transition information and the bottom section contains a grid showing all the probabilistic transition information.

Deterministic Transitions

The deterministic part of the dialog box shows:

- the start and end age of the class,
- the destination after deterministic transition (class identifier in the *Box* field), and
- the cover and structural stage of the destination class.

Timing		To Class		
Start Age	End Age	Box	Cover	Stage
140	999	F	PPine	LSO

The cells for start/end age and destination class can be edited when viewing pathways **from** classes. No cells can be edited when viewing pathways **to** classes.

Probabilistic Transitions

Each row of the probabilistic part of the dialog box represents a different pathway. The grid contains information about:

- **Region:** the regions associated with the Project (this column only displays for Projects with multiple regions) – note that each pathway is repeated for each of the regions in the Project;
- **Transition Type:** the transition type associated with each pathway;
- **Prob:** the probability of the transition pathway occurring (less than or equal to one);
- **Propn:** the proportion of time that the transition leads to the specified class within the specified region (less than or equal to one) – by default these values are set to 1; and
- **To Class:** pathway destination class information (box, cover type and structural stage).

Region	Transition Type	Prob	Propn	Prob x Propn	To Class		
					Box	Cover	Stage
Fire-and-Treatments	PPUB	0.0500	1.00	0.0500	B	SHR	OL
Fire-and-Treatments	SUCC	0.0500	1.00	0.0500	D	SHR	CT
Fire-and-Treatments	WSRF	0.0100	1.00	0.0100	A	HRB	OL
Fire-Suppression	PPUB	0.0500	1.00	0.0500	B	SHR	OL
Fire-Suppression	SUCC	0.0500	1.00	0.0500	D	SHR	CT
Fire-Suppression	WSRF	0.0000	1.00	0.0000	A	HRB	OL
No-Management	PPUB	0.0000	1.00	0.0000	B	SHR	OL
No-Management	SUCC	0.0500	1.00	0.0500	D	SHR	CT
No-Management	WSRF	0.0100	1.00	0.0100	A	HRB	OL

The cells for transition type, probability, proportion and destination class identifier can all be edited when viewing pathways **from** classes. No cells can be edited when viewing pathways **to** classes.

To save class properties information:

1. When finished with all edits, click on the **OK** button to save all the changes to memory and close the **Class Properties** dialog.
2. Alternatively, you can save your changes to memory without closing the dialog by clicking **Apply**.

These actions do *not* save your changes to the database; to do so, you need to save your Project (**File**|**Save** or **File**|**Save As**).

The **Cancel** button (or the ESC key) allows users to leave the dialog box and ignore all changes.

THE USER INTERFACE

File Menu

The **File** menu provides access to VDDT's file management features. The options on this menu allow users to create new Projects, open existing Projects, save Project information, and import/export Project information. Use the **File** menu to also manage Project properties, select a different database with which to work, and close VDDT. The following sections of the User Guide provide details for each of these features.

CREATING NEW PROJECTS

The simplest way to create a new project is to make a copy of an existing project.

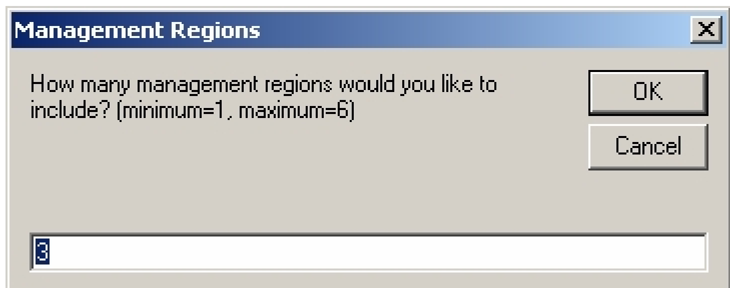
To copy an existing Project:

1. Open an existing Project using the **File|Open** menu.
2. Save the Project under a new name using the **File|Save As** menu.
3. Edit the newly created Project.

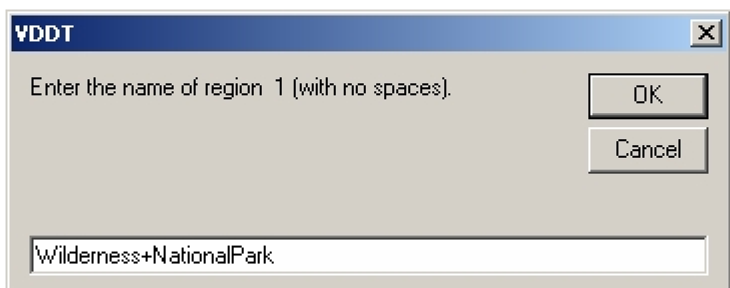
Alternatively, Projects can be created without starting from an existing Project. Users can build a Project based only on a set of text definition files. Classes and pathways can be added as needed.

To create a new Project:

1. Choose **New** from the **File** menu; VDDT prompts for selection of definition files.
2. Select the DISTCODE.* file that represents the location and file extension for all of the definition files you wish to use as a basis for your Project.
3. VDDT will proceed to load all five files.
4. Choose the number of regions to be used in the Project (minimum = 1, maximum = 6).



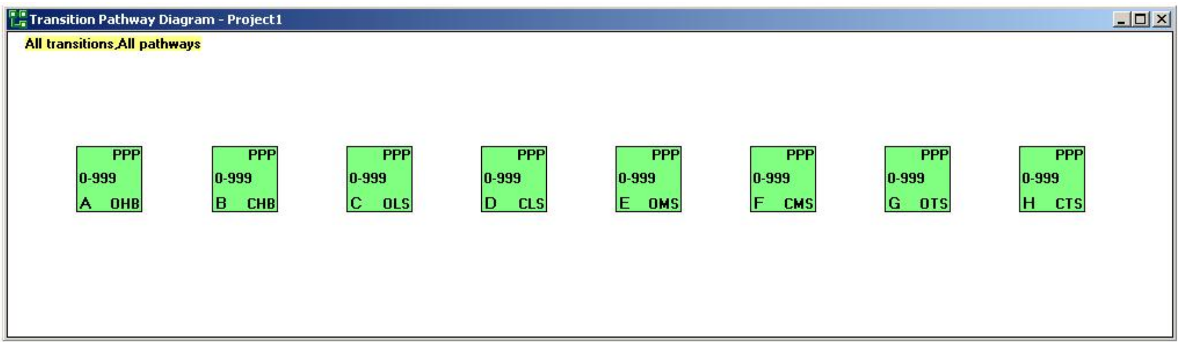
5. Following the prompts, create a name for each region in your Project (no spaces).



These steps allow the user to create zones in the Project area that have different probabilities for transitions, e.g., an area of fire suppression would have a lower probability of wildfire than areas without any suppression activity.

6. Add a class to your Project by selecting a *Cover Type* and *Structural Stage* from the drop-down lists provided; click **OK.**

7. Add the rest of the classes you need for your Project using the **Add new class** option on the **Diagram** menu.



8. Save your Project (**File**|**Save** or **Save As**) to the database.

At this point in your Project development, you have a transition pathway diagram in place and you are ready to start creating pathways by adding details about deterministic and probabilistic transitions to each of your classes using the **Diagram** menu.

Opening Existing Projects

Projects that have been saved to the database can be accessed using **Open** from the **File** menu.

To open an existing Project:

1. With VDDT running and the database that contains your project active in memory, select **Open** from the **File** menu.
2. From the **Open Project** dialog, select the Project you wish to open from the list of available projects in the current database and click **Open**.

If the Project you want is not listed, use the **Database** option under the **File** menu to select a different database; then try again to open the project as described above.

Closing Projects

Close an active Project by selecting **File|Close**. You will be prompted to save your Project to the database if any changes were made during the session.

Saving Projects

Save an active Project by selecting **File|Save**. This action will update all Project-related information in the database for the currently opened Project. If you wish to keep the old Project information in the database, while creating a new Project for your changes, select the **File|Save As** option and give the edited Project a new name.

Importing Projects and Files

Projects that were created in VDDT version 4.4c or earlier, that reside in another VDDT database, or that originate from other users, need to first be imported (**File|Import**) and saved to the active database before they can be accessed with **File|Open**. The **Import** option also allows users to change the definition information for an open Project by loading one or more customized definition files, or to create Projects based on component files from earlier versions of VDDT.

Import a Project

To import a Project from an *.MDB file:

1. Select **Import|Project|MDB** from the **File** menu.
2. Using the **Select VDDT Database** window, browse to the *.MDB that contains the project or projects you wish to import, select it and click **Open**.
3. An **Import Project** window opens that lists all projects in the selected database. Select the project(s) you wish to import into the active database. Select multiple non-contiguous projects from the list by using Ctrl and left-click; select multiple contiguous projects by using Shift and left-click. When you have selected all the projects you wish to import, click **Import**.

The selected project(s) will open briefly in the main window as each gets integrated into the active database.

To import a Project from a *.PRJ file:

1. Select **Import|Project|PRJ** from the **File** menu.
2. Using the **Open Project** window, browse to the *.PRJ file that contains your Project information, select it and click **Open**.

   The selected Project will open into memory, displaying the pathway diagram.

> **Note:**
> The *.PRJ files contain path information that tells VDDT where the associated definition and other project-related files can be found. If this path information is not correct, VDDT will not be able to load the file and will generate an error message. Correct the problem by opening the *.PVT file in a text editor such as Notepad; edit the path information so the required files can be found.

3. Select **Save** or **Save As** from the **File** menu to integrate the Project information into the active database.

> **Note:**
> When projects with multiple regions are imported from a *.PRJ file, initial conditions for only the active region will be included with the import; initial conditions for all non-active regions will have to be entered manually (**Run|Settings|***Initial Conditions* tab).

Import Definition Files

With VDDT running and an open Project on the screen, you can change the current definition information by loading one or more of your customized definition files.

To load all definition files:

1. Select **Import** from the **File** menu and click on **Definitions|All files**.

   The program then warns that all files must be in the same directory, have the same file extension as each other, and must have the prefixes that are listed in the default files.

2. From the **Select one code file** window, choose the DISTCODE.* file that represents the location and file extension for all of your definition files.

VDDT will proceed to load all five files. If any files are not present in the specified location, they are skipped.

To load a single type of definition file:

1. Select **Import** from the **File** menu and click on **Definitions|Disturbances**, **Cover types**, or **Structural stages**.

   If **Disturbances** or **Cover types** is chosen, two files will be loaded, i.e., DISTCODE.* and DISTGRP.* as a pair, and COVER.* and COVERC.* as a pair.

2. Choose the file you want to import and click **Open**.

In all cases, the information displayed in the pathway diagram will be updated to reflect the new definition information.

> **Note:**
> Changes to the definitions will not be saved to the database until the project itself is saved.

Import Transitions

If you wish to make a large number of changes to the transitions in an existing Project, you may find it easier to work in Excel rather than VDDT. To edit your transitions in Excel, you must first use VDDT to export the transitions you wish to edit (see *Export Transitions*, below); this process creates a *.CSV file that can be opened directly in Excel.

To import transitions to a file:

1. Open the Project that contains the transitions you wish to edit, and export them (**File|Export|Transitions** and choose **Probabilistic** or **Deterministic**, depending upon which type of transition you wish to export). The resulting *.CSV file contains all the same information as the corresponding MS Access table (i.e., the **Probabilistic Transition** table or the **Deterministic Transition** table).

2. Open the resulting *.CSV file directly in Excel, edit as needed and save your changes in Excel.

   To make the transition information easier to edit, the Access column headings and ID values in the first seven columns of the *.CSV file, which define the Project and its properties, are replaced with meaningful text strings. These text strings are recognized by VDDT when the file is imported back into your Project.

> **Note:**
> It is important to ensure that your edits are consistent with the defined properties of the Project into which you are going to import the transitions. For example, transitions added to a Project must already be defined (**File|Properties|Definitions**), and combinations of cover type and structural stage must correspond with existing classes. If your edited *.CSV file contains any undefined transition or state class information, VDDT will abort the import process and display an error message that identifies the first error encountered and provides its location in the file.

3. Select **Import|Transitions|Probabilistic** or **Deterministic** from VDDT's **File** menu, browse to your modified *.CSV file and click **Open** to import the new transitions into your Project. VDDT can import the transitions for one project at a time. The target project does not need to be open for the import to proceed; VDDT imports the transitions into the project identified in the first column of the *.CSV file.

> **Note:**
> When you import transitions into a Project, the changes are sent directly to the database, replacing existing values. There is no need to explicitly save your Project after successfully importing a set of transitions. If the target project is open when you initiate the import process, VDDT will close it before implementing the import.

Import Component Files

Importing component project files allows users to:

- change the current definition, PVT, scenario and initial condition information for a Project by loading customized definition, PVT, SCN and IC files into an open Project, and
- create new Projects from customized component files.

In both cases, **Import** opens the selected files into memory; nothing is saved to the database until the user explicitly saves a Project by selecting **Save** or **Save As** from the **File** menu.

To change the current information for a Project:

1. Open the Project for which you wish to change conditions, and select **Import** from the **File** menu.
2. If you wish to change the definition information, select **Definitions** from the **Import** sub-menu. You can choose to change all definition information (choose **All files**), or just selected definition information (choose **Disturbances**, **Cover types** and/**or Structural stages**).
3. If you wish to change the PVT information, select **PVT** from the **Import** sub-menu. When you elect to change your PVT information, VDDT will prompt you to select scenario and location files as well.
4. If you wish to change just the scenario information for your Project, select **Scenario** from the **Import** sub-menu and open the SCN file of your choice.
5. If you wish to change just the initial conditions for your Project, select **Initial Conditions** from the **Import** sub-menu and open the IC file of your choice.

To create a Project from component files:

1. If you have a Project open on the screen, close it. From the **Import** sub-menu, select **Definitions|All files.**

2. From the **Select one code file** window, choose the DISTCODE.* file that represents the location and file extension for all of your definition files.
3. From the **Import** sub-menu, select **PVT**. VDDT will open a series of windows from which you must choose PVT, scenario (SCN) and location (LOC) files for your Project.

   When done, the Project defined by the selected files will open into memory, displaying the pathway diagram.
4. If you wish, you can also import initial conditions for your Project by selecting the **Initial Conditions** option from the **Import** sub-menu.
5. Select **Save** or **Save As** from the **File** menu to integrate the Project information into the active database.

IMPORT MULTIPLIERS

Use this option to import transition and temporal multipliers into a Project and integrate them into the active database.

To import transition multipliers:

1. Open the Project into which you wish to import transition multipliers.
2. From the **File** menu, select **Import|Multipliers|Transition**. Navigate to and open the *.MLT file that contains your transition multipliers and click **Open**.
3. You can view the multipliers you just imported under VDDT's **Run** menu (see about *Optional Run Settings*).

Earlier versions of VDDT also stored area limits in the *.MLT file, and these can still be imported from this file type.

To import temporal multipliers:

1. Open the Project into which you wish to import temporal multipliers.
2. From the **File** menu, select **Import|Multipliers|Temporal** and choose either the CSV or MCM option, depending upon the type of file you have used to save your temporal multipliers. The process of importing temporal multipliers replaces all existing temporal multipliers in the open Project, so a warning message will appear. Click **Yes** to continue.
3. Navigate to and open the *.CSV or *.MCM file that contains your temporal multipliers and click **Open**. A message will appear confirming the import, reporting the number of multipliers loaded, and identifying any errors that occurred.

Note:
An accessory program for generating complex multipliers streams, named BUILD_MCM, is explained in Appendix F of the User Guide.

4. You can view the multipliers you just imported under VDDT's **Run** menu (see about *Optional Run Settings*).

Note:
If the file containing the temporal multipliers being imported contains transition types or run settings (e.g., number of timesteps or number of Monte Carlo simulations) that do not match those of the destination Project, errors may be reported. For example, if a file containing multipliers for 1000 timesteps is imported into a Project with only 100 timesteps, the import confirmation message will report that 900 lines of the import file were skipped. However, if a file containing multipliers for 100 timesteps is imported into a Project with 1000 timesteps, 100 multipliers will be imported and no error will be reported.

Import Attributes

Use this option to import calculated, categorical or numeric attributes into a Project so they can be used in the next simulation.

To import attributes:

1. Open the Project into which you wish to import attributes.
2. From the **File** menu, select **Import|Attributes**. Navigate to and open the *.ATT file that contains your attributes and click **Open**.
3. You can view the attributes you just imported under VDDT's **Run** menu (see about *Optional Run Settings*).

Exporting Projects and Files

Users can share their Projects and project-related information files with others by exporting them using the **Export** option under the **File** menu. Additionally, Projects can be exported to a database, or to a series of files suitable for importing into TELSA, or as comma and quote delimited files that can be imported into other applications such as Microsoft Access or Excel.

Export a Project

To export a Project to *.MDB:

1. Select **Export|Project|MDB** from the **File** menu. This action opens an **Export Projects** window that contains a list of all projects in the active database.
2. Select the project(s) you wish to export. You can select multiple non-contiguous projects from the list by using Ctrl and left-click; select multiple contiguous projects by using Shift and left-click. When you have selected all the projects you wish to export, click **Export**.
3. Using the **Select VDDT Database** window, navigate to and select the database into which you wish to export the project(s). If you want to create a new database for the exported project(s), simply type a name for the new database into the *File Name* field. Click **Open**.

   The selected project(s) will open briefly in the main window as each gets integrated into the active database.

To export a Project to *.PRJ:

1. Open the Project you wish to export (**File**|**Open**); this action enables all options under the **Export** sub-menu.
2. Select **Export|Project|PRJ** from the **File** menu.
3. Using the **Save Project File As** window, browse to the location in which you want to save your Project file; enter a name for it (the extension should be PRJ) and click **Save**.

The export process creates a folder, at the chosen location, bearing the Project's name and containing text files with all of the information about the Project that is stored in the database. This information is exported in the form of the text definition files associated with the Project, plus an initial conditions file (*.IC), a PVT file, scenario and location files. If sharing a Project, users need to send these plus any advanced external files, such as attribute files (*.ATT), to make the exported Project complete. The database only stores information about the location of advanced files, not the information itself.

Export Definition Files

You can also export the definition files associated with any Project using the **Export** option under the **File** menu. Exported definition files can be used as a template for creating new definition files, or shared with other users.

To export all definitions files:

1. Open the Project whose definition files you wish to export (**File**|**Open**); this action enables the export option.
2. Select **Export|Definitions** from the **File** menu; this action opens a series of **Save As** windows, one for each of the 5 definition files to be saved.

The definition information for each file is saved from memory rather than taken from the database.

3. Enter names for your definition files in the *File Name* field of each **Save As** window, and click **Save**.

Export Transitions

If you wish to make a large number of changes to the transitions in an existing Project, you may find it easier to work in Excel rather than VDDT. Use the **Export|Transitions** option under the **File** menu to create a *.CSV file of your transitions that can be opened directly in Excel for editing and then imported back into your Project (**File|Import|Transitions**) (see *Import Transitions* topic, above). VDDT can export the transitions for one project at a time.

To export transitions to a file:

1. Open the Project that contains the transitions you wish to edit; this action enables the export option.
2. Select **Export|Transitions**, and then choose to export either the **Probabilistic** or the **Deterministic** transitions associated with the Project.
3. Using the **Export Transitions** window, browse to the folder in which you wish to save the file and click **Save**.

VDDT will export the transitions associated with the open Project to a *.CSV file; this file contains all the same information as the corresponding MS Access table (i.e., the **Probabilistic Transition** table or the **Deterministic Transition** table). To make the transition information easier to edit, the Access column headings and ID values in the first seven columns of the *.CSV file, which define the Project and its properties, are replaced with meaningful text strings. These text strings are recognized by VDDT when the file is imported back into your Project.

Export Probabilities Files

VDDT allows users to save probability information about their Projects for later reference, or as output for subsequent processing in graphical or statistical programs. The probability file is an ASCII file which combines most of the information in the Project file into a new file which may be printed and used for examining the pathways and probabilities.

To export a probabilities file:

1. Open the Project that contains the probabilities you wish to export (**File|Open**); this action enables the export option.
2. Select **Export|Probabilities** from the **File** menu.

3. Using the **Save Probabilities As** window, browse to the location in which you want to save your probabilities file; enter a name for it (the extension should be PRB) and click **Save**.

Export Initial Conditions Files

The initial conditions file contains information about structural stage, cover type, age, TSD (optional), and the proportion of cells for each combination of these. Use **Export|Initial Conditions** to create a file (*.IC) that can be imported into other Projects.

To export initial conditions to a file:

1. Open the Project that contains the initial conditions you wish to export (**File|Open**); this action enables the export option.
2. Select **Export|Initial Conditions** from the **File** menu.
3. Using the **Save Initial Values As** window, browse to the location in which you want to save your initial conditions file; enter a name for it (the extension should be IC) and click **Save**.

Export Multipliers

Use this option to export transition and temporal multipliers from a Project so you can import them into other Projects as needed.

To export transition multipliers to a file:

1. Open the Project from which you wish to export transition multipliers (**File|Open**); this action enables the export option.
2. From the **File** menu, select **Export|Multipliers|Transition**.
3. Using the **Save Multipliers As** window, browse to the location in which you want to save your transition multipliers file; enter a name for it (the extension should be MLT) and click **Save**.

To export temporal multipliers to a file:

1. Open the Project from which you wish to export temporal multipliers (**File|Open**); this action enables the export option.
2. From the **File** menu, select **Import|Multipliers|Temporal|CSV**. This action opens the **Export Temporal Multiplier** window.
3. Browse to the location in which you want to save your temporal multipliers file, enter a name for it (extension *.CSV) and click **Save**.

Export Attributes

Use this option to export calculated, categorical or numeric attributes from a Project so you can import them into other Projects as needed. The resulting attribute files define the structure and values of the Project’s attributes.

To export attributes to files:

1. Open the Project from which you wish to export attributes; this action enables the export option.
2. From the **File** menu, select **Export|Attributes**.
3. Using the **Save Attribute File As** window, browse to the location in which you want to save your attributes file; enter a name for it (the extension should be ATT) and click **Save**.

Export as TELSA-ready Files

Two specialized exporting options are included with VDDT: exporting for the CRB Paradox Database (see below) and exporting for TELSA.

The TELSA export option produces three comma-delimited files that can be read by the TELSA interface and imported into the TELSA database (see Appendix D for the file format).

To export files in TELSA-ready format:

1. Open the Project for you wish to export TELSA-ready files (**File|Open**); this action enables the export option.
2. Select **Export|TELSA** from the **File** menu. This option generates 3 text files (TX1, TX2 and TX3).
3. Using the **Save Files In Telsa-Ready Format As** window, browse to the location in which you want to save your files; enter names for each in turn and click **Save**.

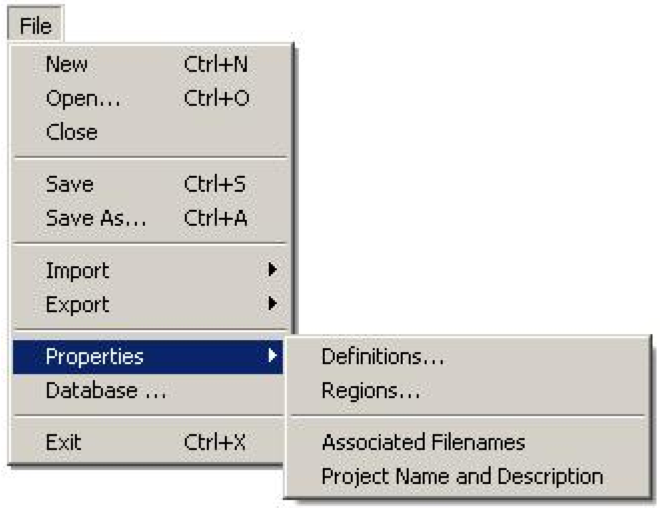
Export as Comma Delimited Files

Two specialized exporting options are included with VDDT: exporting for the CRB Paradox Database and exporting for TELSA (see above).

The CRB Paradox Database format files are two comma and quotation mark delimited files (PDX and PSC) containing the information from the Project file, and are in a format that can be directly entered into the Paradox database without further processing (see Appendix D for the file format). To use this option, select **Export** and then **Comma-delimited** from the **File** menu, enter names for the files and **Save** them.

PROJECT PROPERTIES

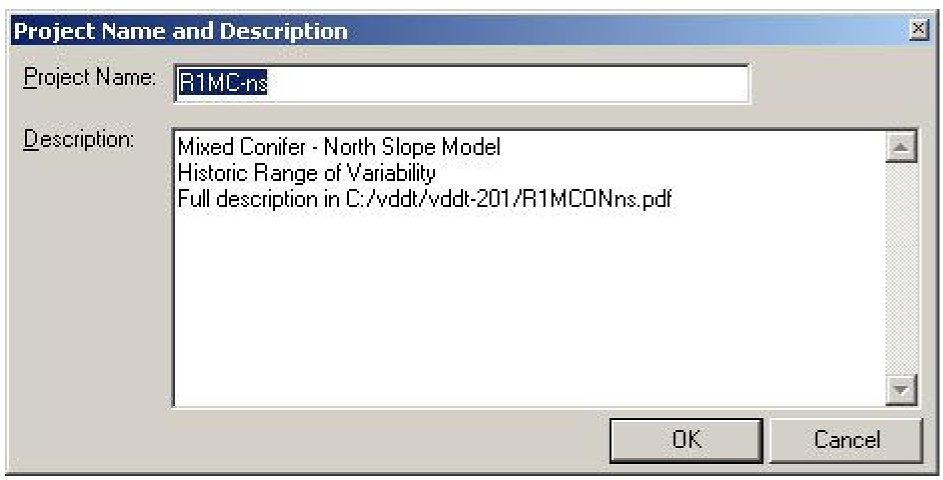
Use the **Properties** option under the **File** menu to review or modify information about **Definitions** files, review the list of **Associated Filenames**, or review/edit the **Project Name and Description**.



Project Name and Description

To view/edit a Project's name and description:

1. With an open Project on the screen, select **Project Name and Description** from the **File** menu. The **Project Name And Description** dialog opens.



2. The *Project Name* and *Description* of the open Project can both be edited.

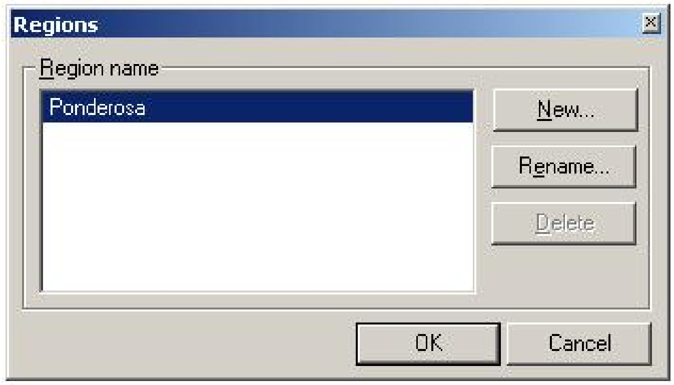
3. Click **OK** when done or **Cancel** to abandon your changes and return to the pathway diagram.

Defining Regions

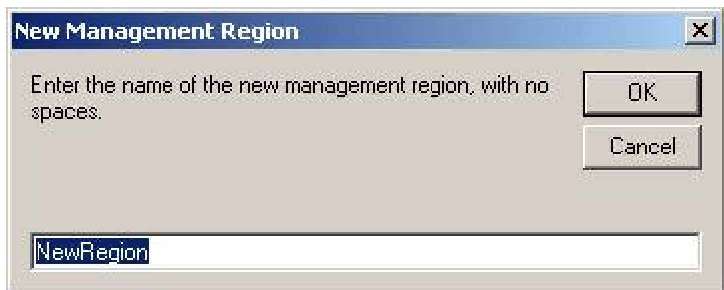
Use the **Regions** option on the **File**|**Properties** sub-menu to create new regions for your Project, to rename existing regions, and to delete regions you no longer want.

To create a new region:

1. Select **Properties** from the **File** menu and then **Regions.** Click on the **New** button.



2. Enter a new **name**, with no spaces, into the box that appears.



3. Click on the **OK** button to save the information to memory, or **Cancel** to abandon the process of adding a new region. Both actions will close the **New Management Region** window and return you to the pathway diagram.

The new region will be added to the information in memory, and will be part of the Project when it is next saved. Note that this new region will contain no probabilities at the time it is created.

To edit region names:

1. Select **Properties** from the **File** menu, and then **Regions**.
2. Highlight the region to be renamed with a left-click, and click on **Rename** to edit the name of the selected region (no spaces).
3. Click **OK** to close the screen and return to the pathway diagram.

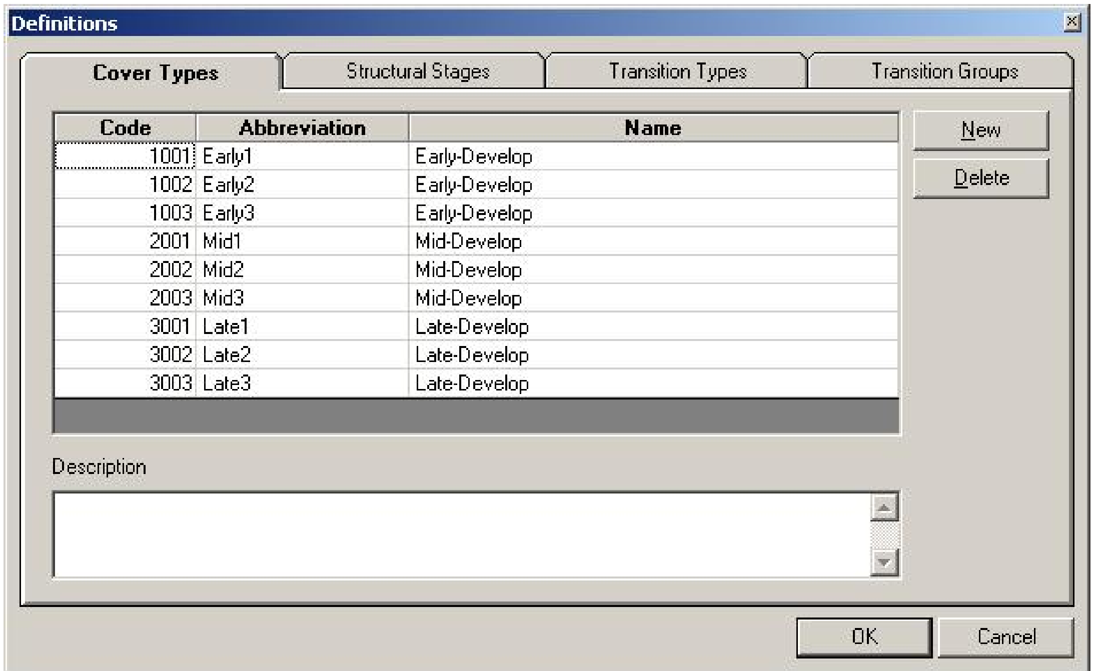
When the name of the currently active region is changed, the change will appear in the **Status** window.

To delete an existing region:

1. Select **Properties** from the **File** menu, and then **Regions**.
2. Highlight the region to be deleted with a left-click, and click on **Delete** to remove the selected region from your Project.

Definition Properties

Use the **Properties** option under the **File** menu to edit the names and abbreviations of your cover types, structural stages, transitions and transition groups. You can also use this option to create new definitions and to remove unwanted definitions from Projects.



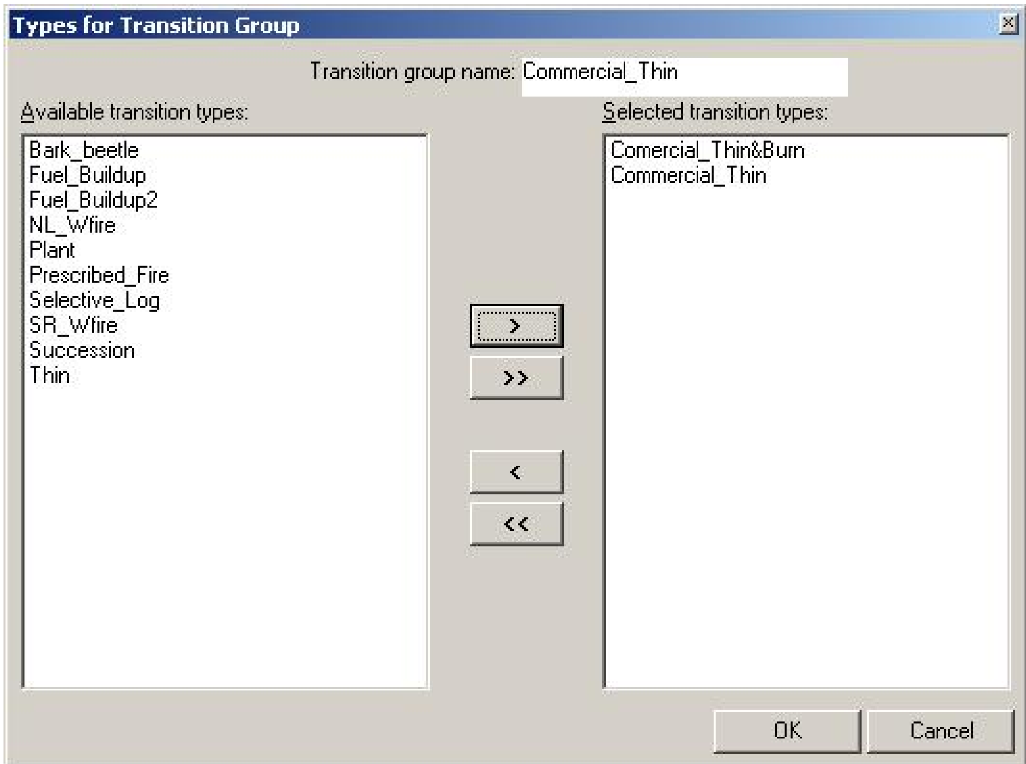
To edit definition names and abbreviations:

1. Select **Properties** from the **File** menu and then **Definitions** to open the **Definitions** dialog.
2. Change names and abbreviations for cover types, stages and transitions by typing into the selected field. Codes cannot be edited.
3. Click **OK** when done. The pathway diagram will be updated to show your changes to cover type and stage.
4. Save your changes (**File|Save**).

To add/remove transition types associated with transition groups:

1. Select **Properties** from the **File** menu and then **Definitions** to open the **Definitions** dialog.
2. Click on the *Transition Groups* tab and left click to select the transition group for which you wish to change the associated transition types.
3. Click on the **Types** button. The **Types for Transition Group** dialog shows the selected transition group in the *Transition group name* field, the *Available transition types* in the left pane and the types currently associated with the selected group in the *Selected transition types* pane on the right. In the example below, the selected Commercial_Thin

transition group contains transition types Commercial_Thin&Burn and Commercial_Thin.



4. Move transition types between the left and right panes using the arrows in the center of the dialog until you have all the types you want to associate with the selected group showing in the right-hand pane.

To create new definitions:

1. Select **Properties** from the **File** menu and then **Definitions** to open the **Definitions** dialog.
2. Click on the tab that contains the type of definition you want to create and click **New**.
3. A new row, with an automatically generated code, will appear in the grid (this code can be edited); enter an abbreviation and/or a name (depending on the type of definition you are creating), and click **OK**. Integrate the new definition into your Project using the **Diagram** menu.

> **Note:**
> VDDT can accommodate up to 30 transition groups and 99 structural stages; more than this will prompt a warning message to display.

To delete a definition:

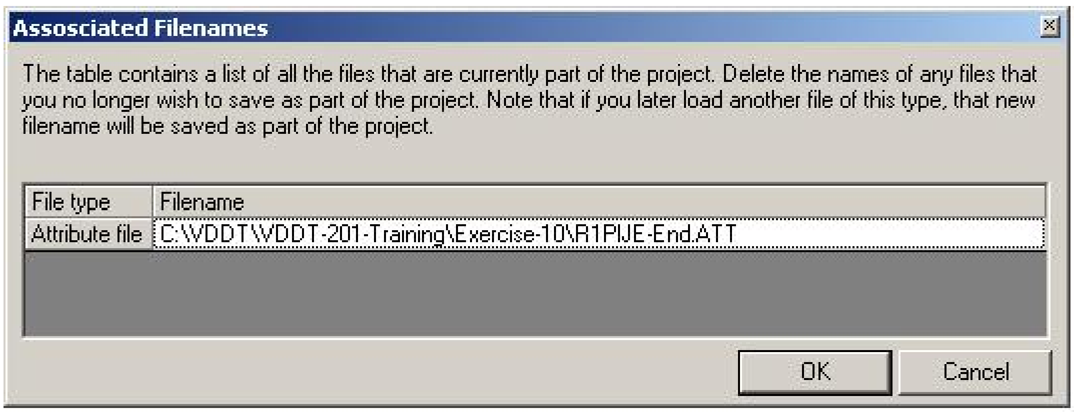
1. Select **Properties** from the **File** menu and then **Definitions** to open the **Definitions** dialog.

2. Click on the tab that contains the definition you want to delete, select the definition (click in any cell in the row) and click **Delete**.

Note:
You cannot delete a definition that is used in the current Project. If you try to do so, a warning message will appear prompting you to edit your model so that the definition you wish to delete is no longer being used. Click **Cancel** to abandon the deletion or **OK** to return to the **Definitions** dialog.

Managing Associated Files

Use the **Properties** option under the **File** menu to review the list of **Associated Filenames** related to the currently open Project. Associated files can be removed from the Project by deleting them from the associated files list.



To delete an associated file from a Project:

1. Select **Properties** from the **File** menu and then **Associated Files** to open the **Associated Filenames** dialog.
2. Click on the *Filename* of the file to be deleted and hit the **Delete** key on your keyboard.
3. Click **OK** to close the dialog. A message will appear warning that the deletion will not take effect until you save and re-load the Project file.

CHANGING DATABASES

To change the active VDDT database:

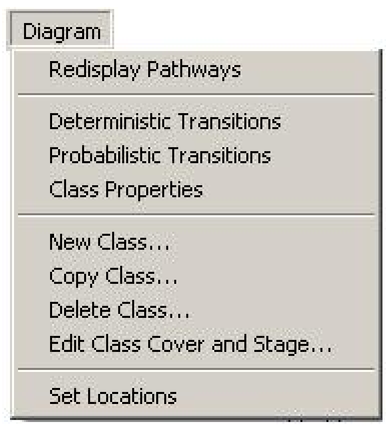
1. From the **File** menu, select **Database** to open the **Select VDDT Database** window.
2. Navigate to and select the database with which you wish to work. Click **Open**. You can now use **File|Open** to open any of the Projects in the new database.

EXIT VDDT

When your VDDT session is over, select **Exit** from the **File** menu to close VDDT. You will be prompted to save your Project if you made any changes during the session.

Diagram Menu

Existing Projects can be edited to add information to them, or to create new Projects based on existing ones. Using the **Diagram** menu, the cover type and structural stage of each class can be changed, new classes can be added, and classes can be deleted. Pathways for both deterministic and probabilistic transitions can also be edited, created, or deleted. At any point, the Project file may be saved (**Save** or **Save As** under the **File** menu), and/or the new information can be applied to a new simulation run.



DRAWING AND EDITING PATHWAYS

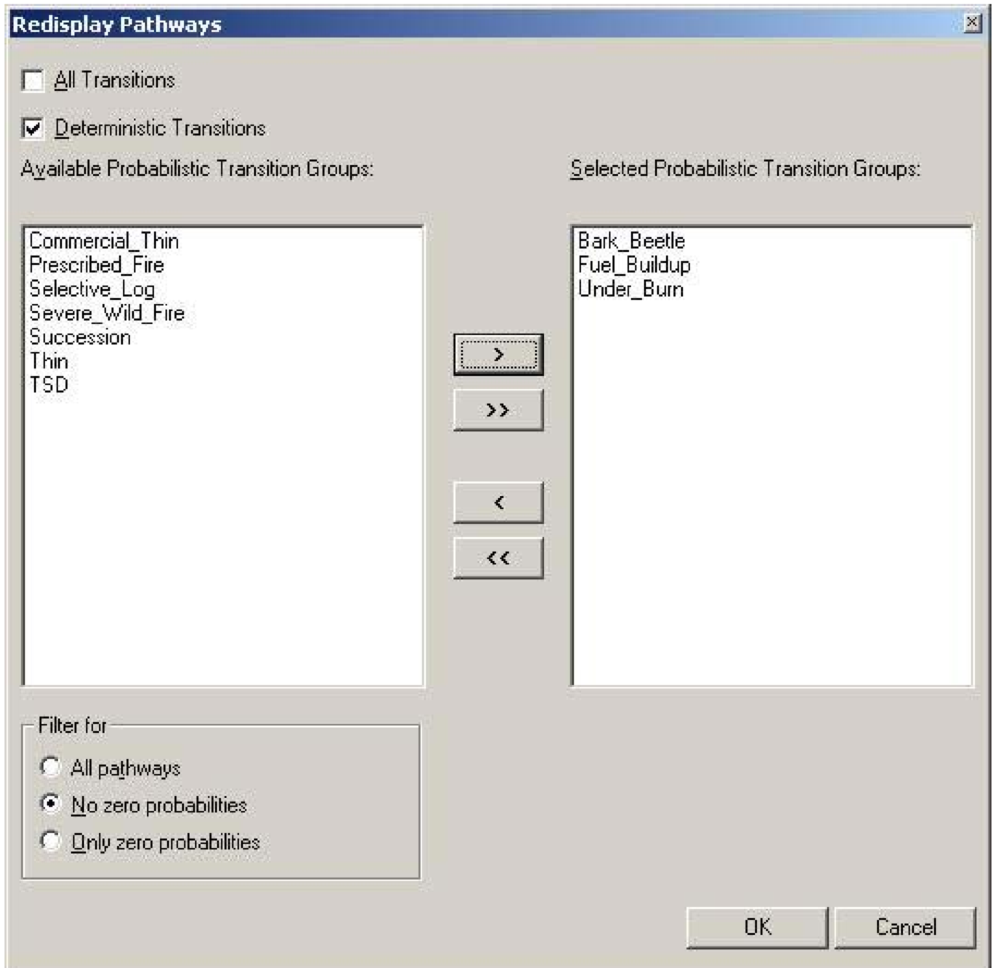
In most pathway diagrams, it is virtually impossible to actually trace each pathway when all are displayed. The model allows users to display all or a specified subset of pathways. Users can choose to display:

- certain probabilistic transitions or combinations of probabilistic transitions,
- pathways with or without defined probabilities, or
- all the pathways to or from a certain class.

To display the pathways for the entire Project:

1. From the **Diagram** menu, select **Redisplay Pathways**. A dialog box will open listing all probabilistic transitions defined for the Project.
2. Users can display all transitions by selecting *All Transitions* (both probabilistic and deterministic). When this option is enabled, the option to view only *Deterministic Transitions* and the list of *Available*

Probabilistic Transition Groups are disabled. Alternatively, users can specify certain probabilistic transition groups, with or without *Deterministic Transitions*, by de-selecting *All Transitions* and then moving selected groups across to the right-hand side of the screen. In the example below, deterministic transitions have been selected as well as three probabilistic transitions.



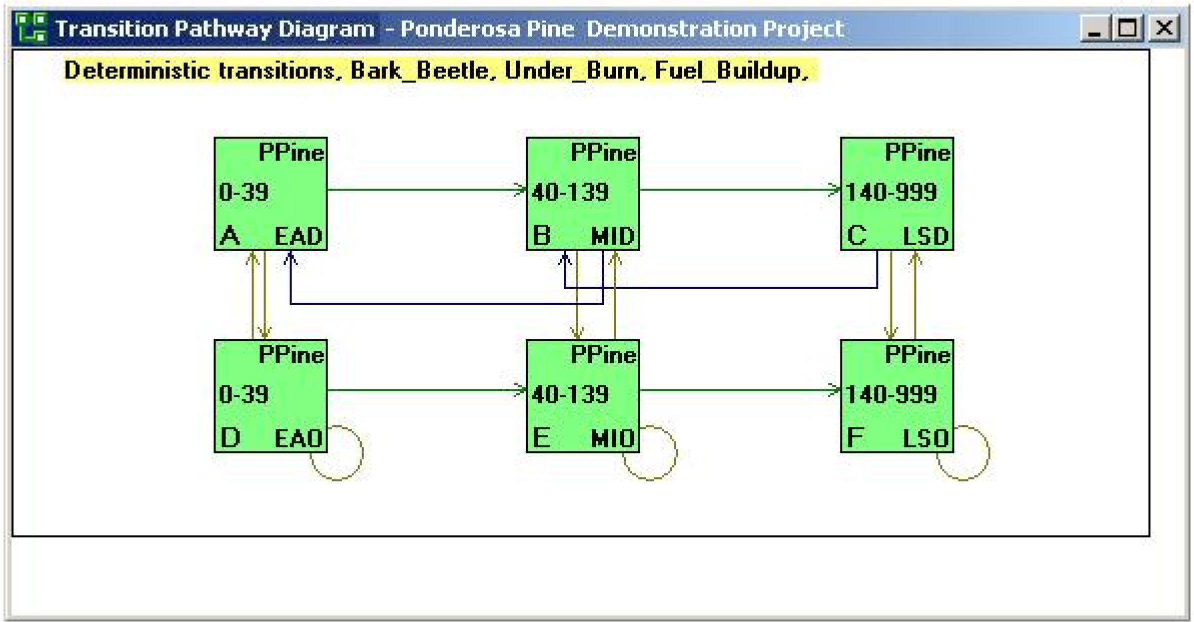
3. The bottom of the **Redisplay Pathways** dialog box allows users to filter pathways based on whether or not a probability has been defined. The options are to draw:

   - **All pathways** which fit the criteria chosen in the upper part of the dialog box;
   - those pathways which fit the criteria and which have a probability defined (**No zero probabilities**); or
   - those pathways which fit the criteria but which have either no defined probability or a zero probability (**Only zero probabilities**).

In the example above, pathways for deterministic transitions and three probabilistic transitions (Bark_Beetle, Fuel_Buildup and Under_Burn) will be displayed in the pathway diagram, provided they have a probability defined in the current scenario file and the current region. Note that the transition groups listed in the dialog are those defined by the user in the DISTGRP.TXT file.

Note:
If either of the last two options are selected (those pathways that have a probability or those that do not have a probability), the model will look at the probabilities defined for the current region only. If no region has been selected, the probabilities from the first region entered will be used.

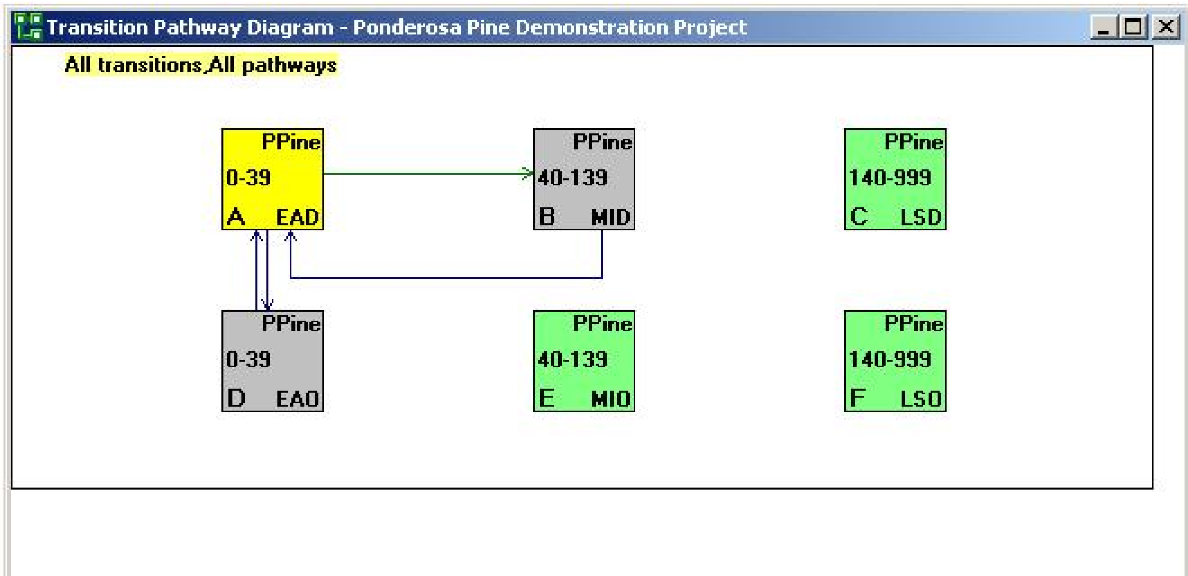
When done, the selected items will be indicated at the top of the TPD window, and only those pathways will be drawn. The program will remember this selection until it is changed by the user or until a new Project is loaded.



To show all the pathways to or from a particular class:

1. Move the mouse over the box of interest and click the **RIGHT button**.

2. From the resulting context-sensitive menu, select the **Show Class Pathways** option. The selected class will be highlighted (yellow on most computers), and only the transitions to and from that class will be displayed.



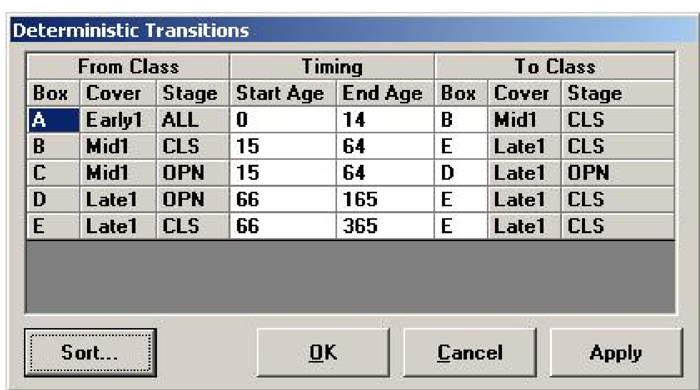
3. To redisplay pathways from all boxes, right-click anywhere on the pathway diagram and select **Show All Pathways** from the context-sensitive menu. Alternatively, you can redisplay all pathways by resizing the pathway window a small amount or by selecting **Redisplay Pathways** from the **Diagram** menu and clicking **OK.**

Deterministic Transitions

The **Deterministic Transitions** option under the **Diagram** menu provides an overview of the deterministic transitions defined for all classes in your Project.

To view/edit deterministic transitions for a Project:

1. Select **Deterministic Transitions** from the **Diagram** menu. The **Deterministic Transitions** dialog opens to show all deterministic transitions that have been defined for the active Project.



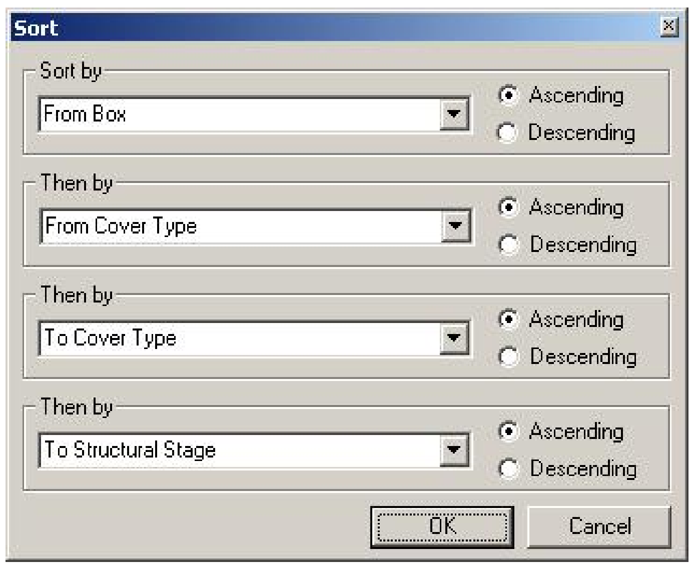
From Class			Timing		To Class		
Box	Cover	Stage	Start Age	End Age	Box	Cover	Stage
A	Early1	ALL	0	14	B	Mid1	CLS
B	Mid1	CLS	15	64	E	Late1	CLS
C	Mid1	OPN	15	64	D	Late1	OPN
D	Late1	OPN	66	165	E	Late1	CLS
E	Late1	CLS	66	365	E	Late1	CLS

2. You can edit values for *Start Age*, *End Age* and destination class (*Box*). The program will check to ensure that the letter that is entered in the *Box* field represents a class that is currently part of the diagram. If you change the destination class, the *Cover* and *Stage* information will update to correspond to information about the new class.

