ArcFuels

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ArcFuels Download and Install Instructions

ArcFuels download: ***www.fs.fed.us/wwetac/arcfuels***

ArcFuels VBA macros are contained in an ArcMap project file (.mxd) and are written for ArcGIS version 9.2. The download site contains a complete set of data and a partial set of programs for demo purposes. There is no installation program for ArcFuels. Follow the steps below:

1. Create a directory c:\arcfuels and download the following files from http://www.fs.fed.us/wwetac/arcfuels

   arcfuels.mxd - ArcMap project file with ArcFuels macros

   arcfuels_projects.mdb - Stores information about data and program directories and paths. The demo data uses the *mtemily* table.

   data.zip - demo data for the Mt Emily project.

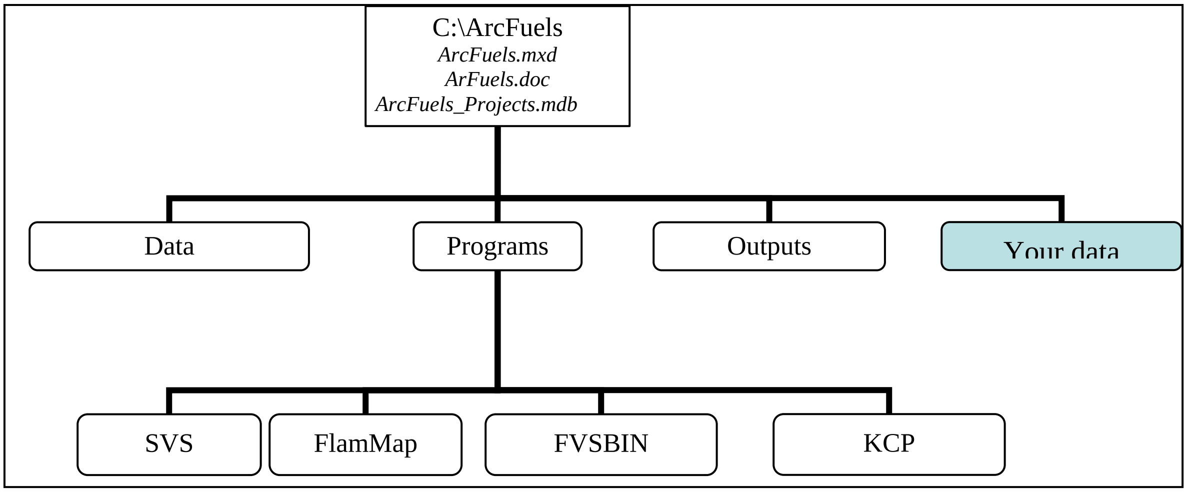
   programs.zip - a selected set of FVS executables, SVS, and FlamMap

   docs.zip - supporting literature (optional)

2. Unzip *data.zip* and *programs.zip* into the folder *c:\arcfuels*. Unzipping will create several subfolders containing data files and programs.
3. Create a folder *c:\arcfuels\outputs*
4. Check for the existence of *C:\arcfuels\data*, *C:\arcfuels\outputs*, and *C:\arcfuels\programs* after unzipping. The directory structure should appear as in the figure below. Other directory structures can be used for ArcFuels providing that the defaults are changed accordingly in the projects database. This is discussed in subsequent sections. ArcFuels will run from any directory, but ArcFuels.mxd and ArcFuels_projects.mdb must be located in the same directory.

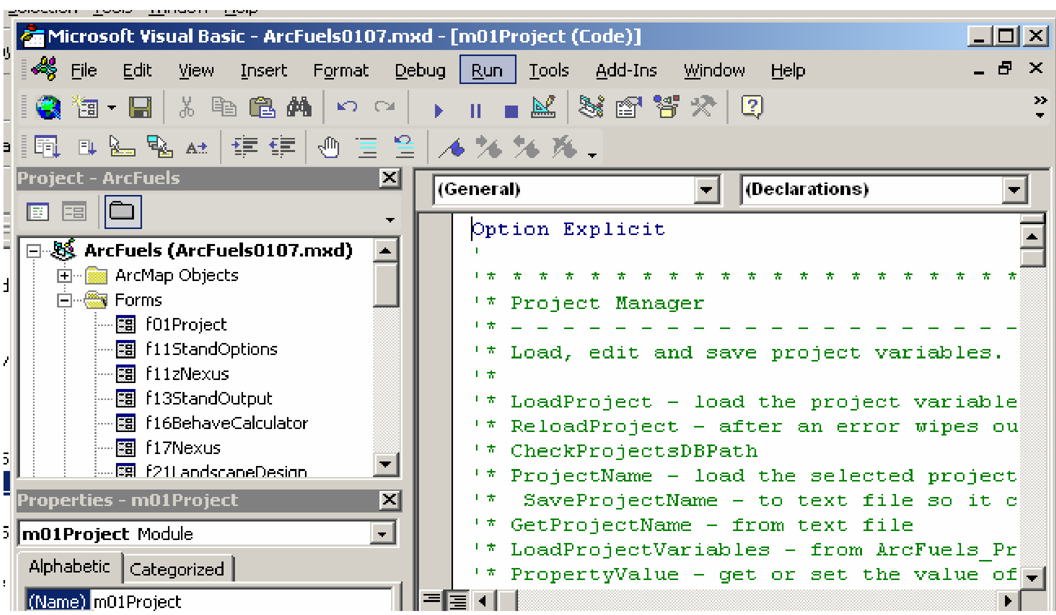
The demo data set includes versions of several fire behavior programs and FVS. These programs get copied into the c:\arcfuels\programs and are for demonstration purposes only. You should eventually go to the respective websites and download the most recent version. Only three variants of FVS are included in the demo data.

Many of the routines in ArcFuels use database fieldnames to retrieve data from MS Access databases. The code is case sensitive, using lowercase as the convention, with few exceptions. If you build your own stand and tree tables, use the example data tables to find the correct convention. Refer to the FVS database extension manual for database formats. Also note that the stand ID fields must be alphanumeric – this is an FVS convention. Do not include spaces when naming input databases, tables, fields, coverages, grids, etc.

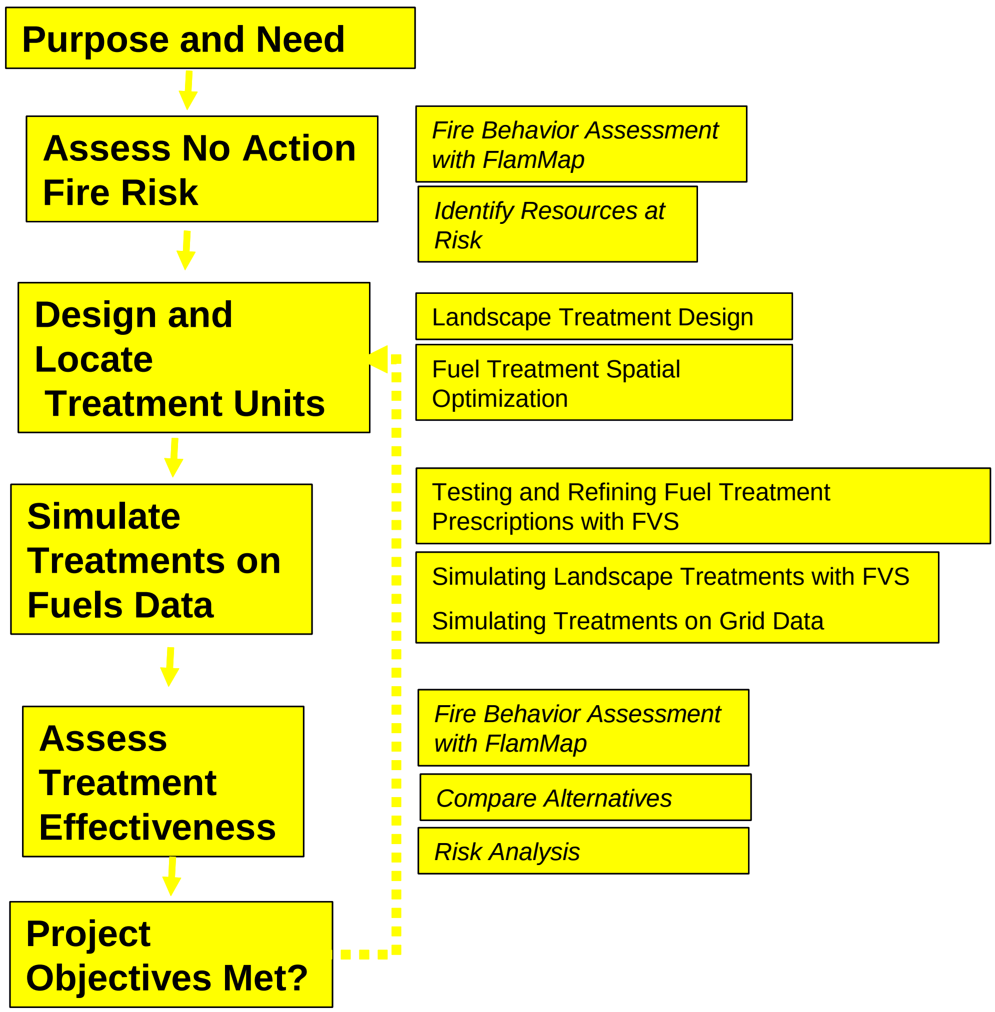


Start up Errors

If an error is generated by the ArcFuels macros, the VBA editor will open and the offending code will be highlighted in yellow. Click Run Reset on the main menu (see figure below) and File Exit to close the VBA editor and return to ArcMap and resume the session. The blue square below the Run will also reset the project. The VBA editor can be opened at anytime by clicking Alt F11. Most errors generated by ArcFuels are caused by incorrect pathnames and fieldnames in the project database. If you are using ArcFuels on a non-Forest Service PC and get an error at startup, you will probably need to edit the VBA references.



The VBA editor pops up if there is an error in the ArcFuels code. ArcMap will not crash. Click Run, Reset to resum your ArcMap session.

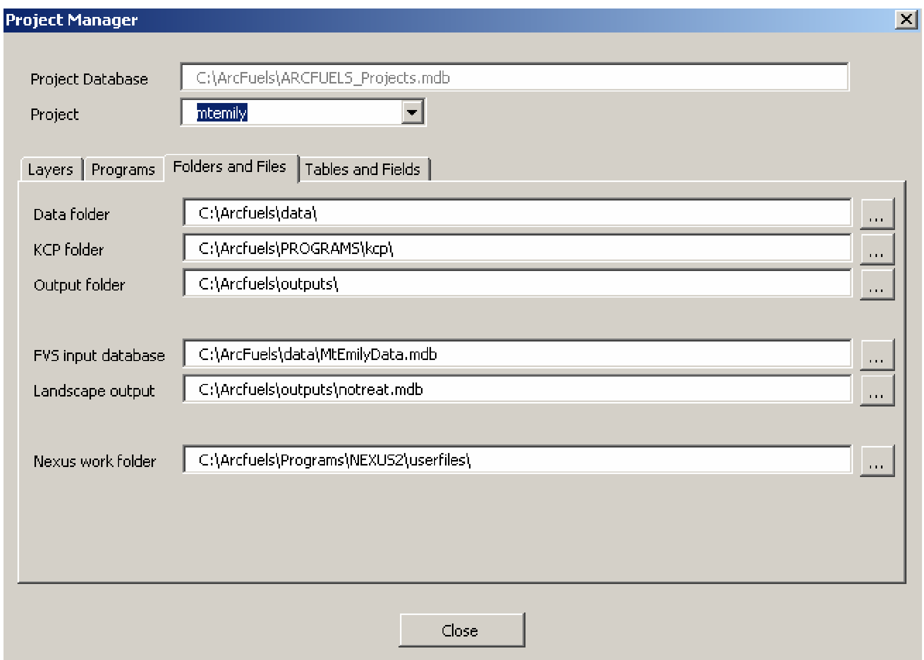


Steps in the Planning process and corresponding sections in this tutorial

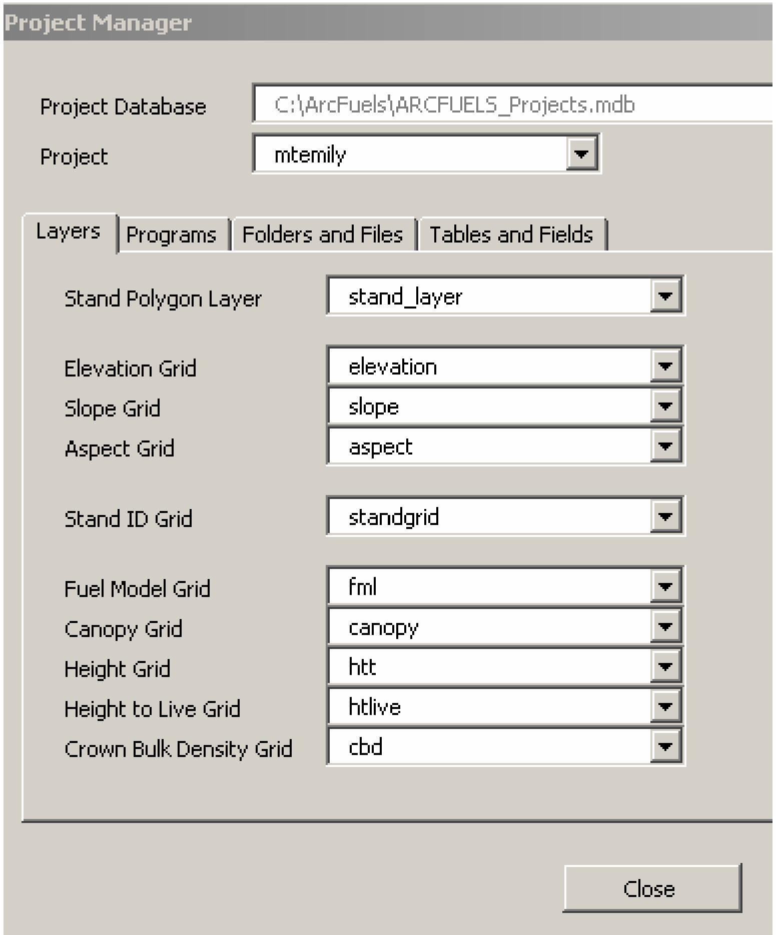
Module 1. Getting Started

Exercise 1. Load data

- Start ArcMap and navigate to c:\Arcfuels and load ArcFuels.mxd. The project manager form will appear. In the *Project* textbox [second from top]. Select the *mtemily* table. This table is stored in the database *c:\arcfuels\arcfuels_projects.mdb* and contains information on folders, files, GIS data, and programs for your project. The form can be modified at any time to reflect changes in data, directories, or programs.
- Close the form
- Load the GIS layer file for the demo data. Click the  icon and navigate to *c:\Arcfuels\data* and select the *mt emily demo data.lyr* file. Your data should appear on the ArcMap table of contents
- Now that the data are loaded you can view the project manager form and check to see if all the information is correct. Click the *Manage Projects* button on the upper right ArcFuels toolbar and review the 4 tabs of information. See the directory structure in the previous graphic.



The Project Manager form in ArcFuels is used to set the locations of gis layer, programs, folders and files, and database tables and fields. The image to the left shows the Folder and Files tab.



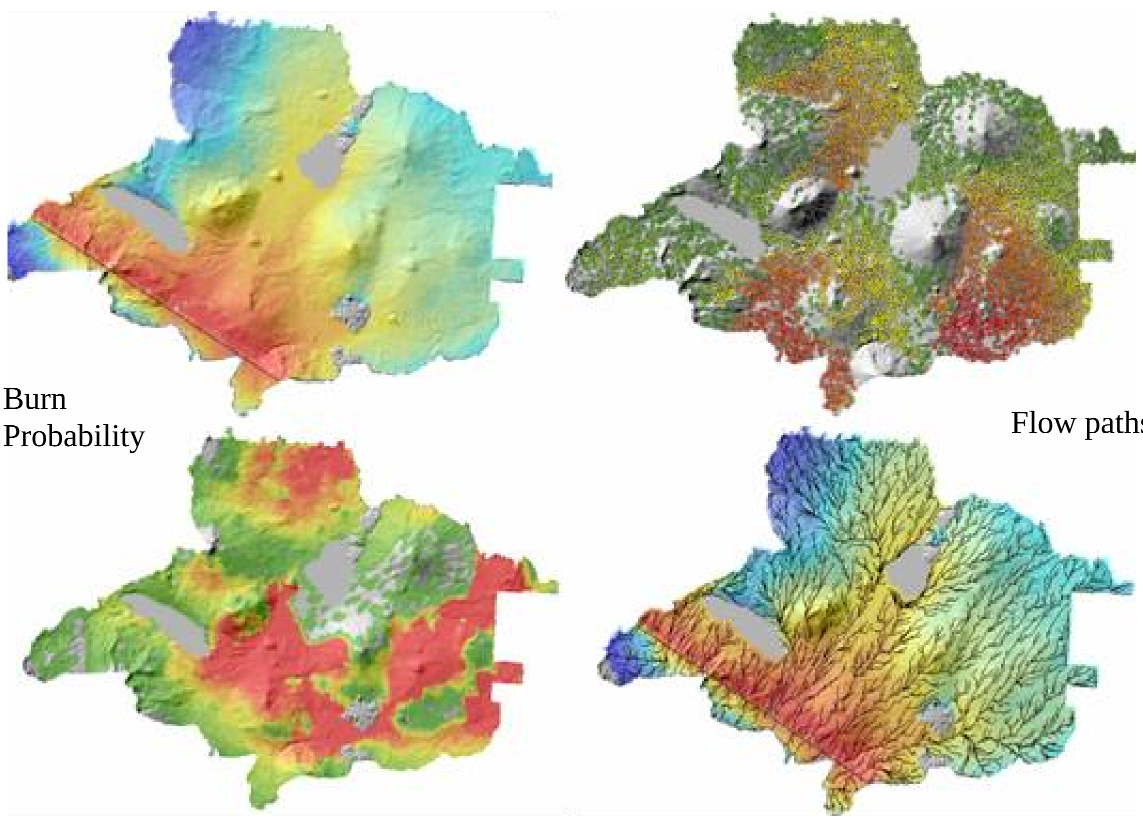
The Layers Tab on the project manager where the default fuel and other grids used to create FlamMap input files are identified. Layers must be loaded in ArcMap before theycan be selected on the form

Module 2. Fire Behavior Assessment with FlamMap

This module describes a simple process assessing landscape fire behavior and generating outputs to identify resources at risk and plan a fuel treatment scenario. The demo data are used for three simulation exercises with FlamMap to generate maps of burn probabilities, flow paths, crown fire activity, fire arrival time, and other outputs (see images below). These outputs will be used in subsequent modules to compare post treatment fire behavior.

The three types of simulations are

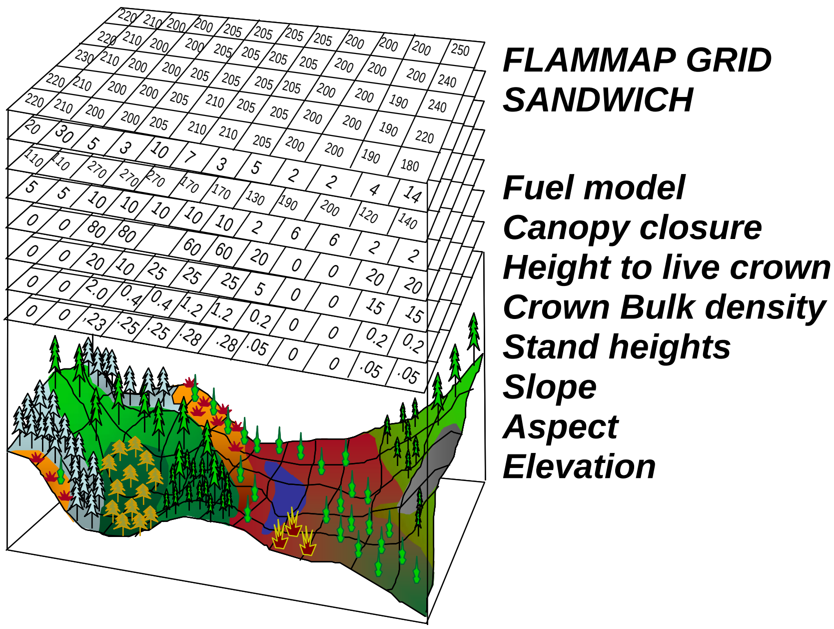
1. A single burn period within a defined problem fire
2. Many burn periods to generate burn probabilities
3. A large fire that burns the entire project area to generate arrival times and flow paths

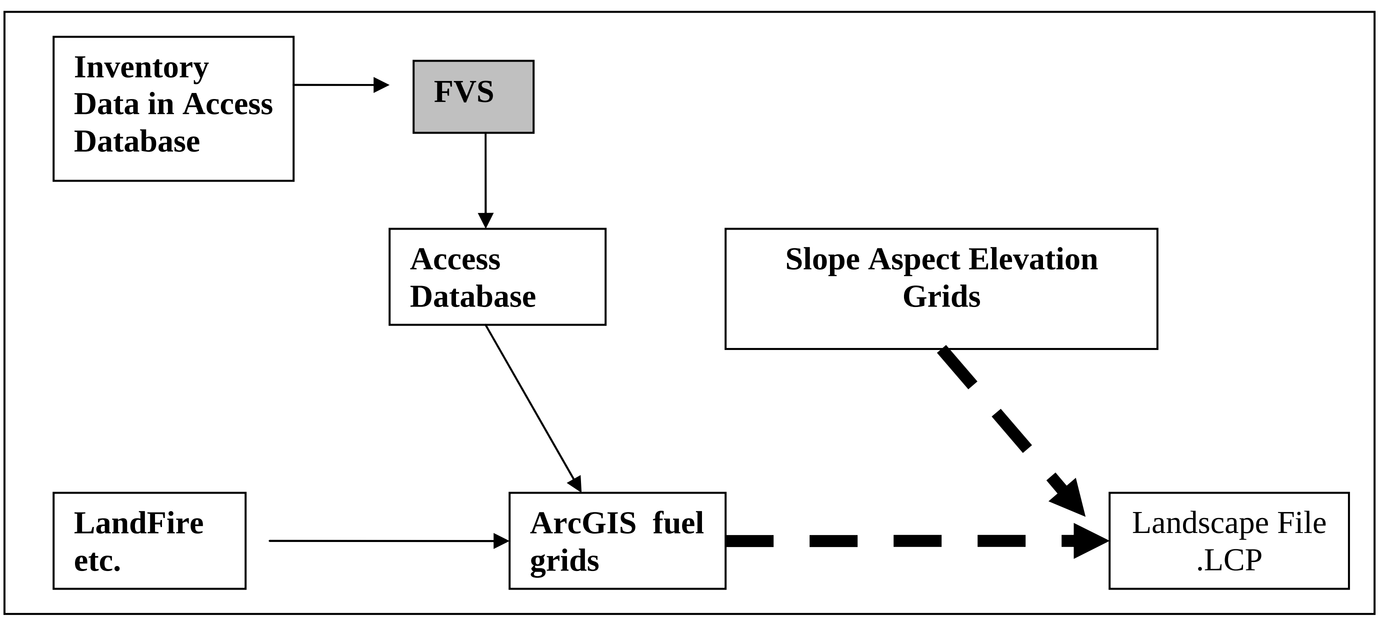


Example FlamMap outputs for the 160,000 acre Five Buttes Planning Area on the Deschutes National Forest.

