Tutorial I: Introduction to Alternative Future Scenario Analysis and Envision

Lesson 1: Basics of the Envision Interface

In this lesson, you will learn the basics of working with the Envision interface by exploring the landscape data for the Blue River Watershed (the sub-basin of the McKenzie River Basin that contains the Andrews Experimental Forest). Along the way, we will define key terms and concepts used in Envision.

A. Getting to Know IDUs and the Envision Interface

Step 1: Installing Envision

If Envision has not already been installed on your computer, the first step is to get the installation package from the website and run it. The best option is to install the software in a directory called [d:]\Envision. The drive letter (C, D, etc) does not matter. The 64-bit version of the software can be found at: http://envision.bioe.orst.edu/Downloads/Setup-x64.msi . A 32-bit version of the software can be found at: http://envision.bioe.orst.edu/Downloads/Setup.msi.

If you are running a 64-bit version of Windows, you should use the 64-bit version of Envision. Otherwise, install the 32-bit version. This installs the main Envision executable files and a standard set of plug-ins.

The next step is to get an example Envision study area project from the Envision website.

The datasets used in this tutorial are at http://envision.bioe.orst.edu/StudyAreas/Tutorials/Tutorials.msi. Using the default install directory will allow the files to run unmodified. When you do that, you should end up with a directory [d:]\Envision\StudyAreas\Tutorials\ that includes a couple of subdirectories and a number of different files.

At this point, you should have installed both the Envision executable files and a set of input files (termed a “Project” in Envision terminology, and are ready to run Envision.

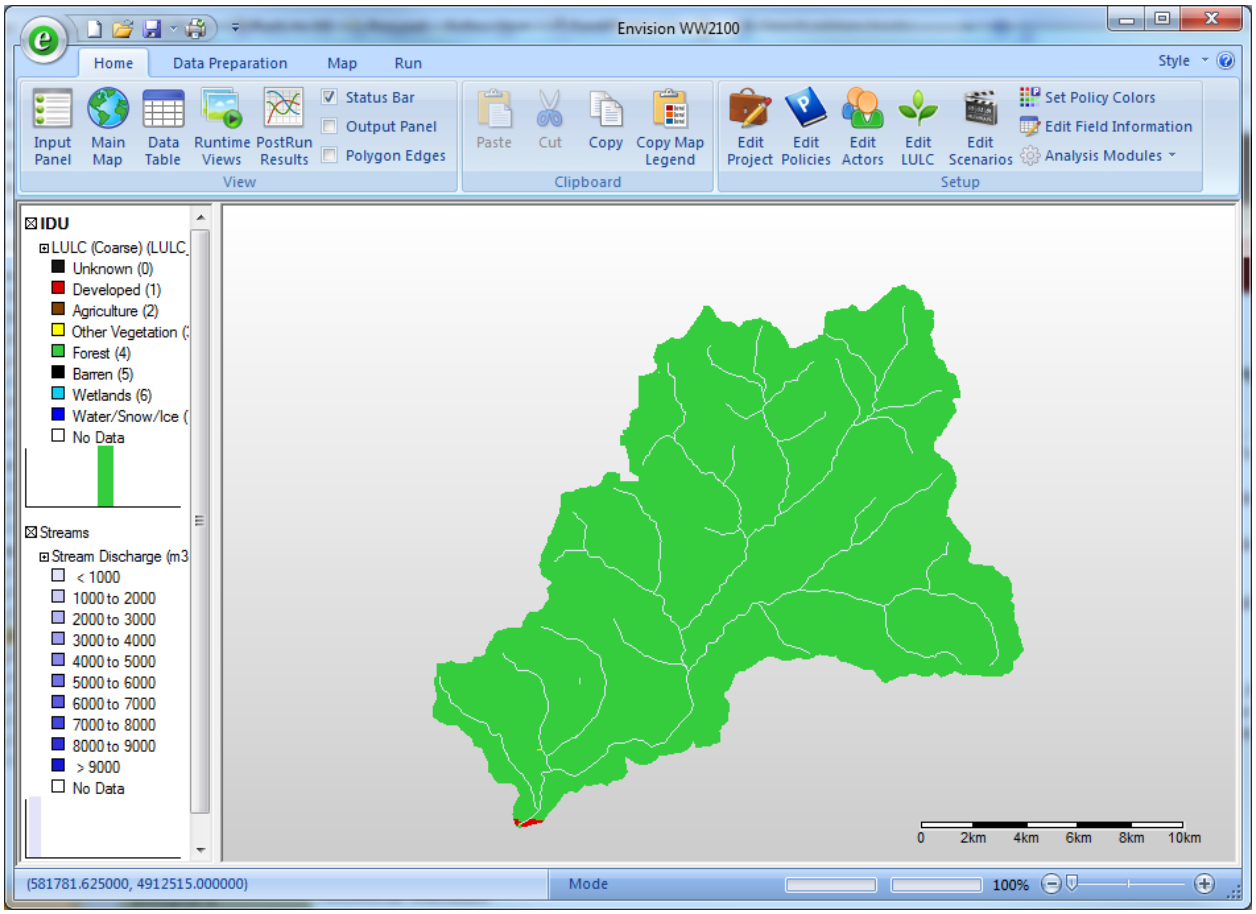
Step 2:
Running Envision

To run Envision, following the normal steps for the version of Windows you are running. You should have an Envision icon that will launch Envision, or run Envision from your Start menu.

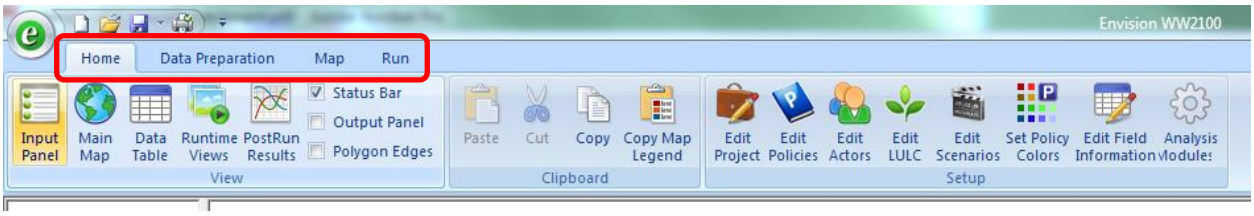
When you first launch Envision, you should see a window like the one below:

Click on "Find Existing Project" and map to the directory that contains the sample project. Navigate to [d:]\Envision\StudyAreas\Tutorials and click on the "Lesson1.envx" file. Click on "Open" to open theis project.

When you open the project, there will be two map layers displayed. One is the polygon coverage of Independent Decision Units (IDUs) and the other is the Stream network coverage. In addition, the model loaded 2 separate plugin models. One is called DynamicVeg. It is a representation of the VDDT vegetation state transition model and is one of the plug-ins you will work with during this tutorial. The other is called Flow, and while we won't use it in this lesson, it is the Envision Hydrology model and will be references in an upcoming lesson. We will discuss more about how these plugins are developed and specified later on. The software should now look something like this:



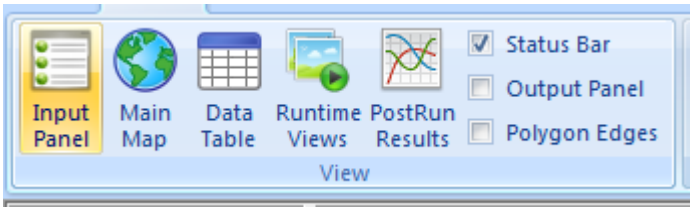
The project includes two shapefiles, one called IDU and the other called Streams. The map is classified based on a particular attribute in the IDU shapefile, called LULC_A.