3. Click **Apply** to save your changes to memory and keep the dialog open; click **OK** to save your changes to memory and close the dialog. Your changes will be reflected in the pathway diagram. Click **Cancel** to abandon your changes and return to the pathway diagram.

To sort deterministic transitions for a Project:

1. Select **Deterministic Transitions** from the **Diagram** menu.
2. Click on the **Sort** button to open the **Sort** dialog.



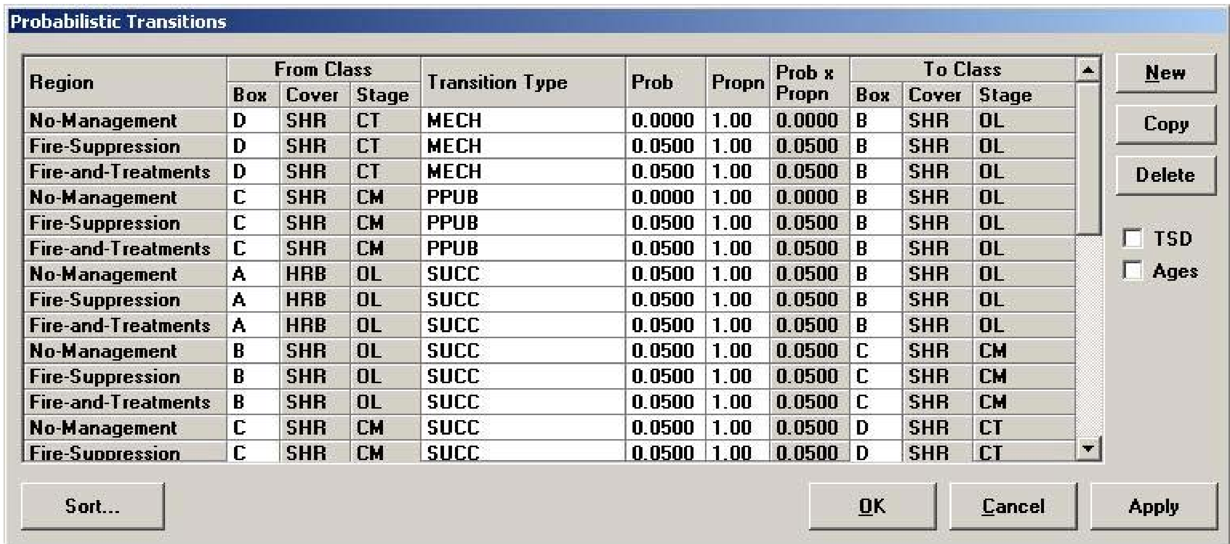
3. Select the sort fields from the drop-down lists. You can sort by up to four fields, in either ascending or descending order.
4. Click **OK** to return to the **Deterministic Transitions** dialog and your sorted list of transitions.

PROBABILISTIC TRANSITIONS

The **Probabilistic Transitions** option under the **Diagram** menu provides an overview of the probabilistic transitions defined for all classes in your Project.

To view/edit all of the probabilistic transitions for a Project:

1. Select **Probabilistic Transitions** from the **Diagram** menu. The **Probabilistic Transitions** dialog opens to show all probabilistic transitions that have been defined for the active Project. If the active Project has only one region, no *Region* column will appear in the grid.



Probabilistic Transitions

Region	From Class Box	From Class Cover	From Class Stage	Transition Type	Prob	Propn	Prob x Propn	To Class Box	To Class Cover	To Class Stage
No-Management	D	SHR	CT	MECH	0.0000	1.00	0.0000	B	SHR	OL
Fire-Suppression	D	SHR	CT	MECH	0.0500	1.00	0.0500	B	SHR	OL
Fire-and-Treatments	D	SHR	CT	MECH	0.0500	1.00	0.0500	B	SHR	OL
No-Management	C	SHR	CM	PPUB	0.0000	1.00	0.0000	B	SHR	OL
Fire-Suppression	C	SHR	CM	PPUB	0.0500	1.00	0.0500	B	SHR	OL
Fire-and-Treatments	C	SHR	CM	PPUB	0.0500	1.00	0.0500	B	SHR	OL
No-Management	A	HRB	OL	SUCC	0.0500	1.00	0.0500	B	SHR	OL
Fire-Suppression	A	HRB	OL	SUCC	0.0500	1.00	0.0500	B	SHR	OL
Fire-and-Treatments	A	HRB	OL	SUCC	0.0500	1.00	0.0500	B	SHR	OL
No-Management	B	SHR	OL	SUCC	0.0500	1.00	0.0500	C	SHR	CM
Fire-Suppression	B	SHR	OL	SUCC	0.0500	1.00	0.0500	C	SHR	CM
Fire-and-Treatments	B	SHR	OL	SUCC	0.0500	1.00	0.0500	C	SHR	CM
No-Management	C	SHR	CM	SUCC	0.0500	1.00	0.0500	D	SHR	CT
Fire-Suppression	C	SHR	CM	SUCC	0.0500	1.00	0.0500	D	SHR	CT

New
Copy
Delete
TSD
Ages
Sort...
OK
Cancel
Apply

2. You can edit values for origin class (*Box*), *Transition Type*, probability (*Prob*), proportion (*Propn*), and destination class (*Box*). The program will check to ensure that letters entered into the *Box* fields are classes that are currently part of the diagram. If you change either the origin or destination classes, the *Cover* and *Stage* information will update to correspond to information about the new class.
3. Click **Apply** to save your changes to memory and keep the dialog open; click **OK** to save your changes to memory and close the dialog. Your changes will be reflected in the pathway diagram. Click **Cancel** to abandon your changes and return to the pathway diagram.

To sort probabilistic transitions for a Project:

1. Select **Probabilistic Transitions** from the **Diagram** menu.
2. Click on the **Sort** button to open the **Sort** dialog.
3. Select the sort fields from the drop-down lists. You can sort by up to four fields, in either ascending or descending order.
4. Click **OK** to return to the **Probabilistic Transitions** dialog and your sorted list of transitions.

CLASS PROPERTIES

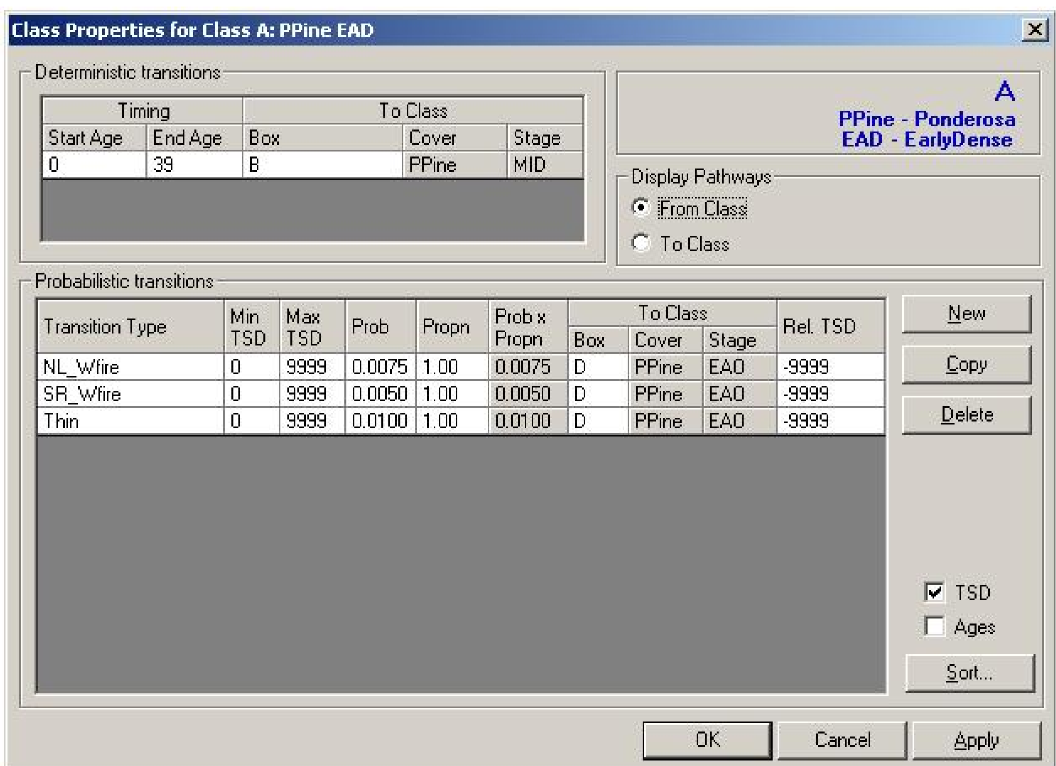
Changes to pathways are made in the **Class Properties** dialog box which lists all the information about the pathways associated with a class. If any changes are made in this box, the last line in the **Status** window will change to read *Modified*.

Each pathway has an origin, a destination, and either a transition probability or a transition period. This information can be changed, and pathways can be added or deleted. For example, the probabilities for a particular agent in a single pathway may be modified. This is useful for choosing initial probabilities, setting probabilities which change for different classes, and for making subtle refinements to probabilities.

To open the class properties dialog box:

1. With a pathway diagram open on the screen, double-click the left mouse button on the box representing the class of interest; *OR*
2. Select **Class Properties** from the **Diagram** menu, and enter the letter of the class of interest; *OR*
3. Right-click on the box representing the class of interest, and select **Class Properties** from the context-sensitive menu.

The **Class Properties** dialog for the selected class box will appear, showing all the pathways going away from the class. To view pathways to the class, click the *To Class* radio button in the *Display Pathways* section of the screen.



Note:
You can have multiple **Class Properties** screens open at one time.

Changing Pathway Information

Probabilities, destinations, probabilistic transition agents, relative ages, and deterministic transition information may all be changed in the **Class Properties** dialog box (**Diagram** menu). In the top right corner of the dialog, the class identifier is shown along with the cover type and structural stage of the class. Below this is the *Display Pathways* section of the dialog, with which users can choose to view information about pathways going from the class (*From Class*) or to the class (*To Class*).

The information in the dialog is divided into two main sections. The top section contains the deterministic transition information and the bottom section contains a grid showing all the probabilistic transition information.

From Class Pathways

Deterministic and probabilistic transition information **from a selected class** is presented in the **Class Properties** dialog (**Diagram** menu).

Deterministic Transitions

The deterministic part of the dialog box shows:

- the start and end age of the class,
- the destination after deterministic transition, and
- the cover and structural stage of the destination class.

The cells for start/end age and destination class can be edited.

The destination for the deterministic transition pathway is the letter identifier of the target class. The program will check to ensure that the letter that is entered is a class that is currently part of the diagram.

Note:
Changing the deterministic transition destination may change the location of the current class in the diagram (unless the locations are being set manually).

The beginning age of the class is used by the model to provide a value from which to start incrementing the number of years a cell has been in the class and for determining when each probability is valid. It is also presented as a reference, to help users picture the class and define probabilities.

Each class must go somewhere through deterministic transition. If the class is considered an **endpoint**, and cells would only leave that class through a probabilistic transition, it should be given a large number of years to stay in the class, and then should go to itself through deterministic transition. For example, if Class F is an endpoint, the deterministic transition part of the dialog box might look like:

Timing		To Class		
Start Age	End Age	Box	Cover	Stage
140	999	F	PPine	LSO

If the beginning age of the class or the number of years in the class are changed, VDDT will ask if the probabilistic transition information should also be updated. If so, it will change the beginning age of all probabilistic transitions that had the original class starting age and it will change the ending age of all probabilistic transitions that had the original class ending age.

Note:
If VDDT does not automatically update the ages of some probabilistic transitions, check to ensure that the transition ages are still within the range of the class. Probabilistic transitions with ages outside the class range will not occur.

Probabilistic Transitions

Each row of the probabilistic part of the dialog box represents a different pathway, and can be sorted by up to 4 fields. The columns are as follows:

Column	Description
Region:	Region name. For Projects with multiple regions, the first column in the grid will show the region name; this information cannot be edited. A Project with three regions and three transition types will have 9 rows in the grid, one for each region/transition type combination.

Region	Transition Type	Min Age	Max Age	TSD	Prob	Propn	Prob x Propn	To Class Box	Co
Fire-and-Treatments	SUCC	15	24	5	0.0500	1.00	0.0500	C	SHF
Fire-and-Treatments	WMSF	15	24	0	0.0050	1.00	0.0050	B	SHF
Fire-and-Treatments	WSRF	15	24	0	0.0020	1.00	0.0020	A	HRE
Fire-Suppression	SUCC	15	24	5	0.0500	1.00	0.0500	C	SHF
Fire-Suppression	WMSF	15	24	0	0.0000	1.00	0.0000	B	SHF
Fire-Suppression	WSRF	15	24	0	0.0000	1.00	0.0000	A	HRE
No-Management	SUCC	15	24	5	0.0500	1.00	0.0500	C	SHF
No-Management	WMSF	15	24	0	0.0050	1.00	0.0050	B	SHF
No-Management	WSRF	15	24	0	0.0020	1.00	0.0020	A	HRE

By default, columns will be wide enough to show the entire region name. Columns may be resized to hide part of the name and allow more columns to be visible on the dialog box without scrolling. Management region names can also be shortened using the **Properties|Regions** option under the **File** menu.

The *Region* column will not display for Projects with only one region defined.

Transition Type:	Probabilistic transition type. This column displays the transition type for each pathway. To change the transition type, click on the transition to be

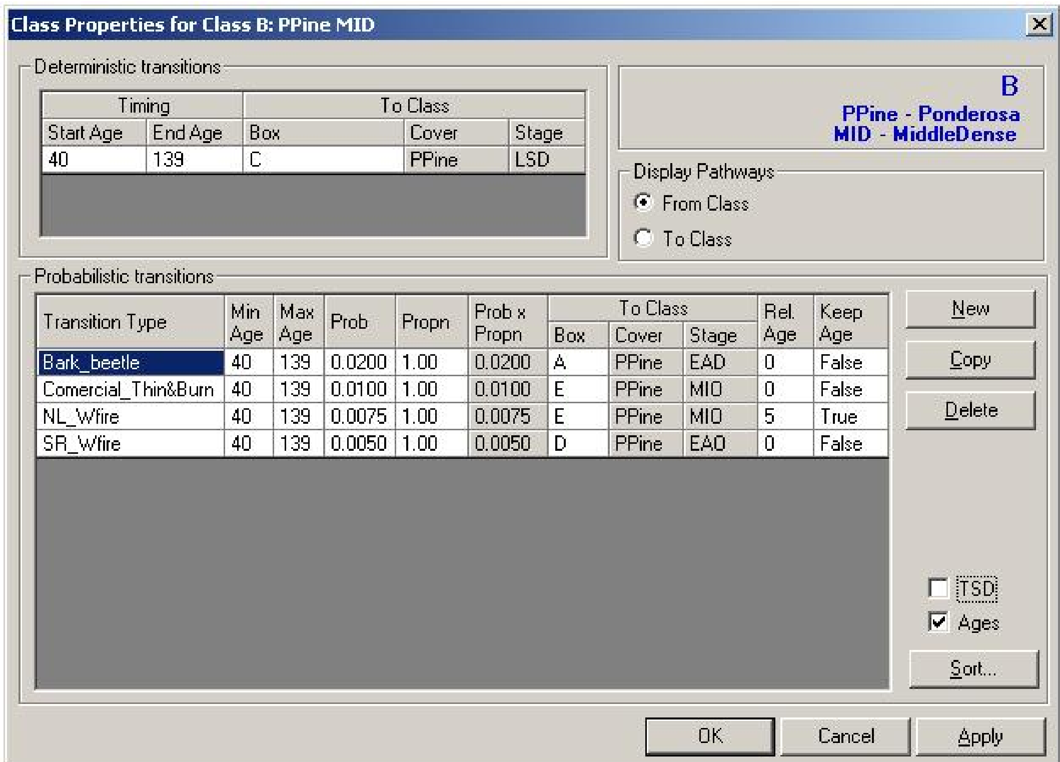
	changed and open the drop-down list; select an alternative transition.
Prob:	The probability of the transition pathway occurring. New values (less than or equal to one) can be entered into these cells. Probabilistic transitions will not occur in a particular region if the probability is zero.
Propn:	Proportion. This field is used to help represent multiple branching pathways associated with a single transition type out of a class. For example, suppose that there is a probability of 0.1 that a "Fire" transition may occur in a particular class, and that there are 2 possible pathways out of this class associated this "Fire" transition type, each with a 50% chance of occurring. In this situation, both pathways can be assigned the same value for *Prob* (i.e., 0.1), and then each pathway is assigned a *Propn.* of 0.5. When the model actually runs, VDDT will calculate the effective probability for each of the branching pathways as *Prob X Propn*. If you do not wish to use this feature, set *Propn* to 1 for all transitions.
Prob x Propn:	Probability times Proportion. This is the value actually used by the VDDT model for calculating transitions – it is a calculated value used by the model, and can only be changed by editing either the *Prob* or *Propn* values. Try to ensure that the total of all *Prob X Propn* values leaving a class does not exceed 1. Where the sum of all probabilities exceeds 1, the probabilities will all be adjusted downwards. This is due to the fact that only one probabilistic transition per cell per year is allowed.
To Class:	Pathway destination, cover and stage information. If a different letter is entered into the *Box* column of this section in the grid, the destination of the probabilistic transition will be changed and the cover and stage information updated to match.

Probabilistic Transitions – Ages

By default, transition probabilities apply to the entire class for which they are defined. These probabilities can, however, be made to apply only to a selected range of ages within the class. Thus, different probabilities can be assigned to the same transition type, as long as the ages do not overlap.

To view/edit the age information:

1. On the **Class Properties** dialog, click in the *Ages* box to enter a checkmark there. Four new columns will appear – *Min Age*, *Max Age*, *Rel. Age* and *Keep Age*.



Column	Description
Min Age:	The minimum age at which the probabilistic transition can occur. Note that the minimum age cannot be less than the beginning age of the class, and that the age can differ between management regions.
Max Age:	The maximum age at which the probabilistic transition can occur. Note that the maximum age cannot be greater than the sum of the beginning age and the number of years in the class, and that the age can differ between management regions.
Rel. Age:	Relative age. Relative age means slightly different things, depending on the type of pathway. In both cases, however, the relative age is a number of years, not an age. **Pathways starting and ending in different classes:**

After this type of probabilistic transition, the model assumes that the cell enters the new class with an age equal to the beginning age of that class. The relative age tells the model that after this probabilistic transition, the cell will enter the new class with a higher age (i.e., beginning age plus relative age) and thus will stay in the new class for a shorter period than it would otherwise. Relative ages can only be positive in this case.

Pathways starting and ending in the same class:

In this case, the probabilistic transition does not change the cell's class but it either advances or delays its deterministic transition to the next class. A positive relative age shortens the amount of time that the cell will remain in that class (i.e., deterministic transition is moved forward). A negative age allows the cell to remain in that class longer (i.e., deterministic transition is set back).

In both cases, the age of the cell is bounded by the age limits in that class. A cell in a class can never be younger than the beginning age of the class, and can never be older than the ending age of the class (beginning age plus the number of years in the class).

Keep Age: Keep the relative age? If true, when the probabilistic transition occurs, the relative age, i.e., the number of years that the cell has been in the class, will not change even if the class changes. Note that this has no effect on pathways that start and end in the same class.

Source & Destination Classes	Keep Age?	Destination Class Age
Different	FALSE	[Dest. Class Beginning Age] + [Relative Age]
Different	TRUE	[Current Source Class Age] + [Relative Age]
Same	FALSE	[Current Source Class Age] + [Relative Age]
Same	TRUE	[Current Source Class Age] + [Relative Age]

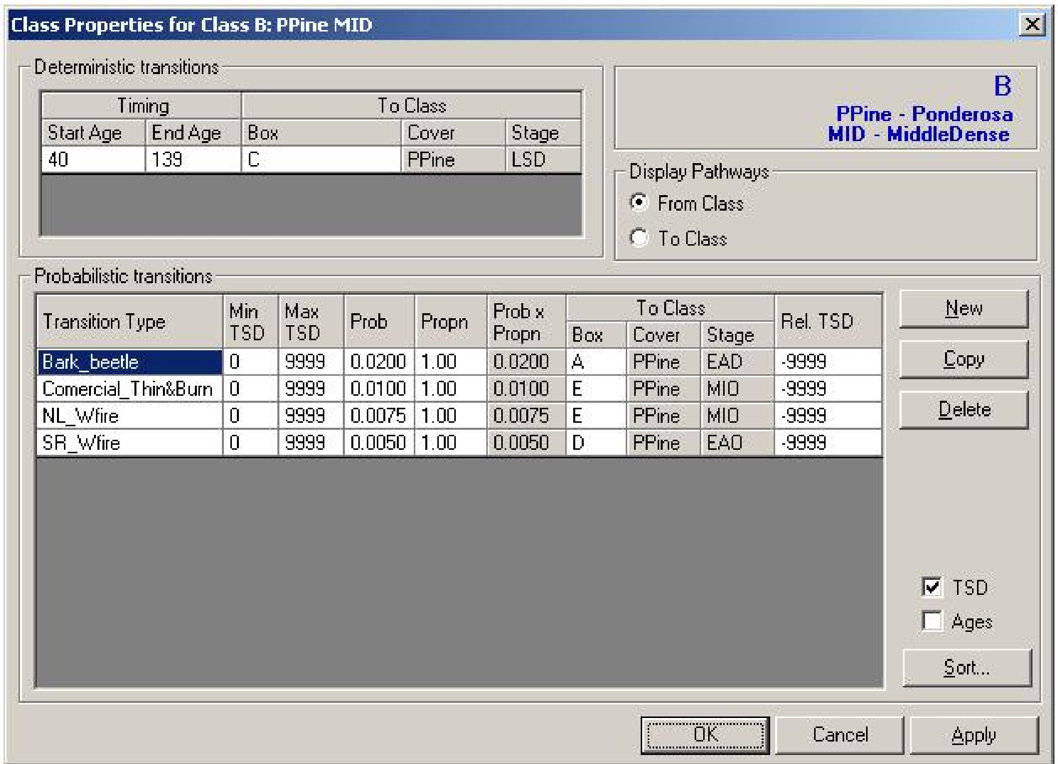
Note:
If using two pathways that begin and end in the same class, and are the same transition type, do not use different relative ages or a different value for the keep age flag. The Project file saves only one version of the pathway, and will therefore save only one relative age and relative age flag.

Probabilistic Transitions – TSD

The probability of some transitions occurring may depend on the time interval since a previous set of probabilistic transitions. In VDDT, these types of relationships can be defined using the *TSD* (Time Since Disturbance) columns of the grid.

To display the TSD columns:

1. On the **Class Properties** dialog, click in the *TSD* box to enter a checkmark there. Three new columns will appear in the grid – *Min TSD, Max TSD, and Rel. TSD.*



The *TSD* columns allow users to define when a probabilistic transition can occur relative to other transitions in associated groups (associations are set using **Run|Settings|***Options*), and how the transition will impact the TSD of the affected cell. For example, a user could define that eradication of knapweed via chemical control can occur in a cell up to 3 timesteps following knapweed invasion. Alternatively, application of herbicides may fail to eradicate knapweed but prolong the time which it takes for knapweed to become established in the cell by 2 time steps (*Rel. TSD* -2).

Column	Description
Min TSD:	The minimum number of timesteps following the occurrence of any probabilistic transitions belonging to the transition's associated TSD Group (**Run|Settings|***Options*) after which the probabilistic transition can occur. For example, a *Min TSD* of 4 means that a particular chemical treatment pathway can only occur after 4 timesteps

have elapsed following an initial knapweed invasion.

Max TSD: The maximum number of timesteps following the occurrence of any probabilistic transitions belonging to the transition's associated TSD Group (**Run|Settings|***Options*) after which the probabilistic transition cannot occur. For example, a *Max TSD* of 5 means that a particular chemical treatment pathway cannot occur after 5 timesteps have elapsed following an initial knapweed invasion.

Rel. TSD: This value defines how transitions affect the TSD of a cell when they occur. For example, if a particular chemical treatment has a *Rel. TSD* value of -2, it will reduce the TSD for the affected cell by 2 timesteps following the treatment for any probabilistic transition groups to which the transition type belongs. A *Rel. TSD* value of -9999 sends the cell back to TSD of 0.

Multiple TSD data lines may be used to portray a more complex relationship. For example, following a fuel treatment, the probability of a stand replacement fire may be only 0.5% per year. This probability may double after 15 years without a treatment and increase to 100% after 30 years without a treatment. This could be modeled using three TSD data lines containing the same transition type. These lines would have the Min/Max TSD variables set to 0/14, 15/29, and 30/9999 years and the annual probabilities set to 0.005, 0.01, and 1, respectively.

Note:
VDDT does not use TSD values by default. Time since disturbance must be turned on (**Run|Settings|Options**) before the TSD values will be used during a run.

Probabilistic Transitions – Manage Rows

Probabilistic transitions can be added to and removed from the grid, and they can be sorted.

To add rows to the grid:

1. On the **Class Properties** dialog, click on the **New** or **Copy** buttons to add rows to the bottom of the grid.
2. For new rows, the *Transition type* and destination *Box* **must** be filled in. Default values for probability (0) and proportion (1) will be entered by VDDT if not specified by the user. For copied rows, edit the existing values as required.

   For Projects with multiple regions, the **New** and **Copy** buttons add one row to the grid for each defined region. For example, if a Project has 3 regions, 3 rows will be added to the grid.

To remove rows from the grid:

1. On the **Class Properties** dialog, select the row to be removed and click **Delete**.

   For Projects with multiple regions, the **Delete** button removes the selected pathway for all regions.

To sort rows in the grid:

1. On the **Class Properties** dialog, click the **Sort** button; this action opens the **Sort** screen.
2. Choose the sort order from the drop-down lists in each section of the screen. You can sort in ascending or descending order by *Region*, *Transition Type*, destination class (*Box*), *Cover* and structural *Stage*. Up to 4 sort fields can be set.

Save class properties information

When finished with all edits, click on the **OK** button to save all the changes to memory and close the **Class Properties** dialog. Alternatively, you can save your changes to memory without closing the dialog by clicking **Apply**. These actions do ***not*** save your changes to the database; to do so, you need to save your Project (**File|Save** or **File|Save As**). If the **OK** button is selected, the **Status** window will change to *Modified*, even if no changes have been made.

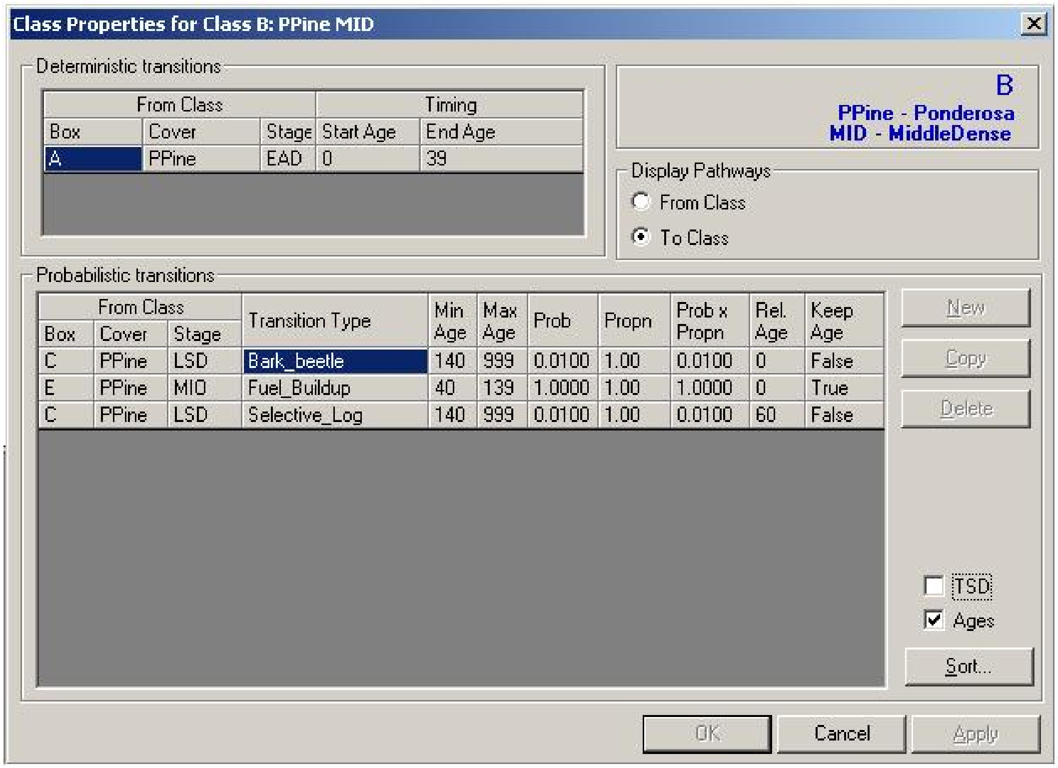
The **Cancel** button (or the ESC key) allows users to leave the dialog box and ignore all changes.

To Class Pathways

By default, the **Class Properties** dialog box shows all the pathways which originate in a class.

To view pathways to a class:

1. On the **Class Properties** dialog (**Diagram** menu), click the *To Class* radio button. A message will appear warning that any changes made in the *From Class* view of the dialog box will be lost, and the user will be given the option of saving the changes.
2. The *To Class* view shows all deterministic and probabilistic transition pathways entering the class. This information is read-only.



The *To Class* view is essentially the same as the one showing the pathways **from** a class. The only differences are:

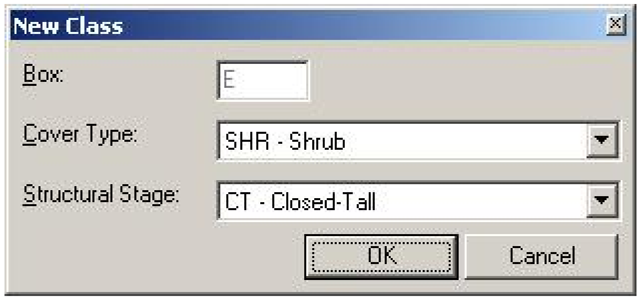
- more than one deterministic transition pathway can go to a single class, and each will be shown,
- the letters in the Box column are now those of the originating class (the class from which the pathway started), and
- transition pathways cannot be edited, added or removed.

Creating New Classes

New classes may be added to a pathway diagram using the **Diagram** menu.

To add a new class:

1. Choose **New Class** from the **Diagram** menu. The **New Class** dialog box will appear with fields in which to enter the class cover type, and structural stage of the new class. A letter, which will be the assigned label of the new class, will appear in the first cell. This letter is the first letter of the alphabet that is not used in the diagram. Users cannot change this letter.



2. Enter the **cover type** and **structural stage** by selecting from the drop-down lists.
3. Click on the **OK** button (or hit the **Enter** key on the keyboard) to save your edits to memory and add the new class to the pathway diagram. Alternatively, you can select the **Cancel** button (or the **ESC** key) to exit the dialog box without saving any changes.

The program will give a warning message if the cover type and structural stage combination is the same as an existing class, and a different cover type or structural stage must be chosen.

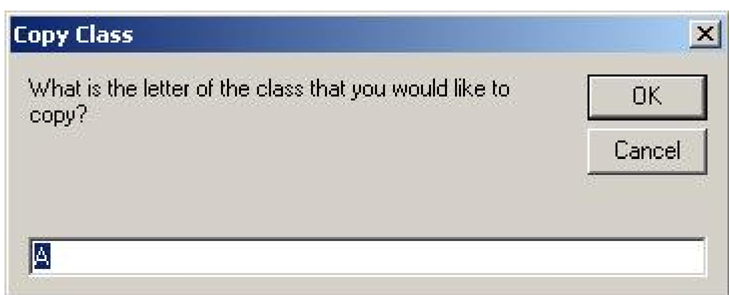
You are now ready to add the deterministic and probabilistic transitions which start in the new class (see about *Class Properties*).

Copying Classes

Existing classes can be copied and used as a basis for adding new classes to a pathway diagram.

To copy a class:

1. Choose **Copy Class** from the **Diagram** menu.



2. Enter the **letter** of the class to be copied. A dialog box will appear which contains fields showing a new class letter, and the cover type and structural stage of the class you are copying.
3. Change the **structural stage** and/or **cover type** by selecting from the options in the pull-down lists.
4. Click on the **OK** button (or hit the **Enter** key on the keyboard) to save your edits to memory and add the new class to the pathway diagram. Alternatively, you can select the **Cancel** button (or the **ESC** key) to exit the dialog box without saving any changes.

The program will give a warning message if the cover type and structural stage combination is the same as an existing class, and a different cover type or structural stage must be chosen.

When a class is copied, all pathways and probabilities associated with the class are also copied, but attributes are not.

DELETING CLASSES

An entire class, and all the transitions which leave from the class, can be removed from the Project.

To delete a class:

1. Select **Delete class** from the **Diagram** menu.
2. Enter the **letter** of the class to be deleted. If pathways exist whose destination is the deleted class, then VDDT will highlight all the pathways going to and from that class and give a warning message stating that some pathways from another class need to have a new destination.
3. If new deterministic transition destinations are required, VDDT will open a Deterministic Transitions dialog and if new probabilistic transitions are required, VDDT will open a Probabilistic Transitions dialog box. In either case, the values that correspond to pathways going towards the class to be deleted will be highlighted. The destination on these pathways must be changed. Users may either specify a new destination (by entering a new destination class) or, in the case of a probabilistic transition, choose to delete the pathway. If alternate destinations are not entered for all pathways to the class chosen for deletion, the class will not be deleted.
4. Click on the **OK** button to leave the pathways dialog. The pathways diagram will redraw with the new pathway destinations.

If there are no pathways to the class chosen for deletion, the class will simply be deleted.

EDITING COVER AND STAGE

Class information may be changed using the **Diagram** menu.

To edit class cover and stage information:

1. Choose **Edit Cass Cover and Stage** from the **Diagram** menu. The **Edit Class** dialog box will appear which contains fields in which to enter the class letter, the cover type, and the structural stage.
2. Enter the **letter of the class** to be edited. The cover type and structural stage of that class will automatically appear in the appropriate cells.

3. Change the **structural stage and/or cover type** by selecting from the drop-down list.
4. Click on the **OK** button (or hit the **Enter** key on the keyboard) to save your edits to memory or select the **Cancel** button (or the **ESC** key) to exit the dialog box without saving any changes. The program will give a warning message if the cover type and structural stage combination is the same as an existing class, and a different cover type or structural stage must be chosen.

Edits to cover and/or structural stage will be reflected in the labels on the class box in the pathway diagram.

Setting Locations

When you have finished adding classes to your pathway diagram, you can define the location of those classes in the diagram using the **Set Locations** option under the **Diagram** menu.

When a class is read from the Project file, when a new class is created, or when the structural stage or cover type of a class is edited, VDDT determines the class's location based on its deterministic transition pathway. In many cases, especially if there are few cover types, the resulting diagram is readable and usable. Some Projects are complicated: using many cover types and classes. The resulting diagram in these cases may be quite difficult to read.

To change the locations of one or more classes in the diagram:

1. Select **Set Locations** from the **Diagram** menu.
2. Type in the **number of rows** you would like to display. The minimum possible number of rows is the current number of rows showing. The Transition Pathway Diagram will redraw itself and show all the possible locations for classes (given the number of rows requested), the current class locations, and the transition pathways.

> **Note:**
> While many rows are possible, only eight (8) columns can be used. If some of the final columns are not used in the diagram, they will be hidden after all the locations are assigned.

3. To change the location of a class, left-click the **class** whose location is to be changed and then left-click on the desired **location**. The class information will move to the new location. This can be done for as many classes as necessary, and classes can be moved more than once.

> **Note:**
> The deterministic transition pathways are not redrawn. Since these are tied to the class and not to the class's location, their information is still correct, and they will be drawn properly after the location setting is done. [If the dialog box is resized, the pathways may be redrawn, but some of the information may be temporarily lost. The information will be restored after location setting is done.]

4. The menu item **Set Locations** now has a check-mark next to it. When all classes are in their desired location, simply select **Set Locations** again to remove the check-mark. The diagram will redraw itself into the usual format.

VDDT retains the memory of the class locations. This means that once they have been set for a Project, they will not need to be set again, unless new classes are added.

Run Menu

VDDT simulates the dynamics of vegetation over time. It assumes that the area in a landscape is stratified into broad vegetation classes, each of which is described in the pathway diagram of a Project. These pathway diagrams contain definitions of all classes and the pathways between them, as described in the previous sections. To run the model, users must therefore pick:

- a Project; and
- a region (if more than one region is present in the project).

Users then:

- define the run settings;
- execute the model; and
- explore the results.

SETTINGS

Define the conditions for the next model run using the **Settings** option under the **Run** menu. Select general run settings such as the length and scale of the simulation, define your initial conditions and choose any optional settings you wish to use in your run.

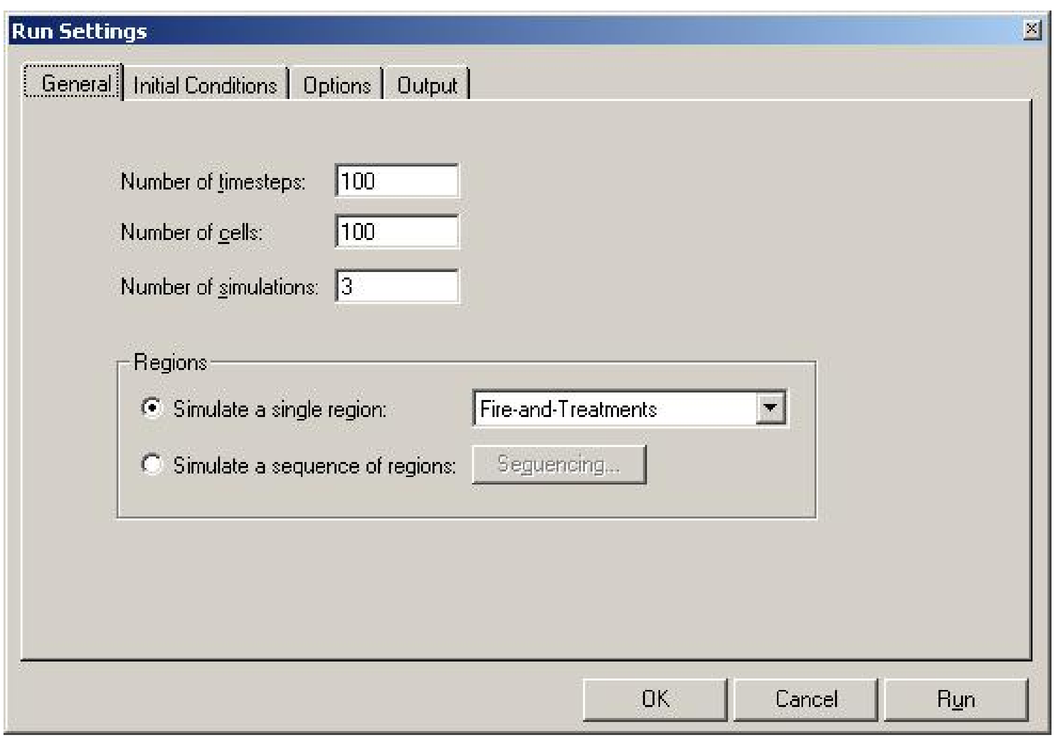
General Run Settings

General run settings are all those that must be set for a model run. They include the length of the simulation (in timesteps), the total number of cells to simulate, the number of Monte Carlo simulations to include in the run, and the region to simulate. Additionally, general run settings also offer users an opportunity to define how VDDT will handle multiple regions, if applicable.

Users can run the model for any number of years between 1 and 1000, and any number of Monte Carlo iterations (see below for details). To run the model for longer than 1000 years, the maximum time possible, run the model for 1000 years, then ask the model to use the ending conditions to start the next run (see about the *Initial Conditions* tab, under the **Run** menu, for more information about using end values). Note, however, that the results will only show the last run.

To enter/edit general run settings:

1. Select **Settings** from the **Run** menu to open the **Run Settings** dialog.
2. On the *General* tab, enter values for the length of the simulation (default 100) and the total number of cells to simulate (default 100, maximum 50,000).



A large number of cells makes the model slower, but less dependent on the choice of random number (see **Run**|**Settings**|*Options* tab). Hence, the random variation in results between successive runs will decrease with increasing number of cells.

> **Note:**
> The number of cells used in a simulation has a direct impact on the length of time it takes for a run to be completed, and you may run into memory problems when using a large number of cells.

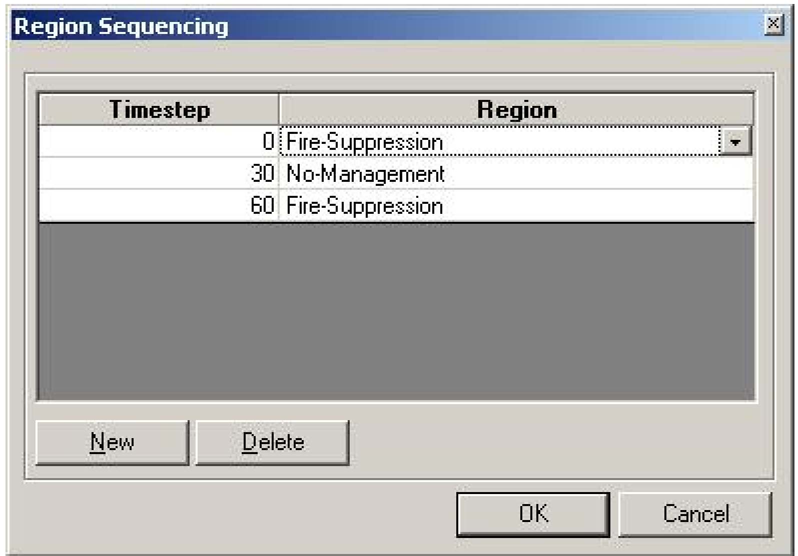
3. Enter a value for the number of Monte Carlo simulations to include in the run.
4. If the Project has only one region, the *Regions* controls will be disabled. If the Project has multiple regions, you can either choose a single region to simulate from the drop-down list or use the **Sequencing** feature to define which regions to run and for how long (see below).
5. Click **OK** to save your general run settings to memory and close the dialog.

To define a sequence of regions for a run:

Regions are just collections of probabilities. While these may represent different management regions, they may also represent different management *regimes* in time, such as past and present fire suppression policies. The current version of VDDT allows users to ask the model to run one region for a number of years, and then switch to a different region in order to use different probabilities. Regions can be run in any order and for any length of time within the time span defined for the run. Each sequence of regions gets run for each simulation in the run.

The advantage of this approach is that the complete run can be viewed at once, and the model will easily calculate the statistics over multiple Monte Carlo simulations.

1. On the *General* tab of the **Run Settings** dialog, click the **Sequencing** button beside the *Region to simulate* field. This action will open the **Region Sequencing** dialog.



2. Use the **New** button and the drop-down lists to enter each *Region* to be included in the run. The *Timestep* represents when to start simulating each region. For example, if a timestep value of 0 is entered for the region called Fire-Suppression, and a timestep of 30 is entered for the region called No-Management, then VDDT will run the Fire-Suppression region from years 0 to 29.
3. Remove unwanted regions from the grid using the **Delete** button.
4. Click **OK** to save your changes to memory and close the **Region Sequencing** dialog. Click **Cancel** to abandon your changes and return to the *Initial Conditions* tab of the **Settings** dialog.

This information will be incorporated into your Project the next time you save it (**File|Save** or **Save As**).

Initial Condition Run Settings

The model simulates the dynamics of a number of cells, each of which is assigned one of the classes defined in the Project. Users must tell the model how many cells to simulate (*General* tab) and how to distribute those cells among classes. The total area represented by your Project can also be specified. Additionally, if Time Since Disturbance (TSD) is being used in the Project, users can either assign specific TSD values to each set of cells (record) in the grid or randomize initial TSD across the entire landscape.

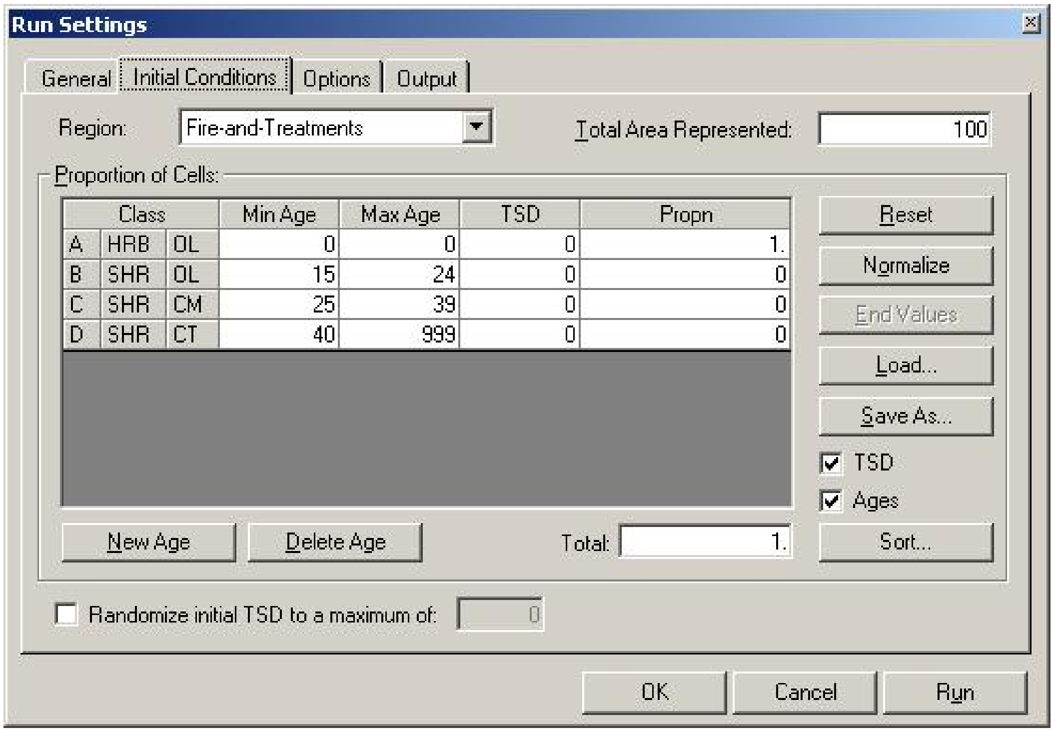
If no initial conditions have been assigned, the model will prompt the user to enter initial conditions before running.

To enter/edit initial condition run settings:

1. Select **Settings** from the **Run** menu to open the **Run Settings** dialog. Click on the *Initial Conditions* tab. To see the TSD and age columns of

the grid, ensure that the **TSD** and **Ages** boxes on the right side of the dialog are checked.

2. If your Project has more than one region, select the region for which you wish to enter initial conditions from the *Region* drop-down list. If your Project contains only one region, the *Region* field will not appear on the *Initial Conditions* tab.



3. For the selected region (if applicable), enter values for the total area represented by your Project. Total area can be any value greater than 0 (if you don't know the area, you can leave this as the default value of 100). Area affects only the value of calculated and numeric attributes, and each cell has the same area. VDDT does not do any translation of units, so it is up to the user to ensure that the units are consistent between the attributes and the area. The area value can also be read from a file (see about the **Load** button, below).

4. In the *Proportion of Cells* grid for the active region, enter values for TSD (Time Since Disturbance) and for the initial proportion of cells to be assigned to each class (total should equal 1) (see about *Distributing Cells Across Classes*, below). TSD values entered here apply only to cells in the records for which they are entered rather than to the entire landscape.

   Class information in this dialog cannot be edited.

5. TSD for each region (if applicable) can also be controlled using the **Randomize initial TSD to a maximum of** field at the bottom of the dialog. This feature randomly assigns initial TSD values between zero and the maximum (or the age of the cell, if the cell is younger than the

maximum TSD entered) to each cell in the landscape. Note, that if you enable the **Randomize initial TSD** option, the value entered there will override any TSD values in the *Proportion of Cells* grid.

6. Repeat Steps 2 through 5 for each region in your Project.
7. Click **OK** to save your changes to memory and close the **Settings** dialog, or **Cancel** to abandon your changes and return to the main VDDT window. Click **Run** to start a model run based on the conditions just entered.

Managing Records in the Grid

New records can be added to the grid for each region using the **New Age** button. This feature allows users to apply different TSD and proportion values to different timeframes within classes.

To add a new record to the grid:

1. For example, if you wish to add a record for Class A, left-click anywhere on an existing row for Class A and click on **New Age**.
2. Enter the minimum and maximum ages for the new record and click **OK**. The new record will be added to the bottom of the grid. Use the **Sort** button to arrange the records by *Class*, *Cover Type*, *Structural Stage* or *Min Age*.
3. Enter a proportion value for the new record, making sure that when you are done, the total for all records is still 1 (see about *Distributing Cells Across Classes*, below).
4. Is you wish, you can enter a specific *TSD* value for the new record. Remember that if you have enabled the **Randomize initial TSD** option at the bottom of the screen, the value entered there will override any TSD values you enter in the *Proportion of Cells* grid for the active region.
5. Repeat steps 1 through 4 for each region in your Project to which you wish to add records.
6. Click **OK** to save your initial conditions to memory. When you run your simulation, VDDT will run each record in each region according to the assigned proportion and TSD values.

Note:
If a newly added record has the same *Class*, *Min Age* and *TSD* as an existing record in the grid, the *Propn* values for those records will be summed into a single record (the one with the highest *Max Age*) when you save and re-open your Project.

Distributing Cells Across Classes

To distribute cells evenly across the classes:

1. In the *Proportion of Cells* grid of the *Initial Conditions* tab (**Run|Settings**), all proportion values (Propn column) should either be

empty or have the **same number**. You can reset all the values in this column to 0 by clicking on the **Reset** button.

> **Note:**
> **Reset** also changes TSD values in the grid to zero, removes any added records, and sets minimum and maximum ages back to class specifications. If you have added records and/or changed age values in the grid, adjust proportions manually rather than using the **Reset** feature.

2. If the *Total* does not equal 1, click on the **Normalize** button to adjust the values so they total 1 but retain their relative values.
3. Repeat Steps 1 and 2 for each region in your Project (if applicable).

To put all the cells in one class:

1. In the *Proportion of Cells* grid of the *Initial Conditions* tab (**Run|Settings**), enter a **1** in the cell corresponding to the class.
2. Make sure all other cells are empty or contain a zero.
3. Repeat Steps 1 and 2 for each region in your Project (if applicable).