Exercise 2.1 Build FlamMap landscape files

Landscape files are binary files containing grid data used by the FlamMap and FARSITE fire behavior programs.   If you are not familiar with a landscape file read the Flammap tutorial (C:\Arcfuels\programs\flammap3\flammap3.chm).   Landscape files can be created from several data structures including Arc grids, [e.g. Landfire], stand inventory data, or some combination. Stand inventory data must be processed through a program such as FVS to generate the fuel parameters required in the landscape file. Examine the flow chart below. The dashed lines are the process in this exercise. The other processes will be covered later.

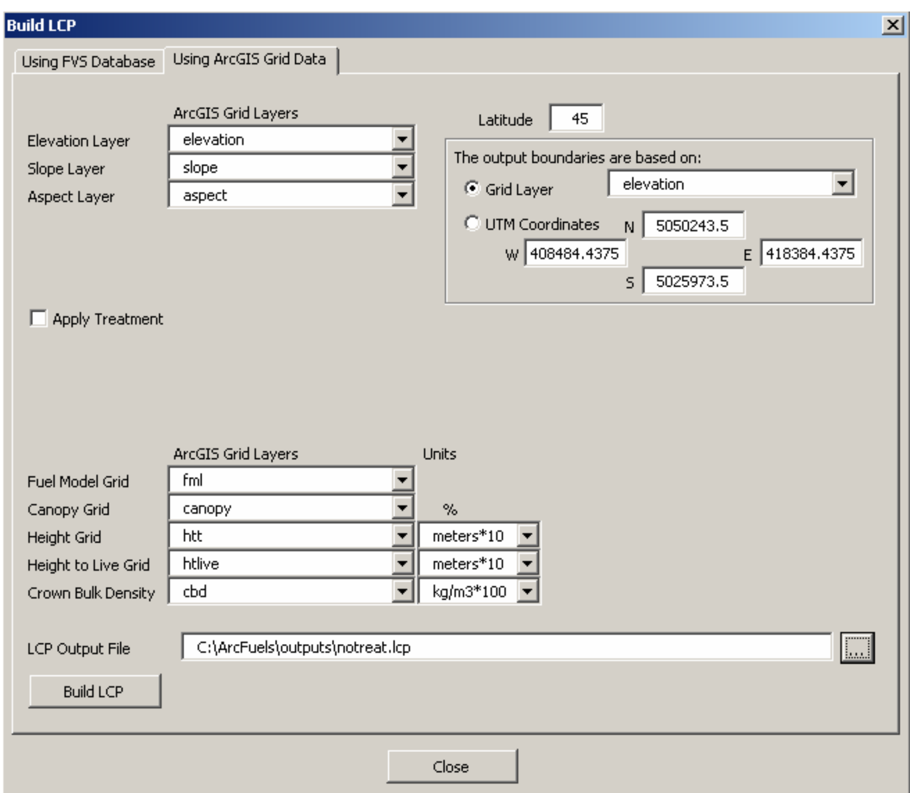




- Click *Build FlamMap Landscape* on the lower ArcFuels toolbar and select the center tab U*sing ArcGIS Grid Data*. This brings up the form shown below. The fields should contain the appropriate entries for the demo data.   Review the entries.
- Click on the directory button to the right of the box for the output file name. Navigate to C:\arcfuels\outputs and then enter *notreat.lcp*.   The text box should read *C:\arcfuels\outputs\notreat.lcp*

- It is important to specify the correct units. The defaults on the form are those used by Landfire. See the table below for other conventions.
- Note the default folder for outputs is set to c:\arcfuels\outputs. You can change the defaults in the project manager form.
- Press *Build* to create the landscape file. When processing is complete, close the form.
- Click the *Wildfire Models* button on the bottom ArcFuels toolbar and select FlamMap v3.0 from the list, or start FlamMap from your desktop. We distributed FlamMap version 3.0 with the data package for each team.
- Click *Run* in the right pane of the FlamMap interface and load the landscape file. Change the run name to *notreat*
- When the landscape loads in FlamMap, browse the layers. Are the data and units correct? Do the data look reasonable?

	Data source		
Variable	FVS	Landfire	USGS DEM
% canopy cover	percent cover*	percent cover*	-
canopy base height	feet	decimeters	-
crown bulk density	kg/m3	kg/m3	-
average canopy height	feet	decimeters	-
slope	%	degrees	depends
aspect (azimuth)	degrees	degrees	degrees
elevation	feet	meters	meters



Arcfuels form for building FlamMap landscape files from Arc Grids Boundaries can be clipped by entering a clip grid in the right panel.

Exercise 2.2 Define the problem fire

A *problem fire* definition consists of wind speed, direction, burn period, and fuel moisture file. The problem fire should be based on observations of a recent local and severe [i.e. where suppression is ineffective] wildfire event. These parameters will be used to generate burn probabilities, flow paths, arrival time, and other landscape measures of fire behavior with FlamMap. The problem fire definition used here should refer to one or more extreme burn periods within the problem fire. Weather (wind speed and direction) are held constant in FlamMap fire simulations (in contrast for FARSITE).

The problem fire definition for the demo data are:

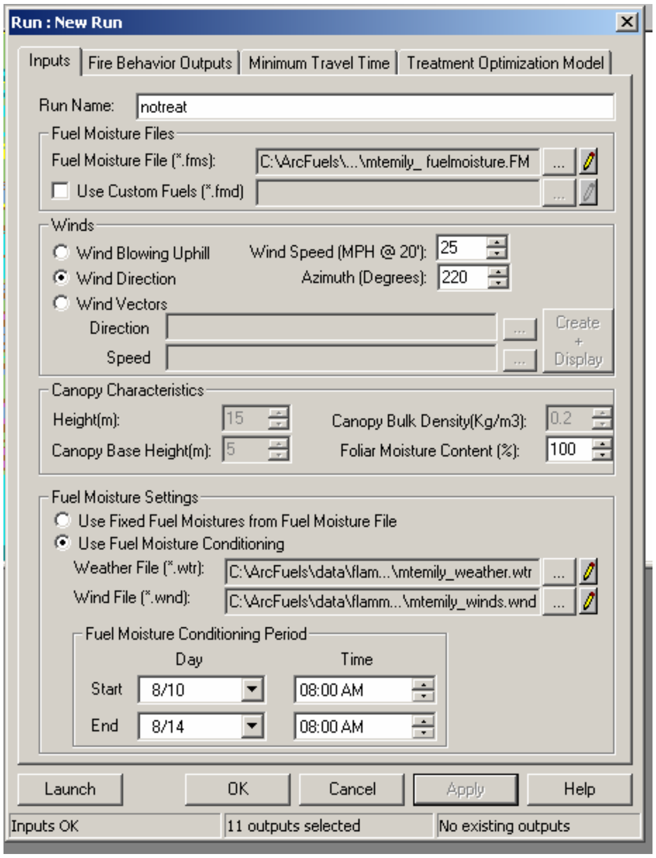
- Potential fire size (1000 – 4000 acres)
- Length of burn period (480 minute)
- Wind speed 25 mph (20 ft.)
- Direction 220 degrees
- Fuel moisture: c:\arcfuels\data\flammap run\mtemily_fuelmoisture
- Weather for fuel moisture preconditioning: c:\arcfuels\data\flammap run\mtemily_fuelmoisture
- Winds for fuel moisture preconditioning c::\arcfuels\data\flammap run\mtemily_winds

Exercise 2.3 Test the problem fire

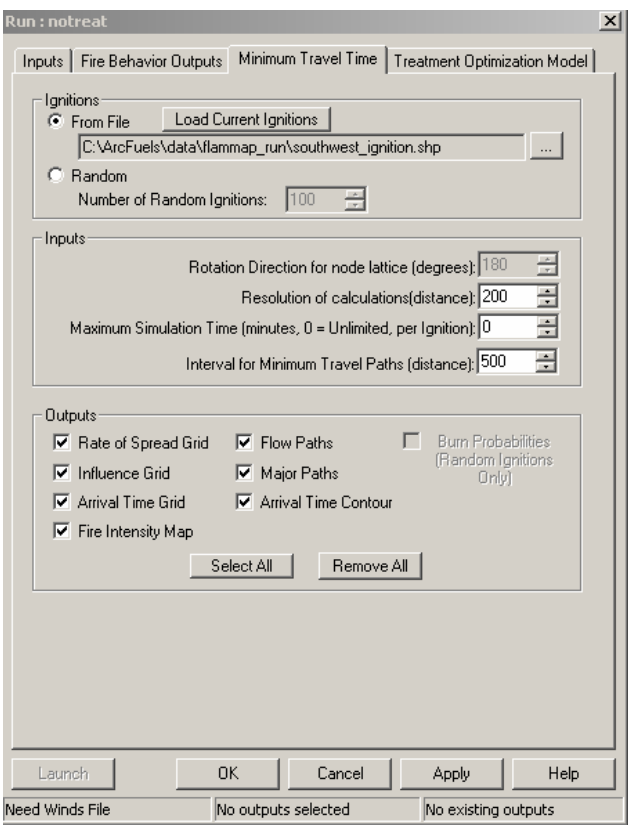
In this exercise a single problem fire will be simulated for several point ignitions to test the fire simulation parameters. The target fire size for the demo data is several thousand acres.

This section assumes familiarity with FlamMap. See the tutorial (C:\Arcfuels\programs\flammap3\flammap3.chm).

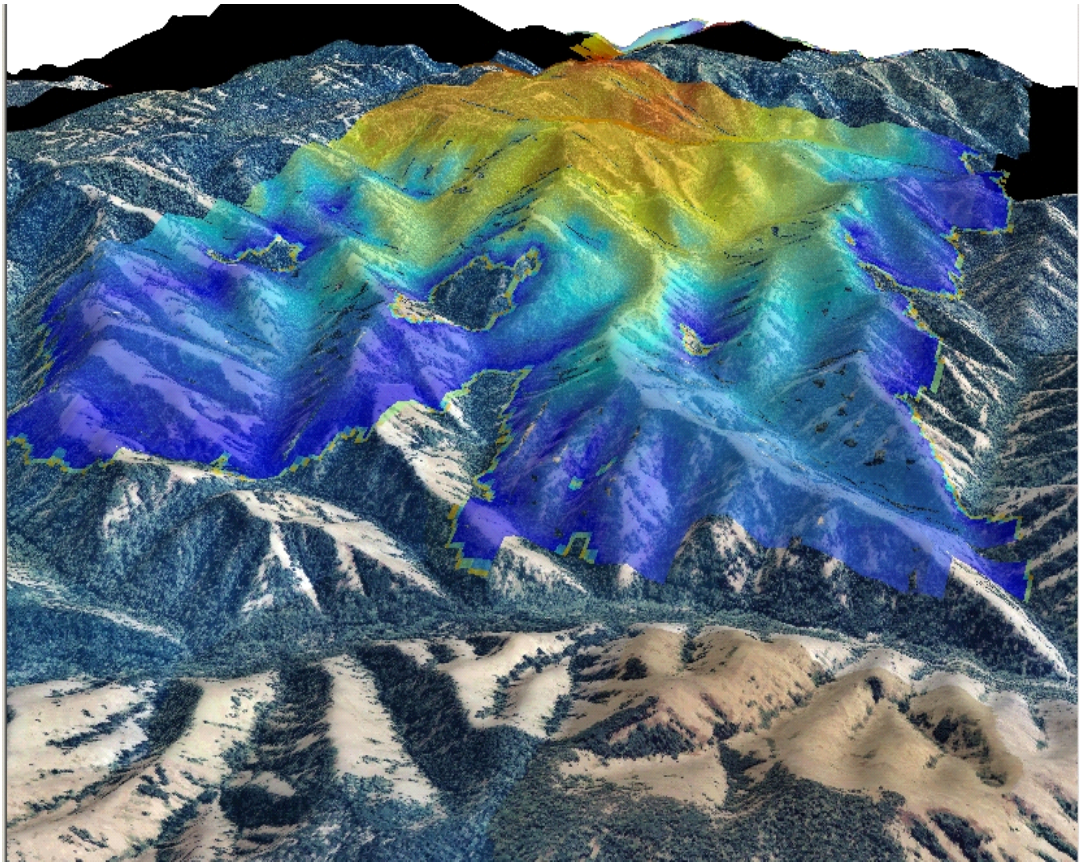
- FlamMap should be open from the previous exercise and the *notreat.lcp* landscape file loaded.
- Create a point or line ignition in FlamMap with the drip torch button . Select an area where a problem fire is likely (i.e. not on the leeward side of the project area)
- Turn off the drip torch by clicking the pointer or other icon on the toolbar 
- Double click on *Run* to open the FlamMap run parameters form.
- Load fuel moisture file (*c:\arcfuels\data\flammap_run\mtemily_fuelmoisture.fms*)
- Load weather file (*c:\arcfuels\data\flammap_run\mtemily_weather*.wtr)
- Load the winds file (*c:\arcfuels\data\flammap_run\mtemily_winds.wnd*)
- Enter the wind speed of 25 mph and wind direction of 220 for a problem fire
- Examine the FlamMap graphic below to check if the parameters are correct
- Select *Fire Behavior Outputs* tab and check *Select All*
- Open the *Minimum travel time* Tab and click load current ignitions (form is displayed below)
- Change the resolution of calculations to a relatively large number to speed up the simulations (e.g. 200)
- Select *All Outputs* and *Launch*
- Examine outputs and determine the size of the fire - are the problem fire parameters generating a reasonable problem fire?



FlamMap data input form for the Mt Emily demo data



FlamMap Minimum Travel time form set up to simulate a single fire using an ignition file created with the drip torch



Plot of arrival time for a FlamMap simulated fire in the Mill Creek Watershed.

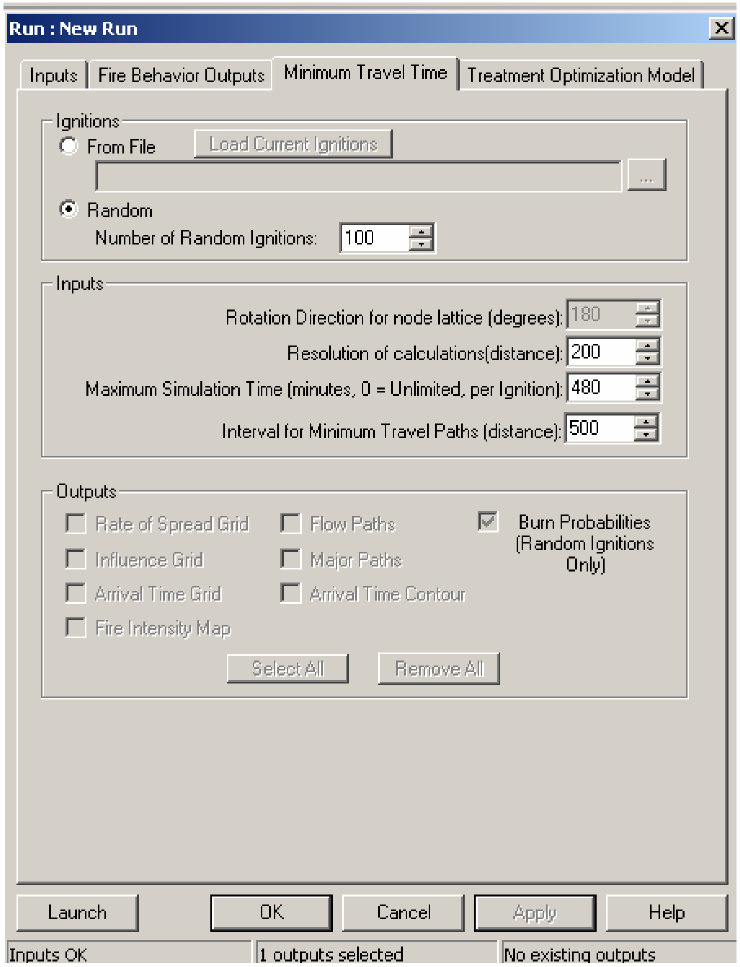
Exercise 2.4 FlamMap run for burn probability

This exercise generates information about spatial patterns of wildfire behavior to help determine where treatments might be useful. Burn probability maps will be generated using FlamMap to show probability of a pixel burning in the project area given a random ignition. A number of other fire behavior outputs are also generated in this exercise.

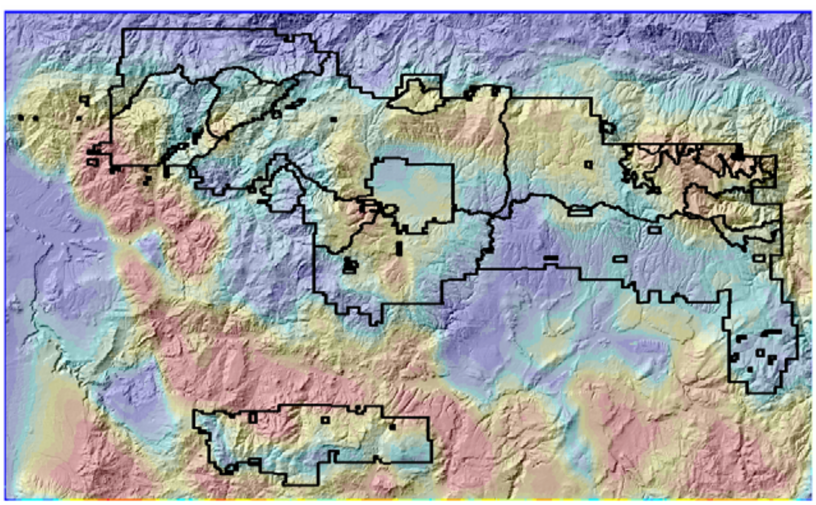
The burn probability simulation uses the problem fire definition. Weather is held constant. The weather and winds file is used for fuel moisture preconditioning.

Follow the steps below to set up a burn probability run.

- With FlamMap *Run* form open from the previous exercise, tab over to *Minimum Travel Time*, and click on the *Random* radio button. Set the *Number of Ignitions* to 100 and a *Resolution of calculations* to 200 m and the *Maximum Simulation Time* to 360 minutes (see form below). These are coarse setting for an initial run.
- Click OK and launch
- When the run is completed, view the burn probability map and the other FlamMap outputs.



FlamMap Minimum Travel Time tab set up to run a burn probability simulation

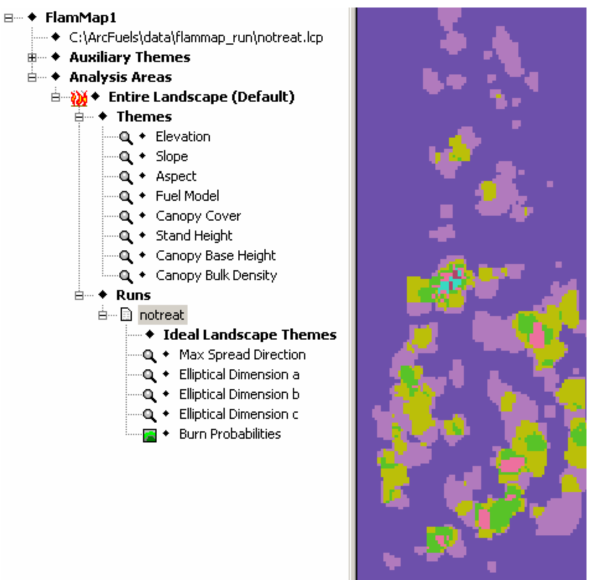


Example burn probability map for 2 million acres around the Ochoco NF Burn probability is shown for flame lengths > 12 feet.

