CommunityViz Tutorials

Use with CommunityViz 5.2

and

CommunityViz version 5.2 tutorials

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Scenario 360 tutorials

These CommunityViz tutorials provide tutorial instructions aimed at familiarizing you with the procedures and concepts necessary for working with Scenario 360, Scenario 3D and related tools like Google Earth. These tutorials are just fictional examples, and although they represent realistic decisions that people face every day, the data and assumptions used are simply for illustration. The analyses have no "right" answers and are not meant to imply any bias on any of the issues considered.

There are seven tutorials. Tutorial 1 gives a broad overview of capabilities, and Tutorial 2 introduces some basic concepts in more detail. If you are new to ArcGIS, you may prefer to start with Tutorial 2 and then return to Tutorial 1 before proceeding through the other tutorials.

- Tutorial 1 – This tutorial gives you an overview of the capabilities of Scenario 360 by applying "decision tools" (**Suitability**, **Land Use Designer** and **Sketch Tools**, **Build-Out**, **TimeScope**, **Common Impacts** and **Custom Impacts Wizards**) in combination with one another to create a comprehensive growth analysis.
- Tutorial 2 - Explore an existing analysis. This tutorial uses two scenarios (rural and village type development options) to walk you through investigating variables that affect development suitability and road construction cost models.
- Tutorial 3 – Set up your own analysis. This tutorial will walk you through creation of a cost analysis in an urban environment.
- Tutorial 4 – Create and work with a **Scenario 3D** scene. This tutorial will walk you through the creation of a 3D scene, including terrain and textures. You can then "fly" around and through the landscape and its features.
- Tutorial 5 – Run a **Build-Out** analysis. This tutorial will walk you through setting up and running a more detailed numeric, spatial, and visual build-out than you did in Tutorial 1.
- Tutorial 6 - Run an analysis and create **presentations**. This tutorial will walk you through displaying analysis information, creating saved views, comparing scenarios, and creating web-ready reports and analyses.
- Tutorial 7 - Export your analysis to **Google Earth** and display different TimeScope build dates in the 3D world of Google Earth.

Remember that these tutorials represent only a subset of what is possible in CommunityViz Scenario 360 and Scenario 3D.

Before you begin

☑ **Have a working knowledge of ArcMap** – The CommunityViz tutorials assume that you have a working knowledge of ArcMap. For assistance with ArcMap and ArcGIS tools, see the ArcGIS help.

☑ **Install CommunityViz** - Install Scenario 360 and Scenario 3D. Activate your license using the License Activation Wizard. For detailed instruction on installing Scenario 360 and Scenario 3D, refer to the installation instructions provided with your software.

Install the tutorial data - The data required to use these tutorials is provided online at http://communityviz.city-explained.com/communityviz/resources.html. On the Tutorials tab at the bottom of the resources page, click on the **Tutorial Dataset Installer**. In the **File Download – Security Warning** window, click **Run** to automatically load the tutorial data into the **C:\CVFiles** directory on your computer. If prompted with a security message such as "Do you want to run this software…," say yes.

The tutorial data must be installed in the exact location used by the installer, which is C:\CVFiles\. Do not attempt to move the files to another location or subdirectory. However, you may wish to make a compressed ("zipped") copy for backup purposes. The tutorial data will be included in four folders in C:\CVFiles: Buildout, Communityville, Sunny Vista and Tutorial 3. In addition there will be a PDF copy of the Tutorial instructions (these instructions) in the CVFiles directory. **Please be sure to remove all old tutorial files, if any exist, before you start this tutorial.**

- ☑ **Print these instructions.** If desired, print a paper copy of these instructions to use as you work through the tutorials.

About working with tutorials

- ☑ **You can start and stop any time** – To start Scenario 360, double-click the 360 icon on your desktop. This will automatically launch ArcMap with the Scenario 360 extension enabled. To stop, simply close the ArcMap window. You will be asked whether you want to save or discard your work. If you are already in ArcMap, you can launch Scenario 360 at any time by clicking the red **Start Scenario 360** button on the Scenario 360 toolbar. Use the same button to switch to a different Scenario 360 analysis.
- ☑ **Saving copies** – To save your work at any time, click **File | Save** from the top of the ArcMap window. If you want to make a copy of a Scenario 360 analysis, click **File | Save Analysis As…** from the top of the ArcMap window and save the analysis with a new name. Always save analyses to the C:\CVFiles\ location. Please do not try to copy analyses or rename analyses using Windows Explorer, and do not create your own subdirectories.
- ☑ **If you make a mistake** – Don't worry! Most of the time you can go back and do something over. If you are in the middle of using a Wizard, simply use the **Back** button to return and make changes. If you have already closed the Wizard, open it again and step through until you get to the part you need to change. If all else fails, you can close the analysis (use the red X on the ArcMap window) and choose to **Discard Changes.**
- ☑ **Question boxes** – If you are asked whether you want to "Convert to a File Geodatabase," or if you want to "Create Indexes," say yes.
- ☑ **If your screen isn't the same as the instructions** – Do not be concerned about small differences between the images in these instructions and the display on your screen. The particulars of what you see will depend on your computer and your set up, especially for layers displayed on the map, colors, and screen layout. You may find it helpful to turn layers on or off in your display to match the illustrations.
- ☑ **If buttons are grayed out (inactive)** – Make sure you have stopped editing. Make sure that Scenario 360 and Scenario 3D are installed and licensed (check the **ArcMap Customize| Extensions…** menu). You can also look for useful messages in the lower left corner of your screen that appear when you hover your cursor over a button.

Tutorial 1 – Integrated analysis using decision tools

This tutorial will give you a good overview of the capabilities of Scenario 360 that are provided by the decision tools for community planning. This tutorial contains a series of exercises that demonstrate how to use the decision tools with one another in the course of a comprehensive growth analysis. It starts with a **Suitability** analysis that selects the best places to build, followed by a land use sketching exercise using **Land Use Designer.** Then comes **Build-Out** and **TimeScope** to simulate the development and its changes over time. Finally, the tutorial uses the **Common Impacts** and **Custom Impacts** Wizards to evaluate some of the development's effects.

The purpose of this tutorial is to provide some examples of how Scenario 360 decision tools can be used on their own or in combination with one another. The sequence we've chosen is just one example of the many ways you can use these modular components. The tutorial does not go into great detail on any of the individual decision tools, but it is intended to give you an idea of what each one can do and provide some examples of how they can be used together.

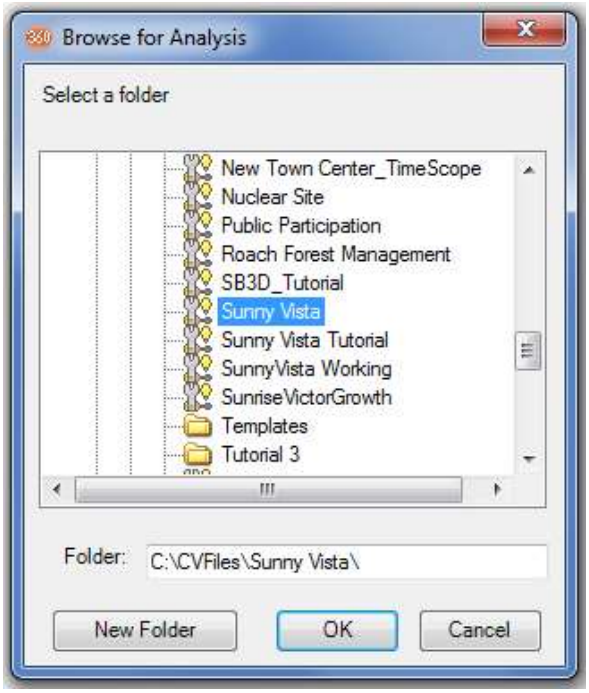
Once you have installed the tutorial data using the "Install the tutorial data" directions in the *Before you Begin* section, you will find this analysis in the **CVFiles\Sunny Vista** folder.

Objectives

- Rate the suitability and desirability of parcels in two different scenarios
- Create and apply land use styles to existing parcels to explore potential impacts
- Run a standard build-out analysis for some proposed land use areas
- Estimate potential build dates for structures in your plans using build rates and order options in TimeScope.
- Estimate the impacts of building over time using the common and custom impacts decision tools

Starting the tutorial

1. Refer to the *Before you begin* section if you haven't already installed the software and data for this exercise.
2. Start Scenario 360 by double-clicking on the red **Scenario 360** icon on your desktop.
3. On the Scenario 360 Welcome "splash" screen, click **Open Existing Analysis**, browse to the **CVFiles/Sunny Vista** analysis, select it, and click **OK**. If asked about converting to a File Geodatabase, click **YES.** Scenario 360 will load and display a fictional place called "Sunny Vista." Sunny Vista is a high mountain site on the outskirts of a mountain town being considered for development.
4. All decision tools referenced in the following exercises are available from the main Scenario 360 toolbar | Scenario 360 drop-down | Tools or from a separate Scenario 360 Decision Tools toolbar, depending on your toolbar preferences.

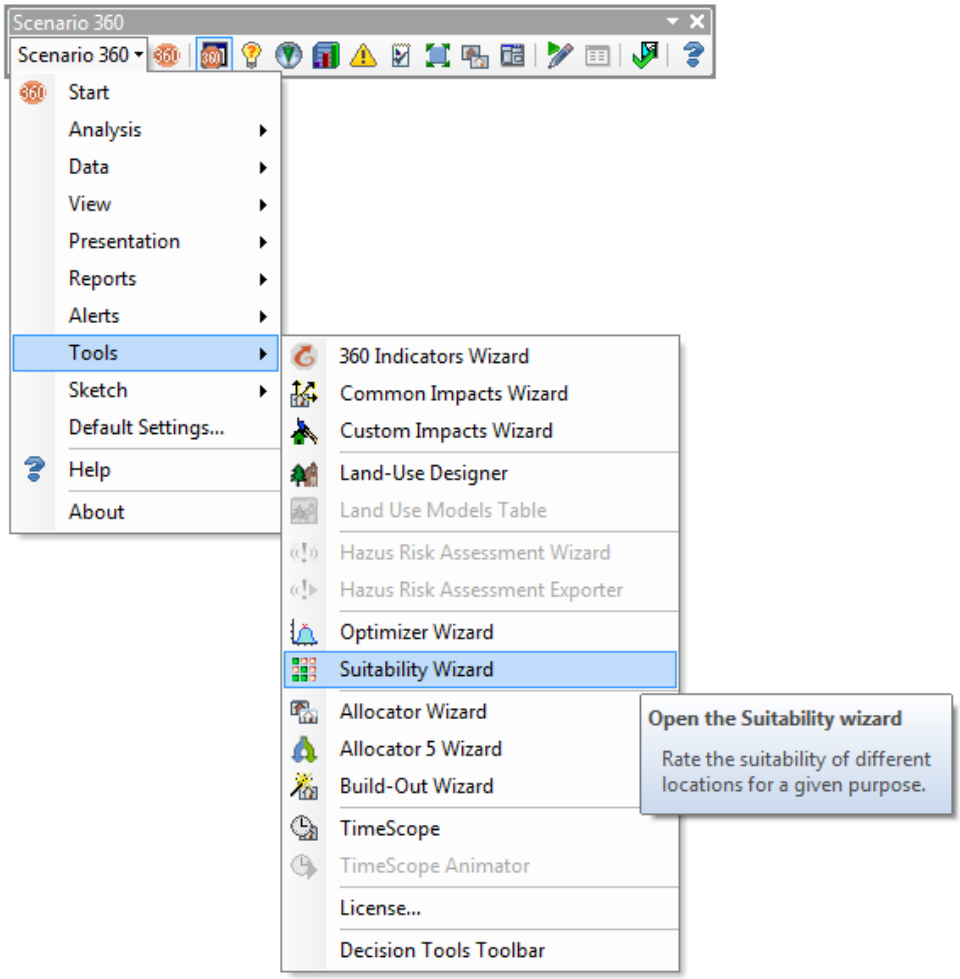


Setting up a suitability analysis

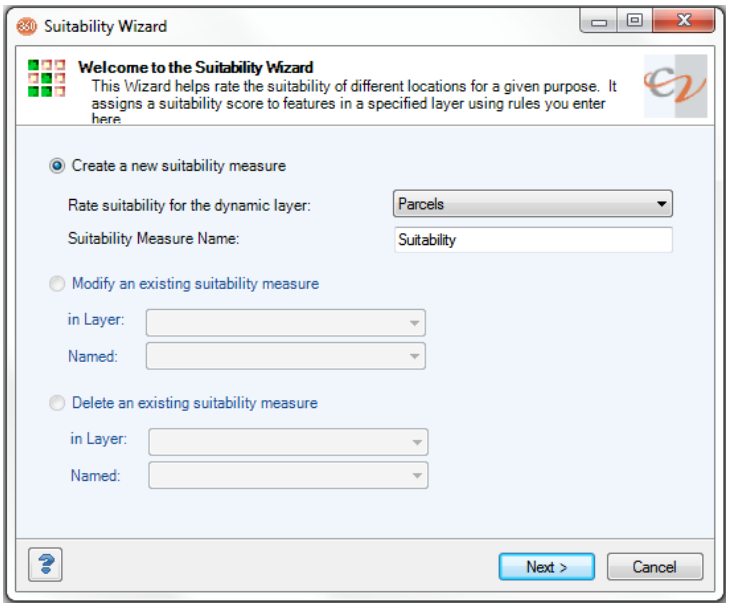
The Scenario 360 suitability decision tool (the Suitability Wizard) helps you set up an analysis that scores geographic features based on their suitability or desirability for a particular application. For example, you can calculate which parcels are best for building, which tracts are most important to preserve, or which locations are most likely to attract retail business. (The same kind of analysis can be used for risk or vulnerability assessment, too.) These separate factors are rated independently and then combined to produce a final suitability score. Optionally, variable weights can be applied to each factor so that the final analysis places more importance on some factors and less on others.

In this exercise you will rate the development suitability of individual parcels based on how close each one is to a water well and whether or not it lies within elk grazing habitat.

1. You can access the Suitability Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list and select **Tools** ▸ **Suitability Wizard**.



2. Ensure the **Create a new suitability measure** radio-button option is selected.
3. Select **Parcels** in the dropdown list after "Rate suitability for the dynamic layer:"
4. Accept the default name of **Suitability** and click **Next**.

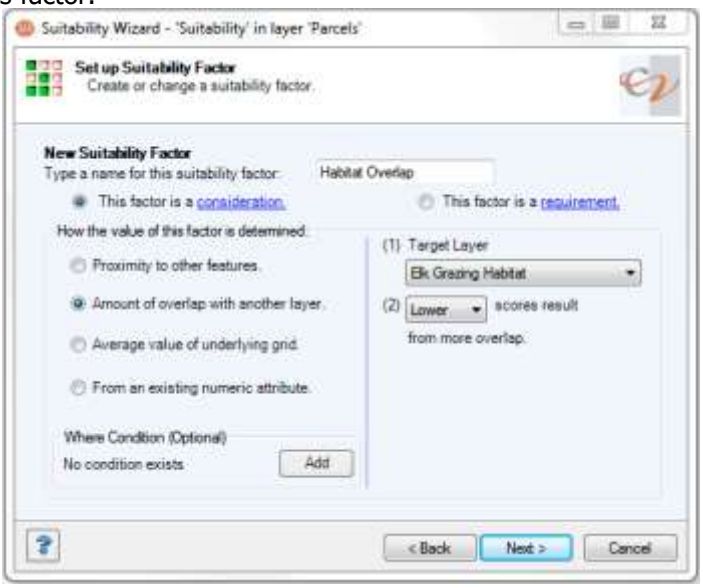


Specifying new suitability factors

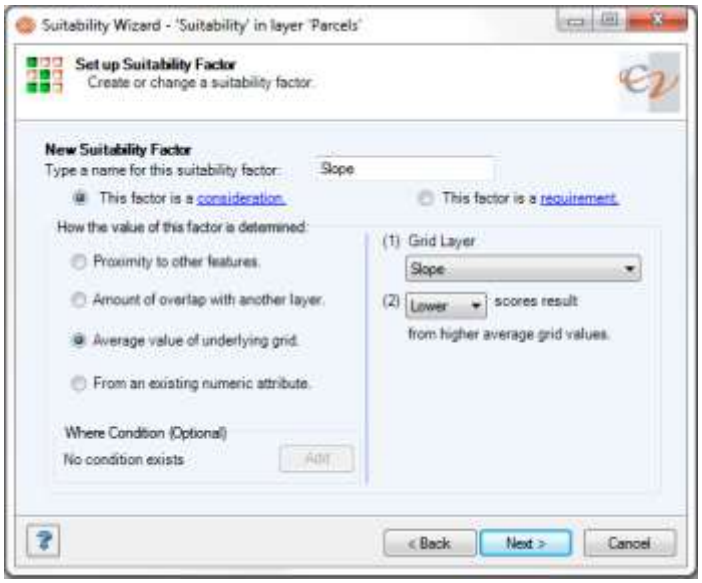
1. You will see a new screen called **Set up Suitability Measure**. Click the **Create a new suitability factor** button.
2. In the **Set up Suitability Factor** window, specify the factor name **Well Proximity** and keep the default for factor type as **This factor is a consideration**. Leave the default method as **Proximity to other features** and default Proximity Type as **Distance to Nearest Feature**, and select the **Water Wells** layer from the Target Layer dropdown list. Also leave in place the default setting that "Higher" scores result from closer proximity. These settings will create a suitability factor rating that is highest for parcels that are closest to wells and lowest for parcels that are furthest from wells.
3. Click **Next**.

4. Accept the default option to create weighting and Yes/No assumptions for this factor by clicking **Next** again at the **Variable Weighting** screen.
5. Now you will create another new factor that will contribute to the suitability measure for your parcels. Click the **Create a new suitability factor** button on the **Suitability Measure Summary** page.

6. Name this factor **Habitat Overlap,** keep the default for factor type as **"This factor is a consideration**, and choose the **Amount of overlap with another layer** method. Select the **Elk Grazing Habitat** layer from the Target Layer drop-down list and specify that "Lower" scores result from more overlap.
7. Click **Next** then click **Next** again to accept the default option to create weighting and Yes/No assumptions for this factor.



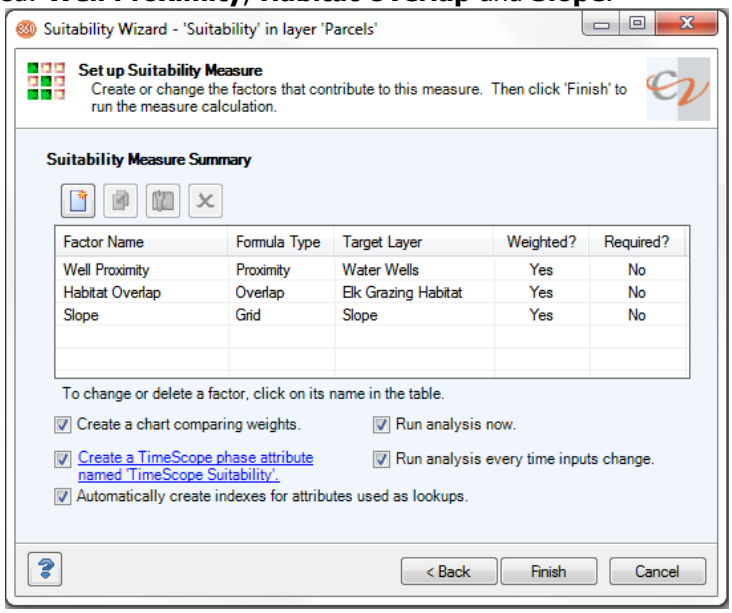
8. **Optional Step**: Create a third factor by repeating the steps above. Name this factor **Slope** and choose the **Average value of underlying grid** method. Select the **Slope** layer from the Grid Layer drop-down list and "**Lower**" from the scores result drop-down list. This indicates that lower scores will result from higher grid values.



9. Click **Next** twice to accept the defaults as before, which will return you to the **Suitability Measure Summary** page.
10. Do not click **Finish** at this time.

Running the suitability analysis

You have now created three factors. Each of these will contribute to the suitability rating for your parcels. Take a moment to think about what these mean and how you created them. The **Suitability Measure Summary** page should display the three factors you just created: **Well Proximity**, **Habitat Overlap** and **Slope**.



1. Ensure the option **Create a TimeScope phase attribute named 'TimeScope Suitability'** is checked. This will create an attribute that is designed to work with the TimeScope decision tool. Its values will be lowest for the most suitable parcels and highest for the least suitable parcels. Later, you will use this attribute to cause TimeScope to build on the most suitable (and presumably most desirable) parcels first. (TimeScope always builds in order from lowest values to highest.)

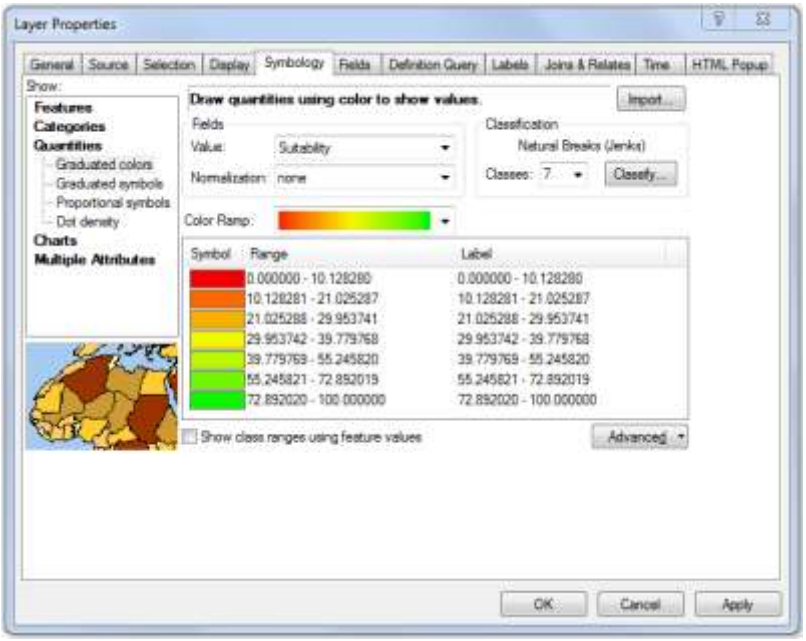
2. You are now ready to run your suitability analysis. Click **Finish** and wait while the Suitability Wizard creates all the necessary analysis components and completes processing.

Viewing the results of your analysis

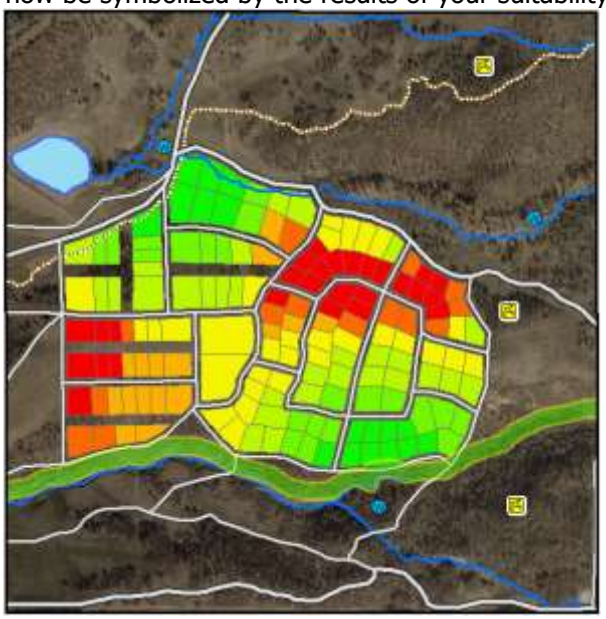
One way to view your results is to open the **Parcels** attribute table (right-click on the layer name in the ArcMap Table of Contents and then click **Open Attribute Table**) and inspect the new field values. You'll note that the Suitability attribute (on the far right of the table) now has values between 0 (least suitable) and 100 (most suitable).

A more graphical way to view your suitability results is to adjust the symbology for your **Parcels** layer.

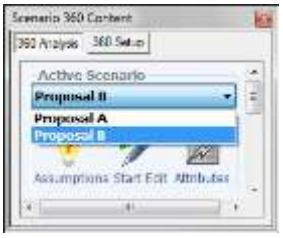
1. From the ArcMap Table of Contents, double-click the **Parcels** layer in the active scenario to open the Layer Properties dialog. From there, select the **Symbology** tab.



2. In the left-hand list, select **Quantities** ▸ **Graduated colors**. Next, use the Value drop-down list to select the **Suitability** field. Choose a color ramp and a number of classes that meet your preference and click **OK**. Your map should now be symbolized by the results of your suitability.

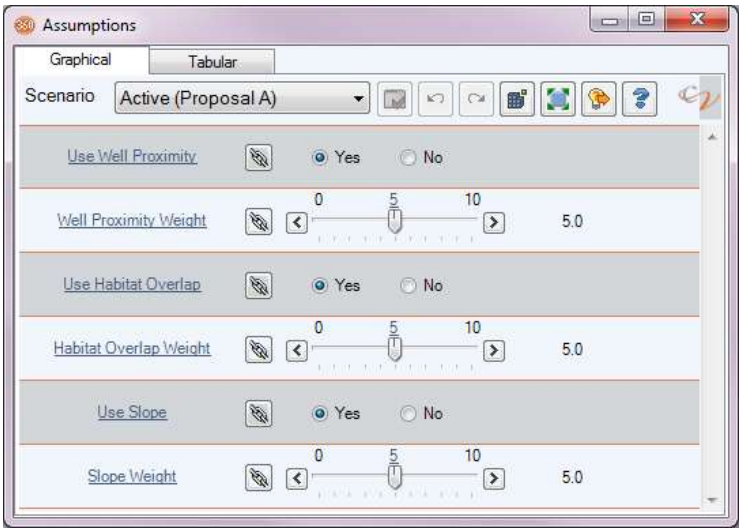


In the above example, the bright green represents the most suitable areas and the red the least suitable according to the three factors in your suitability measurement. (Your map may look a little different from this one depending on which layers you are displaying and other factors.)

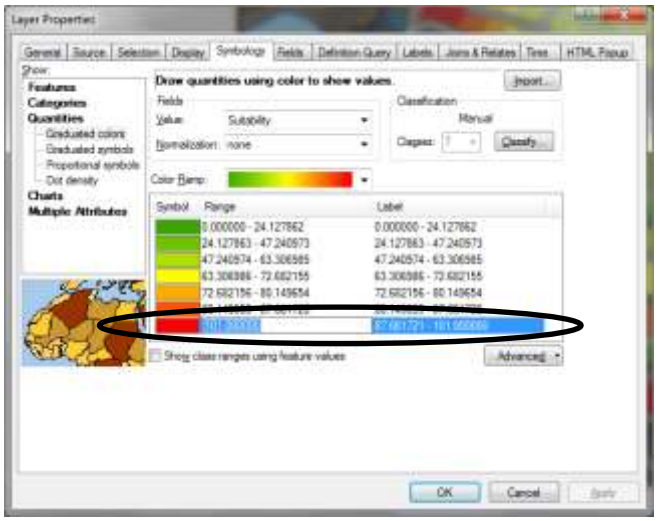


3. Switch the active scenario using the drop-down list on the **360 Analysis** tab to view the Proposal B. (You may need to turn it on via the Scenario 360 drop-down then View ▸ Scenario 360 Dockable Window.)

4. Now you will explore the effects of changing the relative weight of and including or excluding each suitability factor. Open the **Assumptions** window by clicking the **Assumptions** button on the **Scenario 360** analysis tab.



5. Use the slider bars to adjust the weights associated with the three factors driving your suitability analysis (i.e., **Well Proximity**, **Habitat Overlap** and **Slope**), then click the **Apply Assumption Changes** button . Also change the Yes/No assumptions for the three factors to include or exclude the factor in the Suitability calculation, then click the **Apply Assumption Changes** button. The suitability results on the map will change dynamically based on your new settings. If you get some white parcels it means that their score is outside the range ArcMap first detected when you set up symbology. Return to the symbology window from Step 1 by double clicking **Parcels** on the Table of Contents, under Range click on 100.000000, and change it to 101.



Now you can easily see which parcels score highest and lowest based on the criteria you used. Take a moment to compare your colored parcels map with the three layers used in your suitability factors: **Water Wells, Elk Grazing Habitat** and **Slope.** Do the results make sense based on your Assumption changes?

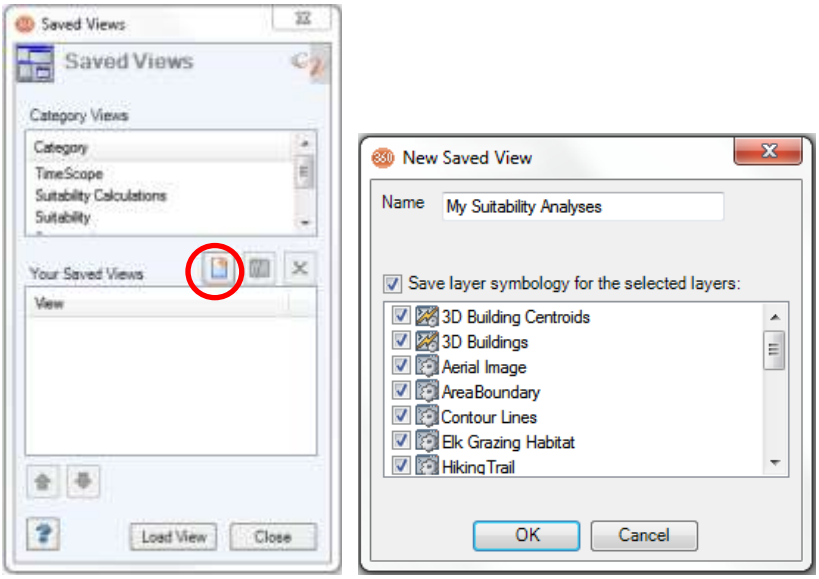
Completing your suitability analysis

Once you finish reviewing your suitability results, make sure the slider bar values of your **Suitability Assumptions** are set to any interesting set of non-zero values. If the **Apply Assumption Changes** button is active (i.e., the checkmark icon appears green), click it to apply the current assumption values to your analysis. This ensures your **Suitability** measure contains varied results (which will be used later when you use these results to drive your **TimeScope** analysis).

Creating a Saved View

You may want to return to your current state later, so create a Saved View that will keep track of your current display settings and layer symbology. Saved Views keep track of which windows are open, which layers are on, and the map extent. They do *not* keep track of your current assumption settings.

1. On the Scenario 360 Toolbar, click the **Saved Views** button.
2. Click the **New Saved View** button.
3. When prompted, overwrite the default name "New View" with "My Suitability Analysis."
4. Check the box labeled Save layer symbology for the selected layers:
5. Check on all the boxes in the list by holding down the Ctrl key on your keyboard and clicking on any one of them.
6. Click **OK.**
7. **Close** the Saved Views window.



Scenario 360 Sketch Tools and Land-Use Designer

In this section, you will sketch a new land-use plan and measure its impacts. You will create land-use styles with the Land-Use Designer, then "paint" land areas with particular land-use models using Sketch Tools and see the resulting impacts. As a refinement, you will learn how to create or modify land-use models and sketch styles on your own. Finally, you will learn to "clone" an existing feature along with all of its land-use characteristics.

You will continue working with the Sunny Vista dataset, so now might be a good time to save. Go to **File | Save** to save your work so far.

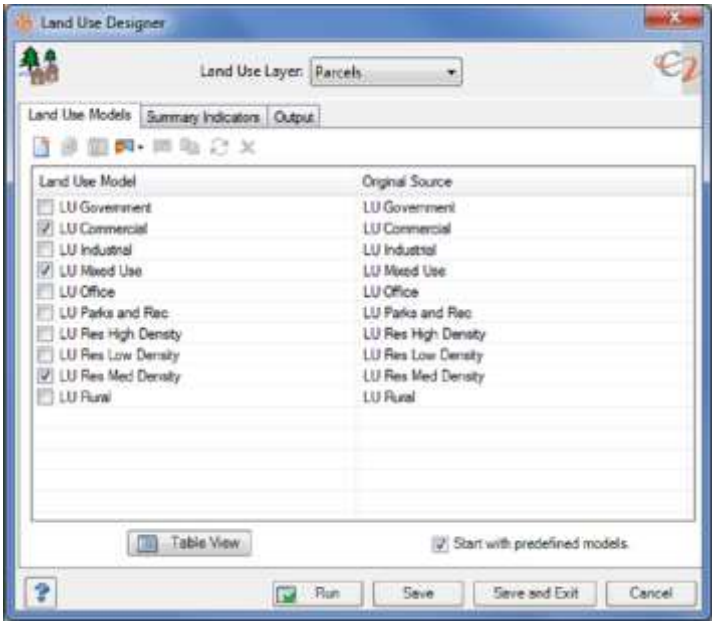
Opening and setting up the data

1. Make sure that **Proposal B** is still the Active Scenario by checking the Scenario 360 Analysis Work Panel, Scenario 360 Analysis, Active Scenario Drop-down.
2. To make it easier to see what you are doing, make the following layers active by clicking on the boxes so that check marks appear:
   - Roads
   - Streams
   - Ponds
   - Parcels
   - Aerial Image

   Turn off the other layers for now.

Starting the Land Use Designer and Scenario Sketch Tools

1. Start the Land Use Designer by going to the Scenario 360 drop-down and selecting **Tools | Land Use Designer** .
2. At the top of the Land Use Designer, select the land use layer **Parcels.**
3. Look at the list of predefined land use models that are available for you to use. For this exercise, deselect all but the following models:



- LU Commercial
- LU Mixed Use
- LU Res Med Density

The "LU" in front of each name labels it as a predefined "Land Use" model.

5. Click **Run.**

Based on your settings, the Land Use Designer will create three land use models you can use on your new layer. Each model contains a name and then several attributes appropriate to that land use, such as building densities and resource utilization rates.

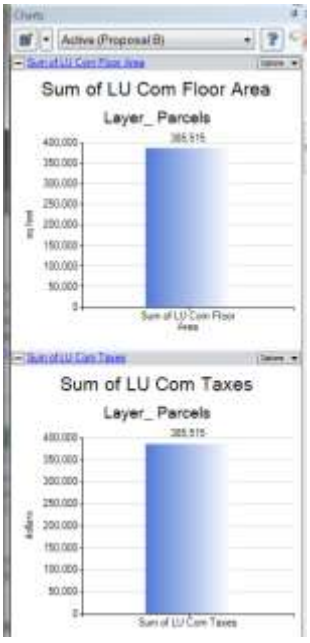
Applying Land Use Styles Using Scenario Sketch Tools

1. By default, closing the Land Use Designer will automatically start an edit session on the Proposed Land Use layer in Proposal B. If it does not, you can start editing by clicking on **Start Edit**  on the 360 Analysis tab. This will make many of the Sketch functions active.
2. When editing starts, ArcMap should automatically open the Editor toolbar and the Create Features window. Find the ArcMap **Editor** toolbar on your screen. (You may need to turn it on via Customize → Toolbars → Editor.) Find the **Create Features** window (You may need to open it by clicking on the **Create Features**  button on the ArcMap **Editor** toolbar.)
3. The styles listed for the Parcels layer in the Create Features window were created by the Land Use Designer. To begin with, our map is like a blank canvas. To apply land use styles to the map, first you need to click on the style you would like to use under Parcels in the Create Features window.
4. At the bottom of the Create Features window are Construction Tools to create data. Select the Painter Tool  (you may need to expand the Construction Tools list by dragging the window edge upward to see the full list of tools).
5. You are now ready to paint! Move the paintbrush cursor to the map and either click or click and drag the cursor over a polygon or series of polygons in the Parcels layer that you would like to designate with a chosen use. After a few seconds of processing, the polygon will change color, indicating your new style has been applied. Use the same procedure to paint the other polygons in your layer, alternating to other uses when desired. You have just "applied" styles to the Parcel polygons. Note that styles are tied to particular layers; you can't apply styles from one layer to another.
6. To apply styles to a larger area, use the following technique. Make sure a land use style is selected under Parcels in Create Features and that the Painter tool is chosen under construction tools. Draw a polygon on the map that covers all or at least part of every parcel you want to paint with a particular land use. To do so, hold down the Ctrl key while clicking polygon corners on the map. Double-click once you want to apply the polygon. All features intersecting the polygon will now take on the chosen land use.