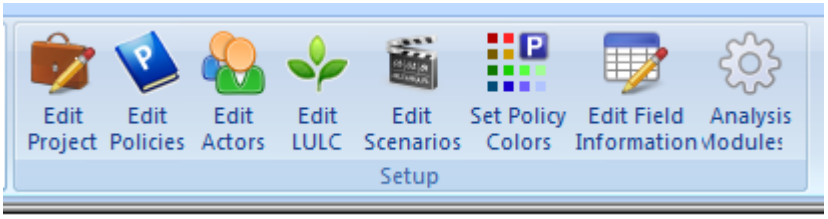
1. Look at the tabs at the top of the interface. These ribbon tabs let you flip between groups of operations in Envision. The four tabs are:

   a. **Home** – basic functions to edit projects and policies.
   b. **Data Preparation** – GIS tools to edit the attributes of the IDUs. For example, to add or remove fields or calculate a field based on other attributes.
   c. **Map** – GIS tools to view and query the data sets.
   d. **Run** – Tools to set up policies and run Envision.

The tutorial sections below will walk you through some of the functionality on each tab.

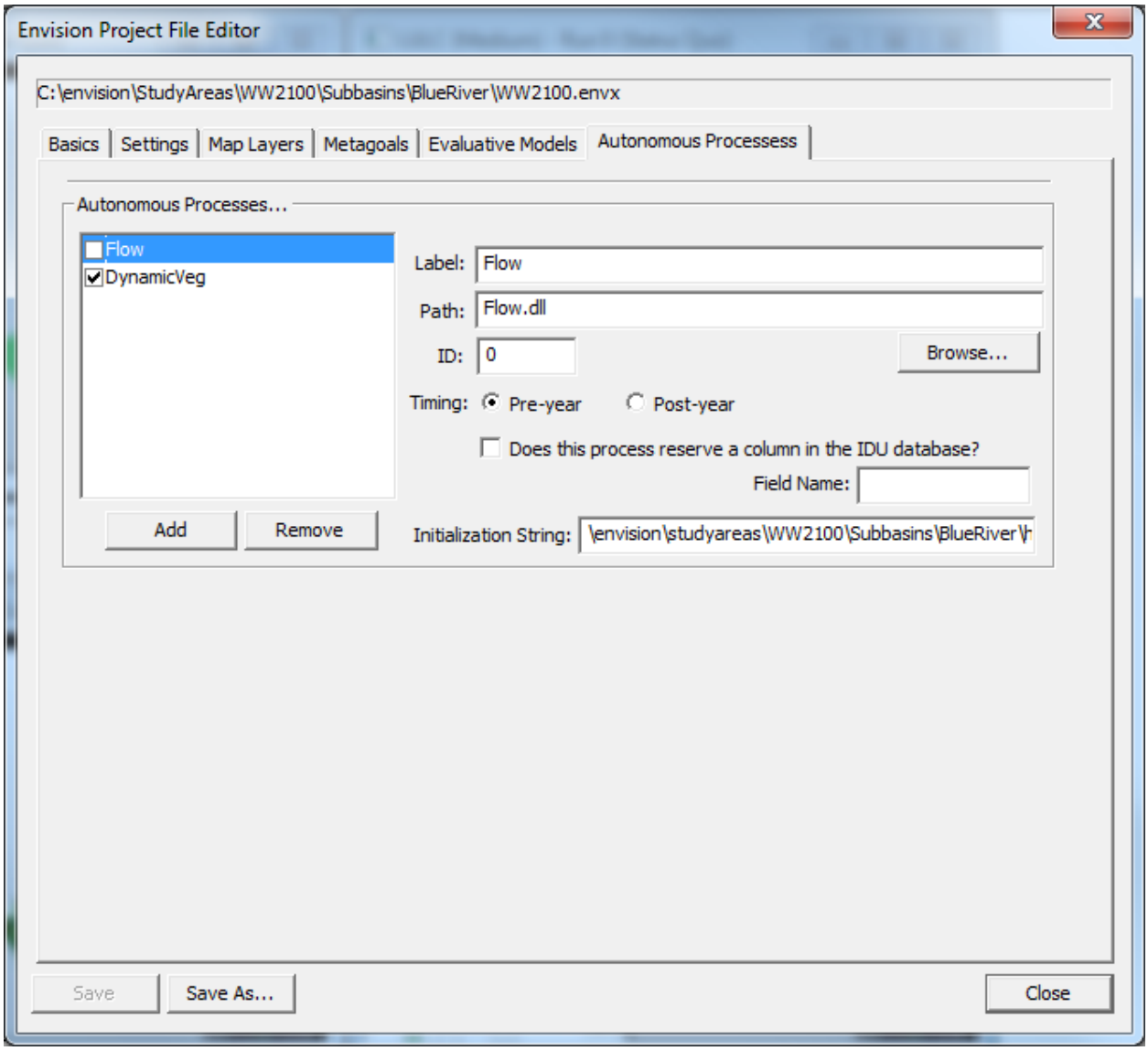


2. When you are on the "**Home**" tab, the buttons in the "View" box change what is displayed in the main content area. These buttons include:
    a. **Input Panel** – this is in development and we will not be using it for our work
    b. **Main Map** – Displays a navigable map of the map layers in the main window. In this part of the tutorial, we will work with the IDU coverage. IDUs are the attributed polygons that Envision uses to represent the landscape and are the basic processing units of Envision. Any landscape specific input data that will be used by plug-in models or analyzed in scenarios is included as an attribute of the IDUs.
    c. **Data Table –** Displays a view of the data tables underlying the map layers. For example, look at the table for the IDU coverage (IDU.dbf). Each row contains the data for one IDU. The columns or "fields" are the associated attributes of the IDU. The data table view includes tools to find and query IDUs with specific characteristics.
    d. **Runtime Views** – these are in development
    e. **PostRun Results** – Displays run results. This will be blank until you have carried out some model runs.
    f. **Status Bar** – Displays the status of a run, e.g. how much is completed in bar form and percent (right side). On the left side it also shows the coordinates of the mouse location in the coordinate system of the data file (in this case UTM).
    g. **Output Panel** – Displays the sequence of processes as they run. This can be useful for problem solving – for example to track when errors occur or to look up the path of where data layers are stored.
    h. **Polygon Edges** – Displays the perimeters of polygons. Helpful if you want to zoom in to the boundaries of particular IDUs.