Exercise 2.5 Refine the burn probability simulations

The first burn probability run used parameters to speed up the simulation. Burn probability runs can take days. It is important to zero in on a set of parameters that generate reasonable results in the minimum amount of time. In this exercise the results will be refined by reducing the value in the *Resolution of Calculations* (try for starters 100) and increasing the *Maximum Simulation Time* to reflect the burn period for the problem fire, and increasing the *Number of Random Ignitions* to 500. There is no exact set of parameters that are right or wrong for a project area, but the burn probability outputs should reflect a complete sampling of the landscape in terms of simulated fires. In other words, we want every cell with burnable fuels to experience a couple of fires to get a robust estimate of the variability in the landscape. Note that the simulation time is very sensitive to the *Resolution of Calculations* value, especially when it is set below 100 – 200 m..

- Experiment with several sets of parameters.
- When finished, save the burn probability outputs as an Ascii grid file by right clicking on burn probabilities in the FlamMap table of contents and saving to c:\arcfuels\outputs\bpnotrt.asc. Save other outputs as well such as crown fire activity and rate of spread in the same directory.
- Do the burn probability maps suggest where treatments might reduce wildfire risk?



FlamMap burn probability run for the Mt Emily demo data. This simulation needs more fires to sample the landscape.

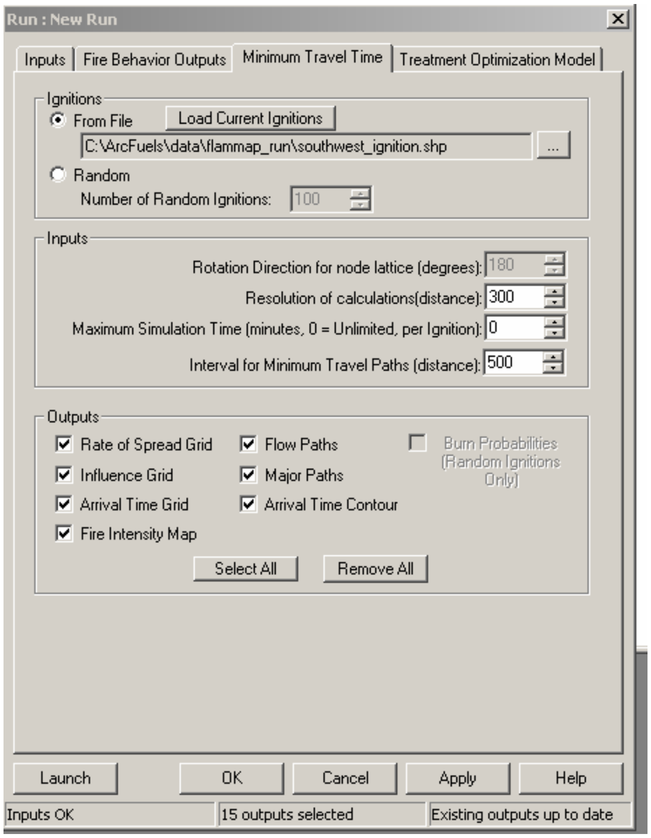
Exercise 2.6 Wildfire spread patterns and arrival time

This exercise generates further descriptive information about spatial patterns of wildfire behavior to help determine where treatments might be useful. However, instead of simulating lots of fires to examine fire likelihoods, the simulation involves burning a single large fire across the landscape under problem fire conditions. The exercise first requires creating an ignition file, and then simulating the fire through the landscape. Several outputs are of interest, including the *arrival time, flow paths,* and others.

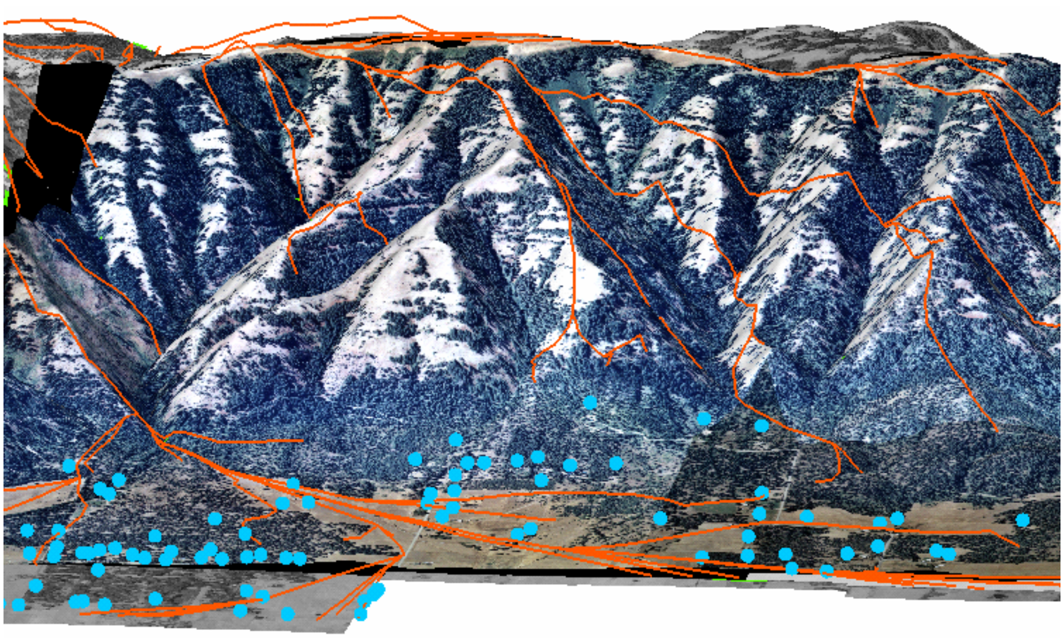
With the FlamMap setup from the previous exercise do the following

- Create a long ignition line along southwest portion of the study area.
- Tab to the *Minimum travel time* form in FlamMap
- Click load current ignitions – FlamMap will ask you for a file name to save the ignition.
- Set the resolution at 300 (for a first try) and the simulation time at 0 (fire burns entire landscape)
- Select *All Outputs*
- *Launch*
- Examine the arrival time and flow paths
- If time permits, reduce the resolution and re-run
- Right click on the outputs to save flow paths, arrival time and others of interest to c:\arcfuels\outputs\. Include *notreat* in the name of the exported data to differentiate it from treatment scenarios run later in the workshop.

- Save the FlamMap run to *c:\arcfuels\outputs\notreat.fmp*



FlamMap form for calculating minimum travel times.



FlamMap wildfire flow paths plotted on a NAIP image in ArcGlobe Cyan points are houses.

Exercise 2.7 Import FlamMap outputs to ArcGIS

When satisfactory FlamMap outputs are obtained (for the purpose of the workshop) the maps can be imported to ArcMap for further processing and display. ArcFuels has an ASCII Grid import function for importing FlamMap outputs like burn probability and arrival time. Note that vector outputs like flow paths are converted to shapefiles by FlamMap ands special importing routines are not necessary. ArcFuels has a batch import feature that allows multiple files to be imported.

- Click the *File Conversion* button on the bottom toolbar and select *Convert ASCII Grid*
- Enter the name of the FlamMap ASCII grid outputs files for burn probability (saved in a previous exercise in c:\arcfuels\outputs)
- After processing, add the grid to your ArcMap project.
- Repeat for other outputs and load into ArcMap
- Add the flow path shapefile to the project.
- Remember to save your project Layer file (lyr) after modifying the ArcMap project.

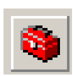
Module 3. Identifying Resources at Risk

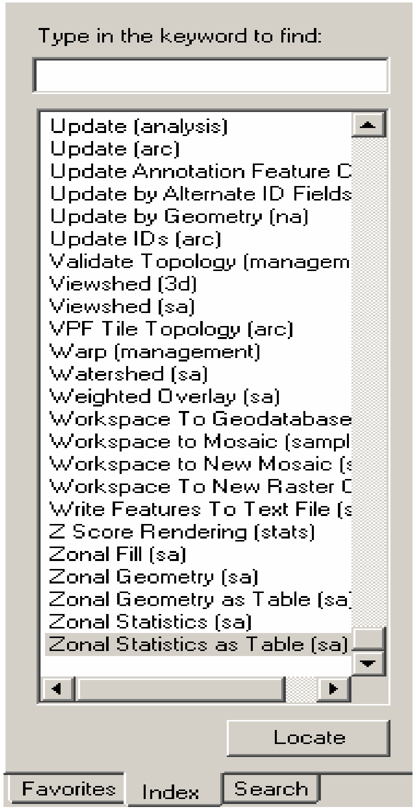
The goal of this exercise is to combine the fire outputs created in the previous section with spatial data on highly valued resources within the project area. This exercise uses the fire behavior outputs from the previous exercise (burn probability, arrival time, crown fire incidence, and flame length) and the spatial data *homesites* and *lynxhabitat* in the demo data. A table that summarizes specific fire behavior within specific resources of concern will be generated. These outputs will be compared to treatment alternatives (Alt1)later in the workshop.

Example table of FlamMap outputs summarized for specific resources of concern. Data for alternatives will be generated later in the workshop.

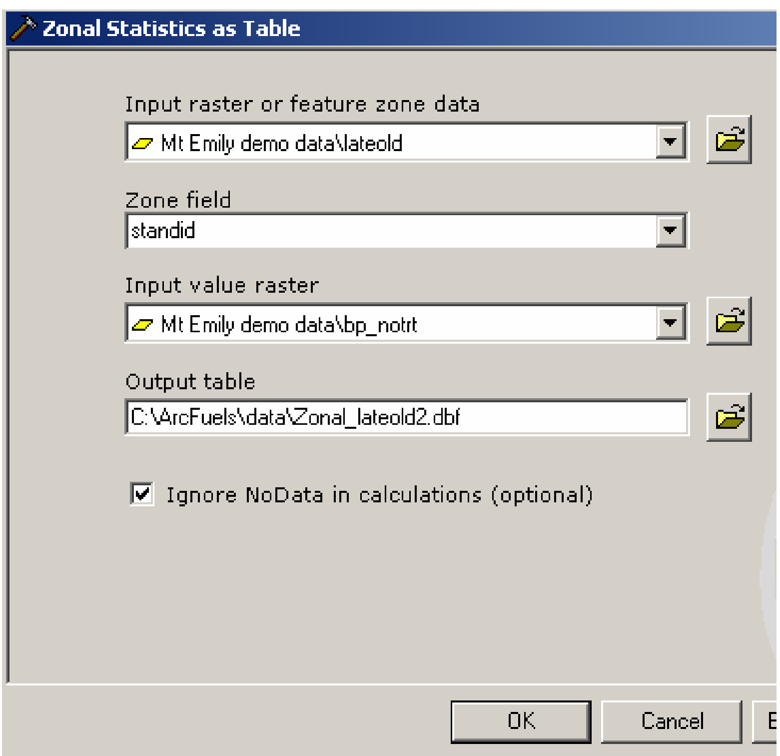
Example Resource Values at risk (use your own)	Burn probability		Arrival time (min)		Crown fire activity (acres)		Average flame length (ft)
	No treat	Alt1	No treat	Alt1	No treat	Alt1	No treat
Project area	0.030	0.025	Na	na			
Lynx Habitat							
Homesites	0.072	0.059					
	0.043	0.028					

Exercise 3.1 Summarize FlamMap outputs

- If not done already, load into ArcGIS maps of burn probability, arrival time, crown fire activity, and flame length from the FlamMap runs in the previous exercise.
- Make the *LynxHabitat* and *homesites* layer visible on top of the FlamMap outputs
- Start the ArcMap Toolbox 
- Locate *Zonal Statistics as Table* in the Toolbox (The easiest way is to click on the index tab at the bottom of the form and scroll down to *Zonal* *(*see the image below)
- In the text box *Input Raster or Feature Zone* Layer enter the *LynxHabitat* layer.
- In the *Zone Field* text box select *standid*. The results will be summarized using unique values in this field.
- In the *Input Value Raster* text box select the burn probability grid
- Select OK.
- The output will be a dbf file. Right click on the dbf file in the ArcMap *Table of Contents* and open (see image below). Save the dbf file as an excel spreadsheet in c:\arcfuels\outputs.
- Repeat with other outputs (arrival time, crown fire activity, flame length, etc.)
- Combine outputs into a single spreadsheet and save for comparison later in the workshop.



Finding commands in theArcGIS toolbox is easier if you click on the index tab at the bottom of the form



The zonal statistics as table form in the Arc ToolBox. The procedure summarizes grid values according to points, polygons, or lines in a feature layer. This process can be used to summarize FlamMap outputs for resources at risk from wildand fire.

VALUE	COUNT	AREA	MIN	MAX	RANGE	MEAN	STD	SUM
114	68	550800	0.000	0.039	0.039	0.022	0.009	1.475
123	100	810000	0.022	0.048	0.026	0.036	0.006	3.604
130	115	931500	0.011	0.045	0.034	0.026	0.008	3.022
149	170	1377000	0.003	0.066	0.063	0.035	0.012	5.877
206	294	2381400	0.002	0.039	0.037	0.012	0.008	3.662
339	11	89100	0.019	0.026	0.007	0.023	0.003	0.258
353	32	259200	0.020	0.050	0.030	0.029	0.008	0.921
454	22	178200	0.026	0.037	0.011	0.033	0.003	0.731
577	10	81000	0.001	0.041	0.040	0.020	0.011	0.196
590	11	89100	0.004	0.041	0.037	0.025	0.010	0.275
592	11	89100	0.026	0.043	0.017	0.035	0.006	0.382
636	17	137700	0.045	0.066	0.021	0.056	0.005	0.954
719	17	137700	0.048	0.065	0.017	0.059	0.004	0.995
761	18	145800	0.050	0.065	0.015	0.057	0.004	1.030
794	40	324000	0.054	0.077	0.023	0.063	0.006	2.519
807	66	534600	0.059	0.088	0.029	0.081	0.006	5.329
850	28	226800	0.075	0.085	0.010	0.081	0.002	2.274
929	24	194400	0.057	0.074	0.017	0.066	0.005	1.574
947	25	202500	0.042	0.065	0.023	0.053	0.006	1.328
980	6	48600	0.040	0.056	0.016	0.050	0.006	0.300
1008	29	234900	0.045	0.058	0.013	0.050	0.004	1.457
1018	18	145800	0.040	0.045	0.005	0.042	0.002	0.757

Example output from the zonal statistics function in Arc Toolbox. The outputs show statistics for the burn probabilities by old growth polygon from the Mt Emily demo data. These outputs can also calculated for fuel treatment alternatives to evaluate treatment effectiveness.

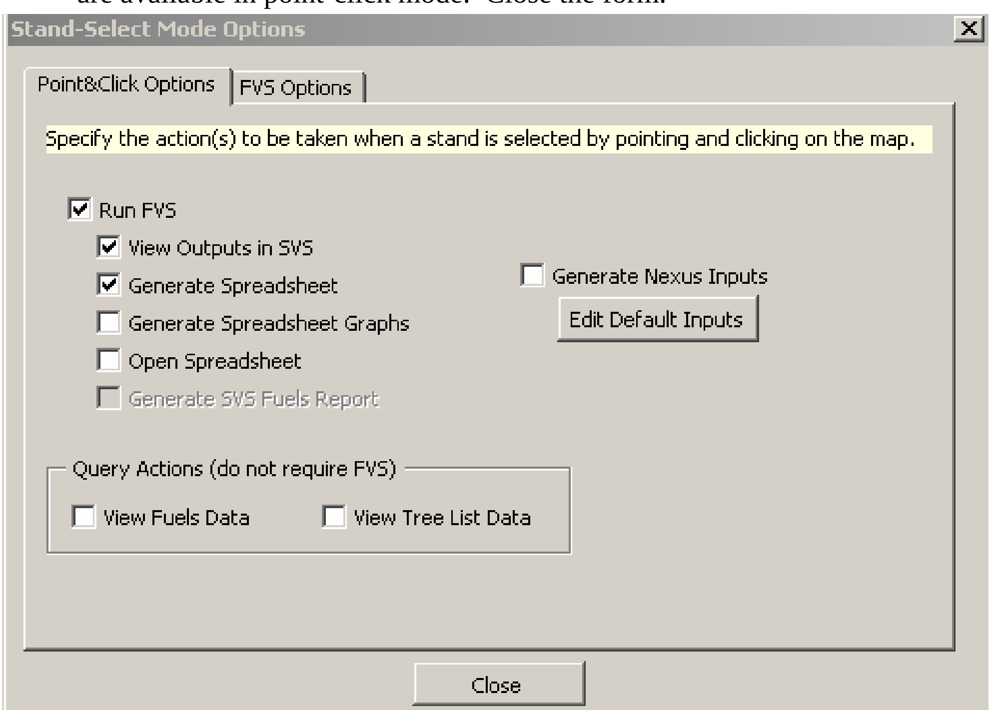
Module 4. Testing and Refining Fuel Treatment Prescriptions with FVS

The objective of this exercise is to develop parameters for simulating fuel treatments. When stand inventory data are available, FVS can be used to simulate treatments via FVS keywords. The FVS outputs are used to rebuild the FlamMap landscape file. In the case where only grid data (e.g. Landfire) are available, other methods must be used to determine how the treatments will change the canopy fuels and fuel model. There is no set method for this latter process, although in this workshop we will suggest several methods.

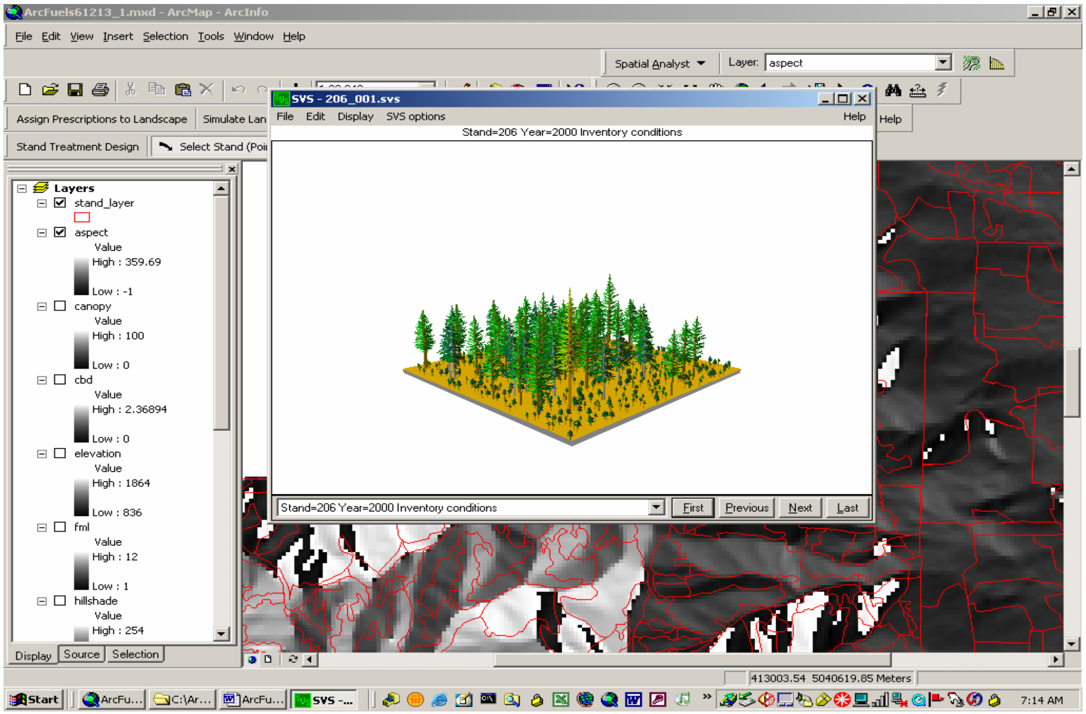
Exercise 4.1 Simulating Fuel Treatments with FVS

Fuel treatments can be simulated in detail using FVS and FFE provided there is inventory data. Thinning, mastication, site removal, burning, and other management activities can be simulated using FVS-FFE keywords. Many example keywords sets are provided in the ArcFuels demo data (c:\arcfuels\programs\kcp). The FFE manual provides extensive documentation (hyperlink). In this exercise we will use FVS-FFE to develop and test fuel treatment prescriptions.

