Social Values for *Ecosystem* Services, Version 3.0 (SolVES 3.0): Quick-Start Tutorial
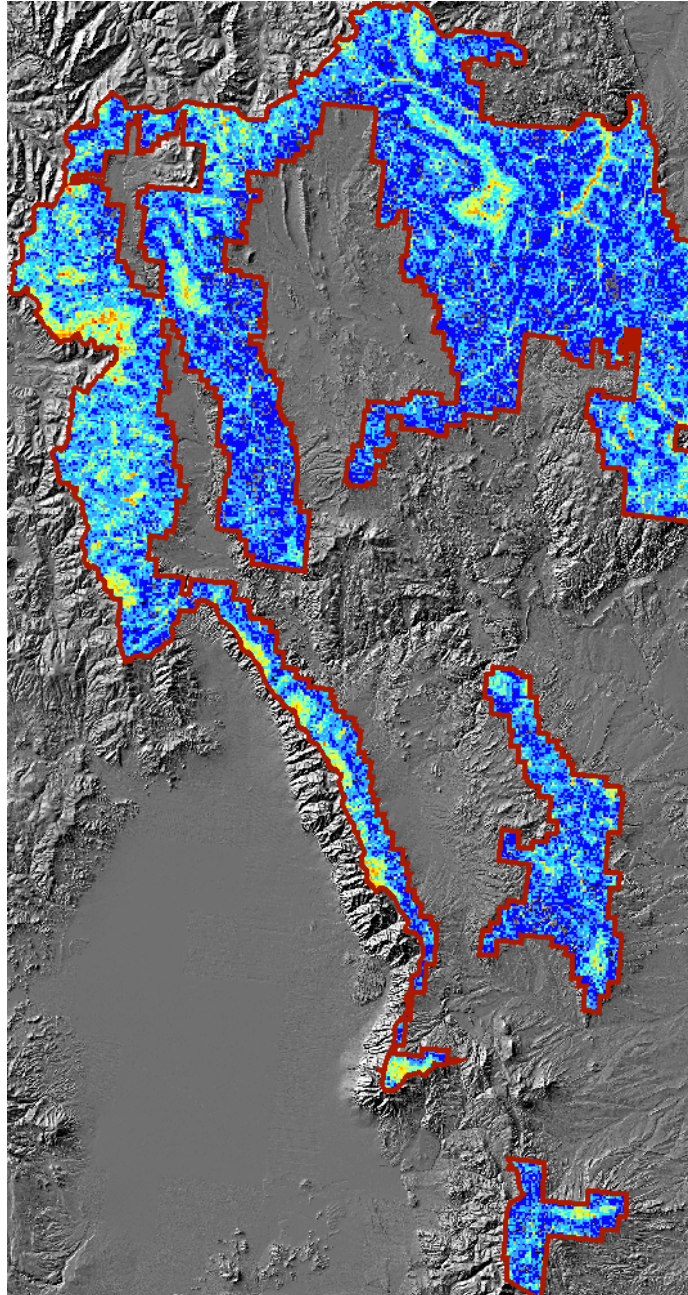
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HARDWARE AND SOFTWARE REQUIREMENTS

SolVES 3.0 requires the Esri ArcGIS 10.x (currently 10.0, 10.1, or 10.2) software and the Spatial Analyst Extension for working with grid-based data. The application is available as a custom toolbar Add-In that must be installed in ArcMap. SolVES 3.0 was developed and tested on systems running Microsoft Windows 7 Enterprise Edition but should function with other operating systems supported by ArcGIS 10.x. SolVES 3.0 also requires the installation of Maxent maximum entropy modeling software, version 3.3.3k. Additionally, the user's computer must also run the .NET Framework and Java. Processing time will vary depending on factors such as the computer's processor speed, the spatial resolution and extent of the study area, and the number of variables selected for analysis.