When finished, stop editing using the **Stop Edit**  button and choose to **Save** edits when prompted.

Viewing Land Use Designer Impacts

The Land Use Designer created many new dynamic attributes (formula-driven fields) in your **Proposed Land Use** layer. When you painted the map, particular values were assigned to these fields.



1. You can see the new attributes and their values by opening the layer's attribute table: right-click on the Parcels Layer in the Table of Context and choose "**Open Attribute Table**." Review the many attributes the Land Use Designer created to define land uses and impacts. Close the table once you are done reviewing.

The Land Use Designer also set up a number of summary calculations, or "indicators," based on the feature attribute values.

2. You can see some of these results by clicking on the **Charts** icon in the Scenario 360 Content → 360 Analysis task pane to open up the charts view. Ensure that the charts drop-down is set to "Active (Proposal B)" at the top of the charts window (If it is already set to Active (Proposal B) you may need to refresh the charts by clicking it again). Scroll through the charts to find ones whose name contains "LU."

3. **Experiment** by starting to edit again and then using the paint brush tool to modify the land use style of some of your polygons. You will notice that the chart values update in response to your new proposed plan.

Advanced/Optional: Customizing Land Use Design Models

This section contains advanced topics. You can skip ahead to the *Setting up Build-Out Analysis* section if desired without losing continuity.

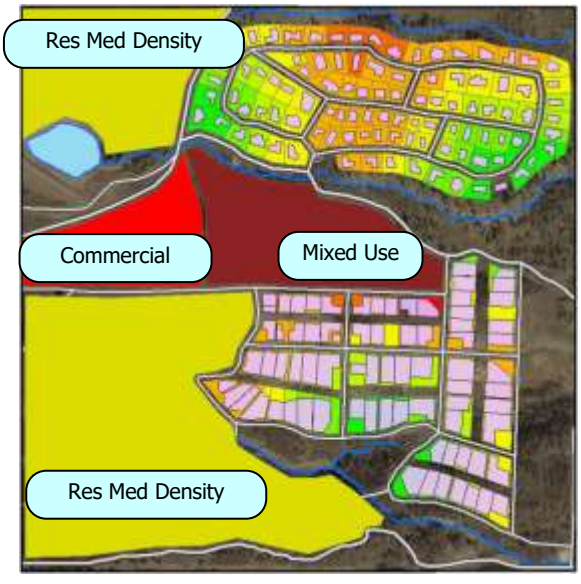
You can modify the pre-defined land-use models you have just used, or you can create entirely new ones. For this exercise you will change some settings in the "LU Res Med Density" style.

1. Make sure that at least one of your land-use polygons is painted with the LU Res Med Density style.
2. Ensure that you have Stopped Editing.
3. Note the current values, as shown in the charts, for the indicators "Sum of LU Children" and "Sum of LU Residents."
4. Reopen the Land Use Designer by clicking on the **Land Use Designer** on the Decision Tools toolbar and make sure the active land use layer is **Parcels.**
5. Highlight the LU Res Medium Density line in the table and click on the Model Properties button on the tool bar in the Land Use Designer window. This opens up the Properties window for that model. You may want to take a few minutes to explore the various tabs.
6. On the **Building Info** tab, change the Dwelling Units per Area from 4 to 10. This increases the proposed density and will therefore increase the number of houses and all their impacts.
7. On the **Per Dwelling Unit** tab, change the LU Children per DU value from 0.6 to 0.8. This setting changes the average number of school-aged children in each house for polygons designated as LU Res Med Density.
8. Click **Finish** to close the model properties wizard.
9. Ensure the LU Res Med Density style box is still checked **on.**
10. **Apply Changes** to update your analysis.
11. Compare your new values for "Sum of LU Children" and "Sum of LU Residents" to your previous ones. You will see that they have updated on the basis of the density and per-dwelling unit changes you made.

In this exercise you learned how to use predefined land-use models and how to change existing settings. There are many more capabilities in the Land-Use Designer, including adding additional attributes to models and creating new models from scratch. Refer to the Scenario 360 Help for details.

Setting up a build-out analysis

While the Land Use Designer gives you quick estimates of land-use impacts from sketched land use options, build-out provides a more sophisticated, in-depth analysis of how much building the land can support given the many details of land-use or zoning regulations. The Scenario 360 build-out analysis tool (the Build-Out Wizard) automates the entire build-out process. It guides you through the choices and selections that will form the basis of your build-out analysis. In the fictional example of **Sunny Vista**, you will run a build-out analysis on a proposed land use layer just west of the parcels you've been analyzing with Land Use Designer. It has some features where we've already defined land use types and you'll use the build-out wizard to define their development potential. Locate the Proposed Land Use layer in the table of contents, make sure it's turned on and take note of the land use types:



- Commercial
- Mixed Use
- Res Med Density

The land-use rules for this analysis are included in the table below. In this tutorial, you will be walked through entering this basic information and a few other rules into the Build-Out Wizard to run a numeric and spatial build-

out analysis. For a more detailed breakdown of the steps involved in creating and running a build-out analysis, please see **Tutorial 5 – Setting up and running a build-out analysis**.

Land-Use Designation	Dwelling Units	Floor Area
Commercial	0	2 FAR
Mixed Use	1 DU/acre	1 FAR
Res Med Density	4 DU/acre	0

Preparing the Data

To begin, make sure **Proposal B** is the active scenario by selecting it from the drop-down list on the **360 Analysis** tab. Make sure Proposed Land Uses is checked on in the table of contents.

Setting up a numeric build-out analysis

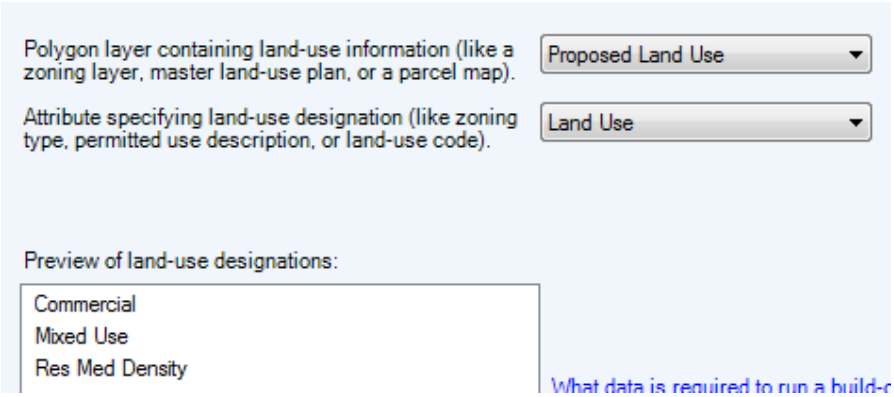
For a numeric build-out analysis, the Build-Out Wizard will calculate the estimated building capacity (in numbers) for each parcel. Note that at any time while you're working with this Wizard, you may exit and retain your entered information by clicking the **Save and Exit** button at the bottom of the wizard.

1. Open the Build-Out Wizard. You can access the Build-Out Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list and select **Tools ▸ Build-Out Wizard.** (For now, do not click the Advanced button, which launches a more detailed version of the Wizard. You can return to it later if desired.)
2. Click the **Numeric** button.

Specifying land-use information

At the prompts on the first page of the numeric build-out, specify the following information:

1. On the **Specify Land-Use Layer** screen, ensure that **Proposed Land Uses** is selected as the layer containing land use information.
2. The attribute specifying land-use designation should read **Land Use.**
3. Preview the land-use designations in the field provided then click **Next**.



Setting up density rules

Density is an indication of the number of buildings per unit area. For residential polygons, density is often provided in dwelling units per area (e.g., 2 units/acre), number of dwelling units, or minimum lot size per area. For non-residential polygons, density is usually provided in floor area (e.g., 10,000 sq. ft.) or by using a floor area ratio (FAR). For this exercise:

1. Either type or click and select from a provided drop-down list to fill in the fields with the information shown in the image below:

Designation	Dwelling Units		Floor Area	
	Quantity	Measurement	Quantity	Measurement
Commercial	0	DU per acre	2	FAR
Mixed Use	1	DU per acre	1	FAR
Res Med Density	4	DU per acre	0	FAR

2. Click **Next.**

Mixed-Use Percentages

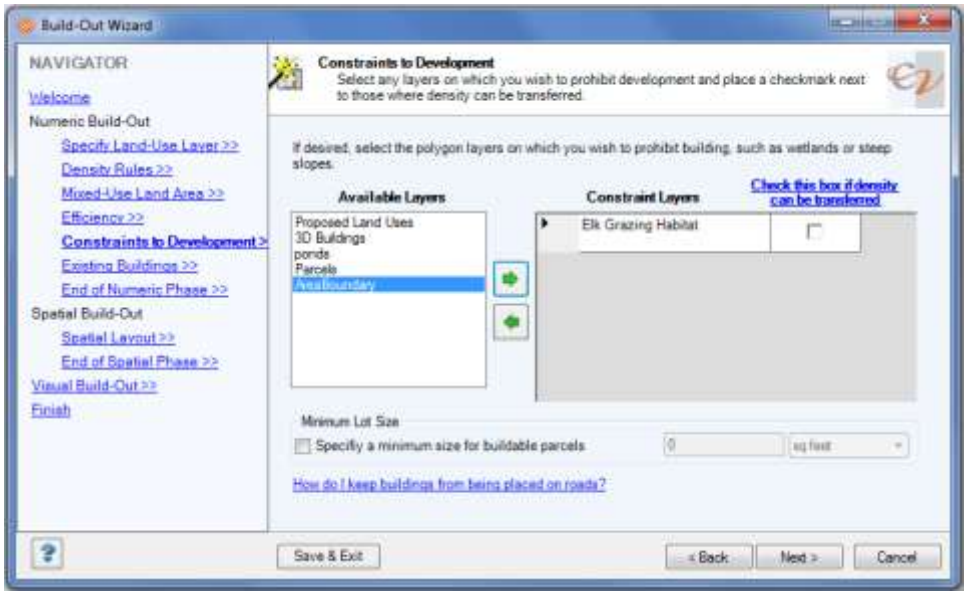
Because at least one of your land-use types mixes residential and commercial uses (i.e., has dwelling units and commercial floor area), the next screen, Mixed-Use Percentages, appears and gives you the option to specify more details. You may ignore this screen for now, accepting the default values and clicking **Next.**

Using efficiency factors

Efficiency factors adjust density values to reflect common density losses, such as area for future roads and open space, which may not be easy to represent spatially. They are useful for areas where the Code or Comprehensive Plan allows for development densities that might not be practically achieved. They are entered as a percentage where 100% means complete efficiency (no density lost), and 0% means no buildings will be estimated for that land use. On the **Efficiency** screen, leave the default setting of **Assume 100% efficiency** checked and click **Next**.

Specifying constraints to development and existing buildings

Land-use regulations may prohibit building in certain areas, such as on rights-of-way or on protected lands such as endangered species habitat. In addition, some areas may be impractical for building because they are on too steep a slope or under water. If your analysis contains layers representing these unbuildable areas, which the wizard calls "constraint layers," you can specify them here. For this example, highlight the layer called "Elk Grazing Habitat" and then click the right green arrow to move it into the list of Constraint Layers.



Some land-use regulations also specify a minimum lot size for new construction, but we will ignore that option here. Click **Next.**

Existing Buildings

In any plan you may have development within the plan area which is already developed. This screen allows you to incorporate a point layer for existing buildings and specify the amount of development for residential and commercial uses. Since our simple plan area is vacant, you can click **Next** to move past the Existing Buildings screen.

Completing the numeric build-out phase

You are now finished setting up the numeric phase of the build-out analysis. On the **End of Numeric Phase** Wizard screen, select **Spatial** to continue on to spatial build-out set up or click **Next**.

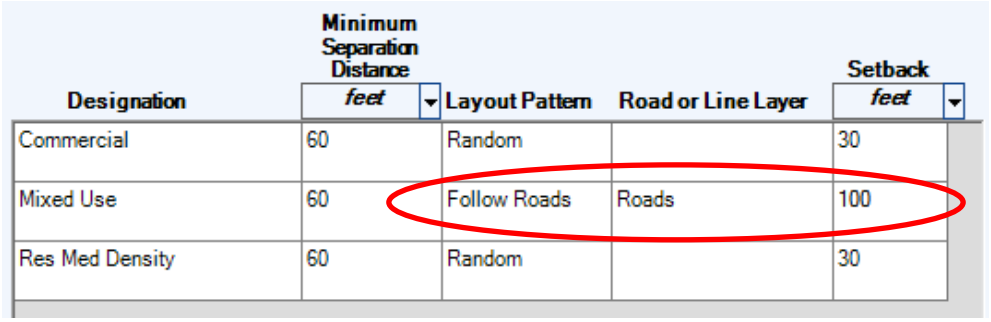
Setting up a spatial build-out analysis

Spatial build-out places potential new building points on a 2D map. It converts the numeric building counts into points representing individual structures, and it attempts (via computerized trial and error) to place those structures on the land without violating a set of spatial rules about where buildings can go. In some cases, it finds it cannot place all the buildings specified by numeric build-out because of the geometry of land-use areas and buildings. For example, an oddly shaped lot may theoretically have enough total area for 2 buildings, but because of setback rules or minimum separation distances, it only may fit 1 unit. In this case, the number of "spatial" buildings is less than the number of "numeric" buildings, providing a more refined estimate of build-out capacity. You must first run a numeric build-out analysis (to get the numeric building counts) if you wish to run a spatial build-out analysis.

Specifying building separation distances and choosing a layout pattern

You have control over how far apart buildings need to be, whether the spatial build-out building points are distributed in a random or grid pattern, and if you want the points to follow a road layer.

1. Make sure the units drop-down list under **Minimum Separation Distance** has **feet** selected.
2. Make sure the units dropdown list under **Setback** has **feet** selected.
3. Using the information in the image below, type or click and select from a provided drop-down list to fill in the **Minimum Separation**, **Layout Pattern**, **Road or Line Layer**, and **Setback** fields.



Designation	Minimum Separation Distance *feet*	Layout Pattern	Road or Line Layer	Setback *feet*
Commercial	60	Random		30
Mixed Use	60	Follow Roads	Roads	100
Res Med Density	60	Random		30

4. Click **Next**.

Running a spatial build-out analysis

1. Move the slider bar to **100**. This is a small study area and will not take a long time to process.
2. Click **Finish**. If it is showing, select the **Overwrite the current results** option. (This option doesn't appear the first time you run a build-out.)

3. Make sure that only **Numeric** and **Spatial** are selected (they have a checkmark next to them) and click **Run Build-Out**.

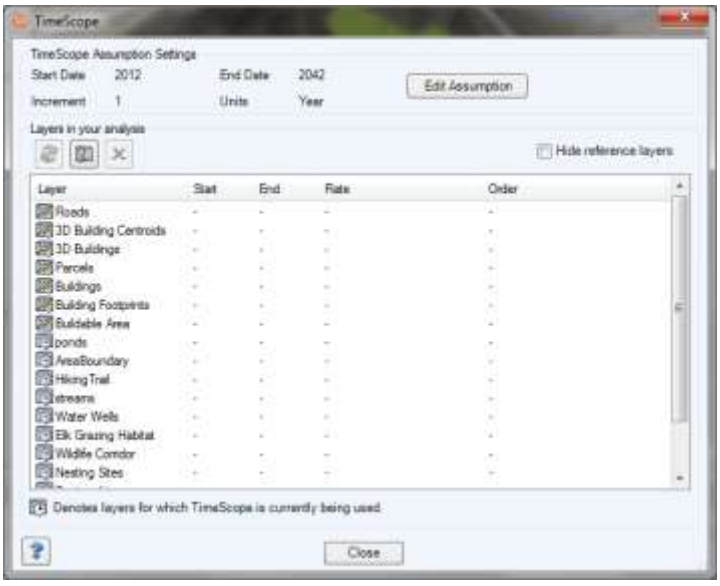
You can monitor the progress of the processing by watching the status bar on your screen, this can take several minutes. When the process completes, locate the Build-Out layer group in the Table of Contents, including the **Buildable Area** layer and the **Buildings** layer. You can expand the group and turn on layers if they are not currently checked on in the table of contents. You can also move the Build-Out group in your table of contents by dragging the group heading, Build-Out, to below ponds in the Table of Contents. Notice that the Buildable Area layer is just like the original **Proposed Land Use** layer except that the Elk Grazing Habitat constraint layer has been cut out or "clipped." (It may help to turn off the Proposed Land Use layer display.) It is also color-coded to illustrate the land-use designation for each area using the same color coding from your original Proposed Land Use layer.

If you open the attribute table for **Buildable Area** (right-click on the Buildable Area layer in the table of contents and select Open Attribute Table in the list), you will see several fields containing useful information. The Buildings layer shows building points placed by spatial build-out. Note that none of the buildings lies on the constrained area, and notice how all the Mixed Use buildings are aligned along a roadway the same distance from the nearest road.

For more details on your build-out analysis, open the Build-Out Report by clicking the **List Reports** button on the Scenario 360 toolbar and then clicking on the name of your build-out report.

Are buildings missing? If your Mixed Use polygons are farther than 100 feet from the nearest road, the Wizard will not place any buildings because you specified a 100-foot setback. Try re-opening the wizard, changing the setback, and re-running the Build-Out. (The ability to run the analysis many times with slight changes is one of the great advantages of the Build-Out Wizard.) There will only be a single commercial building on each feature allowing commercial use because in this set up you did not specify how big each building should be. If you check the attribute table or the build-out report, you will see the number of commercial square feet is large. You can specify commercial building sizes using the Advanced wizard.

Setting up a TimeScope analysis



The Scenario 360 **TimeScope** decision tool helps you look at changes over time by allowing you to specify the rate and order that features will be built. The Wizard prompts you to enter data and assumptions that create a **TimeScope Time** variable assumption and apply TimeScope to one or more dynamic layers in your analysis. In this tutorial, you will be applying a TimeScope analysis to both the **3D Buildings** layer of sketched footprints as well as the **Buildings** layer generated in the Build-Out analysis above.

For clarity, turn on (display) the **3D Buildings** layer and **Parcels** layer in the Table of Contents, and turn *off* the **Buildable Area** layer. You can access the TimeScope Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list and select **Tools ▸ TimeScope.** The initial setup screen displays all layers in your analysis,

marking the dynamic layers with a **Dynamic Layer** icon and reference (non-dynamic) layers with a reference icon.

As you will see after you do the next exercise, if TimeScope has been applied to a layer, its icon changes to a TimeScope icon. The layer's start date, end date, build rate, and build order are displayed for informational purposes. To change any of these, edit the layer using the **Edit** button or double-click on the layer name. The build order indicated refers to features within that layer, not to that layer's order with respect to any other layers.

Setting up TimeScope for a layer

The first time you set up TimeScope in an analysis, a TimeScope **Time** assumption will be created. You can see its default settings on the opening screen. You may leave these defaults in place. In this tutorial, you will be using this assumption for the **3D Buildings** layer and the Build-Out **Buildings** layer.

1. Double-click on **3D Buildings** in the TimeScope layer list.
2. The **Specify Date Range** screen is used to designate the start and end dates for the particular layer you are working on. In this case, accept the defaults and click **Next**.
3. The **Build Rate** screen is used to specify how quickly additional features are built as TimeScope Time moves forward. Select **Exponential growth** as the **Rate Type** then type in the following for **Rate Settings**:
   - Use one rate for all scenarios
   - Growth rate = 10% per year
   - Initial features = 15 (meaning 15 new buildings at the start of growth)
   - Existing features = 0

   Click **Next.**
4. The **Build Order** screen specifies the sequence in which features are built as TimeScope Time moves forward. Select **Phase Layer** as the **Select Order Type**. For the **Order Settings**, select the **Parcels** layer and the **TimeScope Suitability** attribute as shown in the image below. This attribute is the one that was created by the Suitability decision tool when you clicked "Create a TimeScope phase attribute." These settings will cause buildings to appear in the most "suitable" locations first as time moves forward. (*Optional: To refresh your memory on suitable locations, you can look at the Saved View you made earlier using Scenario 360 Toolbar > Open or Save a View > Highlight My Suitability Analysis in the list > Load View. This may turn off your 3D Buildings layer; if so, just turn it back on. If you didn't happen to create a TimeScope Suitability attribute earlier, don't worry. Just choose Random order for this exercise.)* Click **Next**.
5. If desired, TimeScope can automatically keep track of how many features it has built during each time increment. The results can be reported as a set of indicators or in a table. The indicators can then be plotted in sequence as a line chart that shows growth as a function of time. For this step, we're not going to track feature totals. So, at the **TimeScope Feature Counting** Wizard screen, accept the defaults and click **Next**.
6. At the **Finished** page, accept the defaults and click **Finish** to exit the Wizard and run the **TimeScope** analysis.

7. Once it completes, you will see the icon next to the 3D Buildings layer. Close the wizard by clicking on the red X in the upper right corner.

Note that like other decision tools, TimeScope does not automatically re-run when you make changes to your analysis. When you are in analysis mode, changing the **TimeScope Time** variable assumption will cause automatic analysis updates in the same way that other assumption changes cause updates. However, if you edit the map, modify formulas, or make other analysis changes, they will not be reflected in TimeScope until you re-run it.

Experiment with the TimeScope Time assumption

1. Open the **Assumptions** window by clicking the **Assumptions** button on the **Scenario 360** toolbar.
2. Find the TimeScope Time assumption slider bar. If it is not showing, you can expand the window by dragging the bottom edge down. You can also click the **Organize** button, place a check next to TimeScope Time in the list, and click **OK.**
3. Adjust the slider bar for the assumption **TimeScope Time** to a new position and then click the **Apply Assumption Changes** button. You will observe the pattern of mapped buildings change as the year changes. The growth of buildings in this example corresponds to the **Suitability** measure you generated earlier: the first buildings will be built in the parcels with the highest Suitability rating and the last built in the parcels with the lowest Suitability rating. Remember that these suitability ratings are ones you set up in an earlier exercise and probably aren't very realistic for representing actual build order. In your own work, you can set up build orders that make more sense to you based on factors you think are important.

Add TimeScope to another layer

If it is not on already, turn on the Buildings layer in the Build Out group in the Table of Contents.

1. Open the TimeScope Wizard again and double-click the **Buildings** layer that was created by Build-Out.
2. Accept the default Date Range.
3. Under Build Rate, choose **Linear growth** and set the Rate to **10** per year.
4. Under Build Order, choose **Proximity to a layer** and specify the layer **Ponds**.
5. Step through the rest of the wizard accepting all defaults and click **Finish.**

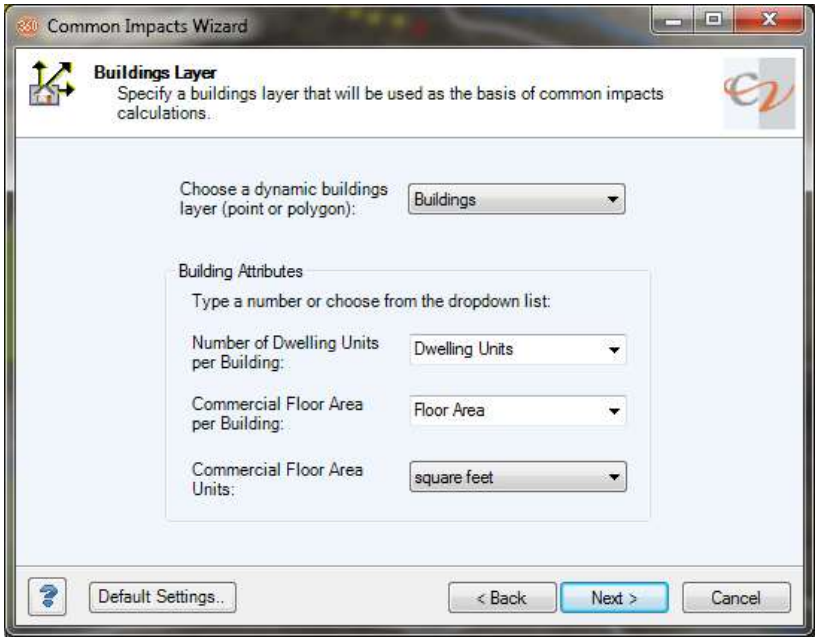
Experiment some more with the TimeScope Time assumption, noting how 3D Buildings and Buildings both appear and disappear as the date changes. Are they being "built" when you expect?

Setting up a Common Impacts analysis

The Scenario 360 **Common Impacts** decision tool, or Common Impacts wizard, automatically generates several commonly used impact indicators associated with growth and development over time. Up to twelve **standard impacts** are generated solely on the basis of a "buildings" layer you specify. Three **special impacts** can be generated if you provide additional information or layers to use for reference. All impacts are optional.

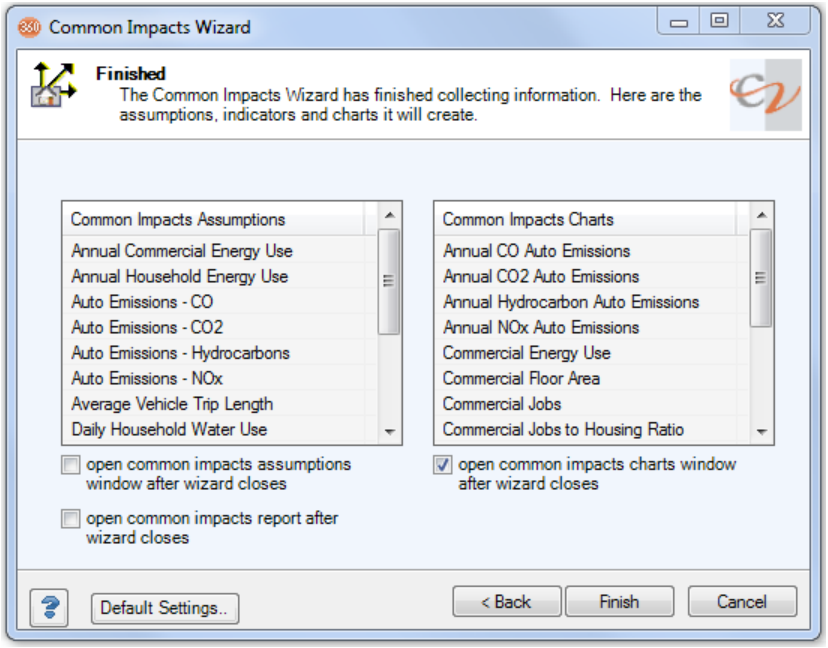
For this exercise, you will start by generating the standard set of **Common Impacts**. The **special impacts** will be skipped in this exercise.

1. You can access the Common Impacts Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list and select **Tools ▸ Common Impacts Wizard.**
2. Accept the default selections on the first page and click **Next**.
3. On the second page, the **Buildings** layer should be selected by default, along with the **Dwelling Units** and **Floor Area** fields within this layer. These fields are the ones generated by build-out and they are used by Common Impacts by default if they are present. If you had not run a Build-Out analysis prior to running this tool, you could specify an appropriate layer to represent your buildings. If fields equating to dwelling units per building and/or floor area per building were unavailable, you could type in a number for either option.



4. Click the **Next** button then click the **Next** button again.

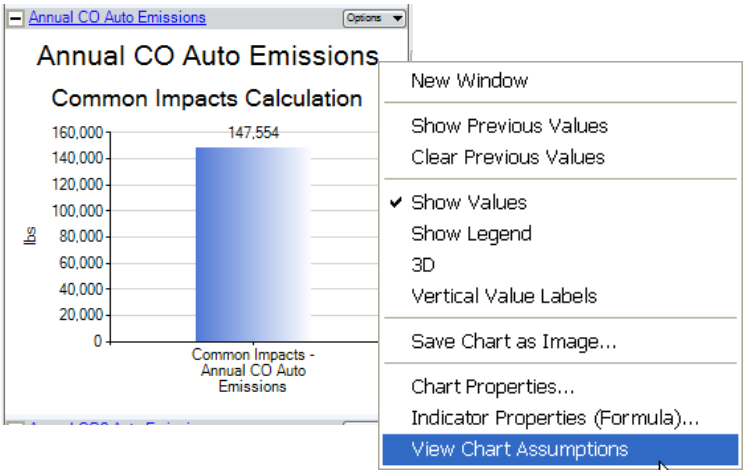
5. The **Finished** page lists all the assumptions and charts that will be created by the Wizard and asks you some questions about which windows you would like to have open once the Wizard completes its analysis. Uncheck the box labeled "**open common impacts assumptions window after window closes"** and then click **Finish** to run the analysis.



Examining the Common Impacts results

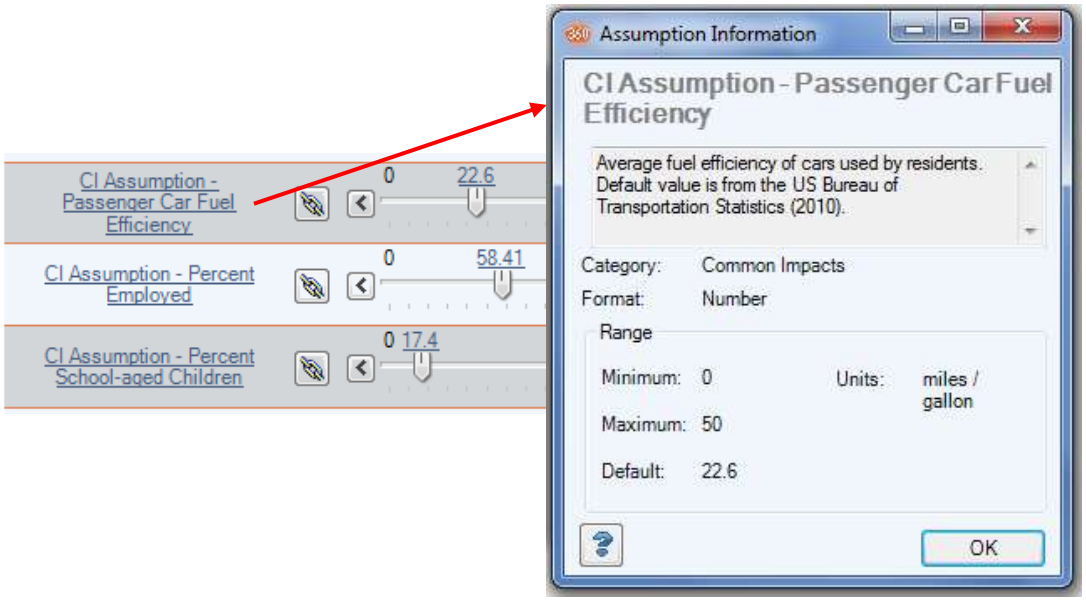
The Common Impacts charts display the results of the analysis you just ran for each scenario.

1. Right click on the chart titled **Annual CO Auto Emissions** and select **View Chart Assumptions** from the pop-up menu.



2. This opens the **Assumptions** window and displays only the assumptions that directly impact **Annual CO Auto Emissions**. These assumptions indicate the base values behind the calculations that were performed.

   Click the name next to the slider for any one of these assumptions and the associated **Assumption Information** dialog will open. This dialog contains a description of the source we used for that assumption's default value.



3. Move the **Passenger Car Fuel Efficiency** slider bar to a new position and then click the **Apply Assumption Changes** button. Note how the values for the various **Annual Auto Emissions** charts changed accordingly. This is a good reminder that these assumption values are intentionally variable. They will change over time and from place to place. Make sure to research your own settings thoroughly to identify corresponding **Common Impacts** assumption values that will make most sense for your individual analyses.

4. Move the **TimeScope Time** slider bar to a new position and then click the **Apply Assumption Changes** button. You should see the values of all the charts for your current scenario change as

the set of built buildings is updated.

Reviewing the Common Impacts report

The Common Impacts Wizard generates a report called **Common Impacts Report** each time it runs. To access this report, click the **Reports** button on the **Scenario 360** toolbar and then double-click the report of interest to view it in your internet browser. The report is in HTML format. This allows you to click on links to access more information.

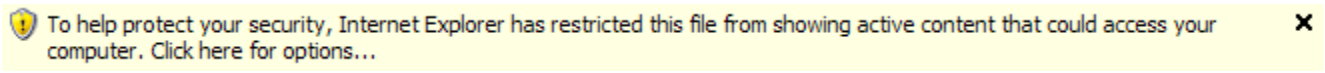
To get an updated report on Common Impacts results after you have changed any assumption settings, click the **New Report** button on the **Reports** form setup and select the **Common Impacts** report type.

Note that when you re-run the Common Impacts wizard, previous common impacts reports are overwritten. To save the report from a particular run, rename your old report before re-running the Wizard.

Active content in reports

Scenario 360 reports may contain **Active Content**.

NOTE: Active content uses Javascript code that may be blocked by your browser as a security precaution, so the active content in the report may be disabled when you open a report. You can usually tell when a browser is blocking active content by looking for a message at the top of your browser window. For example, Internet Explorer 8 displays a message like this at the top of the browser window:



To temporarily enable active content on this report only, right-click on the information bar and choose **Allow blocked content**. You will need to perform this step each time you open the report.

Active content includes buttons that allow you to expand or collapse individual sections of the report, and information boxes that appear when you hover your mouse over a chart.

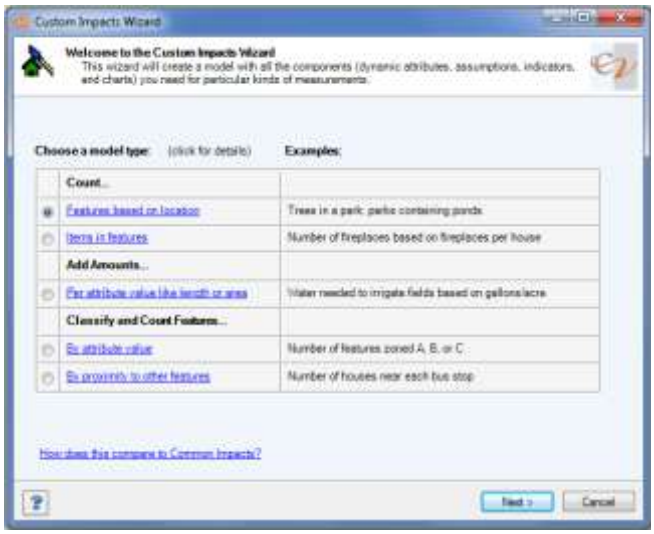
1. Click the **Expand** icon next to a heading to see the full contents of that section. Click the **Collapse** icon to show only the heading. You can expand or collapse all sections at once by clicking **Expand All** or **Collapse All** links at the bottom of the report.
2. To view chart, indicator, assumption and/or attribute descriptions, hover your mouse over the chart or component name in the listed tables.

To persistently enable active content for all files stored on your computer (such as these reports), you can change your browser's settings. See **Using the Common Impacts Report** in the Scenario 360 Help for detailed instructions.

To view the printer friendly version of the report, click the **Printer Friendly** button at the top of the report page. This will open a new window with smaller chart images better suited for printing. Note that all the collapsible sections in the report are open by default. If there is a report section you do not wish to print, simply click the **Collapse** icon for that section and it will be removed from the printed document. Once you are satisfied with the content you wish to print, click the **Send to Printer** button at the top of the printer friendly report.

Custom Impacts analysis

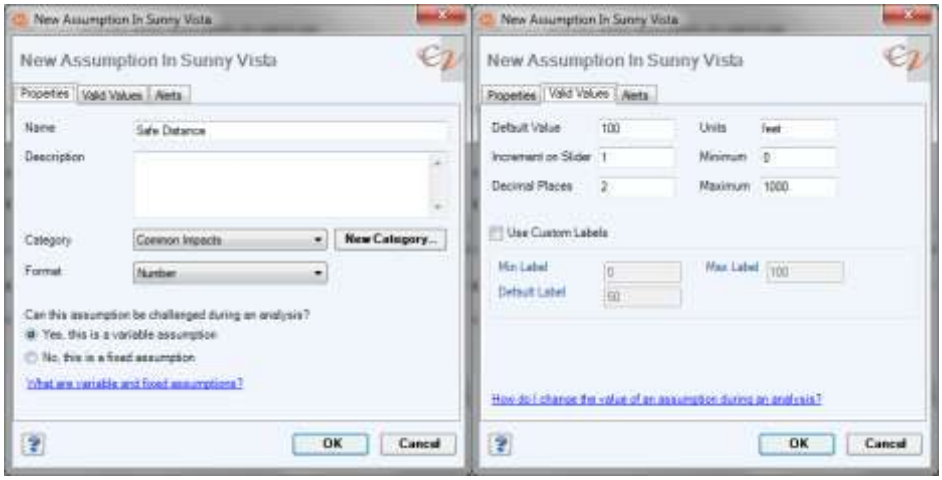
The Custom Impacts Wizard provides an easy way to set up certain kinds of analysis that are not included in Common Impacts or the Land Use Designer. For more specialized analyses you can set up everything yourself using 360 Setup tools, but Custom Impacts provides an intermediate level of sophistication. You can access the Custom Impacts Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list and select **Tools ▸ Custom Impacts Wizard.**



There are several different kinds of impact models available; for this exercise you'll create two.