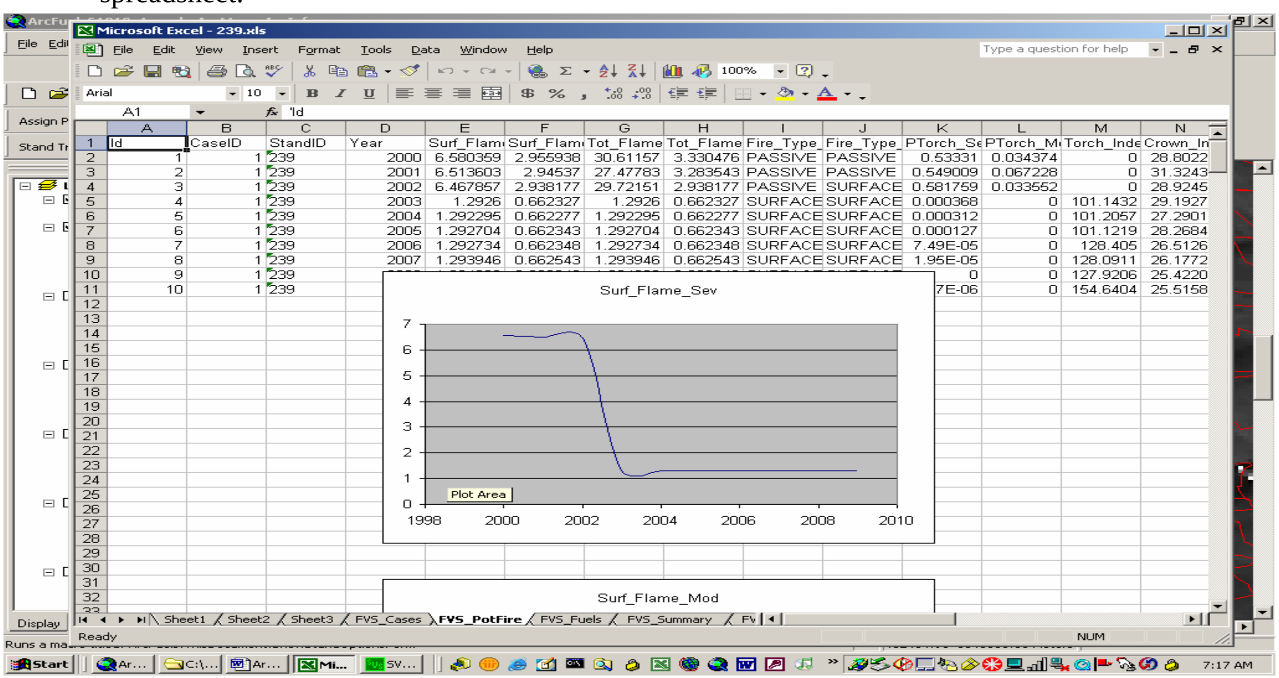
- With the Mt Emily demo data loaded, make the stand polygon layer and NAIP image [if you have one] visible. Click the *Stand Treatment Design* button on the left side of the upper ArcFuels toolbar in ArcMap. The form below opens. Boxes are checked to run FVS and view outputs in SVS. Note the other options that are available in point-click mode. Close the form.



- Now click on the *Select Stand (Point&Click)* button on the upper ArcFuels toolbar. This is a toggle button - once it is pressed, ArcMap responds in the same manner as using the ArcMap Identify function - The map image area becomes active, and ArcMap will attempt to retrieve the polygon ID from the Stand polygon layer and then run the stand data through FVS (one other program depending on what options are selected). Zoom to a polygon on the map and click the mouse to execute an FVS run. SVS should appear as in the form below after the FVS DOS box closes.



- Close SVS and return to the Stand Query form on the ArcFuels toolbar. Check all the spreadsheet options. Close the form, and click the mouse on a polygon. SVS and a spreadsheet should appear with graphs of the FVS outputs. Navigate to the different spreadsheet tabs. After viewing the outputs, close SVS and the spreadsheet.



- To simulate a prescription, re-open the *Stand Treatment Design* button on the left side of the upper ArcFuels toolbar in ArcMap and click on the center tab. Click the radio button *Specify Prescription Files* and a list of .kcp files in the folder *C:\arcfuels\programs\kcp* will appear. These text files contain one or more FVS keywords and parameters. These files are example files that can be modified by the user, saved, and then used within an ArcFuels session. Highlight the *combo.kcp* with one click and then click on the arrow at the bottom of the list box to move the prescription to listbox on the right. Now double click on *combo.kcp* in the listbox on the right. This will open the file in Wordpad. Note that the prescription can be edited at this time. The keywords are explained in the Appendix of this document and in the keyword guide This prescription is listed below with comment lines

```
! thin from below in year 2002 to basal area 120 ft squared
ThinBBA         2002       120      0.99        1.      999.        0.      999.
! start the FFE
FMIN
Simulate fuel removal off the site in year 2003
FUELMOVE        2003         4         0         0        .9
FUELMOVE        2003         5         0         0        .9
FUELMOVE        2003         3         0         0        .9
! set moisture for a spring underburn in 2004
MOISTURE        2004         9        10        11        15        20        94
!simulate an underburn
SIMFIRE         2004         8         2        70
!set moisture in 2007 for a wildfire to test the treatment
MOISTURE        2007         3         4         6         7        20        94
!simulate a fire in 2007
SIMFIRE         2007        20         2        90
! stop the FFE
END
```

- Close the form and click on a polygon to model the prescription.
- Reopen the prescription and edit the basal area to another value. Make sure the new value is within columns 10-20. Save the file
- Re-run the prescription.
- Experiment with other prescription parameters such as timing choices and wildfire intensity.
- To simulate the prescription on the entire landscape jump to Module 7.

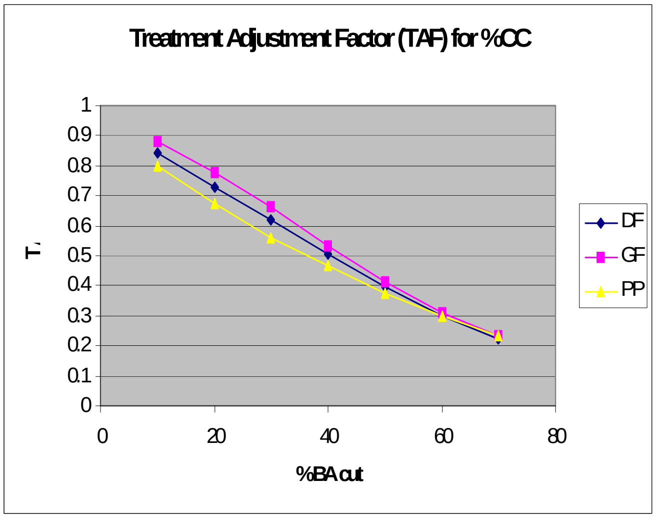
Exercise 4.2 Using FVS to Adjust Grid (Landfire) Data for Treatments

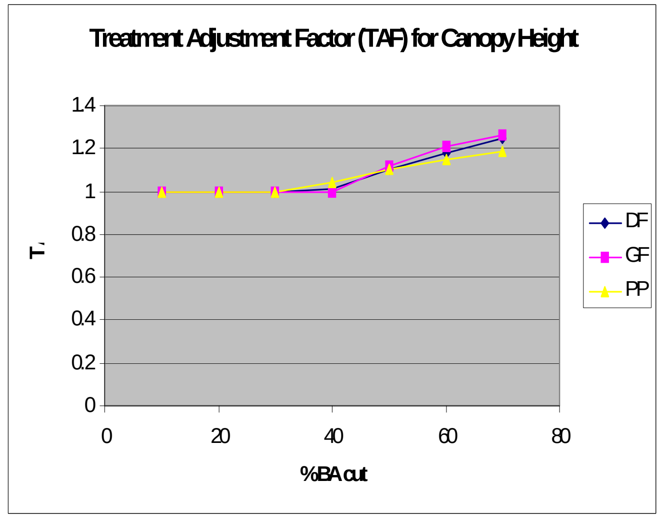
Grid data (e.g. Landfire) must be adjusted to reflect fuel treatment within treatment areas. One option for determining the adjustments by running FVS-FFE with sample plot data that represent potential treatment stands and examine pre- and post - treatment outputs (see c:\arcfuels\docs\BuildTreatDB_w_FVS4ArcFuels_brief.doc). Other options include using photo series (see c:\arcfuels\docs\psw_gtr203_016scott.pdf.

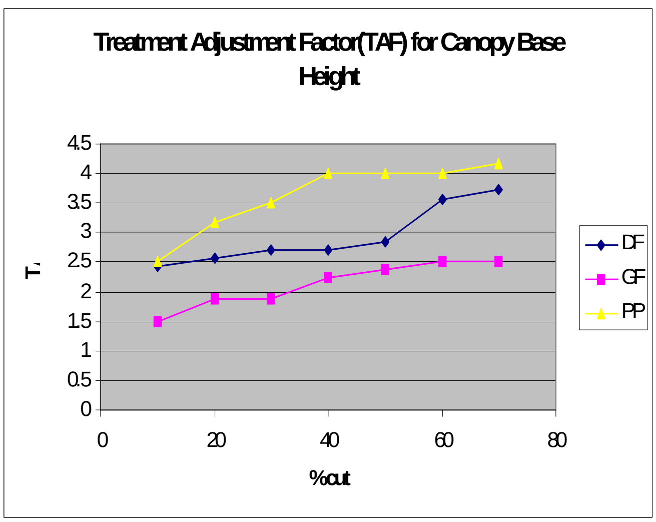
In this exercise we demonstrate using FVS to determine adjustment factors. Sample inventory plots are processed with and without treatments, and the change in canopy fuels are used to create the adjustment factor. The adjustment factors represent the proportional reduction in the specific fuel variable. The figure below was created with a four stands having different species and structure. A thin from below treatment was simulated to remove from 10 to 80 percent of the basal area. The resulting change in fuel variables was calculated from the outputs. This process is straightforward using the *prescription analyzer* in ArcFuels. In this exercise we will use just one treatment level.

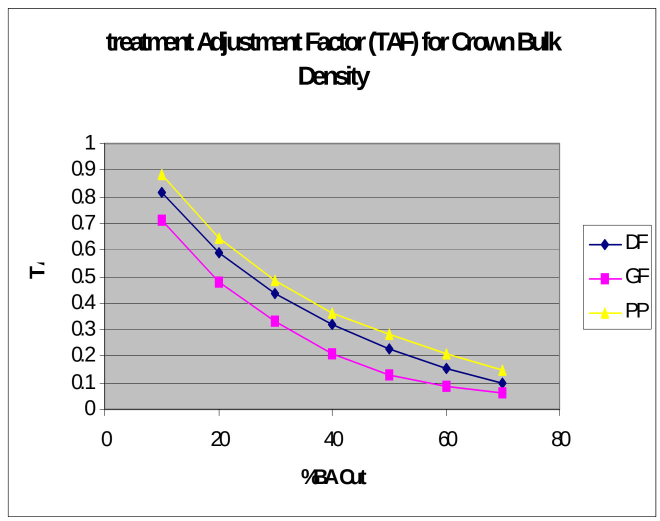
- Use the stand query function to run FVS for a selected stand. Turn on the *View Spreadsheet* option. Save the resulting spreadsheet in the *c:\arcfuels\outputs* folder and close it.
- Add a treatment prescription stand and re-run FVS. Save the spreadsheet with a different name in the location used in the previous step.
- Open both spreadsheets, cut and paste the data in the *compute* table from one spreadsheet to the other and then divide the fuel variables from the treatment run by the no treatment run. These are the adjustment factors. Note that the adjustment for fuel model is simply a change to a different fuel model.

Results from FVS runs showing the effect of different thinning intensities on canopy fuels variables. These outputs can be used to adjust gridded fuels data to reflect fuel treatments







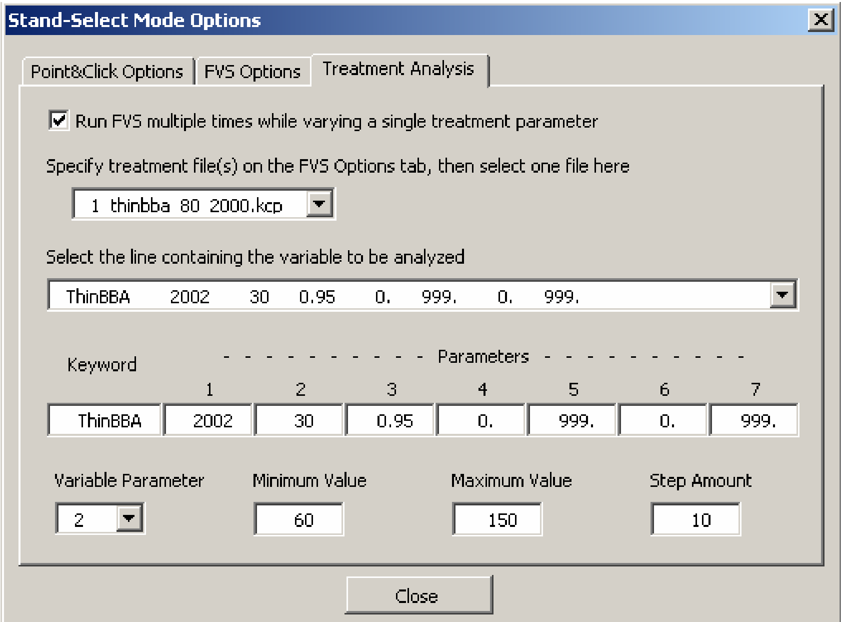


Exercise 4.3 Treatment Analysis (Optional exercise)

The Treatment Analysis form provides a way to analyze a range of treatment intensities to find the optimal prescriptions. For instance, suppose you are interested in finding a thinning intensity that achieves a specific fire behavior, such as flame length or crown fire. Examine the *Treatment Analysis* form below. Fill out the text boxes from top to bottom as follows

- Open a prescription (kcp) file that includes a thinning
- Select the one line in the prescription file that contains the treatment activity
- Choose the parameter field on the keyword line that contains the variable that will be analyzed (keywords have parameter fields)
- Choose a minimum, maximum, and step amount.

- Close the form, and then select a stand to run with the point click option Make sure to turn on the *Generate Spreadsheet* and *Graphs* options on the *point-click options* form
- Examine the output spreadsheet. Each run is labeled in the Compute table. How did flame length change with increasing thinning intensity?



The Treatment Analysis form provides a way to fine tune prescriptions to achieve specific thinning and fire behavior goals. It sets up multiple FVS runs and varies one of the keyword parameters in each run. The outputs from all the runs are saved in a single spreadsheet

Module 5 Data and Modeling Problems

Exercise 5.1 Adjusting FVS fuel model assignments

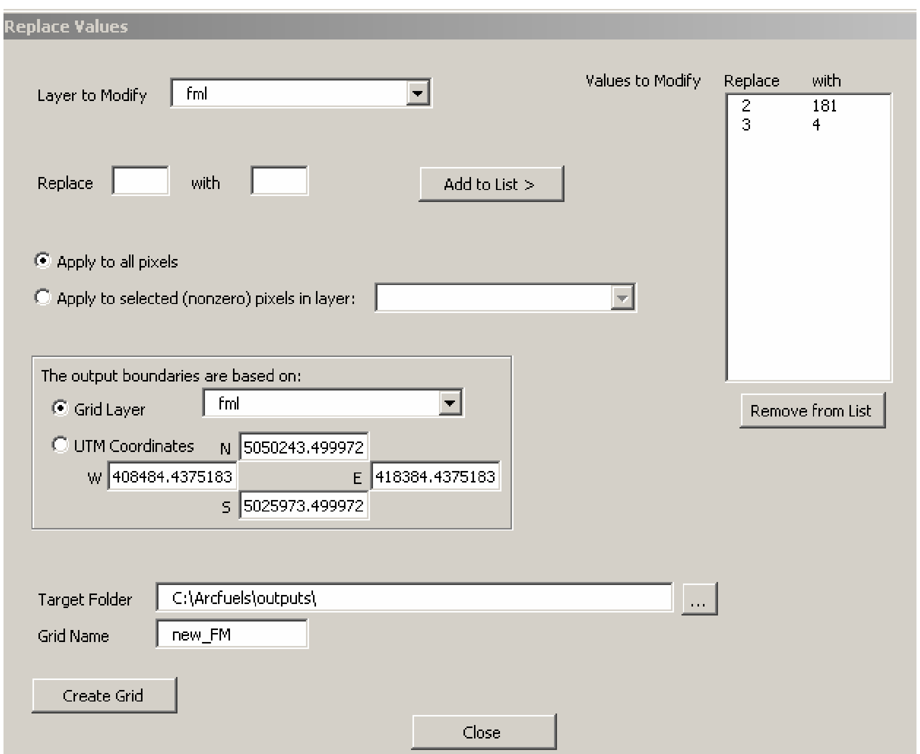
Some users find the default FVS-FFE fuel model assignments are not acceptable. One problem is that the current FFE does not include the new 40 fuel models. Another problem is that surface fuels data are usually lacking in the inventory data and FVS is not provided adequate input data required to select the appropriate fuel model.

There are a number of keywords that can be used to override FVS fuel model assignments. We have automated the user intervention by using 2 fields in the stand data table. *pretreatfuelmodel* and *posttreatfuelmodel* If a stand is not treated the value in the *pretreatfuelmodel* field is written to the output database and subsequently used to build the FlamMap landscape file. If the stand is treated, the value in the *pretreatfuelmodel* field is written to the output database and subsequently used to build the FlamMap landscape file. The checkbox on the simulate Landscape form controls whether these fields are used. If the fields are blank, the fuel model selection is controlled by FVS.

Exercise 5.2 Changing fuel models in grid data

The *Modify Grid Values* form on the bottom ArcFuels toolbar provides a simple process for substituting grid values. For instance, use this process to change fuel models in a fuel model grid. The changes can be global, or targeted to a specific set of cells identified in another grid non-zero values get changed)

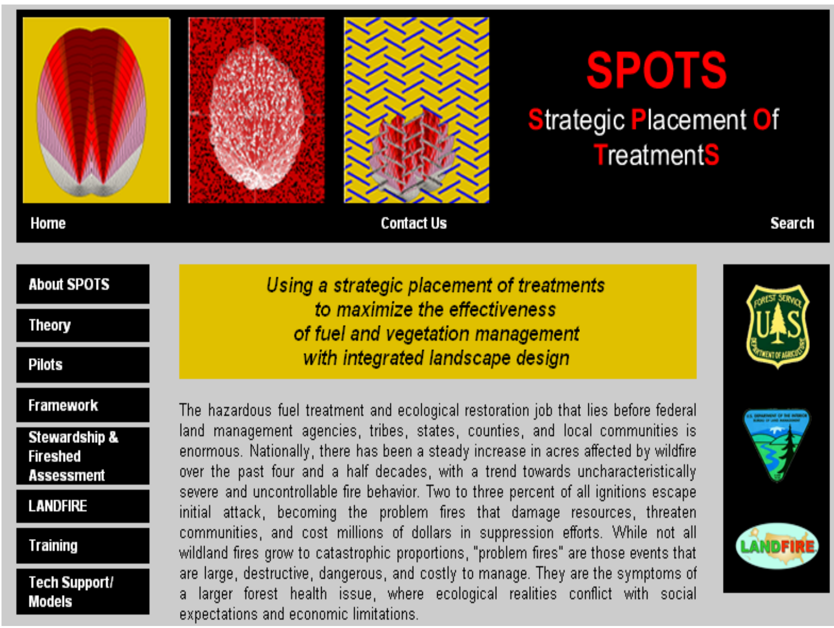
In the form below the FML layer is being edited to replace fuel model 2 with fuel model 181, and fuel model 3 is being replaced with fuel model 4. The change is global because the textbox *Apply to Selected Pixels* has been left blank.



Modify Grid Values form allows the user to make global or targeted changes in grid data and generate a new grid

Module 6. Discussion of Landscape Treatment Design

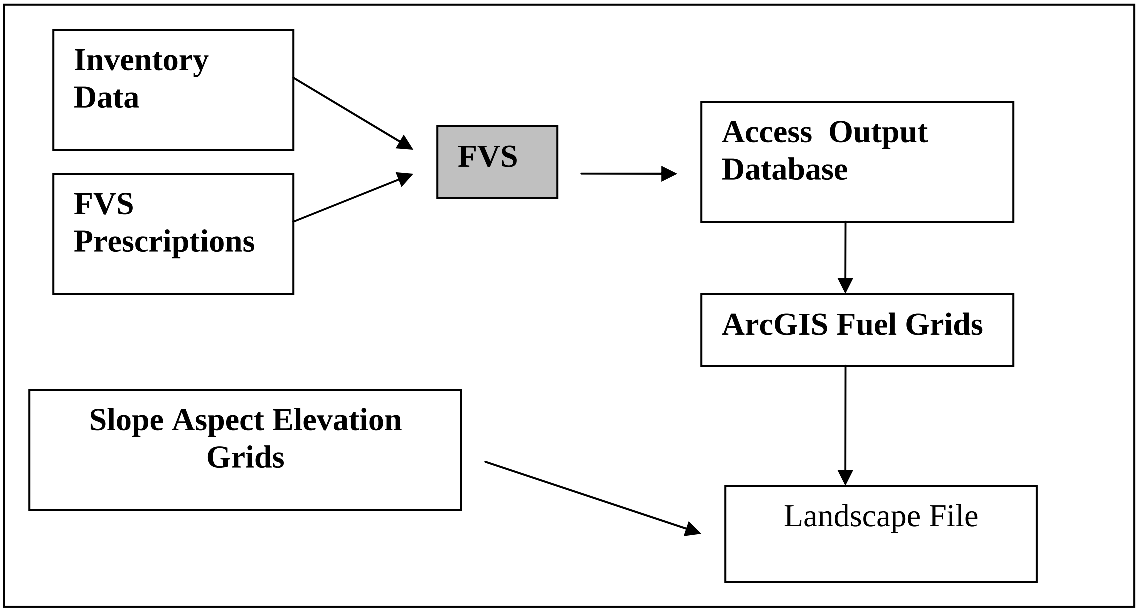
Fuel reduction treatments have proven effective in changing fire behavior and effects at the individual stand level. However, changing ***landscape-scale*** fire behavior with fuel treatments requires consideration of treatment spatial patterns relative to fire spread. Research and empirical data suggest that strategic placement of hazardous treatments on 20-30% of the landscape may dramatically reduce the size and intensity of the problem fire affecting the entire landscape. A strategic approach to the placement of treatments includes their arrangement on the landscape, orientation relative to the prevailing wind, treatment size, treatment shape, and treatment prescription



Stakeholders look over fuel treatment alternatives as part of the 2005 SPOT pilot program.