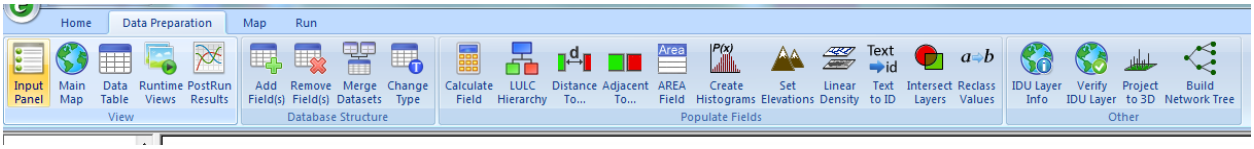
3. Also on the "**Home**" tab, the "Setup" box includes tools to edit the project and its policies and scenarios.
    a. **Edit Project** – Displays a pop-up window that allows you to edit basic properties of the project, such as the input map layers. It also allows you to import elements from other projects. If you look at the Autonomous Processes tab, you can see models that have been loaded, whether or not they are being used for the particular run, and also what

some of the inputs/parameters related to the models are. For this example project, we are only running the process DynamicVeg, so it is the only model with a checked box.

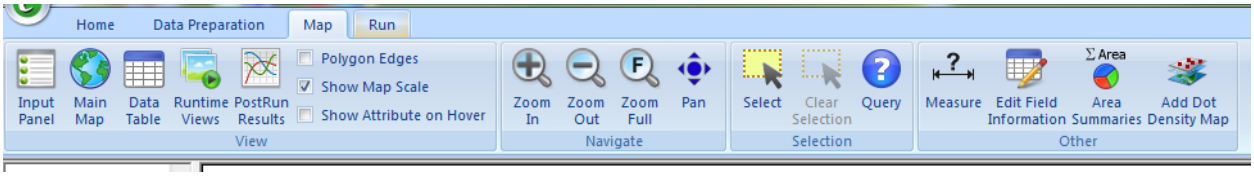


We will talk about some of the other elements here as the course continues, but for now you can ignore them.

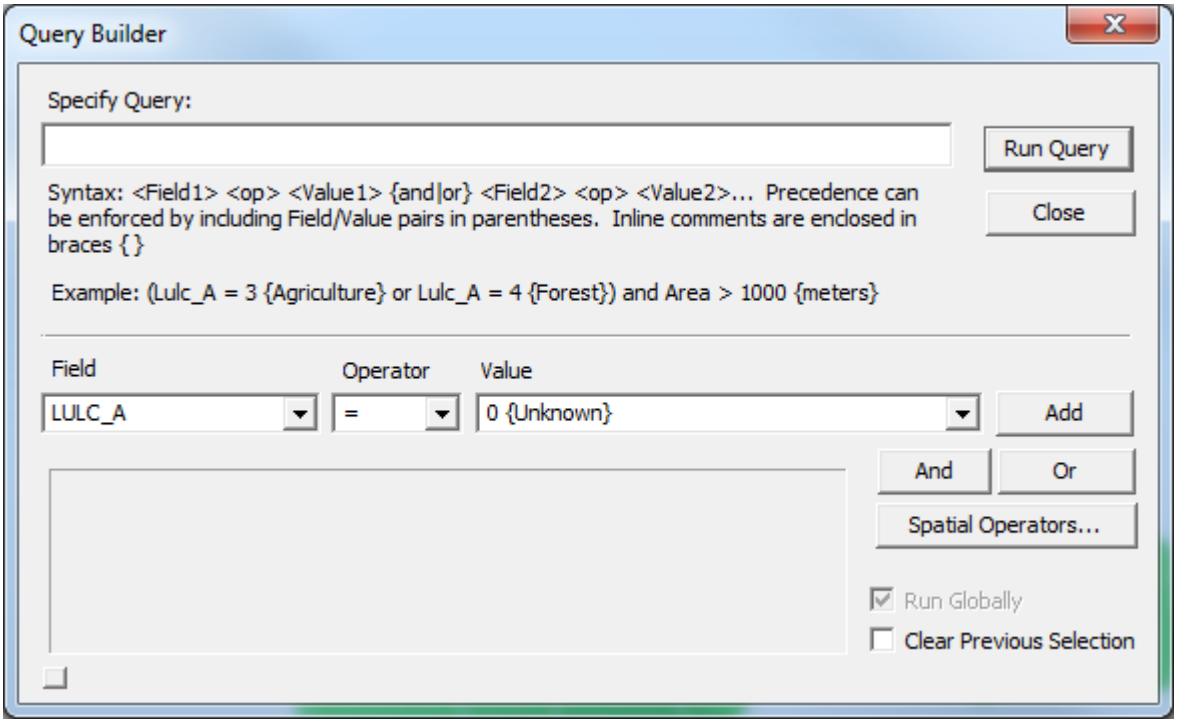
b. We will work with the other buttons in this box ("Edit Policies", etc.) in a later section of this tutorial.



4. The "**Data Preparation**" tab provides tools for editing the IDU polygon coverage. We will not work with these tools in this exercise.

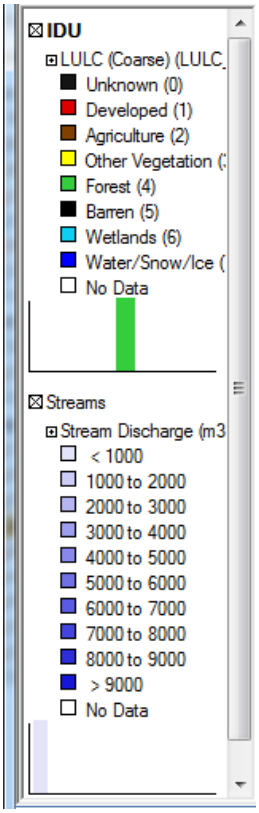


5. The "**Map"** tab includes tools for moving around and displaying information about the landscape:
    a. **Pan and zoom tools** (in the Map Ribbon Tab).
    b. **Selection and query tools** (in the Map Ribbon Tab). Tools to select particular IDUs so that you can summarize information or perform operations only on a defined set of polygons.
    c. **Area Summaries** – A tool to make measurements on the map and calculate total areas for specific attributes. It allows you to specify queries, which can be entered directly or developed with a query builder. To get a query builder, click on Query, and see description g below.
    d. **Add Dot Density Map** – this functionality won't be used during the class
    e. **Choosing the Attribute to Display on the Map** – If you right click in the grey area surrounding the map, you can select different attributes of the IDU polygons to display. For example, try displaying a more detailed version of the land use/land cover (called LULC - Fine) or the land ownership type (e.g. federal, private etc.). Note that each one of these attributes corresponds to a "field" in the IDU's data table. The information that shows up in the popup box is outlined in the Field Information interface, which you can explore by clicking Edit Field Information. We won't go into more detail about this today, but it will be an important component of some elements of the class project. Feel free to explore the editor if you wish.
    f. **Displaying Information for a Specific Polygon** – If you zoom in and right click on a polygon, you can display attributes or take actions specific to that polygon. For example, you can display all of the attributes for that polygon (the "Properties of the Site").
    g. **Query –** This dialog allows you to build a query, select polygons that satisfy that query, and it provides a brief statistical summary of the results. It looks like:



In this case, you can click Add to add the suggested query to the Query Builder, and after that, click Run Query to make use of it.