Count buildings near wildlife corridors

1. On the Welcome screen, choose to **Count... Features based on location** and click **Next**.
2. On the Settings screen, specify
   - the layer containing features to be counted is ***Buildings***
   - the layer to be **near** (second radio button) is ***Wildlife Corridors***
   - for maximum distance considered near, use a **variable assumption**
3. In this case the assumption doesn't exist yet, so make one by clicking New Assumption.
4. Set up the assumption as follows:
   - On the Properties tab, Name: ***Safe Distance***
   - Accept all other defaults and click on the Valid Values tab
   - Set Min: ***0*** Default: ***100*** Max: ***1000*** Units: ***feet***
   - Accept all other defaults and click **OK**.



5. Back on the Settings screen, pick ***Safe Distance*** in the drop-down box for the assumption.
6. Click **Next** to review the components that will be used, then **Finish**.
7. Look at the charts to find **Buildings Near Wildlife Corridors**. This gives the default result.
8. Open the **Assumption** list from the Scenario 360 toolbar. Use the **Organize** button to find and display the ***Safe Distance*** assumption, which will be in the Common Impacts category.
9. Experiment with changes to ***Safe Distance*** by moving the slider bar and then clicking **Apply Changes**. Notice how Buildings Near Wildlife Corridors changes. Does it make sense?

Count parcels by land-use type

1. On the Custom Impacts Welcome screen, choose to **Classify and Count features by attribute value**. Click **Next.**
2. On the Settings screen, specify:

- Layer containing features to be counted is ***Parcels***
- Classify **automatically**
- Attribute upon which classification is based is ***LU Land Use Name***

3. Click **Next** and **Finish.**
4. Look at the new chart called **Count of *LU Land Use Name***. It shows the proportion of parcels of each land-use type. To see exact numbers, right-click the chart, choose **Chart Details**, and change the chart type from ***Pie*** to ***Bar***.

Congratulations – you have completed Tutorial 1

This concludes the tutorial for *Integrated analysis with decision tools*. You have run a suitability analysis, used the Land Use Designer to prepare sketch style paints for a land use plan, completed a build-out analysis, generated TimeScope projections for buildings based upon the suitability analysis and spatial characteristics, generated some common and custom impacts based upon the buildings layer and studied the combined results. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps.

Tutorial 2 – Explore an existing scenario

This tutorial walks you through exploration of an existing analysis. In this fictional example, a rural mountain valley is being considered for development. Two alternatives, or "scenarios", are being considered: a traditional large-lot residential housing development, and a village-style compact development with mixed uses of residences and retail establishments. Part of the analysis will compare road costs between the two scenarios. In addition, the analysis will study the suitability of building sites based on several factors: proximity to wetlands that cover part of the valley, proximity to a nesting site for a protected species of bird, and availability of water from water storage tanks that may or may not be at a high enough elevation to provide sufficient water pressure.

The tutorial will also walk you through using Scenario 360 Sketch Tools to paint feature attributes to other features and to clone features.

Once installed using the "Install the tutorial data" directions on page 1, you will find this analysis in the **CVFiles\Communityville** folder.

In this exercise, you will learn to:

- work with the ArcMap table of contents
- use variable assumptions
- view and use indicators and associated charts
- view and change attributes
- manipulate map features and layers
- compare two scenarios

Suitability and cost analysis of rural residential vs. village development

This tutorial illustrates one of the many kinds of analyses that are possible with Scenario 360 - suitability analysis. In the fictional town of Communityville, some locations are considered appropriate for building (suitable), while others are not. Some factors that might make a location unsuitable include being too close to a nesting site, lying in a wetland area, or having insufficient water pressure. In this tutorial you will experiment with all three.

Objective
Compare and evaluate rural residential development and village-style development in a rural mountain valley.

Issues

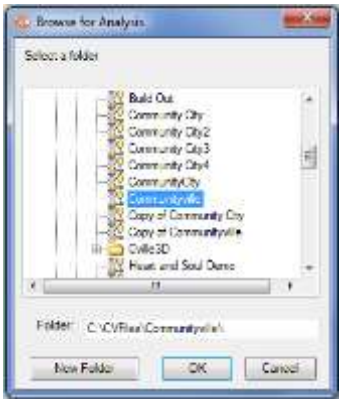
- Site suitability
- Road construction costs

Constraints

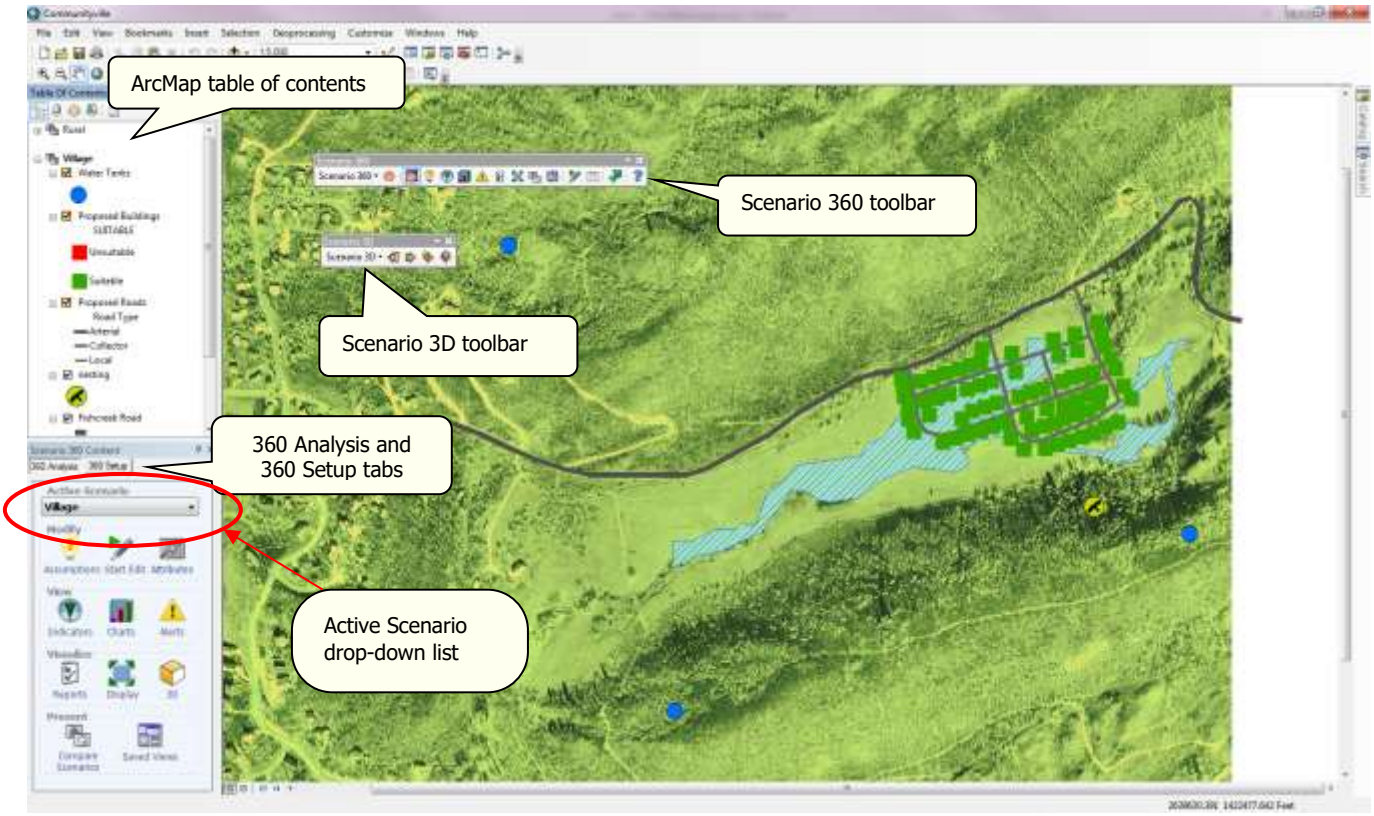
- Proximity to nesting location
- Proximity to wetlands environmental area
- Elevation of water storage tanks relative to dwelling units

Starting the tutorial

1. Start Scenario 360 by double-clicking on the Scenario 360 icon on your desktop.
2. On the Welcome to Scenario 360 window, click **Open Existing Analysis**.
3. Browse to the **CVFiles\Communityville** file, click the file, and click **OK**.
4. If you are asked whether to create indexes, answer **yes.**



The tutorial analysis will load in Scenario 360 and display a fictional place called "Communityville." Communityville is a high mountain meadow site being considered for development.



Note: If you are not seeing the data in the map view and red exclamation points are displayed next to your layers in the ArcMap table of contents, you probably installed your software in a non-standard location. When you open a map, ArcMap looks for the data referenced by each layer in the map. If it can't find the data source for a particular layer, that layer won't be drawn. It will display in the table of contents with a red exclamation mark next to its name and the check box next to the layer will be unavailable.

If you know the new location of the data, you can repair the layer by doing the following:

1. Right-click on the layer name, point to **Data**, and click **Set Data Source**.
2. Navigate to the directory containing the correct data source file, click the file, then click **Add**. ArcMap will attempt to find all data (if it is located in the same folder).

Working with ArcMap

These tutorials assume that you are familiar with using ArcMap navigation tools.

If you are unfamiliar with the ArcMap toolbar (shown below) and working with the map images, layers, and data sets, refer to the ArcMap help accessed via the ArcMap **Help** menu.

You can size the extent shown in the map view using the **Full Extent** or the **Fixed Zoom Out** buttons. You may also use the **Zoom In** or **Zoom Out** tools, just point, click, and drag your cursor, encircling the desired area of the map to shrink or enlarge it. You can refresh the map view by clicking the **Refresh View** button at the bottom left side of the map view.

Working with toolbars in ArcMap

Toolbars in ArcMap can be docked at the top, bottom, left, or right side of the ArcMap window. Alternatively, toolbars can float on the desktop while functioning as part of the application. When you dock a toolbar, it is

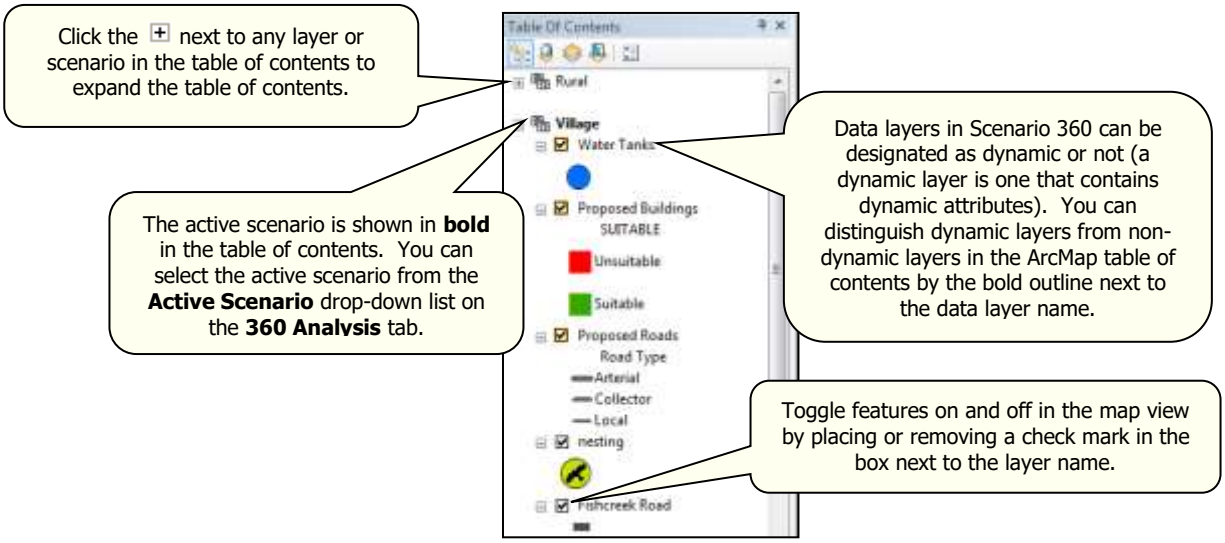
moved and resized with the application window. The Scenario 360 toolbar displays as a floating toolbar the first time you launch the Scenario 360 application.

- To move a docked toolbar, click the move handle and drag the toolbar to the new location.
- To move a floating toolbar, click on the title bar and drag the toolbar to the new location. Note: If you drag the toolbar to the edge of the program window, it becomes a docked toolbar. When you move one docked toolbar, this might affect the location and size of other toolbars on the same row.
- To prevent a toolbar from docking, hold down the **Ctrl** key while dragging it.
- You can close a floating toolbar by clicking the **x** in the upper right corner of the toolbar. You can open or close toolbars by clicking the **View** menu, pointing to **Toolbars**, and then clicking next to the toolbar name you wish to open or close.

You can learn what the toolbar buttons and menu commands do by positioning the mouse pointer over a button or menu command for a second or two. The name of the item will then pop up in a small box. Simultaneously, a brief description will appear in the status bar at the bottom of the application window.

The ArcMap table of contents

Examine the ArcMap table of contents and the symbols representing the various features displayed on the map.

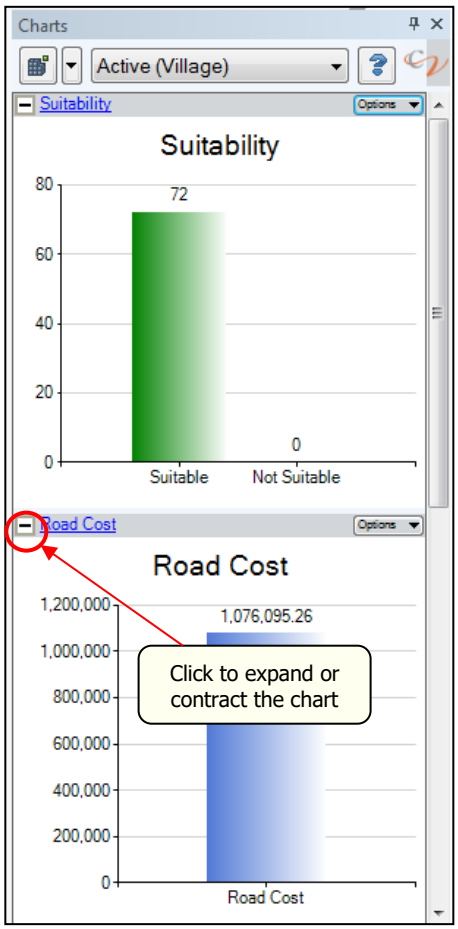


The ArcMap map view

On the map, note the wetlands area and the nesting location. The small green squares represent proposed dwelling units that would constitute a village-style development. The gray lines are roads. All of these features are "layered" over a .tif satellite image of the proposed development. You may toggle these features to change the display on the map by clicking on the check box to the left of the feature in the ArcMap table of contents. Take a few moments to toggle on and off some of the layers in the table of contents and practice using the zoom and extent tools.

Viewing charts

Indicators are impact or performance measures that can reference datasets anywhere in a scenario. They are used to provide an overall measurement and they apply to an entire scenario (as opposed to an attribute, which provides the individual characteristic of a map feature). Indicator values are automatically recalculated as you experiment with alternatives, and these values can be displayed in a chart. Indicators can help people choose alternatives that best match their objectives or desired outcomes. For example, an indicator might be used to evaluate costs, revenues, average household size, "community benefit," or total daily auto trips.



There are three indicators set up for this tutorial:

- Is suitable
- Is not suitable
- Road cost estimation

Charts are dynamically linked to assumptions and indicators. As changes are made in the analysis, chart displays will update automatically to reflect analysis results. Hatched areas on bar charts show the chart's previous value. Target lines may be included to demonstrate a particular goal or threshold. Charts can contain a single analysis value or many values from the same scenario. They can also display values from different scenarios for comparison.

If the chart view is not open (see image right), click the **View Charts** button on the Scenario 360 toolbar to display **Road Cost** and **Suitability** indicator charts. The **View Charts** toolbar button works as a toggle button. You can use it to toggle the chart view on and off. The charts window can be resized and moved around the screen for comfortable viewing. You can choose which scenarios appear in the charts by using the drop-down box at the top of the charts window.

Working with assumptions

An assumption is a value that is used as input to an analysis. They are often changeable, and they always apply to an entire scenario. Assumptions can be a way to express subjective inputs, such as how much weighting to give to a particular community value like open space or economic development.

An assumption can be designated as a numeric value within a valid range (as might be displayed in a slider bar) or as a choice (number, text, or Boolean – yes/no) associated with a defined set of valid values. A numeric assumption can be any number, rate, or standard (number of stories, gallons per household, cost per mile, % discount). "Choice" assumptions may represent a type (dirt, gravel, paved) or time frame (1990, 2000, 2010).

Assumptions can be referenced in any analysis formula. All analysis calculations that depend on an assumption value will be automatically recomputed if you modify that assumption value.

Variable assumptions

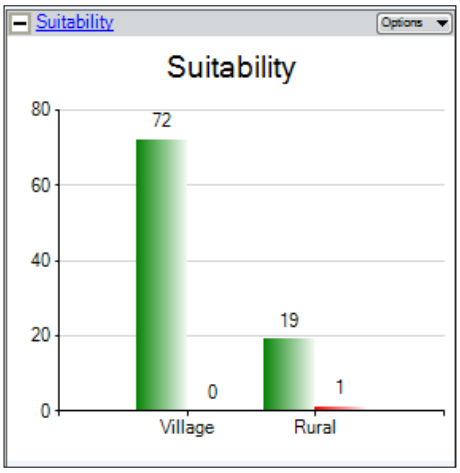
A variable assumption is an input to the analysis that might change as part of the analysis, such as the current interest rate, seasonal resource consumption values, residential density, or survey results. A variable assumption may be altered during analysis using a slider bar, choice button, or drop-down list (see image below), and it can vary across scenarios. Slider bars are excellent for setting relative weighting factors.

Fixed assumptions

A fixed assumption is an input to the analysis that will not likely change, such as the municipal water supply. A fixed assumption value cannot be altered and has the same value across all scenarios.

Changing assumptions for the acceptable distance to the nesting area

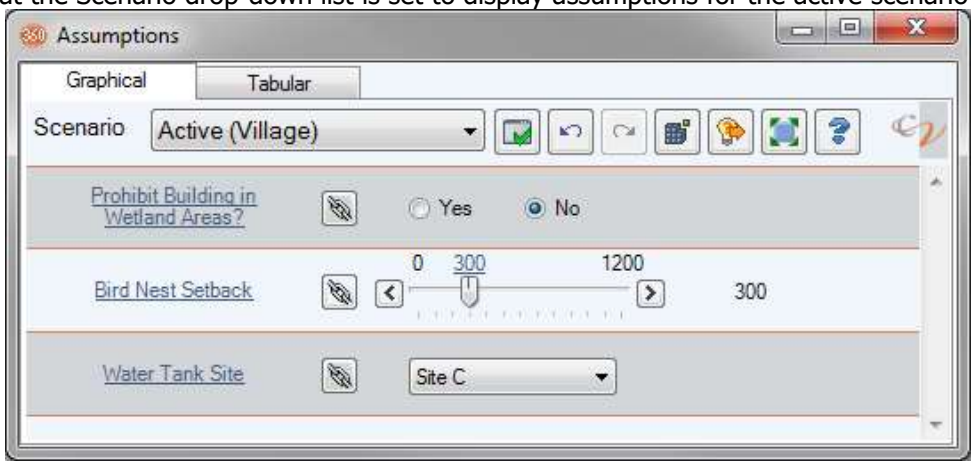
You will work with variable assumptions to change the minimum acceptable distance between the dwelling units and the nest of a protected species of bird. When the assumption was originally setup, the designers of the analysis set the default location to 300 feet. At that setting, all 72 proposed dwelling units in the Village scenario were found to be in suitable locations, as you can see from the map below (all building locations are colored green) and from the chart (72 suitable locations, 0 unsuitable ones in the Village scenario). (To make the chart show both scenarios, choose "Compare by All Scenarios" at the top of the charts window.)



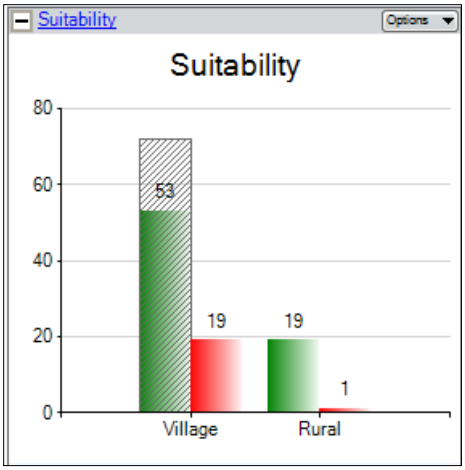
Working with the variable assumption Bird Nest Setback, you will change the assumption and dynamically update the suitability factor for the building locations in this proposed subdivision. These will be displayed on your map and chart. Start by zooming in or out to a map extent that lets you clearly see the individual buildings in the proposed village. Make sure all layers except "elevation" are visible (place a check in the box next to their name in the ArcMap table of contents).

1. To begin, make sure **Village** is the active scenario by selecting it from the drop-down list on the **360 Analysis** tab, if it isn't already.

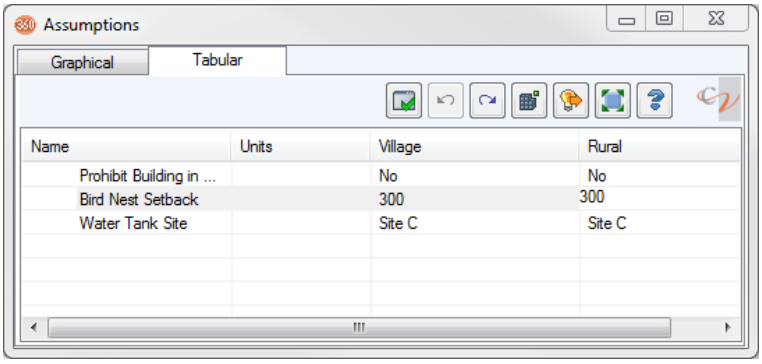
2. Click the **Assumptions** button on the **360 Analysis** tab to display the graphical assumptions view. Note that the Scenario drop-down list is set to display assumptions for the active scenario (Village).



3. You are going to change the acceptable distance from building locations to the nesting site. In this case, you want to explore suitability for building locations located no closer than 600 feet from the nesting site. Click and drag the Bird Nest Setback assumption slider bar to change the assumption value to 600 feet from the nesting site.
   -OR-
   Click the increase ‹ or decrease › buttons to change assumption value to **600** feet from the nesting site.
4. Click the **Apply Assumption Changes** button to apply your changes. Scenario 360 will update the scenario and dynamically change the suitability (from green to red) of all dwelling units located within 600 map units (which are set in feet) of the nesting site. Buildings in unsuitable locations turn from green to red. Notice the chart values showing number of suitable and unsuitable locations in the Village scenario change as well. Scenario 360 will display the previous value (before the assumption change) with gray diagonal lines. Remember, if you need to refresh the map view, click the **Refresh View** button at the bottom left side of the map view.



5. On the Assumptions display, click the **Tabular** tab. You can also use this dialog box to enter numbers and change assumptions. Notice that the table shows assumptions for both scenarios (Village and Rural) side by side.



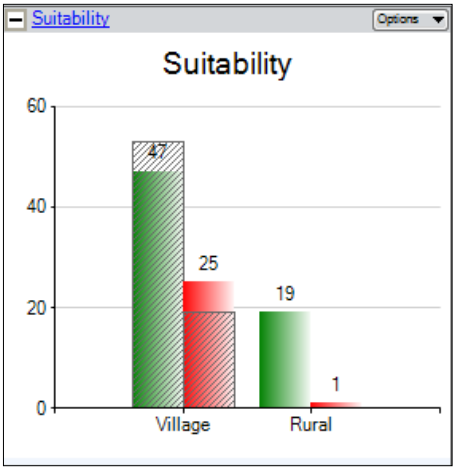
Depending on the type of values for the assumptions, you can type directly in the fields or select from a drop-down list.

6. Type **400** in the **Bird Nest Setback** for the **Village** scenario and click the **Apply Assumption Changes** button. Scenario 360 will update the scenario and dynamically change the suitability (back to green from red) of all dwelling units located farther than 400 feet of the nesting site. Notice the chart values change as well.
7. When you are finished, close the Assumptions window and click **No** when asked whether you want to save assumption changes.

Changing assumptions to prohibit building on wetlands

Now you will work with variable assumptions to change a yes/no assumption about whether building is allowed in the wetlands area. When the assumption was originally setup, the designers of the analysis set the default to **No** - therefore allowing (not prohibiting) construction in wetlands. This resulted in all 72 proposed dwelling units in the Village scenario were found to be in suitable locations. Working with the variable assumption **Prohibit Building in Wetlands?**, you will change the assumption and dynamically update the suitability factor for the building locations in this proposed subdivision.

1. Click the **Assumptions** button on the **360 Analysis** tab then click the **Graphical** tab to display the graphical assumptions view. Note that the Scenario drop-down list is set to display assumptions for the active scenario (Village).
2. Click the **Yes** radio button next to the **Prohibit Building in Wetlands?** assumption and click the **Apply Assumption Changes** button. Scenario 360 will update the scenario and dynamically change the suitability (from green to red) of all dwelling units located on or intersecting the wetland area. Notice also the chart values change as well.



3. When you are finished, close the Assumptions window and click **No** when asked whether you want to save assumption changes.

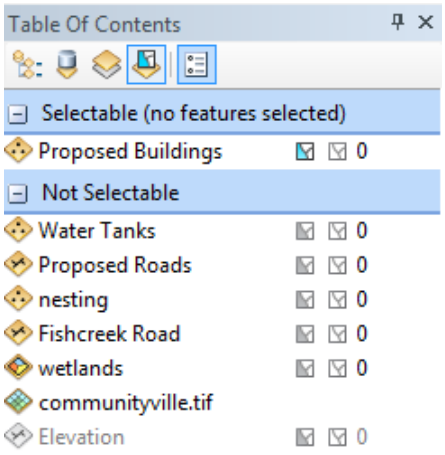
Working with the ArcMap map view

When analyzing alternative scenarios, you may want to consider moving features on a map. For example, you may want to move a building further away from a highway or protected area. In this tutorial you have designated a nesting area for a protected species of bird. In this exercise, you will move a building in the Rural scenario away from the nesting area to make it a suitable location for building.

You can move features by specifying delta, x, y coordinates, dragging the feature, or rotating the feature. In this exercise, you will move a building by dragging it to a new location. Dragging is the easiest way to move a feature if you know the general location; for more precise movement, use the delta, x, y coordinates method (instruction available in the ArcMap help).

Moving features in the map view to change suitability

1. Click the **Active Scenario** drop-down menu on the **360 Analysis** tab and select **Rural** as the active scenario.
2. Click the ArcMap **List by Selection** button (located at the top of the ArcMap interface). This will open a list of available layers that lets you choose which layers you want to select when editing. In this example, you want to select a building by drawing a box around it but you do not want to select the road or any of the features next to it. To avoid selecting multiple features, click on all layers with a **Selectable** symbol except for the **Proposed Buildings** layer. All layers other than Proposed Buildings should have a **Non Selectable** symbol.



3. Click the **Start Scenario Editing** button on the Scenario 360 toolbar or click **Start Edit** on the **360 Analysis** tab.
4. Select **Rural** as the scenario you wish to edit and click **Edit.** Note that your cursor display changes to a pointer and the ArcMap **Editor** toolbar is displayed (shown below as floating – for more information on floating and docked toolbars, see "Working with toolbars in ArcMap" on page 27).

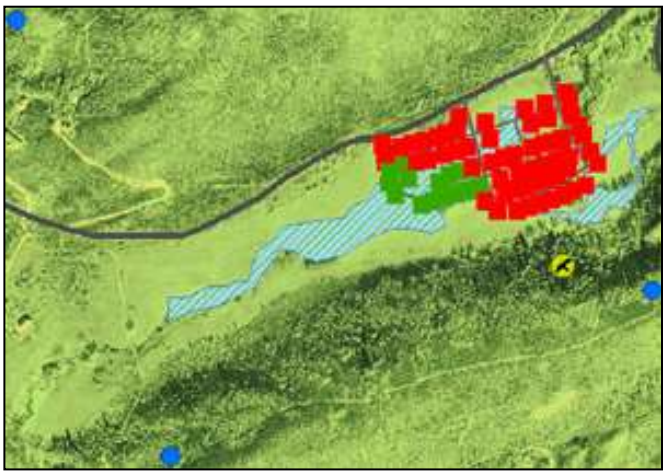
5. Drag a small box around a building colored red (it is displayed in red because it is in too close to the nesting area). ArcMap will highlight the selected feature and place crosshairs on it.
6. Place your mouse cursor over the crosshairs on the building, click on it, and drag the building North and East to a new location further away from the nesting area. When you stop dragging, you will see the building turn green to indicate it is now in a suitable location. The charts will also change very slightly.
7. Click **Stop Scenario Editing** on the Scenario 360 toolbar or **Stop Edit** on the **360 Analysis** tab and answer **No** when asked if you want to save your edits.

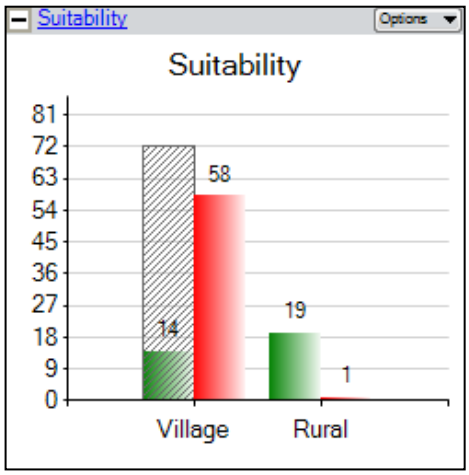
Changing water tank location assumptions to determine water pressure suitability

In this analysis there are three possible locations (Site A, Site B, or Site C) for a water tank. The proposed development sits in a high mountain valley, so water pressure can be a problem. In this fictional analysis, it has been determined that a suitable building site must be at least 60 feet below a water tank. To see how this works, you will experiment each of the three possible water tank locations in the Village scenario and see how the building site suitability changes. You may want to zoom out on the map so that you can see all three potential sites for water tanks.

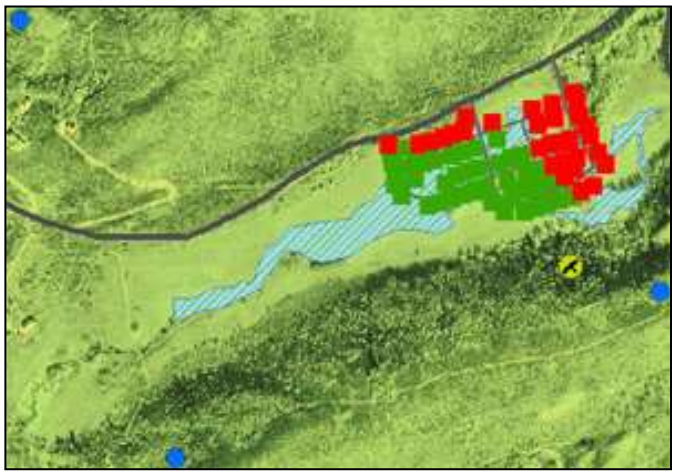
1. Click the **Active Scenario** drop-down menu on the **360 Analysis** tab and select **Village** as the active scenario.
2. Click the **Options** menu on both charts and select **Clear Previous Values** to clear all previous values from each charts.
3. Click the **Assumptions** button on the **360 Analysis** tab to display the graphical assumptions view.
4. Click the drop-down list for the **Water Tank Site** assumption, select **Site A**, and click the **Apply Assumption Changes** button. Scenario 360 will update the scenario and dynamically change the suitability (from green to red) of all dwelling units located higher than an imaginary threshold of 60 feet below the tank at Site A. Try the same experiment with Site B.

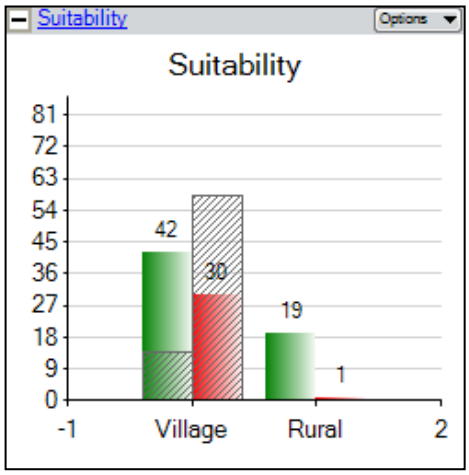
Site A





Site B





5. If desired, you can experiment with moving water tank locations using the techniques you used to move buildings in the exercise "Moving features in the map view to change suitability" on page 33.

6. When you are finished, close the Assumptions window and click **No** when asked whether you want to save assumption changes.

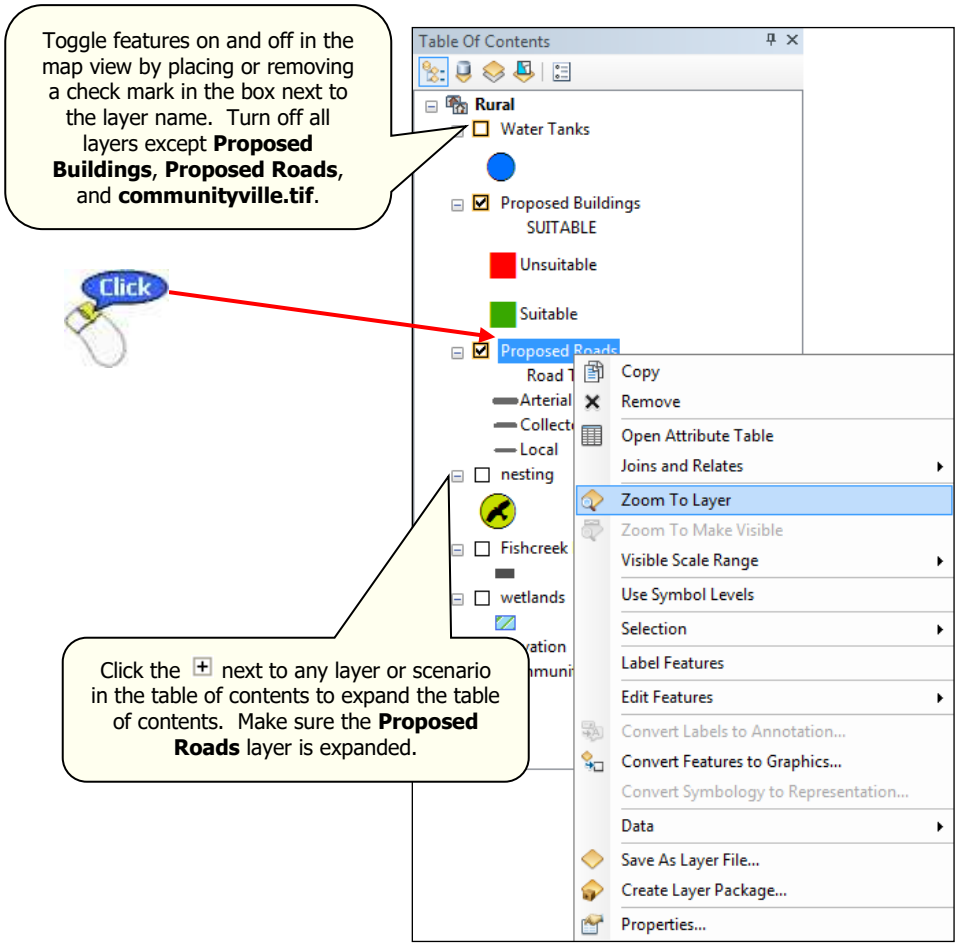
This concludes the suitability portion of the tutorial. You have seen how changing assumptions and moving features on the map can drive changes in indicators illustrated in charts. The suitability of each building is a dynamic attribute that you have seen change based on the analysis you experimented with.