INTRODUCTION

Social Values for Ecosystem Services, Version 3.0 (SolVES 3.0) is a geographic information system (GIS) application developed by the USGS Geosciences and Environmental Change Science Center (GECSC). SolVES incorporates quantified and spatially explicit social-values information into ecosystem service assessments. Social values are defined here as the perceived, nonmarket values the public ascribes to ecosystem services, particularly cultural services, such as aesthetics and recreation. SolVES was originally developed to address the need to account for differing values, attitudes, and preferences among diverse stakeholders in the analysis of tradeoffs among ecosystem services. Ecosystem services provide tangible and intangible benefits to human life. Although these benefits may be quantified in monetary terms, they also exist as public goods that bypass the economy. Further, monetary values, even if available, are not always desirable because they can distract decision makers and stakeholders from the primary purpose of ecosystem management. Decision makers require estimates of social values beyond those defined economically to assess the full range of ecosystem values. These social values involve sociocultural perceptions of human well-being derived from nature, measured using social assessments and other nonutilitarian means of capturing their value. SolVES uses previous social-values mapping research to implement a methodology for incorporating social values into the ecosystem service assessment process by quantifying and mapping these values across a study area as a "value index," which provides a spatial, nonmonetary metric statistically related to characteristics of the underlying physical environment.

SolVES 3.0 provides functionality to assess, map, and quantify social values such as aesthetics, biodiversity, and recreation by deriving social-value maps rendered as a 10-point value index (ranging from 0 to 10) from a combination of spatial and nonspatial responses to public value and preference surveys. SolVES 3.0 also calculates metrics characterizing the underlying environment, such as average distance to water and dominant landcover. Through its integration with Maxent maximum entropy modeling software, SolVES 3.0 can generate more complete social-value maps and offer statistical models describing the relationship between the value index and explanatory environmental variables. Because of its flexible design, SolVES 3.0 users are able to define their own social values and public uses, model any number and types of environmental variables, select weighting options for mapped survey data, and modify the spatial resolution of analysis. SolVES 3.0 provides an improved public-domain tool for decision makers and researchers to evaluate the social values of ecosystem services and to facilitate discussions among diverse stakeholders regarding the tradeoffs among ecosystem services in a variety of physical and social contexts ranging from forest and rangeland to coastal and marine.

This tutorial provides step-by-step instructions to install SolVES 3.0 and to complete practice exercises using the available sample data. It is intended to quickly provide hands-on experience using SolVES 3.0. For more detailed information regarding SolVES 3.0, including its design, functionality, data requirements, and troubleshooting, please refer to the SolVES, Version 3.0 User Manual available for download at *http://solves.cr.usgs.gov*.