To distribute the cells in some specific pattern:

1. In the *Proportion of Cells* grid of the *Initial Conditions* tab (**Run|Settings**), enter the **numbers** in the cells either as a proportion or as an absolute number. For example, if classes A, B, and D are to have twice as much area as classes C, E, and F, then enter (in alphabetical order): 2, 2, 1, 2, 1, 1.
2. If the sum of the cells totals is not equal to 1, then click on the **Normalize** button. This normalizes the proportions in all cells such that they sum to 1 but retain their relative values.
3. Repeat Steps 1 and 2 for each region in your Project (if applicable).

To use ending conditions from the previous run still in memory:

1. On the *Initial Conditions* tab (**Run|Settings**), click on the **End Values** button. The values in the grid will change to reflect the proportions in effect at the end of the previous run.
2. Repeat for each region in your Project (if applicable).

To use conditions from an existing file:

Conditions from an existing file, such as initial conditions files or final conditions files written by the model (see Appendix D for file format), can be loaded from the *Initial Conditions* tab.

1. On the *Initial Conditions* tab (**Run|Settings**), click on the **Load** button. A **Read Conditions** dialog will open; navigate to and open the *.IC file that contains the values you wish to load. The values in the grid will change to reflect the proportions defined in the selected file.

2. If the total is not **1**, click the **Normalize** button.

   Initial condition files can contain information about the proportion or amount of the landscape that is within a class, within a given age range, and with a given TSD. It also can contain the total area being simulated.

> **Note:**
> When the file is read, ages that are less than the beginning age of the class are set to the beginning age of the class. Ages that are greater than the maximum age of the class will be set to the maximum age of the class.

3. Repeat Steps 1 and 2 for each region in your Project (if applicable).

Managing Initial Conditions Information

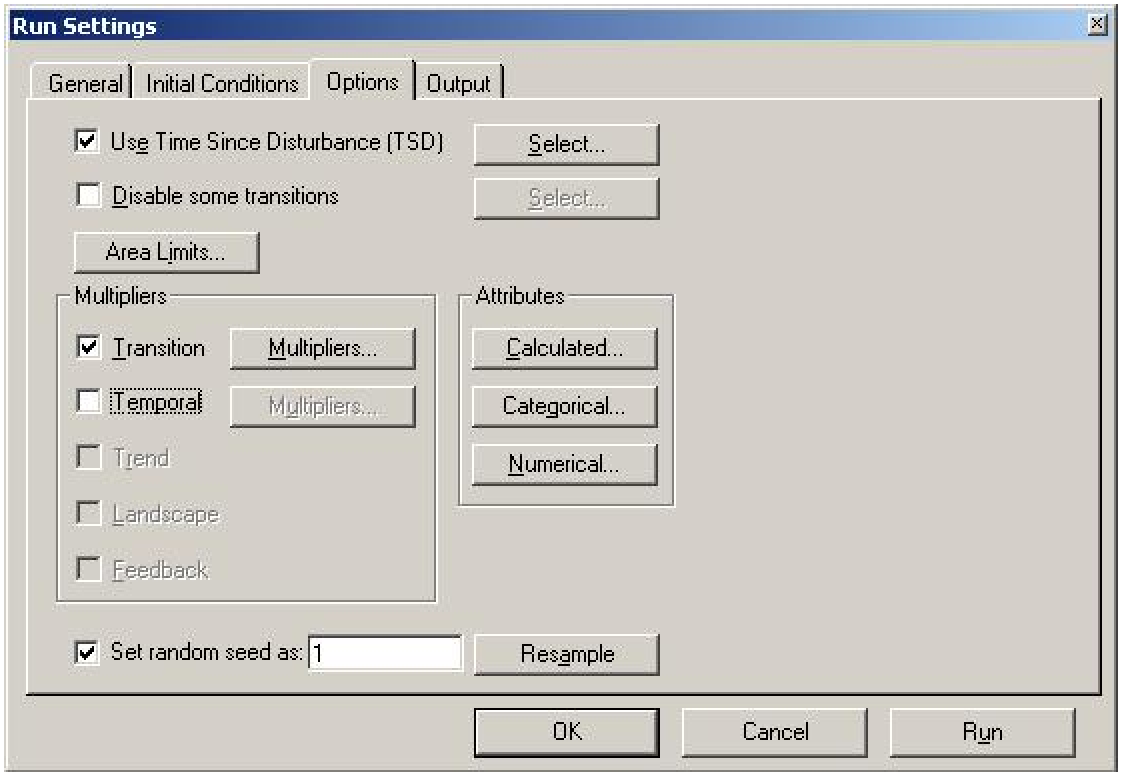
To save initial conditions to a file:

1. On the *Initial Conditions* tab (**Run**|**Settings**), select the region for which you wish to save initial conditions from the **Region** drop-down list. If your Project has only one region, no selection will be necessary here; proceed directly to Step 2.
2. Click the **Save As** button.
3. Navigate to where you want to store the new initial conditions (*IC) file, enter a name for it, and click **Save**.
4. Repeat Steps 1 through 3 for each region for which you wish to save initial conditions, making sure you enter unique names for each file.

Optional Run Settings

Use VDDT's optional run settings to define time since disturbance associations, disable selected transitions, set the random seed, and add advanced features to your Projects such as probability multipliers, area limits and attributes.

Under the **Run** menu, select **Settings** to open the **Run Settings** dialog; open the *Options* tab.



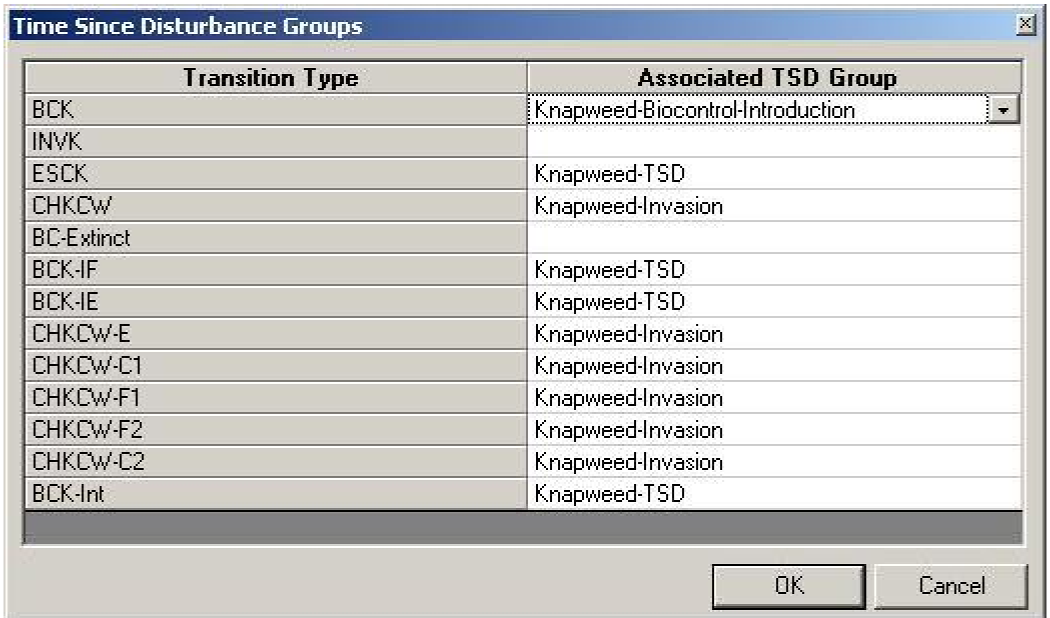
Time Since Disturbance

Time Since Disturbance (TSD) values, set using the **Class Properties** dialog (**Diagram** menu), allow users to define the minimum and maximum number of timesteps, following a particular set of probabilistic transitions for a cell, during which the cell is eligible for a subsequent probabilistic transition (see From Class Properties for information about setting TSD values). For example, a user could determine that eradication of knapweed via chemical treatment can only occur for 3 timesteps following knapweed invasion. In this case, the eradication via chemical control transition type is associated with knapweed invasion. To use TSD values in this way, associations need to be defined for each affected transition type in your Project.

To use the Time Since Disturbance option:

1. Open a Project for which you have assigned TSD values to transitions (**Class Properties** dialog).
2. Under the **Run** menu, choose **Settings** and open the *Options* tab of the **Run Settings** dialog. Place a checkmark in the *Use Time Since Disturbance* option to turn it on.
3. Click on the **Select** button to open the **Time Since Disturbance Groups** dialog.
4. All transition types in your Project will be listed in the left pane of the dialog. From the drop-down lists in the right pane, select the TSD Group with which you wish to associate each affected transition type.

Note – the TSD Group is the group of probabilistic transitions on which the occurrence of an individual transition type is contingent.



5. Click **OK** when done, or **Cancel** to abandon your changes and close the dialog.
6. The next time you run the model using this Project, your TSD values will be used in the simulation. If, at some later time, you wish to run a simulation without the TSD values, simply turn the TSD option off. The model will ignore the assigned TSD values until the option is explicitly turned back on.

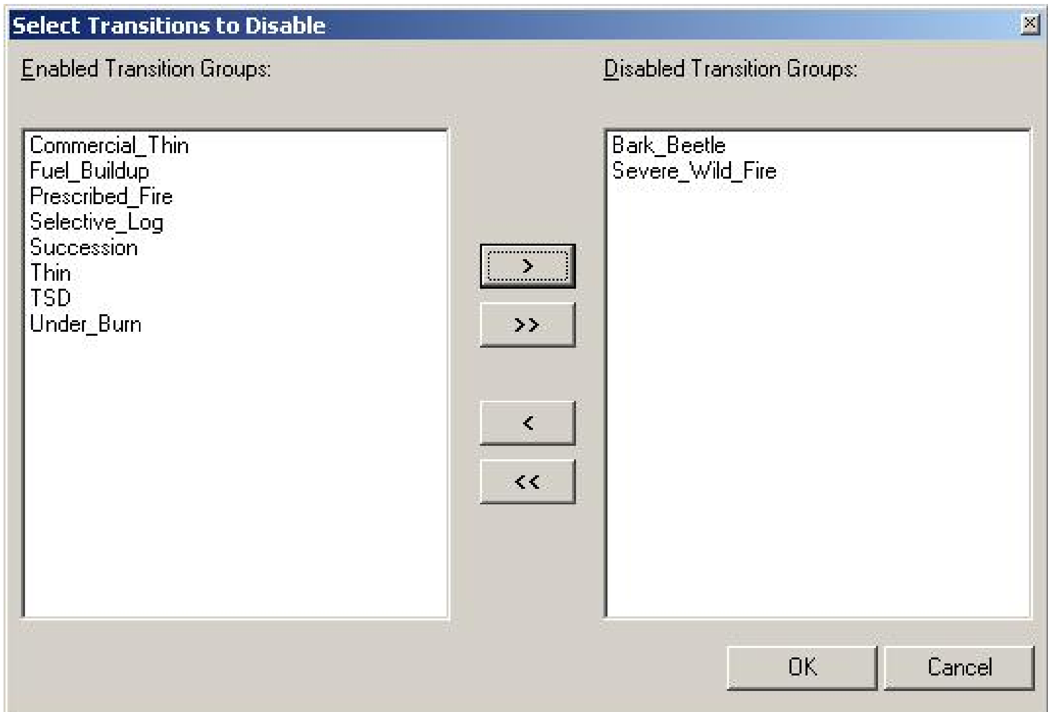
Note:
VDDT does not use time since disturbance values by default. TSD must be turned on (**Run|Settings|***Options*) before the values will be used during a run. Once turned on, all other runs with that Project will use the specified TSD values unless they are explicitly turned off.

Disable Transitions

At times, users may wish to run the model without some of the probabilistic transitions (e.g., in the absence of any management) or with only a particular probabilistic transition (e.g., with fire only).

To disable transitions:

1. Select **Settings** from the **Run** menu to open the **Run Settings** dialog; go to the *Options* tab.
2. Turn on the *Disable some transitions* field by placing a checkmark in the box; click on the **Select** button to open the **Select Transitions To Disable** dialog.



3. Choose the transitions to be disabled by moving them across to the right side of the screen using the arrows in the centre.

4. The **OK** button saves the selection while the **Cancel** button (or ESC key) leaves the window without making any changes. The selected transitions are still present and, although they will not be simulated by the model, the information will be saved with the Project.

If a transition is part of more than one disturbance group, it will not occur if any of those groups are disabled. For example, if the probabilistic transition "pine beetle and wildfire" is a member of the three groups fire, insects and fire/insects, it will not occur if any one of these three groups is turned off for the simulation. The distribution of transition types into transition groups can be defined by the user under the **File|Properties|Definitions** menu choice.

Area Limits

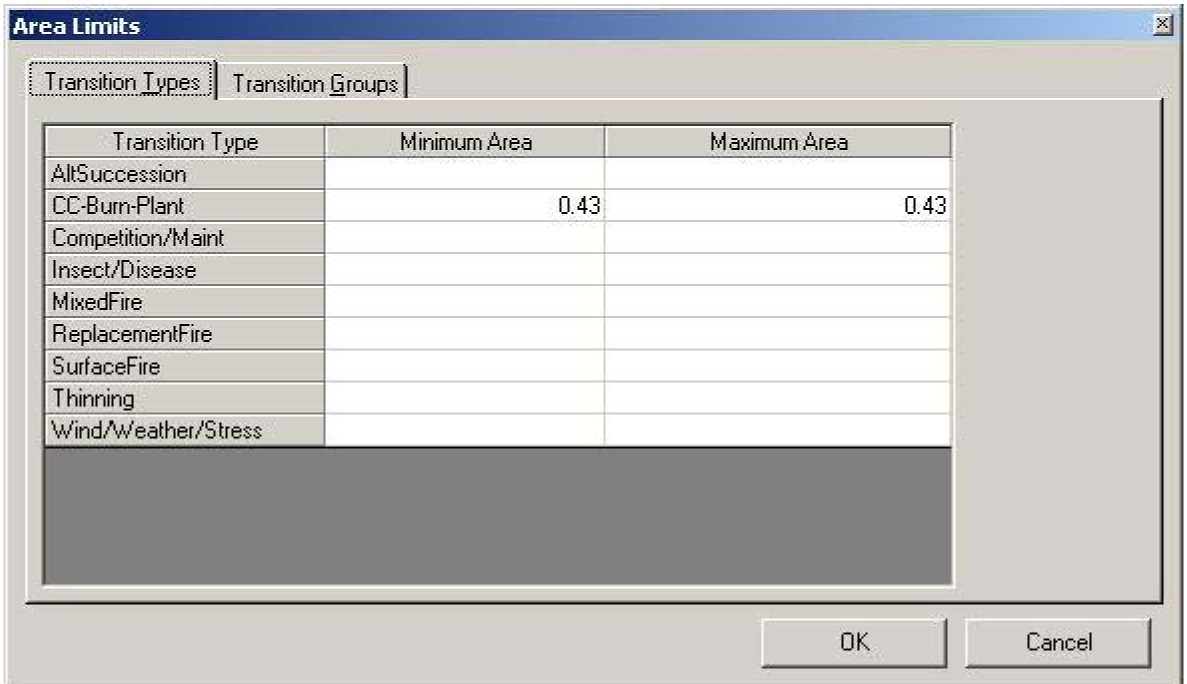
Limits can be applied to constrain the area affected by particular transition types and by transition groups. Target minimum and maximum area limits can be imposed on the total area disturbed by a group of transitions for up to five time intervals.

To limit the area affected by a transition type:

1. Under VDDT's **Run** menu, select **Settings** to open the **Run Settings** dialog; open the *Options* tab. Click on the **Area Limits** button. This action will open the **Area Limits** dialog.

2. On the *Transition Types* tab, type in minimum and maximum area values for the transition types you wish to constrain. Zeros in this grid

mean that no transition will occur; no value means no limit will be placed on the associated transition type.



Note:
In VDDT version 5.1 and earlier, a value of zero in the **Area Limits** grid meant "no limit". If you are working with a Project that you have imported from VDDT version 5.1 or earlier, and it contains zeros in the **Area Limits** grid, be sure to delete them. Otherwise, the transitions to which zero area limits are assigned will not occur in your simulations.

To limit the area affected by a transition group:

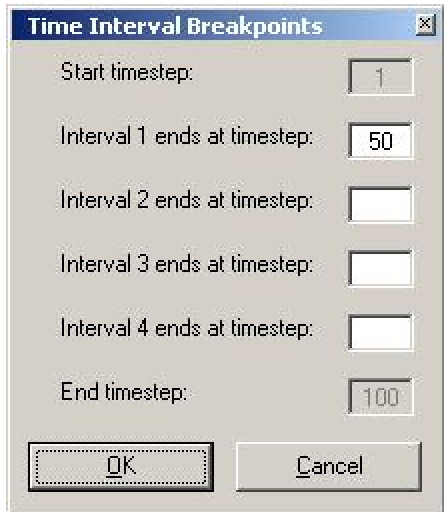
Area limits can also be set for transition groups, as long as care is taken to maintain consistency where values have also been entered for transition types. For example, if you wish to limit the area affected by a specific form of harvesting (e.g., the CC-Burn-Plant transition type), then any limits you place on the total harvest (e.g., the Harvest transition group of which CC-Burn-Plant is part) must be greater than the limits you placed on CC-Burn-Plant.

1. On the **Area Limits** dialog, select the *Transition Groups* tab.
2. Type in minimum and maximum area values for the desired transition groups. Zeros assigned to transition groups in this grid mean that no transition types that are members of that group will occur; no value means no limit will be placed on the associated transition group.

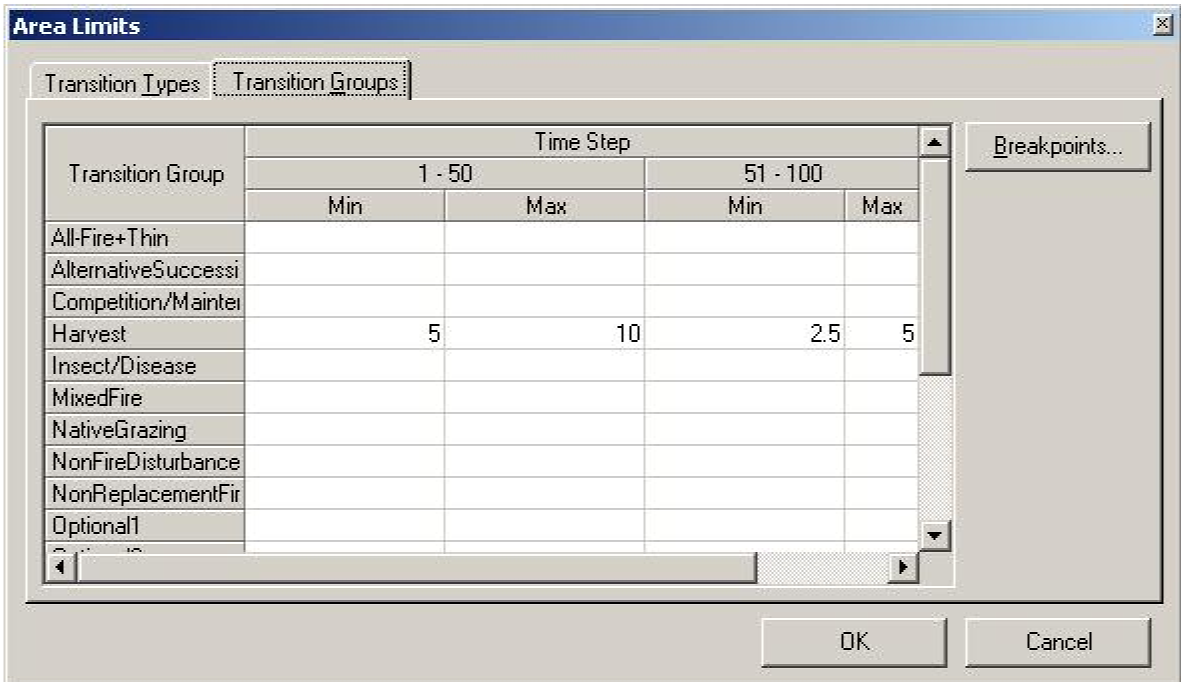
You can also set area limits on up to 5 time intervals for transition groups.

3. On the *Transition Groups* tab, click on the **Breakpoints** button to open the **Time Interval Breakpoints** dialog. The *End Year* is based on the end year defined in the run. For example, if Interval 1 ends at year 50, then it ranges from 1 (*Start Year*) to 50; if no other interval is set, then the last interval ranges from year 51 to 100 (the *End Year*).

   As the example below shows, you do not have to use all four available intervals.



4. Click on **OK** when done, and **Yes** to the confirmation message that appears if you want to go ahead and replace your existing limits. The **Area Limits** dialog will now display columns showing the defined time intervals.
5. Type in the minimum and maximum area limits for the desired disturbance groups.



6. If you wish to remove all breakpoints you have entered, return to the **Time Interval Breakpoints** dialog. Delete the interval values for each time interval and create a single interval by typing the *End timestep* value into one of the interval text boxes. Click **OK**. Click **Yes** to the confirmation message. The **Area Limits** dialog will now show all timesteps in a single interval.

Note:
Each individual transition type can belong to more than one transition group; however you can not have area limits on two groups that share the same transition type.

Area limits will not be met exactly – the more cells that are simulated, the closer the results will be to area limits specified by the user.

Area limits for transition groups or individual transition types may be impossible due to the state of the landscape, e.g., if there is not enough area of harvestable timber to meet a minimum area target.

If area limits on transitions types are in conflict with limits on transition groups, the limits on transition groups will take priority.

Probability Multipliers

VDDT, through its stochastic algorithms, inherently generates some between-year variability in transition probabilities. The area affected by a transition type in any one year is dependent on the state of the landscape. If a large amount of the landscape is in classes that have a high probability for transitions, the number of cells undergoing transitions will be higher than if most of the landscape is in classes in which transitions have low probabilities. Even disturbances that occur in many or all classes will show some minor variation due to random number generation and due to variability in the probabilities for different classes (see Appendix B for a discussion of probability distributions in transition probabilities).

In ecological systems, sources of variation also include external factors such as weather patterns. For example, several warm, dry years may result in higher than average areas burned or affected by mountain pine beetle. VDDT can capture this type of variation with user-defined probability multipliers. For example, suppose a user has information that describes stand-replacing fire behavior over a 100-year period. Outside of VDDT, the user determines the average area burned, and then a multiplier for each year to get from the average area burned to the actual area burned. Use VDDT's multipliers option to apply these multipliers and create between-year variability for stand-replacing fires in your simulation.

Multipliers can be imported into Projects from *.MLT, *.CSV and *MCM file formats (**File|Import|Multipliers**). A Project's multipliers can also be saved to external files (**File|Export|Multipliers**) so they can be edited and imported into other projects.

The *Multipliers* section of the *Options* tab (**Run**|**Settings**) allows users to turn transition and temporal multipliers on and off, to edit transition multipliers, and to specify which temporal multipliers to use in the next simulation.

> **Note:**
> VDDT does not use probability multipliers by default. Multipliers must be turned on (**Run|Settings|***Options*) before they will be used during a run. Once turned on, all other runs with that Project will use the multipliers unless they are explicitly turned off.

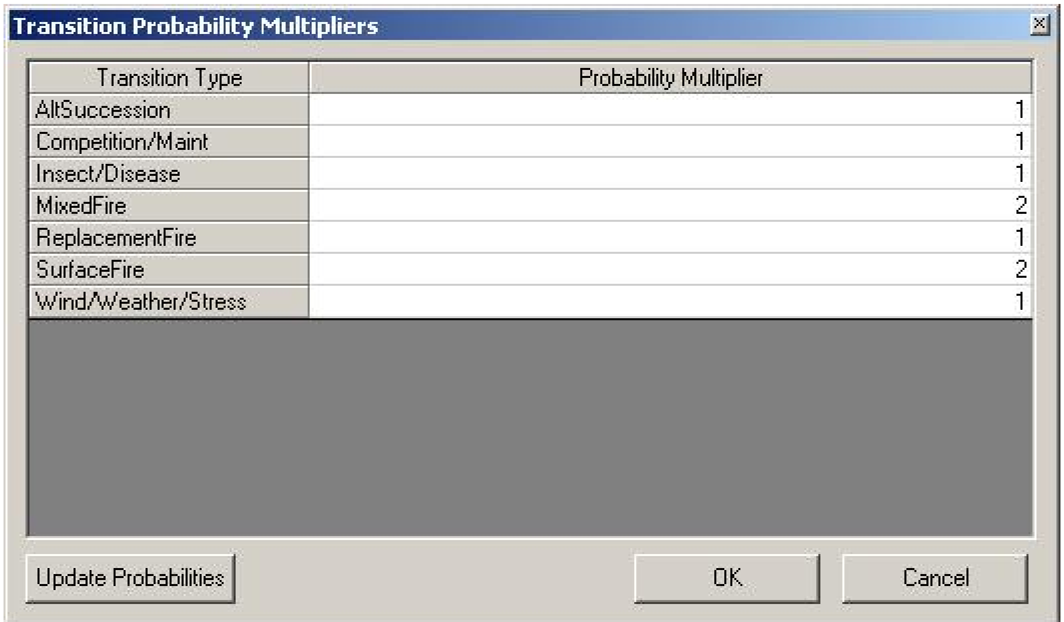
Transition Multipliers

Transition multipliers are values that increase or decrease the probability that the transition types to which they are applied will occur. This is a useful option for testing the sensitivity of the probabilities, or for exploring "what-if" scenarios (such as "what if fires were twice as frequent?").

In order to use transition multipliers in a simulation, you must turn the option on and then assign the multiplier values. If you wish to run a simulation without assigned transition multipliers, simply turn the option off (see below). All subsequent simulations using the same Project will ignore the multipliers until the option is explicitly turned back on.

To use transition probability multipliers:

1. Under VDDT's **Run** menu, select **Settings** to open the **Run Settings** dialog; open the *Options* tab. On the *Options* tab, place a checkmark in the *Transition* option to turn it on.
2. Click on the **Multipliers** button to open the **Transition Probability Multipliers** dialog.



All transition types defined for the open project are listed in the dialog. If the Project contains more than one region, a *Region* field will be included in this dialog. Rows in the grid will be sorted first by *Region*, and then by *Transition Type*.

3. Assign your multipliers by typing them into the *Probability Multiplier* grid. Multipliers can be any positive number, including decimals. A multiplier of 1 is equivalent to assigning no multiplier. A multiplier of 0 means that the transition to which it is assigned will not occur.

   Click on the **Update Probabilities** button if you wish to apply your multipliers to the transition types in the grid and permanently change the probabilities for those pathways. If you wish to use your multipliers in simulation runs but retain the original pathway probabilities, click on OK.

4. The next time you run the model using this Project, your transition multipliers will be used in the simulation. If, at some later time, you wish to run a simulation without the multipliers (i.e., you did not use **Update Probabilities**), simply turn the *Transition* option off. The model will ignore the assigned multipliers until the option is explicitly turned back on.

Temporal Multipliers

Temporal multipliers, known as annual multipliers in earlier versions of VDDT, allow the user to simulate annual variation during a run. In order to use temporal multipliers in a simulation, an appropriate set of multipliers must first be generated outside of VDDT. These can then be imported into an open Project using VDDT's **Import** menu (**File|Import|Multipliers |Temporal**), or loaded directly using the **Temporal Multipliers** dialog (see below).

Your temporal multipliers *.CSV file needs to have the following format:

ProbabilisticTransitionType_Name	Simulation	Timestep	Multiplier
Insect/Disease	1	1	0.00125
Insect/Disease	1	2	0.00125
Insect/Disease	1	3	0.00125
Insect/Disease	1	4	0.00125
Insect/Disease	1	5	0.00125
	……		
Insect/Disease	1	18	12.5
Insect/Disease	1	19	0.125
Insect/Disease	1	20	0.125

For example, a project with 3 Monte Carlo simulations and 100 timesteps would contain 300 multipliers for the Insect/Disease transition type.

VDDT can also read temporal multipliers directly from an *.MCM file, which can be created using the Build MCM Tool (included with the VDDT installation files). Detailed information about the Build MCM Tool is provided in Appendix F. Users who wish to generate multipliers using the MCM Tool will need to enable VDDT's **Variation** menu in order to create the required input files (see Appendix G for information about the **Variation** menu and how to access it).

In order to use temporal multipliers in a simulation, you must turn the option on. If you wish to run a simulation without assigned temporal multipliers, simply turn the option off (see below). All subsequent simulations using the same Project will ignore the multipliers until the option is explicitly turned back on.

To load and view temporal probability multipliers:

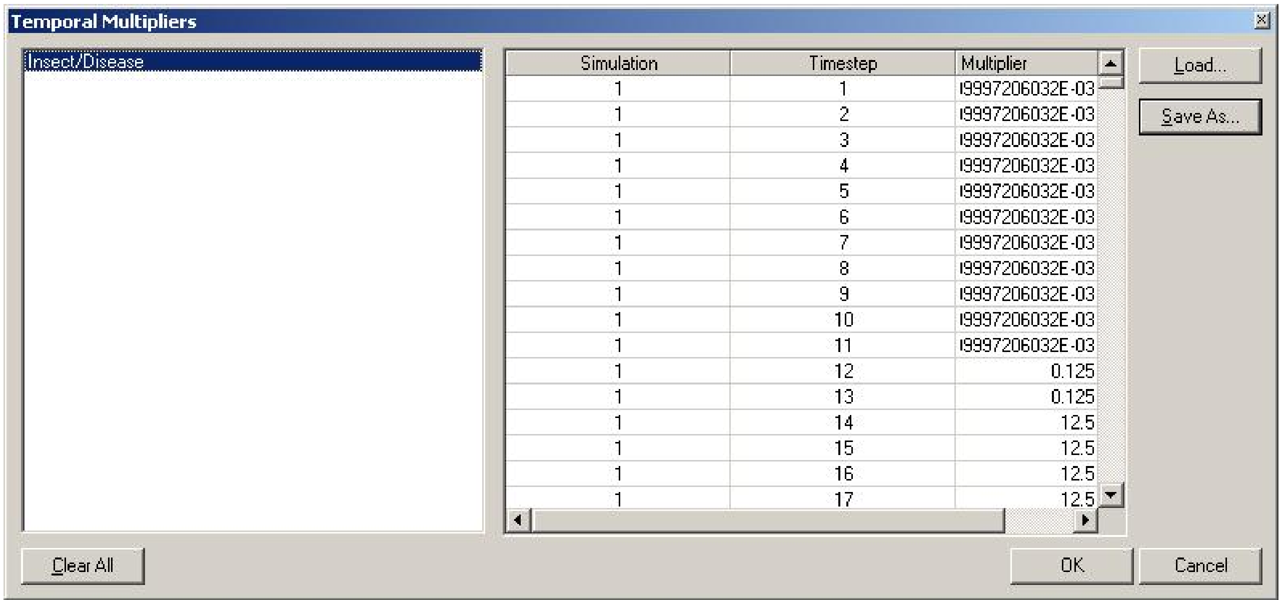
1. Open a Project for which you have temporal multipliers ready to use, i.e., either already in the database or in the form of a file ready to import or load.

   If your multipliers are not already in the database, you can import them from *.CSV or *.MCM files (**File|Import|Multipliers|Temporal**), or you can load them directly from *.CSV files using the **Temporal Multipliers** dialog (see below).

2. Under VDDT's **Run** menu, select **Settings** to open the **Run Settings** dialog; open the *Options* tab. On the *Options* tab, place a checkmark in the *Temporal* option to turn it on. Click on the **Multipliers** button to open the **Temporal Multipliers** dialog.

3. If no transitions are listed in the left-hand pane of the dialog, then you must either import or load them. To load multipliers directly from *.CSV files, click on the **Load** button. Navigate to and select the *.CSV file that contains your temporal multipliers and click **Open** to load them into the open Project. A confirmation message will display when the loading process is complete.

4. Back on the **Temporal Multipliers** dialog, left-click on the transition listed in the left-hand pane of the dialog to display the temporal multipliers you just loaded. Multipliers cannot be edited in the **Temporal Multipliers** dialog.



5. To delete all multipliers from a Project, click on the **Clear All** button. Otherwise, click **OK** to save your multipliers to memory, and **Save** your Project to integrate them into the database.

Project Attributes

Project attributes provide additional information about classes. Use the *Options* tab of the **Run Settings** dialog (**Run|Settings**) to define calculated, categorical (level/group) and numeric attributes for Projects. Attribute types can be mixed and more than one of each type can be assigned to a Project. Once attributes have been added to a Project, they can be edited and graphed within VDDT.

VDDT allows users to create attributes, assign/edit attribute values, import attribute information from external files (**File|Import|Attributes**), and save attribute information to external files (**File|Export|Attributes**) so it can be shared with other Projects. Attribute files are comma and quote delimited *.ATT files (see Appendix D for information about the *.ATT file format).

Three types of attributes are recognized by the model:

Attribute	Description
Calculated:	These are attributes that are dependent on the occurrence of a transition. Values are assigned to a class and transition type, and the final value is "calculated" during a model simulation. For

example, outputs such as smoke emissions and timber harvest volumes can be tracked. Users can set targets for the minimum and maximum amount of calculated attribute output per year. Calculated attribute information is stored in the VDDT database.

Categorical: This is a qualitative descriptor such as "high," "medium," "low," or "excellent," "good," "poor." Graphs of this attribute will show the proportion of cells at each level. This is a class-based attribute only. Categorical attributes are stored in external *.ATT files.

Numeric: Values are numerical descriptors with units, e.g., 20 snags/acre. This is a class-based attribute only. Numeric attributes are stored in external *.ATT files.

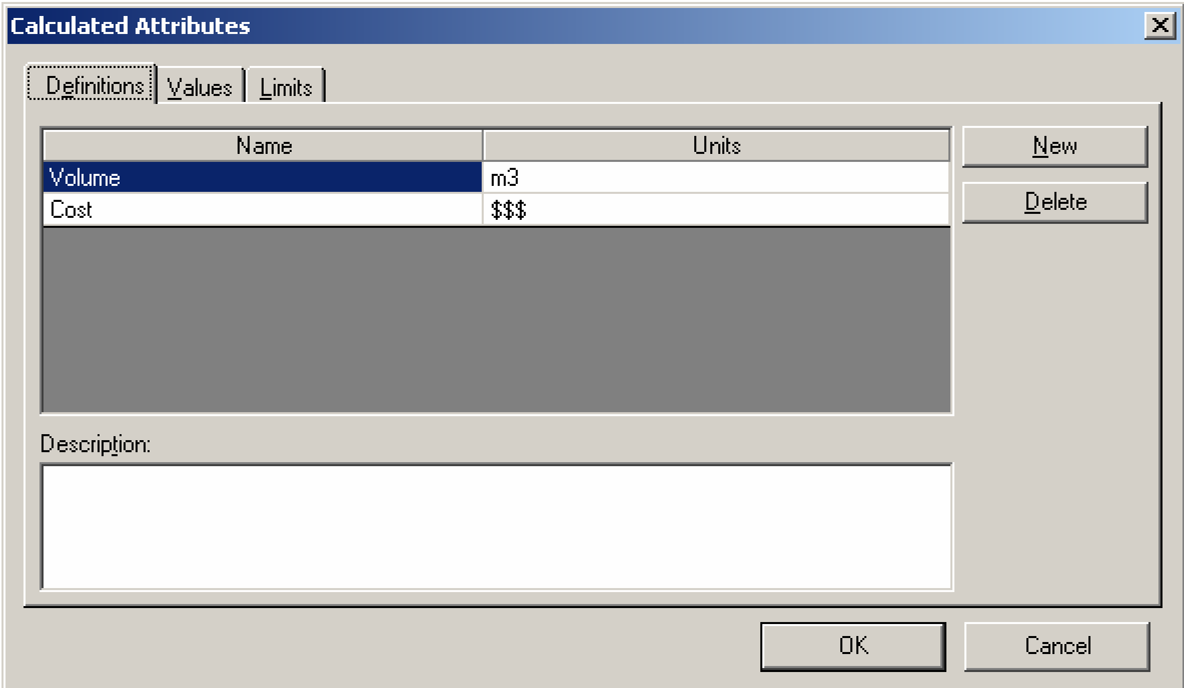
Calculated Attributes

A calculated attribute is one whose value depends on a transition event occurring. Values are linked to a specific occurrence of transition type and class, e.g., if an underburn occurs in Class G the smoke emissions (the calculated attribute) will be *x* while if it occurs in class N they will be *y*.

The **Calculated Attributes** dialog, accessed by selecting **Settings** from the **Run** menu, is divided into three tabs. Use the *Definitions* tab to create new attributes and delete unwanted ones. The *Values* tab allows users to set values for unique attribute/class combinations, and the *Limits* tab specifies lower and upper attribute value limits for specific time periods.

To define calculated attributes:

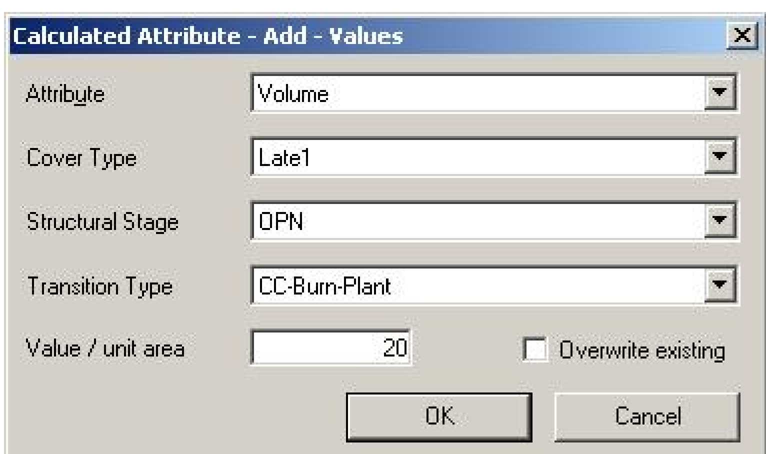
1. Open the Project for which you wish to define calculated attributes.
2. Under the **Run** menu, select **Settings** to open the **Run Settings** dialog. Select the *Options* tab. In the *Attributes* pane, click on the **Calculated** button. This action opens the **Calculated Attributes** dialog.



3. Define your calculated attributes using the *Definitions* tab. Click **New** to insert a row into the grid. Type in a *Name* and specify the *Units* for your first calculated attribute. Provide a *Description* (optional) of the calculated attribute. Continue until you have defined all of your calculated attributes.
4. Click **OK** to return to the *Options* tab of the **Run Settings** dialog, or switch to the *Values* tab to continue setting your calculated attributes.

To specify calculated attribute values:

1. On the *Values* tab of the **Calculated Attributes** dialog, click **New** to open the **Add Values** dialog.

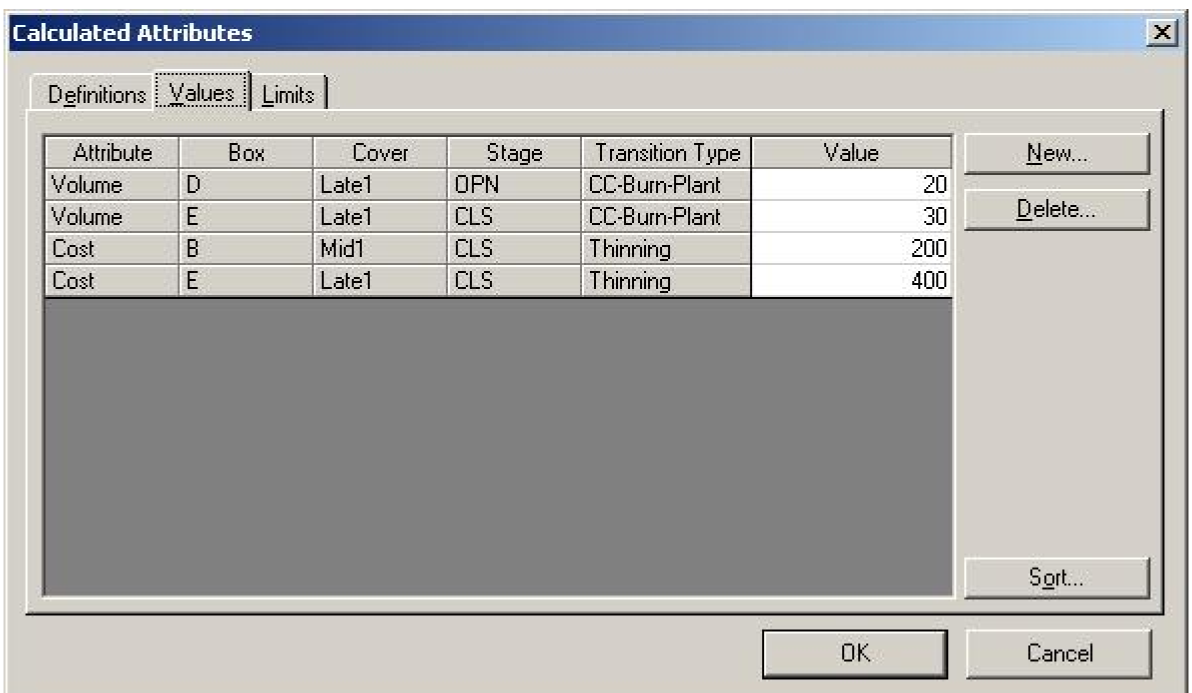


Use this dialog to select the unique combination of attribute, class characteristics and transition type to which you wish to apply an attribute value. The *Attribute* drop-down list contains all of the attributes specified on the *Definitions* tab; the drop-downs in the other fields contain the cover types, structural stages and transition types that have been defined for the active Project. The combination of cover type, structural stage and transition type that you choose must be a valid one for the open Project (check the **Probabilistic Transitions** screen - **Diagram** menu - to review transitions for all classes).

2. Enter the desired attribute value in the *Value/unit area* field, e.g., for a volume attribute with units of m^3, a value of 30 means 30 m^3/unit area. The area units used for the denominator here are the same as determined by the user on the *Initial Conditions* tab (**Run|Settings**). Click **OK** to add your new row to the grid on the *Values* tab.

   Invalid combinations of cover type, structural stage and transition type will generate an error, and the new row will not be added. Additionally, the **Add Values** operation will not overwrite values for combinations you have already added to the *Values* grid, i.e., if you use the **Add Values** dialog to select a combination of attribute, cover type, structural stage and transition type that already exists on the *Values* tab, your new value will not be added unless you enable the *Overwrite existing* option on the **Add Values** dialog.

   Continue until you have associated calculated attributes and values to each combination of cover type, structural stage and transition type you wish.



3. From the *Values* tab, you can also sort the entries in the *Values* grid. To do so, click on the **Sort** button on the *Values* tab to open the **Sort** dialog. You can sort by up to four fields, in either ascending or descending

order. Click **OK** to return to the *Values* grid and your sorted list of calculated attributes.

4. You can also remove unwanted attributes by clicking anywhere on the row and clicking the **Delete** button. A dialog box will open requesting confirmation of the deletion. Click **OK** to delete the row and return to the *Values* tab.

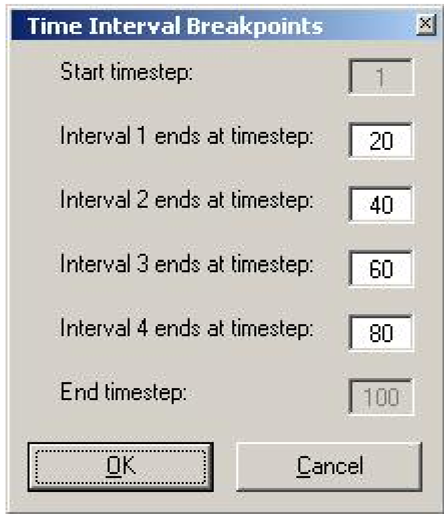
5. Click **OK** to return to the *Options* tab of the **Run Settings** dialog, or switch to the *Limits* tab to continue setting your calculated attributes.

To set calculated attribute limits:

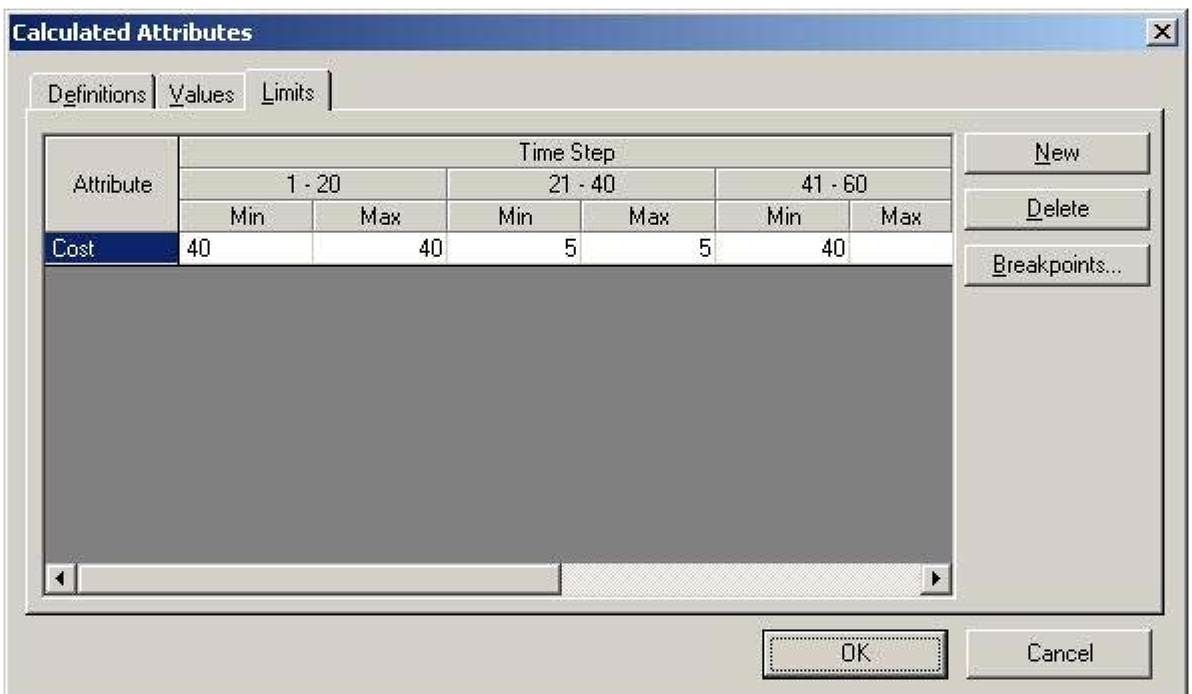
VDDT allows the user to place upper and lower annual limits (for up to 5 time intervals) on the expected total value of a calculated attribute. If users have limits on the area disturbed by either individual transitions or transition groups, and these limits conflict with the attribute limits, the attribute limits will take priority. Attribute limits will only be met approximately because of the probabilistic nature of the model. The more cells used in the simulation, the closer the results will be to the set limits. Attribute limits may not be met at all if the state of the landscape does not allow it (for example, a minimum timber harvest volume may not be possible if the area of mature forest in the landscape is too low).

Note:
The limits will not work properly if limits are placed on two separate calculated attributes that share one or more transitions. The maximum number of calculated attributes allowed is 40.

1. On the *Limits* tab of the **Calculated Attributes** dialog, click on the **Breakpoints** button to open the **Time Interval Breakpoints** dialog. Use this dialog to define the time intervals over which to set the minimum and maximum limits for your calculated attributes. For example, values of 20, 40, 60 and 80 produce intervals of 1-20, 21-40, 41-60, 61-80 and 81-end. Note that you do not have to fill in all four boxes. When done, click **OK** to return to the *Limits* tab.



2. On the *Limits* tab, click on the **New** button to add your first row to the table. Select the attribute for which you wish to set value limits from the *Attribute* drop-down list. Type in the limits for the desired intervals and click on **OK** when done. Continue until you have added one record for each attribute to which you wish to assign limits.



In the above example, the model has been set to spend alternately $40 and $5 annually on restoration in 20 year periods.

3. You can remove unwanted limits by clicking anywhere on the row and clicking the **Delete** button. A dialog box will open requesting

confirmation of the deletion. Click **OK** to delete the row and return to the *Limits* tab.

4. If you wish to remove all breakpoints you have entered, return to the **Time Interval Breakpoints** dialog. Delete the interval values for each time interval and create a single interval by typing the *End timestep* value into one of the interval text boxes. Click **OK**. The **Calculated Attributes** dialog will now show all timesteps in a single interval.
5. When done, click **OK** on the **Calculated Attributes** dialog to save your changes to memory and close the dialog.

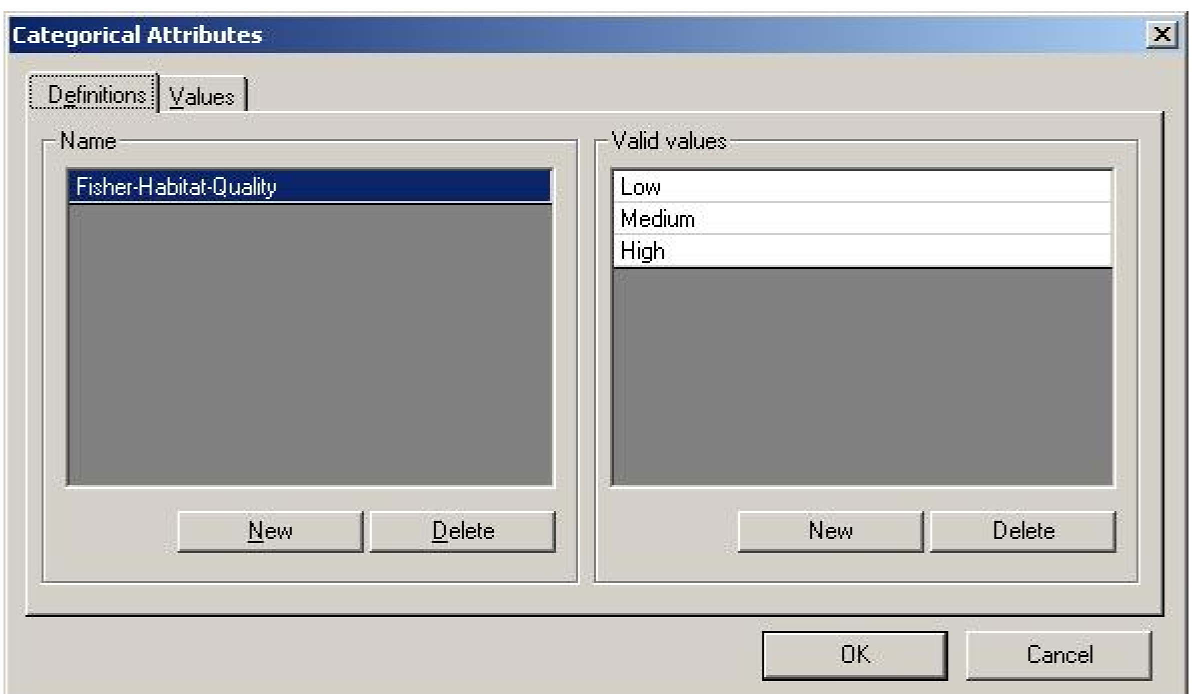
To save your calculated attribute settings to the active Project and to the database, select **Save** from the **File** menu.

Categorical Attributes

Categorical attributes, known as level/group attributes in earlier versions of VDDT, are class-based qualitative descriptors such as "high," "medium," "low," or "excellent," "good," "poor." Graphs of this attribute will show the proportion of cells in each category.

To define categorical attributes:

1. Open the Project for which you wish to define categorical attributes.
2. Under the **Run** menu, select **Settings** to open the **Run Settings** dialog. Select the *Options* tab. In the *Attributes* pane, click on the **Categorical** button. This action opens the **Categorical Attributes** dialog.