Running a road cost analysis

In this exercise you will experiment with changing road construction costs in the Rural scenario. You will change the type of road proposed and then (optionally) change the costs per linear foot in the "Attribute Road Cost" lookup table.

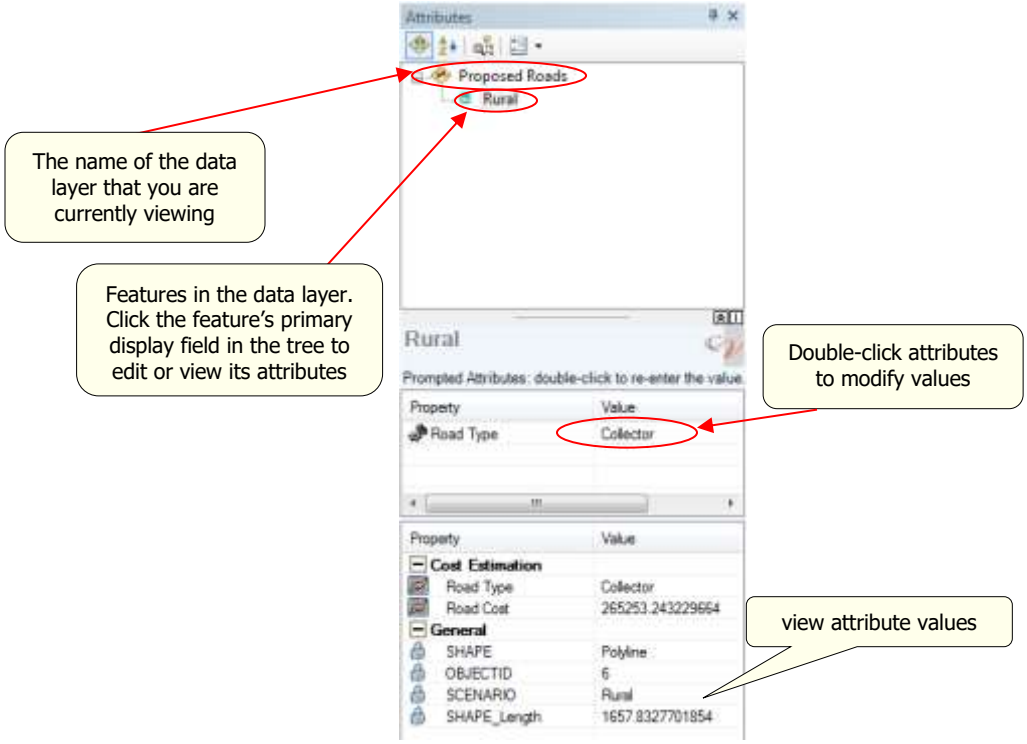
Evaluating road costs by experimenting with changing the road type

1. Click the **Active Scenario** drop-down menu on the **360 Analysis** tab and select **Rural** as the active scenario. You may find you want to zoom out a little to see all of the houses.
2. In the ArcMap table of contents, turn off all the layers in the display except **Proposed Buildings**, **Proposed Roads**, and **communityville.tif**.
3. Right-click on **Proposed Roads** in the ArcMap table of contents and click **Zoom to Layer** on the pop-up menu.
4. Expand the **Proposed Roads** layer in the ArcMap table of contents. Note that there are three types of streets in the **Proposed Roads** layer: arterial, collector, and local. Each type has its own construction cost.

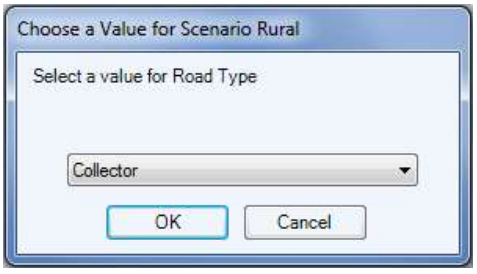


5. If the chart view is not open, click the **View Charts** button to display **Road Cost** and **Suitability** charts. Click the **Options** menu on both charts and select **Clear Previous Values** to clear all previous values from the charts.
6. Click the ArcMap **List by Selection** menu (located at the top of the ArcMap interface). This will open a list of available layers that lets you choose which layers you want to select when editing. In this example, you want to select a road by but you do not want to select the buildings or any of the features next to it. To avoid selecting multiple features, make sure all layers except the **Proposed Roads** layer are **Non Selectable** .

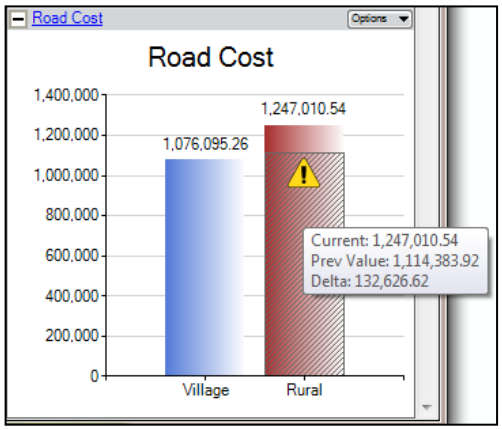
7. To view or change feature attributes you must first be in **Edit Mode**. Click the **Start Scenario Editing** button on the Scenario 360 toolbar, select **Rural** as the scenario you wish to edit and click **Edit.** Note that your cursor display changes to a pointer and the ArcMap **Editor** toolbar is displayed.
8. Click on the road illustrated below to select it. On selection, the road will turn a different color.
9. Click the **View or Change Feature Attributes** button on the **Scenario 360** toolbar to display the **Attributes** for the feature you selected, in this case the *Collector* road type.



10. In the Prompted Attributes pane, double-click on **Road Type**. This will launch a prompt box with a drop-down list of options.

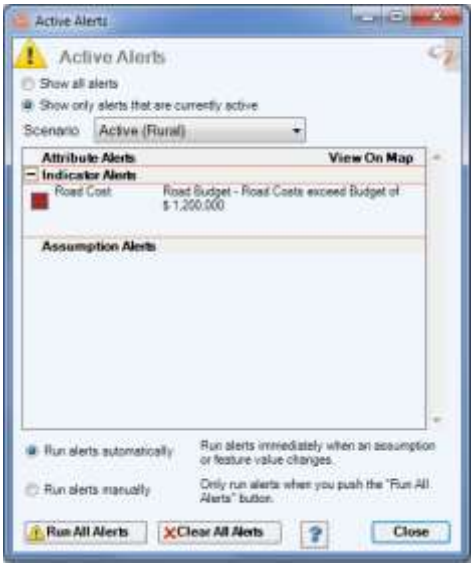


11. Click the Road Type drop-down list, select **Arterial** from the drop-down list, and click **OK**. You have just changed that road from a medium-sized "collector" road to a larger "arterial" type, which costs more per unit of length. Scenario 360 will update the Attributes window and the road feature you selected in the map view. The program will also dynamically update the Road Cost chart to reflect the new, higher cost, and display the previous value with gray diagonal lines. You can see exact information by hovering your mouse cursor (pausing for a second or two) over the bar in the chart.



12. Close the attributes window.
13. Notice that an alert appears on the chart indicating that a pre-established threshold has been crossed – in this case, a roads budget. Hover your mouse cursor over the chart bar for more information on chart values.

You can set alerts to notify you if a goal, target, threshold, or constraint condition has been reached. An alert may be associated with an assumption, a dynamic attribute, or an indicator. An alert is used to monitor values during analysis and reports if specific conditions occur. Alerts may be displayed as a chart with (colored) target bars, an alert message, or as a feature color on a map. An alert has been set in this analysis to indicate that the roads budget threshold has been crossed.



14. Click once on **Alerts** on the **360 Analysis** tab to view more information about the alert you have just triggered. Clear the alert by clicking the **Clear All Alerts** button then click **Close**.

15. Click the **Stop Scenario Editing** button on the Scenario 360 toolbar and click **No** when prompted to save your changes.

Comparing scenarios

This tutorial analysis contains two scenarios. Each scenario represents a different decision-making alternative. Scenario 360 includes a powerful scenario comparison display feature that will allow you to view any combination of maps, images, and/or charts side by side.

1. Make sure that **Proposed Buildings**, **Proposed Roads**, and **communityville.tif** are visible (checked on in the ArcMap table of contents).
2. If the chart view is not open, click the **View Charts** button to display **Road Cost** and **Suitability** charts. Click the **Options** menu on both charts and select **Clear Previous Values** to clear all previous values from the charts.
3. Click the **Compare Scenarios** button on the Scenario 360 toolbar or click **Compare Scenarios** on the **360 Analysis** tab.
4. Use any of the tools described below to modify the map view. When you are finished, close the Scenario Comparison window.

The scenario comparison window includes a toolbar that will allow you to move around the map view, link map extents, and select layout options.

Sometimes just looking at a map isn't enough. You can use the ArcMap **Identify** tool to display all the attributes of a map feature. Click the tool then click on a map feature in the scenario comparison view.

Use the **Pan Map** tool to investigate different areas and features of your map view. Click the tool, move the hand over the map display, and click and drag the hand.

Use the **Zoom In**, **Zoom Out**, and **Zoom to Full Extent** tools to investigate different areas and features of your map view. Click the tool, move the mouse pointer over the map display and click once to zoom around a point in the map view. Alternatively, click and drag a rectangle defining the area you want to zoom in or out on.

Use this **Link Map Extents** tool to synchronize the map extents (zoom and pan settings) shown in the scenario comparison window with one another and with those in the ArcMap map view.

Click the **Select Layout** tool to open an extended toolbar button set of layout options. You can choose from a variety of layout options or customize your window using standard window resize controls (change the width or height of any section of the window by clicking and dragging a border to the desired location). Scenario 360 will "remember" your last saved settings and will display the scenario comparison window as you saved it each time you open the window.

Task menu options are available by clicking the **Scenario comparison tasks** button or by right-clicking on a map, chart, or image in the scenario compare view.

Scenario comparison features

- The **Edit in ArcMap** tool is available from the **Scenario comparison tasks** menu or by right-clicking on a map. This tool allows you to activate a scenario and begin editing it in ArcMap. This will close the Scenario Comparison window and start an ArcMap edit session.
- The **Compare Scenarios** button on the Scenario 360 toolbar or **Compare Scenarios** on the **360 Analysis** tab options work as toggle buttons. Click either one to turn the Scenario Comparison window on or off.

Congratulations – you have completed Tutorial 2

This tutorial has taken you through a sample analysis using Scenario 360. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps. Tutorial 3 will walk you through the process of setting up a new analysis which you will then be able to explore.

Tutorial 3 – Setting up and running an analysis

This tutorial is based on a fictional urban environment called Community City. In this tutorial, you will set up an analysis to look at the cost implications of adding various structures to a proposed development area. This development envisions a new mixed-use development that includes retail, residential, and office buildings. The analysis will include studying the jobs to population balance for various combinations of retail, residential, and office buildings. You will also explore the construction costs inherent in adding more space.

This tutorial will take you through the basic steps for setting up a new analysis in Scenario 360. You will learn to:

- create a new analysis
- define a projected coordinate system
- create a new base scenario
- add data layers
- create, modify, and chart assumptions
- setup and work with dynamic attributes and formulas
- create and chart indicators
- define and display alerts
- add features

Objective

Evaluate commercial development options for a mixed-use development.

Issues

- Population densities
- New jobs
- Construction costs

Starting a new analysis

1. If you haven't already, start Scenario 360 by double-clicking on the Scenario 360 icon on your desktop. If Scenario 360 is open, click the **Start a Scenario 360 Analysis** button on the Scenario 360 toolbar.
2. On the Welcome to Scenario 360 window, click **Create New Analysis** .
3. Select **Create new empty analysis** and click **Next**.
4. In the **Analysis Name** field, type **Community City**.
5. In the **Description** field, type **My practice analysis for a tutorial** and click **Next**.
6. Accept **Base Scenario** as the base scenario name.
7. In the **Description** field for the Base Scenario, type **Original proposal**, click **Next**, then click **Finish**. Scenario 360 will update your files and create your new analysis folders.

Prepare your data

Although prepared data is provided for these tutorials, you will need to get your own data into a projected coordinate system such as UTM or State Plane when you are ready to do your own analysis. If you are unfamiliar with coordinate systems, refer to ArcGIS help.

Adding data

In ArcGIS, geographic information is displayed on a map as **layers**. Each layer represents a particular type of feature such as streams, lakes, or highways. A layer doesn't store the actual geographic data; instead, it references the data contained in coverages, shapefiles, geodatabases, CAD files, images, grids, and so on. Referencing data in this way allows the layers on a map to automatically reflect the most up-to-date information in your GIS database.

Scenario 360 allows you to select additional datasets (e.g. photos, lookup tables, census data, models, and other non-geographic data) from which to create layers, and allows you to examine properties of the attributes contained in each dataset.

Adding existing data layers

There are several sources from which to retrieve data for your analysis. For this tutorial, you will use some CommunityViz provided data layers, and also create some of your own data.

1. Click the 360 Setup tab Work Flow view.
2. Click once on **Data** 

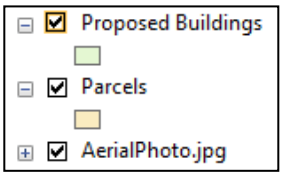
to open the data list.
3. Click the **Add Data** button.
4. Select **Existing Data Layer** and click **Continue**.
5. Browse to **CVFiles/Tutorial 3** (You may need to add CVFiles to your Folder Connections in ArcGIS 10.

   To do this, click the **Connect to Folder** button and browse to your **CVFiles** folder and click **OK**. Now that you have connected the folder, you can browse to **Tutorial 3**.)
6. While holding down the **Shift** key, click to select both available data layers, then click **Add**. Scenario 360 will add the data to your analysis. If you are asked whether to "Create pyramids," say yes. You will see an aerial photo and parcels in your map view. These are representative of data you might get from other sources in a real analysis.

Adding a new empty data layer

Next you will create your own data layer by adding a new, empty dynamic layer for proposed new buildings. Later in this tutorial, you will sketch new buildings into this layer.

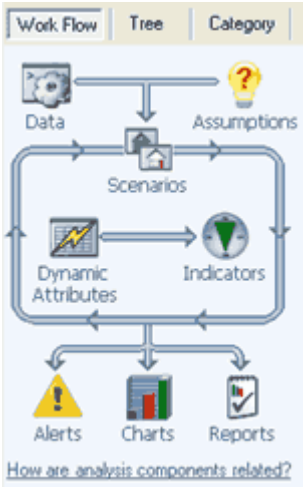
1. Click the **Add Data** button on the data list (if you closed the data list, you can reopen it from the 360 Setup tab Work Flow view, Data icon).
2. Select New Data Layer and click Continue.
3. In the Name field, type Proposed Buildings.
4. In the Description field, type Proposal for new buildings.
5. Click the Layer Type drop-down list and select Polygon.
6. Leave **Link all scenarios** unchecked.
7. Click OK. Scenario 360 will add your new layer to the ArcMap table of contents. Note that the check box in the ArcMap table of contents has a bright outline, indicating that this is a dynamic layer. It is also represented with a different icon in the data list. Close the data list. You have completed the steps of adding data layers to your analysis.



Working with 360 Setup tab

The 360 Setup tab is used to access all of the tools and information you need when setting up an analysis.

When thinking about an analysis, you can think of it as something with inputs, calculations, and outputs - as displayed in the Work Flow view (shown in the image right). You can follow the steps suggested by the flow chart to set up your analysis.



Input

- **Data** are inputs that consist of map layers and tables.
- **Assumptions** are inputs that are user-defined inputs used in an analysis. They are often changeable.

Calculations

- An analysis can contain one or more alternative **scenarios**. Scenarios are alternative viewpoints of an analysis. Each scenario has distinct input settings and outputs, but identical calculation rules.
- **Attributes** are properties or characteristics of map features. A **dynamic attribute** is an attribute that is automatically or manually updated as changes are made in the analysis using the unique capabilities of Scenario 360.
- **Indicators** are impact or performance measures. They are calculated output values that can reference data sets anywhere in the scenario. They are used to provide an overall measurement for a scenario (as opposed to an attribute, which provides the individual characteristic of a map feature).

Output

- **Alerts** are thresholds, defined by you, that are associated with particular assumptions, dynamic attributes, or indicators. Alerts let you know if a scenario value is outside of a specification.
- **Charts** are a graphical way of looking at indicators or assumptions.
- **Reports** summarize the inputs, calculations, and outputs of one or more scenarios.

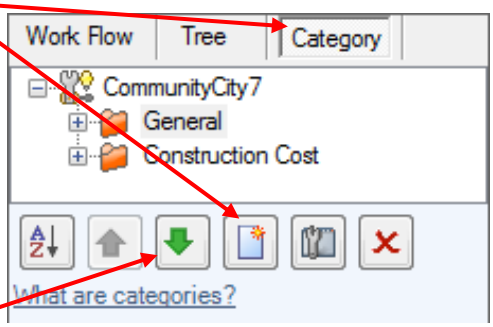
You can use the **Work Flow**, **Tree**, or **Category** view when setting up your analysis.

Creating a new category

Categories are a convenient way to organize a complex analysis by creating groups of information that can be applied across all indicators, assumptions, attributes, and charts. Use categories to filter, sort, and keep track of groups of information.

You can create and name your own categories. In this tutorial, you will create and utilize a **Construction Cost** category that includes all of the indicators, assumptions, attributes, and charts that apply to your work on construction costs in the analysis.

1. Click Category on the **360 Setup** tab.
2. Click the **New Category** toolbar button.
3. Type Construction Cost as the new category name and click OK.



Reordering categories

Category order is reflected in category lists throughout the analysis as well as in reports. In this analysis, you will use the General category for most of your analysis components. You can put that category at the top of the list for easy access when creating components.

1. Click once to select the General category.
2. Click the **Move Category Up** button.

Creating assumptions

Assumptions in a scenario can be defined as fixed or variable. A variable assumption is an input to the analysis that might change as part of the analysis, such as the current interest rate, seasonal resource consumption values, or residential density. A variable assumption may be altered (using a slider bar or other method) during analysis and can vary across scenarios. For more information on assumptions, see "Working with assumptions" on page 29.

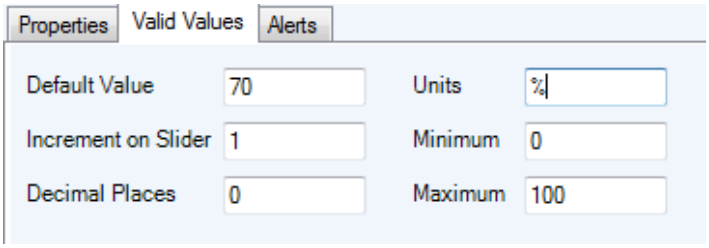
In this exercise, you will set up assumptions about how much of the floor space in the proposed new buildings will be used for each purpose. These will be variable assumptions that you will be able to change later. You will create three variable assumptions: Residential Ratio, Retail Ratio, and Office Ratio.

Creating the Residential Ratio variable assumption

The first variable assumption is called "Residential Ratio." It represents the percentage of floor space that will be dedicated to residential use.

1. Click once on **Assumptions** on the 360 Setup tab **Work Flow** view.
2. Click the **New Assumption** toolbar button.

3. In the **Name** field, type **Residential Ratio**. (Note that ( ) [ ] { } : , " ', tab, return, leading or trailing spaces are not allowed in assumption names.)
4. In the **Description** field, type **Percentage of floor space dedicated to residential use**.
5. Accept **General** as the **Category**.
6. Accept **Number** as the **Format**.
7. Accept the selection **Yes**, this is a variable assumption.



8. Click the **Valid Values** tab.
9. Type **70** in the **Default Value** field, indicating that unless the assumption is changed, 70% of the new floor space will be residential. This will be the default display value.
10. Type **%** in the **Units** field.
11. Accept the default of **1** for the **Increment on Slider**. This number represents the number of units traveled each time you click on the slider increase or decrease buttons when experimenting with the assumption values.
12. Accept **0** as the **Minimum value**.
13. In the **Decimal Places** field, type **0**.
14. Accept **100** as the **Maximum.** Leave Use Custom Labels unchecked and click **OK**.

Creating the Retail Ratio variable assumption

1. If you closed the assumptions list, click once on **Assumptions** on the **360 Setup** tab **Work Flow** view.
2. Click once on the **Residential Ratio** assumption in the assumption list to select it then click the **Duplicate** button. This will create a new assumption with the same properties and values as the Residential Ratio assumption. Any of the new assumption values or properties can be modified as you wish.
3. In the **Name** field, type **Retail Ratio**.
4. In the **Description** field, type **Percentage of floor space dedicated to retail use**.
5. Click the **Valid Values** tab.
6. Type **10** in the **Default Value** field, indicating that unless the assumption is changed, **10%** of the new floor space will be retail. This will be the default display value.
7. Accept all other fields and click **OK**.

Creating the Office Ratio variable assumption

1. If you closed the assumptions list, click once on **Assumptions** on the **360 Setup** tab **Work Flow** view.
2. Click once on the **Retail Ratio** assumption and click the **Duplicate** button.
3. In the **Name** field, type **Office Ratio**.
4. In the **Description** field, type **Percentage of floor space dedicated to office use**.
5. Click the **Valid Values** tab.
6. Type **20** in the **Default Value** field, indicating that unless the assumption is changed, **20%** of the new floor space will be office space. This will be the default display value.
7. Accept all other fields and click **OK**.
8. Close the assumptions list.

Editing assumptions (optional)

You have finished setting up the variable assumptions for the analysis. If you want to make changes however, you can.

1. Open the assumptions list.
2. Double click on any assumption.

3. Change properties, valid values, and alerts. In this exercise, accept the properties defined in the previous exercises and close the assumptions list.

Creating dynamic attributes and associated formulas

A dynamic attribute is an attribute that is updated as changes are made in the analysis using the unique capabilities of Scenario 360. A formula is associated with each dynamic attribute. The formula specifies how the attribute is calculated.

Dynamic attribute formulas

Formulas are expressions that specify how the elements of an analysis depend upon one another. They are statements in an equation of facts, rules, principles, or other logical relationships. The ability of Scenario 360 to calculate values dynamically, using formulas, is a powerful and unique tool; it enables you to make changes in your analysis and see the results immediately.

Types of formulas

- **Attribute formulas** specify the value of dynamic attributes, which are changeable characteristics associated with particular features on the map. Example attributes include name of a road, number of children living in a house, or taxes for a particular lot. Attribute values are usually found by looking at symbols on a map or by clicking on a particular feature to open its attribute table.
- **Indicator formulas** specify the value of indicators, which quantify information that pertains to a scenario as a whole. Example indicators include cost of roads, number of school-age children in a neighborhood, or town tax revenues.

For example, an attribute formula might be used to calculate the cost of each proposed road feature on a map by multiplying the length of the road times the cost per square foot. An indicator formula might be used to sum the total costs for all roads in a scenario by adding the above attribute values.

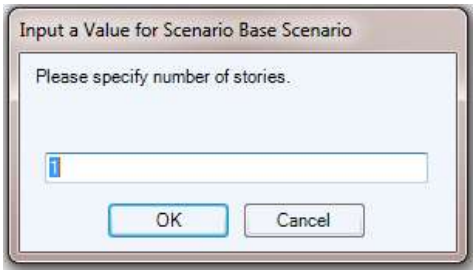
In the following exercises, you will be creating new dynamic attributes and attribute formulas using a variety of options for creating formulas. You will create indicators and indicator formulas later in this tutorial.

Using the Formula Wizard to create a prompted dynamic attribute

Recall that you created a new, empty layer called **Proposed Buildings**. During analysis, a user will sketch new buildings on the map. You want the software to "ask" the user how many stories tall the building is by displaying a small dialog box each time a new building is created. This is known as a "prompted" attribute.

1. Click once on **Dynamic Attributes** on the **360 Setup** tab **Work Flow** view.
2. Click the **New Attribute** button.
3. In the **Name** field, type **Stories**.
4. In the **Description** field, type **Prompts the user to enter the number of stories for new buildings**.
5. Accept **General** as the **Category**.
6. Click the **Layer** drop-down list and select **Proposed Buildings**.
7. Accept **Number** as the **Attribute Type** field.
8. Leave the **Units** field blank.
9. In the **Decimal Places** field, type **0**. Leave the Auto-Statistics box unchecked.
10. Click the **Formula** tab.
11. Click the **Formula Wizard** button. The Formula Wizard assists you in constructing the most common types of analysis formulas.
12. Attributes can be designated as numeric, yes/no, or text. Each of these attribute types include different options when constructing formulas in the Formula Wizard. You are going to be creating a formula function that prompts a user when creating buildings to enter a number (the number of stories in building). Select the **Prompt for a number** option and click **Next**.

13. Select the **Prompt for a specific numeric value** option and click **Next**.
14. In the **Question or statement for prompt field**, type **Please specify number of stories**.
15. Click to place a check mark in the **Provide Default Value** box and type **1** in the field provided.
16. Notice that the program displays your entries in the **Preview of prompt** window as well as a preview of the formula in progress. Click **Next**.
17. Click **Finish** but do not close the attribute creation window.



Creating an alert

You can create an alert to notify users when they create a building that is over 10 stories tall.

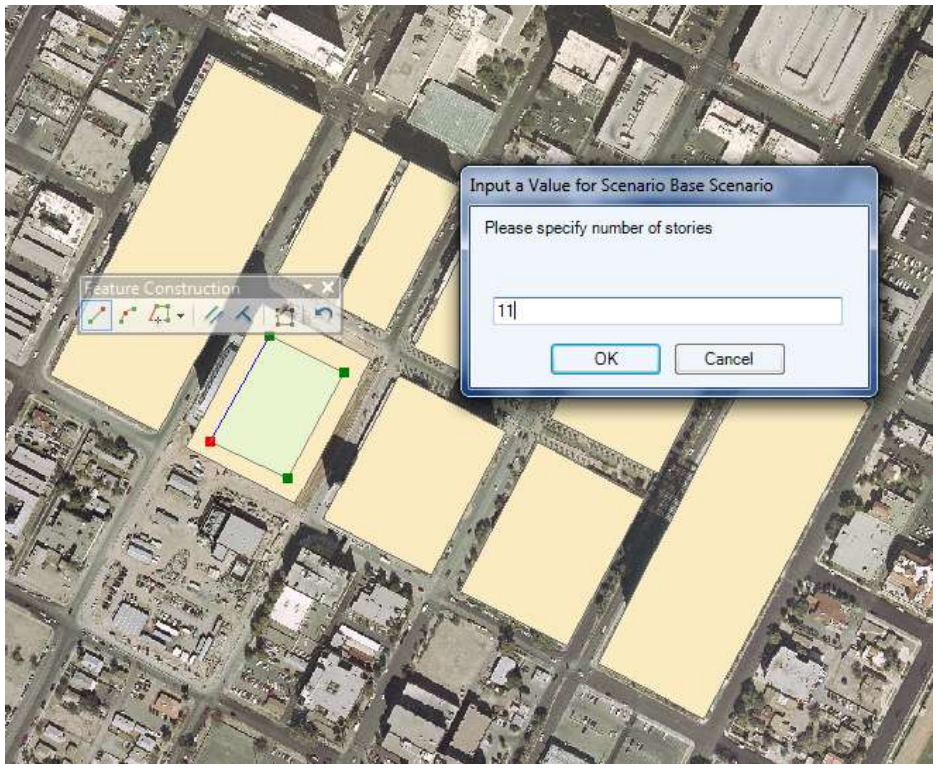
1. Click the **Alerts** tab in the attribute creation window.
2. Click **New**.
3. In the **Alert Name** field, type **Too Tall**.
4. In the **Description** field, type **Building is more than 10 stories tall**.
5. In the **If Stories is** operator drop-down list, select **>** (greater than) in the first box and type **10** in the next box.
6. In the **Display the following messaging in a popup window** field, type **This building is more than 10 stories tall**.
7. Accept the default Alert Color and click **OK**. Click **OK** to close the attribute creation window.

Testing your new formula and alert

You can sketch a new building in your map view and watch your new formula at work.

1. Using the ArcMap zoom tools, zoom in on the parcels area of the map view.
2. Make sure the symbology in the table of contents for the **Proposed Buildings** layer is a noticeable color. If it isn't, you can double click on the symbol, click the **Symbology** tab, and select a new color.
3. Start an editing session by clicking the **Start Scenario Editing** button on the Scenario 360 toolbar.
4. Make sure the **Proposed Buildings** layer is the only selectable layer in the **List by Selection** menu.
5. Click on **Proposed Buildings** in the **Create Features** window.

6. Use the ArcMap Construction tools to draw a large polygon in one of the parcels to represent the footprint of a potential new building (see image at right). Click to create each point, when you have finished creating your points, double-click on the last point to complete the polygon.
7. When prompted, type **11** in the Stories field and click **OK**.
8. Because you exceeded the threshold you set (buildings cannot be more than 10 stories tall), the new building is displayed with a red border around it.



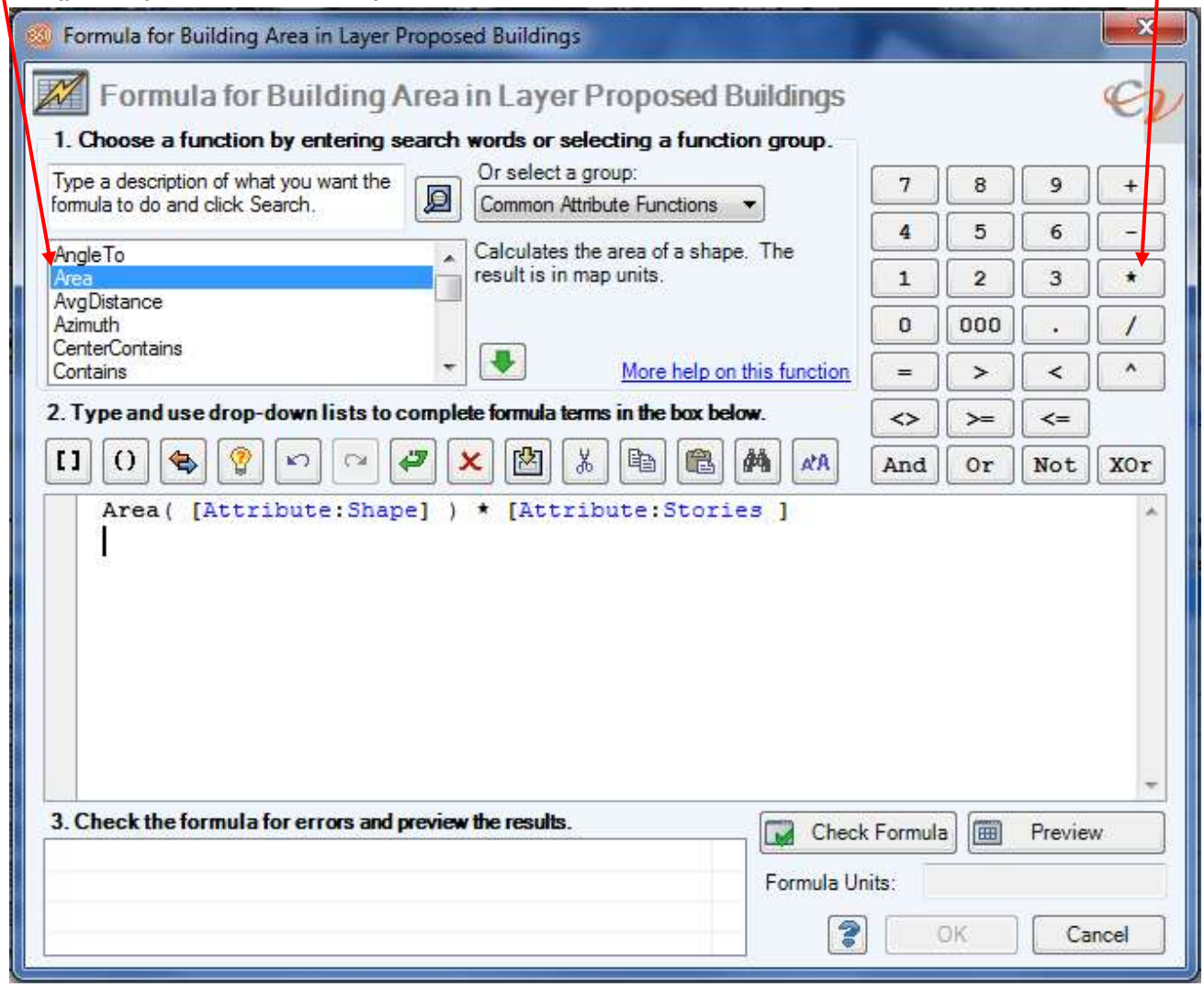
9. Click the **Stop Scenario Editing** button on the Scenario 360 toolbar and click **Yes** to save your edits.
10. Click the **List Alerts** button on the Scenario 360 toolbar to view the alert notification, then close the list alerts window.

Using the Formula Editor to create a dynamic attribute

You can create a dynamic attribute in the proposed buildings layer that will calculate the area of a building in square feet.

1. From the attributes list click the **New Attribute** button (if you closed the attributes list, you can reopen it by clicking **Dynamic Attributes** on the **360 Setup** tab **Work Flow** view).
2. In the **Name** field, type **Building Area**.
3. In the **Description** field, type **Total area of building in square feet, including all floors**.
4. Accept General as the **Category**.
5. Click the **Layer** drop-down list and select **Proposed Buildings**.
6. Accept **Number** as the **Attribute Type** field.
7. Leave the **Units** field blank (this will be calculated for you).
8. In the **Decimal Places** field, type **0**.
9. Click the **Formula** tab.
10. Click the **Edit Formula** button. The **Formula Editor** will be used to create this formula. Conceptually, the formula is simple: multiply the area of the building's footprint by the number of stories.

11. Double-click **Area** in the function list. You will see the text appear in the formula box. For detailed information on the Area function, click the **More help on this function** link.
12. Using the Formula Editor keypad, click the multiplication sign *.
13. Click the Insert Analysis Component button [ ] on the Formula Editor toolbar.
14. Double-click on **Attribute** on the pop-up menu, then double-click on **Stories** on the pop-up menu (you may have to scroll down).



15. Your new formula should read:
Area ([Attribute:Shape]) * [Attribute:Stories]
16. Click **Check Formula**, then click **OK**. Click **OK** again to close the New Attribute window.

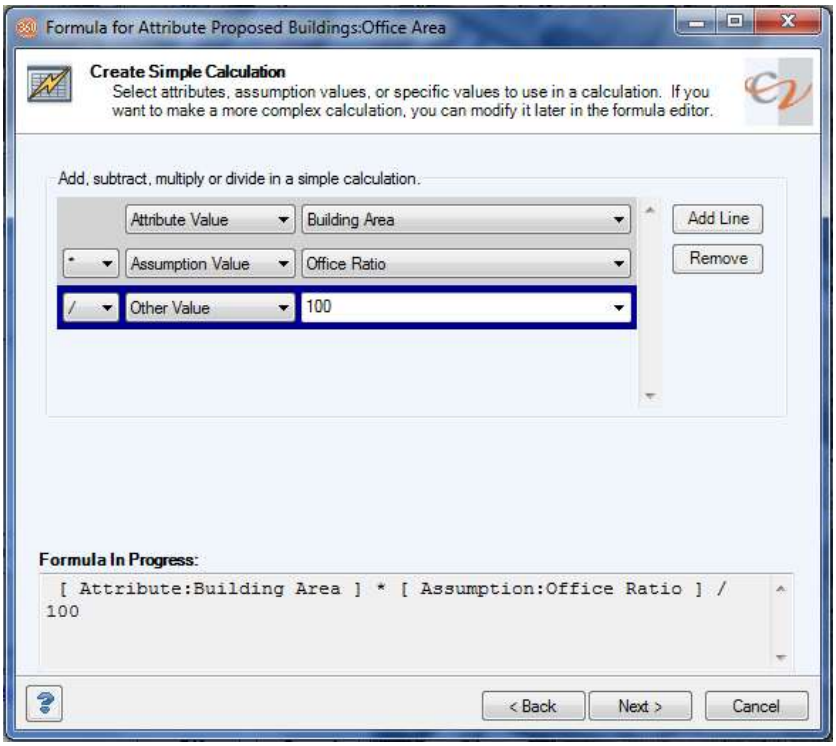
Using the Formula Wizard to create a dynamic attribute

Now that you have set up the building area and the percentage of area dedicated to residential, retail, and office use, three simple formulas will give you the absolute area dedicated to each use.