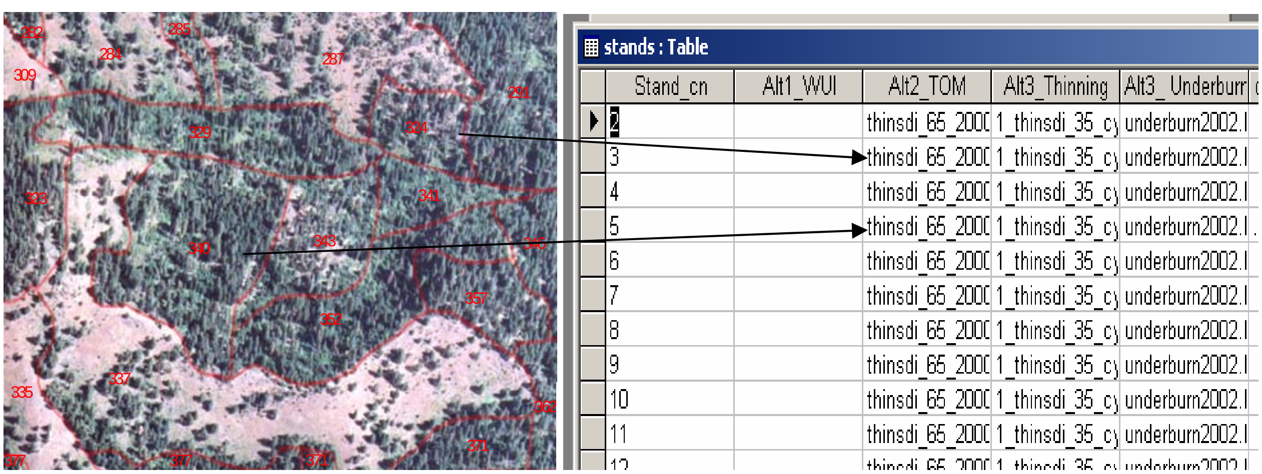
Module 7. Simulating Landscape Treatments with FVS

In this module the FlamMap outputs generated in the previous session will be used to identify treatment units that are strategically placed to reduce fire spread and effects. Treatments will then be assigned and simulated and a new FlamMap landscape file will be generated and analyzed in FlamMap. The process is shown in the diagram below.



ArcFuels stores stand prescriptions in the stand data table. Fields are added to the FVS Stand input database for each scenario, and the records are populated with the name of the prescription [kcp file] for each stand. (see image below) ArcFuels reads the keyword file when the keyword set is built.

To design a landscape scenario, e fields are inserted into the stand data table and populated with name of the prescription filename (e.g. combo.kcp, no path) for each treated stand. (see image below).



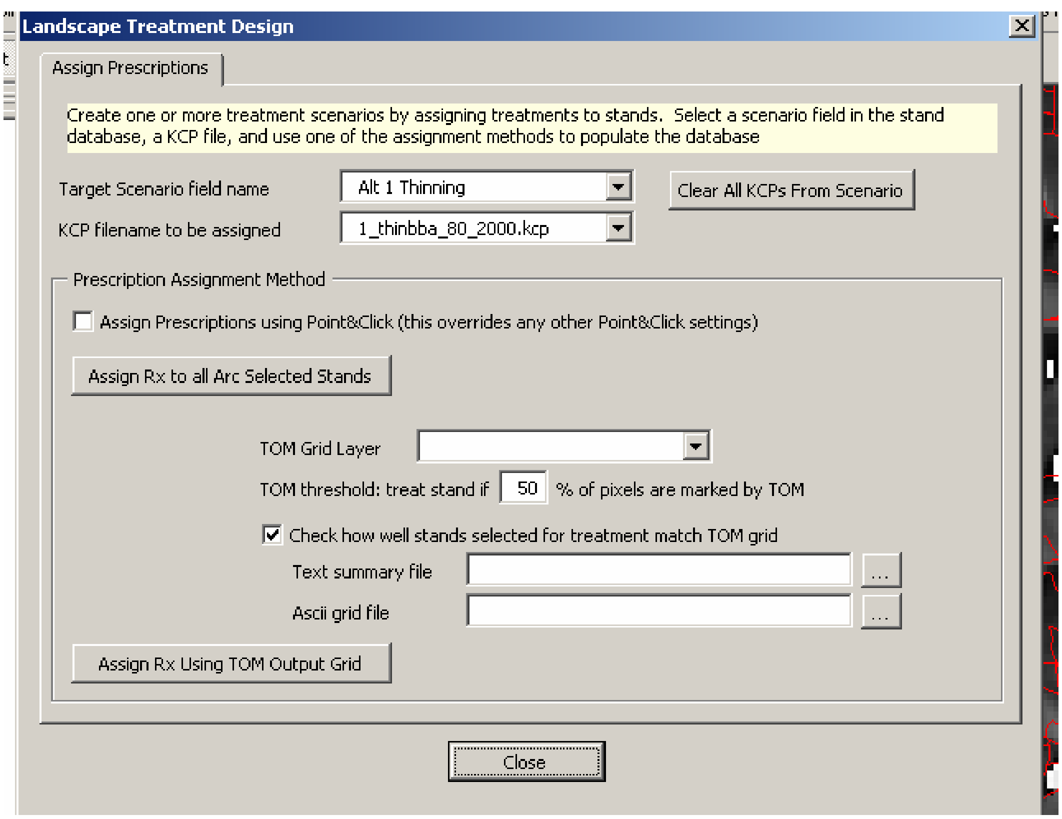
There are five methods for assigning prescriptions to stands:

- Point click on treatment polygons
- Select stands in ArcGIS

- Use an ArcGrid layer with treatment units labeled as non-zero cells (TOM output)
- Use database queries on the stand database
- Combinations of the above.

Exercise 7.1 Assign prescriptions with Point Click

- Examine FlamMap outputs from the *notreat* simulations and maps of the highly valued resources. Plot the flow paths, arrival time, and burn probability outputs. Use the *mt_em.sid* image as a backdrop in the process. Consider the direction of fire spread and the fuels.
- Start by clicking on the *Simulate Landscape Treatment* button on the ArcFuels bottom menu bar and double click on the landscape input database. Open the stand table and create text fields *alt1* and *alt2*. These fields will be used to hold the prescription information. Close the database and the form
- Click the button on the lower left ArcFuels menu *Assign Prescriptions to Landscape*. The form shown below will open. Select *alt1* from the *Target Scenario Name* dropbox as shown on the form below. *Alt1* is the name of the field in the stand database as shown in the example above. Next, select a prescription in the *KCP filename to be assigned* such as *combo.kcp*, or a prescription that was developed in a previous module. Check the box *Assign prescriptions using point click* and close the form.
- Make sure the Select Stand (Point-&Click) button is active on the upper Arcfuels toolbar. Point and click on some polygons on the example data. Respond OK to the screen query after each click operation. This action is writing the selected KCP filename into the stand database field for each selected stand. Every stand that is clicked will receive the treatment in the KCP filename when simulated through FVS.
- Open the input database as described above and navigate to the stand database. Scroll down the Alt 1 thinning field. The thinning prescription will appear in the selected stands.
- Un-toggle *Assign prescriptions using point click.* Close the form and un-toggle the *Select Stand* button by clicking on the ArcMap pointer icon.



Landscape treatment design form

Optional Exercise 7.2 Assign prescriptions to ArcGIS-selected features

The button *Assign RX to all Arc Selected Stands* is a powerful method to populate the database with prescriptions based on spatial data layers.

- Select a set of polygons using the *Select by Attributes* or *Select by locations* on the main ArcMap toolbar. For instance, select all the polygons adjacent to some highly valued resource, or nearby roads.
- After the stands are selected, open the *Assign Prescriptions to Landscape* and Select *Alt1* from the *Target Scenario Name* dropbox as in the example above. Next select a thinning prescription in the *Prescription to be assigned* drop box as shown below. Click on *Assign Rx to all Arc selected Stands*. Click OK, and let the process run. A message will appear that the prescription was assigned in the database to the selected stands. Close the form.
- Note that in the methods described above, ArcFuels overwrites existing prescriptions for selected stands only. Stand selection methods can be combined to create scenarios with multiple .kcp files by executing successive queries that target different sets of stands.

Optional Exercise 7.3 Database Query Scenarios

Scenarios may be quickly developed by running Access queries on the Stand table or other tables to fill in prescriptions. For instance, stands can be processed through FVS to generate summary stand values like SDI, basal areas, structure, and many other metrics. The output database can then be joined to the stand database and the FVS output field used to assign prescriptions based on combinations of various attributes. Although much of the same process can be accomplished within FVS using compute statements and event variables, the database approach is simpler than programming event language in FVS.

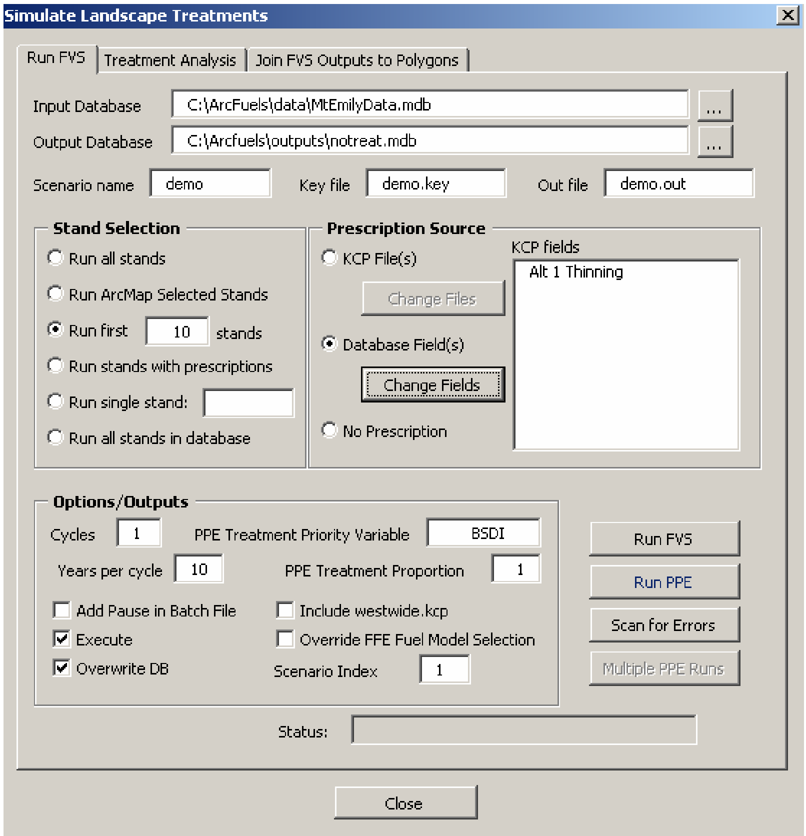
Records in scenario fields are not cleared of existing prescriptions unless they are overwritten by a subsequent query. Thus multiple queries can be executed (ArcSelects, database queries, etc.) to develop scenarios. For instance, in the example above all polygons could be assigned to an underburn keyword file, and then an Arc Select could be executed to assign a thin plus burn prescription to only those polygons within 100 meters of a home.

- Run an ACCESS query to populate the Alt2 field with combo.kcp for all stands

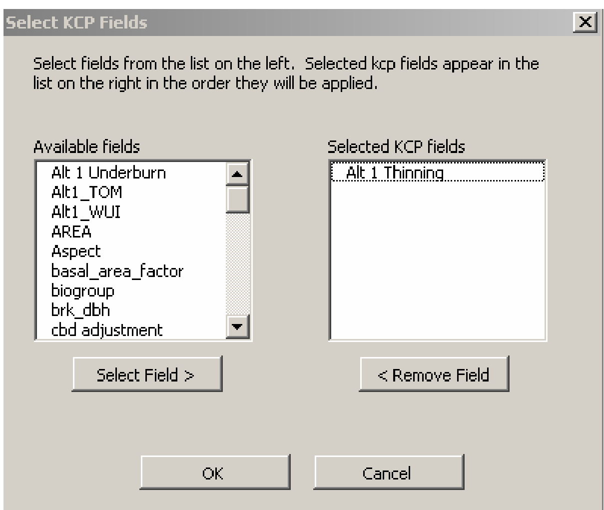
Exercise 7.4 Simulating Landscape Treatments in FVS

This exercise will simulate the prescriptions developed in the previous sections

- Click *Simulate Landscape Treatments* to open the landscape form (shown below).
- In the Prescription Source panel click the database radio button to open the prescriptions
- Edit the number of stands to process. There are several options for selecting stands for a landscape simulation; including run sequential stands in the database, run ArcMap selected stands, and a run single stand.
- Click *database fields* in the *prescription source* panel and select the *Alt1* field in the database (see form below).
- Click *Run FVS*. FVS will sequentially process the first 10 stands using the Stand Select default of 10 stands. Increase the number of stands to process to a value greater than the number of stands in the landscape and and click Run. After the run is complete, double click the output database text box to open the output database, browse the various FVS output tables, especially the Compute table – these are the inputs for FlamMap.



Form for simulating landscape treatment alternatives with FVS. The Prescription Source is set to Database, meaning that the prescriptions (kcp filename) will be read from a database field



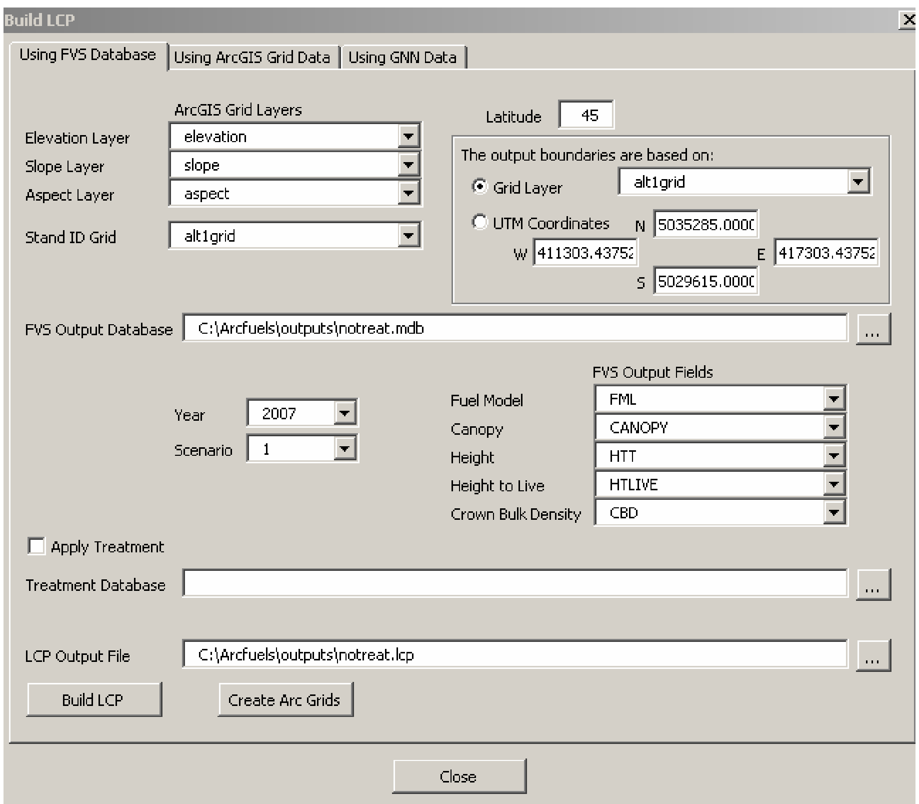
The select KCP fields form pops up when the Database Radio Button is selected on the form above.

Exercise 7.5 Build a FlamMap landscape file from FVS database outputs

The outputs from the FVS run in Exercise 5.4 can be concerted to a FlamMap landscape file.

- Open the *Build LCP* form and select the left tab *Using FVS Database* The form is shown below with the input parameters for the Demo data

- Information from the project database is used to fill out the ArcGIS layers (upper left text boxes). If these are incorrect select the appropriate layers. Note that for inputs that require ArcGIS layers, the layer must be loaded on the ArcMap table of contents to be available on the form.
- The FVS outputs database textbox will contain the output from the most recent run on the *Simulate Landscape* form. The canopy fuels data required for the landscape file is written to the *compute* table. (The data exist in other FVS output tables as well but we rewrite it to the compute table so its all in one table).
- The output boundary option (upper left) can specify any grid that covers the project area. If the grid is smaller than the project boundary the resulting landscape file will be cut according to this layer.
- Leave the Apply Treatment box unchecked. This comes later.
- Change the name of the output landscape file to Alt1.lcp (or select some other name to label the treatment scenario)
- Click *Build LCP*
- Close the form



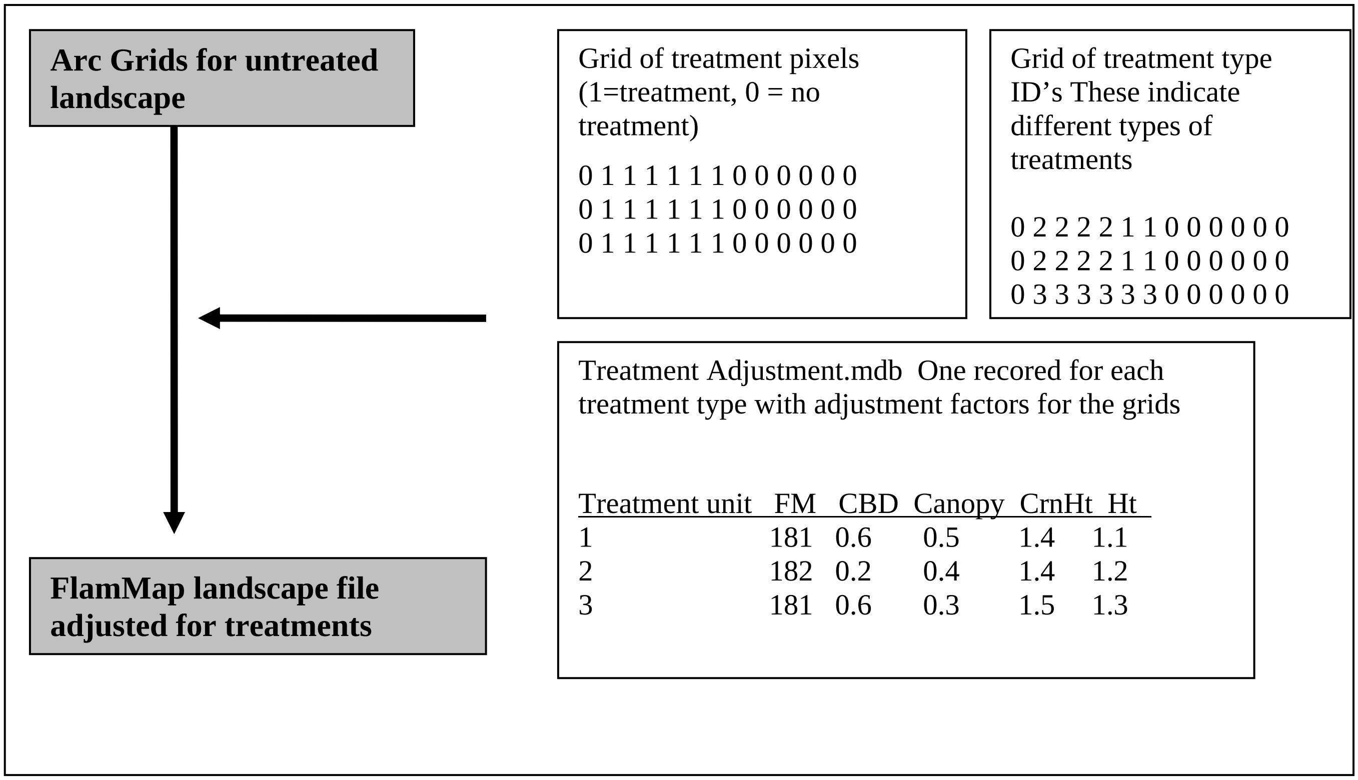
The Build FlamMap Landscape form has tabs for building FlamMap landscape files or from FVS outputs or from ArcGIS grids.