6. The "**Map Legend" panel** includes additional tools for viewing and managing information about the currently loaded map layers. It shows, for each map layers, the currently active field (the field currently being displayed on the map) and the legend associated with the active field. The checkbox next to the layer name controls the visibility of the layer. The order of the layer, if multiple layers are defined, determines the drawing order. The "top" layer is drawn first, with subsequent layers drawn as one moves down the list: layers lower in the list are drawn "on top" of layers higher in the list. In general, user interaction with this panel is via the mouse. Some specific functionalities include:



Layer Properties	Layer properties can be viewed/specified by right-clicking on the layer name and selecting "Properties" from the context menu. A number of properties, including layer type, number of fields, number of rows, IDU area statistics, labeling information, and field-specific information is available in the Properties view
Layer Transparency	Layer transparency can be set by right-clicking on the layer name ad selecting "Transparency"
Legend Colors	Colors used to depict specific attributes can be modified by double-clicking on the color box associated the attribute
Adding "Overlays"	An Overlay allows multiple fields to be drawn using a single coverage. Overlay layers are generally drawn "on top" of the original layer using transparency to allow both layers to be visible

Practice Questions for Section IA

1. Display the medium resolution land use/land cover data. What percentage of the watershed is covered by Closed Conifer forests with a stand age between 120 and 200 years?

2. What is the mean elevation of the IDU with the [IDU_INDEX] field value of 144184?

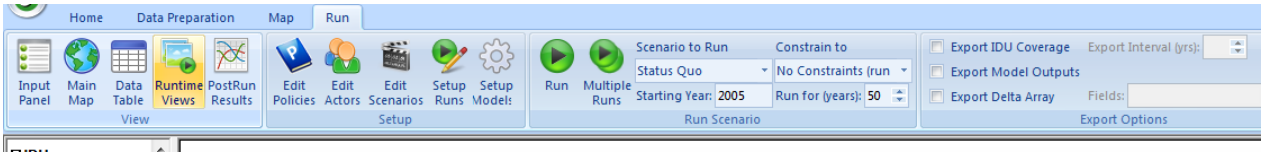
3. How many IDUs are there in the watershed?

4. What is the size range of the IDUs?

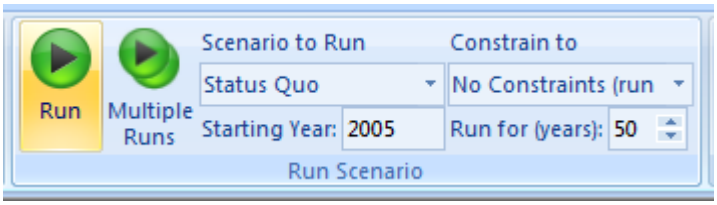
5. Is all of the area zoned for the reservoir, actually covered by water?

6. How much private land has old growth tree stands older than 300 years?

B. Setting Up Policies and Scenarios

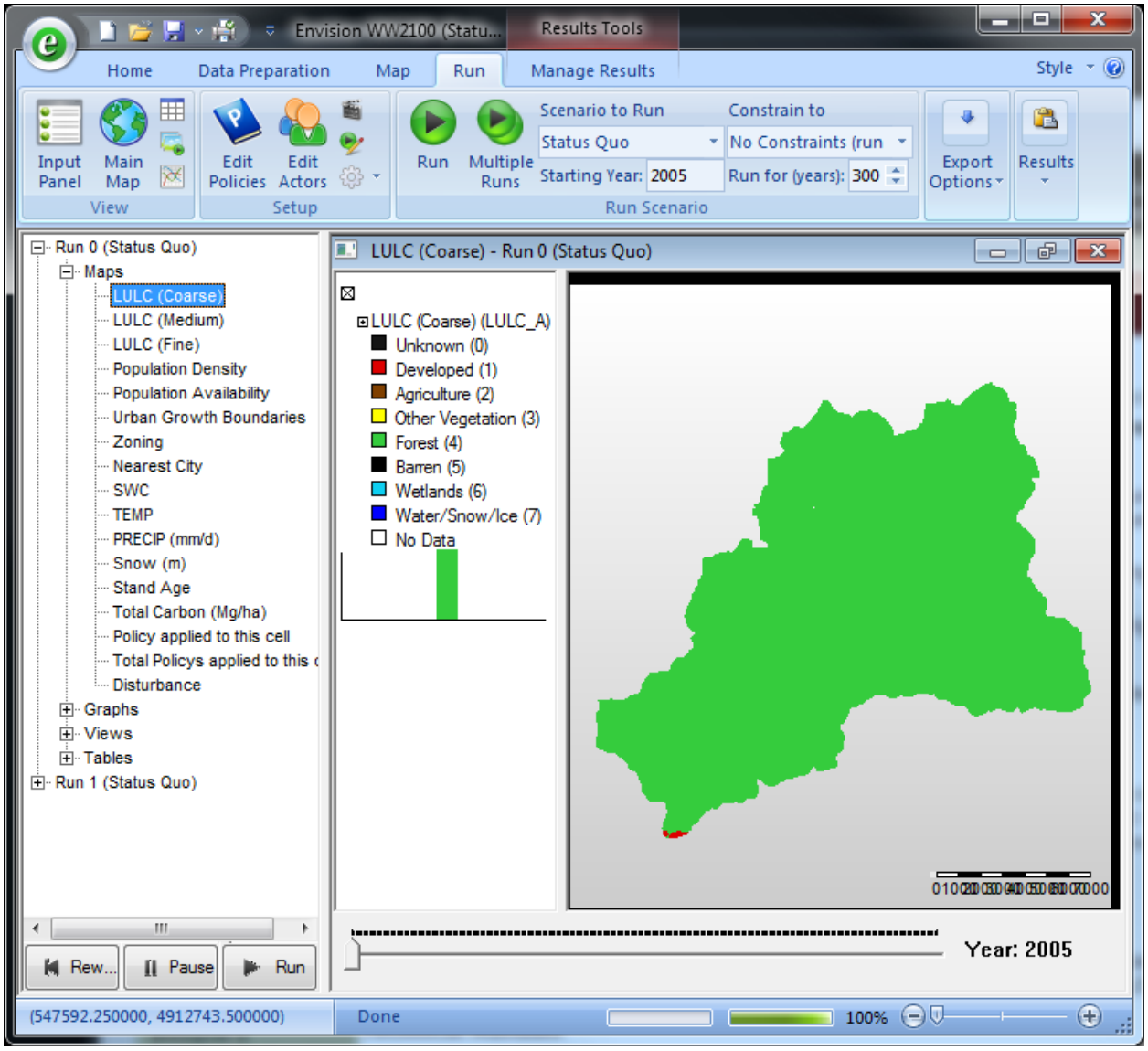


1. The "**Run**" ribbon tab includes tools for setting up and running scenarios in Envision. Scenarios are the projections of future change created by Envision. They consist of a coherent collection of "policies", model settings, assumptions and preferences. As we go through the buttons and functions on the "Run" ribbon tab, we will define the elements of a scenario.