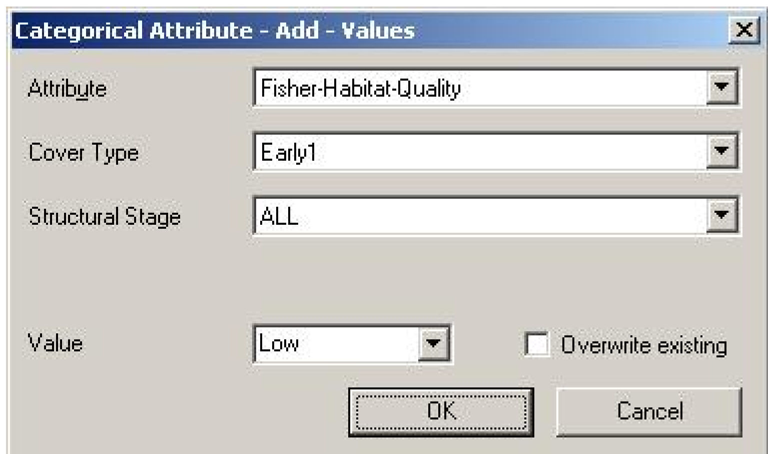
3. Define your categorical attributes using the *Definitions* tab. Click **New** under the *Name* pane to insert a row into the grid. Type in a *Name* for the categorical attribute. Click **New** under the *Valid values* pane, and enter a descriptive label for the first level in the named category. Repeat this step for each level in the category (e.g., Low, Medium, High).

   Remove unwanted entries by clicking on them and then clicking the corresponding Delete button.

4. Click **OK** to return to the *Options* tab of the **Run Settings** dialog, or switch to the *Values* tab to continue setting your categorical attributes.

To specify categorical attribute values:

1. On the *Values* tab of the **Categorical Attributes** dialog, click **New** to open the **Add Values** dialog.

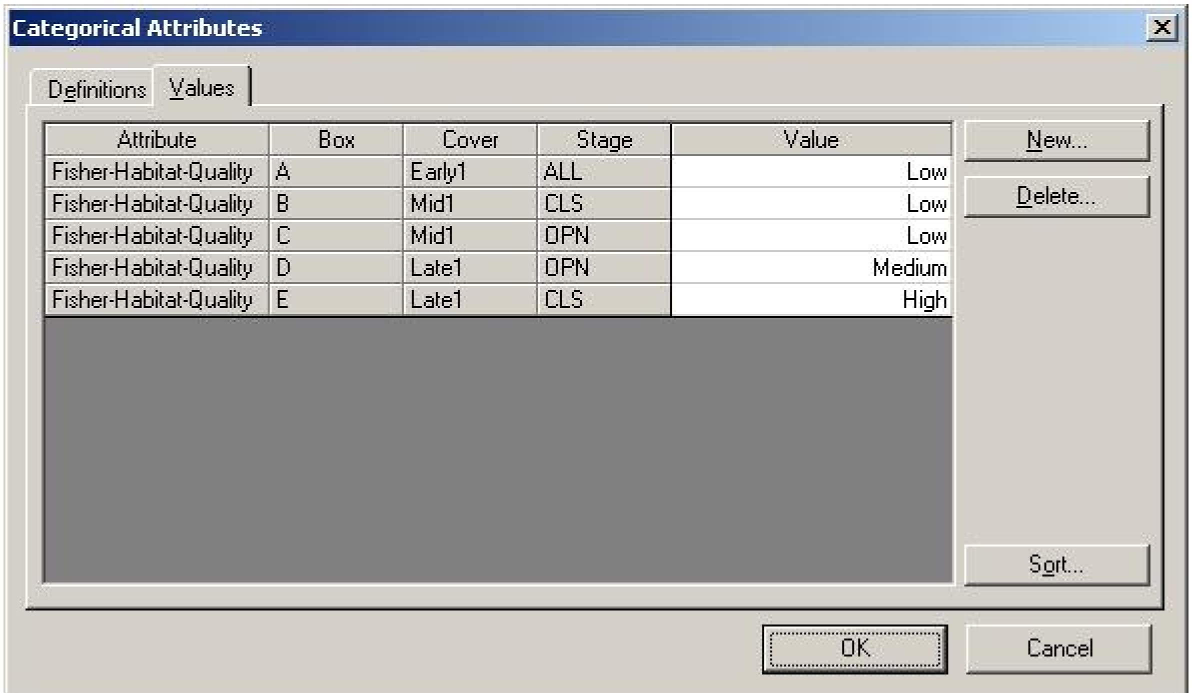


   Use this dialog to select the unique combination of attribute, class characteristics and transition type to which you wish to apply an attribute value. The *Attribute* drop-down list contains all of the attributes specified on the *Definitions* tab; the drop-downs in the other fields contain the cover types, structural stages and transition types that have been defined for the active Project. The combination of cover type, structural stage and transition type that you choose must be a valid one for the open Project (check the **Probabilistic Transitions** screen - **Diagram** menu - to review transitions for all classes).

2. Enter the desired attribute value in the *Value* field, and click **OK** to add your new row to the grid on the *Values* tab.

   Invalid combinations of cover type, structural stage and transition type will generate an error, and the new row will not be added. Additionally, the **Add Values** operation will not overwrite values for combinations you have already added to the *Values* grid, i.e., if you use the **Add Values** dialog to select a combination of attribute, cover type, structural stage and transition type that already exists on the *Values* tab, your new value will not be added unless you enable the *Overwrite existing* option on the **Add Values** dialog.

Continue until you have associated categorical attributes and values to each combination of cover type, structural stage and transition type you wish.



3. From the *Values* tab, you can also sort the entries in the *Values* grid. To do so, click on the **Sort** button on the *Values* tab to open the **Sort** dialog. You can sort by up to four fields, in either ascending or descending order. Click **OK** to return to the *Values* grid and your sorted list of calculated attributes.

4. You can also remove unwanted attributes by clicking anywhere on the row and clicking the **Delete** button. A dialog box will open requesting confirmation of the deletion. Click **OK** to delete the row and return to the *Values* tab.

5. When done, click **OK** on the **Categorical Attributes** dialog to save your changes to memory and close the dialog.

Note:
Valid category values on the *Definitions* tab that are not used on the *Values* tab will be lost when you click **OK** on the **Categorical Attributes** dialog. A message will display to notify users when this is going to occur. For example, if you have High, Medium and Low values defined on the *Definitions* tab, but you assign only Medium and Low values on the *Values* tab, the High category value on the *Definitions* tab will be removed when you click **OK** on the **Categorical Attributes** dialog.

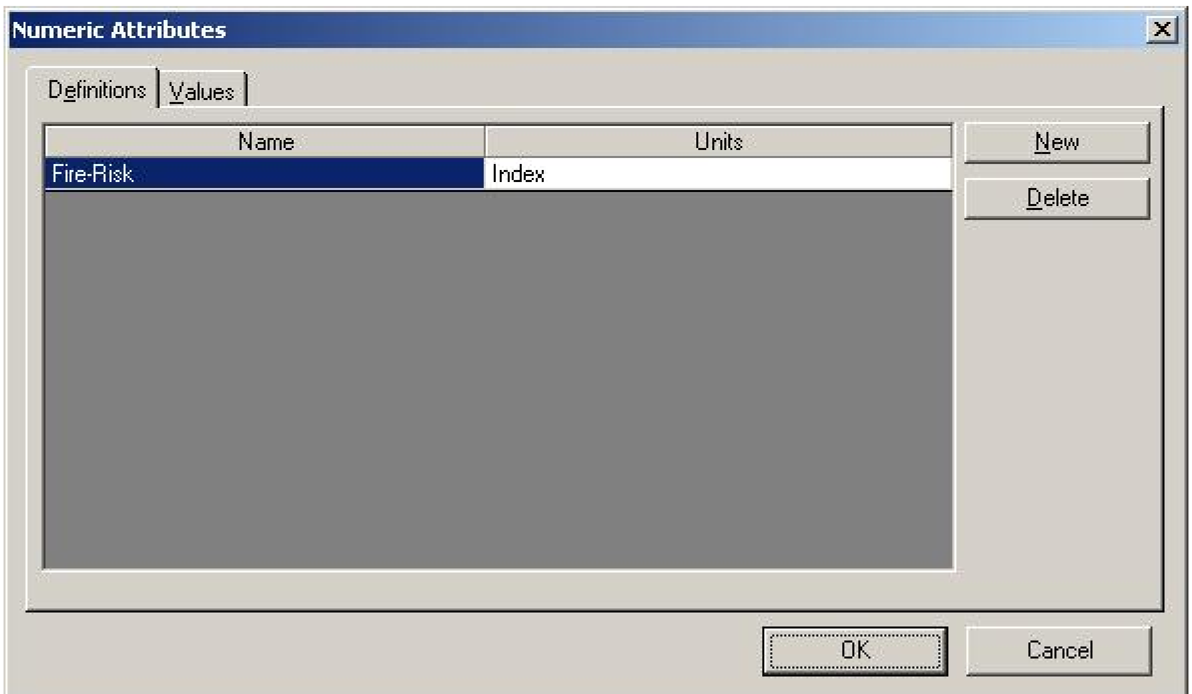
To save your categorical attribute settings to the active Project, select **Save** from the **File** menu.

Numeric Attributes

Numeric attributes are class-based numerical descriptors with units, e.g., 20 snags/acre.

To define numeric attributes:

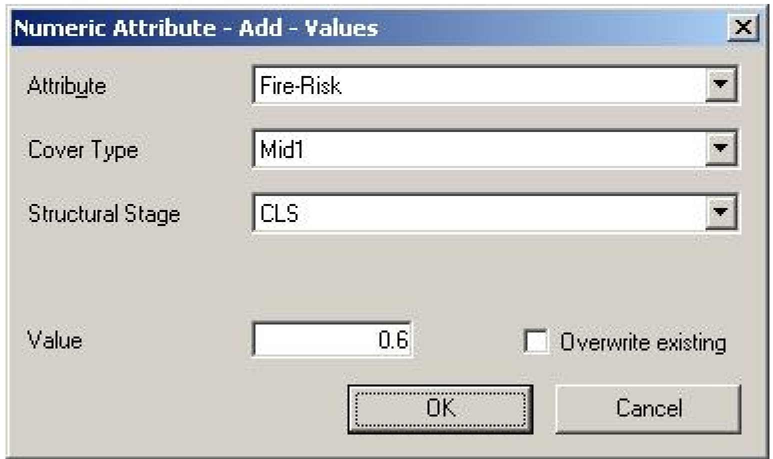
1. Open the Project for which you wish to define numeric attributes.
2. Under the **Run** menu, select **Settings** to open the **Run Settings** dialog. Select the *Options* tab. In the *Attributes* pane, click on the **Numeric** button. This action opens the **Numeric Attributes** dialog.



3. Define your numeric attributes using the *Definitions* tab. Click **New** to insert a row into the grid. Type in a *Name* and specify the *Units* for your first numeric attribute. Continue until you have defined all of your numeric attributes.
4. Click **OK** to return to the *Options* tab of the **Run Settings** dialog, or switch to the *Values* tab to continue setting your numeric attributes.

To specify numeric attribute values:

1. On the *Values* tab of the **Numeric Attributes** dialog, click **New** to open the **Add Values** dialog.

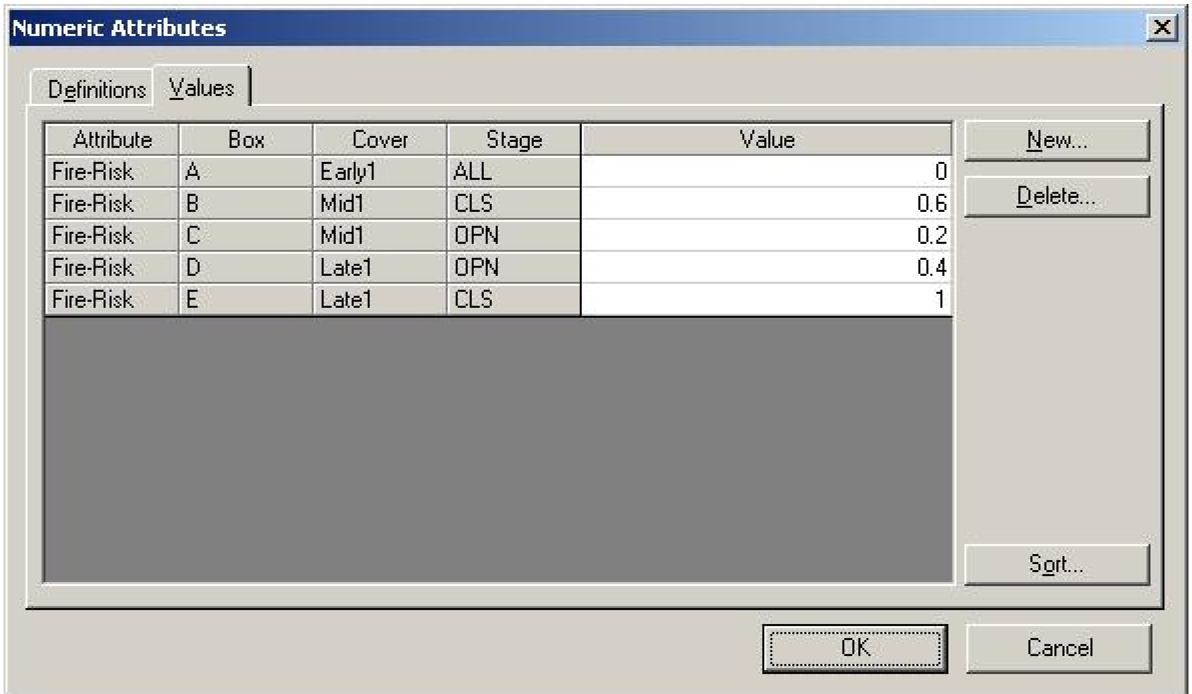


Use this dialog to select the unique combination of attribute, class characteristics and transition type to which you wish to apply an attribute value. The *Attribute* drop-down list contains all of the attributes specified on the *Definitions* tab; the drop-downs in the other fields contain the cover types, structural stages and transition types that have been defined for the active Project. The combination of cover type, structural stage and transition type that you choose must be a valid one for the open Project (check the **Probabilistic Transitions** screen - **Diagram** menu - to review transitions for all classes).

2. Enter the desired attribute value in the *Value* field, and click **OK** to add your new row to the grid on the *Values* tab.

   Invalid combinations of cover type, structural stage and transition type will generate an error, and the new row will not be added. Additionally, the **Add Values** operation will not overwrite values for combinations you have already added to the *Values* grid, i.e., if you use the **Add Values** dialog to select a combination of attribute, cover type, structural stage and transition type that already exists on the *Values* tab, your new value will not be added unless you enable the *Overwrite existing* option on the **Add Values** dialog.

   Continue until you have associated numeric attributes and values to each combination of cover type, structural stage and transition type you wish.



3. From the *Values* tab, you can also sort the entries in the *Values* grid. To do so, click on the **Sort** button on the *Values* tab to open the **Sort** dialog. You can sort by up to four fields, in either ascending or descending order. Click **OK** to return to the *Values* grid and your sorted list of numeric attributes.
4. You can also remove unwanted attributes by clicking anywhere on the row and clicking the **Delete** button. A dialog box will open requesting confirmation of the deletion. Click **OK** to delete the row and return to the *Values* tab.
5. When done, click **OK** on the **Numeric Attributes** dialog to save your changes to memory and close the dialog.

To save your numeric attribute settings to the active Project, select **Save** from the **File** menu.

Set Random Seed

A single model run may consist of many iterations or Monte Carlo simulations. VDDT uses a random seed (integer between 0 and 32,000) to initiate the selection of all its random numbers over the course of a run, which you can edit on the *Options* tab of the **Run Settings** dialog (**Run**|**Settings**).

By default, VDDT selects a different random seed each time you start a run; in this way, each time the model is run, the results are slightly different. However the user does have the option to fix the random seed for the start of each run. Two runs of the model, using the same random seed and identical project parameters, will give identical results. Use the **Resample** button to generate a new starting random number seed, or enter one of your own choosing.

Output Settings

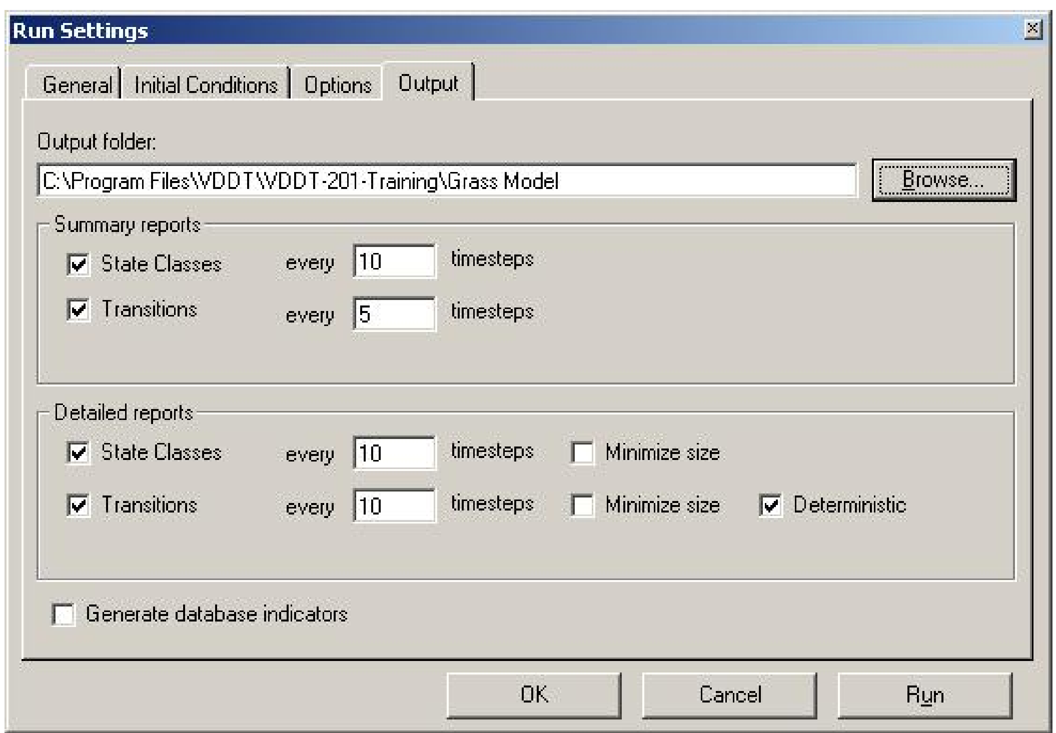
VDDT can produce information about runs that can be saved to file (*.CSV) and opened in a spreadsheet program such as Microsoft Excel. The model can produce summary and detailed output reports for classes and transitions.

VDDT can also send information about ending conditions, probabilistic transition means and output time to a series of tables in the active database.

Output Reports

Use the *Output* tab of the **Run Settings** dialog (**Run|Settings** menu choice) to specify where to save report files, what type of information to generate, and the level of detail for each report. These reporting preferences are saved as part of a Project's settings.

Note:
If no *Output folder* is specified on the *Output* tab, then output will by default be sent to {Application Path}\Output\{Project Name}. For example, if you have VDDT installed at C:\Program Files, then output for a project called "Grass Model" would go to: C:\Program Files\VDDT\Output\Grass Model.



Summary reports

Summary reports provide overview information about classes and transition groups that can be graphed to show trends over time. The reports are generated as text CSV files, which can then be opened directly in Excel for further analysis.

To generate a summary report:

1. Select the *Output* tab from the **Run Settings** dialog (**Run|Settings** menu choice), and use the ***Browse*** button to select the location of the folder into which you want to save your output. If no output folder is specified, then VDDT will create a folder called **Output** directly below the folder in which the active VDDT database is located and place the output files there. The file names for summary output are always ClassesSummary.csv and TransitionsSummary.csv.
2. In the *Summary reports* section of the screen, place a checkmark next to each type of output you wish to generate.
3. Specify the size of time interval, in terms of timesteps, to use for the output by entering the number of timesteps in the text box beside each selected report type. The smaller the time interval, the greater the number of records in the report.

The **State Classes** summary report contains **Area** information for each combination of state class (represented by structural stage (**SSAbbr** and **SSCode**) and cover type (**CTAbbr** and **CTCode**)), Monte Carlo simulation (**MC**) and **Timestep**. In the example below, which shows only the first 15 records, VDDT generated a record of the area in each state class, for each Monte Carlo simulation and timestep. This information can be used to graph area affected in each class over time.

MC	Timestep	ClassCode	CTCode	CTAbbr	SSCode	SSAbbr	Area
1	1	112012	2012	PPine	11	EAD	106175
1	1	122012	2012	PPine	12	MID	828165
1	1	132012	2012	PPine	13	LSD	849400
1	1	212012	2012	PPine	21	EAO	127410
1	1	222012	2012	PPine	22	MIO	106175
1	1	232012	2012	PPine	23	LSO	106175
1	2	112012	2012	PPine	11	EAD	106175
1	2	122012	2012	PPine	12	MID	785695
1	2	132012	2012	PPine	13	LSD	828165
1	2	212012	2012	PPine	21	EAO	191115
1	2	222012	2012	PPine	22	MIO	106175
1	2	232012	2012	PPine	23	LSO	106175
1	3	112012	2012	PPine	11	EAD	148645
1	3	122012	2012	PPine	12	MID	721990
1	3	132012	2012	PPine	13	LSD	849400

The **Transitions** summary report contains **Area** information for each combination of transition group (**TransGrpName** and **TransGrpCode**), Monte Carlo simulation (**MC**) and **Timestep**. In the example below, which shows the first 20 records of the report, VDDT generated area information for every Monte Carlo simulation, timestep, and defined transition group. This information can be used to graph the area affected by each transition group over time.

MC	Timestep	TransGrpC	TransGrpName	Area
1	1	1	Selective_Log	0
1	1	2	Commercial_Thin	0
1	1	3	Thin	0
1	1	4	Prescribed_Fire	0
1	1	5	Bark_Beetle	0
1	1	6	Severe_Wild_Fire	21235
1	1	7	Under_Burn	42470
1	1	8	Fuel_Buildup	21235
1	1	9	TSD	84940
1	1	10	Succession	0
1	2	1	Selective_Log	0
1	2	2	Commercial_Thin	0
1	2	3	Thin	0
1	2	4	Prescribed_Fire	0
1	2	5	Bark_Beetle	21235
1	2	6	Severe_Wild_Fire	63705
1	2	7	Under_Burn	0
1	2	8	Fuel_Buildup	0
1	2	9	TSD	63705
1	2	10	Succession	0

Detailed reports

Detailed reports track the fate of individual cells in the simulation, which provide a history of the state of each cell over time. Detailed reports can be used to look at the distribution of age and time since disturbance. As with Summary Reports, Detailed Reports are generated as text CSV files, which can then be opened directly in Excel for further analysis. Note that these Detailed reports can be very large, as they record output on a per cell basis; if the report exceeds 65,000 records in length, Excel will not be able to import it in its entirety (however such reports can still be imported into Access for analysis).

To generate a detailed report:

1. Select the *Output* tab from the **Run Settings** dialog (**Run|Settings** menu choice), and use the ***Browse*** button to select the location of the folder into which you want to save your output. By default, the file names for detailed output are always ClassesDetailed.csv and TransitionsDetailed.csv.
2. In the *Detailed reports* section of the screen, place a checkmark next to each type of output you wish to generate.
3. Specify the size of time interval, in terms of timesteps, to use for the output by entering the number of timesteps in the text box beside each

selected report type. The smaller the time interval, the greater the number of records in the report.

4. Select the **Minimize size** option if you wish to reduce the number of reported fields. For example, a minimized State Classes detailed report contains only 4 fields: MC, Timestep, ClassCode and Age.
5. For detailed transitions reports, you can also choose to exclude deterministic transitions from your report by clearing the **Deterministic** checkbox. This option is enabled by default.

A non-minimized **State Classes** detailed report contains a row of information for every combination of Monte Carlo simulation (**MC**), **Timestep** and cell (**Pixel**). Information that is recorded includes state class (**SS**), **Age, Area** and **TSD** (time since disturbance). In the example below, which shows only the first 10 records, VDDT generated information for every cell, for each combination of Monte Carlo simulation and timestep.

MC	Timestep	Pixel	ClassCode	CTCode	CTAbbr	SSCode	SSAbbr	Age	Area	TSD-Selective_Log	TSD-Commercial_Thin	TSD-Thin
1	1	1	112012	2012	PPine	11	EAD	25	212.35	2	19	5
1	1	2	112012	2012	PPine	11	EAD	31	212.35	11	5	13
1	1	3	112012	2012	PPine	11	EAD	36	212.35	10	3	2
1	1	4	112012	2012	PPine	11	EAD	36	212.35	11	9	23
1	1	5	112012	2012	PPine	11	EAD	3	212.35	14	3	2
1	1	6	122012	2012	PPine	12	MID	112	212.35	29	13	10
1	1	7	122012	2012	PPine	12	MID	43	212.35	4	18	7
1	1	8	122012	2012	PPine	12	MID	135	212.35	13	26	22
1	1	9	122012	2012	PPine	12	MID	103	212.35	24	2	22
1	1	10	122012	2012	PPine	12	MID	130	212.35	6	21	9

A non-minimized **Transitions** detailed report contains a row of information every time a cell is transitioned during the specified time interval. For each cell transition, information is generated to record the Monte Carlo simulation (**MC**), the **Timestep**, the cell (**Pixel**), the transition type that occurred (**TransType** and **TransTypeName**), the start state class of the cell (i.e., before transition), the end state class of the cell (i.e., after the transition), the **Age** of the cell before the transition occurred, the **Area** of the cell, and the **TSD** values of the cell prior to the transition.

Generate Database Indicators

When you run a simulation, VDDT generates certain information about it. You can write this information to a series of **Output*** tables in your active VDDT database by enabling the **Generate database indicators** option at the bottom of the *Output* tab (**Run|Settings**). After conducting your run, save your Project (**File|Save**) to write the indicators to the database. Information is written to the following three MS Access tables:

- OutputEndingConditions;
- OutputProbabilisticTransitionMean; and
- OutputTime.

Note:
Subsequent runs using the same project will overwrite your database

indicator output unless you disable the **Generate database indicators** option at the bottom of the *Output* tab. If you wish to keep the output from a particular run, the simplest way to do this is to make a copy of the Project that contains the output you wish to keep (**File|Save As**).

START MODEL

Once all decisions are made about general and initial conditions settings and options (see above), the model is ready to start the run.

To start the model:

1. Select **Start Model** from the **Run** menu, *OR*
2. Click the **Run** button on the **Run Settings** dialog box (**Run|Settings** menu choice).

When you start a run, the model will first check to ensure that general run settings and initial conditions are present, and that either a region has been selected or region sequencing has been defined.

GRAPH RESULTS

The easiest way to view the model results is to look at graphs. Once a run has been completed, there are two general types of graphs available in VDDT:

- bar graphs; and
- line graphs over time.

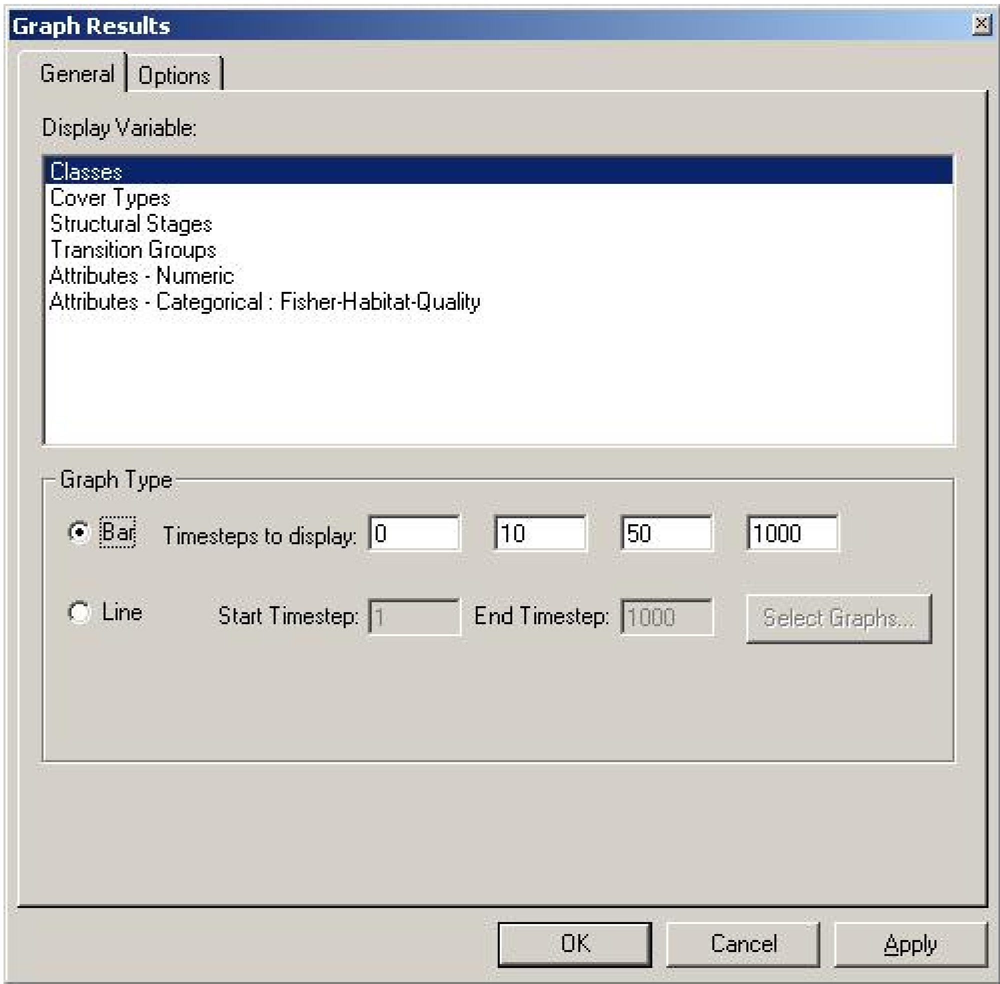
Changes in the distribution of classes, cover types, structural stages, or the occurrence of transitions can be viewed using either bar graphs or time graphs. Other bar graphs include categorical attributes and numeric attributes, while other time graphs include numeric attributes and calculated attributes. In all cases, VDDT will show up to four graphs at any time.

To generate a graph of run results:

1. Select the **Graph Results** option from the **Run** menu to open the **Graph Results** dialog.
2. On the *General* tab, select the variable (class, cover type, etc.) you wish to display, the type of graph (bar, line) you wish to generate, and the timesteps for which you wish to generate the graph.
3. On the **Options** tab, use the graphing options to specify how your graphs will display.
4. Click **Apply** to generate graphs without closing the **Graph Results** dialog. Click **OK** to close the dialog and return to VDDT's main window.

General Graph Settings

Use the *General* tab on the **Graph Results** dialog (**Run|Graph Results**) to select the variable (class, cover type, etc.) you wish to display, the type of graph (bar, line) you wish to generate, and the timesteps for which you wish to generate the graph.



Display Variable

This section of the *General* tab lists the variables available in the active Project for graphing. At a minimum, this list will include **Classes**, **Cover Types**, **Structural Stages** and **Transition Groups**. If attributes have been defined for the open Project, the list will also contain one or more attribute variables, e.g., **Attributes - Numeric, Attributes - Categorical,** and/or **Attributes - Calculated**. Attribute variables can only be graphed over time using **Line** graphs.

Graph Type

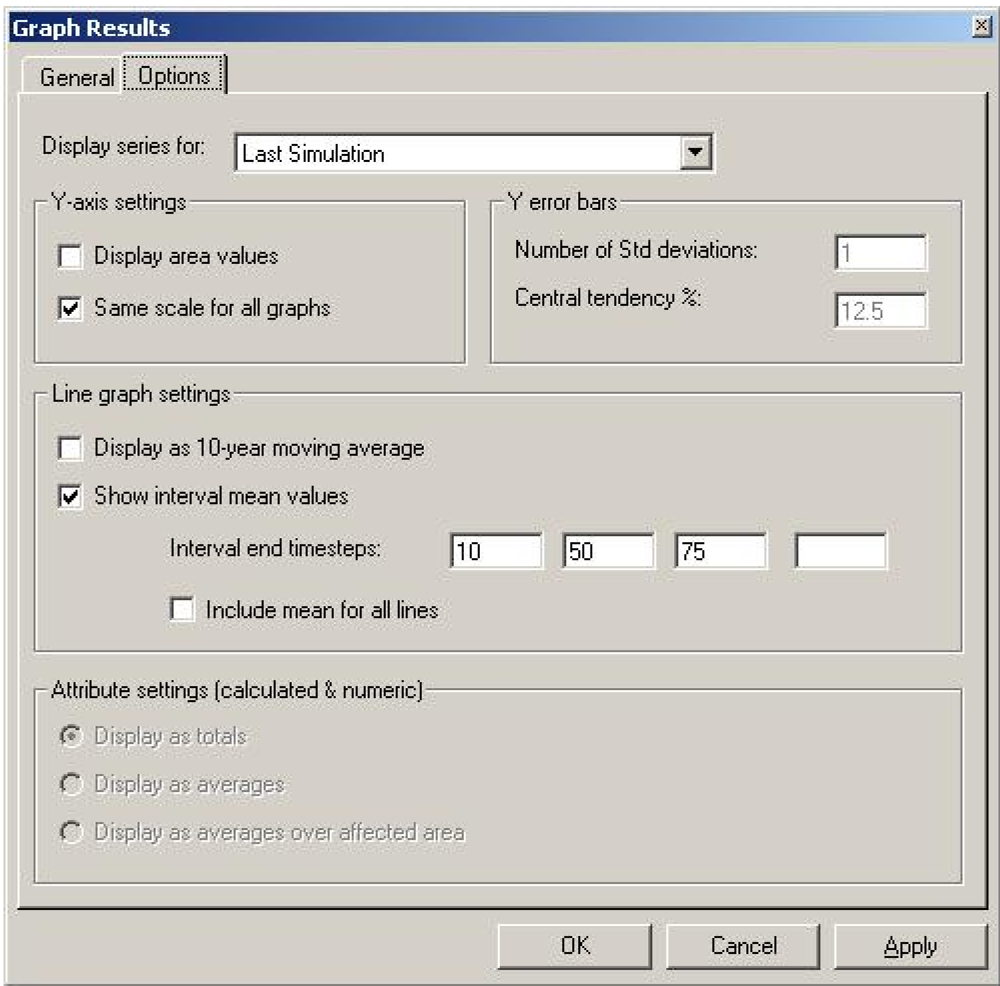
This section of the *General* tab allows users to select the type of graph and the timesteps over which to view the model output.

Bar graphs show the percentage of cells, or the area (see about *Graphing Options*, below), for the selected variable and specified timesteps. VDDT will graph all classes, cover types, structure stages or transition groups (depending upon which variable has been selected for display) that have been defined for the open Project.

Line graphs show the percentage of cells, or the area (see about *Graphing Options*, below), for the selected variable over time. VDDT will graph up to four classes, cover types, structural stages, transition groups, or attributes over time. If an attribute variable has been chosen for graphing, the **Line** graph type will automatically be selected.

Graphing Options

A number of options are available to users to help increase the flexibility of the graphic display. These options are all found on the *Options* tab of the **Graph Results** dialog (**Run|Graph Results**). They include: deciding whether single run or summary statistics will be shown in the graph; setting error bar limits; changing the variable display and scale for the y-axis; setting time intervals; and defining how attributes will be displayed.



Each of these options is described more fully in the topics that follow.

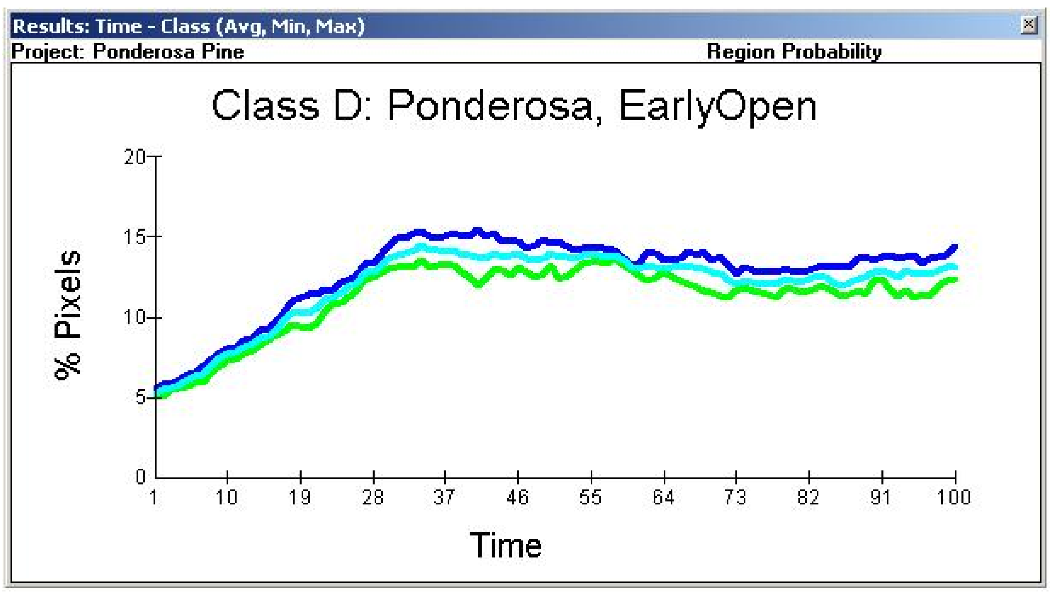
Graph Option: Display Series

When multiple Monte Carlo iterations are simulated, VDDT automatically creates some summary information about the run. Users can view this summary information as well as the results of just the last simulation. Choose the information series you wish to display by selecting it from the *Display series for* drop-down list.

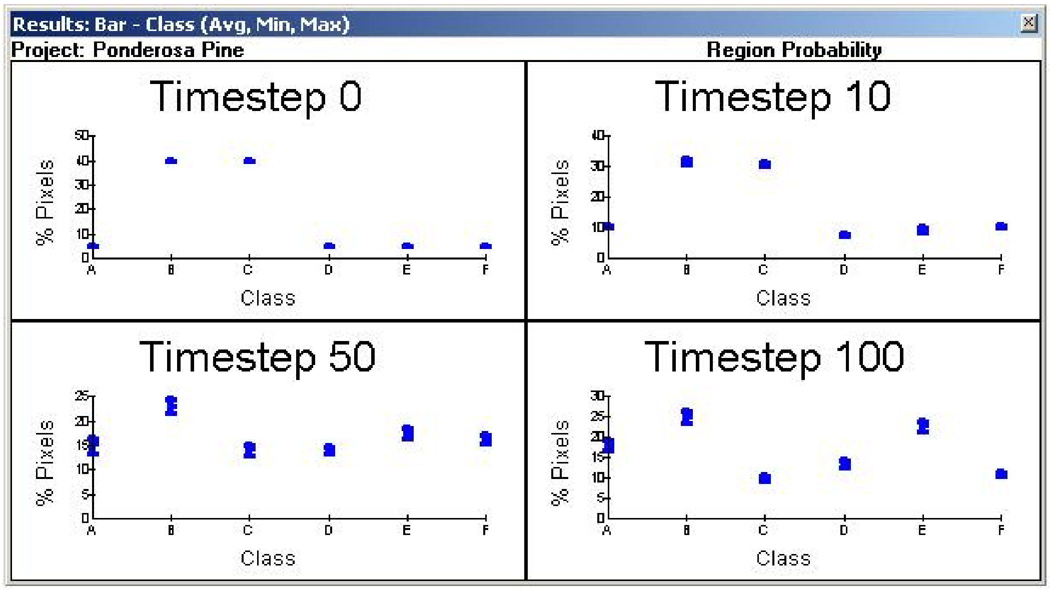
Type	Description
Last simulation	This option graphs the run results for the last simulation only, e.g., the 10th of 10 Monte Carlo simulations.

Average, minimum, maximum

Line graphs:	This shows a line for the average of the iterations, as well as for the maximum and minimum value over all iterations in the given year.



Bar graphs:	A point shows the average of the iterations, and a vertical line indicates the range of the values.



Average & standard deviation

When this series is selected for display, users will also need to specify the number of standard deviations to be shown (any number greater than 0). Enter this value in the *Number of std deviations* text box in the *Y error bars* section of the dialog.

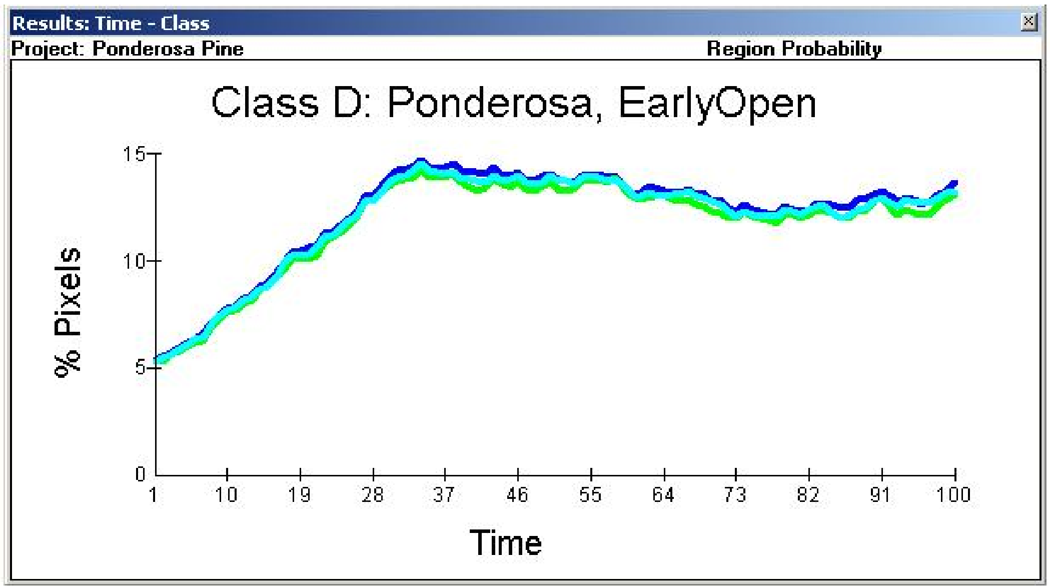
Type	Description
Line graphs:	This option shows three lines: • average • average + n standard deviations, and • average - n standard deviations (with a minimum value of 0).
Bar graphs:	A point shows the average of the iterations, and a vertical line extends from the average - n standard deviations (with a minimum value of 0) to the average + n standard deviations.

Average & central tendency

Showing the central tendency (ct) allows users another way of assessing the variability in their results. VDDT allows the user the flexibility to change the value of the central tendency. When the **Average & central tendency** series is selected for display, users will need to specify a percentage for the central tendency in the *Central tendency %* field of the *Y error bars* section of the dialog.

Type	Description
Line graphs:	This option shows three lines:

- average
- maximum value – ((1-ct)/2 * (max. value – min. value)), and
- minimum value – ((1-ct)/2 * (max. value – min. value))



The above example summary line graph shows a central tendency of 25% for the same data as graphed above for **Average, minimum, maximum**.

Bar graphs: A point shows the average of the iterations, and a vertical line extends from:

- maximum value – ((1-ct)/2 * (max. value – min. value)) to the
- minimum value – ((1-ct)/2 * (max. value – min. value))

Graph Option: Y-axis Settings

Enable the *Display area values* option to change the y-axis variable to display area rather than proportion of cells. The total area being used in the simulation is one of the initial conditions specified on the **Run|Settings|***Initial Conditions* tab.

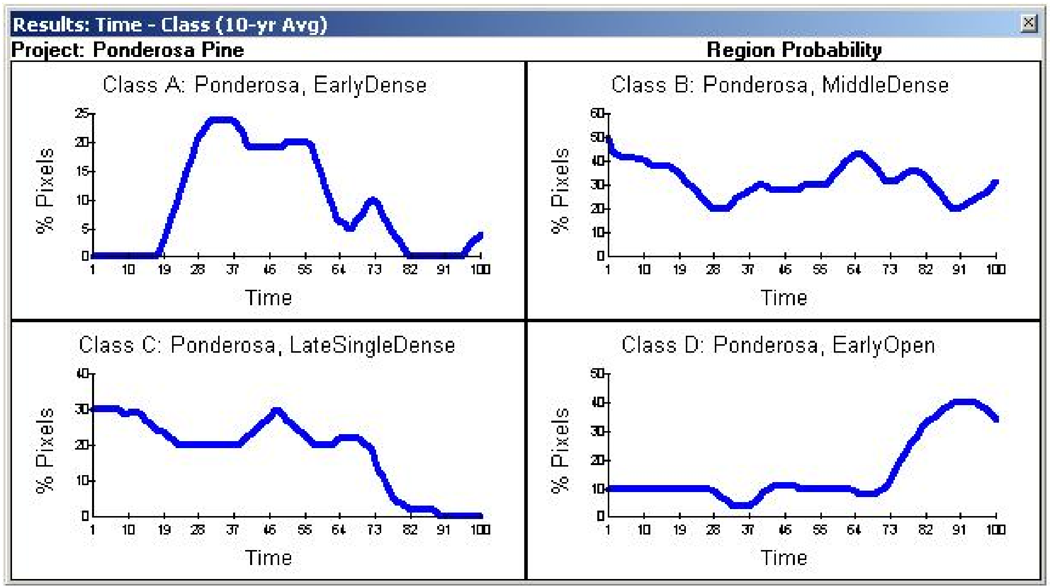
Generated graphs can either be displayed with the same y-axis values or independent y-axis values, depending on their data. The *Same scale for all graphs* option assigns the same values to the y-axes for all generated graphs. This option can be useful for comparative purposes.

Graph Option: Line Graph Settings

Display as 10-year moving average

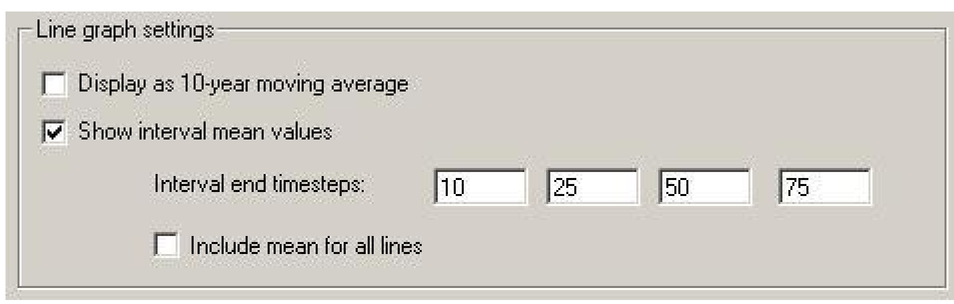
This option allows you to smooth out line graphs. You can graph the 10 year average with any data series selected from the *Display series for* drop-down list at the top of the *Options* tab (see above).

Each point on the line is calculated as the average value of the previous ten time steps, producing a smoothed line representing the variable over the selected time intervals.

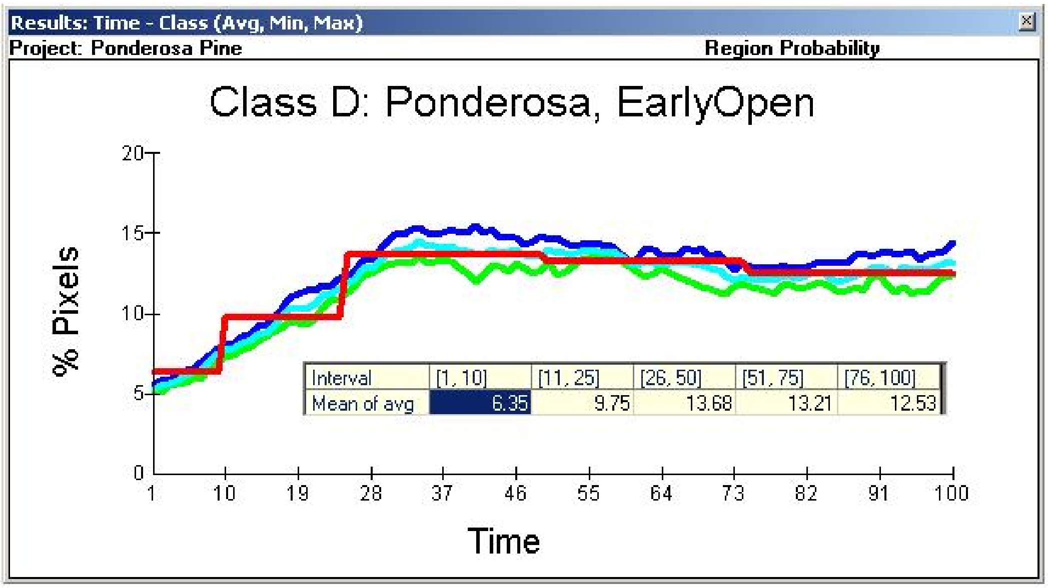


Show interval mean values

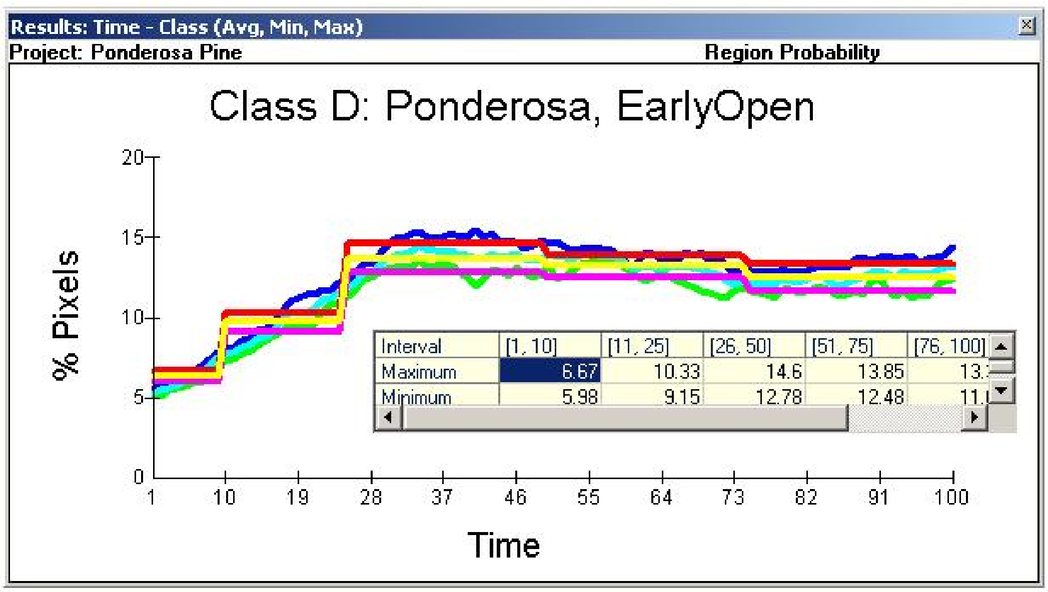
If you select this display option, you must specify the *Interval end timesteps* for each segment of the line graph. In the example below, the mean line will show five distinct segments, one for each of the intervals specified: start-10, 11-25, 26-50, 51-75, and 76-end.