INSTALLATION

1. Download the SolVES_V3.zip file from the SolVES website *http://solves.cr.usgs.gov*.
2. Unzip the file.
3. Double-click the SolVES_v3.esriAddIn file.
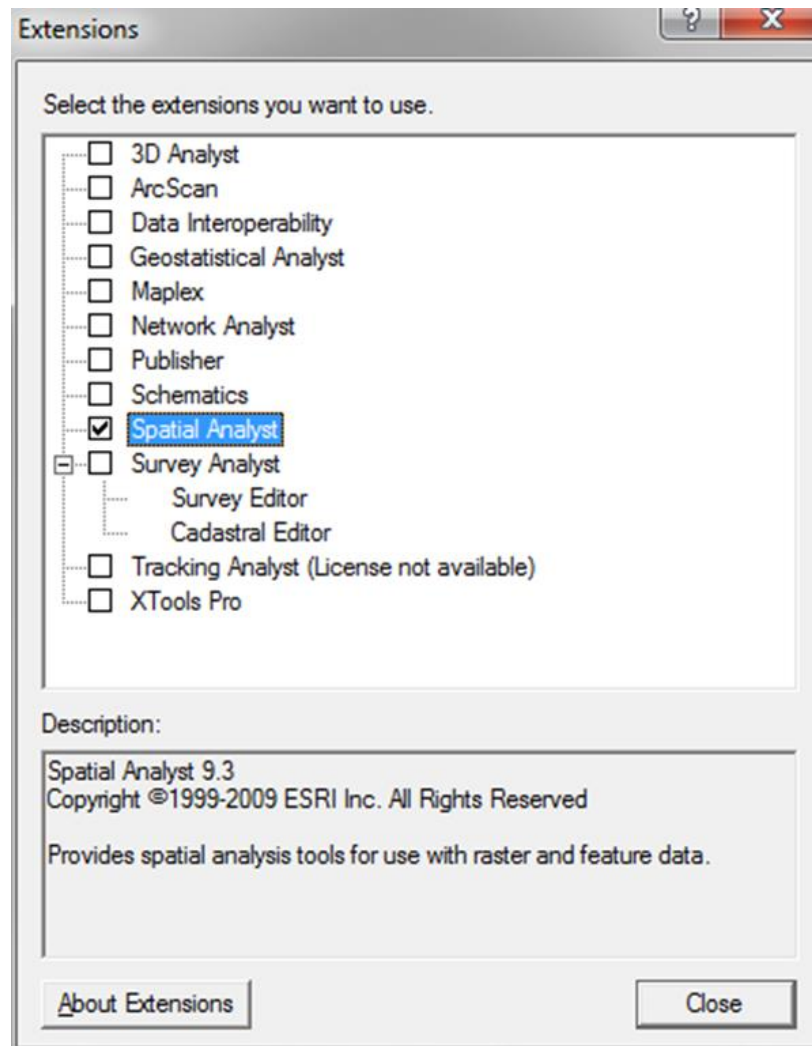4. Click Install Add-In on the Esri ArcGIS Add-In Installation Utility screen.
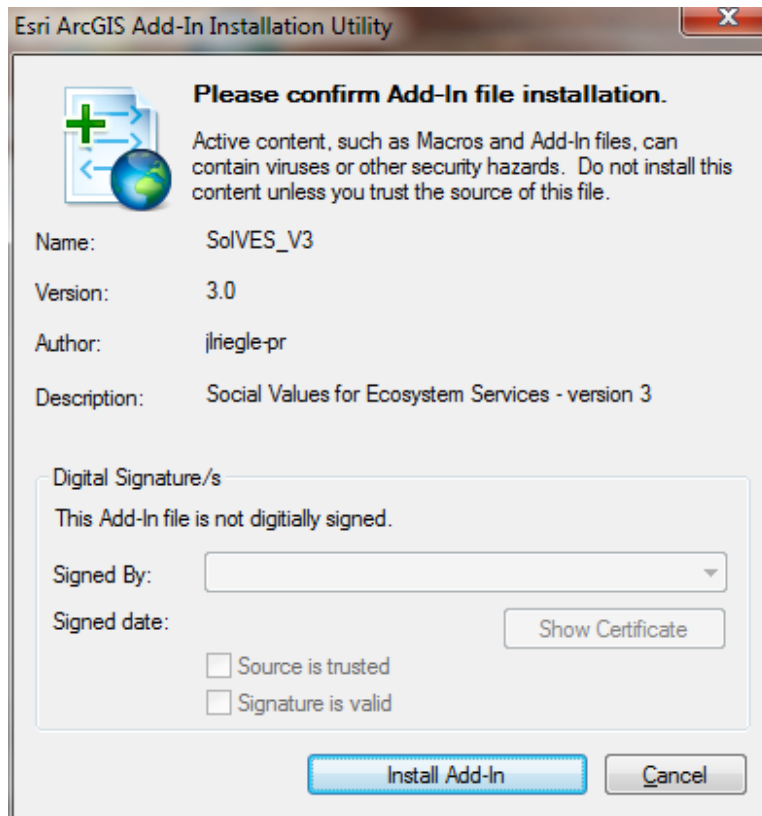

5. Click OK at the Installation succeeded prompt.
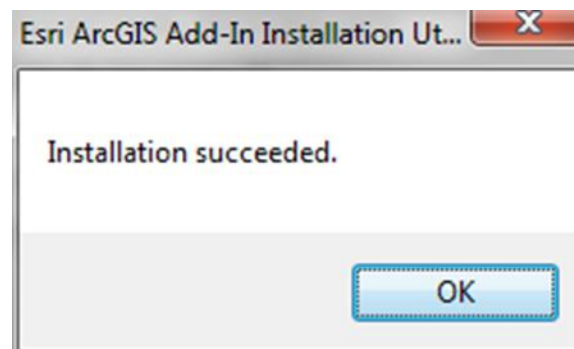
Confirming ArcMap Settings for SolVES 3.0

1. Open ArcMap.
2. Choose Customize > Extensions from the main menu.
3. Confirm the checkbox next to Spatial Analyst is checked.