Calculating office area

1. If you closed the attributes list, you can reopen it by clicking **Dynamic Attributes** on the **360 Setup** tab **Work Flow** view.
2. From the attributes list click the **New Attribute** button.
3. Create a new attribute named **Office Area** in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.

4. In the **Description** field, type **Building area dedicated to office use**.
5. Click the **Formula** tab and click **Formula Wizard**.
6. Click to select the **Calculate a value** option and click **Next**.
7. Using the drop-down lists provided, select the options shown in the image below. You will have to click the **Add Line** button to create a third line.



8. Your formula should read:
   `[ Attribute:Building Area ] * [ Assumption:Office Ratio ] / 100`
9. Click **Next** then click **Finish**.
10. Click **OK** to close the attribute creation window.

This completes the creation of the Office Area formula. You can make a similar formula for retail very quickly using the **Copy formula** button in the Formula Editor, as described in the next section.

Duplicating a dynamic attribute to calculate retail area

1. If you closed the attributes list, click once on **Dynamic Attributes** on the **360 Setup** tab **Work Flow** view.
2. Click once on the **Office Area** attribute and click the **Duplicate** button.
3. Rename the attribute **Retail Area**. It is in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.
4. In the **Description** field, type **Building area dedicated to retail use**.
5. Click the **Formula** tab and click **Edit Formula**.
6. Replace the word **Office** with the word **Retail** in the formula. The formula should read:
   `[ Attribute:Building Area ] * [ Assumption:Retail Ratio ] / 100`
7. Click **Check Formula**, then click **OK**. Click **OK** again to close the attribute creation window.

Copying a formula to calculate residential area

1. From the attributes list click the **New Attribute** button.
2. Create a new attribute named **Residential Area** in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.

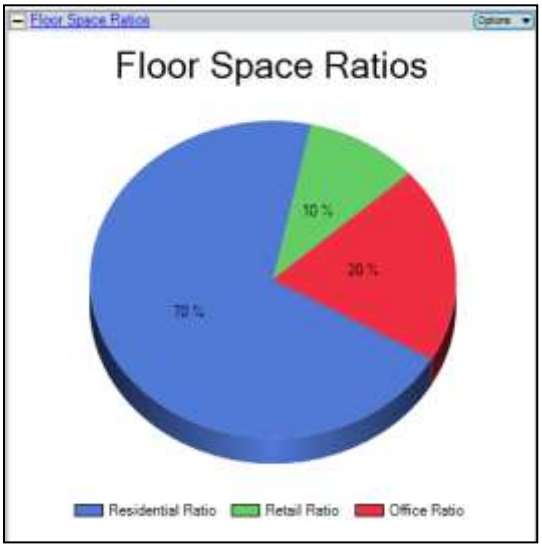
3. In the **Description** field, type **Building area dedicated to residential use**.
4. Click the **Formula** tab and click **Edit Formula**.
5. Click the **Copy formula from another attribute** button, click once to select the very similar attribute **Office Area**, and click **OK**.
6. Replace the word **Office** with the word **Residential** in the formula. The formula should read:
   `[ Attribute:Building Area ] * [ Assumption:Residential Ratio ] / 100`
7. Click **Check Formula**, then click **OK**. Click **OK** again to close the attribute creation window.
8. Close the attributes list.

Creating a new chart

Values for indicators and assumptions are automatically calculated as you experiment with alternatives, and the results can be displayed graphically in a chart. Charts are dynamically linked to assumptions and indicators. As changes are made in the analysis, chart displays will update automatically to reflect analysis results.

In this exercise, you will create a pie chart that tracks the percentage of each building type.

1. Click once on **Charts** on the **360 Setup** tab **Work Flow** view.
2. Click the **New Chart** toolbar button.
3. In the **Name** field, type **Floor Space Ratios**.
4. This will become the title of your chart. Leave the **Subtitle** field blank.
5. Click the **Type** drop-down list and select **Pie**.
6. In the **Decimal** places field, type **0**.
7. If they are not there already, place checks by **Display Values, Display Legend,** and **3D.**
8. Click the **Data** tab and click the **Add Assumption** button.
9. Click once on **Residential Ratio** to select it, then click **OK**.
10. Click the **Add Assumption** button, click once on **Retail Ratio** to select it, then click **OK**.
11. Click the **Add Assumption** button, click once on **Office Ratio** to select it, then click **OK**.
12. Click **OK** to close the create chart window. Your new chart will be added to the list.
13. Close the charts list. You chart will look something like this. If there are "leader lines" pointing to the chart labels, try making the chart wider to remove the leader lines.



14. Save your analysis by clicking the **Save** button on the ArcMap toolbar.

Tutorial 3b – Advanced setup and analysis

This part of the tutorial includes the advanced topic of lookup tables, which can sometimes be used in complex analyses. Once you have created your lookup table, you can create dynamic attributes that reference information in it. You must first complete Tutorial 3a before beginning this tutorial.

Creating a lookup table

You will start by creating a lookup table. Strictly speaking, you don't need a lookup table for this formula. Lookup tables are best for large amounts of data that don't change very often (like tax rates). We are using a small lookup table here to expose you to this potentially useful technique. There are several ways to create lookup tables from scratch; we are presenting one option here.

1. Make sure that you are not in an active editing session (click the **Stop Scenario Editing** button on the Scenario 360 toolbar if available).
2. Click once on **Data** on the **360 Setup** tab **Work Flow** view.
3. Click the **Add Data** button
4. Select **New Data Layer** and click **Continue**.
5. In the **Name** field, type **Lookup**, then type a description of your choice in the **Description** field.
6. Click the **Layer Type** drop-down and select **Table**.
7. Click **OK** then close the data list.
8. Click the **360 Setup** tab then click the **Tree** view.
9. Click the **+** next to the **Data** folder to expand the folder.
10. Right-click on **Lookup** and click **Open Attribute Table** from the pop-up menu to display the attributes of this table.
11. Click the **Table Options** button (at the top left of the table) and click **Add Field** on the drop-down menu.
12. In the **Name** field, type **Land_Use** (spaces are not allowed).
13. Click the **Type** drop-down and select **Text**. This will be the column in your table that specifies residential, office, or retail.
14. Click **OK**. A new field should appear in the table. To see it, you may need to resize the table. Note that you can resize columns by dragging on the divider between headers.
15. Using the **Long Integer** type, create additional fields for **Area_per_Dwelling_Unit**, **Area_per_Employee**, and **Cost_per_Sq_Foot** (use the directions in #11-#14).
16. Start an editing session by clicking the **Start Scenario Editing** button on the Scenario 360 toolbar.
17. Enter three rows of data in your table, as displayed in the image below. Note that you do not need to enter any data in the OBJECTID* field or the SCENARIO field or the CVActive field (if present). Those will populate automatically. You may need to resize the window to see the table properly.

OBJECTID *	SCENARIO	CVActive	Land_Use	Area_per_Dwelling_Unit	Area_per_Employee	Cost_per_Sq_Foot
1	Base Scenario	1	Residential	1000	125	0
2	Base Scenario	1	Office	0	175	225
3	Base Scenario	1	Retail	0	200	500

18. Click the **Stop Scenario Editing** button on the Scenario 360 toolbar. When asked if you want to save your edits, click **Yes**. Close the lookup table.

Editing attributes

1. Right-click on the **Attributes** folder (**360 Setup** tab **Tree** view) and click **Attribute List** on the pop-up menu.
2. Click once on the **Area_per_Employee** attribute and click the **Properties** toolbar button.
3. Ensure that the **Attribute Type** drop-down list reads **Number**.
4. Change the **Decimal Places** field to **0**.
5. Click **OK** and close the attributes list.

Creating a variable assumption

In this exercise, you will setup an assumption for persons per dwelling unit and use this assumption to study jobs to population balance for various combinations of retail, residential, and office buildings.

1. Click once on **Assumptions** on the **360 Setup** tab **Work Flow** view then click the **New Assumption**  toolbar button.
2. In the **Name** field, type **Persons per Dwelling Unit**.
3. In the **Description** field, type **Average number of people living in each dwelling unit**.
4. Click the **Valid Values** tab.
5. Type **1.6** in the **Default Value** field, indicating that unless the assumption is changed, the average number of people in each dwelling unit is 1.6. This will be the default display value.
6. Leave the **Units** field blank and accept **0** as the **Minimum value**.
7. Type **.1** for the **Increment on Slider**.
8. In the **Decimal Places** field, type **1**.
9. Type **4** as the **Maximum** and click **OK**.
10. Close the assumptions list.

Creating dynamic attributes using information from a lookup table

You are now ready to create new dynamic attributes. You will use the **Formula Wizard** and **Formula Editor** to create your formulas. Many of the new attributes will rely on your lookup table for data.

Creating the Office and Retail Employees dynamic attributes

The formula for these attributes will rely on your lookup table for data and will calculate the number of employees expected in the new buildings based on the square feet of office space. The formula starts by calculating the square feet of office or retail space and then divides by the number of square feet associated with each employee. It gets the number from the lookup table which shows how many square feet are needed for employees of offices or retail stores.

1. Open the attributes list and create a new attribute named **Office Employees** in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.
2. In the **Description** field, type **Number of employees expected based on availability of office space**.
3. Click the **Formula** tab then click the **Edit Formula** button.
4. Click the **Insert Analysis Component** [] button on the Formula Editor toolbar.
5. Double-click on **Attribute** on the pop-up menu, then double-click on **Office Area** on the pop-up menu.
6. Using the Formula Editor keypad, click the division sign **/**.
7. Double-click **Get** in the function list. You will see the text appear in the formula box.
8. Click on *attribute* in the formula preview box and the Select Attribute window will appears.
9. Scroll down the list, click once on **Area_per_Employee**, then click **OK**.
10. Click on *where* in the formula preview box and the **Add Where Conditions to Formula** window will appears.
11. Click the **Attribute** drop-down and select **Land_Use**, accept the **=** (equal) operand.
12. Click the **Value** drop-down list, select **Office**, then click **OK**. Your formula should read:

```
[ Attribute:Office Area ] / Get ( [ Attribute:Lookup:Area_per_Employee ],
      Where ( [ Attribute:Lookup:Land_Use ]= "Office" ))
```

13. Click the **Check Formula** button. Click **OK** after you have finished.
14. Click **OK** to close the New Attribute window.
15. The **Improve Analysis Performance** window will ask "Create attribute indexes?" Accept the default "Create an index for each checked attribute."
16. Create a new **Retail Employees** attribute by duplicating the **Office Employees** attribute (use the **Duplicate** button on the attribute setup list). Make sure your decimal points are correct and that you replace "Office" with "Retail" in the name and description fields as well as in the formula. The formula

should read:

```
[ Attribute:Retail Area ] / Get ( [ Attribute:Lookup:Area_per_Employee ],
      Where ( [ Attribute:Lookup:Land_Use ] = "Retail" ) )
```

17. Click the **Check Formula** button. Click **OK** after you have finished.
18. Click **OK** to close the **New Attribute** window.

Creating the Dwelling Units dynamic attribute

You will use this attribute to calculate population. As you change the persons per dwelling unit assumption, this attribute will update automatically.

1. Create a new attribute named **Dwelling Units** in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.
2. In the **Description** field, type **Area per residential dwelling unit**.
3. Click the **Formula** tab then click the **Edit Formula** button.
4. Using the skills you have practiced earlier, see if you can create this formula:

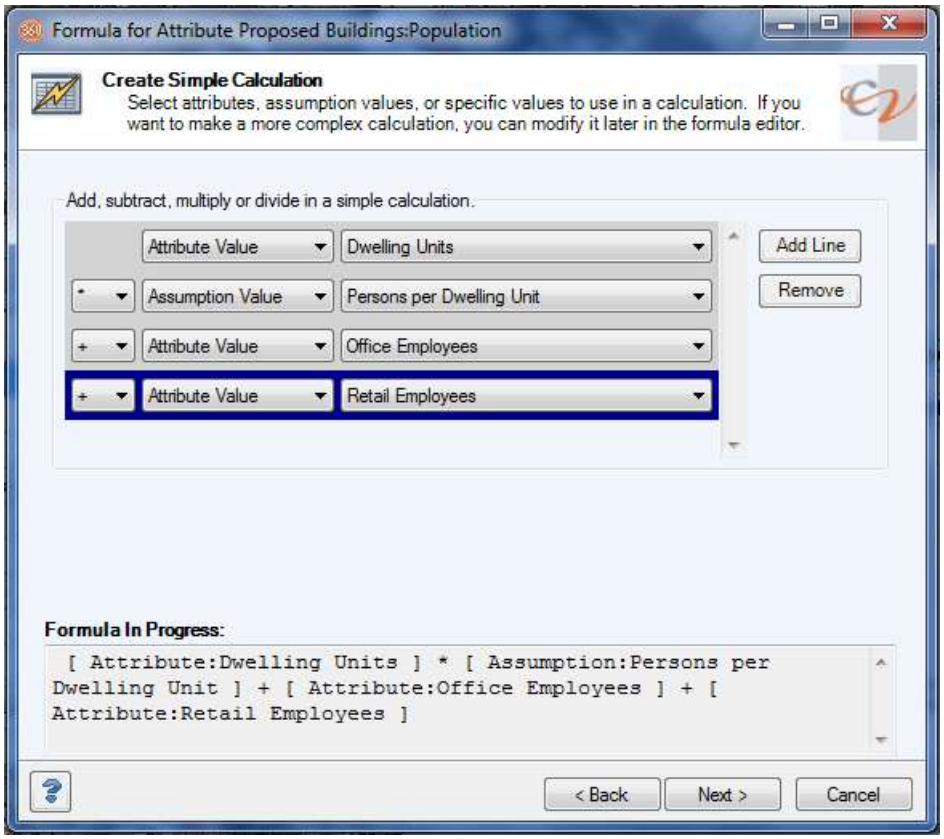
```
[ Attribute:Residential Area ] / Get ( [
Attribute:Lookup:Area_per_Dwelling_Unit ],
      Where ( [ Attribute:Lookup:Land_Use ]= "Residential" ))
```

You can use the hints in the picture below to create your formula. Remember, you must click **Check Formula** before clicking **OK**.

Creating the Population dynamic attribute

You need to calculate population in order to experiment with jobs to population balance for different combinations of retail, residential, and office buildings. You will begin creating this formula using the Formula Wizard and then complete it using the Formula Editor

1. Create a new attribute named **Population** in the **Proposed Buildings** layer. Use the **Number** type, **General** category, and set the decimal places to **0**.
2. In the **Description** field, type **Population based on persons per dwelling unit, number of dwelling units, and office and retail employees**.
3. Click the **Formula** tab then click the **Formula Wizard** button.
4. Click **Calculate a Value** then click **Next**.
5. Using the drop-down lists, create the formula shown in the picture on the next page.



6. Click **Next**
7. Click the **Open Formula Editor** button and click **Yes** when asked if you want to continue.

8. To demonstrate how you can modify a formula after it has been created by the Formula Wizard, type parentheses in the correct places so your formula reads:
```
( [ Attribute:Dwelling Units ]*[ Assumption:Persons Per Dwelling Unit ] )
+ [ Attribute:Office Employees ]+[ Attribute:Retail Employees ]
```
9. Click the **Check Formula** button. Click **OK** after you have finished.
10. Click **OK** to close the New Attribute window but do not close the attributes list.

Creating the Construction Cost dynamic attribute

Later, you will run a cost analysis. You will consider adding another building to the development project. However, your budget is limited. How much space can you add? You will use this attribute to answer this question and see the results of the additional space immediately.

1. Create a new attribute named **Construction Cost** in the **Proposed Buildings** layer. Use the **Number** type, **Construction Cost** category, and set the decimal places to **0**.
2. In the **Description** field, type **Cost per square foot of office, residential, and retail space**.
3. Click the **Formula** tab then click the **Edit Formula** button.
4. Using the skills you practiced earlier, see if you can create this formula (don't forget to insert the parentheses!):
```
( [ Attribute:Office Area ] * Get ( [ Attribute:Lookup:Cost_per_Sq_Ft ],
      Where ( [ Attribute:Lookup:Land_Use ] = "Office" ) ) ) +
( [ Attribute:Residential Area ] * Get ( [ Attribute:Lookup:Cost_per_Sq_Ft ],
      Where ( [ Attribute:Lookup:Land_Use ] = "Residential" ) ) ) +
( [ Attribute:Retail Area ] * Get ( [ Attribute:Lookup:Cost_per_Sq_Ft ],
      Where ( [ Attribute:Lookup:Land_Use ] = "Retail" ) ) )
```
5. Remember, you must click **Check Formula** before clicking **OK**.
6. Click **OK** on the **New Attribute** window.
7. Close the attributes list.

Creating indicators and alerts

Indicators are impact or performance measures that can reference datasets anywhere in a scenario. They are used to provide an overall measurement and they apply to an entire scenario (as opposed to an attribute, which provides the individual characteristic of a map feature). Like dynamic attributes, indicator values are automatically recalculated as you experiment with alternatives, and these values can be displayed in a chart. In this fictional analysis, you will use indicators to total population, employees, construction costs, and ratio of square footage and you will display your results in easy to read charts.

Creating the Population indicator

1. Click once on **Indicators** on the **360 Setup** tab **Work Flow** view.
2. Create a new indicator named **Population**. Use the **General** category, and set the decimal places to **0**.
3. In the **Description** field, type **Total population**.
4. Click to place a checkmark next to **Display this indicator in a new chart**.
5. Click the **Formula** tab then click the **Formula Wizard** button.
6. Select **Add the values of an attribute** and click **Next**.
7. Click to select **Proposed Buildings** from the **Select Layer** drop-down list.
8. Click to select **Population** from the **Select attribute to sum** drop-down list.
9. Ensure the **Sum all features in Proposed_Buildings** option is selected and click **Next**.
10. Click **Next** on the **Preview Formula Results** window.
11. Click **Finish** on the **Finish Formula** window. Your formula should read:
```
Sum ( [ Attribute:Proposed_Buildings:Population ])
```
12. Click **OK** to close the **New Indicator** window. Note that a new chart has been created. If your charts view is not open, click the **View Charts** button on the Scenario 360 toolbar.

Creating the Employees indicator

1. Create a new indicator named **Employees**. Use the **General** category, and set the decimal places to **0**.
2. In the **Description** field, type **Total number of employees (retail and office)**.
3. Click to place a checkmark next to **Add this indicator to an existing chart** then click the **Select Charts** button.
4. Click to select **Population** from the chart list and click **OK**.
5. Click the **Formula** tab then click the **Formula Wizard** button.
6. Select **Add the values of an attribute** and click **Next**.
7. Click to select **Proposed Buildings** from the **Select Layer** drop-down list.
8. Click to select **Retail Employees** from the **Select attribute to sum** drop-down list.
9. Ensure the **sum all features in Proposed Buildings** option is selected and click **Next**.
10. Click to select the **Include additional calculations or values in this formula** option and click **Next**.
11. Select **Add the values of an attribute** and click **Next**.
12. Click to select **Proposed Buildings** from the **Select Layer** drop-down list.
13. Click to select **Office Employees** from the **Select attribute to sum** drop-down list.
14. Ensure the **sum all features in Proposed Buildings** option is selected and click **Next**.
15. Click Next on the **Preview Formula Results** window.
16. Click **Finish**. Your formula should read:

```
Sum ( [ Attribute:Proposed_Buildings:Retail Employees ])
      + Sum ( [ Attribute:Proposed_Buildings:Office Employees ])
```

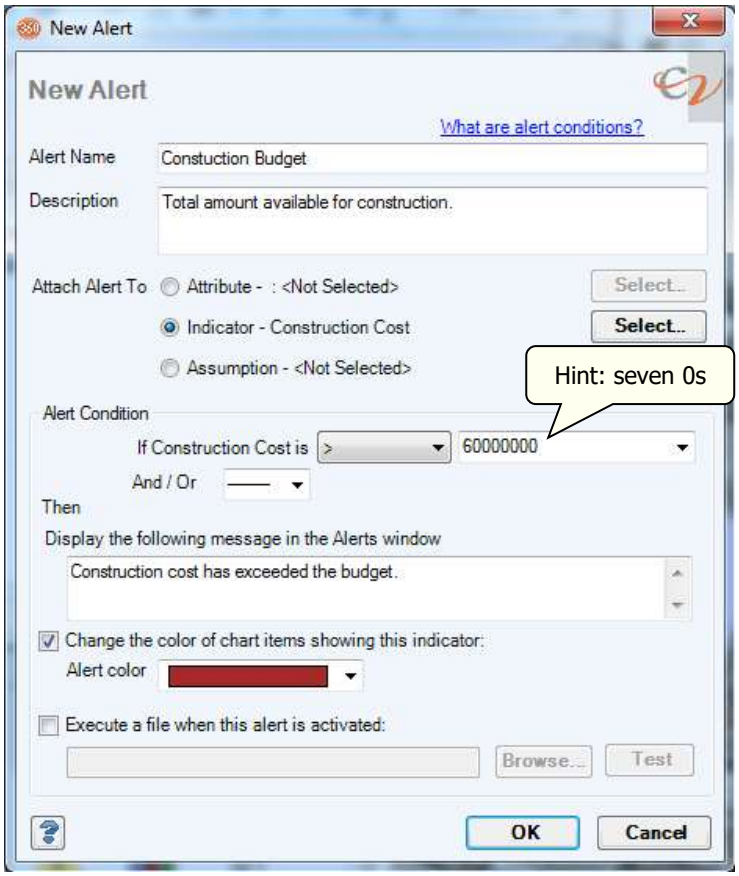
17. Click OK to close the New Indicator window. Note that the employees chart information has been added to the population chart.

Creating the Construction Cost indicator and alert

1. Click once to select the **Population** indicator in your indicators setup list then click the **Duplicate** button.
2. Create a new indicator named **Construction Cost**. Use the **Construction Cost** category, and set the decimal places to **0**.
3. In the **Description** field, type **Total cost of construction**.
4. Edit the formula so that it reads:

```
Sum ( [ Attribute:Proposed
Buildings:Construction Cost ] )
```

5. Remember to check your formula before clicking **OK**.
6. Click the **Alerts** tab, then click **New**. Use the information provided in the image below to create your new alert.



7. Click **OK** to close the alert creation window.
8. Click **OK** to close the **New Indicator** window.
9. Close the indicators list.

Creating and editing indicator charts

Charts are dynamically linked to indicators and attributes. As changes are made in the analysis, chart displaying values for indicators or attributes will update automatically to reflect analysis results. You created an attribute chart earlier in this tutorial (floor space ratios). You will now create a new indicator chart and edit a previously created chart so you can easily view changes and make comparisons in your analysis.

Creating a chart with a threshold line to track the total cost of construction

1. Click once on **Charts** on the **360 Setup** tab Work Flow view.
2. Create a new chart named **Construction Cost**. Use the **Bar** type and set the decimal places to **0**.
3. Click the **Data** tab and click the **Add Indicator** button.
4. Click once on **Construction Cost** to select it, then click **OK**.
5. Click the **Axes** tab, click to remove the checkmark next to **Label**, click to remove the checkmark next to **Auto Axis**, type **0** as the **Minimum**, and type **100000000** (hint: eight 0s) as the **Maximum**.
6. Make sure the **Increment** option is checked on and type **100000** (hint: five 0s) as the increment.
7. Click the **Threshold Lines** tab. Note that the alert you set when you created your indicator created a threshold line in your chart.

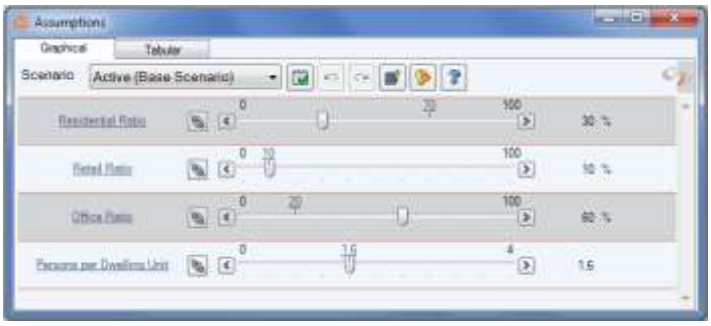
Adding an item line to the chart

1. Click the Item Lines tab
2. To add a line whose position shows the value of an indicator or assumption, use the **Add Indicator** or **Add Assumption** button. To add a line with a set value, use the **Add Custom** button. Fill in the position which refers to the value of the line on the vertical Y-axis and choose the color. The line will be added. Notice that it is a dashed line.
3. Click **OK** to close the create chart window. Your new chart will be added to the list.

Editing the Population chart

1. Click once to select the **Population** chart on the charts list then click the **Properties** button.
2. In the **Name** field, type **Population and Employees** then set the Decimal places to **0**.
3. Click the **Axes** tab, ensure there is no checkmark next to **Label**, and type **0** as the **Minimum** and **5000** as the **Maximum**.
4. Click to select the **Increment** option and type **100** as the increment.
5. Click **OK** to close the chart creation window. Your new chart will be added to the list.
6. Close the charts list and save your analysis.

Experimenting with assumptions



During assumption setup, you divided the building type ratio at 70% residential, 20% office, and 10% retail for the base scenario. Changing these assumptions will dynamically change the population balance and the construction costs. Note that the way this formula is set up, there is nothing stopping you from making the ratios add up to more than 100%. The pie chart you created will continue to display the relative ratios.

1. Make sure the charts view is open. If it is not, click the **View Charts** button on the Scenario 360 toolbar.
2. Click once on **Assumptions** on the **360 Analysis** tab to display the graphical view of the assumptions.
3. Increase the **Office Ratio** assumption value to **60%**.
4. Decrease the **Residential Ratio** value to **30%**.

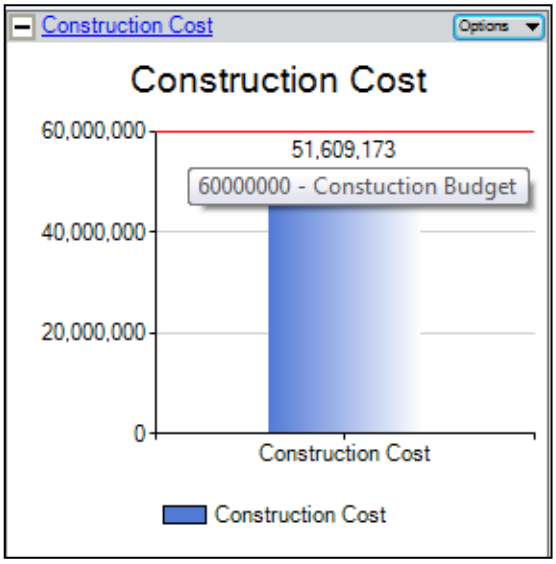
5. Click the **Apply Assumption Changes** button. Scenario 360 will update the scenario and dynamically change the indicators, the results of which are displayed on the charts. Increasing the office ratio while decreasing the residential ratio will increase the population and construction costs. If your construction budget exceeded 60,000,000, the alert you set will be triggered and the chart bar will turn red.
6. Notice the gray diagonal lines on the bar graph indicating the previous values. Hover your mouse over one of the bars on the chart to display a pop-up information window.
7. When you are finished, close the Assumptions window and click **No** when asked whether you want to save assumption changes.
8. To revert to the original default settings on the charts, click the **Options** button on each chart and select **Clear Previous Values**.

Adding new buildings and modifying building stories

In this exercise, you are considering adding another building to the development project. However, your budget is limited. How much space can you add? In Scenario 360, you can find out simply and see the results of the additional space immediately.

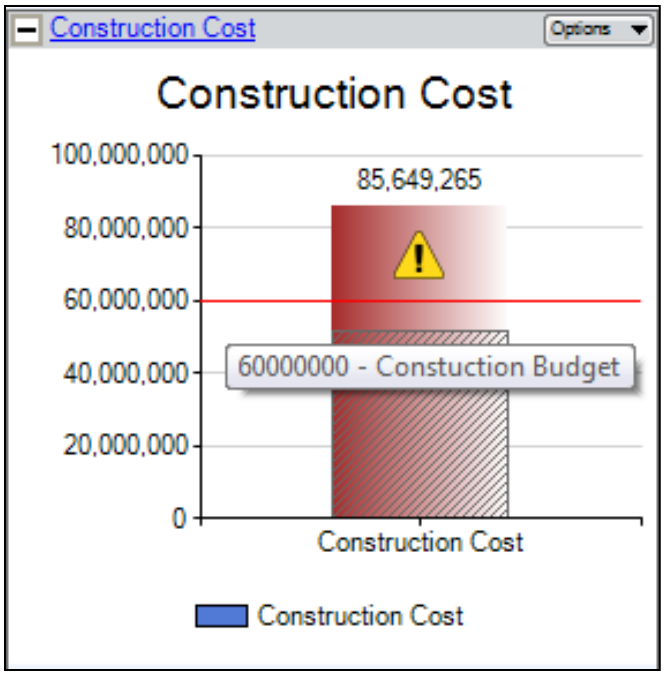
Construction Budget

The bar graph for construction costs should look similar to the one illustrated here (you may have different values). Note the red threshold line at the $60,000,000 level.



1. Start an editing session by clicking once on **Start Edit** on the 360 Analysis tab.
2. Click on **Proposed Buildings** in the **Create Features** window.
3. Draw a new polygon to represent a potential new building (see image on next page). When you have finished creating the four points, double-click on the last point to complete the polygon.
4. When prompted, type **6** in the **Stories** field and click **OK**. Notice that this building does not have a dark red line around it. This is because it does not cross the threshold you set for number of stories (it is not > 10 stories).

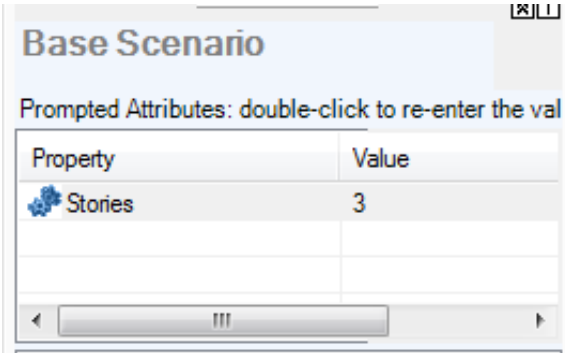
5. The six-story building probably caused the **Construction Cost** chart to change the bar to red because the cost exceeded your budget. Your budget will not allow for an additional six-story building of that size. The target line was exceeded and an alert was triggered.



6. Click the **List Alerts** button the Scenario 360 toolbar to view your alerts.
7. Do not stop your editing session at this time.

Modifying building stories

1. Click the **Edit Tool** on the ArcMap Editor toolbar then click once to select the eleven-story building you previously created (the one displaying the alert).
2. Click the **View and Change Feature Attributes** button on the Scenario 360 toolbar. Double-click on the **Stories** property and, when prompted, enter **3** in the Stories field.



3. Click **OK**. The program will update the indicators and associated charts.
4. Close the Attributes table, click **Stop Edit** on the **360 Analysis** tab, and click **Yes** when asked whether you want to save changes.
5. Click the **List Alerts** button on the Scenario 360 toolbar then click the **Clear All Alerts** button.

Exploring further

This is the end of the tutorial exercises for Community City, but you should feel free to experiment and explore further. For example:

- Using the options available on the **360 Analysis** tab, try changing the persons per dwelling unit assumption, or editing values in the lookup table. Practice editing the proposed buildings – change their shapes, change the number of stories, move, and delete buildings (all of these functions are available on

the ArcMap Editor toolbar). Picture the development you would like to see and try to make it come in under budget and maintain a roughly even jobs-to-population ratio.

- Try creating a report for this analysis.
- Use the Scenario Comparison window to create a view you think would effectively convey the main points of this analysis to a large audience.

Congratulations – you have completed Tutorial 3

You have successfully completed creating a new analysis and base scenario for My City. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps. The next tutorial will show you how to use Scenario 3D. After you have completed the Scenario 3D tutorial, you might want to try repeating the exercise using your data from Community City.

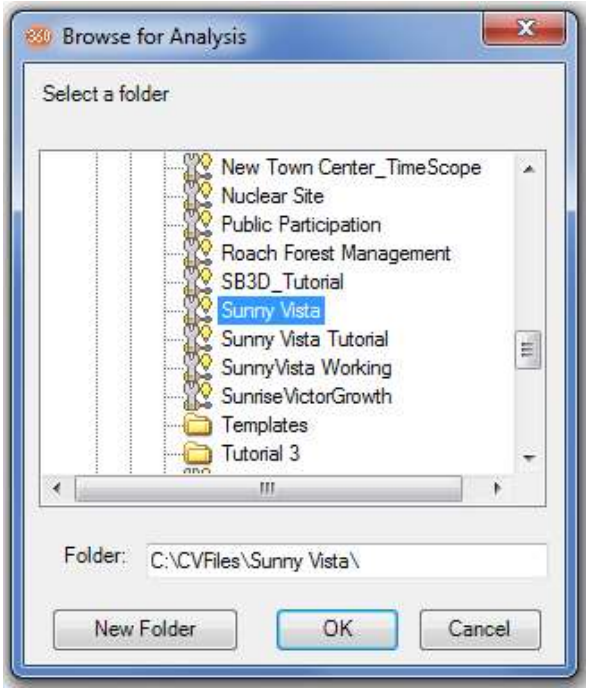
Tutorial 4 – Working with Scenario 3D

The following tutorial contains a series of exercises that demonstrate how to use Scenario 3D to create interactive, geospatial, three-dimensional scenes. Using the Scenario **3D Exporter**, you will create a scene containing terrain and various features. Then, using the Scenario **3D Viewer**, you will navigate and interact with the scene you have created. You will experiment with interactions between the 2D map and the 3D scene, make bookmarks and a flythrough, and set up hyperlinks.

Scenario 3D scenes are built from ArcMap maps. If the map is part of a Scenario 360 analysis you can take advantage of certain additional features, but Scenario 360 is not required. For this exercise you will start with the Sunny Vista Scenario 360 analysis that is also used in some other tutorials.

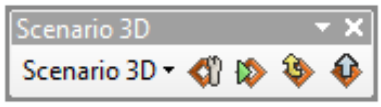
Starting the tutorial

1. Install the tutorials data on your computer.
2. Start Scenario 360 by double-clicking on the **Scenario 360** icon on your desktop.
3. Click **Open Existing Analysis**, browse to the **CVFiles/Sunny Vista** analysis, select it, and click **OK**.
4. Scenario 360 will load and display a fictional place called "Sunny Vista". Sunny Vista is a high mountain site on the outskirts of a mountain town being considered for development.



3D Exporter toolbar

Scenes are created by specifying how you want features from the map to be displayed in the 3D scene, and then exporting. All the tools you need are provided via the Scenario 3D Exporter toolbar.



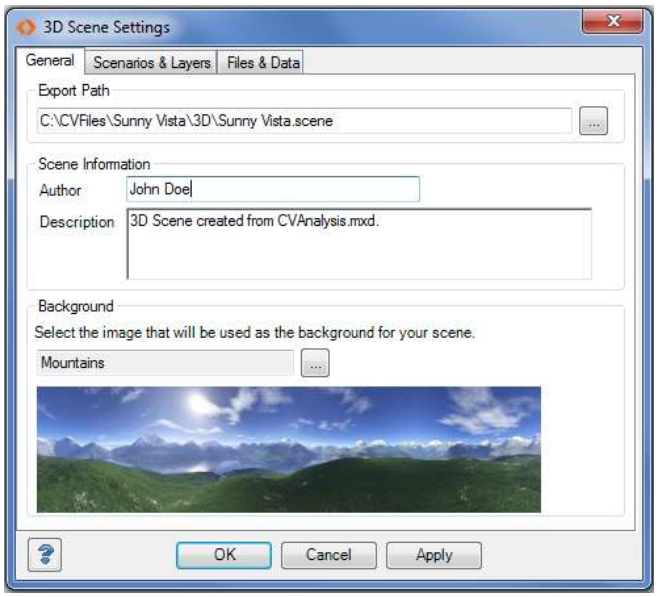
If the 3D Exporter toolbar is not already showing:

1. Make sure that the Scenario 3D extension is turned on in ArcMap. From the ArcMap **Tools** menu, choose **Extensions...** and place a check in the box next to ***Scenario 3D***.
2. Make the toolbar visible. From the ArcMap **Customize** menu, choose **Toolbars...** and place a check next to ***Scenario 3D***.
3. If the toolbar buttons are grayed out and unusable, make sure Scenario 3D is licensed on your computer.