A series of straight line segments representing the mean values of the variable over the selected time intervals is displayed. A table containing the values for the line segments will appear after the **Graph Results** dialog is closed and when the mouse pointer is moved over any one of the graph panes. This table can be set on any graph – to set the table on a particular graph, click once where you want the table to be. If you wish to see the values for a different graph, simply left-click on the graph of your choice and the table will move to that location. The values in the table will refresh to represent the new graph.

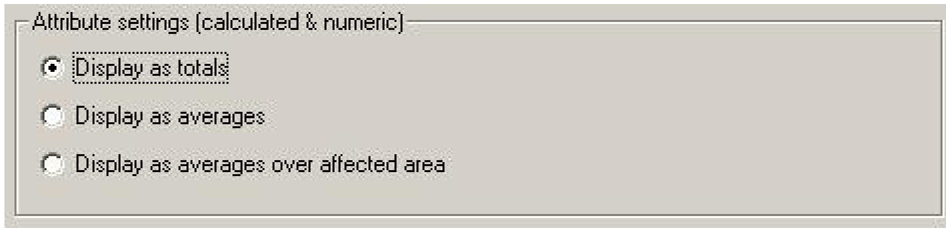


Turn on the **Include mean for all lines** option to display interval mean lines for all lines, i.e., maximum, average and minimum) as in the example below.



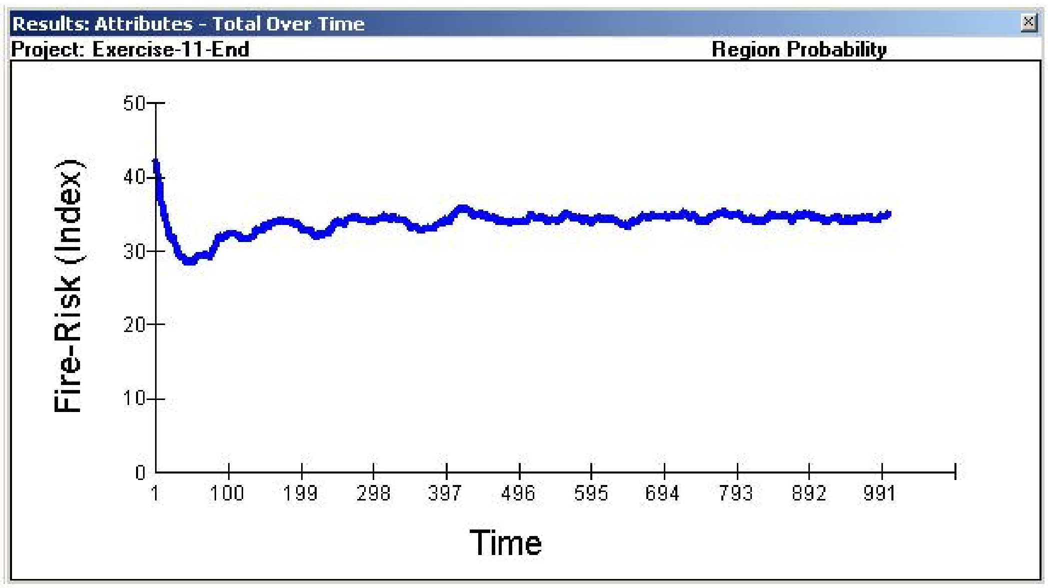
Graph Option: Attribute Settings

Numeric and calculated attribute values can be displayed as totals over time or as averages over time. Calculated attributes can also be displayed as averages over the affected area.



Display as totals

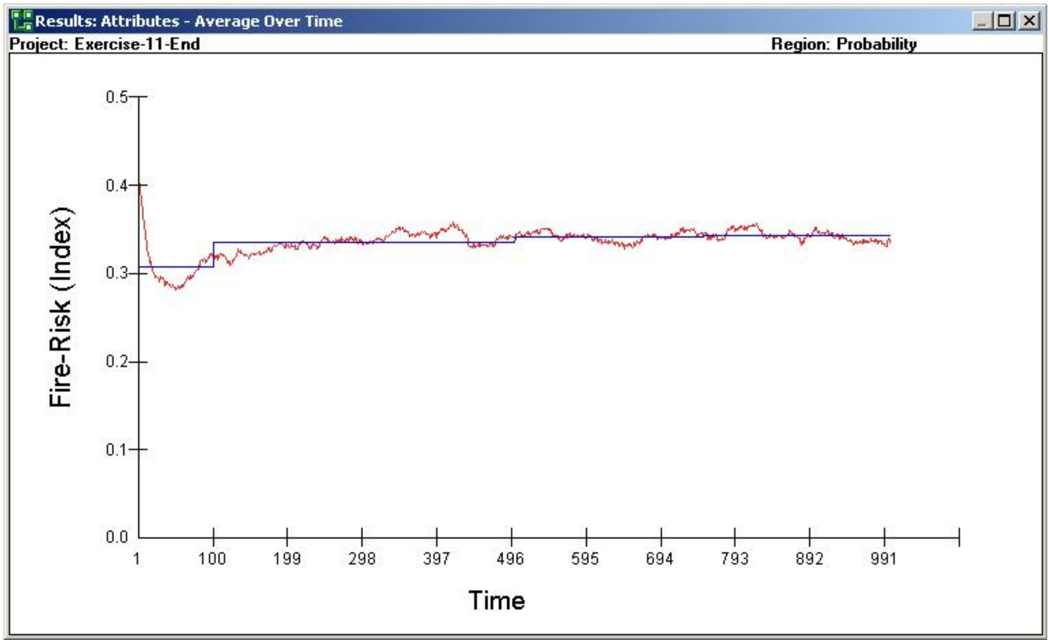
The *Display as totals* option graphs the sum of the attribute over all the cells in the landscape. These graphs are sensitive to the size of the landscape that is being simulated. Larger landscapes will have higher total values, all else being equal. This option is not affected by the number of cells being simulated.



In the above example graph for totals over time, the y-axis shows the sum of the value of the attribute for all cells.

Display as averages

The *Display as averages* option graphs the average value of the attribute in the landscape for each time interval defined in the *Line graph settings* option (see above).



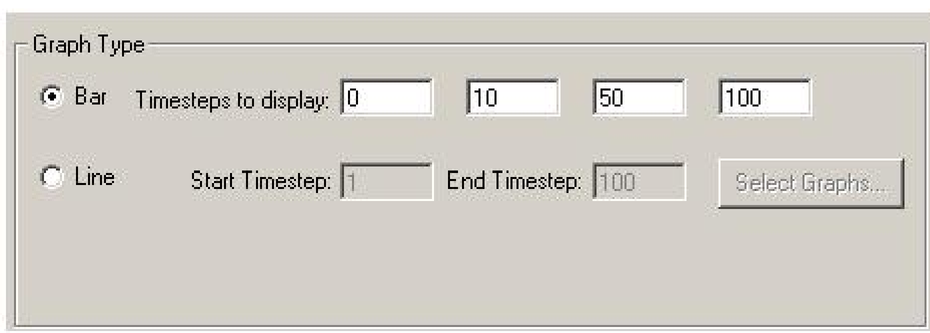
In the above example, the step-wise line represents the averages for three time intervals.

Display as averages over affected area

Averages over the affected area, i.e., the areas for which the attribute has been calculated, can also be graphed for calculated attributes, e.g., the average smoke emissions per unit area burned.

Generating Bar Graphs

Go to **Run|Graph Results** and select the *General* tab. In the *Graph Type* section of the dialog, click the **Bar** radio button to generate different types of bar graphs. Bar graphs can be generated for classes, cover types, structural stages and transition groups.

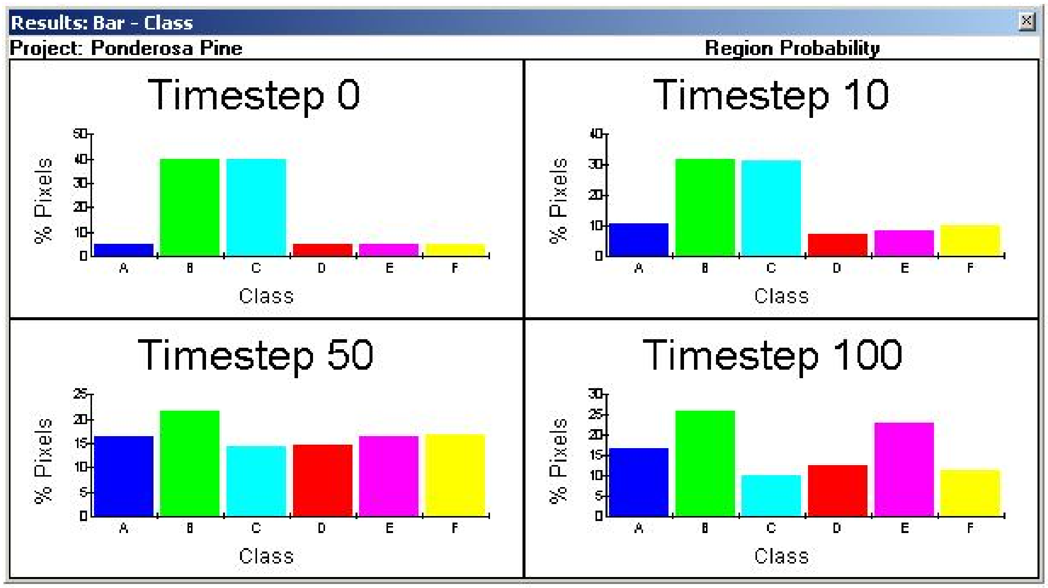


Enter up to 4 **Timesteps to display**; one graph will be generated for each timestep entered.

When you have selected the variable you wish to graph, and have finished setting your graphing options (*Options* tab), click **OK** on the **Graph Results** dialog to generate selected graphs and close the dialog. Click **Apply** to generate graphs and leave the dialog open. Click **Cancel** to abandon your graph selections and close the dialog.

Bar Graphs for Classes

Each bar in the graph represents a different class. Bars are labeled according to the letter of the class.

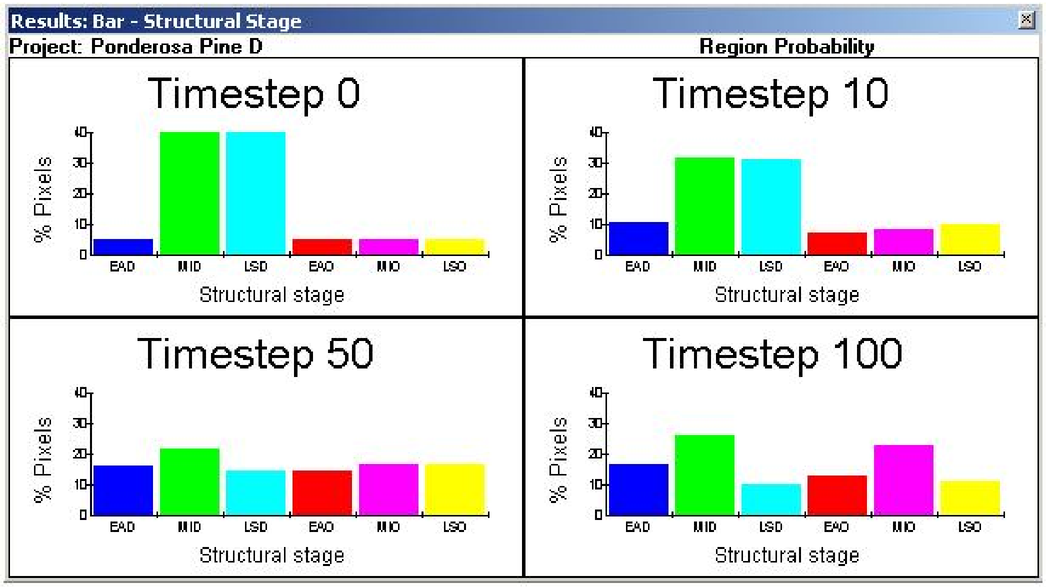


Bar Graphs for Cover Types

Each bar in the graph represents a different cover type, and may combine information from several classes. Bars are labeled with the cover type short code (such as Early1). Each of the shrub types will be given a separate bar if their cover types are different.

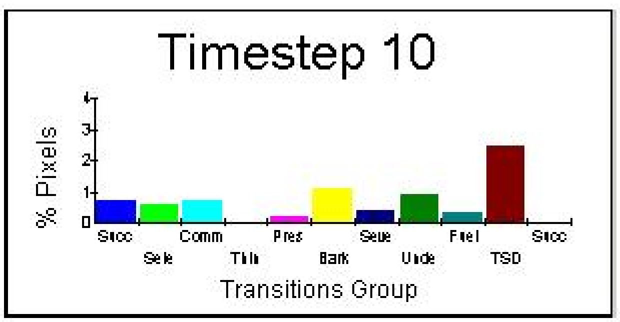
Bar Graphs for Structural Stages

Each bar represents a different structural stage, and may combine information from several cover types. Bars are labeled with the abbreviation of the structural stage.



Bar Graphs for Transition Groups

Each bar shows the proportion of cells disturbed by different groups of probabilistic transition agents, or by deterministic transition. The graph of year 0 will always be empty because no transitions can occur before the model starts its simulation. To avoid showing the empty graph, VDDT will show year 1 instead of year 0 (even if year 0 had been requested).



In the above example of one graph of results by transition, the y-axis shows the percent of cells affected by each transition group.

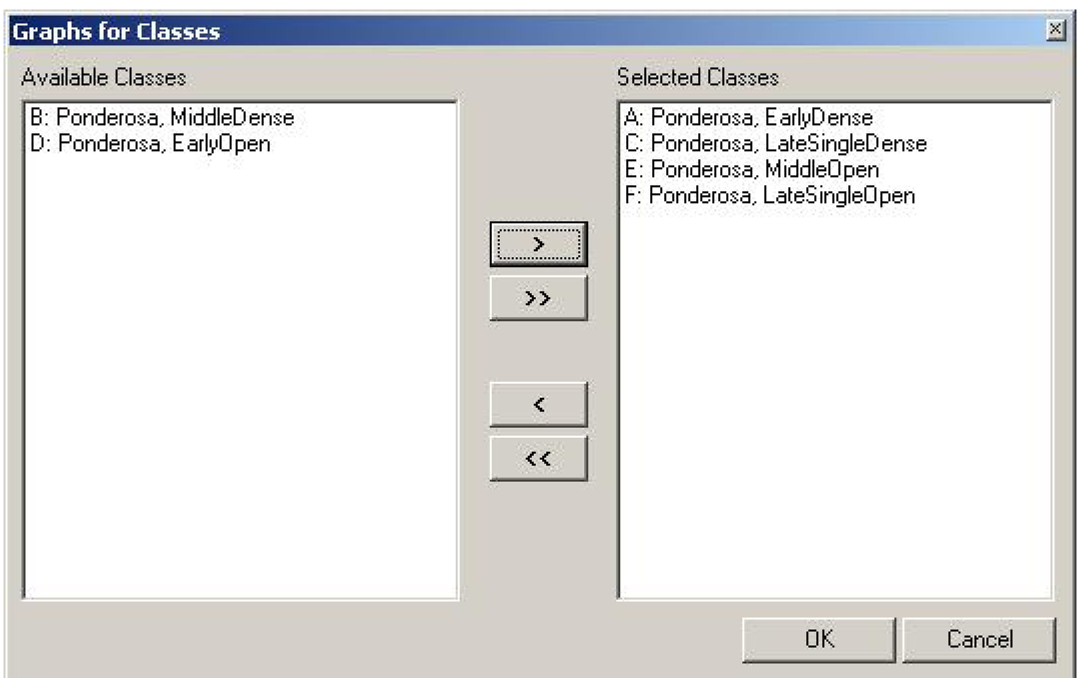
Note:
In some cases, a probabilistic transition may be part of more than one transition group. For example, a transition defined as an "underburn and thin" may be assigned to the "thinning" group, the "fire" group and the "combined" group. If a cell is disturbed by a transition of this type, the cell will appear as affected in each of the three transition groups.

Generating Line Graphs Over Time

Go to **Run|Graph Results** and select the *General* tab. In the *Graph Type* section of the screen, click the **Line** radio button to generate different types of line graphs over time. Line graphs can be generated for classes, cover types, structural stages, transition groups and attributes.

Enter **Start Timestep** and **End Timestep** values to define the interval over which to generate the graphs. The **End Timestep** value cannot be greater than the **Number of timesteps** value specified in **Run|Settings|***General* tab.

The first time you choose to generate line graphs for a particular variable, a **Graphs** dialog will automatically appear enabling you to specify up to four classes, cover types, structural stages, transition groups or attributes to graph. Select the desired items (Ctrl-click to select multiple items) from the list of available items in the left-hand pane of the dialog, and move them into the right-hand pane using the arrow keys. Click **OK** when done. If more than four items are selected, only the first four will be used to generate graphs. In the example of the **Graphs for Classes** dialog below, Classes A, C, E and F have been selected for graphing.

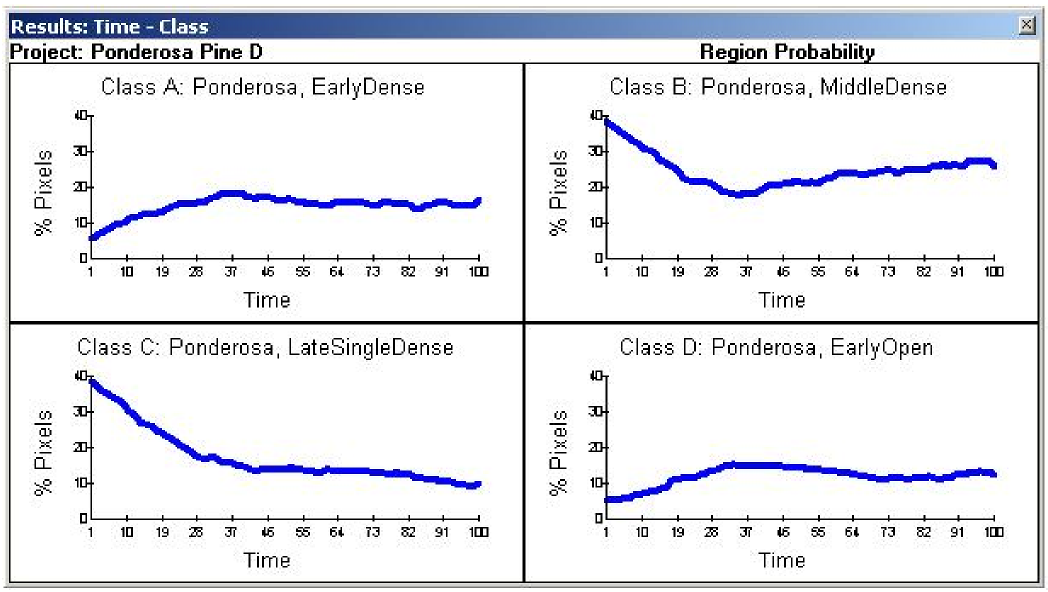


VDDT will remember which items you chose to graph until you run the next simulation, so the **Graphs** dialog will not appear for subsequent generations of line graphs based on the same simulation. If you wish to change the selection of graphs to be generated, click on the **Select Graphs** button; this action will open the **Graphs** dialog, allowing you to edit your choices.

When done with your selections, click **OK** on the **Graph Results** dialog to generate selected graphs and close the dialog. Click **Apply** to generate graphs and leave the dialog open. Click **Cancel** to abandon your graph selections and close the dialog.

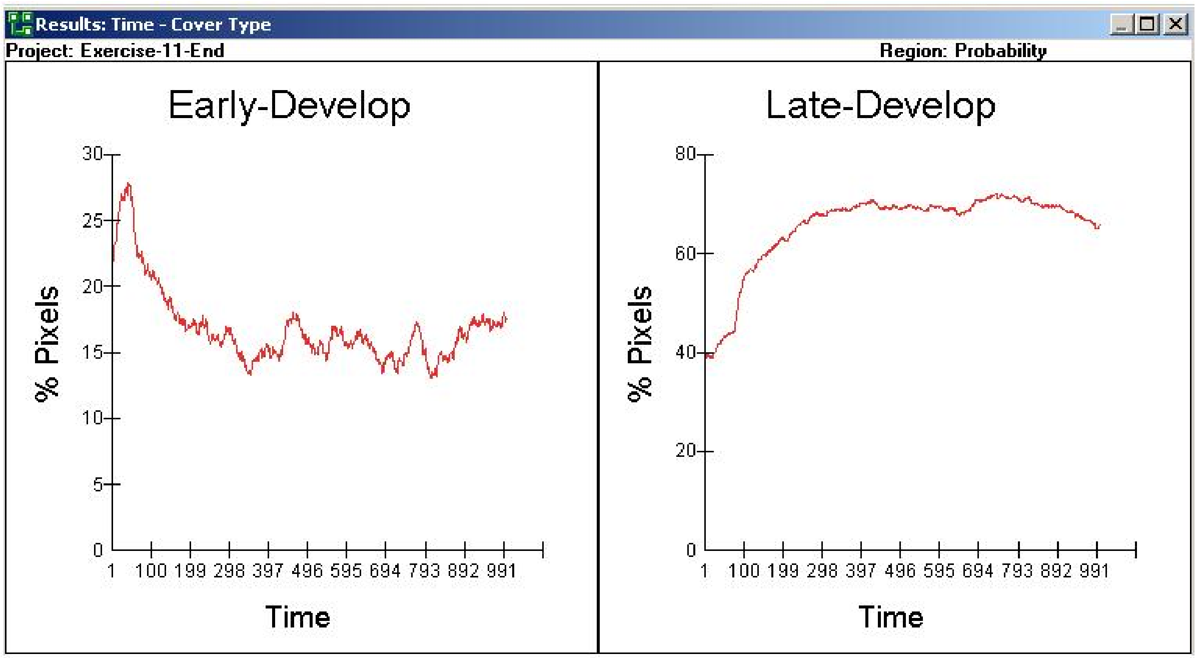
Time Graphs for Classes

This type of graph allows users to view the proportion of cells, or the area, in any given class over time. Each graph represents one class that has been defined for the active Project.



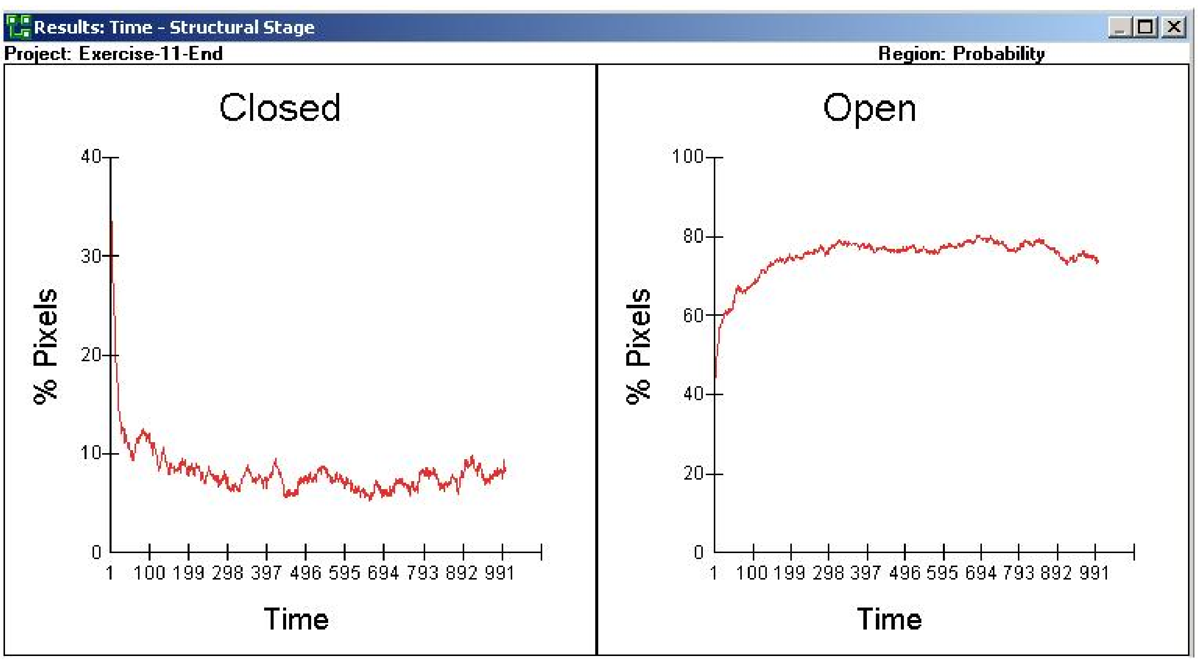
Time Graphs for Cover Types

Cover type line graphs show the proportion of cells, or the area, for any given cover type over time. The graphs will resemble those generated for **Classses** (above), except each graph will represent a different cover type.



Time Graphs for Structural Stages

These graphs show the proportion of cells, or the area, in any given structural stage over time. The graphs will resemble those generated by the **Class** option (above), except each graph will represent a different structural stage.

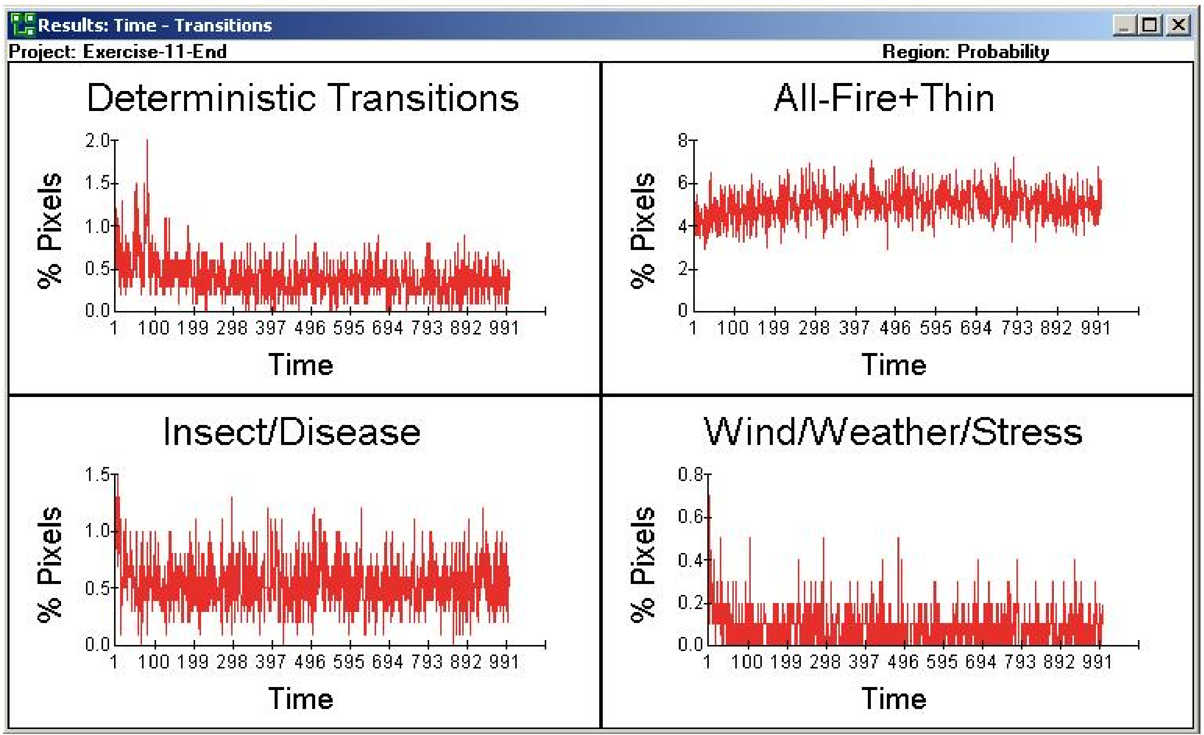


Time Graphs for Transition Groups

Transition group line graphs show the percentage of cells, or the area, disturbed in each time step. The graphs will resemble those generated by the

Class option (above), except each graph will represent a different structural stage.

A **Graphs for Transition Groups** dialog will appear with a list of all the transition groups, including deterministic transition. Only those probabilistic transitions which have occurred at least once during the simulation period can be selected.



Choose to graph *All Transitions*, *Deterministic Transitions*, and/or *Probabilistic Transitions* by placing checkmarks in the appropriate boxes at the top of the dialog. Additionally, you can graph individual probabilistic transitions by selecting one or more from the left-hand pane of the dialog and moving them into the right-hand pane using the arrow keys in the center. If more than four items are chosen on this dialog, including the 3 checkbox items at the top of the dialog, only the first four will be shown.

The graphs show the actual percentage of cells, or the area, disturbed in each time step. The pattern shown in the results depends in part on the number of cells being simulated. The model is stochastic, which means that the line will not be smooth. Larger numbers of cells, however, mean that there is a higher probability of some cell being disturbed, and the line may become smoother (i.e., the variation between years decreases). Also, the larger numbers of cells means that the peaks shown in the graphs may be less conspicuous. If a cell is disturbed when few cells are being simulated, it represents a large percentage of the total. For example, if 100 cells are simulated, each cell is 1% of the total. When 1000 cells are simulated, each cell is 0.1% of the total.

Generating Attributes Graphs

Attributes can be graphed as line graphs over time, and only if categorical (level/group), numeric and/or calculated attributes have been assigned to various classes (either by loading an attribute file or by assigning values within VDDT).

Time Graphs for Categorical Attributes

These graphs show the proportion of cells in a specific value of a single category-type attribute. From the **Run** menu, select **Graph Results**. On the *General* tab of the **Graph Results** dialog, select **Attributes – Categorical**. A dialog box will appear with all the values that have been defined for the selected categorical attribute. Choose up to four values from this list. If more than four are selected, only the first four will be graphed. Each graph represents a different attribute value.

Time Graphs for Numeric Attributes

For Projects that have numeric attributes defined, select **Attributes – Numeric** on the *General* tab of the **Graph Results** dialog. A dialog box will appear that lists all of the numeric attributes that have been defined for the active Project. Choose up to four values from this list. If more than four are selected, only the first four will be graphed. Each graph represents a different numeric attribute.

You can also choose to display numeric attributes as either totals or as averages (see about *Attribute settings* on the *Options* tab of the **Graph Results** dialog).

Time Graphs for Calculated Attributes

Select **Attributes – Calculated** from the *Display Variable* section of the *General* tab. A dialog box will appear that lists all of the calculated attributes that have been defined for the active Project. Choose up to four values from this list. If more than four are selected, only the first four will be graphed. Each graph represents a different calculated attribute.

You can also choose to display calculated attributes as totals, averages or averages over affected area (see about *Attribute settings* on the *Options* tab of the **Graph Results** dialog).

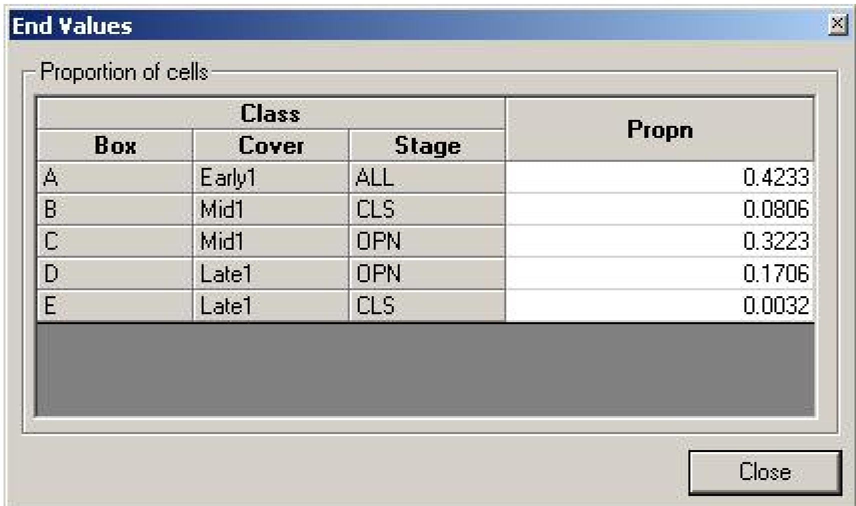
> **Note:**
> For these attributes, it is important that the values used in the calculation are based on the same area units as the area defined on the *Initial Conditions* tab of the **Run Settings** dialog (**Run|Settings** menu choice).

FINAL CONDITIONS

After a run has been completed, you can view the ending conditions without having to get **End Values** when editing initial conditions (**Run|Settings**|*Initial Conditions* tab).

To view ending conditions:

1. Select **Final Conditions** from the **Run** menu.
2. The **Final Conditions** dialog will open, showing the proportion of cells in each class at the end of the run.



Class			Propn
Box	Cover	Stage	
A	Early1	ALL	0.4233
B	Mid1	CLS	0.0806
C	Mid1	OPN	0.3223
D	Late1	OPN	0.1706
E	Late1	CLS	0.0032

For runs with multiple Monte Carlo simulations, **Run|Final Conditions** displays the average of the final timestep for all Monte Carlos.

BATCH RUN

Users can run simulations and generate output for multiple projects simultaneously using the **Batch Run** feature under the **Run** menu. Output and database indicators are generated based on the output settings defined for each project on the *Output* tab of the **Run Settings** dialog (**Run|Settings** menu choice).

To start a batch run:

1. Select **Batch Run** from the **Run** menu. This action opens the **Select Projects to Batch Run** dialog. Note that if you have a project on the screen that contains unsaved changes, you will be prompted to save them because the batch run process will close your project.
2. Highlight the projects you wish to run from the list of *Available Projects*, and use the arrows in the center of the dialog to move your choices to the *Selected Projects* pane. The single-headed arrow will move only the selected projects to the opposite pane; the double-headed arrow will move all available projects to the opposite pane.
3. Click **OK** to conduct the batch run, or **Cancel** to abort the run and close the dialog.

For projects in the batch run that have no output reports specified in their output settings, VDDT will generate two summary reports by default:

ClassesSummary.csv and TransitionsSummary.csv. These files will be saved to the location specified in each project's output settings. If no location is specified, VDDT will automatically create a folder called **Output** directly below the folder containing the active VDDT database. VDDT will then create a further subfolder under the **Output** folder for each batch run, naming the folder according to the project name.

Note:
When a location for output is specified for a project on the *Output* tab (**Run|Settings**), VDDT will send the output generated by a batch run to that location. If this path is the same for two (or more) of the projects included in the batch run, the output from the first project to be run will be overwritten by the output from the next run. There is no overwrite warning. To ensure that output isn't overwritten during a batch run, review your output paths to be sure there is no duplication, or simply delete the location information. When there is no location path on the *Output* tab, VDDT will use the default location (C:\Program Files\VDDT\Output) which includes a folder for each project in the batch run.

Conducting Batch Runs from the Command Line

You can conduct batch runs outside of the VDDT interface from the DOS command prompt. When running batches this way, all projects in the specified database will be included in the run.

To conduct a batch run from the command line:

1. Click on the **Start** button and select **Run**; type **cmd** in the *Open* text box.

2. This action will open a DOS window on your screen. Change to the directory where the VDDT application is located on your computer by typing **cd** followed by the path, e.g.,:

   cd C:\Program Files\VDDT

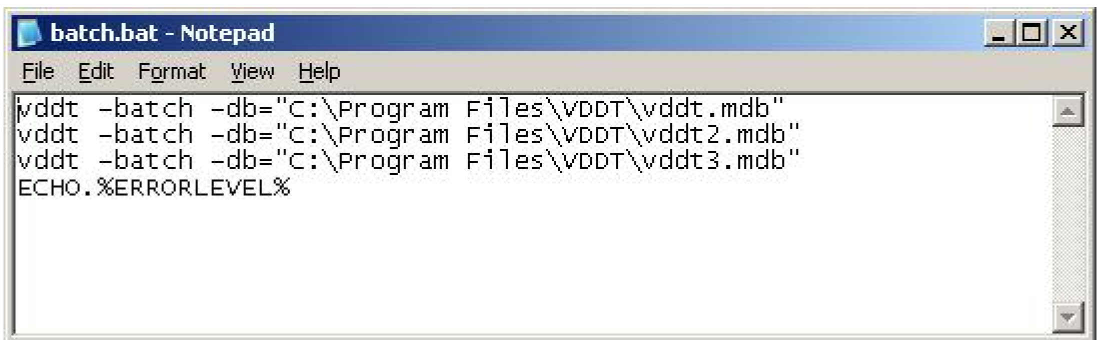
3. Click **Enter** to move to the selected directory. To begin your batch run, type

   vddt -batch -db="filename"

where

- **vddt** is the name of the executable file for the VDDT application
- **-batch** instructs VDDT to launch minimized, and to run thru all the projects in the specified database
- **-db="filename"** allows you to specify the VDDT database file that contains the projects you want to batch run; double quote delimiters are required for filenames that contain space characters in the path

You can also conduct simultaneous batch runs on multiple databases from the DOS command prompt. To do this, you need to create a batch (*.bat) file containing the locations and names of all databases to be included in the run. The following example shows a simple batch file specifying 3 databases (vddt.mdb, vddt2,mdb and vddt3.mdb) and an instruction at the end to display the exit code (see below).



To conduct a batch run on multiple databases from the command line:

1. Create a batch file (*.bat) in a text editor such as Notepad, using the syntax shown in the example above.
2. With the DOS window open, change to the directory that contains your batch file by typing **cd** followed by the path.
3. Click **Enter** to switch to the new directory and type the name of the batch file you wish to use, e.g., **batch.bat**
4. VDDT will launch minimized and conduct the batch run. When the run is complete, the application will return an exit code in the DOS window. The current values for exit codes are as follows:
   - 0 = Success
   - 1 = Database filename unrecognized or cannot be opened.
   - 2 = Command line batch mode (-batch) requires a valid database filename be specified (-db=filename).

TROUBLE SHOOTING

Trouble Shooting

There are generally three types of problems that are encountered by users of VDDT.

1. Those resulting from edits made directly to the input files, i.e., outside of VDDT.

   This is the most common type of problem, simply because it is difficult to manually produce these complex files error-free. While it is possible to edit the ASCII files directly, it is not encouraged.

2. Those resulting from changing some files and not others.

   These problems occur when, for example, PVT files have been modified without also changing all corresponding scenario files or when TXT files are changed after having created PVT and scenario files. While avoiding some problems of this sort is difficult, using care when modifying files will ensure that these problems are kept to a minimum.

Solutions for problems of each of these three categories are given in this section, organized by problem area (not category).

Problems with the Transition Pathway Diagrams

A class does not show up in the diagram.

The input file may contain two classes with the same cover type and structural stage (and a warning would have occurred when the files were read). Select **Edit Class Cover and Stage** from the **Diagram** menu, and enter the letter of the missing class. The cover type and structural stage of the missing class will appear and can be edited. Remember to check all pathways *to* either of the duplicate classes to make sure that they go to the right class.

If there is no duplication of a specific combination of cover type and structural stage, try re-ordering some of the classes in the input file.

If a location file is being used, ensure that the missing class occurs in the location file, and that it is in a different position than other classes.

Some cover types are listed as numbers (or letters) in the diagram.

Cover types have abbreviations which are found in the external file COVERC.TXT. These abbreviations show up as the cover type identifier in the box describing the class. Cover types without defined abbreviations show up as numbers. The displayed label format (as numbers or letters) does not affect how any part of the program functions since it only uses the numbers. Note, however, that any cover types that are not in the COVERC.TXT or COVER.TXT files will not show up in any of the graphs by cover type. This problem usually results from loading the wrong set of text definition files.

To change the display from numbers to letters, add the cover type number to the file COVERC.TXT with a short (3-5 letter) code. Follow the format currently in the file. The full name of the cover type should also be added to the file COVER.TXT. Then, reload the cover type files (**File|Import|Definitions|Cover types**).

Only the lines to/from one class are shown.

The right mouse button was clicked on one of the boxes. To redraw the previously shown pathways, either resize the dialog box or right-click anywhere on the pathway diagram and select **Show All Pathways** from the context-sensitive menu.

Pathways seem to go off the dialog box (usually on the left side).

The number of pathways to or from a class has exceeded program limitations. If fewer pathways are drawn (by right-clicking on a selected class and choosing **Show Class Pathways**), the lines will likely all be drawn properly. The program limitation on drawing the lines does not affect any other program functions (i.e., the information is all retained and can be edited and saved properly).

Some classes have no succession pathways from or to them.

Only succession pathways which move from one class to another are drawn. Therefore, those classes which are an endpoint of succession (i.e., classes that go to themselves through succession) will not have any succession pathway emerging from them. Some classes are only reached via a probabilistic transition and have no deterministic transition pathways to them.

Some pathways are not drawn in the diagram when they are in the files.

Check to see what pathways have been requested for drawing (label in the upper left corner of the diagram). If the label specifies "No 0 Probabilities", then the pathways have not been drawn because no probabilities have been defined for that pathway in that management region. Either request that all probabilities be drawn, select a different management region, or enter a probability. Note that if no management region has been chosen (the label in the **Status** window is blank), the model is drawing the pathways for Region

1. If one of the boxes is yellow, the pathways are being drawn only to and from that one class. To see other pathways, right-click on a different class and select **Show Class Pathways** from the context-sensitive menu. To see all pathways, resize the dialog box or right-click anywhere on the pathway diagram and select **Show All Pathways** from the context-sensitive menu.

Also check to see if the label which specifies what pathways are being shown is covering some of them. An easy way to do this is to maximize the diagram window and look again at the pathways.

Classes switch places when the succession pathway is changed.

By default, VDDT draws the diagrams based on the defined succession pathways. When these are changed, the arrangement of the classes may also change. Class locations can be changed using the **Set Locations** option under the **Diagram** menu.

Problems with Pathways

The disturbance name is "UnknownCode."

The disturbance is not listed in the file DISTCODE.TXT, and will not occur.

Users may add the numerical code (a four-digit number between 0001 and 9999), the transition groups to which it belongs (see DISTGRP.TXT) and the name of the transition (with no spaces in the name) to DISTCODE.TXT. Then, reload the disturbance files (**File**|**Import**|**Definitions**|**Disturbances**).

> **Note:**
> Note that if the final file is to be used with the CRB Assessment process, new numbers should not be added without checking with Don Long at the USFS Fire Lab in Missoula, MT.

The destination class is @.

The particular cover type-structural stage combination listed as the destination for this disturbance does not exist in the Project. Change the @ to the letter of the actual destination.

This error usually occurs when the cover type or structural stage of the destination class was edited.

The destination class is some letter which is not in the diagram.

The cover type and structural stage listed as the destination for this disturbance were both set to zero in the input file. Change the class name (in the pathways window) to the letter of the actual destination.

During deterministic transition, a class goes to itself.

This could occur for two reasons:

1. The class was an "endpoint" and it would normally go nowhere else in the absence of any probabilistic transitions. The model needs some value and so makes the class go to itself after several hundred years.
2. The cover type and structural stage listed in the input file as the destination for deterministic succession does not exist in the Project. By default, the program warns the users when the files are read in and changes the destination to be itself (but does not change the number of years or the age). To fix this, change the destination class.

Blank lines occur in the list of disturbances from or to a box.

The blank lines do not affect the functionality of the program. They correspond to probabilistic transitions that were deleted during this VDDT session. When the Project is saved and re-loaded, the blank lines will be gone.

Changes made in the Class Properties dialog were forgotten.

Three possible causes exist:

1. The **Close** or **Cancel** button was used instead of the **OK** or **Save** button.

   Enter the changes again, and click **OK** to save the changes.
2. Changes were not saved when switching to the "To" (or "From") dialog box.

   Enter the changes again and click **OK** to save and exit or, if going to the "To" (or "From") dialog box, reply **Yes** to saving the changes.
3. The files were not saved in the previous VDDT session.

   Save the Project before exiting or closing VDDT.

Problems with Initial Conditions, Viewing Attributes, or Viewing Results

All cells started in one class.

Check the *Initial Conditions* tab (**Run|Settings**). The proportion of cells in each class should be less than one. If this dialog box shows that more than one class should have values, click **Reset** and then **Normalize** to make sure that all values are less than one, and that they add up to one.

The results show the initial distribution is uneven but cells were supposed to be evenly distributed.

Each class can only be assigned an integer number of cells. If the proportion of cells times the number of cells does not equal an integer number, the model will approximate it by giving some classes slightly fewer cells and some classes slightly more. If this is of concern, increase the number of cells to a multiple of the number of classes.

In the graphs over time, some transition types cannot be selected.

The program will only allow the user to select transition types which have occurred at least once during the simulation. If for example, pathogens were present but did not occur, fire was present and did occur, and insects were not present (no probabilities had been defined), fire would be the only disturbance that could be selected to be viewed over time.

In the transitions bar graphs, the bars do not add to 100 percent.

The transitions bar graphs show the percent of pixels that were *affected* in any year, by either probabilistic or deterministic transition. Some cells will not have been disturbed and will not have aged enough to move to another class (i.e., will not go through deterministic transition). Thus, the sum of the percent of cells affected will not add to one.

In the transitions bar graphs, the bars add to more than 100 percent.

This is a relatively rare occurrence, and it is not an error. This can occur because some probabilistic transitions can belong to more than one transition group. A cell that was disturbed will be accounted for in each group of which it is part. For example, a cell that is disturbed by a transition type that is 'fire and bark beetles' will appear in three different bars: fire, insects, and combination. When disturbance levels are high, and a large number of combination disturbances occur, the sum of the percentages recorded by the bars may be greater than 100.

The probabilistic transition is not occurring.

This error can occur for a number of reasons.

1. The age range for the probabilistic transition is outside the age range of the class. To fix this, change the age for which the transition probability is valid (see about *Class Properties* under the **Diagram** menu). To prevent this problem from occurring, ensure that VDDT changes the valid ages of the probability when the age of the class is changed.
2. A transition group to which this probabilistic transition belongs has been disabled. To fix this, re-enable the transition group (see about *Optional Run Settings* under the **Run** menu).
3. The multiplier for this transition type or group is 0. To fix this, turn off the multipliers or change the multiplier to a number greater than 0 (see about *Probability Multipliers*).
4. Transitions in the time-since-disturbance group are occurring regularly. Either turn off the time-since-disturbance feature, or change the number of years.

None of the attributes are a valid view or printing option.

The types of attributes are only activated if they are present. Unlike earlier versions of VDDT, attributes must now be present before a model run in order to be activated. If attributes have been defined, try re-running the model.

The calculated attribute always has a value of 0 in the graph.

Calculated attributes are linked to specific probabilistic transitions and classes. Thus, the final amount of a calculated attribute will only be greater than 0 if an applicable transition has occurred in the right class. Check to ensure that the transition is occurring.

The summary line graph only shows one line.

Summary line graphs always have three lines. In some cases, little variation occurs between the different iterations, or only one iteration was done. In these cases, all lines may be drawn on top of or close to each other.

How do I see the results from a different iteration?

The graphs only show the results of the last iteration of the model run. The information from the other iterations is seen using the various summary options (see *Graph Option: Display Series*). To get more information about a single iteration, you can either repeat the iteration by starting with the appropriate random number seed (**Run|Settings|***Options*), or generate an output report of your results which will contain information about each iteration in the simulation (see about *Output Reports*).

Problems with Input or Output

Errors reading PVT or SCN files (created from VDDT).

VDDT should be able to read files that it has created (provided that they have not been edited outside the program; see below). Most problems arise because the PVT was saved as a different format than it was originally. This causes problems when reading new scenario files that were not being used at the time the format changed. Load the PVT file again, with the scenario file it used at the time. Save them as a different format and see if a different scenario file can be read.

Errors reading PVT or SCN files (which may have been edited or created outside VDDT).

Most errors occur if the files have been created or modified using an editor or a program other than VDDT. These problems are marked with an '*' below. Check several things:

1. Is more than one copy of VDDT running? To find out, hit CTRL-ALT-DEL once to bring up a list of the programs which Windows thinks are running. If more VDDT is listed more than once, close the unused ones by selecting them and then clicking on the **End Task** button.

*2. Does the file contain tabs? If so, remove them.

*3. Does the file have one or more blank lines after the last set of information or within the main body of the file? If so, remove them.

*4. Do any of the text descriptors contain a blank character (e.g., Lodgepole Pine instead of LodgepolePine or Lodgepole_Pine)? If so, remove the blanks.

*5. Is there a single header line before the PVT number and name? If not, put one in.

and, if none of that works,

*6. Have all the lines been counted accurately (i.e., the number of classes, or the number of probabilistic transitions in a class)? This error usually occurs if the line containing the error is the first line of a class or management region or the last line of a list of transitions.

The error message may give some clue about the problem. In many cases, the error message will print a line number. The error may occur in that line or the line on either side.

Some transition types were not in the PVT file.

The scenario file has probabilities for transitions which are not present in the PVT file. This occurs when probabilistic transitions have been deleted from a PVT when a different scenario file was in use. The model ignores these transitions after giving the warning, and when the scenario file is saved, the transition will no longer be present.

A class was not in the PVT file.

A class present in the scenario file is not present in the PVT file. This occurs when a class has been deleted, or its cover type or structural stage changed when another scenario file was in use. The model ignores the class in the scenario file (after giving the warning), and when the scenario file is saved the class, and all its transition probabilities, will no longer be present. There is no way to tell the model what class it has been changed to.

The destination class for deterministic or probabilistic transition does not exist.

This error occurs in two places:

1. When reading the files: Make a note of the originating class and then, when the diagram has been drawn, double-click on the class and edit the appropriate pathways. The problem pathways will be indicated by an @ or a strange letter combination as the destination.
2. When editing the pathways: The problem box will be highlighted.

a. Check to ensure that the destination letter is one of the classes in the diagram.

b. Check that location in all pages of transitions (i.e., a box in the second row might be highlighted but it may indicate a problem with the second row on page 1, 2, or 3) and ensure that the destination is valid.

c. Look at the diagram. If the labels in the boxes are not all in the corners of the box then click on **Close** (or hit the ESC key). All changes will be lost. Then resize the diagram. If the labels of the boxes are now in the corners, try editing the pathway again.

d. Make sure that blanks were not entered as well as the destination letter.

The probabilistic transition name (in the output files) is "UnknownCode".

The probabilistic transition is not listed in the file DISTURB.TXT, and will not occur.

There are two possible fixes for this problem:

1. Load a different DISTURB.TXT file that contains the probabilistic transition. This error occurs when VDDT is reading the wrong file.
2. Add the numerical code (a four-digit number between 0001 and9999), the transition groups to which it belongs (see DISTGRP.TXT) and the name of the probabilistic transition (with no spaces in the name) to DISTURB.TXT. Then, load the new files (**File**|**Import**|**Definitions**|**Disturbances**) and save your Project. The next time you open the Project, the code will have a name.

> **Note:**
> Note that if the final file is to be used with the CRB Assessment process, new numbers should not be added without checking with Don Long at the USFS Fire Lab in Missoula, MT.

The cover type (in the output files) is "UnknownType."

The cover type is not listed in the file COVER.TXT. As long as the cover type code is between 0001 and 9999, the program will function as usual (since it only looks at the number, not the name).

There are two possible fixes for this problem:

1. Load a different COVER.TXT file that contains the cover type.
2. Add the code (a four-digit number between 0001 and 9999) and name the cover type (with no spaces in the name) to COVER.TXT, and the code and an abbreviated name (with no spaces in the name) to COVERC.TXT. Then, load the new files

(**File**|**Import**|**Definitions**|**Cover types**) and save your Project. The next time you open the Project, the code will have a name.

Note:
Note that if the final file is to be used with the CRB Assessment process, new numbers should not be added without checking with Don Long at the USFS Fire Lab in Missoula, MT.

Other Problems

Garbage fonts.