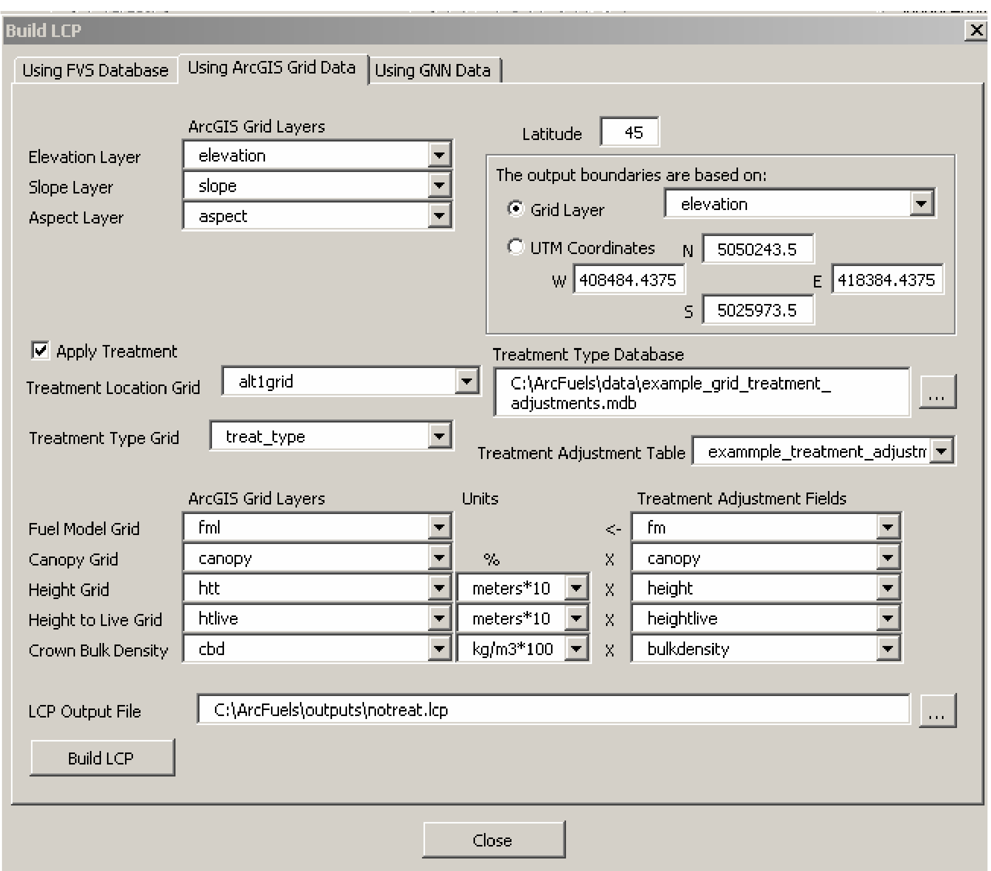
Module 8. Simulating Landscape Treatments on Grid Data

The process of simulating treatments with inventory data outlined in the previous Module is described here for grid data. Treatment adjustments are obtained from a lookup table in a database instead of running FVS to simulate the treatment on inventory data. For instance, a prescription that calls for thinning and underburning needs to be translated into changes in the Landfire grid data for canopy closure, fuel model, crown bulk density, etc. Adjustment for the lookup table can be generated with sample inventory data in FVS or some other source as described in an earlier module.

Exercise 8.1

- Examine the flowchart below
- Open the *example grid treatment adjustments.mdb* and examine the *treatment adjustment* table. This table contains multipliers that indicate the effect of the prescription on the grid data. The field *treat_type* indicates the treatment type based on the adjustment factors.
- Examine the *treat_type* grid (in ArcMap) and look at the flowchart below. The *treat_ type* grid indicates which treatment type (record) in the database is applied to the treated pixels. The treated pixels are indicated by a 0-1 grid (see flowchart).
- Examine the *treat_loc* grid in ArcMap. This 0-1 grid indicates *where* treatment are applied
- Note: This system allows for pixel-level [versus entire stands] manipulation of the Landfire grid data, for a single stand to receive different intensities of treatment.
- Make sure all the fuel and topo grids are loaded into ArcMap
- Open the Build FlamMap Landscape form and tab to the right panel *Using ArcGIS Grid Data*
- Make sure all the text boxes contain the input grid names
- Click the *Apply treatment* checkbox and fill out the form as shown below
- Enter the name for the new LCP
- Click *Build LCP*
- A new FlamMap landscape file has now been created with adjusted fuels data for treatments


Arc Grids for untreated landscape
Grid of treatment pixels (1=treatment, 0 = no treatment)
0 1 1 1 1 1 1 0 0 0 0 0 0
0 1 1 1 1 1 1 0 0 0 0 0 0
0 1 1 1 1 1 1 0 0 0 0 0 0
Grid of treatment type ID's These indicate different types of treatments
0 2 2 2 2 1 1 0 0 0 0 0 0
0 2 2 2 2 1 1 0 0 0 0 0 0
0 3 3 3 3 3 3 0 0 0 0 0 0
Treatment Adjustment.mdb One recored for each treatment type with adjustment factors for the grids
Treatment unit FM CBD Canopy CrnHt Ht
1 181 0.6 0.5 1.4 1.1
2 182 0.2 0.4 1.4 1.2
3 181 0.6 0.3 1.5 1.3
FlamMap landscape file adjusted for treatments


Build LCP
Using FVS Database
Using ArcGIS Grid Data
Using GNN Data
ArcGIS Grid Layers
Elevation Layer
elevation
Slope Layer
slope
Aspect Layer
aspect
Latitude
45
The output boundaries are based on:
Grid Layer
elevation
UTM Coordinates
N
5050243.5
W
408484.4375
E
418384.4375
S
5025973.5
Apply Treatment
Treatment Location Grid
alt1grid
Treatment Type Database
C:\ArcFuels\data\example_grid_treatment_adjustments.mdb
Treatment Type Grid
treat_type
Treatment Adjustment Table
exammple_treatment_adjustm
ArcGIS Grid Layers
Units
Treatment Adjustment Fields
Fuel Model Grid
fml
<-
fm
Canopy Grid
canopy
%
X
canopy
Height Grid
htt
meters*10
X
height
Height to Live Grid
htlive
meters*10
X
heightlive
Crown Bulk Density
cbd
kg/m3*100
X
bulkdensity
LCP Output File
C:\ArcFuels\outputs\notreat.lcp
Build LCP
Close

Module 9 Re-run FlamMap on Treatment Alternatives

Exercise 9.1

- Repeat previous FlamMap exercises and evaluate fire behavior for the treatment alternative (s).
- Save the burn probability and flow path outputs for runs (use a different name for the outputs, c:\arcfuels\outputs).
- Import the FlamMap outputs for burn probability, arrival time, and other outpus of interest (flame length) into ArcGIS.

Exercise 9.2 Summarize FlamMap outputs for resources at risk

Repeat the procedures in Module 3 to summarize FlamMap outputs for the treatment alternatives. This would include using the zonal function in Arc Toolbox to quantify the change in FlamMap outputs.

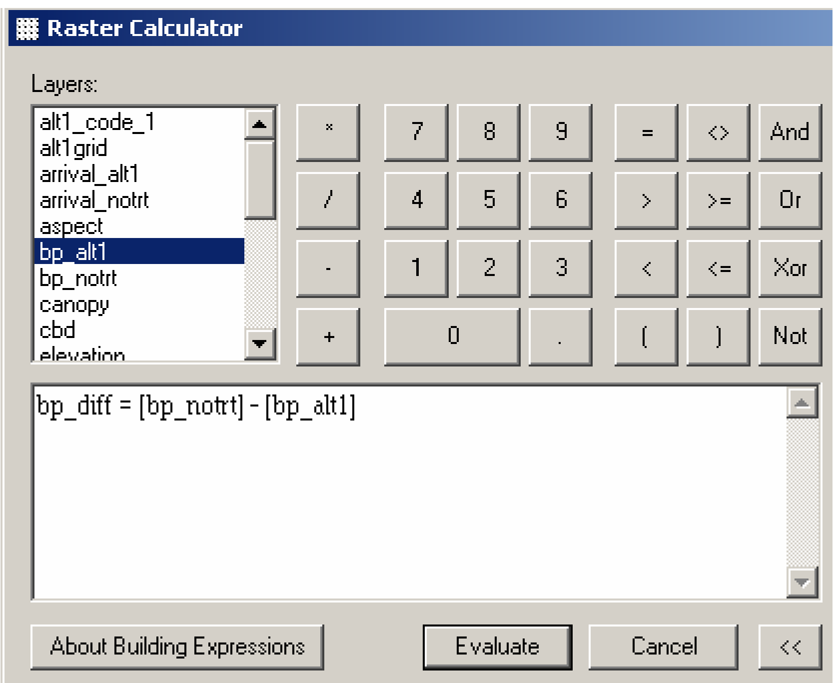
Module 10. Comparing Alternatives

This module demonstrates some simple GIS operations to compare and map treatment alternatives. The module makes use of outputs generated in previous exercises.

Exercise 10.1 Using the grid calculator to build a difference grid

The burn probability and other grids can be subtracted from one another using the Grid calculator in ArcMap. The Grid calculator performs simple grid operations.   Difference grids can be mapped to highlight the effects of fuel treatments.

- Check the options in Spatial Analyst menu – make sure the default output directory is set to your output directory.
- Create a difference grid between the notreat and alt1 grids
- Plot the treatment units on top of the burn probability difference map
- Does the difference grid show differences in burn probability outside of the treatment units
- Repeat with arrival time, crown fire activity, flame length, and any other saved outputs.



Module 11. Fuel Treatment Spatial Optimization

Fuel treatment spatial optimization (TOM) is an automated approach to the landscape design of treatments. Fuel treatment spatial optimization rely on the Minimum Travel time calculations to identify major fire travel routes and to impede them with fuel treatments. Given a proportion of the landscape that can be treated, TOM finds the specific treatment areas that reduce fire growth rates the greatest for the given treatment amount. See the FlamMap tutorial (C:\Arcfuels\programs\flammap3\flammap3.chm). for further discussions as well a paper by Mark Finney docs\finney treatment optimization GTR chapter pnw_gtr610b_chapter19.pdf

TOM is however a computationally intensive process and runs can take days. With the right set of parameters however it is possible to see how the program works with runs less than an hour. This exercise could be set up and run over night..

The treatment optimization program in FlamMap (TOM) requires two landscapes – the *ideal* and the untreated. The *ideal* has every possible treatment implemented on the landscape. The user inputs the two landscapes and the proportion of the landscape that can be treated. The output is a ASCII grid with treatment locations.

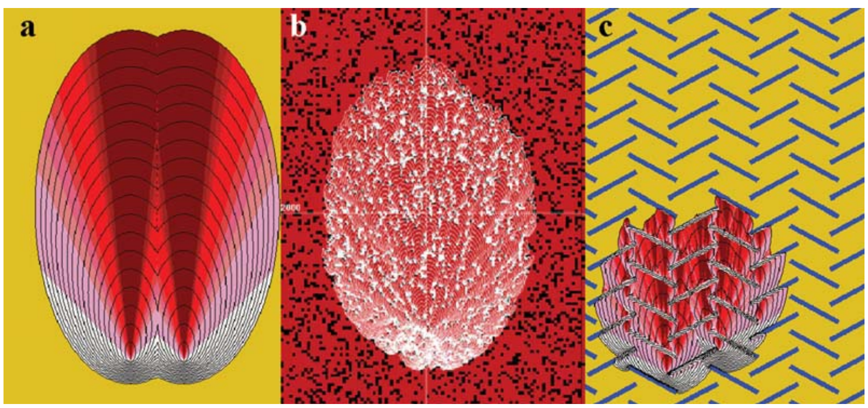
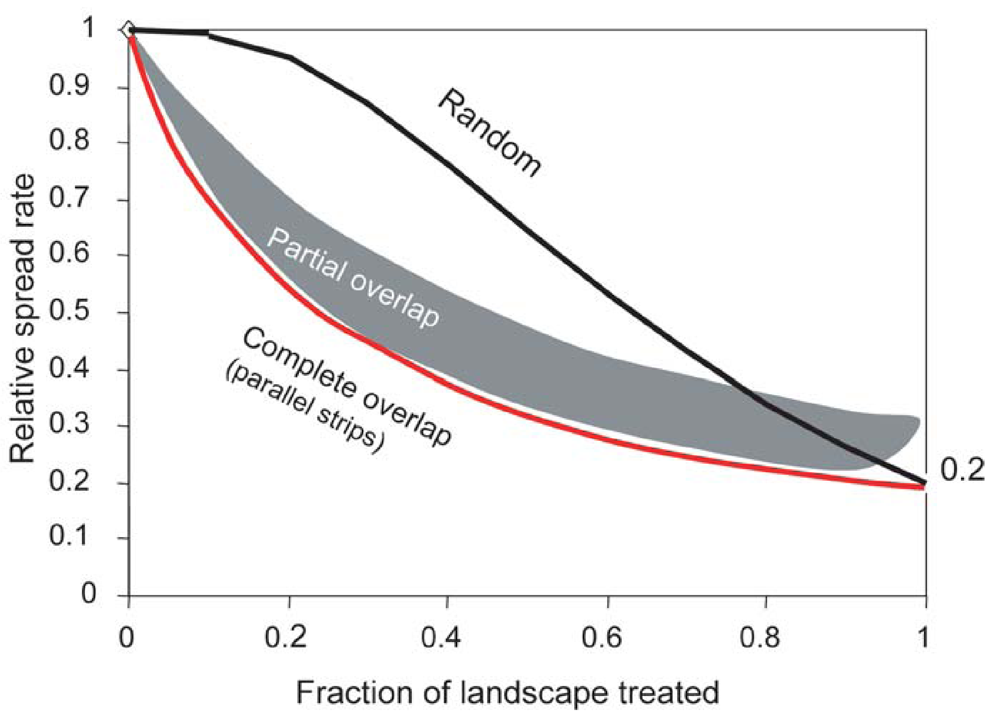


Figure from Finney 2006 showing the effect of different treatment patterns on the spread of fire.



Graph from Finney (2006) showing the relative effect of different treatment patterns on fire spread rate. The graph shows that specific treatment arrangements are more effective than randomly located treatments .

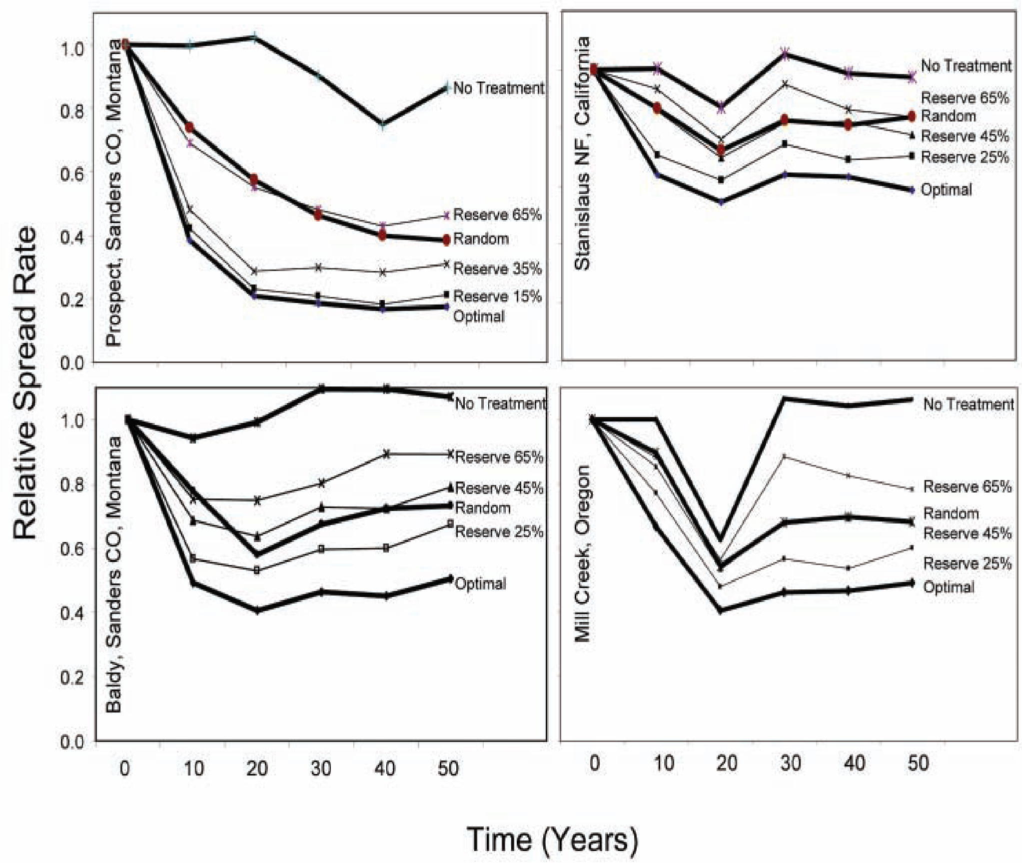


Figure 7 from Finney et al. (2006) showing that reserves reduce the effectiveness of optimal treatment patterns. Reserving >45% makes optimal pattern less effective than a random one.

Exercise 11.1 Create the ideal landscape

- Using methods described in the previous modules create an *ideal* FlamMap landscape file by treating every stand or grid cell (depending on your data) that might be considered for a fuel treatment. Remember that not considering areas for treatment diminishes the potential effectiveness of strategic treatments (see graph above).

Exercise 11.2 Run FlamMap Treatment Optimization

Refer to the FlamMap tutorial; section entitled *Treatment Optimization Model Tab* (C:\Arcfuels\programs\flammap3\flammap3.chm).

Exercise 11.3 Modeling the TOM treatments

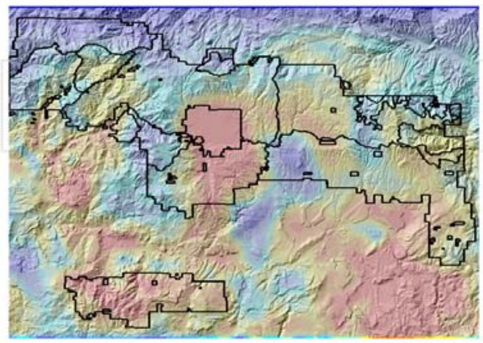
The outputs from TOM include a grid of treatment units. The alternative itself has not been simulated so there is no way to actually measure how well the TOM treatment alternative met the various fuel reduction objectives for the project compared to a no treatment alternative. For instance, how does the burn probability map change with the optimal treatment patterns. To simulate this alternative requires running the treatment units through FVS or the treatment adjustment process to create an LCP for the TOM alternative.

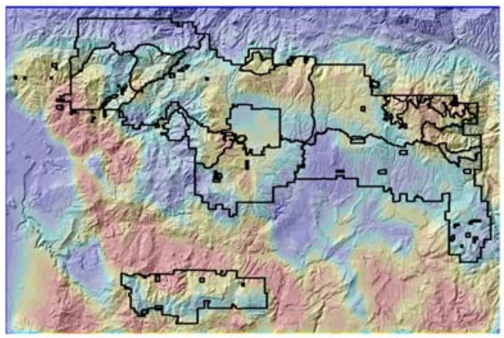
The *Assign Prescriptions to Landscape* form has an option to assign prescriptions to the stand database using the 0-1 treatment grid generated in the treatment optimization process (TOM). The process assigns a prescription to a stand when the number of treated pixels exceeds some user defined threshold. For instance, on the Landscape Treatment

Design form below, the grid of treatment pixels is the layer iflammaptrt, which was generated using the treatment optimization method in FlamMap for Mt. Emily demo data. The threshold of 50% means that TOM must have treated > 50% of the pixels in a stand before the prescription will be assigned to the stand.

Module 12. Risk Analysis

This module will discuss concepts of risk analysis for fuel treatment planning. Risk analysis can be used to measure expected fuel treatment performance compared to a no action alternative. A formal definition of risk combines the likelihood of fire and potential fire effects, and provides a single measure of potential wildfire impacts. In the previous modules, burn probability was used to indicate risk, but burn probability patterns change depending on the fire intensity. The maps below illustrate how burn probability patterns change when fires of different intensity are considered. The left image shows bun probability for fires with flame lengths less than 6 feet. On the right, burn probability considers fires with flames greater than 12 feet. The two images show contrasting patterns of burn probability and suggest different areas for fuel treatments.



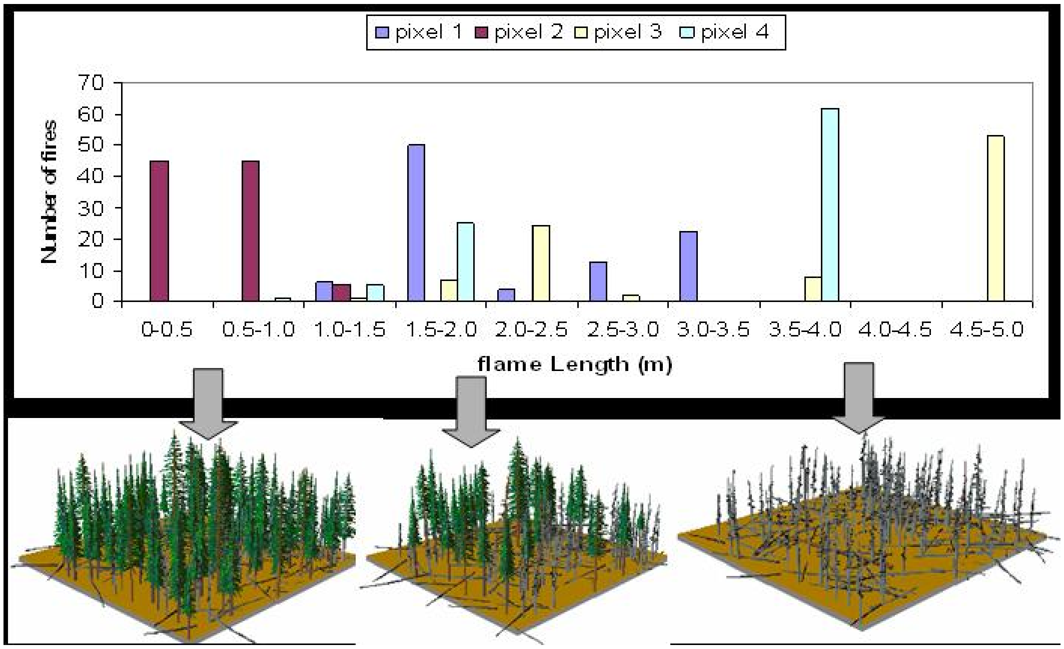


Burn probability maps for the Ochoco NF. Left image is the probability of a fire with a flame length less than 6 ft. Right image shows probability of a fire with flame lengths > 12 feet.