3D Scene Settings – General

Most of the "work" of creating a scene is done via **3D Scene Settings**, available from the Scenario 3D toolbar.

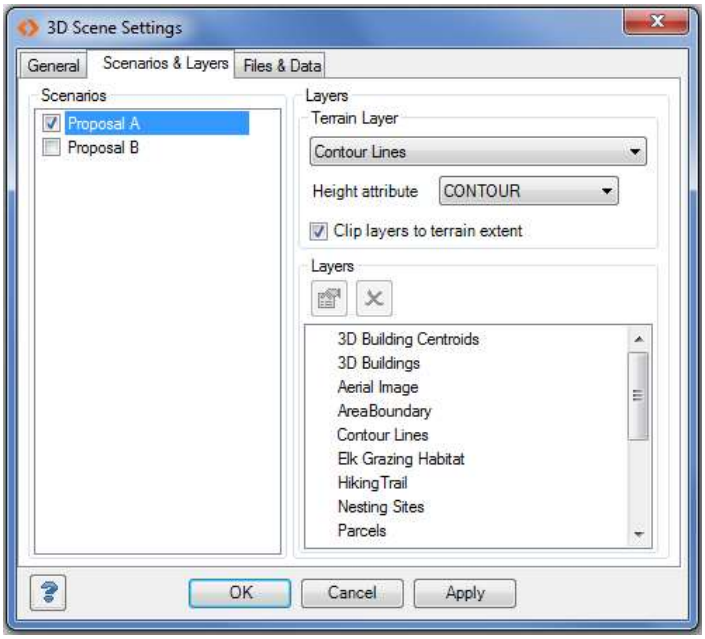
1. Click **3D Scene Settings** on the Scenario 3D toolbar. On the **General** tab, review the default settings. Make sure there is a valid **Export Path.** The Export Path tells you the scene's name and where it will be stored. You can change this information if desired by clicking on the **Browse** button. You can also edit the **Author** and **Description** if desired. Accept the default **Background** of *Mountains* for this exercise. Do *not* click OK yet; you are going to keep working on the other tabs in this window.



3D Scene Settings – Scenarios & Layers

The 3D Scene Settings **Scenarios & Layers** tab is like a table of contents for your 3D scene settings. You use it to select which layer you want to work on, and you can also use it to see which layers have already been set up.

1. If there are multiple scenarios or data frames in your project, you can select which one(s) you want to export by clicking the check box the **Scenarios** list. In this case, check the box for **Proposal A.** You can export multiple scenarios to view them in Scenario 3D.
2. The **Terrain Layer** is used to create the ground surface or landscape in the scene. It is optional, but without it the scene will have flat ground. You can use a raster, TIN, or feature layer that exists in your map. For this exercise, choose ***Contour Lines*** and specify the **Height attribute *CONTOUR***. Also **check the box** labeled "Clip layers to terrain extent."



In the 3D scene, the terrain itself is invisible; it is only used by the computer to calculate vertical positions. Normally you want to create a visible ground layer that drapes over the terrain and looks like ground cover. An aerial image is desirable but not required. For this exercise, we'll use the Aerial Image layer. To set it up:

3. Double-click the name ***Aerial Image*** in the **Layers** list. (Alternatively you can click it once and then click the **Edit Layer Settings** button.)

4. In the **3D Layer Settings – Aerial Image** screen that appears, accept the defaults and click **OK.** Notice that there is now a yellow cube next to Aerial Image in the list, indicating that it has been assigned 3D settings. The yellow cube also contains a green check by default, 

indicating that this layer will be included the next time the scene is created. (You can clear the check if desired, but leave it in place for this exercise.)

"Sneak Peek"

To give yourself a quick preview of how your scene is developing:

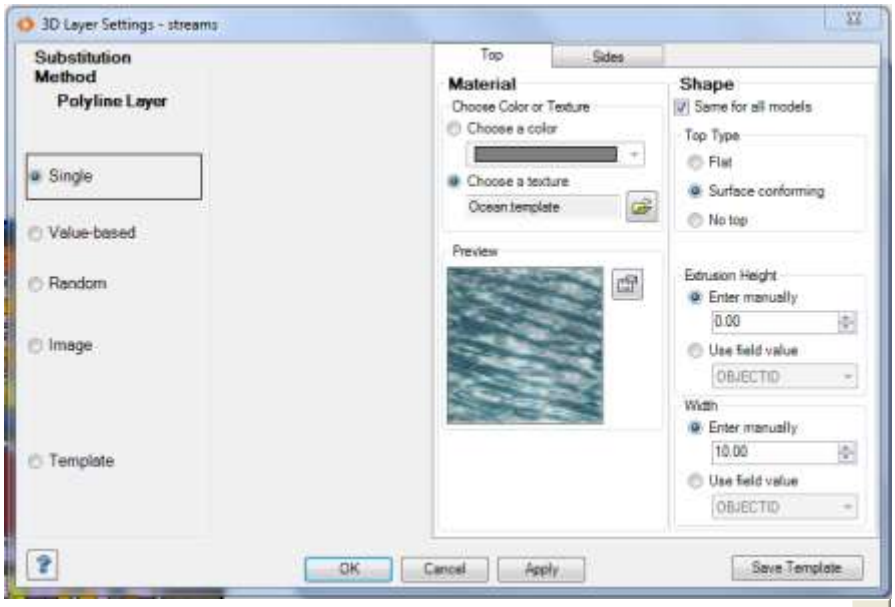
1. Click **OK** at the bottom of the 3D Scene Settings screen to return to the toolbar.
2. On the Scenario 3D toolbar, click **Export Now**  . This will create a scene using your settings so far.
3. Click **Launch Scenario 3D Viewer**  to open the scene in the Scenario 3D Viewer. You'll see the Mountain background you chose on the 3D Scene Settings - General tab and the Aerial Image ground layer you chose draped over the terrain. There isn't much more to see yet, so for now **close** the 3D Viewer window and return to set up. Details on using the 3D Viewer come later in this tutorial.

3D Scene Settings – Lines

In the next few sections of the tutorial you will make settings for two line layers, two polygon layers, and two point layers. There are many options available for these settings; the exercises here will give a small sample.

Features that are *lines* on a 2D map can be represented several ways in 3D. They can be shown as images on the ground; they can be horizontal "ribbons" that add width to the line; they can be "fences" that add height to the line; or they can be "walls" with both width and height. You can also choose whether you want them to be confined to a single horizontal plane ("flat") or follow the contours of the terrain ("surface conforming"). Finally, you can choose how you want their surfaces colored or textured. In this example we'll set up the line layer ***Streams*** as thin, surface-conforming ribbons and the line layer ***Roads*** as surface-conforming ribbons with a little bit of thickness.

1. From the **Scenario 3D toolbar**, click **3D Scene Settings**  . Go to the **Scenarios & Layers** tab and double-click ***Streams*** in the Layers list.
2. The 3D Scene Settings screen reads from left to right. Under **Substitution Method**, choose **Single**. This means that each feature in the layer will be represented the same way.
3. There are tabs for both the Top and Sides of the 3D object you will create. In this case, ignore Sides and ensure you are working on the **Top** tab. For **Material**, select **Choose a texture**. Use the **Browse**  button to open the **Library Browser.**



The **Library Browser** is a special Scenario 3D tool that allows you to find and organize content for use in 3D scenes. It supports Backgrounds like the Mountain background you are using, Textures that can include photos

and other graphics, Materials like the water you are about to use, and Models or 3D objects. The **Views** button in the upper left lets you choose thumbnails, list, or details.

4. In the **Library Browser**, navigate to **Library/Materials** and click on the name ***Ocean*** in the right-hand window. Click **Open**. This will select the water material and you will be returned to the 3D Layer Settings screen. Confirm that the Material texture is now Ocean.template and look for a **Preview** in the small preview window.

5. Look at the setting options in the **Shape** panel. Then set them as follows:

    a. Leave the check in the box called **Same for all models**.

    b. Streams follow the terrain, so for **Top Type** choose **Surface conforming**.

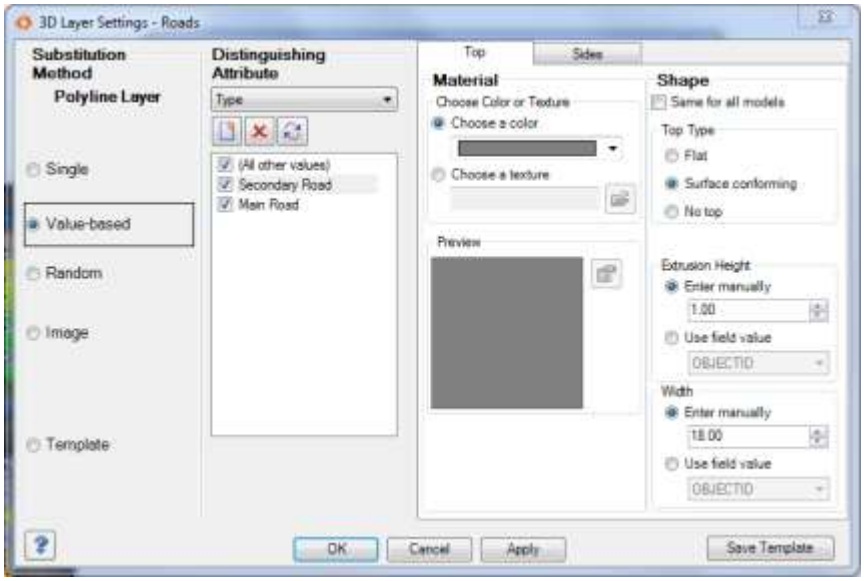
    c. Leave **Extrusion Height** set to **Enter manually** with a value of ***0.00***.

    d. Set **Width** to **Enter manually** with a value of ***10.00***, which will be the width of each stream in map units (feet in this example).

6. You have now specified all the settings for streams. Click **OK** to return to the **Scenarios & Layers** tab. Confirm that there is now a yellow cube with a green check next to ***Streams*** in the Layer List.

Sunny Vista includes two different kinds of roads in the same ***Roads*** layer: Main and Secondary. In the next exercise you'll see how to give each type its own 3D representation.

1. On the **3D Scene Settings – Scenarios & Layers** tab, double-click ***Roads*** in the **Layer** list.
2. For the **Substitution Method**, choose **Value-based**. This means that different features will receive different 3D representations depending on the value of one of their attributes.
3. For the **Distinguishing Attribute**, choose ***Type***. Then click ***Add all values*** to show the current unique values of the attribute called "Type" in the Roads layer.



4. You will set up Secondary Roads first, then Main Roads. Click on **Secondary Road** in the list of attribute values.
5. For the **Top Material**, choose a gray color.
6. For the Top **Shape**, set:
    a. **Same for all models** to **cleared**, because you want different widths for different types of road.
    b. **Top Type** to **Surface conforming**
    c. **Extrusion Height** to **Enter manually** with a value of ***1.00.*** This means the road will be 1 foot thick.
    d. **Width** to **Enter manually** with a value of ***18.00.*** Secondary roads will be 18 feet wide.
7. To specify settings for the 1-foot-high vertical sides of the roads, click the **Sides** tab. Use the same **Material** color. Check **Same for all models** and choose a **Side Type** of **Join to top**. This makes the top edge of the sides align with the edges of the top surface.
8. Click **Apply**. Apply saves your current settings without closing the window.
9. Now create settings for Main Roads. Click on ***Main Road*** in the list of attribute values, then go to the Top tab and change **Width** to ***28.00.*** Make sure all other settings match those for secondary roads.

10. Click **OK.** The Roads layer is now set up.

You have now set up a terrain, a ground layer, streams, and roads. You may wish to give yourself a "sneak peek" of your work so far using the directions above. (Click **Export Now**  **and then c**lick **Launch Scenario 3D Viewer**  .) Don't be alarmed if roads take a couple of minutes to export. Details on using the 3D Viewer come later in this tutorial.

3D Scene Settings – Polygons

Features that are *polygons* in 2D are also polygons of the same size in 3D. They can be thin surfaces (either horizontal or surface conforming), extruded with a flat or surface-conforming top, or sides without tops (like a fence around a field). In this exercise you'll make a pond and extrude some building footprints.

1. From **3D Scene Settings**, double-click ***Ponds*** in the Layers list.
2. Under **Substitution Method**, choose **Single.**
3. Ensure you are working on the **Top** tab. For **Material**, select **Choose a texture**. Use the **Browse**  button to open the **Library Browser** and select the ***Ocean*** material as you did with streams.
4. Set the Shape settings as follows:
    a. Leave the check in the box called **Same for all models**.
    b. Ponds are flat, so for **Top Type** choose **Flat**.
    c. Put **Extrusion Height** set to **Enter manually** with a value of ***5.00***. Extrusion is measured from the lowest vertex of the terrain to the top of the flat surface, so this will make the pond 5 feet deep at its deepest. Setting this value too low will make the pond disappear below the ground (except at the lowest point of the terrain); setting it too high will make the water surface float in the air. In practice, getting the correct value may require a little experimentation.
5. By default Sides are set to "no sides," which is what we want, so no additional action is required. Click **OK** to return to the **Scenarios & Layers** screen. Confirm that there is now a yellow cube with a green check next to ***Ponds*** in the Layer List.

Next, set up building footprints as extrusions. Later you'll set up building points as 3D objects, so you'll have a chance to try both of these popular methods for putting buildings into a scene.

6. From **3D Scene Settings**, double-click ***3D Buildings*** in the Layers list. Note that this is a polygon layer representing the footprints of proposed buildings.
7. Under **Substitution Method**, choose **Value-based.**
8. For the **Distinguishing Attribute**, choose ***Land Use.*** Then click **Add All Values**  to show the current unique values of the attribute called "Land Use" in the 3D Buildings layer. You will see "Single Family Residential," "Commercial," and "Mixed Use."
9. **Clear** the checks from "(All other values)" and "Single Family Residential." Residences will be modeled with a different technique.
10. Click on **Commercial.**
11. **Top** tab:
    a. For **Material**, select **Choose a color** and pick a **gray** color to represent flat roofs.
    b. For **Shape**, check **Same for all models**. This will automatically set "Mixed Use" buildings to the same settings. Set the **Top Type** to **Flat**. Set the **Extrusion Height** to **Use field value** and

choose **Height**. "Height" is an existing attribute in the 3D Buildings layer that gives the height of each building. In practice, you may have to set an approximate height manually.

12. **Sides** tab:

    a. For Material, select **Choose a texture.** Use the **Browse** button to open the **Library Browser.**

    b. In the **Library**, go to the **Textures** folder and navigate to the **Artificial/Buildings/Sides** subfolder and choose ***façade_24.png.*** Click **Open.**

(Textures can be graphics, photos, or any other image in GIF, JPEG, TIFF or PNG format. You can use files from the Library or any other source. If you take a digital photo of the side of a building, you can use it here. You may need to use **Texture Properties** next to the Preview window to adjust the image size properly.)

    c. Set the **Shape** settings to **Same for all models** checked; **Side Type** to **Join to top**.

13. Make sure that Commercial and Mixed Use are still checked in the **Distinguishing Attribute** list. Click **OK** to return to the **Scenarios & Layers** screen. Confirm that there is now a yellow cube with a green check next to ***3D Buildings*** in the Layer List.

14. Click **Apply** to save your work so far.

You have now seen how polygons can be set up as flat surfaces like ponds or extruded 3D objects like buildings.

Note that in the same way you place images on the sides of extruded polygons, you can also place images on the sides of extruded lines. This technique is good for billboards, fences, and images of far-off objects.

You may want to take another "sneak peek" at your work. Details on using the 3D Viewer come later in this tutorial.

3D Scene Settings – Points

Features that are *points* in 2D are usually represented as complex objects such as houses, trees, cars or people in 3D. Scenario 360 uses objects in KMZ, 3DS, or DAE (COLLADA) format. A library of objects is provided, and you can also make or get your own. In this part of the tutorial you will set up trees and houses.

1. From **3D Scene Settings**, double-click ***Trees*** in the Layers list.

2. Under **Substitution Method**, choose **Random**. This method lets you put in several different tree models without having to specify exactly which model goes with which point.

3. Under **Random Choices**, click **New Random Choice** to create an entry called ***New Random Choice*** in the list. Click on this entry **once** to select it, then **click** to make it editable. Rename it ***Spruce***. Make sure its checkbox stays checked.

4. Under **Model**, click **Browse** to open the Library Browser. Go to **Library/Models/Nature** and highlight the **tree_colorado_spruce.kmz** model. Click **Open.**

5. Look at all the **Options** but leave them set to their default values. Click **Apply** to save your work so far.

6. Return to **Random Choices** and repeat **Steps 3, 4, and 5** to create first an **Ash *(tree_white_ash.kmz)*** and then a **Maple *(tree_bigleaf_maple.kmz).***

7. Make sure that all three random choices are still checked on in the list. Click **OK** at the bottom of the **3D Layer Settings – Trees** screen to return to the **Scenarios & Layers** screen. Confirm that there is now a yellow cube with a green check next to ***Trees*** in the Layer List.

Next, set up 3D Models for the houses in the scene. This exercise will skip the steps of setting up models for commercial and mixed-use buildings.

8. From **3D Scene Settings**, double-click ***3D Building Centroids*** in the Layers list.
9. Under **Substitution Method**, choose **Value-based**. Choose the **Distinguishing Attribute *Land Use*** and click **Add All Values**  .
10. Click on **Single Family Residential** in the list of attributes. Under **Model,** click **Browse**  to open the Library Browser. Go to **Library/Models/Residential** and highlight the ***f0433.kmz*** model. Click **Open.**
11. Under **Options,** set Orientation to "Use this field" and choose the field ***Orientation***. This field gives the angle to the nearest road, in degrees, for each building, and it will ensure that buildings face the nearest road. If you use Scenario 360, it is easy to create such a field (dynamic attribute) using the *AngleTo* function. Leave the default values of 1.00 for Scale and 0.00 for Vertical Offset. Click **Apply** to save your work so far.
12. In this exercise, you will not set up models for ***Mixed Use*** and ***Commercial*** buildings. You can always add them later if desired and they are currently being modeled with extrusions set up earlier, so you can clear their checks in the list here along with the box for **(All other values)**. Click **OK** at the bottom of the **3D Layer Settings – 3D Building Centroids** screen to return to the **Scenarios & Layers** screen. Confirm that there is now a yellow cube with a green check next to ***3D Building Centroids*** in the Layer List.
13. Click **OK** to close 3D Scene Settings.

You have now created a good set of 3D Scene Settings for your scene. You have a terrain, a ground layer, and several of the most important feature layers. It's time to export the scene and go look at it.

Export Now and Launch 3D Viewer

From the Scenario 3D toolbar, click **Export Now**  , wait for the progress bars to complete (this may take a few minutes) and then **Launch 3D Viewer**  . The 3D Viewer will open with your scene.

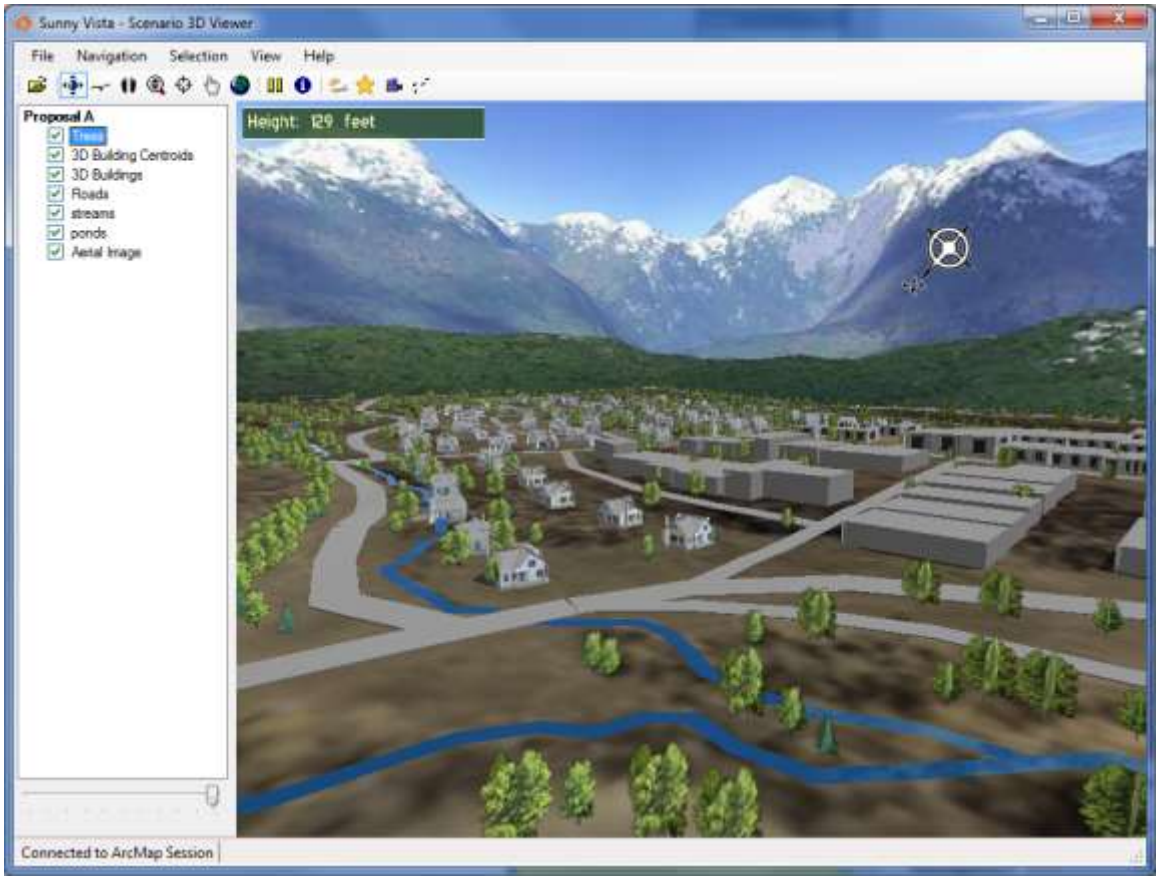
If you did not make a scene, you can view one that has been made for you already. From Windows Explorer, navigate to the Tutorial 4.scene file normally stored here:

C:\CVFiles\Sunny Vista\3D\Tutorial 4.scene

Double-click the file; this will launch the Scenario 3D Viewer application and open this scene.

3D Viewer Navigation

This part of the tutorial gives you a tour of the features in the Scenario 3D Viewer. You may wish to maximize the 3D Viewer window for comfortable viewing.



There are several choices for moving around, or "navigating," the scene. You can choose among them using the **Navigation** toolbar. For a complete list of navigation commands and options, see the Help. You will need a **3-button mouse**: left button, right button, and center scroll wheel. The scroll wheel can be pushed down like a regular button or rolled.

1. Start with the **Maneuver** mode. This navigation mode provides a quick, efficient way to move around and orient the scene. Try gently **dragging** (holding down the button and moving) with each mouse button (left, right, and center) to see the different effects. **Scroll** the middle mouse scroll wheel to zoom in and out. Pick an object in the scene and the **Ctrl+Left Click** on it. This makes that object the new focal point. Notice it stays in the center of the scene as you zoom or left-mouse maneuver.
2. To get back to the starting point and get your bearings, click **Full Extent**.
3. Switch to the **Fly** mode. This aptly-named mode moves you gracefully through the scene and is good for giving yourself and others "tours" of the area. Click and hold the left mouse button to **move forward** toward the cursor and **steer** by moving the cursor around the screen. Click and hold the right mouse to **go backward**. Roll the scroll wheel away from you or toward you to **change your speed**. Notice that your speed is shown in the display in the upper left.
4. Switch to **Walk** mode. This keeps you at a constant height above the terrain as you move through the scene. Use the keyboard keys "w," "a," "s," and "d" to **move laterally** and use the cursor to **steer**. As with flying, you can **change your speed** with the scroll wheel and **adjust your height** by dragging with the middle mouse button pressed down. Try "walking" to the pond to see the effect of the ***Oceans water material***. Set your height to about 6 feet and look for reflections of the mountains.
5. Switch to **Zoom** mode. Double-click on an object in the scene and you will automatically be flown to it.

6. Switch to **Select** mode. Although you can use this mode for simple navigation, its real purpose is "selecting" or choosing features in the scene just as you would select features in ArcMap with a tool like ArcMap Select. Just as in ArcMap, it may be helpful to choose the layers you want to select. To do so, use **Selection > Set Selectable Layers.** Select features by clicking on one or by dragging a rectangle that touches them. They will be highlighted with a semitransparent box. Find those features' attribute values by clicking **Identify**. When finished, **Close** the **Attribute** window and clear the yellow highlight boxes using **Selection > Clear Selection.**
7. The **layer list** on the left of the 3D Viewer works a lot like the one in ArcMap.
    a. **Clear** a few of the checkmarks to see the corresponding layers disappear from the scene. Turn them back on when finished.
    b. (If you have more than one scenario (map or data frame) in your scene, **right-click** on a heading in the layer list and choose **Activate** to display a different scenario.)
    c. Change the transparency of one or two layers. Click a layer name to highlight it, then move the **Transparency** slider bar at the bottom of the list. Notice that Trees look better when left slightly transparent.

Environmental Effects

The 3D Viewer allows you to introduce environmental effects such as lighting, shadows and fog into the scene. Unlike features in layers, these effects are not calculated by your GIS system; they are for display purposes only. Nevertheless, they can be helpful and informative.

1. Open the Environment controls using the **Environment Controls** icon or **View > Environment Controls** and look through the options available to you.
2. Toggle the **Sky** on and off by clicking its check box. Note that the background Sky, including the clouds, distant mountains, and sun, is a static image that you can never get close to or "touch." Leave the Sky **on.**
3. Toggle **Lighting** on and off by clicking its check box. With lighting on, change the **Time of Day** and notice the effect on the sides of 3D objects. Leave Lighting **on.**

Lighting is actually a property of objects, not the surrounding scene. 3D objects that have been given "lighting" properties have more shading on sides that face away from the virtual light source. Objects without lighting are fully lit on all sides. Paradoxically, "lighting" actually makes most objects darker, at least on some sides.

4. Toggle **Fog** on and off. With Fog on, move the Fog slider bar to change its density, which affects how far you can see. For better perspective, try moving to **Full Extent**. Turn fog **off.**
5. Use the slider bar to change the **View Distance**. This causes distant objects not to be drawn, which can improve performance in some cases. For now, restore it to **maximum** distance.
6. Toggle **Shadows** on and off and notice the effect. The length and direction of shadows are determined the **Time of Day** and **Latitude**, which you can set separately. Shadows fall only on ground images, not on surface-conforming polygons or other objects. Leave Shadows **on.**

Bookmarks

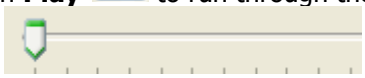
Scenario 3D bookmarks save a particular location and viewing angle so that you can return to it later. They provide a useful, easy way to save and find particular views.

1. Navigate to an interesting position in the scene.
2. Go to **View > Bookmarks** or use the **Bookmarks** icon to open the **Bookmarks** window.
3. Click **New Bookmark**. Type the name ***My Interesting Place*** and click the **Enter** key on your keyboard.
4. **Navigate** to a new position and create a **second bookmark**. Notice that the bookmarks are listed in alphabetical order by name.

5. Highlight ***My Interesting Place*** in the list and click **Go To Bookmark**  . Watch the scene automatically navigate to the correct location. (The speed of transition can be set in **File > Preferences > Navigation**.)

Flythroughs

Scenario 3D flythroughs are particular navigation paths that you have saved and can retrace or replay in either direction and at any speed. They provide a useful way to give tours of your scene.

1. Open the **Flythrough Controls toolbar** from the **Flythroughs**  icon.
2. Click **Create New Flythrough**  to start the process. **Enter a name** for the flythrough you are about to create.
3. Click **Start Recording**  to begin the process of storing the current view.
4. **Navigate** through the scene as desired, using any navigation tool. A **timer** appears just below the Start Recording button to show you how much time has elapsed. Aim for ***5 – 10*** seconds.
5. When finished, click **Stop Recording**  . The flythrough is now saved.
6. Click **Rewind**  and then **Play**  to run through the flythrough as if it were a movie.
7. Use the **Flythrough Slider**  to move immediately back and forth to any time in the flythrough. The timer at the right shows the current position in the flythrough's overall timeline. You can make and save multiple flythroughs if desired. To delete a flythrough, use the **File > Scene Properties... > Flythroughs** tab.

Hyperlinks

One benefit of Scenario 3D scenes is that they are "information rich." If you are making a scene to show other people, you may want them to be able to click on objects and get a photo, an audio recording, a website, or some other media telling them more. Maybe you'd like your viewers to be able to click on a person and hear the person "talk" with a recorded voice. Hyperlinks help you make this happen.

Here is an example.

1. Make sure ***3D Building Centroids*** are selectable using **Selection > Set Selectable Layers.**
2. Navigate to a place where you can comfortably view some of the houses in this layer.
3. Hyperlinks are not active in a scene until you set them up. Right-click on the ***3D Building Centroids*** layer in the list and choose **Properties....** You may have to wait a moment for this window to appear.
4. In the Hyperlinks drop-down, choose the attribute field ***Website***. This is a text attribute we created in the ***3D Building Centroids*** layer that contains the full path name of the website we want to open.
5. Click the **Hyperlink**  icon in the navigation toolbar.
6. Hover the cursor over a particular house and wait for yellow highlighted text to appear.
7. **Click.** Your computer should recognize the weblink and open your default web browser to the correct page, www.communityviz.com.

Movies

The best way to experience Scenario 3D scenes is with the 3D Viewer. However, if you want to share a model with other people who do not have access to the 3D Viewer, recorded movies (videos) may be a good alternative. They allow you to record the view as you navigate through the scene, usually by following a preset flythrough

path. When finished, movies are stored as a stand-alone *.avi or other files that can be freely shared with others.

Movie files can quickly become very large. Use caution when recording and plan ahead if possible.

1. Open the **Flythrough Controls**  toolbar. Make sure that the name of an existing flythrough is showing.
2. Click **Movie Recorder**  .
3. When prompted, enter a **name** for the movie you are about to create. Click **Save.** A movie of your flythrough will be created.
4. To **view** the movie, use Windows Explorer to navigate to its location and double-click it. The default directory for movies is **C:\Users\<username>\Documents\Scenario3D\Movies**. Your computer's media player should launch it automatically.

Movies can also be created "free-hand" without using a flythrough, but quality may suffer. Use **View > Movie Recorder**. If you have trouble creating or viewing the movie, you may need to adjust your default recording settings via **File > Preferences > Movies.**

Congratulations – you have completed Tutorial 4

This tutorial has given you a tour of many, but not all, Scenario 3D features in the 3D Exporter and 3D Viewer. We recommend you look back through the steps to review the Scenario 3D features you used and reflect on the overall approach to the 3D modeling, focusing more on the functions than on the exact buttons and steps. For more information on features, tips, and details, look through the **Help** system available from the **Help** menu.

Tutorial 5 – Setting up and running a build-out analysis

This tutorial walks you through creating and running a detailed build-out analysis. For a simpler introduction to the basics of build-out, use Tutorial 1.

Build-out analyses allow planners to estimate the **amount** and **location of development** for an area. Performing a build-out analysis is the step in the community planning process that identifies the **holding capacity** of the land in terms of buildings and/or floor space. Build-out is a supply-side calculation applied to a clearly delineated area that is based on assumptions for density, physical constraints to development, and land-use regulations that define the size and placement of structures for that area.

A build-out analysis provides an answer to the question "how many buildings could be built in this area according to current land-use regulations?" A build-out analysis provides a convenient reference for future planning because it represents a **theoretical maximum**. It does not imply or forecast how many buildings will actually be built.

In this fictional example, you will run a build-out analysis on a study area containing multiple land-use designations.

Once installed using the "Install the tutorial data" directions, you will find this analysis in the **CVFiles\Build Out** folder. For detailed information on build-out, please see the "Working with the Build-Out Wizard" document available separately.

Data requirements for Build-Out

Before running a Build-Out, you will need:

- A land-use layer (like a zoning map, master land-use plan, or a parcel map).
- This land-use layer must be a **projected coordinate system** as opposed to a geographic coordinate system. More information on coordinate systems can be found in ArcMap's help or at the ArcGIS website.
- The land use layer must have an **attribute** that specifies the **land-use designation** (like zoning type, permitted use description, or land-use code) as a **text field** (not numeric) and cannot exceed 100 characters.
- The land-use layer must have an **attribute** that specifies the **unique identifier** of each land-use area (like feature ID or parcel number).

You will be prompted for this information as you move through the Build-Out Wizard.

About build-out analysis

A build-out analysis is one the many kinds of analyses that are possible with Scenario 360. In the fictional study area, differing land-use designations will be considered for future planning. The build-out process contains 3 separate, but integrated steps: numeric, spatial, and visual. In this tutorial, you will experiment with all three.

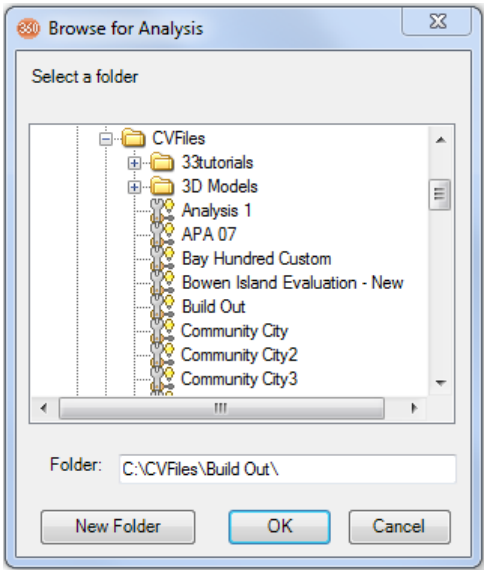
Objective

- Estimate how many buildings could be built in the study area according to current land-use regulations.
- Place the estimated building points in your map view while taking into account the actual geometry of land-use areas and buildings.
- Visualize the buildings in 3D.

Constraint

Proximity to wetlands environmental area.

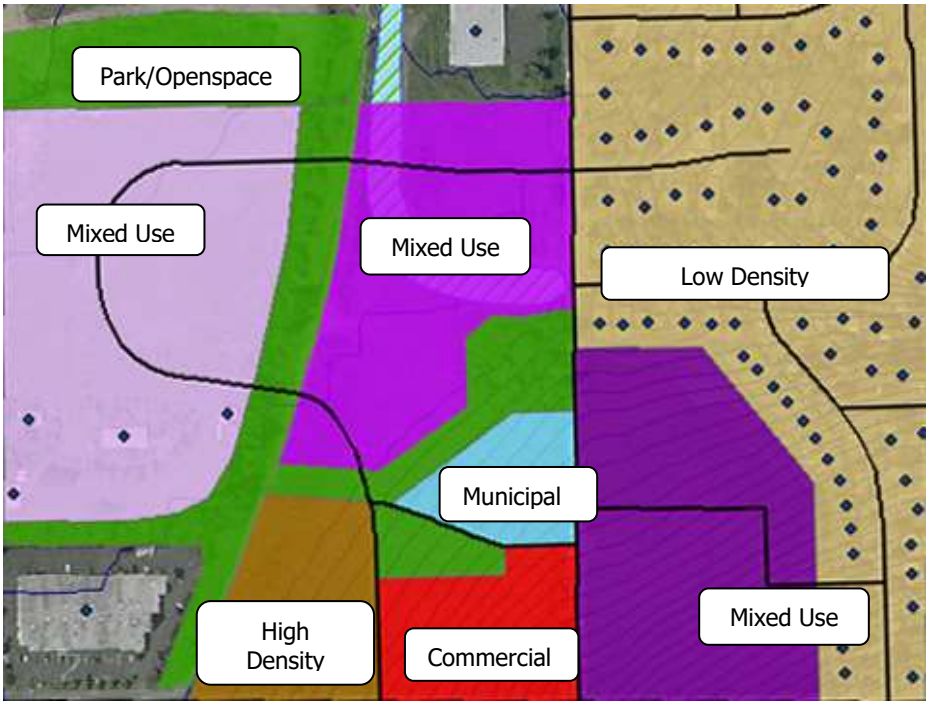
Opening an existing analysis



1. If you haven't already, start Scenario 360 by double-clicking on the Scenario 360 icon on your desktop. If Scenario 360 is open, click the **Start a Scenario 360 Analysis** button on the Scenario 360 toolbar.
2. On the Welcome to Scenario 360 window, click **Open Existing Analysis**.
3. Browse to the **CVFiles/Build Out** file, click the file, and click **OK**. If you had a previous analysis open, you will be prompted to save your changes.