The fonts used by VDDT are MS Sans Serif and Roman, both Windows fonts. Experience has shown that when the Adobe Type Manager (ATM) is active, some of the labels in the program will be unreadable, especially the graph labels. Removing the Adobe Type Manager will alleviate these problems.

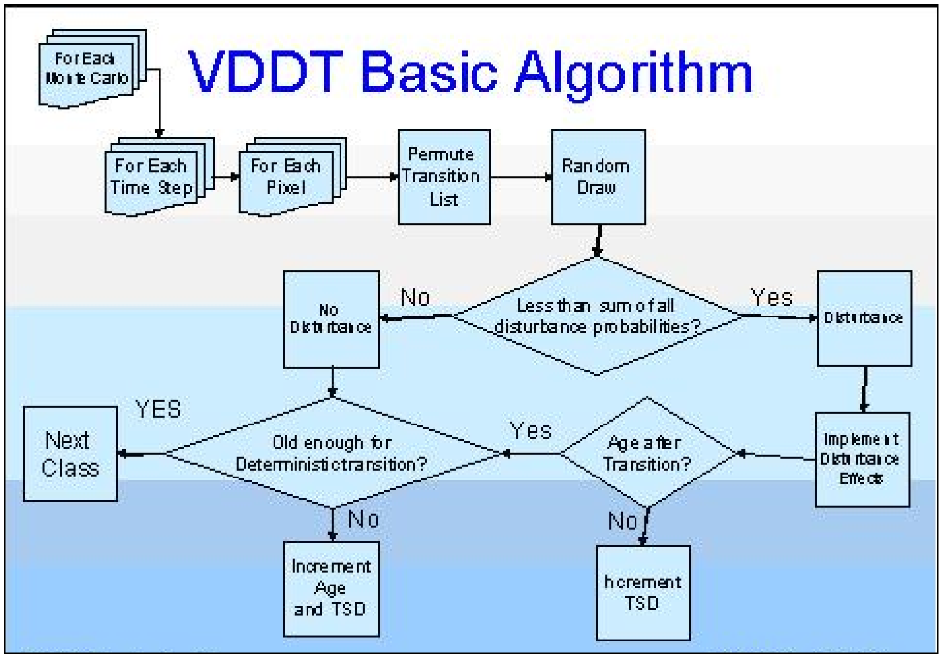
The dialog box for editing pathways and probabilities isn't drawing properly.

Depending on your hardware configuration, VDDT occasionally has memory problems. For best results, including helping solve this problem, close all other open applications in your Windows session.

APPENDIX A: BASIC SIMULATION ALGORITHMS

The steps in a typical VDDT simulation are as follows (see figure below):

- The model loops over the number of Monte Carlo simulations specified by the user.
- For each Monte Carlo simulation, the model loops over the number of years specified.
- For each year, the model loops over the number of cells specified.
- For each cell, VDDT randomly permutes the order of the disturbance list for the current class of the cell.
- For each cell, the model makes a random draw from a uniform distribution between zero and one. If that random draw is less than the total of all transition probabilities for the cell's current class, then a transition occurs for that cell. The decision about which transition occurs is based on the same random draw and on the relative probability of all the possible transitions. For example: Class A has three possible probabilistic transitions in this order: Fire (p=0.01), Wind (p=0.001) and Insects (p=0.02). A random number R is drawn. $R \le 0.01$ would result in a fire, $0.01 < R \le 0.011$ would result in Wind, $0.011 < R \le 0.031$ would result in Insects, and $0.031 < R$ would result in no transition. Beware that when the sum of input probabilities for a class exceeds 1, the observed probabilities will not match the inputs. This is because only a single probabilistic transition can occur to a cell per time-step.


VDDT Basic Algorithm
For Each Monte Carlo
For Each Time Step
For Each Pixel
Permute Transition List
Random Draw
Less than sum of all disturbance probabilities?
No
Yes
No Disturbance
Disturbance
Implement Disturbance Effects
Age after Transition?
Yes
No
Increment TSD
Old enough for Deterministic transition?
YES
No
Next Class
Increment Age and TSD

APPENDIX B: ABOUT PROBABILITY DISTRIBUTIONS IN VDDT

For all the pixels of the same class at any one time step there are two possible outcomes — being disturbed or not. The probability distribution for the number of disturbed pixels of that class at any one time step is the binomial distribution:

$$P(x=k)=\frac{n!}{k!(n-k)!}p^k(1-p)^{n-k}$$

where n is the total number of pixels, p is the probability of disturbance and k is the observed number of disturbed pixels. The mean of this distribution is np and the variance is np(1-p).

When n is large and p is small – the binomial distribution can be approximated by the Poisson distribution:

$$P(x=k)=\frac{e^{-\mu}\mu^k}{k!}$$

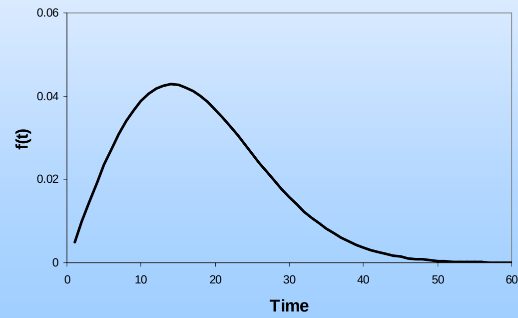
where μ is both the mean and the variance of the distribution. When approximating the binomial distribution μ is equal to np. The Poisson distribution describes the number of events that will occur within a given time period or area when the probability of occurrence is constant across space and time, events occur randomly and are independent of each other.

In addition to describing the distribution of the number of pixels affected by a disturbance in any one VDDT time step we can also describe the following distributions:

1. The Return Interval Distribution f(t) is the probability distribution of the waiting times required before a disturbance occurs.
2. The Cumulative Mortality Distribution F(t) is the cumulative version of f(t) or the time required for a given proportion of the landscape to have been affected by a particular disturbance.
3. The Cumulative Survivorship Distribution A(t) is equal to (1-F(t)) or the proportion of the landscape surviving to be at least t years old before being affected by a disturbance.

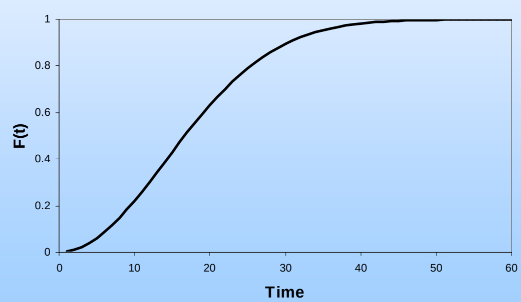
Other distributions in VDDT

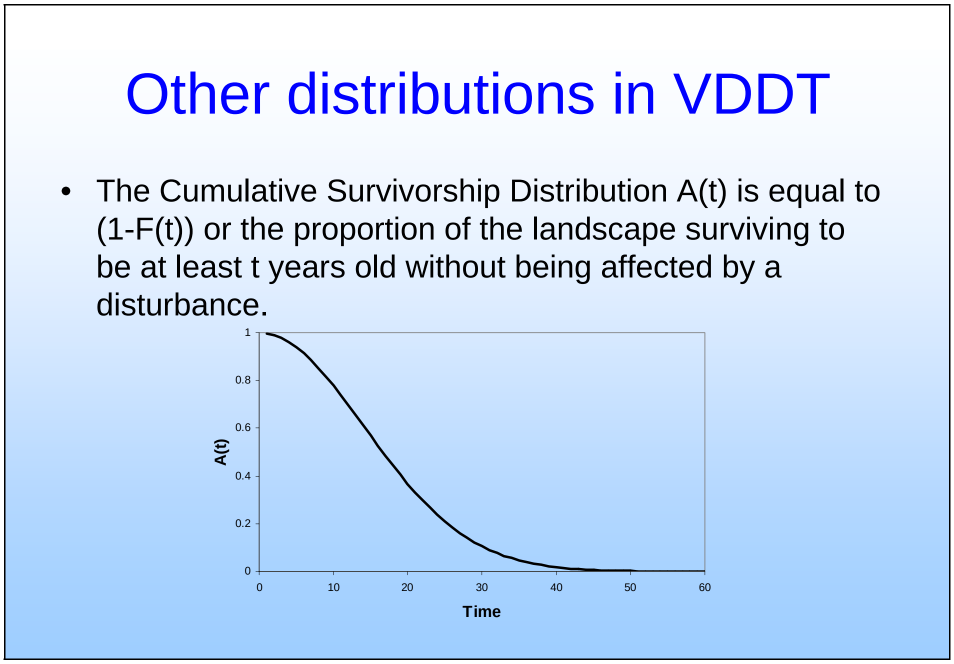
- The Return Interval Distribution f(t) is the probability distribution of the waiting times required before a disturbance occurs.



Other distributions in VDDT

- The Cumulative Mortality Distribution F(t) (cumulative f(t)) is the time required for a proportion of the landscape to be affected by a disturbance.

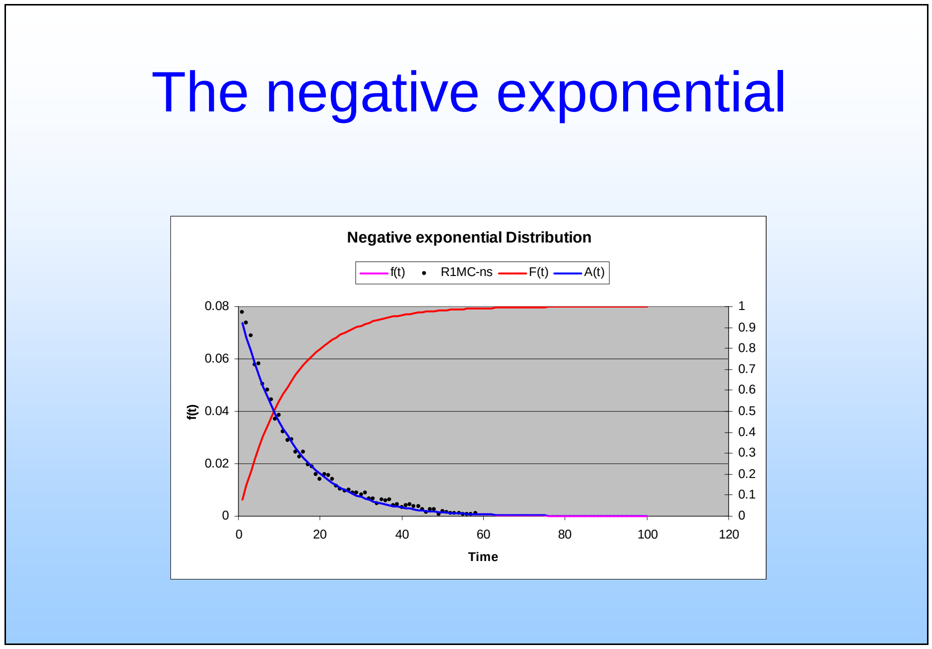




The probability of being disturbed at time t is known as the Hazard of Disturbance Function and is defined as:

$$\lambda(t) = f(t)/A(t)$$

If the Hazard of Disturbance decreases with time, older pixels are less likely to be disturbed. If it increases with time, older pixels are more likely to be disturbed. If $\lambda(t)$ is constant that means that the probability of being disturbed is independent of age.



In the case where: the Hazard of Disturbance is independent of age; the probability of disturbance is constant over time; and the probability of whether any pixel is disturbed is independent of what happens to all other pixels, the Return Interval Distribution f(t) can be described by the negative exponential distribution:

$$f(t) = pe^{-pt}$$

The Cumulative Mortality Distribution F(t) is the integral of this and can be described by:

$$F(t) = 1 - e^{-pt}$$

The Cumulative Survivorship Distribution A(t) can be described by:

$$A(t) = e^{-pt}$$

And the Hazard (or probability) of Disturbance is:

$$\lambda(t) = p$$

In this case p is equal to the probability of disturbance at any point in time.

The Negative Exponential Distribution of Disturbance Return Intervals is a special case of the more flexible Weibull Distribution first proposed by Johnson (1979) as a description of Fire Return Intervals. In this distribution the assumption of a constant hazard of disturbance with age is not necessary. The Weibull Return Interval Distribution is described by:

$$f(t) = p^c c t^{c-1} e^{(-pt)^c}$$

The Cumulative Mortality Distribution F(t) can be described by:

$$F(t) = 1 - e^{-(pt)^c}$$

The Cumulative Survivorship Distribution A(t) can be described by:

$$A(t) = e^{(-pt)^c}$$

And the Hazard of Disturbance function is:

$$\lambda(t) = p^c c t^{c-1}$$

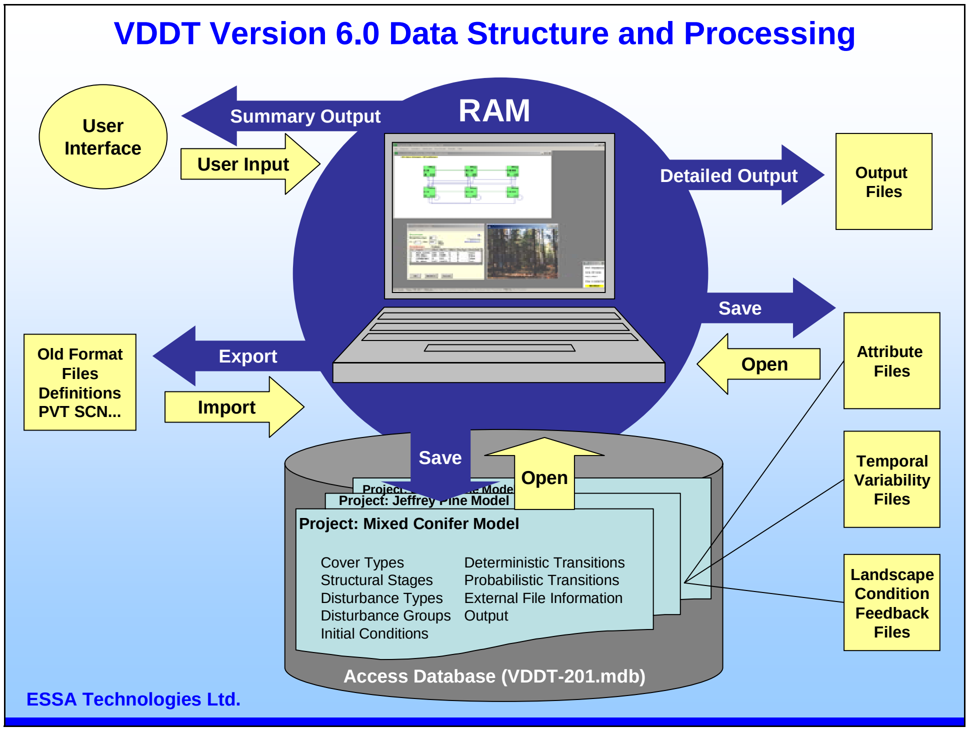
If $c < 1$, the Hazard of Disturbance decreases with age, if $c = 1$ the Hazard of Disturbance is constant and equal to p (negative exponential model); if $c > 1$, the Hazard of Disturbance increases with age.

APPENDIX C:
DATA STRUCTURE AND PROCESSING

VDDT version 6.0 stores all key model input in a relational Microsoft Access 2000 database. Multiple VDDT databases can be stored on a single computer and users can select which database to use within a VDDT session by selecting the Database option from the File menu and navigating to the appropriate Microsoft Access database file (i.e. with extension .MDB). Each VDDT database file can contain multiple 'Projects'. A 'Project' is essentially an independent model in VDDT. It contains all the necessary information to edit the inputs, run and view the output of a model.

With version 5.0 and later, a typical VDDT session goes as follows:

- When VDDT starts, the application establishes a connection with the database that was used most recently.
- Model data are brought into memory either by 'importing' it from the version 4 text file format (using **File|Import**), or by opening an existing Project in the database (using **File|Open**).
- The user makes changes to the VDDT model (in memory) either by changing parameters through the user interface or running the model.
- Any changes to the model can be saved by the user back to the database using the **File|Save** and **File|Save As** menu options; alternatively, models can be saved to old version 4 text file format using the **File|Export** option.


VDDT Version 6.0 Data Structure and Processing
User Interface
Summary Output
User Input
RAM
Detailed Output
Output Files
Save
Open
Attribute Files
Old Format Files Definitions PVT SCN...
Export
Import
Temporal Variability Files
Save
Open
Project: Jeffrey Pine Model
Project: Mixed Conifer Model
Cover Types
Structural Stages
Disturbance Types
Disturbance Groups
Initial Conditions
Deterministic Transitions
Probabilistic Transitions
External File Information
Output
Landscape Condition Feedback Files
Access Database (VDDT-201.mdb)
ESSA Technologies Ltd.

APPENDIX D: DEFINITIONS AND FILE DESCRIPTIONS

ATTRIBUTE STRUCTURE FILE (*.ATT)

The attributes are stored in a file that has the format:

Line 1: PVTno, number of attributes, list of the **name** of each attribute (in " ", and separated by commas)

Line 2: PVTno, number of attributes, list of the **type** of each attribute (in " ", and separated by commas)

Line 3: PVTno, number of attributes, list of the **units** for each attribute (in " ", and separated by commas)

Lines by class:

PVTno, ss-ct #, list of the **value** of each attribute (in " ", and separated by commas)

One line for all calculated attributes:

PVTno, -9999, number of time intervals, time steps for the intervals including start and end year

Repeat for each calculated attribute:

Lines for defining calculated attributes:

PVTno, -999, name of calculated attribute, min and max limit for each time interval

PVTno, "distid", "att", number of disturbance, disturbance numbers

Lines with calculated attribute values:

PVTno, disturbance number, number of attribute that this is based on, multiplier, value for each disturbance type. Note that each row can contain either the number of the attribute and the multiplier, or values for each disturbance type. If both are present, only the first set will be saved.

The "ss-ct #" is a combination number of the structural stage and the cover type number, with the structural stage being the first 1-2 numbers and the cover type being the last four numbers. For example, if the ss-ct # was 261015 (see the fourth row of the example), the structural stage would be 26 and the cover type would be 1015.

An example of an attribute file with two calculated attributes and one numerical attribute:

```
57, 3,"calcatt", "numatt ", "calcatt2"
57, 3,"Calculated", "Numerical", "Calculated"
57, 3,"", "m", ""
57, 261015,, 10,
57, 12009,, 11,
57, 32009,, 12,
57, 42009,, 13,
57, 52009,, 14,
57, 62009,, 15,
57, -9999, 3 , 1 , 50 , 69 , 100
57, -999, "calcatt", 1 , 2 , 3 , 4 , 11 , 12
57, "distid", " att", 6, 261015, 12009, 32009, 42009, 52009, 62009
57, 1022, 0, 11, 1, 0, 0, 0, 0, 0
57, -999, "calcatt2", 5 , 6 , 7 , 8 , 13 , 14
57, "distid", " att", 6, 261015, 12009, 32009, 42009, 52009, 62009
57, 1022, 2, 22, 0, 0, 0, 0, 0, 0
```

BETWEEN-YEAR VARIABILITY FILES

The information about between-year variability is stored in between three and five different files. If information about annual variation is present, only the annual multiplier file is needed. If new annual multipliers are to be generated, year sequence group and year-type multipliers will also be needed.

Year sequence group files (*.YSG)

This file contains all the information relating to "Year Sequence Groups". The first line of the file contains the number of YSGs that are present in the file. Then, the first line of each YSG lists the name of the YSG (in quotation marks), the percentage of the years that are in each type of year ("Very Low", "Low", "Normal", "High", and "Severe"), and the number of disturbances in the YSG. The lines following give the disturbance id numbers for each of the disturbance types in the YSG.

```
 2
"Fires" 16  57  11  11  5  6
 3014
 3011
 3019
 3004
 3001
 3009
"Pests" 10  80  5  3  2  2
 2002
 2101
```

Year-type multipliers file (*.YTM)

This file contains the multipliers associated with each disturbance type and each type of year. Note that in order to load this file, some information about YSGs must already be in memory.

Each line gives a disturbance id number and the multipliers used for that disturbance in each of the five types of years ("Very Low", "Low", "Normal", "High", and "Severe"). Note that only the disturbances that are in a YSG are printed to this file.

```
3011   0.2 1 2 5 10
3014   0.2 1 2 5 10
3019   0.2 1 2 5 10
3001   0.2 1 3 7 10
3004   0.1 1 2 4 8
3009   0.1 1 1.5 3 6
2002   0.5 1 2 5 8
2101   0.1 1 2 4 5
```

Year-type sequence file (*.TSE)

This file contains the type of year for each year that was generated (up to 300 years) for one or more YSGs. Each year is given a number from 1 to 5 to represent the different year types:

1 = "Very Low",
2 = "Low",
3 = "Normal",
4 = "High", and
5 = "Severe".

The first line of the file gives the number of years that are listed. The first line of YSG then gives a YSG number (which is the number of the YSG at the time it was saved) and the name of the YSG. Each line following (for that YSG) gives the year and the type of year.

In the example file, only 20 years have been printed.

```
20
1 Fires
1    2
2    3
3    2
4    2
5    4
6    2
7    2
8    2
9    1
10   2
11   2
12   4
13   3
14   1
15   2
```

```
16   2
17   2
18   2
19   1
20   5
2 Pests
1    2
2    4
3    1
4    2
5    2
6    2
7    2
8    2
9    2
10   2
11   2
12   2
13   3
14   2
15   2
16   2
17   2
18   2
19   2
20   1
```

Multiplier sequence files (*.MSE)

This file contains a multiplier for each disturbance type for each year that was generated (up to 300 years). The values in this file are the originally generated multipliers that have not been normalized. The file has the format:

```
YSG#     "YSG Name"   # of Disturbances in the YSG
0        Dist1 ID     Dist2 ID   Dist3 ID ... Distn ID
year1    Mult1        Mult2      Mult3 ...    Multn
year2    Mult1        Mult2      Mult3 ...    Multn
etc.
```

```
20
 1 "Fires" 6
 0  3014 3011 3019 3004 3001 3009
 1  1  1  1  1  1  1
 2  2  2  2  2  3  1.5
 3  1  1  1  1  1  1
 4  1  1  1  1  1  1
 5  5  5  5  4  7  3
 6  1  1  1  1  1  1
 7  1  1  1  1  1  1
 8  1  1  1  1  1  1
 9  0.2  0.2  0.2  0.1  0.2  0.1
 10  1  1  1  1  1  1
 11  1  1  1  1  1  1
 12  5  5  5  4  7  3
 13  2  2  2  2  3  1.5
 14  0.2  0.2  0.2  0.1  0.2  0.1
 15  1  1  1  1  1  1
 16  1  1  1  1  1  1
 17  1  1  1  1  1  1
 18  1  1  1  1  1  1
 19  0.2  0.2  0.2  0.1  0.2  0.1
```

```
20  10  10  10  8  10  6
2 "Pests" 2
0  2002 2101
1  1  1
2  5  4
3  0.5  0.1
4  1  1
5  1  1
6  1  1
7  1  1
8  1  1
9  1  1
10  1  1
11  1  1
12  1  1
13  2  2
14  1  1
15  1  1
16  1  1
17  1  1
18  1  1
19  1  1
20  0.5  0.1
```

Normalized sequence files (*.NSE)

This file contains a *normalized* multiplier for each disturbance type for each year that was generated (up to 300 years). The file format is identical to the multiplier sequence file.

YSG#	"YSG Name"	# of Disturbances in the YSG		
0	Dist1 ID	Dist2 ID	Dist3 ID ...	Dist*n* ID
year1	Mult1	Mult2	Mult3 ...	Mult*n*
year2	Mult1	Mult2	Mult3 ...	Mult*n*
etc.				

```
20
 1 "Fires" 6
 0  3014 3011 3019 3004 3001 3009
 1  0.947 0.947 0.947 0.96 0.929 0.976
 2  1.895 1.895 1.895 1.921 2.789 1.464
 3  0.947 0.947 0.947 0.96 0.929 0.976
 4  0.947 0.947 0.947 0.96 0.929 0.976
 5  4.737 4.737 4.737 3.842 6.509 2.928
 6  0.947 0.947 0.947 0.96 0.929 0.976
 7  0.947 0.947 0.947 0.96 0.929 0.976
 8  0.947 0.947 0.947 0.96 0.929 0.976
 9  0.189 0.189 0.189 0.096 0.185 0.097
 10  0.947 0.947 0.947 0.96 0.929 0.976
 11  0.947 0.947 0.947 0.96 0.929 0.976
 12  4.737 4.737 4.737 3.842 6.509 2.928
 13  1.895 1.895 1.895 1.921 2.789 1.464
 14  0.189 0.189 0.189 0.096 0.185 0.097
 15  0.947 0.947 0.947 0.96 0.929 0.976
 16  0.947 0.947 0.947 0.96 0.929 0.976
 17  0.947 0.947 0.947 0.96 0.929 0.976
 18  0.947 0.947 0.947 0.96 0.929 0.976
 19  0.189 0.189 0.189 0.096 0.185 0.097
```

```
20  9.475 9.475 9.475 7.684 9.299 5.857
2 "Pests" 2
0  2002 2101
1  0.986 0.992
2  4.934 3.97
3  0.493 0.099
4  0.986 0.992
5  0.986 0.992
6  0.986 0.992
7  0.986 0.992
8  0.986 0.992
9  0.986 0.992
10  0.986 0.992
11  0.986 0.992
12  0.986 0.992
13  1.973 1.985
14  0.986 0.992
15  0.986 0.992
16  0.986 0.992
17  0.986 0.992
18  0.986 0.992
19  0.986 0.992
20  0.493 0.099
```

COMMA-DELIMITED FILES

Two comma-delimited files, in the format expected by the CRB Paradox database, are created when users select **Export** and then **Comma-delimited** from the **File** menu.

The comma-delimited PVT file (*.PDX) consists of 17 columns which describe the class, its succession destination, the disturbances, and their destination. The columns are:

1. the PVT number;
2. the class identifier as a value with the structural stage in the first one or two digits and the cover type as the last four digits;
3. a disturbance code;
4. the number of classes in the PVT;
5. the number of the current class (the class being described);
6. the structural stage of the class;
7. the cover type of the class;
8. the beginning age of the class;
9. the ending age of the class;
10. the class to which this class goes during succession;
11. a column containing a zero (which is not used);
12. the number of disturbances in the class;
13. the destination for the disturbance as the combined class identifier;
14. the age of the pixel after the disturbance;

15. the age increment of the pixel (used if it stays in the same class);
16. the structural stage of the destination class; and
17. the cover type of the destination class.

```
999, 12009, 3001, 6, 2, 1, 2009, 6, 51, 32009,0, 1, 261015, 1, 0, 26, 1015
999, 32009, 3001, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 261015, 1, 0, 26, 1015
999, 32009, 3011, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 261015, 1, 0, 26, 1015
999, 32009, 3021, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 261015, 1, 0, 26, 1015
999, 32009, 3030, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 42009, 91, 0, 4, 2009
999, 32009, 3106, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 32009, 51, 10, 3, 2009
999, 32009, 1103, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 32009, 51, 20, 3, 2009
999, 32009, 1101, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 42009, 91, 0, 4, 2009
999, 32009, 1001, 6, 3, 3, 2009, 51, 91, 42009,0, 8, 261015, 1, 0, 26, 1015
999, 42009, 1001, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 42009, 1021, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 42009, 3001, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 42009, 3011, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 42009, 3021, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 42009, 3009, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 42009, 91, 0, 4, 2009
999, 42009, 3019, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 42009, 91, 0, 4, 2009
999, 42009, 3029, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 42009, 91, 0, 4, 2009
999, 42009, 3483, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 42009, 2002, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 42009, 1103, 6, 4, 4, 2009, 91, 131, 62009,0, 11, 42009, 91, 10, 4, 2009
999, 52009, 1001, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 52009, 3001, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 52009, 3011, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 52009, 3021, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 261015, 1, 0, 26, 1015
999, 52009, 3030, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 1021, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 1103, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 3440, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 3441, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 3442, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 52009, 2002, 6, 5, 5, 2009, 131, 211, 62009,0, 11, 52009, 131, 0, 5, 2009
999, 62009, 3001, 6, 6, 6, 2009, 131, 1130, 62009,0, 4, 261015, 1, 0, 26, 1015
999, 62009, 1001, 6, 6, 6, 2009, 131, 1130, 62009,0, 4, 261015, 1, 0, 26, 1015
999, 62009, 1021, 6, 6, 6, 2009, 131, 1130, 62009,0, 4, 52009, 131, 0, 5, 2009
999, 62009, 2002, 6, 6, 6, 2009, 131, 1130, 62009,0, 4, 52009, 131, 0, 5, 2009
```

The Paradox-format scenario file (*.PSC) consists of 15 columns which describe the scenario and its associated disturbance probabilities. As in the standard scenario file, no disturbances with zero probabilities are included. The columns are:

1. the PVT number;
2. a disturbance code;
3. the class identifier as a combined structural stage (first one or two digits) and cover type (last four digits) value;
4. the management region (as a number);
5. the phase number;
6. an brief description of the scenario;

7. the structural stage;
8. the cover type;
9. a class counter (note that this does not correspond to the class number in the PVT file);
10. the first year of the simulation (usually a 0);
11. the number of years to simulate;
12. the number of disturbances in the class;
13. number of combinations of PVT number and class identifiers in the file (this will usually correspond to the number of classes in the file);
14. the number of management regions; and
15. the probability of disturbance.

```
999, 3001, 12009, 1, 1, "Example", 1, 2009, 1, 0, 300, 1, 5, 3, .006
999, 3001, 32009, 1, 1, "Example", 3, 2009, 2, 0, 300, 3, 5, 3, .002
999, 3021, 32009, 1, 1, "Example", 3, 2009, 2, 0, 300, 3, 5, 3, .001
999, 3106, 32009, 1, 1, "Example", 3, 2009, 2, 0, 300, 3, 5, 3, .0002
999, 3001, 42009, 1, 1, "Example", 4, 2009, 3, 0, 300, 5, 5, 3, .004
999, 3021, 42009, 1, 1, "Example", 4, 2009, 3, 0, 300, 5, 5, 3, .0015
999, 3009, 42009, 1, 1, "Example", 4, 2009, 3, 0, 300, 5, 5, 3, .0001
999, 3483, 42009, 1, 1, "Example", 4, 2009, 3, 0, 300, 5, 5, 3, .0015
999, 2002, 42009, 1, 1, "Example", 4, 2009, 3, 0, 300, 5, 5, 3, .01
999, 3001, 52009, 1, 1, "Example", 5, 2009, 4, 0, 300, 4, 5, 3, .0025
999, 3021, 52009, 1, 1, "Example", 5, 2009, 4, 0, 300, 4, 5, 3, .0025
999, 3440, 52009, 1, 1, "Example", 5, 2009, 4, 0, 300, 4, 5, 3, .0001
999, 2002, 52009, 1, 1, "Example", 5, 2009, 4, 0, 300, 4, 5, 3, .001
999, 3001, 62009, 1, 1, "Example", 6, 2009, 5, 0, 300, 2, 5, 3, .007
999, 2002, 62009, 1, 1, "Example", 6, 2009, 5, 0, 300, 2, 5, 3, .01
999, 3001, 12009, 2, 1, "Example", 1, 2009, 1, 0, 300, 1, 5, 3, .006
999, 3001, 32009, 2, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .002
999, 3106, 32009, 2, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0002
999, 1103, 32009, 2, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0125
999, 1101, 32009, 2, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0023
999, 1001, 32009, 2, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0015
999, 1001, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .023
999, 1021, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .002
999, 3001, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .004
999, 3009, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .0001
999, 3483, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .0015
999, 2002, 42009, 2, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .01
999, 3001, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .004
999, 1021, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0012
999, 3440, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 3441, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 3442, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 2002, 52009, 2, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .001
999, 3001, 62009, 2, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .007
999, 1001, 62009, 2, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .05
999, 1021, 62009, 2, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .005
999, 2002, 62009, 2, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .01
999, 3001, 12009, 3, 1, "Example", 1, 2009, 1, 0, 300, 1, 5, 3, .006
999, 3001, 32009, 3, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .002
999, 3106, 32009, 3, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0002
999, 1103, 32009, 3, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0125
```

```
999, 1101, 32009, 3, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0023
999, 1001, 32009, 3, 1, "Example", 3, 2009, 2, 0, 300, 5, 5, 3, .0015
999, 1001, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .023
999, 1021, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .002
999, 3001, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .004
999, 3009, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .0001
999, 3483, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .0015
999, 2002, 42009, 3, 1, "Example", 4, 2009, 3, 0, 300, 6, 5, 3, .01
999, 3001, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .004
999, 1021, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0012
999, 3440, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 3441, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 3442, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .0001
999, 2002, 52009, 3, 1, "Example", 5, 2009, 4, 0, 300, 6, 5, 3, .001
999, 3001, 62009, 3, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .007
999, 1001, 62009, 3, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .05
999, 1021, 62009, 3, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .005
999, 2002, 62009, 3, 1, "Example", 6, 2009, 5, 0, 300, 4, 5, 3, .01
```

Cover Type Codes Files (COVER.TXT, COVERC.TXT)

Cover types are defined by a four-digit code between 0001 and 9999.

Two cover type code files are necessary for the model to operate. COVER.TXT gives a long version of the name COVERC.TXT is a file containing 4-6 letter abbreviations for the cover types. These abbreviations are the ones seen in the transition pathway diagram. This appendix lists only the long version of the cover types and their numbers.

This example file is the one distributed with VDDT.

```
1001 Rock/Barrenlands
1002 Water
1004 Grass/Forb
1005 Shrub/Regen
1009 Exotics
1010 PerennialNativeBunchgrass
1013 MountainShrub
1014 HerbShrub
1015 GeneralShrub
1016 MountainShrub(Ceanothus)
1017 BareSoil
2001 Spruce/SubAlpineFir
2002 WhitebarkPine
2003 Douglas Fir
2005 WesternLarch
2006 Grand/WhiteFir
2007 WhitePine
2008 Aspen
2009 LodgepolePine
2010 MountainHemlock
2011 PacificSilverFir
2012 HemlockCedar
2013 ShastaRedFir
2014 Aspen/Poa
2014 Aspen/Exotic
2018 InteriorPonderosaPine
2023 WhitebarkPine/SubalpineLarch
2024 SubalpineLarch
2025 JuniperWoodland
4013 SeededNativeGrass(AGSP/FEID)
4015 LowprodPerennialGrass
4019 PioneerForbs
4020 SmallPerennialGrass
4021 NativeForbs
4022 ExoticPerennialGrass
4023 ExoticForbs
4024 ExoticHerbaceous
4025 JuniperForest/ExoticHerb
4027 ArtemisArbuscula/NativeForbs
4028 Juniper/LowSage/Shortgrass
4029 Juniper/PoaSecunda
4031 ArtemisiaArbuscula/NativeBunchgrass
4038 ExoticAnnualGrass
4040 SitanionHystrix
4042 PoaSecunda
4043 Poa/PerennialGrass
4047 ExoticGrass(BRTE/ELCA/POSE)
4048 SeededNativeGrass(POSE/AGSP)
4049 FireMaintainedGrass(POSE/AGSP)
4057 PoaPratensis
4058 Salix/Carex
4059 Salix/Grass
4060 Grass/Carex
4079 GravelBar
4080 Populus/Cornus
4081 PopulusTrichocarpa
4084 Populus/PoaPratensis
4087 Cornus/Crateagus
```

2027 LimberPine
2030 SierraMixedConifer
2031 PacificPonderosaPine
3001 AgropyronSpicatum
3003 Purshia/AgropyronSpicatum
3004 Juniper/Sagebrush/Wheatgrass
3007 MountainMahogany
3010 IdahoFescue/Wheatgrass
3013 Artemisia_tri_tri
3015 SaltDesertShrub
3016 Chokecherry/Serviceberry/Rose
3021 Artemisia/ElymusCinereus
3022 ThreetipSagebrush
4001 ConiferEncroachment/ExoticGrass
4003 ExoticForbs
5011 ConiferEncroachment/Sage/PerennialGrass
5012 NativePerennialGrass
5013 ArtemisiaVasy_triden/PerrennialHerbs
5014 PerennialNativeHerbs
5016 ArtemisiaVasy_triden/PerennialGrass
5017 ConiferEncroachment/Sage/PerennialGrass
5019 Conifer/PerennialGrass
5021 ArtemisiaVasy_triden/ExoticHerbs
5039 IrrigatedCrop
5040 DrylandPasture/HayLand
5041 IrrigatedPasture/HayLand
5043 UrbanLand
5046 DrylandCrop
5047 DrylandPasture/HayLand
5050 ElymusCinereus
5051 ElymusCinereus/Agropyron
5052 ElymusCinereus/BromusTectorum
5053 AgropyronCristatum
5055 AgropyronCristatum/BromusTectorum
5056 PerennialHerbs
5059 ArtemisiaTriparteta/Exotics
5060 ArtemisiaTriparteta/AgropyronCristatum
4089 Salix/Calamagrostis
4090 Salix/Carex
4091 Salix/ExoticForbs
4092 Salix/PoaPratensis
4093 ExoticHerbs
4094 DeschampsiaCalamagrostis
4095 ExoticRiparianHerbs
4096 ExoticMoistHerbs
4097 Agropyron/PoaSecunda
4098 PoaSecunda/FestucaOctaflora
4099 Artemisia/PoaSecunda
5001 BromusTectorum
5002 Artemisia/BromusTectorum
5006 SeededExoticAgropyron
5009 ArtemisiaVasy_triden/PerennialGrass
5061 AristidaLongiseta
5062 ArtemisiaArbuscula/BromusTectorum
5063 PurshiaTridentata/BromusTectorum
5064 PoaSecunda/PerennialForbs
5066 SarcobatusVermiculatus
5067 Ryegrass
5068 Greasewood/Saltgrass
5069 Greasewood
5070 Juniper/LowSage/Fescue
5072 Phylodoce
5073 Conifer/ExoticHerbs
5074 Juniper/NativeBunchgrass
5075 Juniper/ExoticHerbs
5076 Pinus/Populus/Shrub
5077 Fir/Populus/Shrub
5078 Pinus/Populus/Exotic
5079 Fir/Exotic
5080 WhiteOak/Shrub
5081 MidShrub
5082 WhiteOak/Exotic
5084 CarexRostrata/aquatilis
5085 CarexNebraskensis

DISTURBANCE CODE FILE: DISTCODE.TXT

This file defines all the possible disturbances that can occur in the model. Each disturbance is given a four-digit code and a short name. In addition, each disturbance can be a member of between one and three disturbance groups (see the disturbance group file description for more details). The numerical code must be an integer between 0001 and 9999. The short name must contain no commas or blanks, should be fewer than 10 characters (although there is no limit), and should be reasonably descriptive.

The file lists the information in five columns:

col 1: the numerical code;

cols 2-4: the number of the disturbance groups to which this disturbance belongs;

col 5: the short description of the type of disturbance.

For ease of reference, the file is printed here in three sets of columns. This example file is the one distributed with VDDT and may be edited as needed.

1001 1 0 0 CC-Noprep
1003 1 0 0 GrpSelCut
1005 1 0 0 IndSelCut
1006 1 0 0 OSR
1009 1 0 0 SanitationCut
1012 1 0 0 Shelterwood
1014 1 6 0 CC+PlantPP
1015 1 6 0 CC+PlantDF
1016 1 6 0 CC+PlantWL
1017 1 6 0 CC+Plant
1018 1 6 0 CC+PlantWP
1020 1 0 0 PartialCut6
1021 1 0 0 PartialCut
1022 1 5 0 CC+Burn
1023 1 0 0 CC+Sprout
1027 1 0 0 PartialCut1
1028 1 0 0 PartialCut2
1029 1 0 0 OSR1
1031 1 0 0 CC-Noprep2
1035 1 0 0 PartialCut3
1036 1 0 0 PartialCut4
1037 1 0 0 PartialCut5
1040 1 5 0 SW+Burn
1041 1 0 0 SWRsrv
1042 1 0 0 SWRsrv2
1043 1 0 0 SWRsrv3
1045 1 0 0 GrpSelCut2
1048 1 0 0 SWDeadRsrv
1050 1 0 0 SWDeadRsrv2
1052 1 0 0 CCRsrv
1053 1 0 0 CCRsrv2
1055 1 0 0 CCDeadRsrv
1101 1 0 0 CommerThin
1102 4 0 0 PrecomThin
1103 4 0 0 ThinLow
1104 4 0 0 ThinHigh
1105 4 0 0 Thin2
1106 4 0 0 Thin3
1108 4 0 0 ThinLow2
2010 9 0 0 TussockMoth
2013 9 10 0 WPB+RD
2014 9 0 0 Defoliators
2016 9 9 0 DFB+Def
2017 9 0 0 MPB1
2018 9 0 0 MPB2
2020 9 0 0 InsectsGen
2021 9 0 0 BB2
2022 9 10 0 LessI+D
2023 9 0 0 DFB2
2024 9 0 0 MPB3
2025 9 0 0 MPB4
2026 9 0 0 PoplarBorer
2032 9 0 0 BBlow
2033 9 0 0 BBhigh
2035 9 0 0 WPB2
2038 9 0 0 BB3
2044 9 0 0 BB5
2101 10 0 0 BR1
2102 10 0 0 DwarfMistletoe
2103 10 0 0 RootDisease
2104 10 0 0 Canker
1201 6 0 0 BarerootPltng
1301 7 0 0 UnspecGrazing
1302 7 0 0 LCSCG
1303 3 0 0 LCSMG
1304 3 0 0 LCSAG
1305 13 0 0 LCSNG
1306 7 0 0 BSCG
1307 3 0 0 BSMG
1308 3 0 0 BSAG
1309 13 0 0 BSNG
1310 7 2 0 LCSCG+Exotics
1311 3 2 0 BSCG+Exotics
1313 6 6 0 Herbicide+Seed
1314 6 6 0 MechPrep+Seed
1315 3 0 0 WinterGraze
1317 12 0 0 Erosion
1318 11 0 0 Agriculture
1319 7 0 0 UnspecGrazing2
1320 7 0 0 LCSCGsheep
1331 6 0 0 Seed
1332 6 0 0 VegManipulation
1333 6 6 0 VegManip+Seed
1334 6 0 0 VegPlanting
1335 6 6 0 Herbicide+SeedExotic
1501 11 0 0 Till+SeedAnn+Spray
1502 11 0 0 TillSeed
1503 11 0 0 Irrigation
1504 11 0 0 Development
1505 11 0 0 Till+SdNtv+Spray
1506 11 0 0 Till+SdPer+Spray
2001 9 0 0 DFB1
2002 9 0 0 MPB
2003 9 0 0 WPB
2004 9 0 0 MPB/WPB
2005 9 8 0 WPP+SRF1
2006 9 0 0 BB
2007 9 0 0 SpruceBeetles
2008 9 0 0 BWA
2009 9 0 0 SBW
3007 8 0 0 WMFS3
3008 8 0 0 WMSF4
3009 8 0 0 WUB
3011 5 0 0 PPSRF
3012 5 0 0 PPSRF2
3013 5 0 0 PPSRF3
3014 5 0 0 PPMSF
3015 5 0 0 PPMSF1
3016 5 0 0 PPMSF2
3017 5 0 0 PPMSF3
3018 5 0 0 PPMSF4
3019 5 0 0 PPUB1
3020 5 0 0 PPUB2
3021 5 0 0 PUSRF
3022 5 0 0 PUSRF2
3023 5 0 0 PUSRF3
3024 5 0 0 PUMSF
3025 5 0 0 PUMSF1
3026 5 0 0 PUMSF2
3027 5 0 0 PUMSF3
3028 5 0 0 PUMSF4
3029 5 0 0 PUUB

2106 10 0 0 StemDecay
2111 10 0 0 BR2
2112 10 0 0 RD2
2113 10 0 0 BR3
2114 9 0 0 LeafDisease
2115 10 0 0 Canker2
2116 10 0 0 RootPathogens
2118 10 0 0 RD3
2119 10 9 0 RD+BB
2120 10 0 0 RD7
2121 10 0 0 RD8
2122 10 0 0 RD9
2123 10 0 0 RD10
2124 10 0 0 BR4
2125 10 0 0 BR5
2126 10 0 0 BR6
2127 10 0 0 RD3
2128 10 0 0 RD4
2129 10 0 0 RD5
2130 10 0 0 RD6
2133 10 0 0 AspenDiseases
2201 12 0 0 Seed1
2202 12 0 0 Seed2
2203 12 0 0 Seed3
2204 12 0 0 Seed4
2205 12 0 0 Seed5
2206 12 0 0 Seed6
3001 8 0 0 WSRF
3002 8 0 0 WSRF2
3003 8 0 0 WSRF3
3004 8 0 0 WMSF
3005 8 0 0 WMSF1
3006 8 0 0 WMSF2
3446 8 2 0 WSRF+ExoticGrass
3447 5 2 0 PPSRF+ExoticGrass
3448 5 2 0 PUSRF+ExoticGrass
3465 8 7 0 WSRF+LCSCG
3466 5 7 0 PPSRF+LCSCG
3467 5 7 0 PUSRF+LCSCG
3468 8 7 0 WSRF+BSCG
3469 5 7 0 PPSRF+BSCG
3030 13 0 0 WFC
3032 5 0 0 PPMSF5
3033 5 0 0 PUMSF5
3034 8 0 0 WNonLethal
3035 5 0 0 PPNonLethal
3036 5 0 0 PUNonLethal
3102 12 0 0 DroughtDamage
3106 12 0 0 Snow/breakage
3207 12 0 0 Rodents
3208 12 0 0 Beaver
3306 6 0 0 SeedCrstdWhtgrs
3401 7 2 0 LCSCG+ExoticGrass
3402 7 2 0 LCSCG+ExoticForb
3403 2 0 0 BSCG+ExoticGrass
3404 2 0 0 BSCG+ExoticForb
3406 1 12 0 PartialCut+Wind
3416 7 2 0 LCSCG+Exotics
3417 7 2 0 BSCG+Exotics
3418 9 10 0 RR1
3419 9 10 0 RR2
3420 9 10 0 RR3
3421 9 10 0 RR4
3422 9 10 0 RR5
3423 9 10 0 RR6
3424 9 10 0 RR7
3425 10 0 0 DwarfMistletoe2
3426 9 10 0 RR8
3428 1 7 0 CC+LCSCG
3429 1 7 0 CC+BSCG
3430 5 4 0 PPUB+Thin
3440 10 8 0 RD+WUB
3441 10 5 0 RD+PPUB
3442 10 5 0 RD+PUUB
3470 5 7 0 PUSRF+BSCG
3483 8 9 0 MSF+BB
3484 9 10 0 RR+DBF
3485 9 0 0 MPB
3490 12 0 0 Flood+Succession
3491 12 0 0 WtrTblDrp+Drought
3492 12 0 0 WaterTableDrop
3493 10 9 12 Decay+BB+Erosion

A more detailed disturbance description of the disturbance types is given below. This listing is not in any of the included text files, and is given here for reference purposes only.

1001 Clearcut - No prep
1003 Group selection cut
1005 Individual selection cut
1006 Overstory removal
1009 Sanitation cut
1012 Shelterwood cut
1014 Clearcut + plant(Ponderosa pine)
1015 Clearcut + plant(Douglas-fir)
1016 Clearcut + plant(Western larch)
1017 Clearcut + plant
1018 Clearcut + plant(White pine)
1020 Partial cut#6
1021 Partial cut
1022 Clearcut + broadcast burn
1023 Clearcut and sprout
1303 Successional maintenance cattle grazing
1304 Successional accelerating cattle grazing
1305 Not grazed by cattle
1306 Successional change biggame grazing
1307 Successional maintenance biggame grazing
1308 Successional accelerating biggame grazing
1309 Not grazed by biggame
1310 Success. change cattle grazing + exotics
1311 Success. accel. biggame grazing + exotics
1313 Herb. application + seeding native plants
1314 Mechanical prep + seeding
1315 Winter grazing
1317 Erosion
1318 Unspecified agriculture
1319 Grazing

1027 Partial cut
1028 Partial cut #2
1029 Overstory Removal #1
1031 Clearcut - No prep #2
1035 Partial cut #3
1036 Partial cut #4
1037 Partial cut #5
1040 Shelterwood cut + burn
1041 Shelterwood w/Reserves
1042 Shelterwood w/Reserves #2
1043 Shelterwood w/Reserves #3
1045 Group Selection Cut #2
1048 Shelterwood w/Dead Reserves
1050 Shelterwood w/Dead Reserves #2
1052 Clearcut w/Reserves
1053 Clearcut w/Reserves #2
1055 Clearcut w/Dead Reserves
1101 Commercial thin
1102 Precommercial thin
1103 Thin from below
1104 Thin from above
1105 Thin #2
1106 Thin #3
1108 Thin Low #2
1201 Bare root planting
1301 Grazing general
1302 Successional change cattle grazing
2020 Unspecified insects
2021 Bark beetles #2
2022 Less insects + disease than naturally would occur
2023 Douglas-fir beetle #2
2024 Mtn pine beetle #3
2025 Mtn pine beetle #4
2026 Poplar borer
2032 Low intensity bark beetles
2033 High intensity bark beetles
2035 Western pine beetle
2038 Bark beetles #3
2044 Bark beetles #5
2101 Blister rust #1
2102 Dwarf mistletoe
2103 Root disease
2104 Canker
2106 Stem decay
2111 Blister rust #2
2112 Root disease #2
2113 Blister rust #3
2114 Leaf disease
2115 Canker #2
2116 Root pathogens
2118 Root disease #3
2119 Root disease + bark beetles
2120 Root disease taking the stand to Douglas-fir
2121 Severe root disease
2122 Root disease taking the stand to Grand fir
2123 Low intensity root disease
2124 Blister rust #4
2125 Blister rust #5
2126 Blister rust #6
2127 Root disease #3
2128 Root disease #4
1320 Successional change sheep grazing
1331 Unspecified seeding
1332 Vegetation manipulation
1333 Vegetation manipulation + unspecified seeding
1334 Vegetation Planting ie willows
1335 Herbicide applic. + exotic seed source
1501 Till + seed annuals + spray
1502 Till + seed
1503 Irrigation
1504 Unspecified development
1505 Till + seed native + spray
1506 Till + seed perennial + spray
2001 Douglas-fir beetle
2002 Mountain pine beetle
2003 Western pine beetle
2004 Mtn pine beetle + western pine beetle
2005 Western pine beetle + stand replacing fire #1
2006 Bark beetles
2007 Spruce beetles
2008 Balsam wooly adelgid
2009 Spruce budworm
2010 Tussock moth
2013 Western pine beetle + root disease
2014 Unspecified defoliators
2016 Douglas-fir beetles + defoliators
2017 Mtn pine beetle #1
2018 Mtn pine beetle #2
3024 Prescr.-unplanned mixed severity fire
3025 Prescr.-unplanned mixed severity fire #1
3026 Prescr.-unplanned mixed sever. fire #2
3027 Prescr.-unplanned mixed sever. fire #3
3028 Prescr.-unplanned mixed sever. fire #4
3029 Prescr.-unplanned underburn
3030 Wildfire control
3032 Prescr.-planned mixed sever. fire #5
3033 Prescr.-unplanned mixed sever. fire #5
3034 Non-lethal wildfire
3035 Prescr. planned non-lethal fire
3036 Prescr.-unplanned non-lethal fire
3102 Drought damage
3106 Snow breakage
3207 Rodents
3208 Beaver
3306 Seed Crested Wheatgrass
3401 Succ. change cattle grazing + exotic grass
3402 Succ. change cattle grazing + exotic forbs
3403 Exotic grass
3404 Exotic forbs
3406 Partial cut + wind
3416 Succ. change cattle grazing + exotics
3417 Succ. change biggame grazing + exotics
3418 Insects + disease combination #1
3419 Insects + disease combination #2
3420 Insects + disease combination #3
3421 Insects + disease combination #4
3422 Insects + disease combination #5
3423 Insects + disease combination #6
3424 Insects + disease combination #7
3425 Dwarf mistletoe
3426 Insects + disease combination #8
3428 Clearcut + Successional change cattle grazing

2129 Root disease #5
2130 Root disease #6
2133 Aspen diseases
2201 Natural seeding #1
2202 Natural seeding #2
2203 Natural seeding #3
2204 Natural seeding #4
2205 Natural seeding #5
2206 Natural seeding #6
3001 Wild stand replacing fire
3002 Wild stand replacing fire #2
3003 Wild stand replacing fire #3
3004 Wild mixed severity fire
3005 Wild mixed sever. fire #1
3006 Wild mixed sever. fire #2
3007 Wild mixed sever. fire #3
3008 Wild mixed sever. fire #4
3009 Wild underburn
3011 Prescribed-planned stand replacing fire
3012 Prescr.-planned stand replacing fire #2
3013 Prescr.-planned stand replacing fire #3
3019 Prescr.-planned underburn
3020 Prescr.-planned underburn#2
3021 Prescr.-unplanned stand replacing fire
3022 Prescr.-unplanned stand replacing fire
3023 Prescr.-unplanned stand replacing fire
3429 Clearcut + Successional change biggame grazing
3430 Underburn + thin
3440 Root disease + wild underburn
3441 Root disease + prescr.-planned underburn
3442 Root disease + prescr.-unplanned underburn
3446 Wild stand replacing fire + exotic grass
3447 Prescr.-planned stand replac. fire + exot grass
3448 Prescr.unplanned stand replac fire + exot grass
3465 Wild srf + succ. change cattle grazing
3466 Prescr. planned srf + succ. change cattle graz
3467 Prescr. unplanned srf + succ. change cattle graz
3468 Wild srf + succ. change biggame grazing
3469 Prescr. planned srf + succ. change biggame graz
3470 Prescr. unplanned srf + succ. change biggame graz
3483 Mixed sever. fire + bark beetles
3484 Insect + disease combo + Douglas-fir beetle
3014 Prescr.-planned mixed sever. fire
3015 Prescr.-planned mixed sever. fire #1
3016 Prescr.-planned mixed sever. fire #2
3017 Prescr.-planned mixed sever. fire #3
3018 Prescr.-planned mixed sever. fire #4
3485 Mtn pine beetle
3490 Flood and succession
3491 Water Table Drop + Drought
3492 Water Table Drop
3493 Decay + Bark beetles + erosion

DISTURBANCE GROUP FILE: DISTGRP.TXT

This file lists the groups of disturbances. These groups are used for:

1. displaying the pathways on the transition pathway diagrams;
2. graphing results;
3. changing probabilities using multipliers;
4. generating between-year variability multipliers or landscape feedback multipliers;
5. selecting the type of disturbance for a new or modified pathway; and
6. disabling disturbances for a simulation.