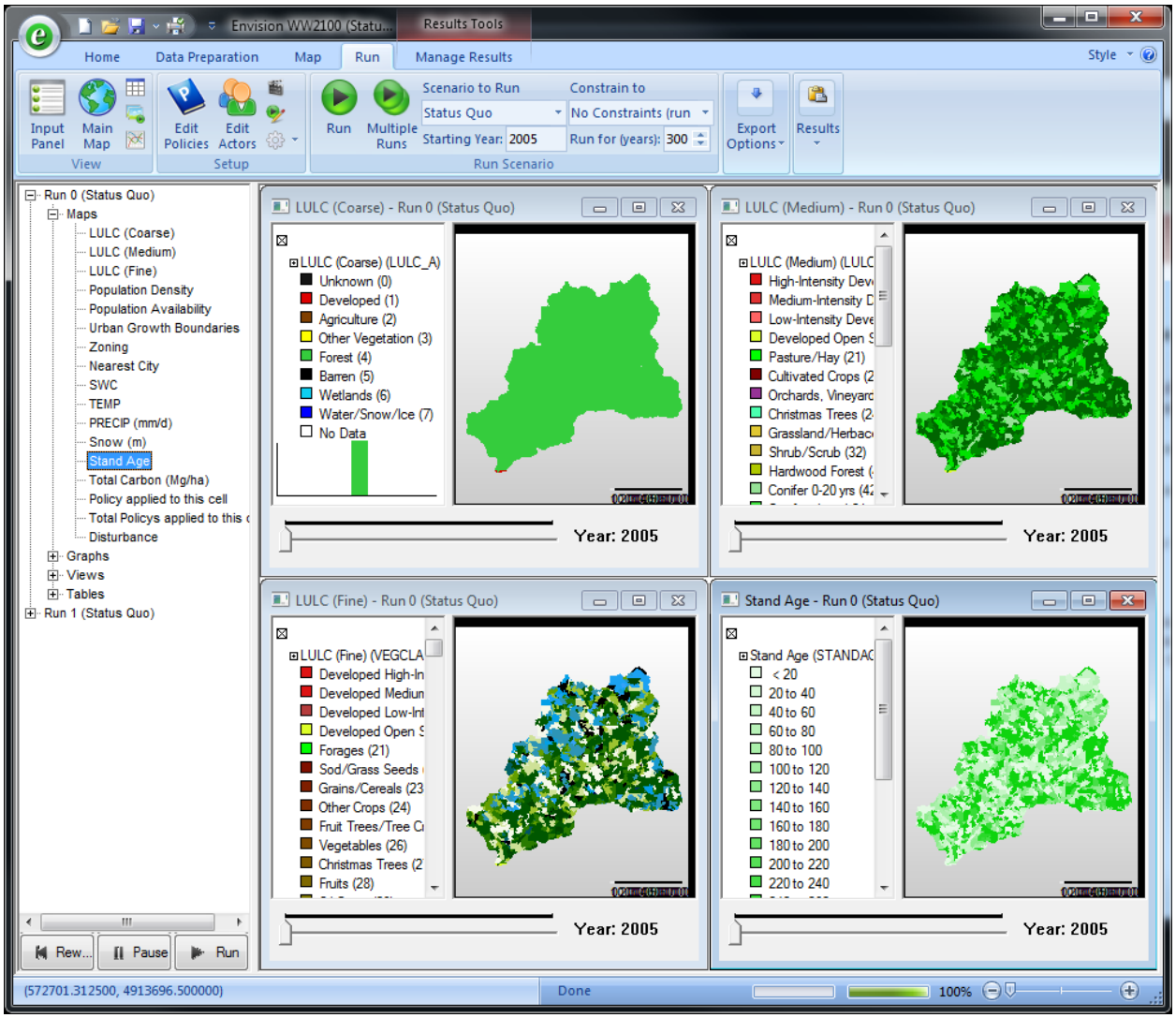


1. **Run Scenario** –The "**Run Scenario**" bar allows you to choose the scenario to run and to constrain where it runs (for example to a particular set of IDUs that you have selected with the query tools). It also allows you to select the starting year and duration of your run. There are no constraints on the starting year you choose, but it makes sense to choose a year consistent with the base data sets that make up the IDUs. In this example, the land use/land cover is from about 2005, so we start from there.
    a. Try running the "Status Quo" Scenario (for the whole basin) with a starting year of 2005 and run time of 300 years. It should take 30 seconds or so. As it runs, right click to pull up the classification popup window, and switch between different landcovers, and perhaps Disturbance and Stand Age (under Terrestrial System). As the simulation runs, the DynamicVeg plugin is keeping track of time, and the map is being modified to reflect those changes.

2. **Viewing Results –** Click on the "PostRun Results" button on the "View box". The expandable Tree (Run 0 above) allows you to view results in a variety of formats. After running the "Status Quo" Scenario, you can explore the types of maps and graphs that can be displayed. The screen should look something like the following if you expand the hierarchy on the left and double click on "LULC (Coarse)".



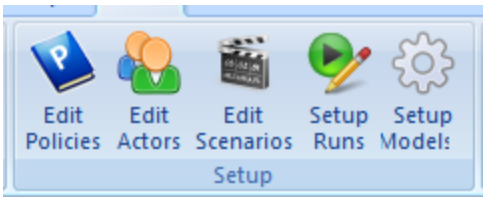
3. The Run buttons at the bottom of the screen allow you to view the results dynamically and watch how they change through the years of the model run.
    a. Assuming you already double clicked LULC (Coarse), do the same for the other 2 LULC categories and also Stand Age. The screen now should look something like the following. These are depictions of the initial conditions for each of the 4 related elements of the system.