Scenario 360 will load and display a fictional study area being considered for development. This area displays eight land use designations:

- Low Density Residential
- High Density Residential
- Mixed Use A
- Mixed Use B
- Mixed Use C
- Commercial
- Municipal
- Park/Openspace



The land-use rules for this fictional analysis are included in the table below. In this tutorial, you will be walked through entering this information into the Build-Out Wizard to run your build-out analysis.

Land-Use Designation	Density	Mixed Use	Building Info	Min Separation Distance
Commercial	.25 FAR		0 DU/Building 10000 sq. ft. 1 floor	100 feet
High Density Residential	14 DU/acre 80% efficiency		6 DU/Building 4 floors	80 feet
Low Density Residential	0 DU/acre (already built)		0 DU/Building 0 floors	0 feet
Mixed Use A	3 DU/acre .2 FAR 50/50 % split		1 DU/Building 1400 sq. ft. 3 floors	80 feet
Mixed Use B	.65 FAR	Apartments = 30% and 1200 sq. ft Retail = 20% Office = 50%	0 DU/building 2800 sq. ft. 5 floors	80 feet
Mixed Use C	.3 FAR	Apartments = 75% and 1000 sq ft Retail = 25%	0 DU/Building 4000 sq. ft. 2 floors	100 feet
Municipal	.3 FAR		0 DU/Building 3 floors	40 feet
Parks/Openspace		0 DU/Building 0 floors		0

Opening the Build-Out Wizard

The Scenario 360 Build-Out Wizard automates the entire build-out process. It guides you through the choices and selections that will form the basis of your build-out analysis. You can access the Build-Out Wizard using the Scenario 360 toolbar. Click the **Scenario 360** drop-down list, point to **Tools**, and click **Build-Out Wizard**.

For this tutorial you will used the Advanced version of the Wizard. Click the **Advanced** button on the Welcome screen.

Setting up a numeric build-out analysis

For a numeric build-out analysis, the Build-Out Wizard will calculate the estimated building capacity (in numbers) for each polygon in an area.

1. Open the Build-Out Wizard.
2. Click the **Numeric** button.

Specifying land-use information

When following the numeric Build-Out Wizard steps, you will be prompted to specify:

- A land-use layer (like a zoning map, master land-use plan, or a parcel map). This must be a projected coordinate system (as opposed to a geographic coordinate system). For information on coordinate systems, see ArcMap help.
- The attribute in that layer that specifies the land-use designation (like zoning type, permitted use description, or land-use code). This must be a text field (not numeric) and cannot exceed 100 characters.
- The attribute that specifies the unique identifier of each land-use area (like feature ID or parcel number).

In this tutorial, the data has been set up for you.

1. On the **Specify Land Use Layer** screen, ensure that **Land Use** is selected as the layer containing land use information;

2. The attribute specifying land-use designation should read **LU_Designation**.
3. The attribute specifying the unique identifier of each land-use area should read **OBJECTID**.
4. Preview the land-use designations in the field provided, then click **Next**.

Setting up density rules

Density is an indication of the number of buildings per unit area. Attributes specifying land-use designations may contain fields that describe the permitted (or projected or planned) densities in each polygon. For residential polygons, density is often provided in dwelling units per area, number of dwelling units, or minimum lot size per area. For nonresidential polygons, density is usually provided in floor area or by using a floor area ratio (FAR). If these fields are not provided, you may enter numbers for each land-use type in the Build-Out Wizard, or use the default values suggested by the Wizard.

1. Either type or click and select from a provided drop-down list to fill in the fields with the information shown in the image below:

Designation	Dwelling Units		Floor Area	
	Quantity	Measurement	Quantity	Measurement
Commercial	0	None	0.25	FAR
High Density Residential	14	DU per acre	0	None
Low Density Residential	0	None	0	None
Mixed Use A	3	DU per acre	0	None
Mixed Use B	0	None	0.65	FAR
Mixed Use C	0	None	0.3	FAR
Municipal	0	None	0	None

2. Do not exit the Wizard or click Next at this time.

Using the FAR Estimator

Sometimes, land-use regulations don't specify FAR but instead use other rules such as minimum set back from lot lines and maximum building height. The Build-Out Wizard includes a FAR Estimator to help you derive FAR from other commonly used land-use rules. You will use the FAR Estimator to calculate FAR for the Mixed Use A and Municipal designations.

Calculating FAR for the Mixed Use A designation:

1. Click the **FAR Estimator** button on the **Density Rules** Wizard screen.
2. Click the **Lot Size/Setback** tab, click to place a checkmark next to **Average lot size is sq. feet or sq. meters** and type **1400** into the field provided. Note, the FAR Estimator does not need to know which measurement system (feet or meters) you are using, but you must be consistent.
3. Make sure there is a checkmark next to **Building setbacks in sq. feet or sq. meters** and type **30** in the **Front setback** field.
4. The FAR calculation at the bottom of the window should read **.2**.
5. Click to select **Mixed Use A** from the **Apply to land-use designation** drop-down list then click **Apply**.

Calculating FAR for the Municipal designation:

1. Click to remove the checkmarks on the **Lot Size/Setback** tab then click the **Buildings** tab.
2. Click to place a checkmark next to **Maximum building heights** and type **3** for the number of floors allowed.
3. Click to place a checkmark next to **The building coverage ratio** and type **10** in the field provided.
4. The FAR calculation should read **.3**.
5. Click to select **Municipal** from the **Apply to land-use designation** drop-down list then click **Apply**.

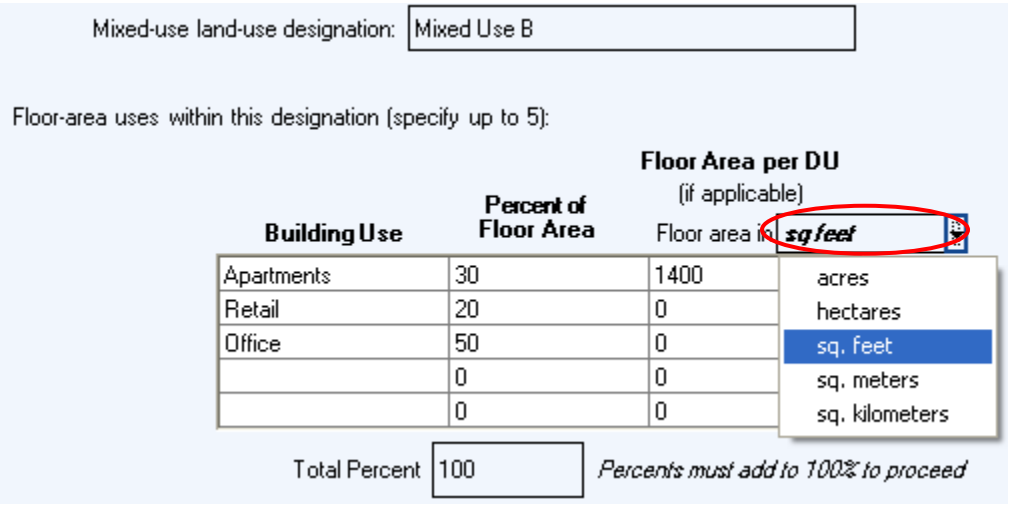
6. Click the **Close** button to close the FAR Estimator and view the FAR calculated for the Mixed Use A and Municipal designations on the Wizard screen. Verify that your numbers match those in the image below. Do not exit the Wizard or click Next at this time.

Designation	Dwelling Units		Floor Area	
	Quantity	Measurement	Quantity	Measurement
Commercial	0	DU per acre	0.25	FAR
High Density Residential	14	DU per acre	0	FAR
Low Density Residential	0	DU per acre	0	FAR
Mixed Use A	3	DU per acre	0.2	FAR
Mixed Use B	0	DU per acre	0.65	FAR
Mixed Use C	0	DU per acre	0.3	FAR
Municipal	0	DU per acre	0.3	FAR

Specifying mixed-use designations

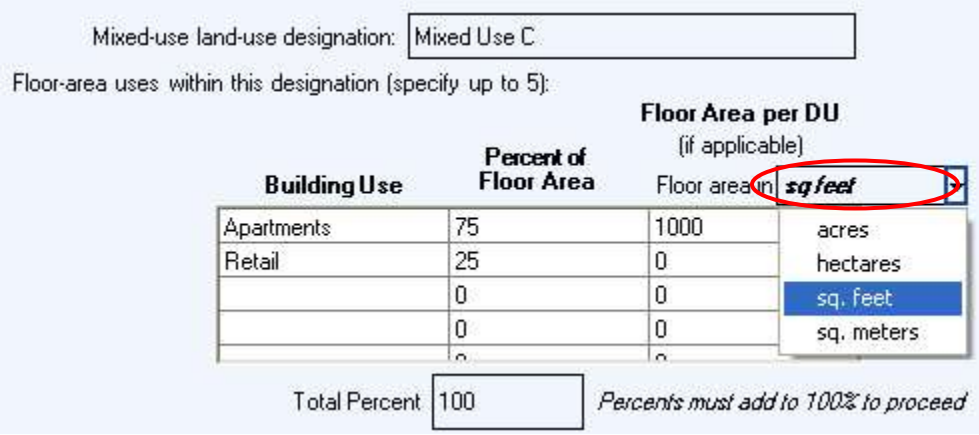
Build-out can apply to residential dwelling units (DU) and/or commercial or mixed-use buildings. Mixed-use buildings can include both DU and commercial space. In your study area, Mixed Use A is a mixed-use land area with some all-residential buildings and some all-non-residential buildings. Mixed Use B includes mixed buildings with apartments, retail, and office space. Mixed Use C includes buildings with apartments and retail space. When using the Wizard for mixed-use buildings (as in these two examples), the number of dwelling units is specified in the mixed-use screens shown below – not in the density screens. This way, even though the density screen says 0 DU/acre, the residential units within mixed-use buildings will still be counted in your analysis.

1. Place a checkmark next to the link **One or more designations include mixed-use buildings** on the **Density Rules** Wizard screen and click **Next**.
2. In this analysis, two of your mixed use designations include mixed use buildings. Click to place a checkmark next to the Mixed Use B and Mixed Use C designations and click **Next**.
3. Make sure the units drop-down list under **Floor Area per DU** has **sq feet** selected. Then, using the information provided in the image below, type the **Building Use** field information and the **Percent of Floor Area per DU** information for Mixed Use B in the fields provided.



4. Ensure that your building use percentages add up to 100% and click **Next**.

5. Make sure the units drop-down list under **Floor Area per DU** has **sq feet** is selected. Then, using the information provided in the image on the next page, type the **Building Use** field information, the **Percent of Floor Area**, and the **Floor Area per DU** information for Mixed Use C in the fields provided.



6. Ensure that your building use percentages add up to 100% and click **Next**.
7. Because you entered both residential (DU) and commercial (FAR) uses for the Mixed Use A designation, you are given the option to specify the percentages of land area that will be considered when calculating densities for residential and commercial use. On the **Mixed-Use Percentages** Wizard screen click the radial button to select **Specify smaller percentages**, then type **50** into the Dwelling Units **Percent** field and **50** into the Floor Area **Percent** field. (If you leave these percentages at 100 each, the tool will calculate the number of residential units and commercial floor per polygon independently, using the densities you gave on the Densities screen and the entire area of the polygon.)
8. Click **Next**.

Using efficiency factors

Efficiency factors adjust density values to reflect common density losses. They are entered as a percentage where 100% means complete efficiency (no density lost), and 0% means no buildings will be estimated for that land use. In this fictional analysis, the High Density Residential designation requires 10% of the area to be dedicated to roads and 10% to schools. Therefore, you need to enter efficiency information for this designation.

1. Click to select the **Customize efficiency for each designation** option.
2. For the **High Density Residential** land-use designation, type **80** in the **Efficiency Percent** field and click **Next**.

Entering building information

The **Building Information** Wizard screen allows you to set up building size, dwelling units per building, and footprint of each building.

1. Make sure the units drop-down list under **Area** has **sq feet** selected.
2. Using the information provided in the image below, type the **DU per Building**, **Area** (in sq. feet), and the **Floors** in the fields provided then click **Next**. Again, note that Mixed Use B and C correctly show 0 DU per building on this screen because their dwelling unit numbers are calculated by a different method.

Designation	DU per Building	Area sq. feet	Floors
Commercial	0	10000	1
High Density Residential	12	0	3
Low Density Residential	1	0	1
Mixed Use A	1	1400	3
Mixed Use B	0	2400	5
Mixed Use C	0	4000	2
Municipal	0	2800	5
Park/Openspace	0	0	0

Specifying constraints to development

The "Constraints to Development" screen allows you to prevent development in particular places, such as a designated wetlands area or a right-of-way. For this example:

1. In the **Available Layers** list, click **Wetlands**, click the **Add selected layer(s) to constraints** button, then click **Next**.

The wizard also provides the ability to specify a minimum lot size, so that a polygon that is too small is not allowed to have any buildings. For this example you will not use that option.

Specifying existing buildings

If an area is zoned for 100 buildings but already contains 15, then you may want to limit your study to the 85 new buildings that are allowed. The build-out wizard can automatically subtract existing buildings from its results if you specify a point layer containing them. Normally each point is considered to be one dwelling unit, but if the layer contains attributes that specify a particular number of dwelling units per point, or a commercial floor area per point, you can use them here.

1. In the **Available Layers** list, click **Existing Buildings**, then click the **Add selected layer(s) to existing buildings** button.
2. In the **Value or attribute specifying DU/bldg** field, select **DUs** from the drop-down list.
3. In the **Value or attribute specifying floor area** measurement drop-down list, make sure **sq feet** is selected, then select **FootPrntSF** from the drop-down list in the field provided.
4. Click **Next**.

Layers containing existing buildings	Value or attribute specifying DU/bldg	Value or attribute specifying floor area: sq feet
Existing Buildings	DUs	FootPrntSF

Running a numeric build-out analysis

You can run a numeric build-out analysis by itself or as the first step in running a spatial or visual build-out analysis. In this tutorial, you will run the numeric build-out, view the results, then continue on to spatial build-out.

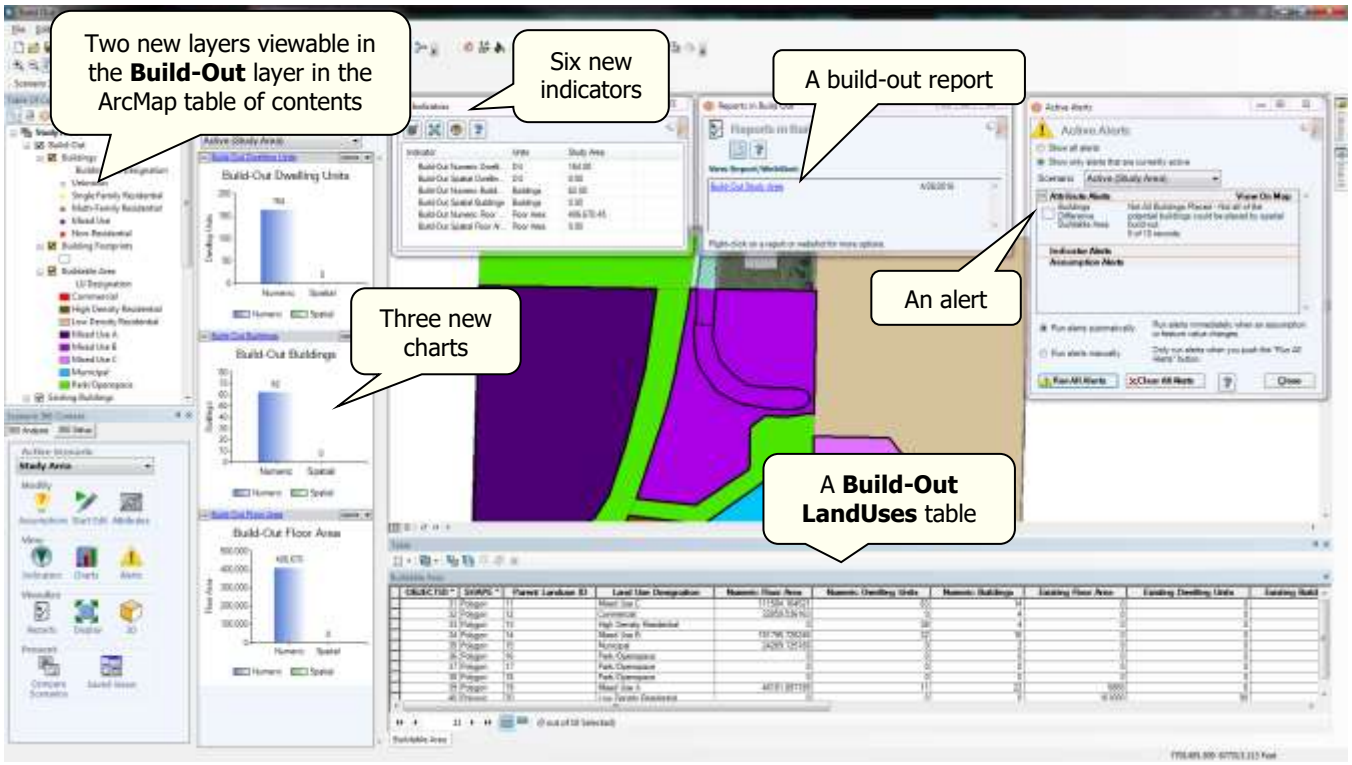
1. Ensure the output units for the available floor area read **sq feet**.
2. Click on **Finish** on **End of Numeric Phase** window to Finalize set up of numeric build-out and continue to the next step.
3. Make sure that only **Numeric** is selected (it has a checkmark next to it) and click **Run Build-Out** on **Finish** window.

Numeric build-out will now convert your land-use information (like density, design efficiency factors, and constraints to development) into numeric building counts. Running this numeric build-out analysis produced:

- Two new layers viewable in the **Build-Out** layer in the ArcMap table of contents. One is called **Buildings** and the other is **Buildable Area**. You can click and drag the **Build-Out** layer set beneath the **Existing**

Buildings and **Roads** layers in the ArcMap table of contents to view existing buildings and roads in your map view.

- A **Build-Out LandUses** table. You can click the **List by Source** tab, right click on the **Build-Out LandUses** table and click **Open** on the pop-up menu to view the contents of this table.
- Six indicators. Click the **List Indicators** button on the Scenario 360 toolbar to view the new indicators.
- A **Build-Out** report. Click the **List Reports** button on the Scenario 360 toolbar then click on the report name to view the report.
- Three new charts: **Build-Out Dwelling Units**, **Buildings**, and **Floor Area**. Click the **View Charts** button on the Scenario 360 toolbar to open the charts view. You may
- A new **Buildings Difference Buildable Area** alert. Click the **List Alerts** button on the Scenario 360 toolbar then click **Show all alerts** to view the alert. You may need to **Run All Alerts**.



Setting up a spatial build-out analysis

Spatial build-out will create a new point or polygon layer representing individual buildings placed on the map according to your land-use rules. Spatial build-out can take a long time so it's a good idea to try some initial experiments with a hundred buildings or less before working with larger numbers. Settings in the Spatial Layout window are vital to the final spatial build-out results.

Spatial build-out converts the numeric building counts into points representing individual structures. It then refines the numeric building counts by taking into account the actual geometry of land-use areas and buildings. For example, an oddly shaped lot may have enough total area for 2 buildings, but because of setback rules or minimum separation distances, it may only fit 1 unit. You must first run a numeric build-out analysis (to get the numeric building counts) if you wish to run a spatial build-out analysis.

1. Open the Build-Out Wizard.
2. Click the **Spatial** button.

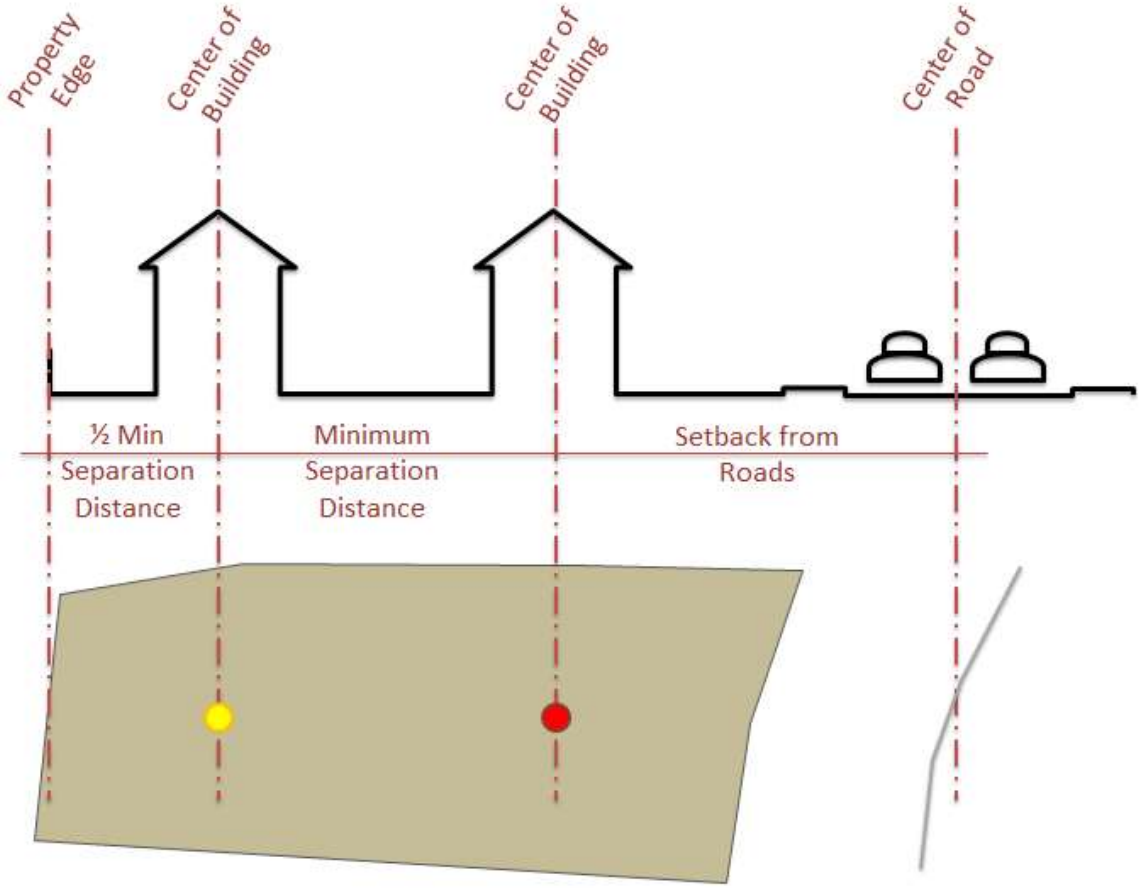
Specifying building separation distances and choosing a layout pattern

When setting up a spatial build-out analysis, you will be prompted to specify building **minimum separation distance** rules for your land-use designations. Building separation identifies the minimum distance required between building centroids.

The **minimum separation distance** defines the minimum distance between a new building point/polygon center and another existing or new building point or polygon center. Also, a new building point will be separated from its containing polygon's edge by at least half the minimum separation distance. If you set the Minimum Separation Distance too large, no buildings will be allowed. Therefore it's best to begin conservatively with a smaller distance that you can increase in later runs. Settings are retained from one run to another, so you can skip other windows that contain values you don't want to change.

In choosing a Layout Pattern for the proposed buildings, "**Random**" is a good layout pattern to start with. If you use the **Follow Roads** layout pattern, you must specify a **Setback** distance. The setback is the exact distance from the road centerline to the building point or building polygon center. Setback distances are ignored when the grid or random layout pattern is used.

Tip: Setback distances should be greater than the distance from the road centerline to the edge of the land-use polygon PLUS half the minimum building separation distance. Otherwise, no building will be placed.



You have control over whether the spatial build-out building points are distributed in a random or grid pattern, or if you want the points to follow a road layer.

1. Make sure the units drop-down list under **Minimum Separation Distance** has **feet** selected.
2. Make sure the units drop-down list under **Setback** has **feet** selected.
3. Using the information in the image below, type or click and select from a provided drop-down list to fill in the **Minimum Separation**, **Layout Pattern**, **Road or Line Layer**, and **Setback** fields.

Designation	Minimum Separation Distance (feet)	Layout Pattern	Road or Line Layer	Setback (feet)
Commercial	100	Random		0
High Density Residential	80	Grid		0
Low Density Residential	0	Random		0
Mixed Use A	80	Follow Roads	Roads	60
Mixed Use B	80	Grid		0
Mixed Use C	100	Random		0
Municipal	40	Random		0
Park/Openspace	0	Random		0

4. Click **Next**.

Running a spatial build-out analysis

Each time you run a new build-out analysis on a given scenario, the old build-out analysis for that scenario will be overwritten. To explore and compare different alternatives without overwriting your previous results, you are given the option to create and use new scenarios in your analysis. For example, you may want to compare "build-out if we impose more restrictive zoning" versus "build-out if we create an enterprise zone". In this tutorial, we will run each build-out step and overwrite the previous results.

1. Move the slider bar to **100**. This is a small study area and will not take a long time to process.
2. Click on **Finish** next to the **Finalize set up of numeric and spatial build-out and continue to the next step** option.
3. Make sure that only **Numeric** and **Spatial** are selected (they have a checkmark next to them) and click **Run Build-Out**.
4. A pop-up window will ask whether you want to overwrite existing build-out results. Select **Overwrite the current results** and click **OK**.

Spatial build-out analysis results

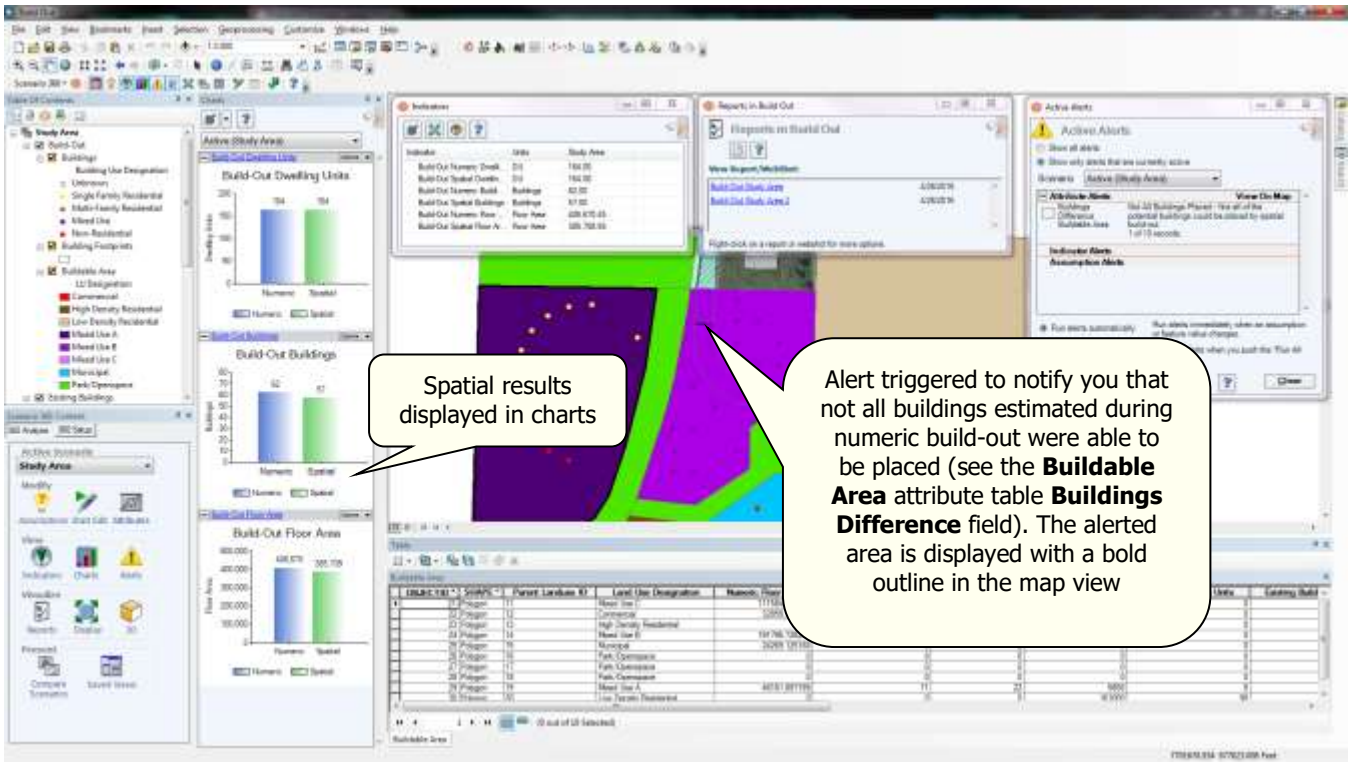
Spatial build-out converts the building counts estimated during numeric build-out into points representing individual structures you can view on your 2D map. Potential building points are distributed two-dimensionally into each polygon one at a time. Spatial build-out places building points so that they avoid development constraints, other buildings, and polygon boundaries (land-use areas, zone districts, or lot lines).
Spatial build-out analysis takes into account factors which cannot be accounted for in a numeric estimate, such as the minimum allowable offset between building or parcel shapes. Therefore, the results of spatial build-out are sometimes lower than the numbers derived in a numeric build-out.

Keep in mind the following when viewing the results of a spatial build-out analysis:

- A new building point will be separated from another new building or any existing buildings point in the same polygon by at least the minimum separation distance specified for that polygon's land-use class.
- A new building point will be offset from its containing polygon's edge by at least half the minimum separation distance specified for that polygon's land-use class.
- If a building does not appear in a polygon when you expect one to appear, or if fewer buildings are added than there is capacity, examine the attributes of the polygon. Was an estimated capacity correctly computed? Are there more existing buildings in the polygon already than there is capacity? Also, examine the dimensions of the polygon. Perhaps the minimum offset distance is too large.
- After spatial build-out has been run, you are free to edit the new buildings layer manually. You can add, move, or delete building points. This way you can turn a planning-level building pattern into more of a design-level distribution, with buildings following a uniform frontage line, etc.

Running this spatial build-out analysis:

- Populated fields in the **Buildable Area** attribute table and the **Build-Out LandUses** table. Right-click on the **Buildable Area** layer in the ArcMap table of contents and click **Open Attribute Table** to view the contents of this table. You can also click the **Source** tab, right click on the **Build-Out LandUses** table and click **Open** on the pop-up menu to view the contents of this table. You map may not match this picture exactly. There is some randomness in each run of spatial build-out.
- Added information to the **Build-Out** report.
- Updated the **Spatial** information in the charts created during numeric build-out.
- Triggered the **Buildings Difference Buildable Area** alert created during numeric build-out. Click the **List Alerts** button on the Scenario 360 toolbar, click to select the **Show only alerts that are currently active** option, then click **Run all alerts** to view the alert. The alerted area is displayed in the map view with a bold outline. It has been colored red in the image on the next page to highlight the area.



Setting up a visual build-out analysis

Spatial build-out placed the building points onto the 2D map. Visual build-out designates a building model (flight) file for those building points that can be viewed in a 3D scene. Therefore, you must first run spatial build-out (which requires you to run numeric build-out) before running a visual build-out.

There are three options for models that you can use with visual build-out.

A. Using models from the CommunityViz Model Library, suitable for viewing in Scenario 3D or Google Earth.
B. Using models created in SketchUp® or downloaded from Trimble's 3D Warehouse, and also suitable for use with Scenario 3D or Google Earth.
C. Using models you create or obtain yourself, in 3DS, DAE, or KMZ format.

To learn more about these options, read this section. To continue with the tutorial, skip to the section "To conduct a visual build-out" below.

A. Using models from the CommunityViz Model Library:

The CommunityViz Library contains a useful collection of pre-made KMZ-format 3D models that can be used in Scenario 3D or Google Earth in conjunction with the CommunityViz Google Earth Exporter.

Normally these files are installed in C:\CVFiles\3D Models\KMZ or in C:\Program Files (x86)\CommunityViz\Scenario 3D\Library.

B. Using models created in SketchUp or downloaded from the 3D Warehouse:

Google operates a warehouse of 3D models provided by the public intended for public use. Go to: https://3dwarehouse.sketchup.com

At this website, you can search for a model representing the building type you desire, e.g. schoolhouse, and click on "Download to SketchUp." Once you are in SketchUp, export the image to a .KMZ file, saving it to the C:\CVFiles folder where your analysis is stored, e.g. C:\CVFiles\Sunny Vista. Later you will navigate to this location to use this image. Go to:
http://www.sketchup.com/

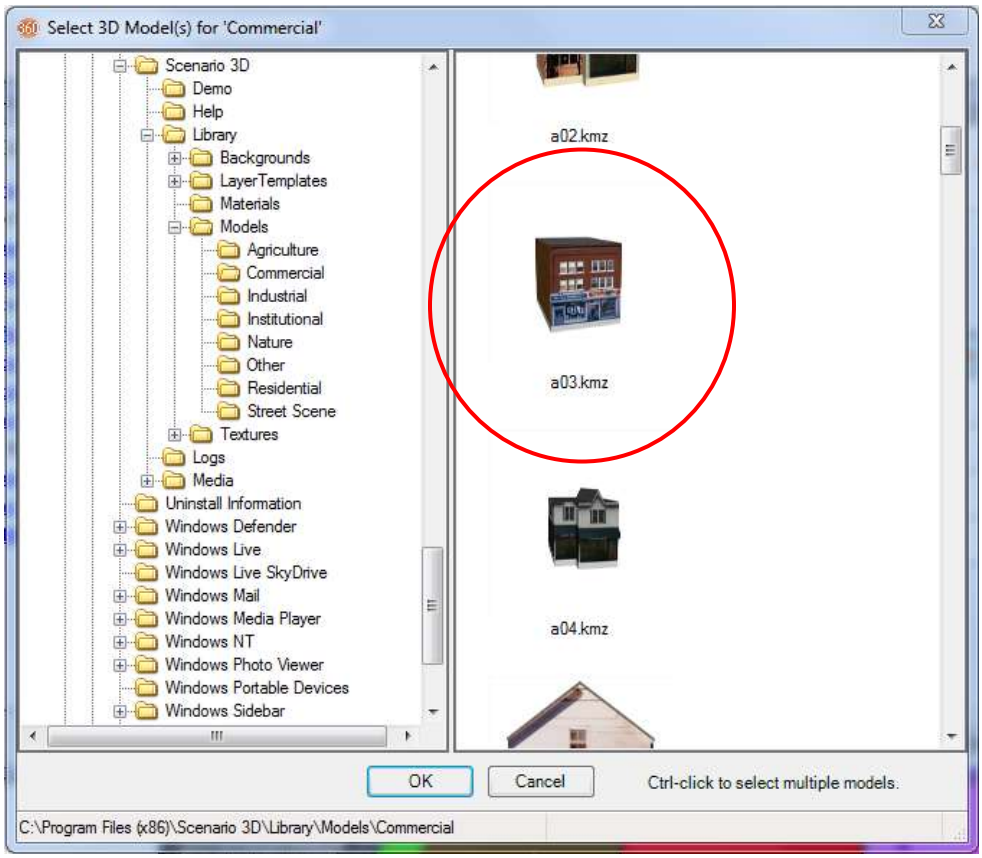
Once at this website, go to the "Downloads" tab where you can download the software SketchUp for free. Use the tutorials or SketchUp instructions to learn how to create your own model. Once satisfied with your model, export the model to a .KMZ format, saving it to your analysis folder, e.g. C:\CVFiles\Sunny Vista. Later you will navigate to this location to use this image.

C. Using models you obtain or create yourself:

Scenario 3D supports files in KMZ, 3DS, and DAE (COLLADA Interchange) formats. Google Earth supports files in KMZ format.

To conduct a visual build-out:

1. Open the Build-Out Wizard.
2. Click the **Visual** button.
3. Click once in the **3D Model** field next to **Commercial** then click the **Browse** button  .
4. Navigate to the location on your hard drive where your models are located.
    - To use the pre-made CommunityViz KMZ models (for use in Scenario 3D or Google Earth), go to C:\CVFiles\3D Models\KMZ or to C:\Program Files (x86)\CommunityViz\Scenario 3D\Library.
    - If you saved SketchUp or 3D Warehouse models in your analysis folder, you can look there, e.g. C:\CVFiles\Sunny Vista\data.