There can be up to 15 different groupings.

The file must contain two columns: a number from 1 to 15 in the first column and the name of the group (with no spaces) in the second column.

The example file below is the one distributed with VDDT and, like the other TXT files, may be edited.

```
1 CommTimberHarvest
2 Exotics
3 NonImpactGrazing
4 Pre-commThinning
5 PrescribedFire
6 Seed/Plant/ExoticsControl
7 SuccChangeGrazing
8 Wildfire
9 Insects
10 Pathogens
```

```
11 Agriculture
12 Weather/Wildlife
13 Other
14 Other2
15 Other3
```

The colors used when drawing the pathways are linked to the group number. The current associations are:

Colour	Green	Yellow	Red	Black	Blue
Group Number	9	7,8	10	1,2,3	All others More than 1 agent

Disturbance Probability Multiplier File (*.MLT)

The first line in the MLT file is an indicator that the area limit information starts. The second line gives the time interval limits including the start and end years. The next lines give the information for the area limits by disturbance group (dist group, min and max area for each time interval – in this example, lines starting with 1 through 20). The line with -9999 indicates the end of area limits information. The rest of the lines contain the multiplier information by disturbance type and region.

```
-999
1 10 30 50 100 150
1 1 1 1 1 1 1 1 1 0 0
2 1 1 1 1 1 1 1 1 0 0
3 1 1 1 1 1 1 1 1 0 0
4 1 1 1 1 1 1 1 1 0 0
5 1 1 1 1 1 1 1 1 0 0
6 1 1 1 1 1 1 1 1 0 0
7 1 1 1 1 1 1 1 1 0 0
9 1 1 1 1 1 1 1 1 0 0
10 1 1 1 1 1 1 1 1 0 0
11 1466 1466 226 226 828 828 1 1 0 0
12 697 697 374 374 164 164 24 24 0 0
13 1 1 80 80 1 1 1 1 0 0
14 267 267 936 936 1 1 1 1 53 53
15 255 255 34 34 1 1 1 1 3 3
16 1 1 159 159 1 1 1 1 0 0
17 2777 2777 805 805 1110 1110 379 379 348 348
19 134 134 472 472 57 57 1 1 20 20
20 1 1 1421 1421 1 1 600 600 0 0
-9999
1002 1 1 1 1 1 1 0 0
1003 1 1 1 1 1 1 0 0
1004 1 1 1 1 1 1 0 0
1005 1 1 1 1 1 1 0 0
1006 1 1 1 1 1 1 0 0
1007 1 1 1 1 1 1 0 0
1010 1 1 1 1 1 1 0 0
1011 1 1 1 1 1 1 0 0
1101 1 1 1 1 1 1 0 0
```

```
1102 1 1 1 1 1 1 0 0
```

...

Initial Conditions File (*.IC)

The initial conditions file has the format (items in [ ] are optional):

structural stage, cover type, proportion of pixels with that combination,
[minimum age, maximum age, [TSD]]
[-999, area]
[-9999, max TSD value]

By default, the VDDT model initially spreads the pixels out among the ages associated with each class. The optional minimum and maximum age fields can be used to further define the actual ages associated with each class. The optional TSD field can be used to tell the model how long since the area has been disturbed by a particular disturbance. The last line of the file can optionally include the number -999 and then the area represented by this file.

For example (no ages or TSD, but with area):

```
 26 1015  12
 1 2009  36
 3 2009  20
 4 2009  17
 5 2009  8
 6 2009  7
-999 3672
```

or (with ages but not TSD or area):

```
 26 1015  6 1 6
 26 1015  6 11 20
 1 2009  36 21 50
 3 2009  10 100 110
 3 2009  5 120 130
 3 2009  5 131 170
 4 2009  17 200 299
 5 2009  8 300 450
 6 2009  2 500 510
 6 2009  5 550 560
```

or (with ages, TSD, and area):

```
26 1015  2 1 6 10
 26 1015  4 1 6 21
 26 1015  6 11 20 0
 1 2009  36 21 50 25
 3 2009  10 100 110 0
 3 2009  5 120 130 20
 3 2009  5 131 170 50
4 2009  9 200 250 125
 4 2009  8 251 299 175
 5 2009  8 300 450 200
 6 2009  2 500 510 330
 6 2009  5 550 560 41
-999 3672
-9999 25000
```

LANDSCAPE FEEDBACK FILE: *.LCM

The landscape feedback file (*.LCM) contains all the information necessary to generate a feedback curve that relates the maximum possible proportion of the area disturbed by the disturbance type (in a "normal" year) to a multiplier that may increase or decrease the probabilities based on the current proportion of the landscape at risk. The file lists the disturbance ID and then six values. The six values represent the multipliers to be applied if the proportion of the landscape at risk is at 0%, 20%, 40%, 60%, 80%, or 100% of the maximum possible proportion. Values with a "-1" indicate that no value has been defined for that proportion.

```
1001 1 -1 -1 -1 -1 1
1021 1 -1 -1 -1 -1 1
1022 0.25 3 -1 -1 -1 -1
1201 0.25 -1 -1 -1 3 -1
2002 3 -1 -1 -1 -1 0
2101 1 -1 -1 -1 -1 1
2201 0.25 3 -1 -1 -1 -1
2202 0.25 3 -1 -1 -1 -1
3001 0.25 -1 -1 -1 3 -1
3004 0.25 -1 -1 -1 3 -1
3009 0.25 -1 -1 -1 3 -1
3011 0.25 3 -1 -1 -1 -1
3014 0.25 3 -1 -1 -1 -1
3019 0.25 3 -1 -1 -1 -1
3021 0.25 3 -1 -1 -1 -1
3024 0.25 3 -1 -1 -1 -1
3029 0.25 3 -1 -1 -1 -1
3030 3 -1 -1 -1 -1 0
```

Note that LCM files from version 3.0 have 7 columns rather than 6. VDDT will import these files, but give a warning that they are from the older version. Thus, the multipliers will be offset from their original location.

LANDSCAPE CONDITIONS FEEDBACK FILE: *.LCF

The Landscape Conditions Feedback file (*.LCF) contains information on the landscape condition feedback groups used to link disturbance probabilities to numerical attributes. A simple example is shown below. The first line indicates the number of groups, in this case 2. Each group is then listed with one line of information followed by the disturbance codes of the disturbances associated with the LCF group:

"name of the group", "numerical attribute", "prop area affected", "percent 1 – 4", "number of disturbances"

```
2
"Risk of Fire","FireRisk",1,15,30,45,60,2
```

```
 3001
 3011
"Risk of Insects","BugRisk",1,15,30,45,60,1
 2011
```

Location File

The location file (*.LOC) stores the location of all the classes in a PVT. Once it is created for a PVT, it is required for all future use of the PVT file (unless it is not loaded with the PVT). If the file is deleted, the PVT file will load, but the locations will be set by VDDT.

The columns are: PVT number, the location of the class, the cover type, and the structural stage. Class location is defined by imagining that there are 8 boxes on each row, with the first box labeled 0, and then numbering from left to right along each row. Thus the boxes in the first four rows of the first column will have the location codes 0, 8, 16, 24.

Example:

```
 999   0    1015   26
 999   1    2009   1
 999   3    2009   3
 999   4    2009   4
 999   6    2009   6
 999   13   2009   5
```

MCM File

A **Monte Carol multiplier** (*.MCM) file can contain up to 300 sets of randomized YSG multipliers.

The first line of the MCM file contains the number of years and the Monte Carlo ID number:
‘# of Years’ ‘MC ID’

The second line contains the YSG group ID number, the YSG name, and the number of disturbances in the YSG group:
'YSG Group ID' 'YSG Name' '# of Disturbances in YSG Group'

Line 3 contains disturbance IDs for each disturbance indicated in line 2:
0 'DistID 1' 'DistID 2' ...

Line 4, repeated for the number of years indicated in line 1, lists the multipliers for each disturbance:
1, Mult, Mult, Mult, ...
2, Mult, Mult, Mult...

Repeat Lines 2 to 4 for each YSG in the model.

Line 5:
-999

Repeat lines 1 to 5 for each Monte Carlo.

In the following example MCM file: the number of years = 10; there are two YSGs (Drought and RainFire); the YSG called "Drought" contains 1 disturbance and the YSG called "RainFire" contains 7 disturbances; and there are two Monte Carlos.

```
10  1
 1 "Drought"  1
 0      3103
 1      0
 2      0
 3      0
 4      0
 5      0
 6      0
 7      0
 8      0
 9      0
 10     0
 2 "RainFire"  7
 0      1319    1301    1302    3004    3001    1315    3105
 1      0.5     0.5     0.5     1       3       1       1
 2      0.5     0.5     0.5     1       3       1       1
 3      1       1       1       2       2       0.5     0.5
 4      0.3     0.3     0.3     0       10      1       1
 5      1       1       1       2       2       0.5     0.5
 6      0.3     0.3     0.3     0       10      1       1
 7      1       1       1       2       2       0.5     0.5
 8      1       1       1       2       2       0.5     0.5
 9      1       1       1       2       2       0.5     0.5
 10     2.5     2.5     2.5     3       1       0       0
 -999
 10  2
 1 "Drought"  1
 0      3103
 1      0
 2      0
 3      0
 4      0
 5      0
 6      0
 7      0
 8      0
 9      0
 10     0
 2 "RainFire"  7
 0      1319    1301    1302    3004    3001    1315    3105
 1      2.5     2.5     2.5     3       1       0       0
 2      1       1       1       2       2       0.5     0.5
 3      1       1       1       2       2       0.5     0.5
 4      1       1       1       2       2       0.5     0.5
 5      1       1       1       2       2       0.5     0.5
 6      1       1       1       2       2       0.5     0.5
 7      1       1       1       2       2       0.5     0.5
 8      0.5     0.5     0.5     1       3       1       1
 9      1       1       1       2       2       0.5     0.5
 10     1       1       1       2       2       0.5     0.5
 -999
```

Probability File

The first line is a header line which gives the name of the scenario file containing the probabilities that are printed in this file. The second line gives the number and name of the PVT that is printed. The remainder of the information is divided into three types of lines. The first gives information identifying the class (class letter, structural stage number and name, and cover type number and name). The second line type contains the letter of the class that the pixel would go to through succession, and the number of years that it would take before succession occurred. The third line type lists all the information about a disturbance: the letter of the destination class, disturbance ID, disturbance name, the **probability** associated with the disturbance in each of the three management regions, and the ages for which this probability is applicable.

```
SCN: Sample.scn
 999 SamplePVT
 A 26 ClosedMidShrub 1015 GeneralShrub
  Succession: B  5
 B 1 StandInitiationForest 2009 LodgepolePine
  Succession: C  45
  A 3001 WSRF    0.006 6 51  0.006 6 51  0.006 6 51  0
 C 3 StemExclusionClosedCanopyForest 2009 LodgepolePine
  Succession: D  40
  A 1001 CC-Noprep  0 0 0   0.0015 51 91 0.0015 51 91 0
  A 3001 WSRF    0.002 51 91  0.002 51 91  0.002 51 91  0
  A 3021 PUSRF   0.001 51 91  0 0 0   0 0 0   0
  C 1103 ThinLow   0 0 0   0.0125 51 91 0.0125 51 91 20
  C 3106 Snow/breakage 0.0002 51 91 0.0002 51 91 0.0002 51 91 10
  D 1101 CommerThin  0 0 0   0.0023 51 91 0.0023 51 91 0
 D 4 UnderstoryReinitationForest 2009 LodgepolePine
  Succession: F  40
  A 1001 CC-Noprep  0 0 0   0.023 91 131 0.023 91 131 0
  A 3001 WSRF    0.004 91 131 0.004 91 131 0.004 91 131 0
  A 3021 PUSRF   0.0015 91 131 0 0 0   0 0 0   0
  A 3483 MSF+BB   0.0015 91 131 0.0015 91 131 0.0015 91 131 0
  D 3009 WUB    0.0001 91 131 0.0001 91 131 0.0001 91 131 0
  E 1021 PartialCut  0 0 0   0.002 91 131 0.002 91 131 0
  E 2002 MPB    0.01 91 131  0.01 91 131  0.01 91 131  0
 E 5 YoungMulti-strataForest 2009 LodgepolePine
  Succession: F  80
  A 3001 WSRF    0.0025 131 211 0.004 131 211 0.004 131 211 0
  A 3021 PUSRF   0.0025 131 211 0 0 0   0 0 0   0
  E 1021 PartialCut  0 0 0   0.0012 131 211 0.0012 131 211 0
  E 2002 MPB    0.001 131 211 0.001 131 211 0.001 131 211 0
  E 3440 RD+WUB   0.0001 131 211 0.0001 131 211 0.0001 131 211 0
  E 3441 RD+PPUB   0 0 0   0.0001 131 211 0.0001 131 211 0
  E 3442 RD+PUUB   0 0 0   0.0001 131 211 0.0001 131 211 0
 F 6 OldMulti-strataForest 2009 LodgepolePine
  Succession: F  999
  A 1001 CC-Noprep  0 0 0   0.05 131 1130 0.05 131 1130 0
  A 3001 WSRF    0.007 131 1130 0.007 131 1130 0.007 131 1130 0
  E 1021 PartialCut  0 0 0   0.005 131 1130 0.005 131 1130 0
  E 2002 MPB    0.01 131 1130 0.01 131 1130 0.01 131 1130 0
```

PROJECT FILE

In VDDT version 4, the project file stores the full filename of all files that are in use in VDDT at the time that the project file is saved. It is useful for grouping definition files with a PVT, and for loading all files at once without going through multiple windows and menu items.

The file format is generally: code word identifying the type of information, filename or value. The code word must be present, but the area after the ":" can be blank if the relevant file does not exist or should not be loaded automatically.

Dists:	disturbance type filename (distcode.*)
DistGroups:	disturbance group filename (distgrp.*)
LongCover:	cover type names filename (cover.*)
ShortCover:	cover type abbreviation filename (coverc.*)
Structure:	structural stage filename (structur.*)
PVT:	PVT filename (*.PVT)
SCN:	scenario filename (*.SCN)
LOC:	location filename (*.LOC)
Atts:	attribute filename (*.ATT)
Des:	model description filename (*.DES)
ICs:	initial conditions filename (*.IC)
YSGdef:	year-sequence group filename (*.YSG)
YTMult:	year type multiplier filename (*.YTM)
MSE:	multiplier sequence filename (*.MSE)
NSE:	normalized multiplier sequence filename (*.NSE)
LandMult:	landscape feedback multiplier filename
MCMults:	filename containing the normalized annual multipliers for multiple Monte Carlo simulations
Trend:	filename containing trend multipliers (*.TRD)
LCFdef:	filename containing landscape condition feedback file definitions (*.LCF)
LCF:	filename containing landscape feedback multipliers (*.LFM)
Mults:	filename containing multiplier definitions for disturbances or groups (*.MLT)
PFormat:	file that is saved when exiting the **Print to File** screen with **OK**.
PFormatOut:	saves the name of all output files defined after making the run and selecting the **Results**|**Print** menu.
AllTransFileName:	holds the filenames selected from the menu **Run Model|Print (during simulation)**. There can be up to three files separated by commas.
TransFileName:	TRN filename
ClassesFileName:	OUT files containing class information
DistFileName:	OUT files containing disturbance information
AvgDistProbFileName:	OUT files containing the average disturbance probability information
GOptions:	a T or F indicate which graph options are selected followed by a number indicating the number of standard deviations or the central tendency %
GMInt:	mean line time intervals
DisableDist:	a T or F indicate which disturbance groups are disabled
DoVariation:	boolean for whether the variation multipliers are on
DoLandscape:	boolean for whether the landscape feedback multipliers are on
DoLCF:	a T or F indicates if landscape condition feedback multipliers are on
DoTremd:	a T or F indicates if trend multipliers are on
UseMult:	a T or F indicates if disturbance multipliers are on
TSD:	number of the disturbance group used for time-since-disturbance calculations (-1 = none)
Region:	current management region

Times:	number of years to simulate, graph start time, graph end time, four times for each of the bar graphs
Options:	multiplier options: years generated; what generated; generation criteria; and normalization criteria
MC:	number of Monte Carlo iterations to do
MCSeq:	option to use for sequencing the between year multipliers during multiple Monte Carlo iterations
Size:	number of pixels, area
Batch:	the information for running a sequence of regions: number of values, region number, number of years

Example:

```
Dists: C:\VDDT\distcode.dem
DistGroups: C:\VDDT\distgrp.dem
LongCover: C:\VDDT\cover.dem
ShortCover: C:\VDDT\coverc.dem
Structure: C:\VDDT\structur.dem
PVT: C:\VDDT\sample.PVT
SCN: C:\VDDT\sample.SCN
LOC: C:\VDDT\sample.LOC
Atts: C:\VDDT\sample.ATT
Des: C:\VDDT\sample.des
ICs: C:\VDDT\sample.ic
YSGdef: C:\VDDT\sample.YSG
YTMult:
MSE:
NSE:
LandMult:
MCMults:
Trend:
LCFdef:
LCF:
Mults:
PFormat: C:\VDDT\sample.FMT
PFormatOut: C:\VDDT\sample.out
AllTransFileName:
TransFileName: C:\VDDT\sample.trn
ClassesFileName: C:\VDDT\Classes.out
DistFileName: C:\VDDT\Disturbances.out
AvgDistProbFileName: C:\VDDT\Avg prob.out
GOptions: TFFTFTFFF, 2
GMInt: 10, 25, 50, 75
DisableDist: FFFFFFFFFFFFFF
DoVariation: True
DoLandscape: False
DoLCF: False
DoTremd: False
UseMult: True
TSD: -1
Region: 1
Times: 100, 0, 100, 0, 10, 50, 100
Options: 100, 0, 1, 0
MC: 3
MCSeq: 0
Size: 100, 100
Batch: 1 , 1, 100
```

PVT File (Old Format)

The first line of this file is a line that can be used as a file header or identifier. Any information on this line is not used in the model but will be remembered and written to the file when saved. The second line shows the number of the PVT (999), its name (Sample), and the number of classes in the PVT (6). After that, the file has two types of lines. The first type is those that give the information about the class (its number, cover type, structural stage, beginning and ending age, the cover type and structural stage it goes to after succession, and the number of disturbances which originate in that class). The second line type lists the information about the possible disturbances from that class (disturbance ID, disturbance name, destination structural stage, destination age, destination cover type, relative age at the destination, and (optional) whether the relative age is maintained when the disturbance occurs).

Note:
Note that the relative age value shown in the dialog box with all the pathway definitions is calculated from the destination age and beginning age of the destination class when a pathway changes classes, and from the relative age value when the pathway remains in the same class.

Note that the third line of the file must contain at least one letter in order for the file to be recognized as an old format PVT file.

```
Optional file header/identifier
999 Sample 6
  1  26 CloseLowShrub  1015 Shrubfield  1 6 1 2009 0
  2  1 StandInitiation  2009 Lodgepole  6 51 3 2009 1
  3001 WSRF  26 1 1015 0 False
  3  3 StemExclusionClosed 2009 Lodgepole  51 91 4 2009 8
  3001 WSRF  26 1 1015 0 False
  3011 PPSRF  26 1 1015 0 False
  3021 PUSRF  26 1 1015 0 False
  3030 WFC  4 91 2009 0 True
  3106 Snow/breakage 3 61 2009 10 False
  1103 ThinLow  3 71 2009 20 False
  1101 CommerThin 4 91 2009 0 False
  1001 CC-Noprep  26 1 1015 0 False
  4  4 UnderstoryReinitiation 2009 Lodgepole  91 131 6 2009 11
  1001 CC-Noprep  26 1 1015 0
  1021 PartialCut 5 131 2009 0
  3001 WSRF  26 1 1015 0
  3011 PPSRF  26 1 1015 0
  3021 PUSRF  26 1 1015 0
  3009 WUB  4 91 2009 0
  3019 PPUB  4 91 2009 0
  3029 PUUB  4 91 2009 0
  3483 MSF+BB 26 1 1015 0
  2002 MPB  5 131 2009 0
  1103 ThinLow 4 121 2009 10
  5  5 YoungForest   2009 Lodgepole  131 211 6 2009 11
  1001 CC-Noprep  26 1 1015 0
  3001 WSRF  26 1 1015 0
  3011 PPSRF  26 1 1015 0
  3021 PUSRF  26 1 1015 0
  3030 WFC  5 131 2009 0
  1021 PartialCut 5 131 2009 0
```

```
1103 ThinLow  5 131 2009 0
3440 RD+WUB  5 131 2009 0
3441 RD+PPUB  5 131 2009 0
3442 RD+PUUB  5 131 2009 0
2002 MPB   5 131 2009 0
6  6 OldForestMultiStrata 2009 Lodgepole  131 1130 6 2009 4
3001 WSRF   26 1 1015 0
1001 CC-Noprep  26 1 1015 0
1021 PartialCut 5 131 2009 0
2002 MPB   5 131 2009 0
```

PVT FILE (NEW FORMAT)

The "New Format" is very similar to the "Old Format" but there are a few important differences. The primary difference is the lack of text: new format files do not name every cover type and structural stage. The second main difference is the use of five or six digit numbers to represent the class. These numbers are the combined form of the structural stage (the first one or two digits) and cover type (the last four digits). This number uniquely identifies different classes within a PVT, and will be called the class identifier in the following description.

As in the old format files, the first line of this file can be used as a file header or identifier. Any information on this line is not used in the model but will be remembered and written to the file when saved. The first line shows the number of the PVT (999), its name (SamplePVT), and the number of classes in the PVT (6). After that, the file has two types of lines (also like in the old format case). The first gives information about the class: the class identifier, the structural stage (alone), the cover type, the beginning and ending age, the class identifier for where it goes after succession, a new age (not used, so set to 0), and the number of disturbances which originate in that class. The second line type lists the information about the possible disturbances from that class: disturbance ID, disturbance name, destination class identifier, destination age and the relative age at the destination, and (optional) whether the relative age is maintained when the disturbance occurs.

Note:
Note that the relative age value shown in the dialog box with all the pathway definitions is calculated from the destination age and beginning age of the destination class when a pathway changes classes, and from the relative age value when the pathway remains in the same class.

```
Optional file header/information
 999 SamplePVT 6
  261015 26 1015 1 6 12009 0 0
  12009 1 2009 6 51 32009 0 1
   3001 WSRF   261015 1 0 False
  32009 3 2009 51 91 42009 0 8
   3001 WSRF   261015 1 0 False
   3011 PPSRF   261015 1 0 False
   3021 PUSRF   261015 1 0 False
   3030 WFC   42009 91 0 True
   3106 Snow/breakage 32009 51 10 False
```

```
  1103 ThinLow  32009 51 20 False
  1101 CommerThin 42009 91 0 False
  1001 CC-Noprep  261015 1 0 False
 42009 4 2009 91 131 62009 0 11
  1001 CC-Noprep  261015 1 0
  1021 PartialCut 52009 131 0
  3001 WSRF   261015 1 0
  3011 PPSRF   261015 1 0
  3021 PUSRF   261015 1 0
  3009 WUB   42009 91 0
  3019 PPUB   42009 91 0
  3029 PUUB   42009 91 0
  3483 MSF+BB  261015 1 0
  2002 MPB   52009 131 0
  1103 ThinLow  42009 91 10
 52009 5 2009 131 211 62009 0 11
  1001 CC-Noprep  261015 1 0
  3001 WSRF   261015 1 0
  3011 PPSRF   261015 1 0
  3021 PUSRF   261015 1 0
  3030 WFC   52009 131 0
  1021 PartialCut 52009 131 0
  1103 ThinLow  52009 131 0
  3440 RD+WUB  52009 131 0
  3441 RD+PPUB  52009 131 0

3442 RD+PUUB  52009 131 0
  2002 MPB   52009 131 0
 62009 6 2009 131 1130 62009 0 4
  3001 WSRF   261015 1 0
  1001 CC-Noprep  261015 1 0
  1021 PartialCut 52009 131 0
  2002 MPB   52009 131 0
```

RESULTS FILES

VDDT can produce information about runs in the form of reports (*.CSV files) that can be saved to file and opened in a spreadsheet program such as Microsoft Excel. The model can produce summary and detailed output files for classes and transitions:

- ClassesSummary.csv
- ClassesDetailed.csv
- TransitionsSummary.csv
- TransitionsDetailed.csv

The names for these four files never change.

Summary Reports

Summary reports provide overview information about classes and transition groups that can be graphed to show trends over time.

The classes summary report contains **Area** information for each combination of structural stage (**SSAbbr** and **SSCode**), cover type (**CTAbbr** and **CTCode**), Monte Carlo simulation (**MC**) and **Timestep**. In the example below, which shows only the first 15 records, VDDT generated area information in intervals of 10 timesteps. For each of the selected timestep intervals, one record was generated for each of the 6 structural states in the project. This information can be used to graph area affected in each class over time.

MC	Timestep	ClassCode	CTCode	CTAbbr	SSCode	SSAbbr	Area
1	10	112012	2012	PPine	11	EAD	11
1	10	122012	2012	PPine	12	MID	27
1	10	132012	2012	PPine	13	LSD	34
1	10	212012	2012	PPine	21	EAO	5
1	10	222012	2012	PPine	22	MIO	12
1	10	232012	2012	PPine	23	LSO	11
1	20	112012	2012	PPine	11	EAD	13
1	20	122012	2012	PPine	12	MID	24
1	20	132012	2012	PPine	13	LSD	24
1	20	212012	2012	PPine	21	EAO	9
1	20	222012	2012	PPine	22	MIO	15
1	20	232012	2012	PPine	23	LSO	15
1	30	112012	2012	PPine	11	EAD	17
1	30	122012	2012	PPine	12	MID	19
1	30	132012	2012	PPine	13	LSD	19

The transitions summary report contains **Area** information for each combination of transition group (**TransGrpName** and **TransGrpCode**), Monte Carlo simulation (**MC**) and **Timestep**. In the example below, which shows the first 20 records of the report, VDDT generated area information in intervals of 5 timesteps for every defined transition group. This information can be used to graph the area affected by each transition group over time.

MC	Timestep	TransGrpCode	TransGrpName	Area
1	5	1	Selective_Log	0
1	5	2	Commercial_Thin	0
1	5	3	Thin	0
1	5	4	Prescribed_Fire	0
1	5	5	Bark_Beetle	0
1	5	6	Severe_Wild_Fire	0
1	5	7	Under_Burn	3
1	5	8	Fuel_Buildup	0
1	5	9	TSD	3
1	5	10	Succession	0
1	10	1	Selective_Log	2
1	10	2	Commercial_Thin	1
1	10	3	Thin	0
1	10	4	Prescribed_Fire	0
1	10	5	Bark_Beetle	0
1	10	6	Severe_Wild_Fire	0
1	10	7	Under_Burn	1
1	10	8	Fuel_Buildup	1
1	10	9	TSD	3
1	10	10	Succession	0

Detailed reports

Detailed reports contain information about individual cells in the simulation, which provide a history of the state of each cell over time. Detailed reports can be used to look at the distribution of age and time since disturbance.

A classes detailed report contains **Age** and time since disturbance information for every cell (**Pixel**) and transition group (**TSD-***) in the simulation. This information is generated for every combination of structural stage (**SSAbbr** and **SSCode**), cover type (**CTAbbr** and **CTCode**), Monte Carlo (**MC**) simulation and **Timestep**. In the example below, which shows only the first 5 records and the first 3 transition groups, VDDT generated information for every cell in intervals of 10 timesteps.

MC	Timestep	Pixel	ClassCode	CTCode	CTAbbr	SSCode	SSAbbr	Age	TSD-Selective_Log	TSD-Commercial_Thin	TSD-Thin
1	10	1	112012	2012	PPine	11	EAD	34	11	28	14
1	10	2	122012	2012	PPine	12	MID	40	20	14	22
1	10	3	122012	2012	PPine	12	MID	45	19	12	11
1	10	4	122012	2012	PPine	12	MID	45	20	18	32
1	10	5	212012	2012	PPine	21	EAO	8	23	12	11

A transitions detailed report contains information about the starting and ending state of every cell (**Pixel**) that has a transition during the specified time interval. For each of these cells, information is generated for every combination of transition type (**TransType** and **TransTypeName**), transition group (**TSD-***), structural stage, cover type, Monte Carlo (**MC**) simulation and **Timestep**. A series of **Start*** fields shows the state of the cell before transition and corresponding **End*** fields show the state of the cell following transition.

SCENARIO FILE (OLD FORMAT

The first line is a simple header line. The second line gives a code for the phase, the name of the phase, the beginning and ending years of the simulation, and the number of management regions which are present in the file. After that, the file is divided into the different management regions. The first line of each management region gives the region number, the region name, and the number of classes in the region. Note that these region names are those that will be used inside the program. The remainder of the information about the region is divided into two types of lines. The first gives information identifying the PVT and class (PVT number and name, structural stage, cover type, and the number of disturbances containing probabilities which originate in that class). The second line type lists the information about the disturbance (disturbance ID, disturbance name, percentage, and TSD value). Note that the values given in this file are a **percentage**, not a probability.

```
Printed from VDDT
 1 PhaseOne 0 300 2
 1 Wilderness+NationalPark 5
  999 Sample 1 StandInitiation 2009 Lodgepole 1
  3001 WSRF   .6 0
```

```
 999 Sample 3 StemExclusionClosed 2009 Lodgepole 3
 3001 WSRF   .2 0
 3021 PUSRF   .1 0
 3106 Snow/breakage .02 0
 999 Sample 4 UnderstoryReinitiation 2009 Lodgepole 5
 3001 WSRF   .4 0
 3021 PUSRF   .15 0
 3009 WUB    .01 0
 3483 MSF+BB   .15 0
 2002 MPB    1 0
 999 Sample 5 YoungForest 2009 Lodgepole 4
 3001 WSRF   .25 0
 3021 PUSRF   .25 0
 3440 RD+WUB   .01 0
 2002 MPB    .1 0
 999 Sample 6 OldForestMultiStrata 2009 Lodgepole 2
 3001 WSRF   .7 0
 2002 MPB    1 0
2 USFS+Federal    5 0
 999 Sample 1 StandInitiation 2009 Lodgepole 1
 3001 WSRF   .6 0
 999 Sample 3 StemExclusionClosed 2009 Lodgepole 5
 3001 WSRF   .2 0
 3106 Snow/breakage .02 0
 1103 ThinLow   1.25 0
 1101 CommerThin  .23 0
 1001 Clearcut-Noprep .15 0
 999 Sample 4 UnderstoryReinitiation 2009 Lodgepole 6
 1001 Clearcut-Noprep 2.3 0
 1021 PartialCut  .2 0
 3001 WSRF   .4 0
 3009 WUB    .01 0
 3483 MSF+BB   .15 0
 2002 MPB    1 0
 999 Sample 5 YoungForest 2009 Lodgepole 6
 3001 WSRF   .4 0
 1021 PartialCut  .12 0
 3440 RD+WUB   .01 0
 3441 RD+PPUB   .01 0
 3442 RD+PUUB   .01 0
 2002 MPB    .1 0
 999 Sample 6 OldForestMultiStrata 2009 Lodgepole 4
 3001 WSRF   .7 0
 1001 Clearcut-Noprep 5 0
 1021 PartialCut  .5 0
 2002 MPB    1 0
```

SCENARIO FILE (NEW FORMAT)

As with the PVT files, the structure of the new and old format files is very similar. The main difference is the use of the class identifier (see PVT New Format description) and the lack of cover type and structural stage descriptors. The first three lines are in the same format as the old format files. The remainder of the information about the region is divided into two types of lines. The first gives information identifying the PVT and class (PVT number and name, class identifier, and the number of disturbances containing probabilities which originate in that class). The second line type lists the information about the disturbance (disturbance ID, disturbance name, percentage, and TSD value). Note that the values given in this file are a **probability**, not a percentage as in the old format.

```
TS
 1 PhaseOne 0 300 2
 1 Wilderness+NationalPark 5
  999 SamplePVT   12009 1
  3001 WSRF   .006 0
  999 SamplePVT   32009 3
  3001 WSRF   .002 0
  3021 PUSRF   .001 0
  3106 Snow/breakage .0002 0
  999 SamplePVT   42009 5
  3001 WSRF   .004 0
  3021 PUSRF   .0015 0
  3009 WUB    .0001 0
  3443 UnknownCode  .0015 0
  2002 MPB    .01 0
  999 SamplePVT   52009 4
  3001 WSRF   .0025 0
  3021 PUSRF   .0025 0
  3440 RD+WUB   .0001 0
  2002 MPB    .001 0
  999 SamplePVT   62009 2
  3001 WSRF   .007 0
  2002 MPB    .01 0
 2 USFS+Federal    5
  999 SamplePVT   12009 1
  3001 WSRF   .006 0
  999 SamplePVT   32009 5
  3001 WSRF   .002 0
  3106 Snow/breakage .0002 0
  1103 ThinLow   .0125 0
  1101 CommerThin  .0023 0
  1001 CC-Noprep  .0015 0
  999 SamplePVT   42009 6
  1001 CC-Noprep  .023 0
  1021 PartialCut  .002 0
  3001 WSRF   .004 0
  3009 WUB    .0001 0
  3443 UnknownCode  .0015 0
  2002 MPB    .01 0
  999 SamplePVT   52009 6
  3001 WSRF   .004 0
  1021 PartialCut  .0012 0
  3440 RD+WUB   .0001 0
  3441 RD+PPUB   .0001 0
  3442 RD+PUUB   .0001 0
  2002 MPB    .001 0
  999 SamplePVT   62009 4
  3001 WSRF   .007 0
  1001 CC-Noprep  .05 0
  1021 PartialCut  .005 0
  2002 MPB    .01 0
```

STRUCTURAL STAGE FILE

Structural stages are referenced throughout the model by number (although the transition pathway diagram may also show character abbreviations). A label attached to each number is printed to the output file (in the old format) for informational purposes only. The labels and character abbreviations are read from the file STRUCTUR.TXT, contained in the base directory where VDDT resides. Like the other TXT files, the structural stage file can be modified as desired.

The file has the format:

column 1	structural stage number (must be a number from 1-50)
column 2	code to put in the transition pathway diagram (number or 1-3 characters)
column 3	name or description of structural stage (used for informational purposes only, but must not contain any blanks).

The following is the structural stage file that comes with VDDT.

```
1 SIF StandInitiationForest
2 SOF StemExclusionOpenCanopyForest
3 SEF StemExclusionClosedCanopyForest
4 URF UnderstoryReinitationForest
5 YMF YoungMulti-strataForest
6 OMF OldMulti-strataForest
7 OSF OldSingle-strataForest
11 SIW StandInitiationWoodland
12 SEW StemExclusionWoodland
13 URW UnderstoryReinitiationWoodland
14 YMW YoungMulti-strataWoodland
15 OMW OldMulti-strataWoodland
16 OSW OldSingle-strataWoodland
21 OHB OpenHerbland
22 CHB ClosedHerbland
23 CLS ClosedLowShrub
24 OLS OpenLowShrub
25 OMS OpenMidShrub
26 CMS ClosedMidShrub
27 OTS OpenTallShrub
28 CTS ClosedTallShrub
31 CRP Agricultural
33 URB Urban
34 WTR Water
35 RCK Rock
```

Temporal Trend Multiplier File

The temporal trend multiplier file (*.TRD) contains all the information necessary to generate a temporal trend curve for a given disturbance. There is a line in the file for each trend multiplier defined. The first column contains the code for the disturbance type. The remaining columns contain the step followed by its associated value — repeated for each step. To illustrate, the first line in the example below contains the disturbance code 1004 followed by the first time step of 0 and its corresponding value of .0031.

```
1004 0 .0031 10 .0025 20 .002 30 .0013 40 .0016 50 .0011 60
.0008 70 .0008 80 .0007 90 .001 100 .002

 1010 0 .0031 10 .0025 20 .002 30 .0013 40 .0016 50 .0011
60 .0008 70 .0008 80 .0007 90 .001 100 .002
```

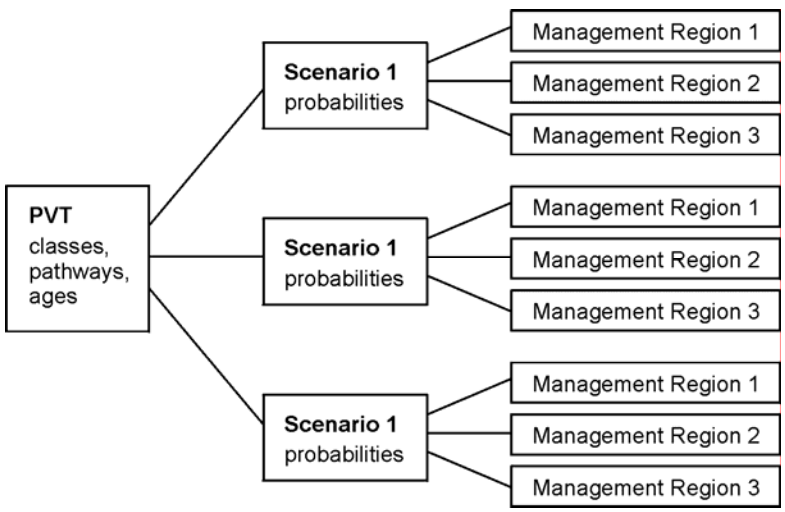
```
 1011 0 .0031 10 .0025 20 .002 30 .0013 40 .0016 50 .0011
60 .0008 70 .0008 80 .0007 90 .001 100 .002

 1012 0 .0031 10 .0025 20 .002 30 .0013 40 .0016 50 .0011
60 .0008 70 .0008 80 .0007 90 .001 100 .002

 1013 0 .0031 10 .0025 20 .002 30 .0013 40 .0016 50 .0011
60 .0008 70 .0008 80 .0007 90 .001 100 .002
```

APPENDIX E: LEGACY VDDT FILES

FILE DESCRIPTIONS

Two general types of files were used by VDDT version 4.4c and earlier: PVT files and scenario files. These files can still be imported into version 6 to create Projects. The information about a transition pathway diagram for each potential vegetation type (PVT) is defined in the PVT file. This includes all valid combinations of cover type and structural stage, and all the possible pathways. The scenario file (extension SCN) contains the non-zero probabilities for the pathways in each management region.

Each PVT file must have at least one scenario file (with the disturbance probabilities) associated with it. A single PVT file may be referenced by several scenario files, each of which defines probabilities under different scenario assumptions for one or more different management regions.



In order to run the model a scenario file must be loaded. The program will prompt the user to load a scenario file once a PVT file has been loaded.

Most users do not need to know the structure of the PVT and scenario files, but this information is sometimes useful. Example files, with a brief description, are shown in Appendix D.

PVT, Scenario, and Location Files

PVT and scenario files

The PVT and scenario files contain the minimum amount of information necessary to run the model for a specific landscape or situation. As such, they will always import and export together.

New scenario files may be loaded at any time by selecting **Scenario** from the **File|Import** menu. Only one scenario file can be loaded at any time, so the new one replaces the previously loaded one as the active file. The program assumes that the loaded scenario file is associated with the PVT in memory.

If there are more than six management regions in the scenario file, the user is given the option to load only the first six. When a scenario file is saved, only those management regions that were read will be saved. For example, if a scenario file contains nine management regions and only the first six are read at the time the scenario file is loaded, these six will be the only management regions in memory. When the scenario information is saved, these six will also be the only regions present in the new file. **Six management regions are the recommended maximum number of regions.**

As a safeguard against possible operator errors, the program performs a series of error checks while scenario files are loading. It displays a warning message if the scenario file is trying to access a PVT, class (cover type-structural stage combination), or disturbance which is not part of the currently loaded PVT. If any of these are not present in the PVT file, the model will ignore them, and when saved, the new scenario file will not contain this information. Warning messages may be an indication that incompatible PVT and scenario files are being loaded. See the section about *Trouble Shooting* for additional information.

After both files are loaded, the program does some checking of the PVT file to make sure that all information is valid. Warning messages will appear if file contains two classes with the same cover type and structural stage definition, or if some pathways (succession or disturbance) go to non-existent classes. The model may not run with these problems, so users should note the problems and fix them when the pathway diagram is fully loaded.

Warnings about additional discrepancies, such as having a disturbance code or cover type that is not in the current disturbance or cover type file, will also be shown. These warnings are often an indication that the files were created with a different set of the TXT files than those that are currently in memory.

Location file

The location file contains information about the placement of the classes in the TPD diagram. This information is optional, as VDDT can organize classes using an internal rule-base.

After the scenario file is read, the model will look to see if there is a location file with the same name as the PVT file. If so, the user will be prompted to load the location file as well. The information in the location file will overwrite the default information produced by VDDT. Once a location file is being used for a VDDT session, all new classes must be placed in the desired location.

Clicking on the **Cancel** button when VDDT asks for the location file name will cause VDDT to ignore the location file, and to use the default locations for the classes.

Note:
Note that if the location file has a different name than the PVT file, the model will not find the file and will not prompt the user to load it. You can open a location file with a different name by navigating to the directory containing the file, and selecting it.

APPENDIX F: BUILD MCM TOOL

This program generates complex multiplier streams for **Year Sequence Groups** and melds them into one Monte Carlo multiplier (*.MCM) file. In summary, the program:

- reads an YSG file to determine the disturbance codes that apply to each YSG;
- reads an YTM file to determine the multipliers that apply to each disturbance; and
- generates up to 300 non-normalized sequences for each YSG and melds the data for up to five YSGs into one *.MCM file.

To generate multipliers for multi-year outbreaks, use only the *normal*, *high*, and *severe* year types when defining YSGs. One suggested method is to put the actual probabilities associated with each year type (e.g. the actual probabilities during an outbreak) in the VDDT disturbance tables, then put multipliers of 1 or 0 in the YTM file to turn these disturbances on or off. In the program:

Year type	Description
Severe	represents "outbreak" years
High	represents "pre and post outbreak" years
Normal	represent non-outbreak years

The figure below shows the dialog box used when running the program.

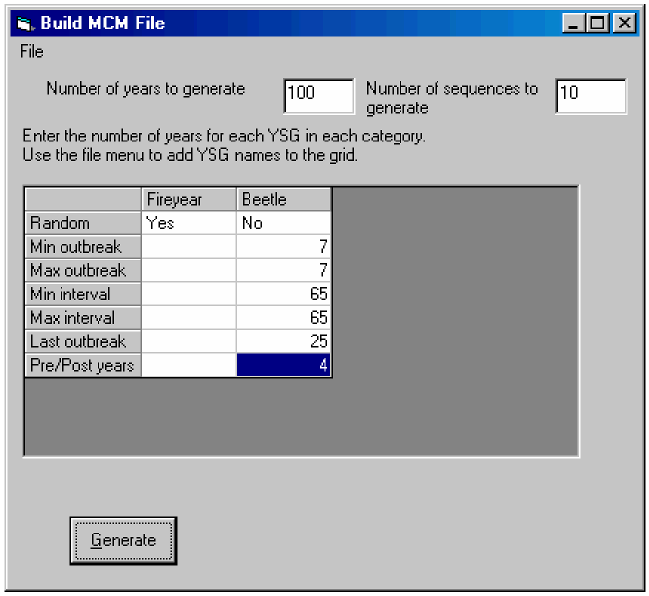
To run the program:

1. Enter the number of years and the number of sequences to generate.
2. Load your YSG and YTM files by selecting the option from the **File** menu.
3. Click on each box in the row labeled *Random* and select Yes or No.
4. Complete the variable information for each YSG. The variables that apply to each YSG are as follows:

Variable	Description
Min and Max Outbreak:	Min and max number of years in each outbreak
Min and Max Interval:	Min and Max years between outbreak midpoints
Last Outbreak:	Years since the midpoint of the last outbreak

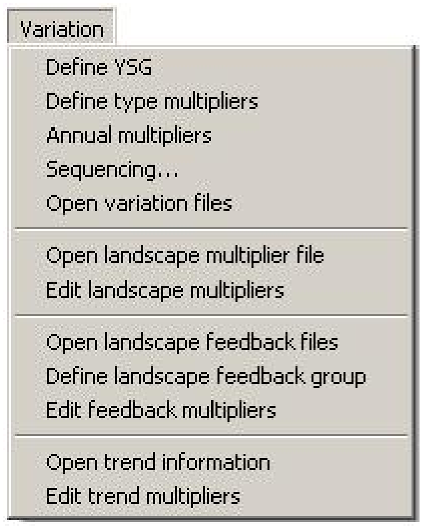
Pre/PostYears:	Number of high (non-normal) years proceeding and following each outbreak

5. Click **Generate** to calculate the multipliers.
6. Save the results to a *.MCM file by selecting **Save MCM File** from the **File** menu.



APPENDIX G: VARIATION MENU

In earlier versions of VDDT, the **Variation** menu was used to define year sequence groups, and to generate and edit a variety of probability multipliers.

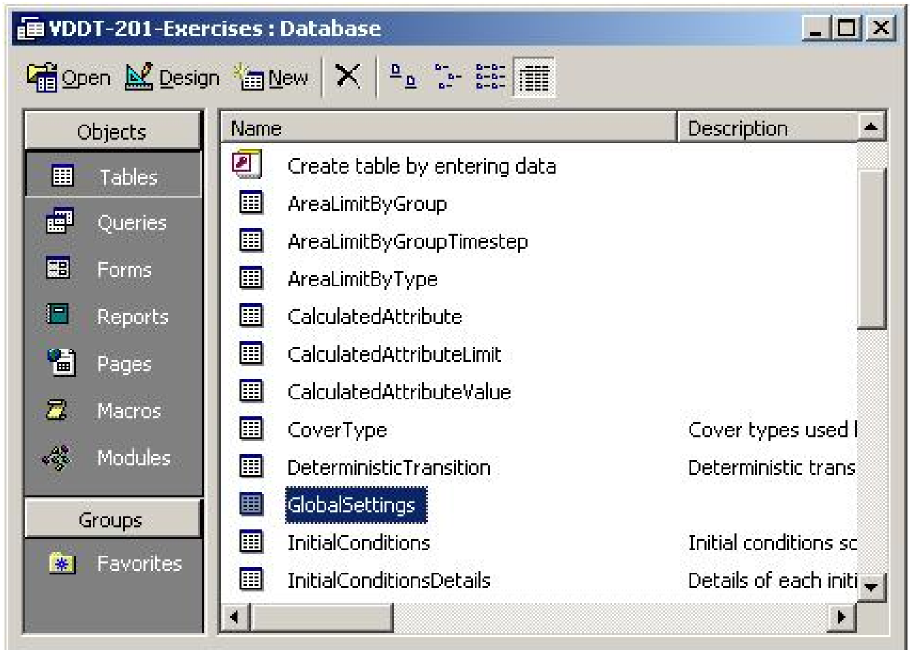


In the current version of VDDT, the most commonly used options from the **Variation** menu have been moved to the **Run** menu (**Run|Settings**), and the **Variation** menu has been hidden from view.

Users who wish to continue using the **Variation** menu so they can work with VDDT's less commonly used advanced features, such as trend multipliers and landscape feedback, can still do so. The **Variation** menu is also still needed by users who wish to generate their own temporal multipliers using the Build MCM Tool (see Appendix F).

To access VDDT's Variation menu:

1. Navigate to and open the Microsoft Access VDDT database that contains the Project with which you wish to work (e.g., C:\Program Files\VDDT\VDDT.mdb).
2. Open the database in Microsoft Access 2000 or later.
3. Open the **GlobalSettings** table.



4. By default, this table contains a single record with the value -1 for the field *HideVariationMenu*, which hides the **Variation** menu in VDDT. Change this value to 0 and close the table. Exit Microsoft Access (there is no need to save the database before exiting the program).

4. The next time you open VDDT with the modified database selected, the **Variation** menu will be accessible as soon as you open a Project.

The following sections of this user guide describe all of the options under the **Variation** menu, and provide guidance about how to use them.

VARIATION MENU

VDDT, through its stochastic algorithms, inherently generates some between-year variability in transition probabilities. The area affected by a transition type in any one year is dependent on the state of the landscape. If a large amount of the landscape is in classes that have a high probability for transitions, the number of cells undergoing transitions will be higher than if most of the landscape is in classes in which transitions have low probabilities. Even disturbances that occur in many or all classes will show some minor variation due to random number generation and due to variability in the probabilities for different classes (see Appendix B for a discussion of probability distributions in transition probabilities).