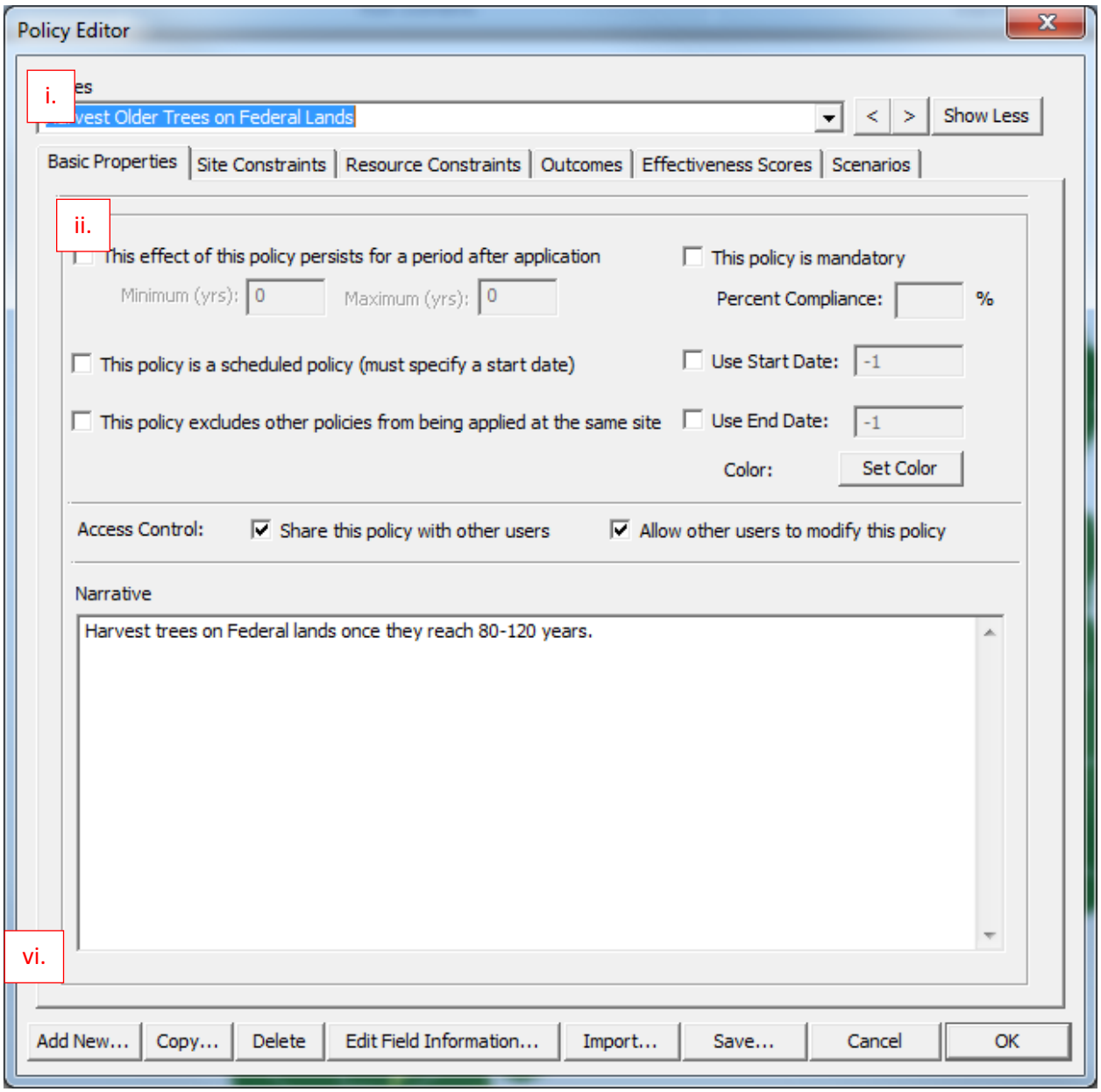
b. Click on the "run" button to watch how this attribute changes with time.

Practice Questions for Section 1B: How do you interpret these 4 elements and the patterns that develop? Is this a good representation of the Status Quo?

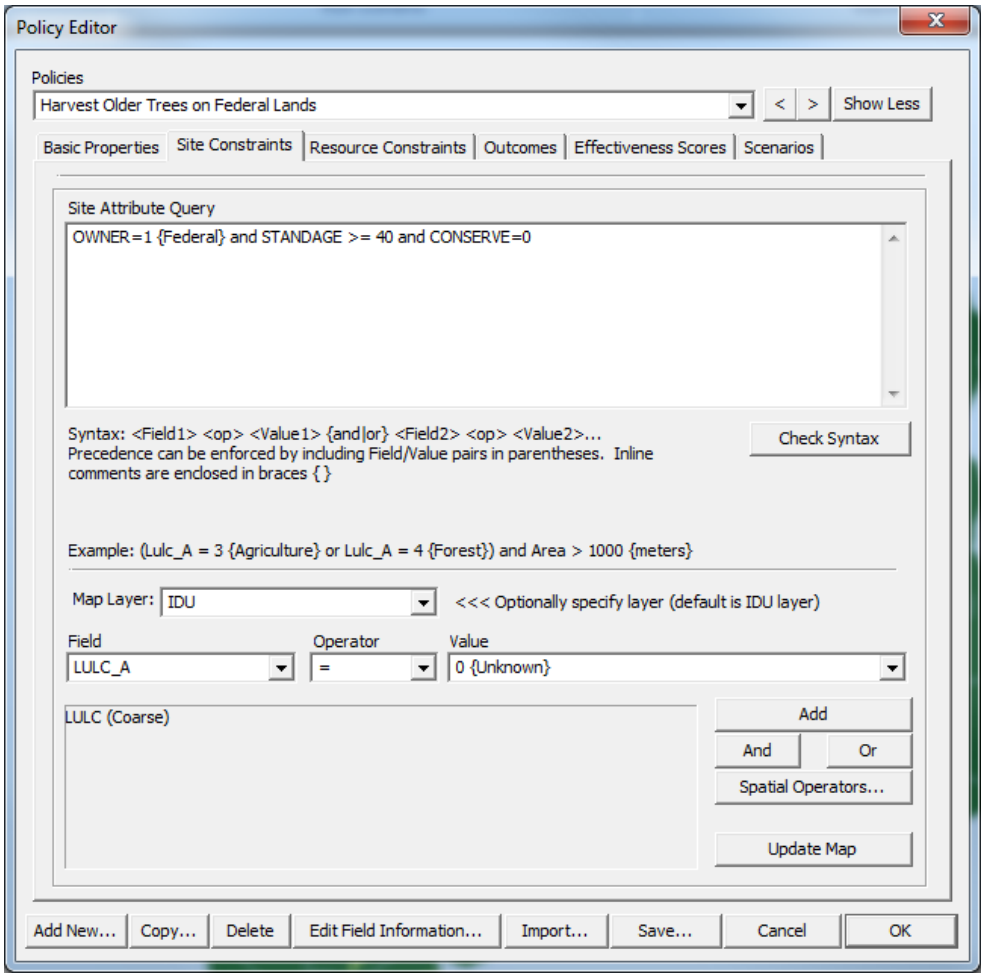
At this point, we have explored some of the input data associated with our sample project, and we have run the model through time, allowing an automomous landscape process (*DynamicVeg*) to change the data in our maps as a reflection of time progressing and the landscape aging that goes along with it. The next step is too include actors and policies, and in this case we will do that by allowing for harvest of some of the aging timber.