5. Browse for a suitable building, click once to select it, and then click the **Select** button. Use the **CTRL** key to select multiple buildings.
6. Continue steps 3-5 for all of your building layers (you do not have to select a model for the **Park/Openspace** layer). When you have completed selecting models, click **Next**.

Running a visual build-out analysis

1. Make sure that **Numeric**, **Spatial**, and **Visual** are selected (they have a checkmark next to them) and click **Run Build-Out**.
2. Click **Run Build-Out**. A pop-up window will ask whether you want to overwriting existing build-out results. Select **Overwrite the current results** and click **OK**.

Visual build-out analysis results

Visual build-out provides a convenient way to populate the 3D model file field in the buildings layer created during your spatial build-out analysis. You can use this field when you create a 3D model of your scene in Scenario 3D, as described in the **Scenario 3D Tutorial**, or in Google Earth, as described in the **Google Earth Export Tutorial.** To use the building models you specified in visual build-out:

In Scenario 3D:

1. In **3D Scene Settings** on the **Scenarios & Layers** tab, double click the ***Buildings*** layer to set its properties
2. Under **Substitution Method**, choose **Model Attribute**
3. Under **Model Attribute**, select the attribute called ***3D Model***.
4. Optionally, adjust any Option settings. These will be the same for all models in this layer.
5. Click **OK**.

Set up the rest of the Scenario 3D scene normally. When ready, click Export Now on the Scenario 3D toolbar to create your scene, then view it with the Scenario 3D Viewer.

In Google Earth:

1. In the **Google Earth Exporter** on the **Layers** tab, select the ***Buildings*** layer
2. Export Layer as **3D Model**
3. For **3D Model Settings**, choose **Get 3D model file from a field**
4. Choose the **Model File Field** called ***3D Model.*** You can use the 3D models generated by visual build-out in *either* Scenario 3D *or* Google Earth, but not both at once. If you want to use both 3D tools, use another method for specifying which 3D model will be used for each build-out building.

Set up the rest of the Google Earth export normally. When you Export Now, the models you have specified will appear in the Google Earth scene.

Exploring further

This is the end of the programmed exercises for build-out, but you should feel free to experiment and explore further. You can go back to the Build-Out Wizard and change any of your values then re-run build-out to view your new results.

Congratulations – you have completed Tutorial 5

This tutorial has taken you through a sample build-out analysis using Scenario 360. You have set up and run numeric, spatial, and visual build-out on this analysis. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps.

Tutorial 6 – Run an Analysis and Create a Presentation

This tutorial will walk you through several different ways of presenting your analyses which you can use in any combination. You will learn how to create clear, interactive, and impressive presentations using web-ready analyses, reports, and **WebShots.** In addition to these, consider viewing and sharing your analyses using the 3D visualization tools including **Scenario 3D** and the **Google Earth Exporter.**

In order to have results to present, the first step is to create an analysis using the skills you have learned in previous tutorials. Consider it a challenge!

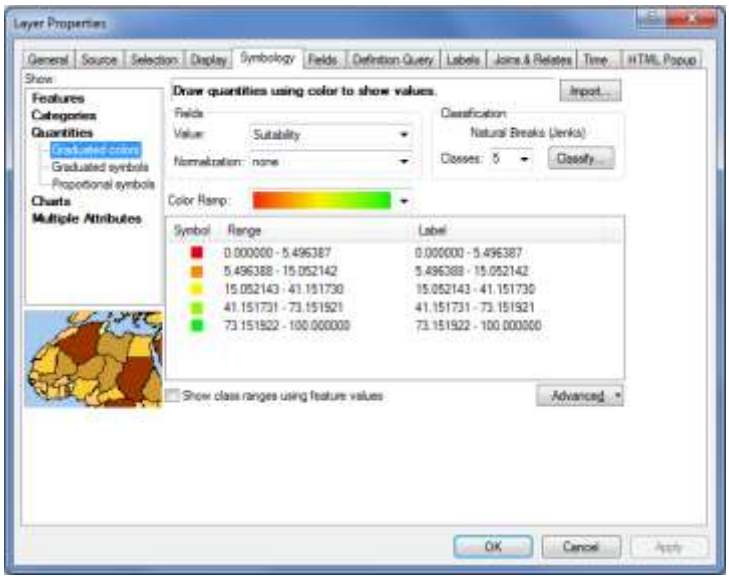
A challenge: run and modify an analysis

1. Using the **Communityville** data set, run a Suitability Analysis using the **Suitability Wizard**, creating two suitability factors and making the factors **weighted**:
   - **Proximity to wetlands** using **lower** suitability scores with closer proximity to wetlands
   - **Proximity to nests** using **lower** suitability scores with closer proximity to nests

2. Examine the pie chart in the chart display. What is the relative weighting of the two suitability factors, proximity to wetlands and proximity to nests? Using the **variable assumptions**, change the weighting of the proximity to wetlands to be **8 out of 10** or **80%** and the weighting of the proximity to nests to **2 out of 10** or **20%.** Check that these changes are updated on the chart.

3. Open the **Properties** of the **Proposed Buildings** layer and go to the **Symbology** tab. Show **Quantities → Graduated colors**, and select **Suitability** as the Field.

   Click on the heading called **Symbol** in the table and select **Properties for all symbols**. Select a symbol called **Square 1** and change the symbol size to be **12.00**. Click **OK**. All of the symbols in the table will be black squares.

   Now select a red to green color ramp. The higher values which represent more suitable sites should be **green** and the lower values should be **red.** If they are not, then click on the **Symbol** column in the table and select **Flip Symbols**. This will reverse the order of colors. The symbology table should look like the one displayed here.

   Click **Apply** and look at the map. Do the results make sense?

4. Now run the **Common Impacts Wizard**, deselecting the impacts affecting commercial areas, of which there are none in this analysis. Otherwise accept all of the defaults and click **Finish.**

5. On the **360 Analysis** tab, click on **Reports**. There is a report listed called "Communityville Common Impacts." Double-click on it to open it. Examine the contents displayed in the report. Notice that it is being displayed in your browser and that it was saved in HTML format so that you can display it on a website if you like.

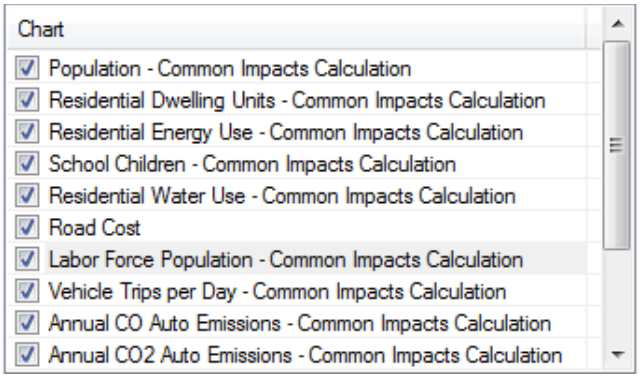
6. Change the **Active Scenario** to **Rural** and examine the map. Change it back to the **Village** scenario.

7. Change the Chart display to be **Compare by All Scenarios**.

8. **Note:** If you want to return the map to its original appearance, go back to the **Symbology** tab of **the Layer Properties** window and change it to **Show: Categories → Unique Values**, selecting "**Suitable**" for the Value Field. Click on "**Add All Values**" below the table, and then modify each symbol by double-clicking on it to open the "**Symbol Selector**" window. Change the symbol with the value of 0 to be a red square and the symbol with the value of 1 to be a green square. You can select the shape and size first and modify the color after. Click "**Apply**" at the bottom right of the Layer Properties window to see if you like the results.

Organizing and displaying analysis information

9. Click the **Organize** button above the charts and change the order of the charts to be as follows for the top several charts:



Close the Organize Charts window, and examine the chart display.

10. Why does the village scenario have a much higher total **household energy** usage than the rural scenario?

    What is the **population** of each scenario? Given the populations, which scenario has a higher **cost of building roads per person?**

11. Examine the chart displaying the **Annual CO_2 auto emissions**. Which scenario currently would emit more CO_2 auto emissions, the rural or village scenario? Once you have determined the answer, click on the **Assumptions** icon on the **360 Analysis** tab, and **change** the assumptions for each of the scenarios to the following, clicking the **apply** button when done:

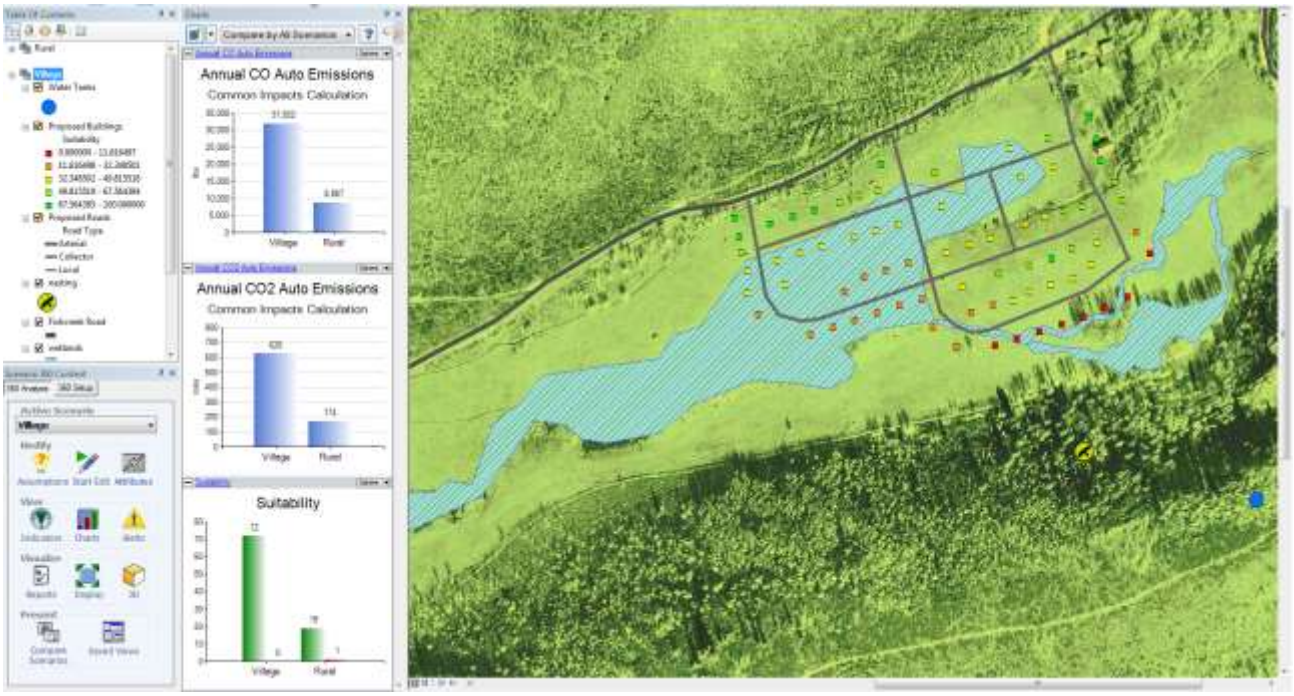
    Village Scenario
    Vehicle Trips per Day → to **8.0**
    Average vehicle trip length → to **3.0** miles

    Rural Scenario
    Vehicle trips per day→ to **10.0**
    Average vehicle trip length → to **12.0** miles

    Examine the charts. How does the **annual CO_2 auto emissions** compare by scenario now that you have changed the **vehicle trips per day** and **average vehicle trip length** for the rural and village scenarios?

Creating and using saved views

12. Arrange the view to look approximately like that below.



13. Once you have your analysis set up, create a saved custom view of your current display by clicking the **360 Analysis** tab **Saved Views** icon (see right) or by clicking the **Open or Save a View** toolbar button on the Decision Tools toolbar. Then simply click the **New Saved View** button and enter a name for it, such as "**Village Suitability Analysis**." It is often desirable to save the layer symbology you are currently using as well. To do so, place a check in the box called "Save layer symbology for the selected layers" and then place a check next to the layers whose symbology you want to save. You can use **Ctrl+click** to select all. If you only want to save symbology and not the rest of the view, use the **Symbol Saver** on the **Presentation** toolbar or menu.

This saved view is a snapshot of the screen as it is displayed right now that you can call up in Scenario 360 at any time, and can be used to illustrate different scenarios to community members.

To view previously saved views, simply click on the **Saved Views** button and select from the list.

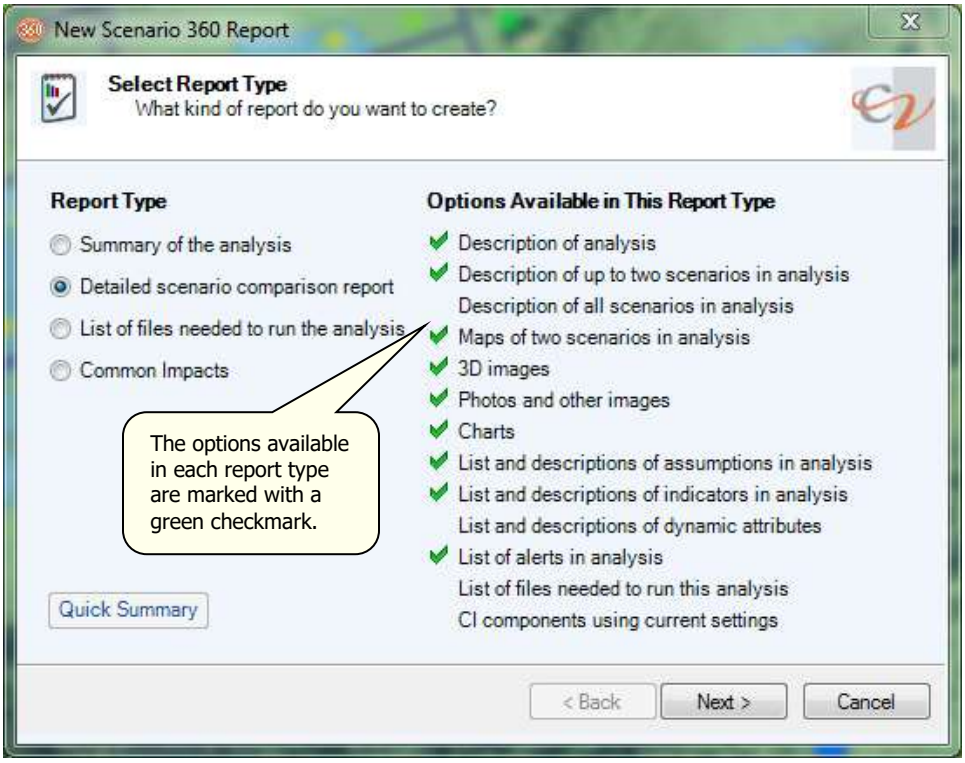
Creating a web-ready report

Now you will generate a professional report in HTML format, ready for hard copy publication or web site posting. The Reports Wizard will guide you through the reports process, allowing you to customize your report.

Scenario 360 web-ready reports are now more flexible, allowing the viewer to customize the report in real time and providing for charts that compare all scenarios in an analysis.

1. Click the **360 Analysis** tab **Reports** icon or click the **List Reports** toolbar button.
2. Click the **New Report** button.
3. Choose the "Detailed scenario comparison" (see figure below)
4. The Reports Wizard will guide you through the reports process, allowing you to customize your report. For this tutorial, accept the default settings. This will require you to leave many fields blank, selecting **Next** as you move through the steps.

5. Completed reports are saved in the analysis folder **Reports** directory. Within the **Reports** directory, all pictures included in your report (such as charts and maps) are saved in an **Images** folder. You can import these images into any presentation or document (including PowerPoint presentations and Microsoft Word documents).



6. When you are finished with your report, you will be returned to the **Reports** window. Click on the name of your new report (the default name is **Communityville Scenario Comparison**) to open it. This report is a stand-alone file that you can copy and share with friends.

Note: Within the **Reports** directory, all pictures included in your report (such as charts and maps) are saved in an **Images** folder. You can import these images into any presentation or document (including PowerPoint presentations and Microsoft Word documents). Its default location is:

C:\CVFiles\Communityville\Reports\Communityville Scenario Comparison\Report.htm.

7. When you are finished, close ArcMap and **Discard Changes**.

Creating WebShots

This section will take you through the steps of creating **WebShots.** WebShots are HTML files preserving snapshots of your analyses that you can display on a **website** as a **slide show** or in a **partly interactive format**. Viewers of the interactive website can change scenarios with a limited ability to change assumptions and see the results. The web pages produced by WebShots allow viewers to see your analysis in two modes:

- **Slide show mode** displays a series of screen images in the order you specify
- **Explore mode** allows viewers to choose the scenario they are viewing and to vary assumptions.

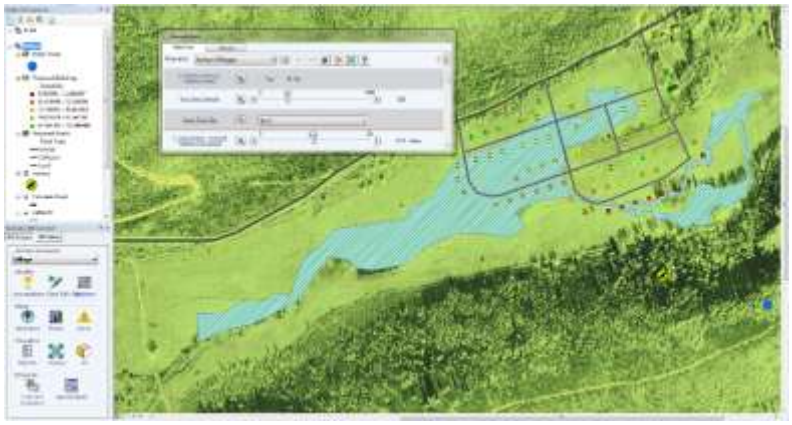
It is important to run the WebShots Wizard after having created all the scenarios and variable assumptions you think you will use, as the Wizard does not detect any analysis changes made after it has been run; you will need to run it again if you do more analyses.

The **WebShots Wizard** will let you choose:

- Up to 5 scenarios to display
- Up to 5 assumptions that you will be able to vary

- Up to 5 discrete settings for each variable assumption (in addition to its default setting)

Assumption values that are not varied in your WebShots display will be **fixed** at the values they have when you start the WebShots Wizard, even if they are variable assumptions. Therefore, you should **set them to the values** you want to use before starting the wizard.



First set up your screen the way you want it to appear on the web in terms of the **map symbology** and which layers are on or off.

The exercise below provides you with an example of how you might set things up using the Suitability and Common Impacts analyses you just ran on the Communityville data set.

1. If the Communityville data set isn't already open, go to the Scenario 360 menu, point to Analysis, and select **Open** and choose the Communityville data.

2. Make sure that the Active Scenario is the Village scenario. Zoom out until the squares representing the houses are not touching each other.

3. On the **Scenario 360** Analysis tab, click on Assumptions. Change the **Bird Nest Setback** to **400 feet**. This means that sites located closer than 400 feet to nests of particular bird species are not considered suitable. Select "**Yes**" for the assumption called "**Prohibit Building in Wetland Areas**." Click on the **Apply** button.

4. Click the **Scenario 360** menu, point to **Presentation**, and click **WebShots Wizard**. [If the WebShots Wizard is grayed out or disabled, see CommunityViz help for the conditions necessary for it to be enabled.]

5. The **WebShots Wizard** prompts you for various settings and preferences. If in doubt about what information to provide on any given screen, simply click **Next**. You will receive a helpful message if more information or different information is needed. For detailed information on the required settings, see WebShots in the help.

6. In the WebShots Wizard, click **Next**, and then choose both the village and rural scenarios. Click **Next**.

7. Choose all three assumptions. These will be variable, and viewers will be able to change one assumption at a time while other assumptions are set to default values. Click Next twice.

8. When the first window entitled "Choose Discrete Settings for Assumptions" appears, note that True and False are already in the WebShot Value(s) box on the right for the assumption "Prohibit Building in Wetland Areas." Click Next.

9. For the Water Tank Site, select Sites A, B, and C, and respectively click on the green arrow pointing to the right to select these as WebShot values. Click Next.

10. For the Bird Nest Setback, enter 200 (ft) in the left-hand box and click on the right-pointing green arrow to include this as a WebShot value. Do the same with 400 and 600. Click Next.

11. On the window entitled "Choose WebShots," leave the Slide Show boxes blank, selecting only the "Explore" boxes. Click "Next" and then "No" when a dialog box appears asking if you want to create Slide Show slides.

12. Click "Next" six times, accepting the defaults for each window that comes up. Then click "Finish."

To open your new Web Shots presentation, navigate to the WebShots subfolder of your analysis in Windows Explorer. In here, there is another folder for the WebShots you just created. Double-click the index.htm file in this folder to open the WebShots in your default browser. If you have trouble viewing the WebShots or get errors, check the following:

- The Web Shots viewer requires Adobe Flash player. You should be prompted to install it if you don't have it, or perhaps to allow it to run for this site.
- Newer versions of Flash player cannot open local files, so you may get an error message indicating the WebShots data could not be read. To work around this, you can add the WebShots folder to the local Flash Player security settings:
    1. Open the Global Security Settings panel: http://www.macromedia.com/support/documentation/en/flashplayer/help/settings_manager04.html#117502
    2. Under 'Always trust files in these locations:', add the path to the WebShots folder (you may need to enter the path in the text box instead of browsing for files).
    3. Close and re-open the browser and try opening the webshots file.

Congratulations – you have completed Tutorial 6

This tutorial has taken you through several different ways to prepare your analyses to be shared and presented. You have learned how to create saved views, reports in HTML format, and WebShots. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps.

Tutorial 7 - Exporting Analyses to Google Earth™

This tutorial will walk you through exporting an analysis for 3D viewing in **Google Earth**, exporting **TimeScope** build dates so you can look at changes over time in Google Earth, and exporting your analysis with 3D models from the CommunityViz **Scenario 3D Library** or any other KMZ model. The 3D scene will open up to its proper global location as represented by satellite images, with your scenario displayed in three dimensions and your charts displayed in a window. Most feature layers will be automatically "draped" on the Google Earth terrain. The files you export will be in Google Earth's .KMZ format which can be freely shared with others so they can view it in Google Earth as well.

Requirements

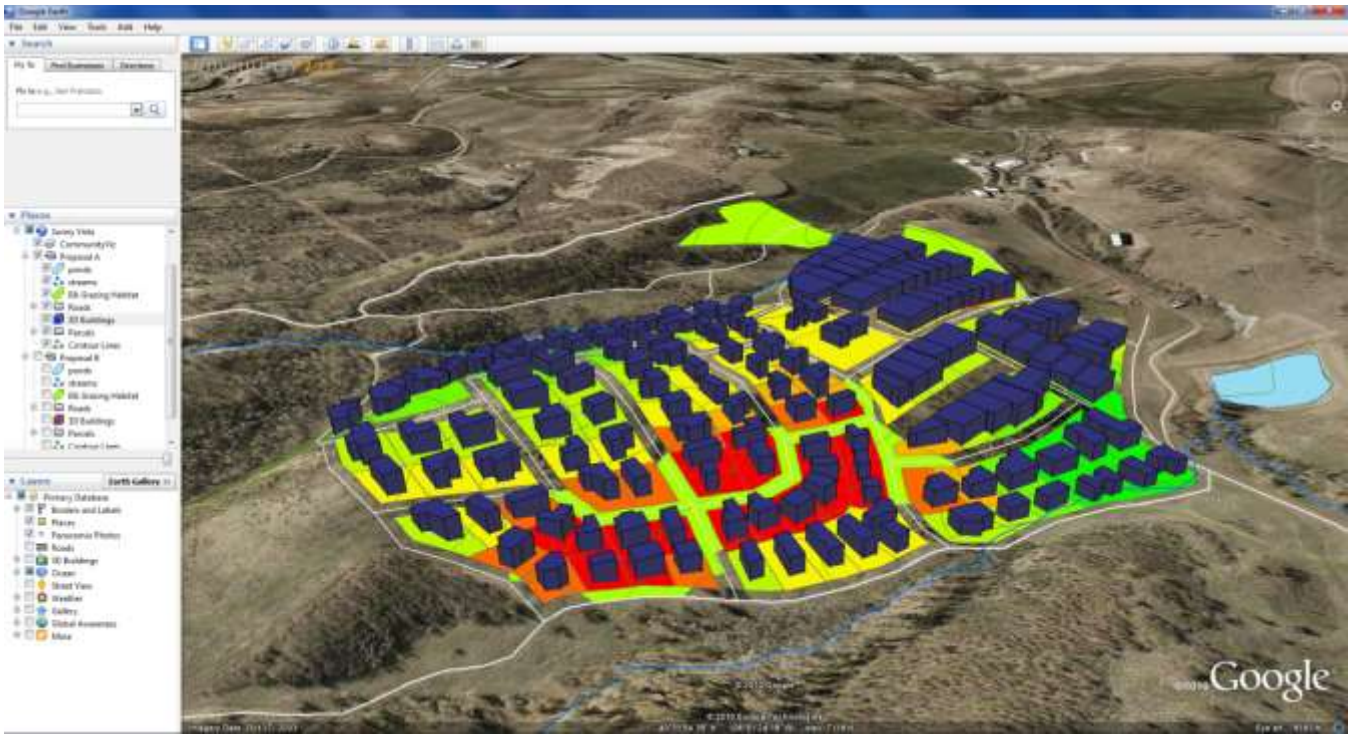
You must have installed **Google Earth 4** or later onto your computer in order to take advantage of all of the features described here. A high-speed Internet connection is also recommended. Google Earth is an independent application that must be installed separately. Information is available at earth.google.com.

Exporting an analysis to Google Earth – the basics

1. Open the Sunny Vista analysis.
2. Click on the **Scenario 360 toolbar menu** ▸ **Presentation** ▸ **Google Earth Export Settings.**
3. On the **General** tab, note the default path name for the .KMZ file that Scenario 360 is about to create. (For future reference, you can change the file name or location by clicking the **Browse** button.)
4. Go to the **Scenarios** tab. Choose to export both Proposal A and Proposal B.
5. Go to the **Layers** tab. To specify which layers to export, place a check by their name in the list on the left. To set up particulars of how each layer will be exported, highlight its name in the list and then provide settings in the panel on the right. For this exercise, check the following layers: Streams, Ponds, Contour Lines, Roads, Elk Grazing Habitat, Parcels, and 3D Buildings.
6. Click on the **3D Buildings** layer so that it is highlighted and selected as the current layer.
7. Change this layer's "Export Layer As" setting to "**Extrude Polygons**" rather than "**Geometry**." Note that this is only possible with polygon layers (not points, lines, or rasters).
8. Change the color to one that you think would be suitable for a building.
9. Select "Enter height manually" and change the height to 12 m. This is the height to which all the buildings will be extruded. (For future reference, you can use a height attribute in the layer instead.)
10. Go to the **Charts** tab. Select two or three charts that you would like to export to Google Earth.
11. Click the **Export Now** button.

Google Earth will launch and take you to the location of Sunny Vista.

12. Use the Places list to determine which scenario you are looking at: A or B. Change to the other scenario and experiment with selecting and deselecting layers.
13. Move your mouse to the upper-right corner near the North arrow, and two slider bars and a rotating dial will appear. Use these to change your viewing position of the scene. The vertical slider changes the proximity to the scene and the horizontal slider changes your viewing height or viewing angle of the scene. Use the dial to change the direction of view.
14. Right-click on the **3D Buildings** layer and select **Properties**. Click "OK," choose the **Style, Color** tab, and click on the color box. Select a different color and click 'OK.' Notice that the color of the buildings changes. Click 'OK.' With the 3D Buildings layer still highlighted, try moving the slider bar at the bottom of the Places list to make the extruded buildings partly transparent.
15. Below the scenarios in the Places list, expand the Charts folder and select one chart at a time to display. (Selecting the entire Charts folder will simply display all charts on top of one another, which is not recommended.)



Additional information on the settings for exporting to Google Earth can be found in the desktop Scenario 360 Help.

Exporting TimeScope™ build dates to Google Earth

In this part of the tutorial you will be guided through exporting TimeScope build dates to Google Earth, where you will be able to visualize future scenarios as they change through time by using Google Earth Timeline.

Exporting TimeScope build dates to Google Earth

1. Open the **Sunny Vista** analysis in Scenario 360 if it is not already open.
2. Run TimeScope, double click the **Buildings** layer, accept the default start and end dates, and choose **linear growth.** Accept all of the defaults, click **Next** as needed and then **Finish** to run TimeScope.
3. In the ArcMap Table of Contents, expand the **Build-Out** layer and right-click on the **Buildings** layer to **Open Attribute Table**. Make sure that the attribute called **TS_BUILD_DATE** exists in the attribute table. Close the table.
4. Go to: **Scenario 360 toolbar menu ▸ Presentation ▸ Google Earth Export Settings.**
5. Go to the **Scenarios** tab. Choose to export both Proposal A and Proposal B.
6. Go to the **Layers** tab. Deselect any layers you don't want to export, such as the mask, or area boundary.
7. Click on the **Buildings** layer and select **Export Layer as: Geometry**.
8. Click the **TimeScope** tab. Any layers for which you have run TimeScope will be displayed. Select the **Buildings** layer which has a TimeScope build date attribute (TS_BUILD_DATE). If you do not see any layer names displayed, you may have skipped a step.
9. Go to the **Charts** tab. Select the charts that you would like to export to Google Earth.
10. When you are ready, click the **Export Now** button.
11. Move your mouse to the upper-right corner near the North arrow, and two slider bars and a rotating dial will appear. Use these to change your viewing position of the scene. The vertical slider changes the proximity to the scene and the horizontal slider changes your viewing height or viewing angle of the scene. Use the dial to change the direction of view.
12. Notice the Timeline slider bar adjacent to the other slider bars. To mimic the behavior of a moving the TimeScope Time variable assumption slider bar in Scenario 360, set the Timeline's left-hand slider to the

current year and move the right-hand slider into future years. Notice that Google Earth Timeline allows you to display or hide features on the image according to their TimeScope build date.

Using KMZ models in Google Earth™

In this part of the tutorial, you will learn how to use existing 3D models in KMZ format to represent buildings, trees or other map points in your Google Earth scene. KMZ models are available in the CommunityViz Model Library (included with your software), or in Trimble's **3D Warehouse** (sketchup.google.com/3dwarehouse/). You can create your own models using Trimble's free software **SketchUp®** (http://www.sketchup.com).

1. Still in the Sunny Vista analysis, go to: **Scenario 360 toolbar menu ▸ Presentation ▸ Google Earth Export Settings.**

2. Go to the **Layers** tab, click on the **Buildings** layer in the list, and choose **Export Layer As: 3D Models**.

   Note: Only point layers can be exported as 3D Models.

3. Choose "**Select a random 3D model from a list.**" Using the **Browse for Model Files** button, go to C:\KMZ Model Library and choose a house model. (For future reference, if you have more than one model, you can add all of them here. Scenario 360 will choose a random model for each point.) Once you have found a model, click **Open.**

4. If desired, you can **orient** (turn) your model so it faces a particular direction such as towards the nearest road by entering an orientation (in degrees) manually, or by referring to a numeric attribute in the point layer.

   Advanced tip: you could write a simple dynamic attribute formula using the **AngleTo** function that gives the angle to the nearest road, and then use that as an orientation field.

5. Click on the **Export Now** button and Google Earth will be launched. If you select the Buildings layer to be displayed, your new model will appear.

Note: You can specify Google Earth models in the Visual portion of the Scenario 360 **Build-Out Wizard** if desired. After doing so, choose "**Get 3D model file from a field**" in the Layer export settings and choose the attribute field called "3D Model."

Using SketchUp and 3D Warehouse models

In addition to the CommunityViz KMZ Model Library, you can obtain 3D models from Trimble's on-line **3D Warehouse** or you can make your own using SketchUp**.** For either of these options, you will need to download and install **SketchUp** from http://www.sketchup.com.

1. Go to the Trimble **3D Warehouse** at: https://3dwarehouse.sketchup.com

   This is a site that hosts three-dimensional images that are posted by members of the public. Search for a house of the Cape Cod style by typing "Cape Cod" in to the search engine and clicking "Search." Select a house by double-clicking on it, and then click the **Download to SketchUp** button. When you are prompted, select **Open with SketchUp** rather than Save to Disk.

- OR -

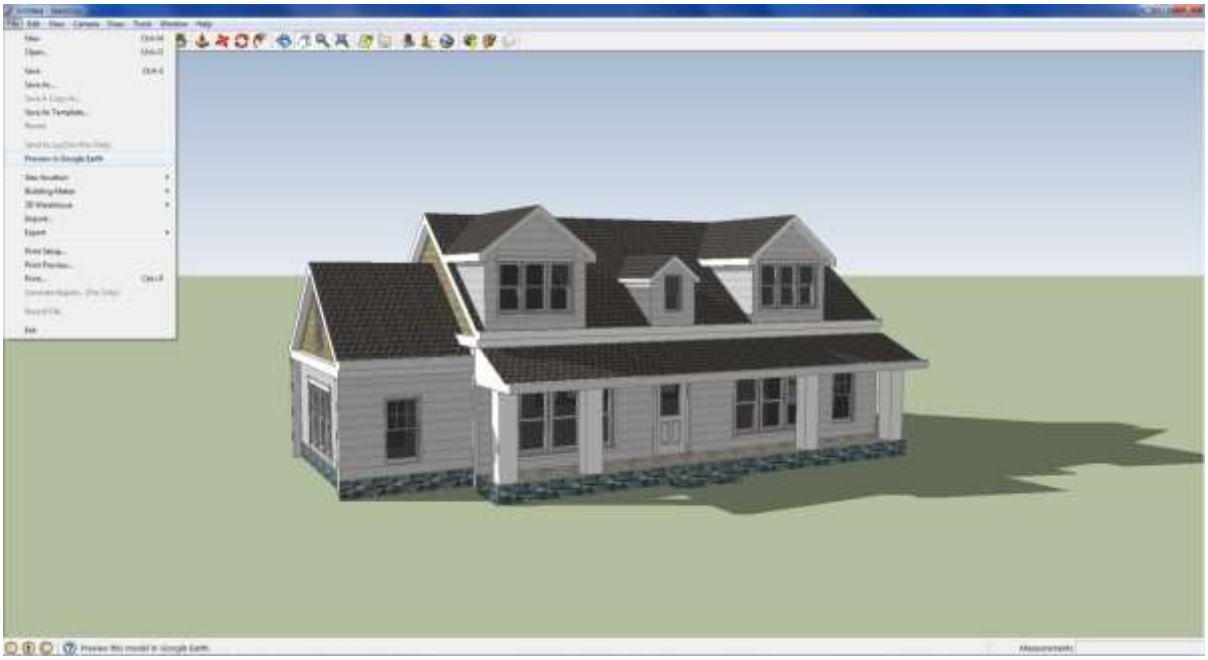
Create a model of your own in SketchUp. Follow the directions within SketchUp or their tutorials.

2. Once your selected 3D Warehouse model has been opened up in SketchUp or you have created your own model in SketchUp, export your model into Google's .KMZ format so that it can be imported into Google Earth. Normally models are saved in SketchUp as .SKP files. To export the file, go to the **SketchUp menu** and choose **File ▸ Export ▸ 3D Model.** Save it as a Google Earth *.KMZ file in your analysis directory or in your local KMZ Model Library. Examples:

   C:\CVFiles\3D Models\KMZ\CapeHouse.kmz

   - OR -

   C:\CVFiles\Sunny Vista\3D\GoogleModels\CapeHouse.kmz.



You may also go to **File ▸ Preview in Google Earth** to launch your model in Google Earth.

On your own, try resetting the Buildings layer export settings to use the Cape House, and see how it looks!

When you are finished using Google Earth, close the window and, when asked whether you want to save items to your "My Places" folder, answer **No.**

Congratulations – you have completed Tutorial 7

This tutorial has taken you through exporting a scenario to Google Earth, exporting TimeScope build dates to Google Earth, and using a SketchUp 3D model to represent points in the Google Earth scene. We recommend you look back through the steps to review the Scenario 360 features you used and reflect on the overall approach to the analysis, focusing more on the functions than on the exact buttons and steps.