In ecological systems, sources of variation also include external factors such as weather patterns. For example, several warm, dry years may result in higher than average areas burned or affected by mountain pine beetle. VDDT can capture some of this variation using some user-defined information, described in the following sections.

The first question to be asked is if there is to be between-year variability from external conditions. If so, there are two paths to be followed, depending on whether or not external multipliers are to be used. External multipliers are ones that can be used directly. For example, suppose a user has information that describes stand-replacing fire behavior over a 100-year period. Outside of VDDT, the user determines the average area burned, and then a multiplier for each year to get from the average area burned to the actual area burned. These multipliers could then be placed in a file (in the format described in Appendix D) and used to create between-year variability for stand-replacing fires in VDDT. External files can also be created from saving the between-year multipliers generated in earlier runs of VDDT.

Many users will not have external files, at least not initially. Thus, their first step must be to create groups of disturbances that respond to similar conditions ("year sequence groups" or YSGs). For example, the group could contain disturbances that react to rainfall. Some disturbances (such as fires) may do worse in wet years than in dry years while other disturbances (such as flooding) will have an increased occurrence in wet years. But, since both disturbances respond to rainfall, they can be included in the same group. Once the groups are defined, the next question becomes whether the user wants to control the multipliers that are used. If not, the model can be asked to generate one or more sequences of random numbers.

If users want more control over the multipliers, they can define multipliers for up to five different year conditions for each disturbance type that was placed within one of these YSGs (groups of disturbances). These "year type multipliers" will then be applied to a sequence of year conditions and turned into a stream of multipliers.

The expected methodology is to use annual average probabilities in the pathways table for each succession class. The multipliers represent the ratio of acres disturbed in each year-type as defined in a YSG. For example, if stand replacement wildfires occur every 200 years, the average annual disturbance probability is 0.005. If the ratio of acres burned in low, normal, and high fire years is 1 to 10 to 40, these numbers would be included as the multipliers.

Multipliers must be normalized when average disturbance probabilities are used. Normalization is a process whereby the actual values of the multipliers are adjusted, while keeping the relative values the same, to get an overall average multiplier of 1. This process eliminates any inherent bias arising from the use of between-year variation, and ensures that, barring any changes to the state of the landscape, the average area disturbed over the simulation period by different disturbance types is the same whether or not the multipliers are used.

In some cases the user may have actual disturbance probabilities for each year-type as defined in a YSG. In this instance, the user would put a constant less than or equal to 1 in the pathways tables and put the actual disturbance probabilities in the between-year multiplier table. There would be no need for normalization.

Note that these between-year variability multipliers are not used by default. Multipliers must be generated or read from a file in order for the model to use them during a run. This must be repeated each time a new Project is used. Once the multipliers have been used for a run for a Project, all other runs with that Project (in the same VDDT session) will use the same multipliers unless they are explicitly turned off.

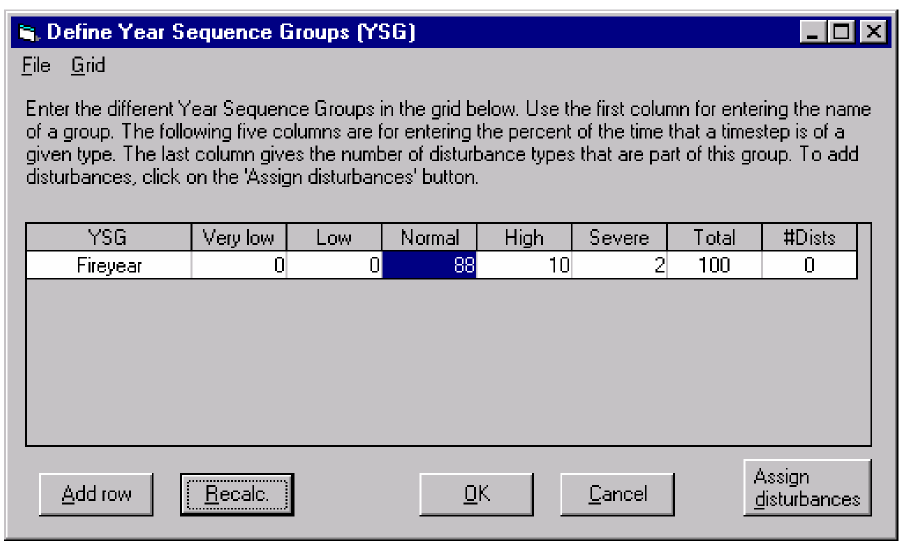
Note:
To create multipliers that change probabilities based on landscape conditions (i.e., internal factors), use the landscape condition feedback multipliers described.

Defining Year Sequence Groups

At the highest level, users define one or more "Year Sequence Groups" (YSG). A YSG defines a group of disturbances that are all affected by the same conditions. The definition also includes the percentage of the years that are expected to be in each of five different categories.

To define a YSG:

1. Select **Define YSG** from the **Variation** menu. A window will appear with a grid containing any already defined YSGs.

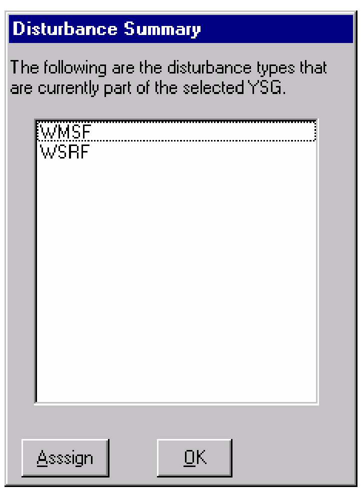


In the above example, one YSG has been defined: Fireyear. The YSG "Fireyear" has 0 disturbances assigned and the assigned proportions add to 100%.

If no YSGs have been defined, the grid will contain a blank line. The columns are as follows:

Column	Description
YSG (1):	The name of the YSG.
Very Low –Severe (2-6):	The percentage of the years in each of the different categories.
Total (7):	The sum of the percentages.
#Dists (8):	The number of disturbances that have been assigned to this YSG.

2. Type in the percent of the time that a year is in that condition in columns 2 through 6. The different types of year conditions are named "Very Low," "Low," "Normal," "High," and "Severe." Users can interpret these for their own conditions and may use as many year types as are needed to model your problem
3. Click on the cell in the *Total* column to add up the values in the previous five columns.
4. If the result is different from 100, you can either adjust the numbers to make them add to 100 or click on the **Recalc** button to ask VDDT to recalculate the numbers so that they retain the same relationship to each other but add up to 100%. You can also select **Recalculate all rows** from the **Grid** menu.
5. The last column of the grid in the main YSG dialog box shows the number of disturbances that are assigned to the YSG. To get a list of these disturbances, double-click on a cell in the last column. A summary dialog box will appear listing the disturbances currently assigned to the YSG.



In the above example, the YSG Fireyear was selected. Two disturbances are listed here. Note the Assign button which allows users to go to a dialog box for adding and deleting disturbances.

6. To add or remove disturbances, click on the **Assign** button at the bottom of the dialog box, or click on the **OK** button to leave this dialog box. Then click on the **Assign disturbances** button just below the grid. A second dialog box will appear that contains two lists.

   The list on the left contains all the disturbance groups that have at least one disturbance defined in the Project. If one of these disturbance groups is selected by the user, a list of the disturbance types will appear on the right. Users can then pick one or more disturbances from one or more lists. Clicking on the **Summary** button will bring up the window that lists all the currently selected items. Note when the summary dialog box is accessed from this window, the **Assign** button will not be visible because the assignment is already in process. The summary window must be closed down (by clicking on the **OK** button) before adding more disturbances

   Note that disturbances may be in up to three different disturbance groups. If the disturbance is selected under one of the groups, it will also be selected in the other groups.

7. When done adding disturbances, click on the **OK** button to keep any changes or the **Cancel** button to ignore any changes. In either case, the window will close.

> **Note:**
> Disturbances can belong to only one YSG. If a disturbance is selected that is already in another YSG, a message will appear:
>
> "The disturbance *name* is already part of another YSG. Do you wish to remove it from that YSG? Note that if the disturbance remains part of that YSG, the disturbance will not be added to the current YSG."
>
> Responding "No" to the message will mean that the disturbance remains part of the other YSG and is not saved as part of the current YSG. Conversely, selecting "Yes" as the response will remove the disturbance from the other YSG and save it in the current YSG.

To add more YSGs:

1. In the main YSG dialog box, click on the **Add Row** button or select **Add Row** from the **Grid** menu. Note that when a YSG is added, it contains no disturbances.

To delete a YSG:

1. Place the cursor on the **row** to be deleted and select **Delete current row** from the **Grid** menu.

Once done, values may be saved to a file by selecting **Save** from the dialog's **File** menu. This saves all information contained in the grid: the name of the YSG, the distribution in the different categories, and the associated disturbances. For complete details, see Appendix D. This file may later be loaded by selecting **Load** from the **File** menu. Loading a file completely overwrites any values that are currently in the grid. In addition, any disturbance types that are in the file that are not part of the current PVT will not be loaded, and thus, cannot be resaved.

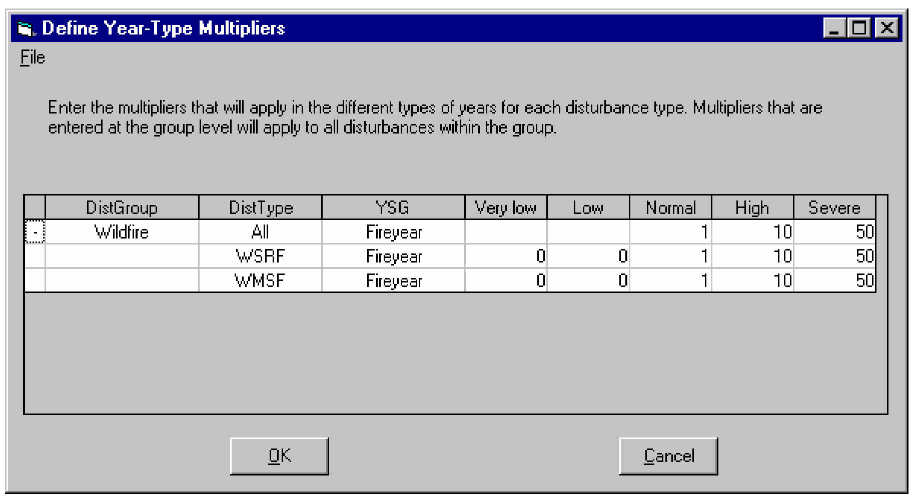
Clicking on the **OK** button saves the information to memory, for use in defining the remaining information required for between-year variation. Clicking on the **Cancel** button closes the window without saving any of the changes that were made.

Defining Type Multipliers

In order for the model to generate annual multipliers, each disturbance that is part of a YSG must have multipliers assigned for each of the five types of years that are used (Very Low, Low, Normal, High, and Severe). In a later step, these multipliers for each disturbance and year type will be combined with information about the YSG to generate annual multipliers.

To assign the multipliers:

1. Select **Define Type Multipliers** from the **Variation** menu. A dialog box will appear with a grid containing all the disturbance groups that contain at least one disturbance that is in a YSG.



2. As in other grids, clicking on the **+** in the first column of the grid will show the specific disturbance agents in that disturbance group. Clicking on the **-** will hide the disturbance agents, while remembering any values that were assigned in the dialog box.

3. Type in the **multipliers** for a group by entering them on the same line as the name of the disturbance group, which is also the line that has **All** in the **DistType** column (e.g., "Wildfire" in the example above). When a group multiplier is entered, it automatically overwrites all values for that year-type for all disturbances in that disturbance group. Values can also be entered for individual disturbances.

Note that if a disturbance occurs in more than one disturbance group, the actual multiplier that is applied is the one that occurs in the last group for which it is defined.

If a value for one of the disturbance types is deleted by the user, and if no value is entered that applies to the entire group, the multiplier is assumed to be zero.

The values in the grid can be saved to a file by selecting **Save** from the **File** menu on the dialog. Multipliers can also be loaded from a file by selecting **Load** from the dialog's **File** menu. Note that if multipliers are loaded, they will overwrite any existing values in the grid. Also, any disturbance types that are not in the file will have no multipliers (or will have a multiplier of 1) and any disturbance types that are in the file that are not defined as part of a YSG will not be loaded. The default file extension is *.YTM (Year Type Multiplier) and the file format is given in Appendix D.

Clicking on the **OK** button saves the information to memory, for use in defining the annual multipliers. Clicking on the **Cancel** button closes the window without saving any of the changes that were made.

Annual Multipliers

Annual multipliers are the values that are actually used by VDDT during a model run. In most cases, these will be generated based on the information in the previous two dialog boxes (the YSGs and the Year-Type Multipliers). In these cases, for each YSG, the generation routine first creates a stream of types of years based on the proportions defined earlier. Second, for each disturbance type, the model changes the year category into the corresponding multiplier (as defined in the second step of the process). This creates sets of annual multipliers for each disturbance type. These multipliers are then normalized to ensure that there is no inherent bias in their use. Alternatively, multipliers can be read from external files.

Note:
An accessory program for generating complex multipliers streams, named BUILD_MCM, is explained in Appendix F.

To create the multiplier streams:

1. Select **Annual multipliers** from the **Variation** menu.
2. To turn off all between-year multipliers (but not remove them from memory), select **Turn off** from the **Multipliers** menu on the **View And Generate Multipliers** dialog, and then click on the **OK** button. The status bar at the bottom of the main VDDT window shows whether or not the multipliers are being used (Annual Mult.).
3. There are several options available for generating the annual multipliers. In the simplest case, users can click on the **Generate** button, then on the **Normalize** button and then on the **OK** button to save the values, exit the window, and use the resulting values for their run. Many users, however,

will want to have more control over their options, to view the multipliers, or to load or save the multipliers. Each of these is described in more detail below.

Generation Options

Many of the options can be found by selecting **Options** from the **Multipliers** menu on the **View And Generate Multipliers** dialog. Four categories of options can be set:

1. The disturbance types to generate.

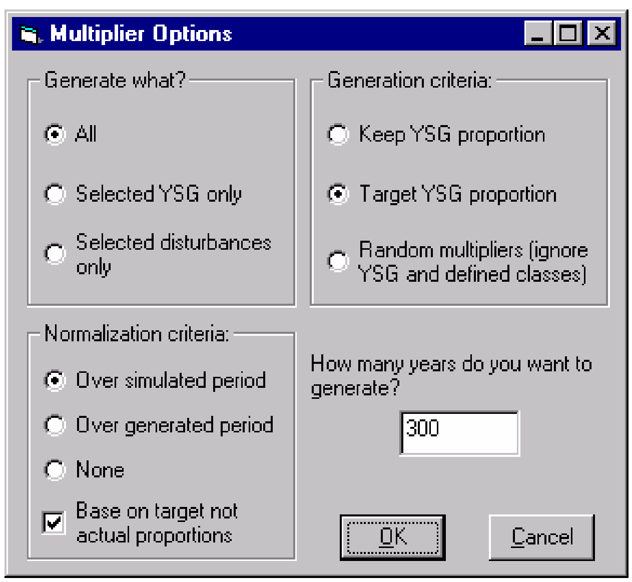
   Under this option, users can choose whether they want to generate the multipliers for:

   a. all disturbance types (default),

   b. for the selected YSG, or

   c. for the selected disturbance types.

   Most of the time, the default option is the most appropriate (see example screen below). The second option may be chosen if the user likes most of the patterns, but wants to refine the scenario for just one or two YSGs, or if the multipliers were read from a file and some of the disturbances in a YSG were missing. The third option is not recommended for anyone who is using YSG information for generating the multipliers, and should only be used if the third option from the generation criteria is selected.



2. *Generation criteria.*

   The first step of the definition of between-year variability was to define the proportion of years in each different year-type. The options basically allow users to decide whether these defined proportions are to be maintained, whether they are just a guideline, or whether they should be totally ignored. Three options exist to control how the generation occurs:

a. Keep the defined YSG proportions for the different types of years;
b. Target the YSG proportions (default); and
c. Ignore all YSG information.

If one of the first two options is chosen, the model will use the information to generate annual streams of types of years for each YSG, based on the proportion of the years that should get the different types. Disturbance multipliers are then generated from this information.

If the first option is chosen, the model will maintain the defined YSG proportions for the different types of years. For example, if the annual probability of a **severe** year is 0.01, exactly 3 **severe** years will be generated in a 300 year simulation.

With the second option (default), the defined YSG proportions for the different type of years are not maintained. With this option each generated year type is based on an independent random draw. Because the number of years in each type is not fixed, this option results in more stochastic variation between runs.

If the third option is chosen, the generation routine will totally ignore the proportions and the defined multipliers and will simply generate a sequence of normally distributed random numbers for each disturbance type (or for each selected disturbance type if that option has been chosen).

3. *Normalization criteria.*

Normalization is a process by which the multipliers retain their sequence and their relative magnitude but are adjusted such that their average over a given period is one. As with the other criteria, there are also three options for normalization.

a. Normalize over the period to be simulated (default). This ensures that the multipliers introduce no bias and that the disturbance probabilities remain, on average, as originally defined. If there were no large differences in disturbance probabilities due to landscape conditions (i.e., state classes), the same proportion of cells would be disturbed with the normalized multipliers and without any multipliers, but the between-year variability would differ.
b. Normalize over the period that was generated. This option assumes that the generated period is similar to the one for which the probabilities are defined. Users may only use a fraction of this normalized stream, and may thus alter the average area disturbed.
c. Do not normalize. This option is not recommended. The primary function of this option is to allow users to enter actual disturbance probabilities for each type of year defined in a YSG.

d. Base on target not actual proportions. The default option (#1) adjusts the multipliers based on the actual number of years in each year type for each YSG. This method holds the average expected frequency of each disturbance more or less constant and prevents the total area disturbed over the entire simulation period from varying significantly from run to run. The option's adverse effect is that multiplier sequences with relatively more *severe* years result in the same total area disturbed as sequences with relatively few (or no) *severe* years. By checking **Base on target not actual proportions,** VDDT does not adjust for the actual proportions of years in each type, instead there is more variation from run to run. **This should be seriously considered instead of the default.**

4. The number of years to generate.

   This option is self-explanatory. The default value is 300 years, the same as the default number of years allowed for a simulation run. It is recommended that the number of years generated is the same as the number of years being simulated.

The default multiplier values are automatically set, so most users will not have to set or change the options. If options are selected, however, clicking on the **OK** button saves the options and clicking on the **Cancel** button ignores the changes. The options are remembered throughout the VDDT session. Thus, once the options are set as desired, they will not need to be changed.

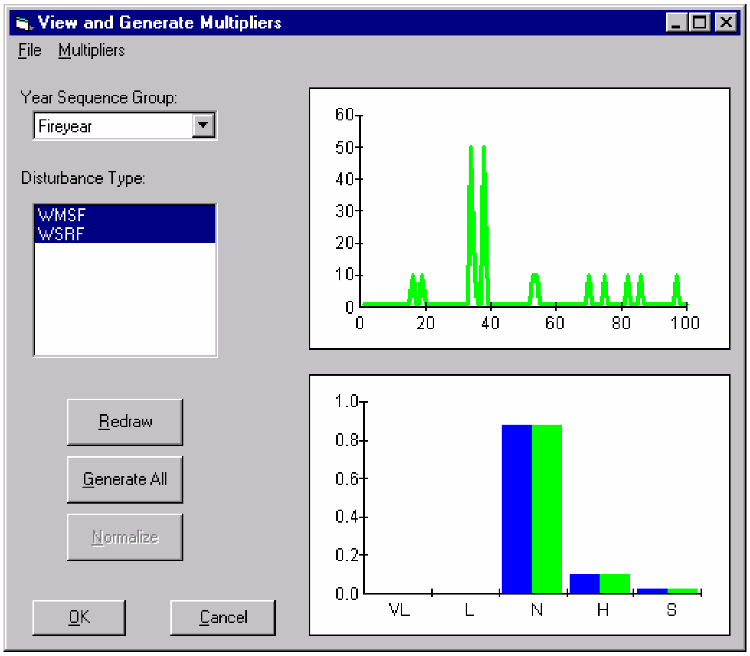
Generation Procedures

To generate the multipliers:

1. Click on the **Generate** button, or select **Generate** from the **Multipliers** menu. If the options specified that only a specific YSG or specific disturbances are to be generated, then these must be selected from the appropriate list. Note that once a YSG is chosen, the related disturbance types are listed and can be selected.

To view the multipliers:

1. Select one or more disturbances from a YSG and click on the **Redraw** button. One or two graphs will appear.



In the above example, the multipliers have been generated using the default options. The multipliers for the disturbance "WMF" have been graphed. The top graph shows the actual multiplier sequence (unnormalized), while the bottom graph shows the relationship between the actual proportion of years of each condition (left bar) and the pre-defined proportions for that YSG (right bar).

The top graph shows the disturbances. If the default options were chosen, or if the generation was done using YSG information, all the disturbances in the graph should follow the same pattern, although their magnitudes will be different. In addition, a second graph appears below the first. This graph shows the actual percent of the years in each year type and the defined percent of the years in each year type. If the default options were chosen, the two sets of bars will be identical.

The second step of the generation process is to normalize the multipliers. This is not done automatically.

To normalize the multipliers:

1. Click on the **Normalize** button or select **Normalize** from the **Multipliers** menu. No visible change will occur on the dialog box.
2. The changes can, however, be seen by selecting **Graph normalized** from the **Multipliers** menu. A check mark will appear next to the menu item and the graph will be redrawn using the normalized multipliers instead of the original multipliers. The graph will look identical except that the y-axis scale will have changed. Selecting this menu item again

will remove the check-mark and will graph the unnormalized multipliers.

You can eliminate any effect of the multipliers by resetting them to one.

To reset some or all multipliers to one:

1. Select **Remove** from the **Multipliers** menu. This will reset the multipliers as determined by the options. Thus, if the options suggest generation for only the selected disturbances, the multipliers for the selected disturbances only would be set to one.

Clicking on the **OK** button will save the results to memory and close the window. The normalized multipliers (unless otherwise specified) will be applied to all VDDT runs until they are explicitly turned off or until a new Project is loaded. The **Cancel** button closes the window without making any changes.

Saving and Loading

There are several aspects of the between-year multipliers that can be saved to or read from external files. The most appropriate option depends on the goal.

Goal:

1. *Have the same series of high and low years between runs.*

   This option would be used if the same YSG is being used in a number of situations with different disturbances (because of having different disturbances in different PVTs or because of adding or deleting disturbances from a YSG) or different year-type multipliers. The generation routine in each simulation would then be given the same sequence of years and would generate the annual multipliers based on the defined disturbances and year-type multipliers.

   This method has the advantage that, when comparing simulations, the high and low years are in the same place and only the magnitude of the multipliers changes. Also, if a new disturbance is part of a YSG, it will automatically use the same pattern of years as the other members of its YSG.

> **Note:**
> The annual year-type sequence is regenerated each time the **Generation** button is clicked. Thus, even within a single PVT, the only way to use the same sequence of years for multiple runs is to save the sequence to a file and reload it before generation.

Saving and loading these files is done by picking **Load** or **Save** from the **File** menu on the **View And Generate Multipliers** dialog, and then selecting **Year-type sequence**. The default extension for these files is *.TSE (Time Sequence), and the file format is given in Appendix D.

Note that a *.TSE file can be easily modified or built with a text editor to create any desired sequence of years. In this manner, the user can model the potential effect of cyclic climatic patterns, global warming, etc. For more details on generating complex sequences, see Appendix F.

2. *Use identical multipliers between runs*

   This option would be used to control for differences in between-year variability. If identical multipliers are used, the differences between runs has more to do with the differences in landscape conditions or defined probabilities than with the annual multipliers.

   The main disadvantage to this method is that if any disturbances have been added to a YSG, they will have no multipliers. The multipliers for these disturbances will need to be generated which will likely cause them to have a different pattern of years than the other members of the YSG.

   The main advantage of this method is that actual multipliers can be loaded and used. In addition, the multipliers can be reloaded and normalized with a different option before using in the simulation.

Saving and loading these files is done by picking **Load** or **Save** from the **File** menu and then selecting **Multiplier Sequence** or **Normalized Sequence**. The default extension for these files is *.MSE (Multiplier Sequence) or *.NSE (Normalized Sequence), and the file format is given in Appendix D.

Note:
The "unnormalized" multipliers are not saved when this part of VDDT is exited (unless the routine was specifically asked not to normalize the multipliers). Thus, the only way to use the same set of raw multipliers, even within a single VDDT session, is to save the values to a file and to reload them when next entering this window.

Note also that, since the year types are not saved with the multipliers, the second graph (that compares the defined YSG proportion with the actual) will not be shown.

Multiple iterations

If the annual multipliers are being used in a run with multiple Monte Carlo simulations, users are asked to choose from the following when defining a run:

1. Read multipliers from the database

   This is the default option for new Projects. It directs the model to use annual multipliers for the next simulation that are already associated with the Project and incorporated into the active database. If your Project contains annual multipliers that have been imported or loaded from *.MCM or *.CSV files, they are in the database and can be read from there. Under this option, each Monte Carlo iteration can have a different combination of low and high years, thus allowing for the possibility of simulating rare events.

2. Use the same multiplier sequence for each iteration.

   Under this option, differences in the results are only a result of differences in picking the random numbers and in the resulting state difference. The same years will have large or small multipliers applied. This method shows little variation between runs and is not recommended.

3. Use the same set of multipliers in a different order for each iteration.

   Under this option, the high and low multipliers will be applied in different years, adding another source of variation between the iterations. This ensures, however, that each run has exactly the same set of “good” and “bad” years, just varying their order. This is an easy way to show variation between runs while holding the total area affected by the disturbances more or less constant.

4. Read the multipliers from an external file.

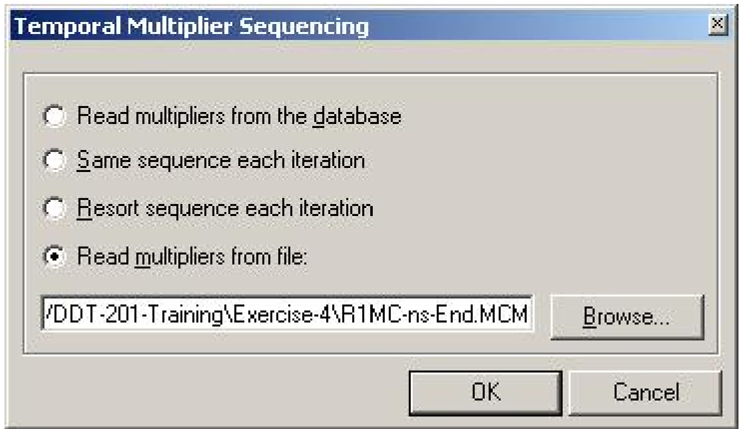
   Under this option, each iteration may have a different combination of low and high years, thus allowing for the possibility of simulating rare events. This method best shows the variation that could occur and is recommended.

The first option requires that annual multipliers have been loaded into the Project (see about *Temporal Multipliers* in the *Probability Multipliers* topic, above) and incorporated into the active database. The second two options require that multipliers have been loaded into memory from the annual multipliers dialog box. The last option requires only that the annual multipliers have been turned on, and that a file with the appropriate format has been created. This file can be created in the **Annual Multipliers** window by selecting **Make MC file (all YSGs)** from the **Multipliers** menu. The user will be asked the number of Monte Carlos to generate and the file name in which to store the results. The file is saved in **Monte Carol multiplier** (*.MCM) format (Appendix D) and can contain up to 300 sets of randomized YSG multipliers. The model will generate information for all disturbances in the number of years listed in the **Multiplier Options** window. Note that the current multipliers stored in memory will be replaced with one of the sets of multipliers generated for the file.

If the third option is chosen for the model run, the user will be asked to supply a filename, with the default being the file created in the **Annual Multipliers** window. The model will read this file at the beginning of each Monte Carlo. If it reaches the end of the file before all Monte Carlos have been simulated, VDDT will produce a warning, and will read the file again from the beginning.

To use annual multipliers in a simulation run:

1. Under VDDT’s **Variation** menu, select **Sequencing** to open the **Temporal Multiplier Sequencing** dialog. The option chosen here will dictate where VDDT will look for the annual multipliers for the next simulation and how to use them.



3. Click **OK** to save the chosen settings to memory, or **Cancel** to abandon the changes and close the **Temporal Multiplier Sequencing** dialog.
4. The next time you run the model using this Project, your annual multipliers will be used in the simulation according to the sequencing option you selected. If, at some later time, you wish to run a simulation without the multipliers, simply turn the multipliers off (under the **Multipliers** menu of the **View and Generate Multipliers** dialog (**Variation|Annual Multipliers**) or on the *Options* tab of the **Run Settings** dialog (**Run|Settings**)). The model will ignore the assigned multipliers until the option is explicitly turned back on.

Note that if the **Sequencing** option under the **Variation** menu is grayed out, this means that the multipliers are turned off.

Open Variation Files

Use this option under the **Variation** menu to load multiplier values from files.

To load multiplier values from files:

1. Select the **Open variation files** option from the **Variation** menu.
2. A series of "open file" windows will appear from which you will choose the year sequence group (*.YSG), year type multipliers (*.YTM) and multiplier sequence (*.MSE or *.NSE) files you need.
3. After each choice, click **OK** to load the values and close the screen.

Landscape Multipliers

In VDDT, the area disturbed by a particular agent increases as the proportion of the cells in the landscape that are susceptible to this disturbance agent increases. For example, if through prolonged suppression of fires, the average age of the cells in the landscape increases and if older successional classes are more susceptible to mountain pine beetle, then the area disturbed by the beetles will increase. In this example, more area is disturbed because there are more susceptible cells, but each cell still has the same probability of being affected by this agent.

For some disturbance agents, the probability of disturbing a particular cell may be altered by the spatial context of the cell. For example, a stand that is susceptible to mountain pine beetle has some likelihood of being attacked. It is often thought that this probability is higher if the stand is surrounded by susceptible stands than if it surrounded by non-susceptible stands. Because VDDT is a non-spatial model, contagion processes cannot be represented in detail. Instead, users can define a multiplier that is designed to provide feedback between the probabilities of disturbance and the landscape condition.

Open Landscape Multiplier Files

Use this option under the **Variation** menu to load landscape multiplier values from files.

To load landscape multiplier values from files:

1. Select the **Open landscape multiplier files** option from the **Variation** menu.
2. An "open file" window will appear from which you will choose the landscape multiplier file (*.LCM) you need.
3. Click **OK** to load the values and close the screen.

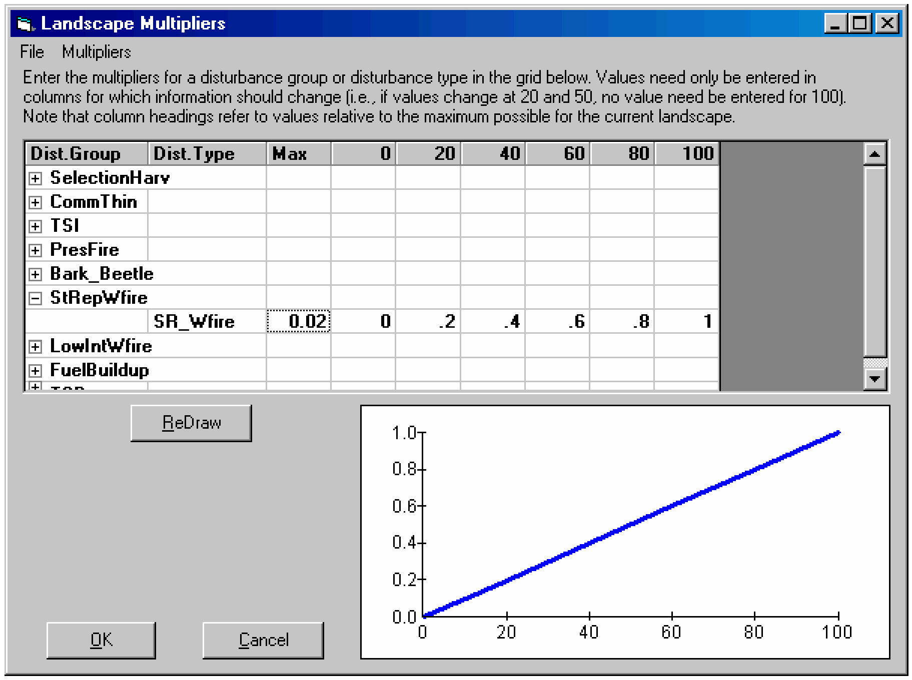
Edit Landscape Multipliers

The intent of the multiplier function is to either increase or decrease the "average" probability of disturbance based on the proportion of the cells in the landscape that are in a state that is susceptible to the disturbance agent. To measure the state of the landscape, VDDT compares the current area to be disturbed by the agent with the maximum area that could be disturbed by the agent. The maximum area is the product of the highest probability of disturbance for this agent, times the number of cells in the landscape. The current area to disturb is the product of the probability of disturbance of each successional class times the number of cells in each class.

Note:
Note that use of the landscape multipliers will slow down the model. This will be especially apparent for Projects with a large number of transitions, for runs with large numbers of cells, and on slower machines.

To set up one or more landscape multipliers:

1. Select **Edit Landscape multipliers** from the **Variation** menu.
2. A window will appear that lists all currently active transition groups.



The columns of the grid in the **Landscape Multipliers** dialog are:

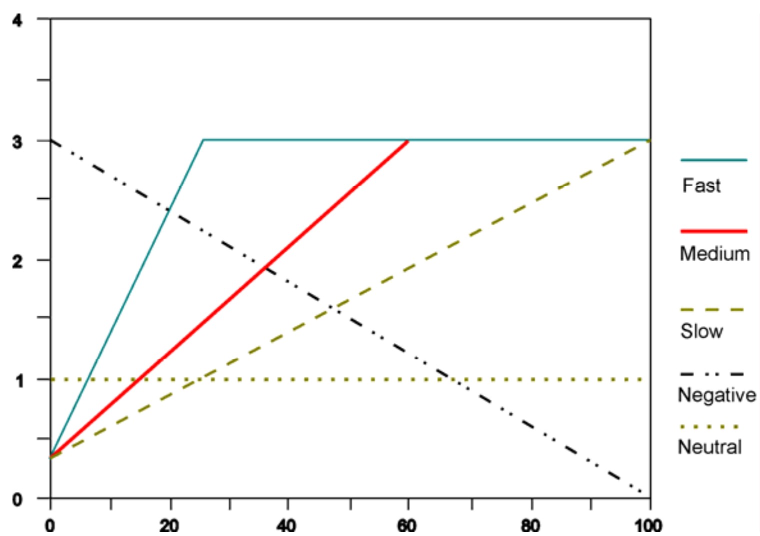
Column	Description
DistGroup:	The name of the disturbance group.
DistType:	The name of the associated disturbance types. Note that the first line of the group will always contain the work "All" as the type. If the "+" is clicked in the first column of the group, the other disturbance agents will appear.
Max:	The maximum possible proportion of the landscape that could be disturbed by the given disturbance agent using just the defined multipliers (i.e., no between-year multipliers). This value cannot be edited and is just there as a guide for how much disturbance is possible without additional multipliers. Each year, the potential proportion of the landscape that could be disturbed will be compared to this value.
0, ..., 100:	These columns are for adding the multipliers that would be used if the potential percent of the area that would be disturbed by a disturbance agent were at the listed percentage. For example, if a 2 were entered in the column labeled 40, and if the maximum proportion of the landscape that could be disturbed in a year were 0.01, then, if the potential amount of the landscape that would be

disturbed in the current year were 40% of the .01 (or 0.004), the probabilities for that disturbance agent would all be multiplied by 2.

In the above example, the disturbance group *StRepWfire* (stand replacement wildfire) has been expanded to show the available disturbance agents, in this case only "SR_Wfire." The values shown represent one of the pre-defined sets of multipliers and have been graphed.

Multipliers can be defined either for the entire group or for individual disturbance types. If values are entered on the top line of the disturbance group, next to the disturbance type **All**, they will be applied to the entire group. If the individual types are visible (either by clicking on the +next to the group name or by selecting **Show all** from the **Multipliers** menu) then values can be entered into the row next to the disturbance agent's name.

In the simplest case, users can assign one of five pre-defined sets of multipliers. To do this, place the cursor on the row to which the values should be assigned and select the appropriate **pre-defined function** from the menu. Values will be entered into the row, and the function will be graphed. The x-axis in the relationship is the ratio of the maximum to the current area to be disturbed by the disturbance agent. The y-axis describes the value of the multiplier to be applied to the disturbance probabilities. A positive feedback is achieved if the multiplier increases as the proportion of the stands in the landscape that are susceptible increases. No feedback between landscape conditions and the probability of disturbance is obtained with a multiplier of 1. This is also the current default condition. A negative feedback is achieved if the multiplier declines with an increasing proportion of the landscape in the susceptible class. There may be no ecological systems in which this negative feedback exists and the pre-defined condition is only an example.



The above figure provides a summary of the pre-defined landscape multipliers.

Users can also define other relationships by entering values directly in the appropriate columns. Values only need to be entered in some of the columns. Thus, to create a curve that increases from 0 to 4, simply enter a 0 in the first column (the *0* column) and a 4 in the last column, and a line will be drawn. During a simulation the model:

- applies the last defined multiplier up to the maximum (100%);
- sets the value in the "0" column to 0 if values have been assigned in later columns; and
- interpolates between defined values, unless otherwise specified by the user.

For example, suppose a user puts a 2 in the 40% column, and that is the only column with an assigned value, and the user is using the default option of interpolation. The model will:

- use the 2 for all landscape conditions from 40% to 100% (inclusive);
- use a 0 for 0%; and
- interpolate between 0 and 2 for landscapes between 0% and 40% (exclusive).

To graph a user-defined curve, place the cursor on the row to be graphed and click on the **Redraw** button.

The multipliers can be used with or without interpolation between the defined values. The default is with interpolation. With no interpolation, changes happen more abruptly. To use the example above, when using interpolation, the multiplier would change from 1.95 to 2 as the landscape went from 39% to 40%. Without interpolation, the multiplier would change from 0 to 2 with the same change in landscape value. Each type of change is appropriate for simulating different types of effects. Note, however, that the decision of whether or not to use interpolation applies to all disturbances.

These landscape multipliers may be saved to a file by selecting **Save** from the **File** menu. This saves all values in the grid. Reading multipliers from a file can be done by selecting **Load** from the **File** menu. When the file is loaded, multipliers that have been defined for disturbances not currently in the Project are ignored. All multipliers for disturbances that are in the current Project and not in the file are left as the last value defined in the model.

Note:
The breakpoints for the multipliers have changed from version 3.0. Thus, a warning will appear if version 3.0 files are read. The program will attempt to process the file appropriately, but it is important to double-check all values (and save them in the version 6 format).

Clicking on the **OK** button saves the information to memory and tells the model to use the defined landscape multipliers (unless explicitly told otherwise). Clicking on the **Cancel** button closes the window and ignores any changes that were made.

Note that defined multipliers can be explicitly disabled for a simulation by selecting **Turn off** from the **Multipliers** menu. A check will appear next to the menu item to indicate that the multipliers are not being used, and a warning will occur as when the **OK** button is clicked.

> **Note:**
> No normalization is done to these multipliers because it is impossible to anticipate the distribution of successional classes in the simulation run. Thus, the average area disturbed by a disturbance agent that is using these multipliers may be very different than the average area when the multipliers are not used. The amount and direction of the bias depends on the landscape condition and the shape of the curve.

Landscape Feedback

Use the **Open Landscape Feedback Files** option under the **Variation** menu to load landscape feedback values from files.

To load landscape feedback values from files:

1. Select the **Open landscape feedback files** option from the **Variation** menu.
2. Two "open file" windows will appear from which you will choose the landscape feedback files (*.LCF and *.LFM) you need.
3. Click **OK** to load the values and close the screen.

Defining Landscape Feedback Group

The landscape condition feedback (LCF) option allows the user to link disturbance probabilities to the average value of a *numeric* attribute – or landscape scale condition. This means that you can create an attribute to calculate any environmental risk (fire, insects, etc.), then simulate a major disturbance when the risk reaches a critical threshold.

To use this option, you first need to have created a numeric attribute that defines the landscape condition (**Attribute** menu). Values from 0 to 1 must be used to represent the condition associated with each succession class. Examples of landscape variables are fire risk and insect risks.

A suggested method for using the LCF option is to assign a very low background disturbance value for each succession class susceptible to the disturbance, then to enter large multipliers associated with critical breakpoints. For example you may have little or no mountain pine beetle until average conditions reach a critical level, then have a major epidemic killing 50% of the stands.

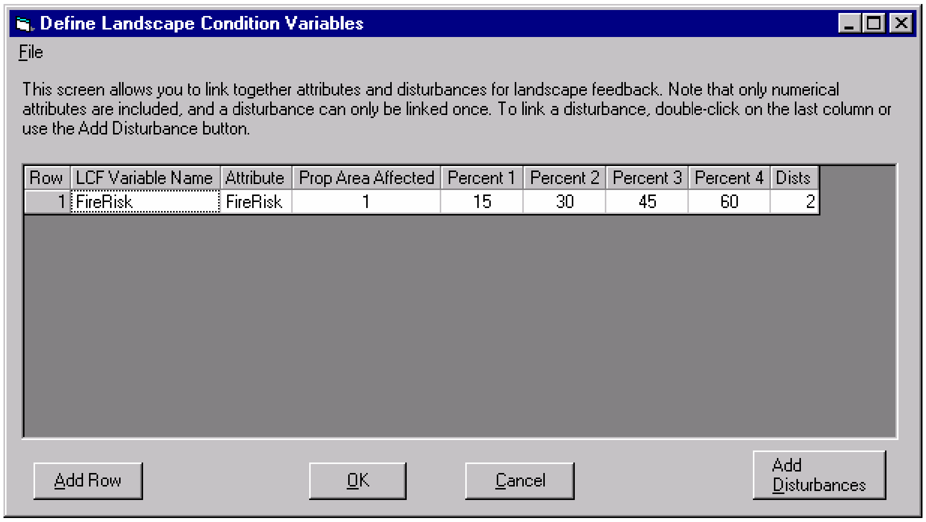
To define a landscape feedback group:

1. Select **Define landscape feedback group** from the **Variation** menu.
2. Click on the **Add Row** button.
3. In the *Landscape condition variables* table that appears:

a. name each group,

b. indicate the attribute that applies, and

c. link the associated disturbances to the group.



Column	**Description**
LCF Variable Name:	The name of the LCF variable is typed in here.
Attribute:	The numeric attribute that applied. Select from drop-down list. Note that only numeric attributes are shown in this list.
Prop Area Affected:	Refers to the proportion of the study area for which the LCF group applies. For example your VDDT Project may cover an entire watershed, but the LCF variable for mountain pine beetle may apply only to the lodgepole pine area within that watershed.
Percent 1, ..., 4:	Represent the breakpoints to use to when applying the multipliers. You can specify from 1 to 4 breakpoints. A breakpoint of 50 would represent an average condition of 0.5. By default the tool creates breakpoints at 0 and 100 percent.
Dists:	Number of disturbances linked to the corresponding LCF variable. Double-click on this column to select disturbances or click on the **Add Disturbances** button.

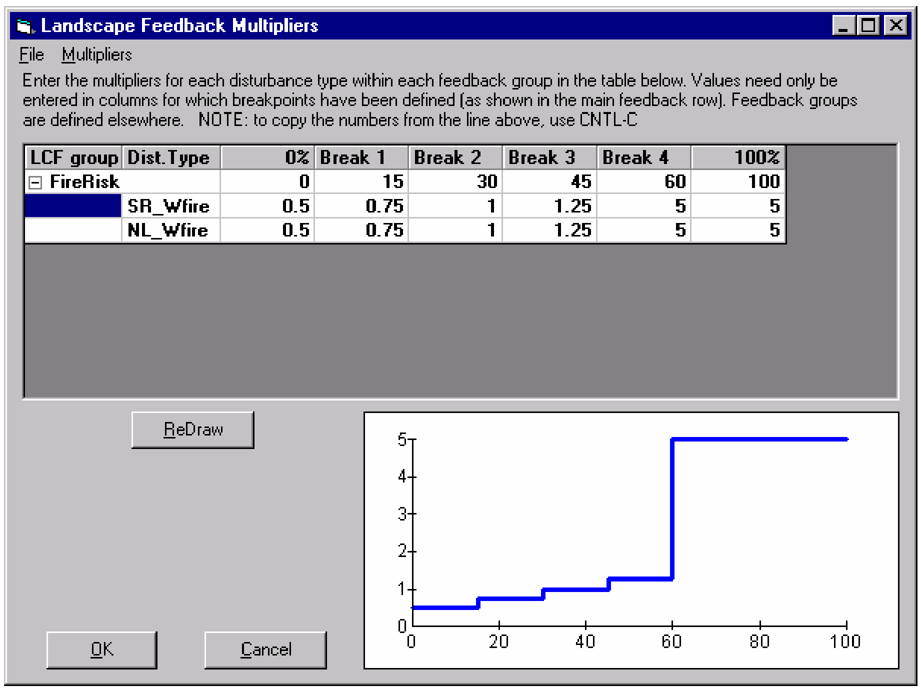
4. When done, select **Save** from the **File** menu on the **Landscape Feedback Multipliers** dialog to save the data to the LCF file (see Appendix D for more detail).

5. Alternatively, you can load LCF values from a file by selecting **Load** from the dialog's **File** menu.

Editing Feedback Multipliers

To edit landscape feedback multipliers:

1. Select **Edit** feedback multipliers from the **Variation** menu to edit the landscape feedback multipliers table.



2. Click on the + sign at the beginning of the data line to see the multipliers.

3. For each disturbance within each LCF enter the multiplier to apply.

4. After entering all multipliers select Redraw to review your assumptions.

5. Select **Save** from the **File** menu on the **Landscape Feedback Multipliers** dialog to save the multipliers to the LFM file (see Appendix D for more detail).

6. Alternatively, you can load LFM values from a file by selecting **Load** from the dialog's **File** menu.

Temporal Trend Lines

Use this feature under the **Variation** menu to add an explicitly temporal trend line to any disturbance. There are several ways to add trend lines:

- load trend multiplier values from files;
- enter predefined values; and
- define your own values.

Open Trend Information

Use this option under the **Variation** menu to load trend multiplier values from files.

To load trend multiplier values from files:

1. Select the **Open trend information** option from the **Variation** menu.
2. An "open file" window will appear from which you will choose the trend information file (*.TRD) you need.
3. Click **OK** to load the values and close the screen.

Editing Trend Multipliers

To use predefined temporal trend lines:

1. Select **Edit trend multipliers** from the **Variation** menu.
2. Select the **disturbance type** you want to use by clicking on the **+ sign** to expand the desired disturbance group and clicking on the **Disturbance Type**.
3. Select **Use predefined** from the **Multipliers** menu and click on the desired option:

   a. No trend,

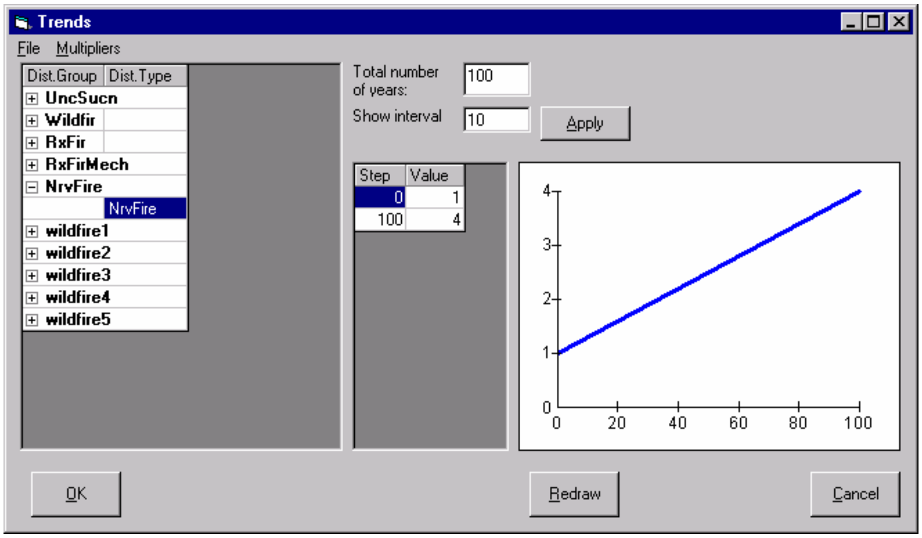
   b. Slow increase,

   c. Fast increase,

   d. Slow decrease,

   e. Fast decrease.

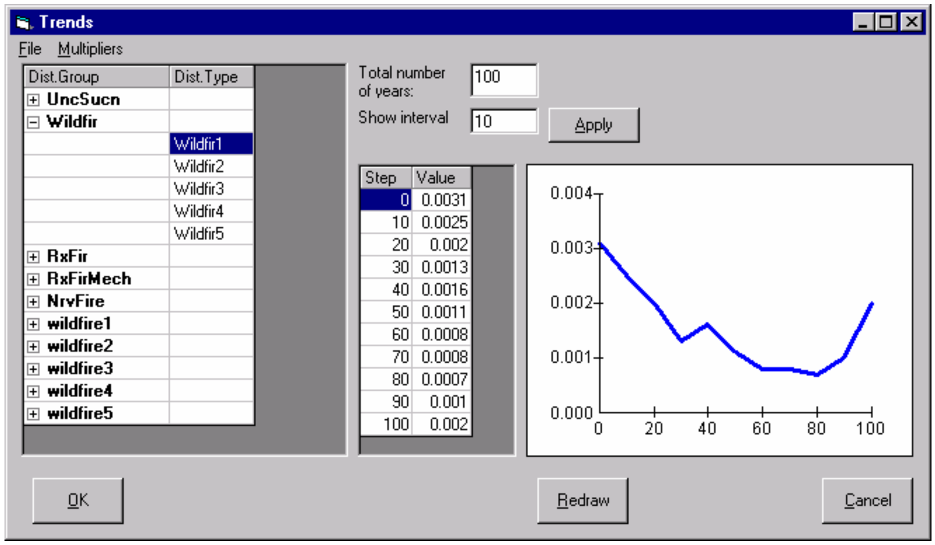
   The predefined values will appear in the *Step* and *Value* columns in the middle of the screen and the graph will be redrawn.
4. Select **Save** from the **File** menu to save the multipliers to the TRD file (see Appendix D for more detail).



The above example shows pre-defined trend multipliers for the *Fast increase* option.

To create your own temporal trend lines:

1. Select **Edit trend multipliers** from the **Variation** menu.
2. Select the **disturbance type** you want to use by clicking on the **+ sign** to expand the desired disturbance group and clicking on the **Disturbance Type**.
3. Type in the **Total number of years** you want to use for the trend line.
4. Type in the **interval** in years for defining values.
5. Click on the *Apply* button. The *Step* and *Value* columns will change based on what you defined in Steps 3 & 4.
6. Type in the appropriate **value** for each step.
7. Click on the **Redraw** button to draw the graph of your temporal trend line.
8. Select **Save** from the **File** menu to save the multipliers to the TRD file (see Appendix D for more detail).
9. Alternatively, you can load TRD values from a file by selecting **Open** from the dialog's **File** menu.



The above example shows user defined trend multipliers with an interval of 10 years.

Note that defined multipliers can be explicitly disabled for a simulation by selecting **Trend Multipliers OFF** from the **Multipliers** menu. A check will appear next to the menu item to indicate that the multipliers are not being used, and a warning will occur as when the **OK** button is clicked.

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