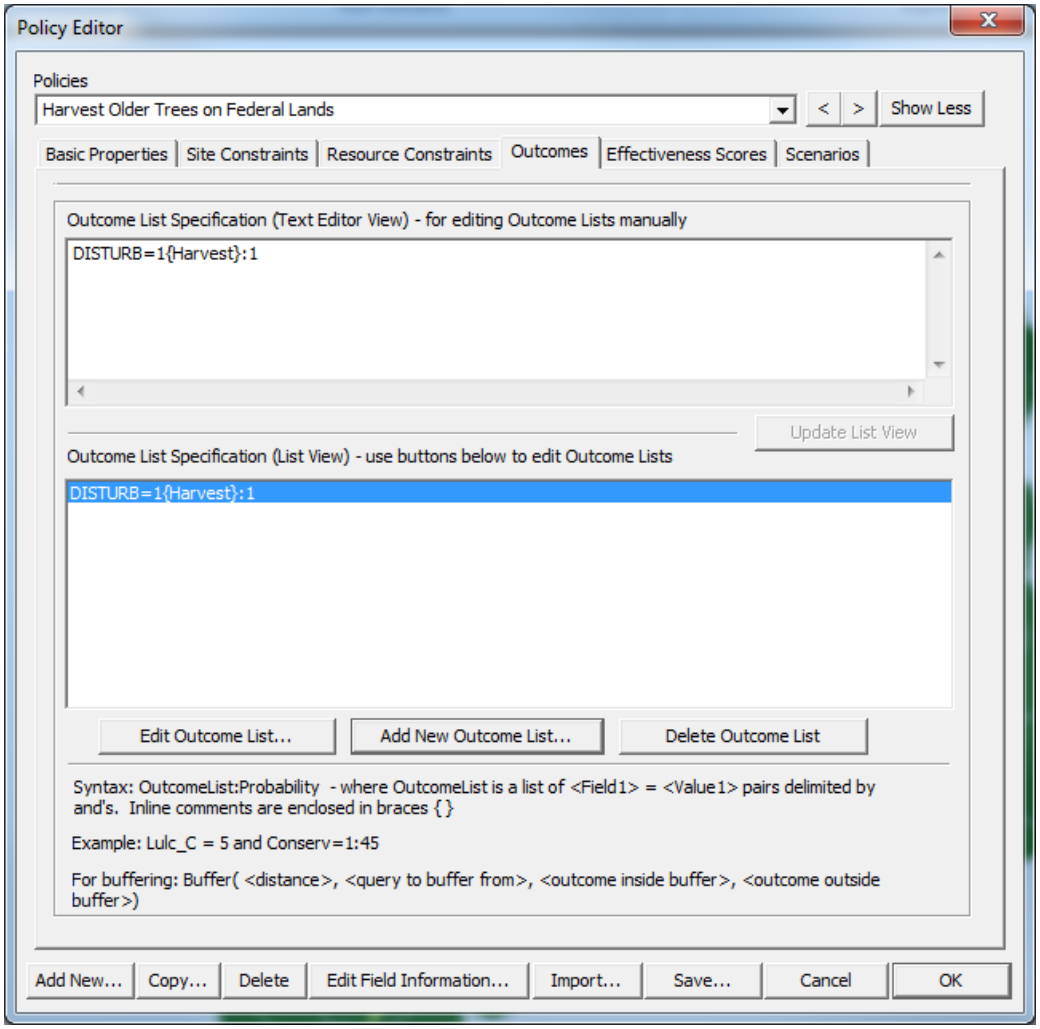
4. The “Set Up” bar lets you adjust the suite of settings that will affect a scenario. We will go through each of the buttons and their function individually. The first of these is behind the button labeled Edit Policies. Click it and you will see the following dialog box:



5. **Edit Policies** - The "**Policy Editor**" dialogue box allows you to view and define the characteristics of each policy that is part of the project. Policies capture rules, regulations, incentives, management actions and other strategies that will modify the landscape when the scenario runs. This will become clearer as you step through the setting for a policy:
    a. Open the policy editor and use the drop down box at the top to view the "**Harvest older Trees on Federal Lands** policy. The tabs in the box allow you to control when, how, where and what will happen when the policy is implemented. Click through the tabs to get a sense of the variety of functions that are available. We will only work with some of the tabs in this tutorial and will work with others next week.
        i. Click on the "**Site Constraints**" tab. The expression in the "Site Attribute Query" defines how Envision will select IDUs where the policy will be implemented. For example, in this policy, the query selects all IDUs where the owner is federal (OWNER=1 {Federal})and the forest stand age is greater than or equal to 40 years (STANDAGE >= 40) and where the land has no special conservation status (CONSERVE = 0). You can type in these queries or you can use the drop down boxes at the bottom to build the queries.



ii. The "**Outcomes**" tab lets you control what will happen when the policy is implemented. The Outcome is written in a similar format to the "Site Constraints" query, in this example the expression is: DISTURB=1{Harvest}:50 meaning that when the policy runs, the DISTURB field for some IDUs will change to a value of "1" or Harvest. The "1" in the expression controls the probability that the outcome will occur. In this case, the 1 indicates that each year, 1% of all the polygons that satisfy the Site Constraints will have this outcome. For the other 99%, nothing will happen as a result of this particular policy.

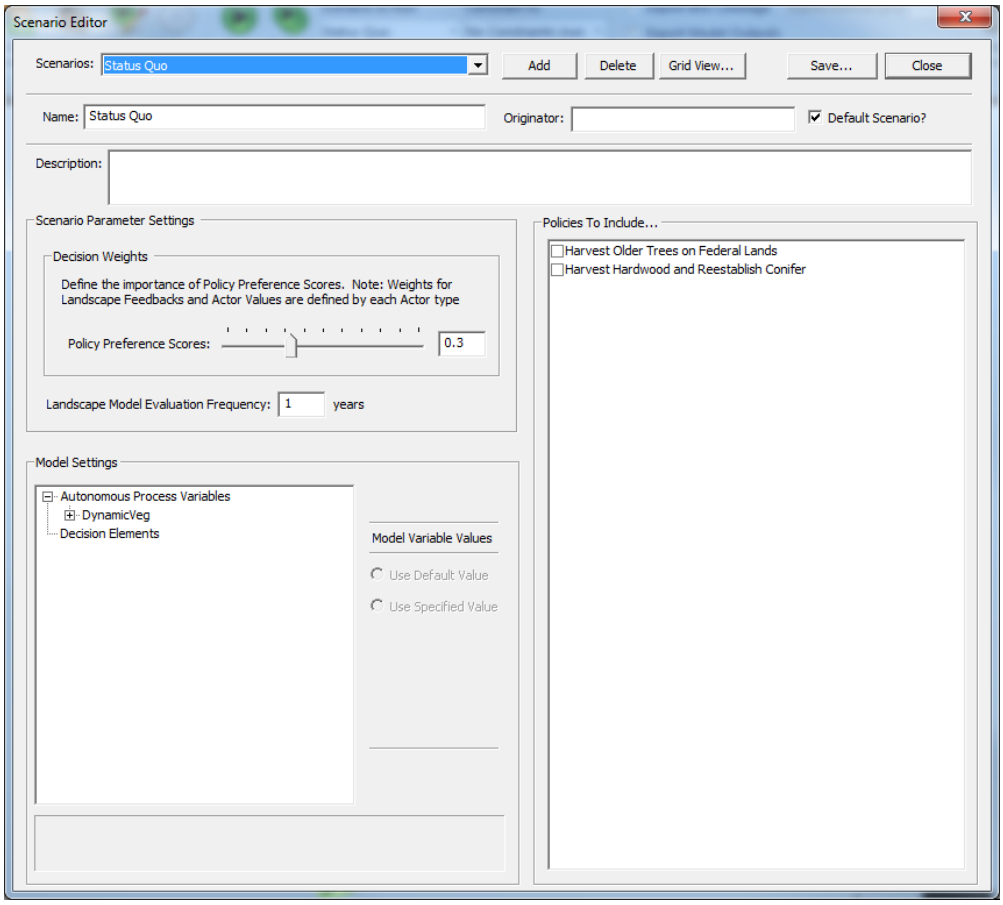


iii. The "**Resource Constraints**" tab allows you to add additional complexity to the policy implementation, for example to add an initial cost and annual maintenance cost for application of the policy. This feature uses a look up table and while we won't work with it here, it will likely show up later in the class.