To measure risk it is necessary to understand the relationship between fire intensity and change in resource value. These *loss/benefit functions* are difficult to estimate for many values (e.g. structures, aquatic resources). However if resources values are based on forest composition and structure definitions, then loss functions can be built using FVS (see image below). The First Order Fire Effects Model (FOFEM) can also be used for the same purpose.

Exercise 12.1 Discussion of risk concepts

- Example risk analysis using outputs from the new FlamMap will be demonstrated.
- Further reading
  - Risk concepts docs\joe scott risk rmrs_p041_169_184.pdf
  - Example of risk analysis methods used for a fuel treatment project docs\Ager FEM wildfire risk.pdf
- The challenge of quantitative risk assessmemt docs\finney 2005 for ecol mgmt.pdf



The bar chart shows the distribution of flame lengths for 4 pixels on a landscape after simulating 200 fires.

Appendix

A-1 Using the FVS Parallel Processing Extension (PPE)

The PPE is a useful extension for landscape planning with FVS. It simulates multiple stands in a parallel fashion, i.e. the simulation is completed for all stands each time period before cycling to the next time period. PPE can model multiple, spatially explicit treatment constraints and priorities at the stand scale for a given landscape.

For example, suppose a comparison is desired of two treatment strategies, one where stands are selected for treatment based on their tree density, and one based on the proximity to structures. Suppose also that 5 treatment levels are desired where 0, 5, 10, 20, 30, and 40% of the landscape is treated. These scenarios are simulated with the MSPOLICY keyword to set the priority treatment variable, and the total treatment constraint. The Priority variable can be an FVS event monitor variable or a variable read from the stand database. Sample priority data is included in the stand database in the *homedens* field. To read the variable into an FVS run add the *readvariablesfromstanddatabase.kcp* in the demo data The contents of the file are as follows:

```
Database
DSNIN
C:\Arcfuels\data\mtemilydata.mdb
SQLIN           1
SELECT homedens FROM stands
WHERE stand_cn = '%stand_cn%'
EndSQL
```

The subsequent commands make a compute variable to echo the database contents into the FVS output database.

```
compute    0
hdens = homedens
end
```

The .kcp file reads the *homedens* variable from the stand input table and sets an FVS compute table equal to the variable. On the ArcFuels Simulate Landscape Treatments form, enter *hdens* into the priority text box and set the proportion to 0.2. With the number of stands set to 200, click the Run PPE button. The resulting run will treat 20% of the landscape [about 200 stands] and prioritize the treatments according to the distance to homes.

To use an event monitor variable as the treatment priority declare the variable in a COMPUTE variable, i.e. make a new variable and set it equal to a pre-defined FVS event monitor variable. The statement below defines and sets the variable CBSDI to the values of the FVS variable BSDI, which is the before thin stand density index.

```
compute    0
CBSDI= BSDI
End
```

It is also possible to create more elaborate treatment priority schemes using external programs. Coding a ‘1’ in the last field of the MSPOLICY field instructs FVS-PPE to stop execution at each cycle and execute a user-supplied program called *computepriority*. FVS-PPE expects this latter program to generate an ascii file containing treatment priorities. Prior to stopping the user can write the current state of FVS variables to an ACCESS database to be read by computepriority. An example application of this system can be found in Finney et al. (2006).

A-2 Example FVS Keywords for fuel treatments

A few useful FVS keywords for fuel treatments are described below for demonstration purposes. Andrew McMahan prepared this material. Users should read the FVS Keyword Guide and the Fire and Fuels Extension for a complete explanation.

THINBBA - Thins to a basal area target

THINSDI - Thins to a stand density index target'

FUELMOVE - Mechanical fuel treatment, either shift in size or removal from site

SIMFIRE - Underburn or wildfire

THINBBA

Thins to a desired Basal Area. The following THINBBA keyword thins FROM BELOW all species in the stand in cycle 1 to 80 sq ft of BA throughout all dbh and height ranges at a 95% efficiency. An explanation follows. Fields are 10 columns wide. Fields end in columns 10, 20, 30, 40, 50, 60, 70 & 80

```
ThinBBA       2000      150     0.95       0.     999.       0.     999.
```

THINBBA thins the stand from below to a residual BA target.

Field 1: FVS cycle or calendar year in which the thinning is to occur

Field 2: target residual BA (sq ft / acre)

Field 3: thinning efficiency

Field 4: smallest dbh (inches) to be considered for removal

Field 5: largest dbh (inches) to be considered for removal

Field 6: shortest tree height (feet) to be considered for removal

Field 7: tallest tree height (feet) to be considered for removal

Note: all thinning occurs in the first year of the cycle in which they are scheduled. For example, if a simulation begins in 2005 with 5-yr cycle length, a thin scheduled for 2009 would actually occur in 2005. The specified target is for the user-defined dbh and height range. The thinning efficiency controls what proportion of eligible tree records are actually removed.

SPECPREF

SPECPREF sets a removal preference, by species, for subsequent simulated thinning. This affects the order in which trees are selected for removal when a harvest is implemented. When a thinning is implemented, tree records with the highest removal priority are removed first. Removal priority is defined by: removal priority = (DBH * Fd) + SP where Fd= 1 for thinning from above; -1 for thinning from below SP = species preference (species preference is zero by default). Field 1: year or cycle that the preference is to be applied. Once in effect it remains in effect until replaced by a subsequent multiplier. Field 2: Species code whose multiplier is to be changed. Field 3: species preference value. Positive values favor removal; negative values favor retention.

For example, the keyword set below sets a removal priority three tree species. These priorities favor retention of ponderosa pine (PP), Douglas-fir (DF), and western larch (WL) whenever a thinning is implemented. The retention priorities are weighted such that PP is most heavily favored for retention, followed by DF, followed by WL). These priorities are in effect for the entire simulation.

```
SpecPref      0     PP    -100.
SpecPref      0     DF     -50.
SpecPref      0     WL     -20.
```

FUELMOVE

FUELMOVE keyword moves fuel between fuel size classes to simulate fuel treatments. Amount of fuel to move from one size class to another can be specified four different ways: by specifying specific (1) AMOUNTS to move, (2) PROPORTIONS to move, or RESIDUAL amounts to leave or create in (3) source or (4) leave pools If values are provided to move fuels by more than one method, FVS will move via the method that moves the greatest amount. Setting the SOURCE POOL to ZERO implies fuel is being MOVED IN from outside the stand. Setting the DESTINATION pool to ZERO implies REMOVING fuel from the stand. Field 1 specifies the year or cycle number to perform the fuel movement.

The following set of FUELMOVE keywords removes from the stand 90% of fuels from size classes 3, 4, & 5 in 2002. An explanation follows. Fields are 10 columns wide. Fields end in columns 10, 20, 30, 40, 50, 60, 70 & 80.

FMIN

FUELMOVE 2002 4 0 0 .9

FUELMOVE 2002 5 0 0 .9

FUELMOVE 2002 3 0 0 .9

Field 2 is the SOURCE pool SIZE CLASS (size class table follows below), Field 3 is the DESTINATION fuel pool SIZE CLASS, Field 4 (method 1) is an AMOUNT of fuel to move (in Tons per acre) from source pool to destination pool, Field 5 (method 2) is a PROPORTION of fuel to move from source to destination (note decimal syntax), Field 6 is a RESIDUAL AMOUNT to leave in the SOURCE pool (method 3), and Field 7 is a target AMOUNT to end-up with in the DESTINATION pool (method 4), The order of fuelmove keywords is important, especially if proportions are used. FFE processes keywords in the order written and removes fuel from source pool at that time. Fuel is not added to destination pools until all keywords for the year have been processed. Size class definitions are as follows:

0	1	2	3	4	5	6	7	8
none	<0.25"	0.25-1"	1-3"	3-6"	6-12"	>12"	litter	duff

SIMFIRE

SIMFIRE signals that a fire and its effects should be simulated. Use one SIMFIRE keyword for each fire you want to simulate. The following SIMFIRE keyword invokes a fire in 2003, with DRY fuel conditions, 8 mph windspeed, and an air temperature of 70 degrees F. Fields are 10 columns wide. Fields end in columns 10, 20, 30, 40, 50, 60, 70 & 80.

FMIN

SIMFIRE 2003 8 2 70

END

Field 1: the FVS cycle number or calendar year in which fire is to occur.

Field 2: Wind speed in MPH, 20 feet above ground

Field 3: Nominal moisture level class (1-4) (see table below)

Field 4: Temperature (avg. air temperature during the fire, Farenheit)

Nominal Fuel Moisture Levels (Percent)

VALUE	NAME	1-HR	10-HR	100-HR	>3'	DUFF	LIVE
1	VERY DRY	4	4 5	10	15	70	
2	DRY	8	8	10	15	50	100
3	MOIST	12	12	14	25	125	150

4	WET	16	16	18	50	200	150

Reproduced from Table 3.1 (p 67) Reinhardt and Crookston (tech eds) The Fire and Fuels Extension to the FVS Gen. Tech. Rep. RMRS-GTR-116. Note: moisture percentages are expressed as (mass of water / dry weight) * 100 Note: Moisture values may be re-set to user-defined values via the MOISTURE keyword.

This SIMFIRE keyword invokes a fire in 2010, 20 mph windspeed, an air temperature of 90 degrees F, with user-defined fuel moisture levels. Fields are 10 columns wide. Fields end in columns 10, 20, 30, 40, 50, 60, 70 & 80.

```
FMIN
MOISTURE     2007     3     4     6     7     20     94
SIMFIRE     2007     20     2     90
END
```

MOISTURE

Keyword is used to set the moisture levels for each fuel size class. If this keyword is used, user MUST specify moisture levels for all size classes (there are no defaults). MOISTURE settings apply for the year specified, and override the settings of SIMFIRE's Field 3 (assuming the SIMFIRE is the same year as the MOISTURE). Field 1: The FVS cycle number or calendar year in which moisture levels are to be defined

Field 2: Moisture value (%) for 1-HR fuels (0-0.25")

Field 3: Moisture value (%) for 10-HR fuels (0.25-1")

Field 4: Moisture value (%) for 100-HR fuels (1-3")

Field 5: Moisture value (%) for 3"+ fuels

Field 6: Moisture value (%) for duff

Field 7: Moisture value (%) for litter

Note: moisture percentages are expressed as (mass of water / dry weight) * 100

Nominal Fuel Moisture Levels (Percent) for SIMFIRE Field 3

VALUE	NAME	1-HR	10-HR	100-HR	>3'	DUFF	LIVE
1	VERYDRY	4	4	5	10	15	70
2	DRY	8	8	10	15	50	100
3	MOIST	12	12	14	25	125	150
4	WET	16	16	18	50	200	150

Reproduced from Table 3.1 (p 67) Reinhardt and Crookston (tech eds) The Fire and Fuels Extension to the FVS Gen. Tech. Rep. RMRS-GTR-116. Note: moisture percentages are expressed as (mass of water / dry weight) * 100. Note: In this example, moisture values are re-set to user-defined values via the MOISTURE keyword.

COMPUTE variable Stand database

This .kcp file fetches, for each stand, a user-defined variable from the STANDS table in the user's input database. This variable can then be used in the FVS Event Monitor in COMPUTE statements or as a priority for multi-stand. This example retrieves data from the field "homedens" from the mtemilydata.mdb

```
Database
DSNIN
C:\Arcfuels\data\mtemilydata.mdb
SQLIN        1
SELECT homedens FROM stands
```

```
WHERE stand_cn = '%stand_cn%'
EndSQL
SQLIN           1
SELECT user_definedVariable2 FROM stands
WHERE stand_cn = '%stand_cn%'
EndSQL
End
```

Next make a compute variable to echo the database read into the database output.

```
compute    0
hdens = homedens
end
```

Users must change the name of "databasename.mdb" to the name of the database containing their data. Also, verify that the path to the DB is correct. Likewise, change "user_definedVariable1" to the actual variable name you want to read-in from the stands table. If a second variable is to be read-in, un-comment out the block of code above that contains the double exclamation points ("") by removing the double exclamation points, and insert the second variable name in place of "user_definedVariable2". Copy and paste subsequent identically structured statements for each of the other variables you want the program to read-in.

A-3 FVS Data Structures

Refer to the FVS database extension guide docs\DB-FVS-UserGuide.pdf. Three fields control the relationship between the stand polygon layer, the stand database, and the treelist table (see table below). There is always a 1 to 1 relationship between the polygon identifier and the stand table stand_cn variable. The tree list identifier for each stand indicates the tree records in the tree table that are to be used for that stand. There are multiple tree records for each stand describing the species by DBH by TPA. If there are tree data for every polygon from field or other inventories then there will be a unique tree list for every stand. If MSN or GNN is used to find sample tree lists for each stand, most tree lists will be used for multiple stands. It is for this reason that there needs to be a separate identifier for the linkage between stands and trees.

Database structure showing the fields and fieldnames for the data that link spatial data in ArcGIS with Access tables containing stand-level, tree-level, and plot-level data. Fieldnames are lowercase without spaces. The example data show a situation where a MSN procedure was used to find sample tree lists for each polygon, i.e. tree lists are used multiple times. There can be one to one or one to many relationships between the stand polygons and the stand table. However, in this data structure if FVS processes the entire stand database the resulting outputs will not represent the entire landscape. A better solution is to outer join the polygon PAT table with the stand database and adopt the Arc ID number as te new unique stand identifier.

In the table below a one-one relationship exists between the polygon id and stand ID. The same tree list is used for multiple polygons. There is only one plot of tree list information per stand Field names in bold need to appear as shown (i.e. don't change the name). Note that the only one tree table record is shown per stand. Tree tables generally have multiple records per stand with data on different species and sizes.

Data source					
Polygon Map	MS Access stand table			MS Access tree table	
Arc polygon_id	stand_cn	treelist_id	Num_plots	Treelist_id	Plot_id
1	1	4	1	31	1
2	2	2	1	51	1
3	3	4	1	16	1

4	4	4	1	14	1
5	5	3	1	13	1
6	6	3	1	15	1
7	7	2	1	15	1
8	8	1	1	13	1

A-4 Mt Emily Demo data

- stand_layer stand polygons with ID that links to the Mt Emily FVS database
- canopy 30 m grid canopy cover in percent
- cbd crown bulk density
- fml fuel model
- htlive height to live crown
- htt total stand height
- standgrid stand id in the polygon layer
- mt_em.sid color NAIP image
- elevation elevation in meters
- slope slope in degrees
- aspect aspect in degrees azimuth
- hillshade hill shade of the elevation data
- homevalue a density map displaying
- values An example resourve value layer where each polygon has been rated with a integer score of 1-3
- iflammaptrt
- alt1 a set of polygons selected for treatment
- alt1_raster version of the alt1 polygon layer with standID as the grid cocde for each cell
- alt1_code_1 same as alt1_raster with cells recoded as 1

A-5 Links to fire behavior and other program downloads

- Wildfire behavior programs (FlamMap, Behave, Nexus, etc.): www.fire.org
- Forest Vegetation Simulator (FVS): http://www.fs.fed.us/fmsc/fvs/software/
- FVS keyword guide: http://www.fs.fed.us/fmsc/ftp/fvs/docs/gtr/keyword.pdf
- Fire and Fuels Extension guide: http://forest.moscowfsl.wsu.edu/gems/RMRS-GTR-116.pdf
- FVS Database extension guide: http://www.fs.fed.us/fmsc/ftp/fvs/docs/gtr/DB-FVS-UserGuide.pdf
- Wind analysis: http://www.raws.dri.edu/index.html
- How to measure success conference Portland 2005 http://www.treesearch.fs.fed.us/pubs/contents/24476
- Aerial imagery http://datagateway.nrcs.usda.gov/GatewayHome.html
- ArcFuels: http://www.fs.fed.us/pnw/wwetac/arcfuels

A-6 Additional ArcFuels Documentation

MAPPING FVS OUTPUTS

On the same form, click on the Join FVS Outputs to Polygons tab to open the form shown below. Select the output database, set year to 2000, and select the Compute table to join. Click Do Join.

To view the joined attributes from FVS outputs, close the form and right click on the Stand_Layer in the Table of Contents.in ArcMap. Click on Properties, Symbology and the form shown below will open. Select Graduated Colors on the left pane. In the Value text box select one of the joined fields from the output database, such as CBD (crown bulk density). Close the Symbology form and view the resulting rendered map of the FVS outputs.

SHORTCUT METHOD FOR RUNNING TREATMENT ALTERNATIVES THROUGH FVS

To eliminate the need to re-simulate the entire landscape with each treatment scenario, it is possible to combine a no-treatment landscape output with the simulation outputs from only the treated stands to create a hybrid landscape file. In other words, FVS outputs for the treated stands replace the FVS outputs for the no treatment scenario for the stands that are treated. If relatively few stands are treated, the process of creating several treatment scenarios is accelerated.

Click on the Apply Treatment radio button on the Use FVS Database tab. Press the file dialog button on the right and select from the folder C:\arcfuels\data\exampletreatmentdatabase.mdb. Press Build LCP. The resulting process will combine the FVS output database specified in the text box with the treatment database, overwriting the stand data for stands that appear in the Treatment Database.

LABELING SCENARIOS IN THE OUTPUT DATABASE

The Scenario text box on the landscape form allows the user to specify a scenario label for the output. In this way multiple scenarios can be written to the same output database and comparison among alternatives can be done with pivot tables. The label is output to the COMPUTE table and the default is set to 1. Since FVS will append multiple runs to the output database if the overwrite DB checkbox is not checked on the ArcFuels Simulate Treatment form, multiple scenarios can be output to a single database and labeled with the scenario field. Running multiple scenarios in a database and using the pivot table in Excel or Access provides a fast way to compare tabular scenario outputs.

A-7 Data Checklist

All project data projected to a standard projection, and cut to the same extent

- Project boundary
- Stand polygon
- Stand ID grid
- Slope grid
- Aspect grid
- Elevation grid
- Landfire grids [note – these need to be re-projected]
- Stand Treatment database for treating pixels
- Stand and tree databases in FVS-ready format
- Samples for part of the project to develop treatment coefficients
- Resource value layers – anything that affects treatment type and locations, late old forest, structures, TES, etc.
- Purpose and need statement
- Problem fire definition
- Burn period
- Wind speed and direction
- RAWS wind rose
- Fuel moisture .FMS
- Weather file for fuel moisture conditioning (.WTR)
- Treatment polygons
- Raster version of the treatment polygons
- Ideal landscape
- Combo prescriptions
- Set inventory year to 2000
- layer file

A-8 Exporting ArcGIS data to Google Earth

If you want to share ArcGIS spatial data for public viewing in Google earth there are ArcMap extensions that will generate KML (keyhole markup language) files from ArcGIS layers. The files can then be distributed or posted at a Google earth site for viewing in Google Earth. Download the KML extension at http://arcscripts.esri.com/details.asp?dbid=14273

GIS Appendix

Prepared by Bridget Naylor, PNW Research Station, La Grande Lab, bnaylor@fs.fed.us

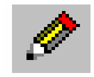
Creating a new shapefile (point, line, or polygon).

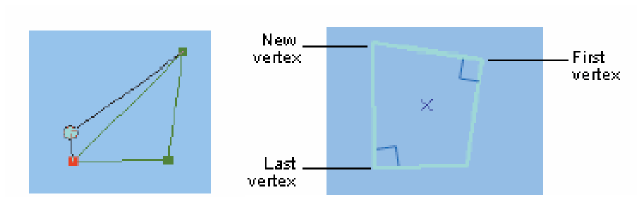
1. In ArcCatalog, select a folder in the Catalog tree
2. Click the File menu, point to New, and click Shapefile
3. Click in the Name text box and type a name for the new shapefile
4. Click the Feature Type drop-down arrow and click the type of geometry the shapefile will contain
5. Click Edit to define the shapefile's coordinate system
6. Select, import, or define a new coordinate system
   Most likely, you'll want to import a coordinate system from existing data:
   - **Importing a coordinate system**
     i. In ArcCatalog, click the shapefile whose coordinate system you want to define
     ii. Click the File menu and click Properties
     iii. Click the XY Coordinate System tab
     iv. Click Import
     v. Navigate to the data source whose coordinate system parameters you want to copy
        - For example, you can get coordinate system information from coverages, rasters, or feature datasets and feature classes in a geodatabase
     vi. Click the data source
     vii. Click Add
        - The coordinate system's parameters are listed in the Details box
     viii. Click OK on the Shapefile Properties dialog box
7. Click OK

Create polygons in a shapefile (by digitizing)

To create a new feature in ArcMap, you create an edit sketch. A sketch is composed of vertices (the positions that define the shape of a line or polygon feature) and segments (the lines that connect the vertices). You create a sketch using the sketch construction tools located on the Editor toolbar tool palette. Please read the Editor toolbar documentation in ArcGIS Desktop Help for more information about all the editing options that are available.