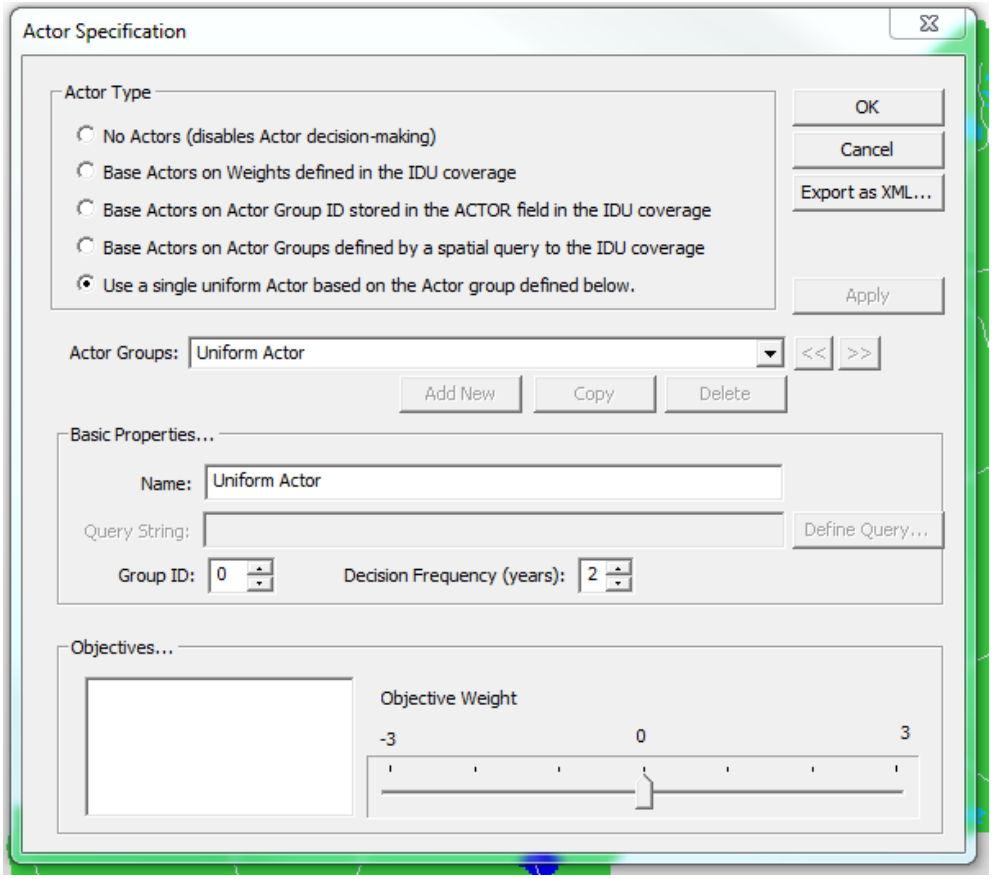
iv. We will work with the "**Effectiveness Scores**" tab later in the quarter.

v. The "**Scenarios**" tab allows you to view and edit the scenarios that use this particular policy.

vi. Note that the buttons on the bottom of the policy editor allow you to create "new" or "copy" policies and to "save" any new or edited policies so that you can work with them again later.



6. **Edit Scenarios** - The Scenario Editor is the dialogue box that allows you to create scenarios and define which policies will be active in a particular scenario. For example, in the "Status Quo" policy (shown above) neither of the 2 example policies are selected. This is why we did not see any timber harvest occurring when we initially ran the model. There are also a couple of additional settings:
    a. **Landscape Model Evaluation Frequency** – This controls how frequently the landscape evaluation plugin models will be run. Envision has a yearly time step, so as set up here, the models will run each time envision runs a year. The number could be larger, in which case the models will run less frequently. This can speed up the overall time it takes to run the simulations.



7. **Edit Actors** – When you click on this "Edit Actors" button it opens the "Actor Specifications" dialogue box. One of the features of Envision is that it allows you to model the ability of different individuals or "actors" to make different decisions about the management of their land based on their own "values". This dialogue box allows you to control whether there will be multiple actors with different "values" affecting their decisions. We will work more with this feature in a different exercise. For now, we will leave this box set as shown above, with a single uniform actor.
8. **Setup Runs** – This dialogue box adjusts settings for a run. For example, you can run multiple iterations, to look at the range of outcomes that might result from the combinations of policies and characteristics in a particular scenario. You can also alter how the results will be displayed and exported. For now, we will not use these elements.
9. **Setup Models** – This button provides access to any user interfaces that the plugins might define. For now, our plugins do not provide interfaces, so the button is non-functional.

Problem Set for Section 1C (explore on your own)

1. You are the forest manager for the federal forests in the Blue River Watershed. Set up/Run a scenario where there is a probability of harvesting trees. You could do this in two ways. The first is to modify one of the existing scenarios, using the scenario editor and then simply running that modified scenario. For example in the scenario editor you can click to "Unmanaged Growth – Extractive Forestry" and put a check mark next to the two existing policies. If you save that, and run the scenario, the results will be quite different from what we saw previously.

   The second option is to create your own new policies and a scenario to go along with them. If you chose this option, you might take some of the following steps:

   a. Use the Policy Editor to create a new policy.
      i. To help with the syntax, try using the buttons at the bottom of the policy editor to start out by creating a copy of one of the existing harvest policies and renaming it to your new policy.
      ii. Use the "Site Constraints" tab to set up the attribute query that will make the policy active on all of the IDUs with a federal owner, a standage older than 80 years, and a conservation status of "0" (or other site attributes for different policies).
      iii. Use the "Outcomes" tab to specify what will happen when the policy takes effect. In this case, you will change the disturbance attribute to "Harvest" and there is a x% chance that the disturbance will happen each time the policy is applied.
   b. Use the Scenario Editor to create a new scenario and turn off all of the existing policies and to turn on your new policy.
   c. Try viewing your results (after running the simulation) using the "PostRun Results" button, and note that you can compare the results from different runs (or scenarios) directly.

Glossary

Actors (agents) – entities that make decisions about the management of particular portions of the landscape for which they have management authority

IDUs (Independent Decision Units) – Attributed polygons that represent a portion of the landscape. IDUs are the basic processing units for Envision. The attributes within an IDU are homogenous – for example, all of the area within an IDU is a specific land cover type.

Landscape - a set of polygon-based geographic information system maps and associated information containing spatially explicit depictions of landscape attributes and patterns

Multiagent Decision-making - the process of selecting policies and generating land management decisions affecting the landscape pattern

Policies - Fundamental descriptors of constraints and actions defining land use management decisionmaking; Policies capture rules, regulations, incentives and other strategies promulgated by public agencies in response to demands for ecological and social goods, as well as considerations used by private landowners/land managers to make land and water use decisions.

Response Indicators – stakeholder relevant metrics for evaluating landscape change

Scenario - A primary mechanism for capturing a set of bundled concepts for managing water, growth, land use, etc. They consist of coherent collections of "policies", model settings, assumptions and preferences related to future change. Envision uses these to assess future trajectories of landscape productions e.g. "things people care about". They are a primary mechanism for capturing stakeholder input.