1. In ArcMap, add new shapefile to the table of content
2. Select Editor and click Start Editing from the Editor toolbar
3. Click the Current Task drop-down arrow and click Create New Feature

4. Click the Target layer drop-down arrow and click the polygon layer you want to edit
5. Click the tool palette drop-down arrow and click the Sketch tool 
6. Click on the map to digitize the feature's vertices
7. When finished, right-click anywhere on the map and click Finish Sketch
8. The polygon is created on your map



EDITING TIPS:

- *To delete a single vertex from a sketch, center the pointer over the vertex until the pointer changes. Right-click, then click Delete Vertex.*
- *To delete the entire sketch of the feature you're creating, position the pointer over any part of the sketch, right-click, and click Delete Sketch, or press Ctrl + Delete.*
- *To finish a sketch, you can also double-click the last vertex of the feature or press F2.*
- *You can undo the last vertex you created by clicking the Undo button on the ArcMap Standard toolbar. Click the button again to undo the second-to-last vertex you created, and so on. Click the Redo button if you want to re-add the vertex.*
- *You can add the shape of a line or polygon feature to the sketch by right-clicking over the feature with the Sketch tool and clicking Replace sketch.*

Create polygons in a shapefile (by copying from another polygon shapefile)

1. In ArcMap, add new shapefile to the table of content
2. Select Editor and click Start Editing from the Editor toolbar
3. Click the Target layer drop-down arrow and click the layer to which you want the copied feature to belong
4. Click the Edit tool

5. Click the feature you want to copy. *Hold down the Shift key while clicking features to select additional features*
6. Click the Copy button on the ArcMap Standard toolbar
7. Click the Paste button on the ArcMap Standard toolbar. *The feature is pasted on top of the original feature*

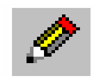
EDITING TIPS:

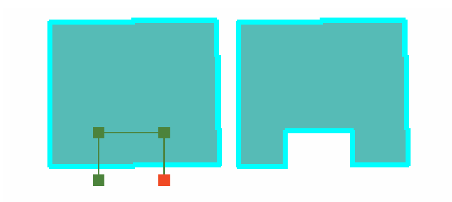
- *Using Cut and Paste (rather than Copy and Paste) will only transfer geometry. Attributes are not pasted, even if the source and target layers are the same or have identical schema. The appropriate geodatabase behavior and default or null values will be populated in the target layer*

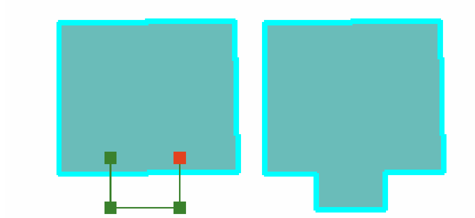
– *If attributes are not copied, you can copy and paste the individual attributes or use the Attribute Transfer tool on the Spatial Adjustment toolbar to pass along the existing attribute values to the new features*

Modify polygon shapes

1. In ArcMap, add shapefile to the table of content
2. Select Editor and click Start Editing from the Editor toolbar
3. Click the Target layer drop-down arrow and click the layer to which you want to edit
4. Click the Current Task drop-down arrow and click Reshape Feature
5. Click the Edit tool

6. Click the feature you want to reshape
7. Click the tool palette drop-down arrow and click the Sketch tool 
8. Create a line according to the way you want the feature reshaped



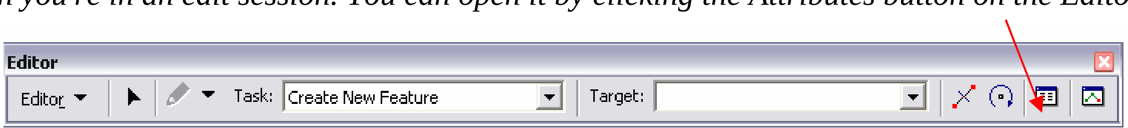


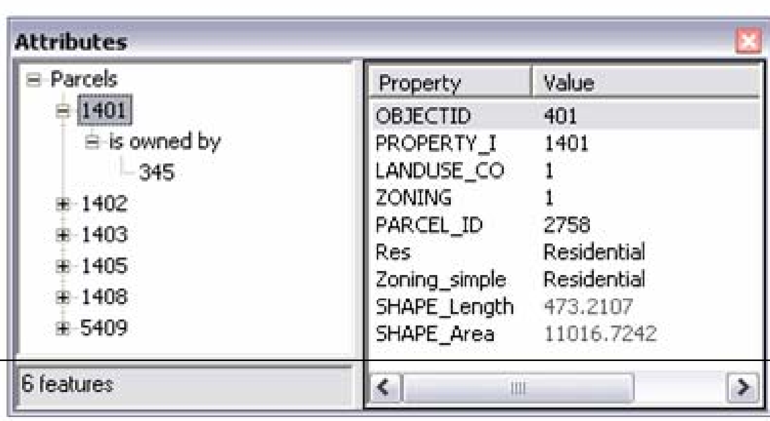
9. Right-click anywhere on the map and click Finish Sketch.

The feature is reshaped.

Editing attributes for a shapefile (with the attribute dialog box)

The Attributes dialog box allows you to view and edit attributes of features you've selected in your map when you're in an edit session. You can open it by clicking the Attributes button on the Editor toolbar.





The left side of the dialog box lists the features you've selected. Features are listed by their primary display field and grouped by layer name. The number of features selected is displayed at the bottom of the dialog box.
The right side of the Attributes dialog box contains two columns: the

attribute fields of the layer you're viewing, and the values of those attribute properties. The attribute fields, such as ZONING and PARCEL_ID, are listed under the Property column, and their values are in the Value column.

The attribute values that appear on the right side of the dialog box depend on what you click in the tree on the left side of the dialog box.

1. Click the Editor menu and click Start Editing
2. Click the Edit tool on the Editor toolbar
3. Select the features whose attributes you want to edit
4. Click the Attributes button on the Editor toolbar
5. Click the feature on the left side of the dialog box

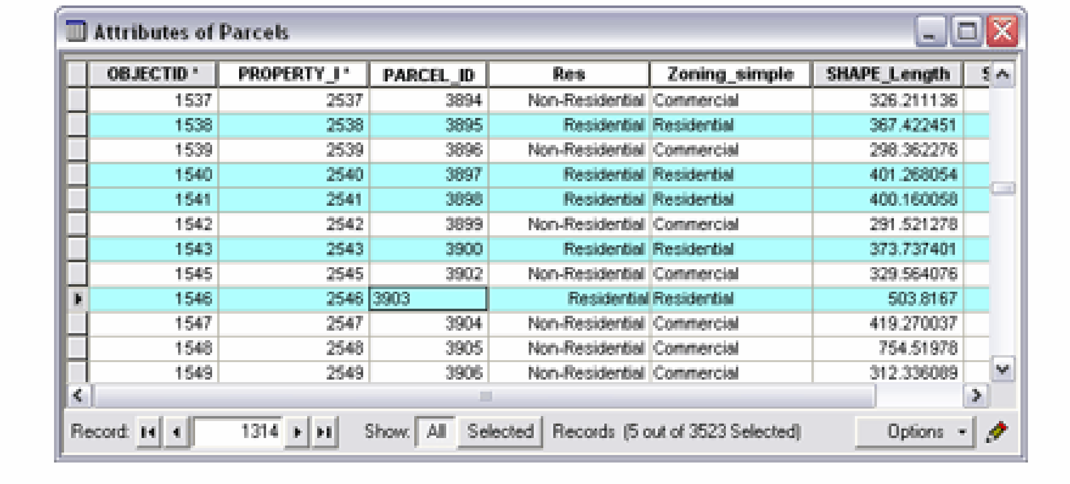
   The layer's attribute properties appear on the right side of the dialog box, and the feature flashes on the map
6. Click in the Value column on the right side and type the attribute value
7. Press Enter
8. Click the Close button to close the dialog box

EDITING TIPS:

- *You can change the primary display field for a layer on the Fields tab of the Layer Properties dialog box. To open the dialog box, right-click the layer name in the table of contents.*
- *To add attributes to all selected features in a layer, click the layer name, click in the Value column, type the attribute value, then press Enter.*
- *To flash a feature on the map, click the primary field on the left side of the dialog box; to zoom to the feature, right-click and click Zoom To.*
- *Double-click a layer name to see the primary display fields representing the selected features in the layer. Double-click again to hide the primary display fields.*
- *To remove features from the selection, right-click the primary display field on the left side of the dialog box and click Unselect.*
- *To delete an attribute value, right-click over the value and click Delete. You can also press the Delete key.*
- *To undo edits, click the Undo button on the ArcMap Standard toolbar.*
- *You can use attribute domains to create a list of valid attribute values for a feature in a geodatabase. For more information, see Editing with default values and attribute domains.*
- *You can also view and edit attributes using the table window.*
- *When editing attributes, you can perform calculations using the field calculator in the table window. For more information, see Making field calculations.*
- *You can also view and edit attributes .using the table window.*

Editing attributes for a shapefile (from the table window)

You can also edit attributes .in the table window. An attribute table window can show you the values for all features in a layer, not just those selected. Editing attributes through the table window allows you to *quickly make changes to several features (records) at once using the field calculator. In addition, the table window allows you to add and delete fields and customize how the fields appear by setting up field .aliases, hiding fields, and so on.*

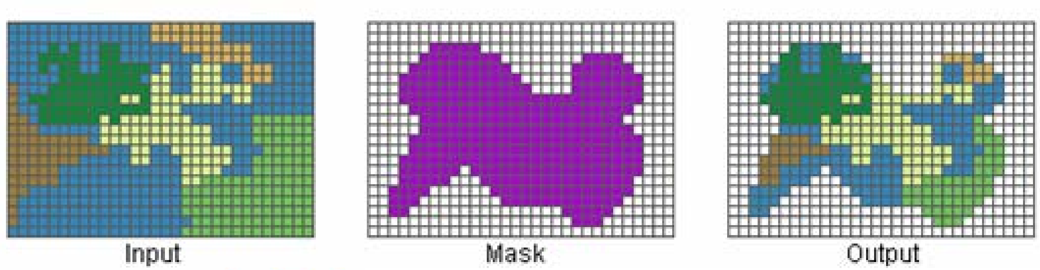


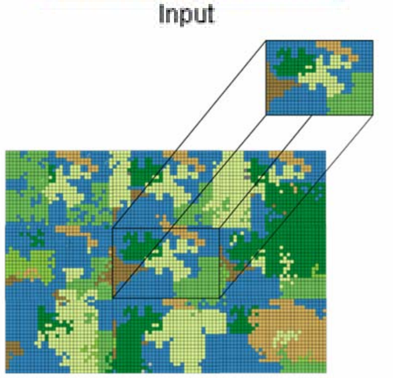
OBJECTID *	PROPERTY_I *	PARCEL_ID	Res	Zoning_simple	SHAPE_Length
1537	2537	3894	Non-Residential	Commercial	326.211136
1538	2538	3895	Residential	Residential	367.422451
1539	2539	3896	Non-Residential	Commercial	298.362276
1540	2540	3897	Residential	Residential	401.268054
1541	2541	3898	Residential	Residential	400.160058
1542	2542	3899	Non-Residential	Commercial	291.521278
1543	2543	3900	Residential	Residential	373.737401
1545	2545	3902	Non-Residential	Commercial	329.564076
1546	2546	3903	Residential	Residential	503.8167
1547	2547	3904	Non-Residential	Commercial	419.270037
1548	2548	3905	Non-Residential	Commercial	754.51978
1549	2549	3906	Non-Residential	Commercial	312.336089

1. Click Editor on the Editor toolbar and click Start Editing.
2. Open the table.
3. Click the cell containing the attribute value you want to change.
4. Type the values and press Enter. *The table is updated.*

Setting options in the Spatial Analyst Extension to make project parameters constant

<u>The Analysis Mask</u>: The mask identifies those locations within the analysis extent that will be included when performing an operation or function. The mask can be a raster or a feature class. For rasters, all input cells that fall outside the mask will not be considered in the analysis and will be assigned the NoData value in the result.

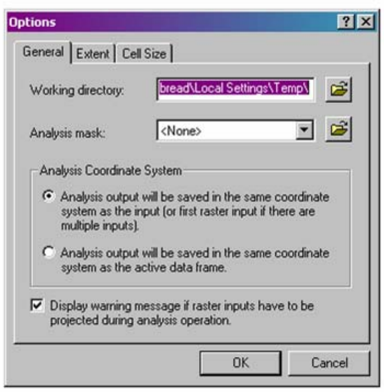


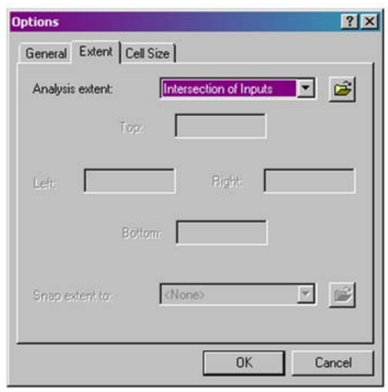


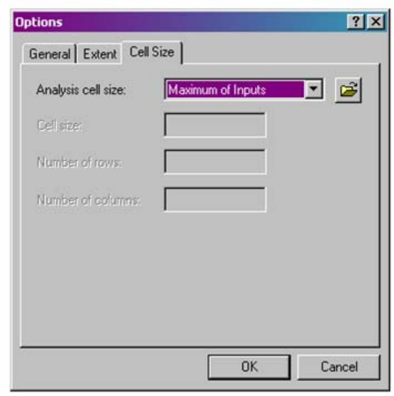
<u>The Analysis Extent</u>: When performing analysis, if the area of interest is a portion of a larger raster dataset, the analysis extent can be set to encompass only the desired cells. All subsequent output rasters from analysis will be sized to this extent. The analysis extent is a rectangle and is specified by identifying the coordinates of the window in map space.

<u>Setting the following three parameters before you use Spatial Analyst will insure your raster outputs will have consistent analysis area, extent and cell size.</u>

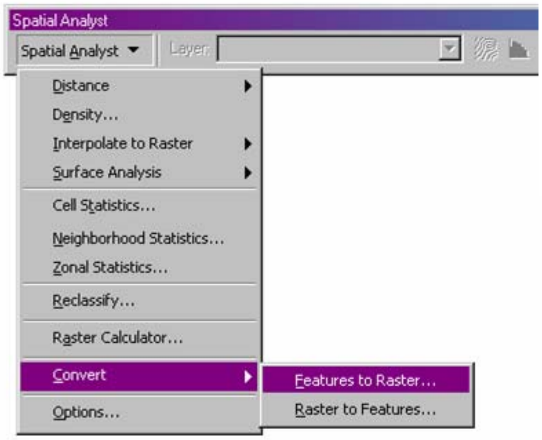
1. Click the Spatial Analyst dropdown arrow and click Options.
2. Click the General tab.
3. Click the Analysis mask dropdown arrow and click one of your project raster layers.
4. Click the Extent tab.
5. Click the Analysis extent dropdown arrow and click one of your project raster layers.
6. Click the Cell Size tab.
7. Click the Analysis cell size dropdown arrow and click one of your project raster layers.

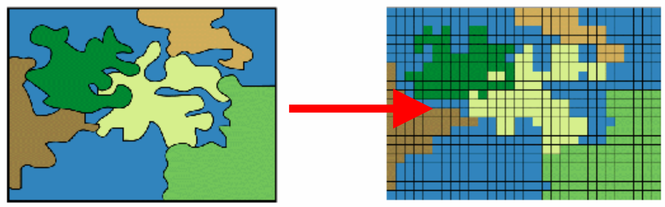






Converting from polygons to raster format (with the Spatial Analyst Extension)





Polygon features   Raster polygon features

1. Click the Spatial Analyst drop-down arrow, point to Convert, and click Features to Raster.
2. Click the Input features drop-down arrow and select the feature layer you want to convert to raster.

   Alternatively, click the browse button to navigate to the location of a feature dataset.
3. Click the Field drop-down arrow and click the field you want to use in the conversion process.

   This is the field used to assign values to the output raster. It can be any field in the input feature attribute table. The field you choose will be added to the output raster's attribute table.
4. Optionally, type a value for the cell size of the output raster.

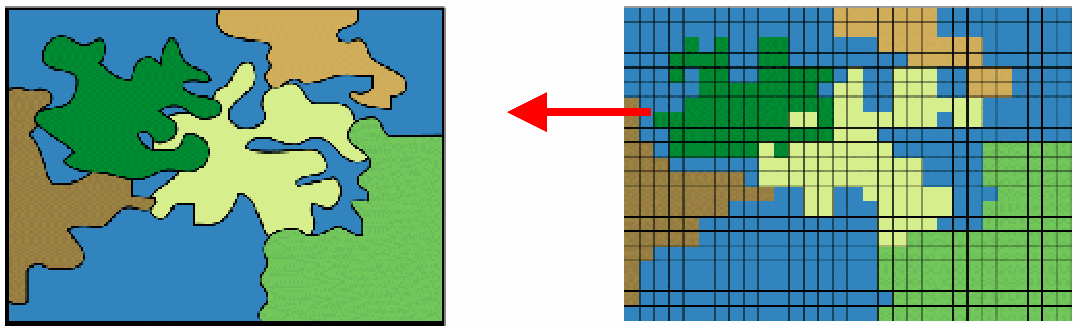
   The default takes the cell size you may have specified on the Cell Size tab of the Options dialog box. If you have not specified a cell size in the Options dialog box, the default takes the width or height (whichever is shortest) of the extent of the input, and divides it by 250 to calculate the output cell size.
5. Type a name for the output raster.

   Output rasters can be created in ESRI GRID, TIFF, and ERDAS IMAGINE formats. Add the file extension of your choice (myresult.tif or myresult.img) to the name of your output raster to save the output in one of those formats. If you do not specify a format, the output will be saved in the default ESRI GRID format.

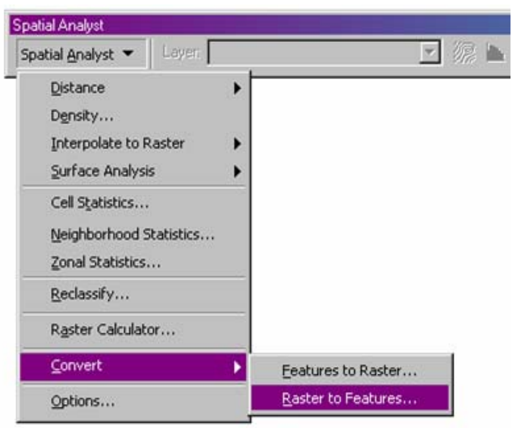
EDITING TIPS:

- *If any features are selected in the layer you choose as the input, only those selected features will be converted.*
- *The working directory for your results is set on the General tab of the Options dialog box (click the Spatial Analyst dropdown arrow and click Options). The default working directory is your system's temporary directory.*
- *When running Features to raster via the Spatial Analyst toolbar, you can only save the output raster as an ESRI GRID, TIFF, or ERDAS IMAGINE format. If you want to save the output into a different format (such as to a geodatabase), you can run the appropriate feature to raster tool from the To Raster toolset of the Conversion toolbox.*

Converting from raster format to features (with the Spatial Analyst Extension)



Polygon features   Raster polygon features



1. Click the Spatial Analyst drop-down arrow, point to Convert, and click Raster to Feature.
2. Click the Input raster dropdown arrow and select the integer raster layer you want to convert to features. *Alternatively, click the browse button to navigate to an integer data source on disk.*
3.
4. Click the Field drop-down arrow and select the field you want to use in the conversion process.

   This is the field used to assign values from the cells in the input raster to the features in the output dataset. It can be an integer, floating point or string field. The column containing the cell values (VALUE) in the raster attribute table will always become a column with the heading Grid_code in the attribute table of the output shapefile.
5. Click the Output geometry type drop-down arrow and select the geometry type (point, polyline or polygon) you want to use.
6. Optionally, check Generalize lines if you want to generalize the lines of the output features by weeding them to reduce the number of vertices. *This is helpful in getting rid of the stair-stepped look that features can have when converted from raster*.
7. Type a name for the output shapefile (.shp) you want to create.

   If you accept the default path, or just type a name, the output shapefile will be permanently written to the location set for your working directory on the General tab of the Options dialog box.

Alternatively, you can type the path to a different location on disk, for example, c:\data\myresult.shp

8. Click OK to run the tool.

EDITING TIPS:

- *When Generalize lines is checked, and the output feature geometry type is polygon, an algorithm designed specifically for raster-to-feature conversion is used. The algorithm uses the following rules:*
  - *You can convert back to the original raster by converting the weeded output features back to raster using the same cell size as the original raster.*
  - *The number of vertices between nodes is minimized subject to rule 1 above.*
  - *The maximum distance of a vertex from its original position is minimized without increasing the number of vertices in the line as determined in rule 2 above.*
  - *For polyline output the Douglas-Puecker algorithm for line generalization is used with a tolerance of sqrt(0.5) * cell size.*
- *You can type a partial path to a location on disk for the output. For example, data\myresult.shp will place the output feature called myresult.shp in the directory called data in your working directory. The directory called data will be created for you if it does not already exist.*
- *The browse button ToolTip for the Output features parameter displays the path to the location you last browsed. If you type a name for the output, it will always be placed in your working directory. The location of your working directory is not necessarily the last location you browsed to.*
- *When running Raster to features via the Spatial Analyst toolbar, you can only save the output features as a shapefile. If you want to save the output into a different feature class format (such as to a geodatabase), you can run the appropriate raster to feature tool from the From Raster toolset of the Conversion toolbox.*