4. Close the Extensions form.
5. Choose Geoprocessing > Geoprocessing Options from menu.
6. On the General tab, confirm the checkbox next to Overwrite the outputs of geoprocessing operations is checked.
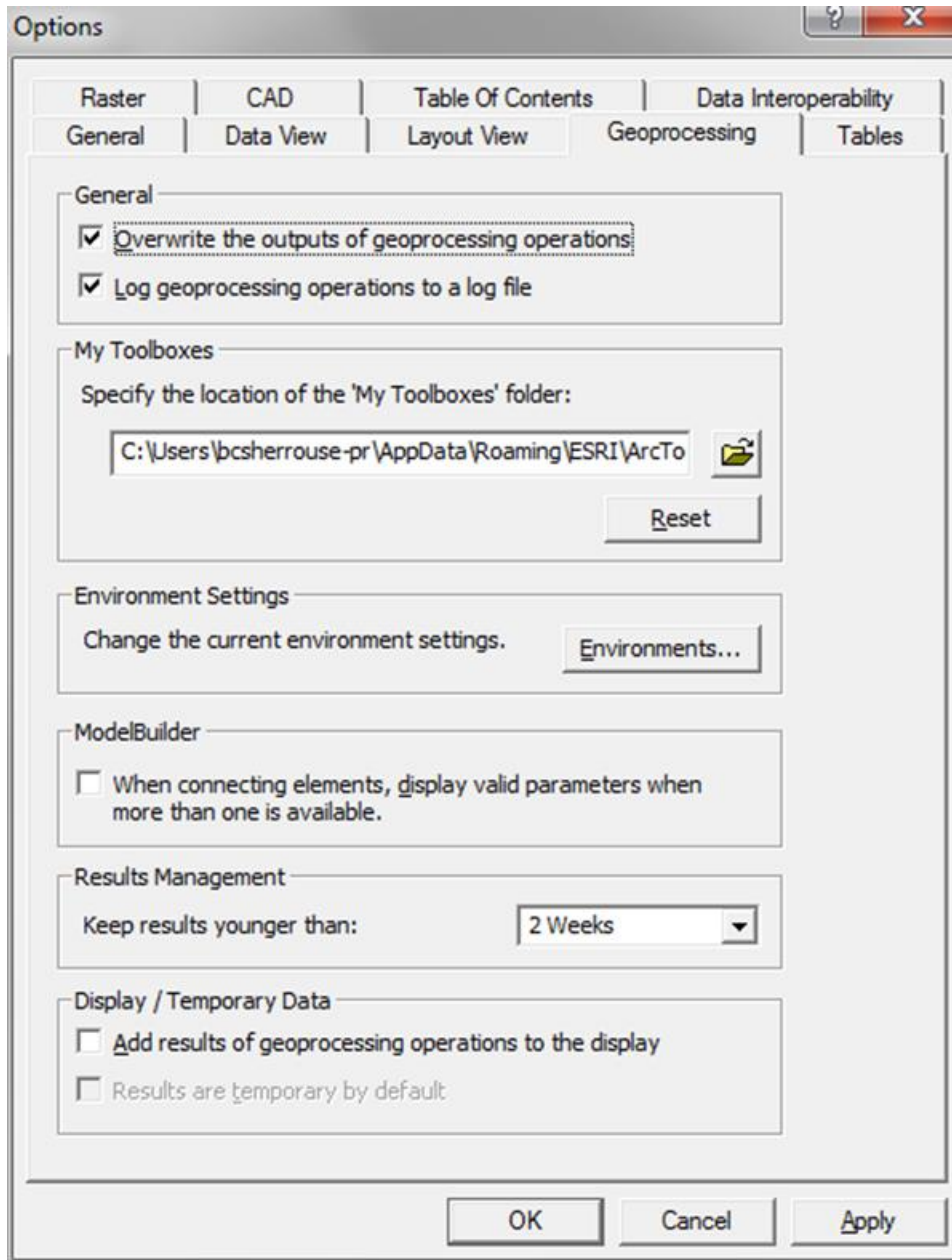
7. Select OK to close the Options form.
8. If the SolVES toolbar is not already displayed in ArcMap, Choose Customize > Toolbars from the main menu.

9. Select SolVES from the list of toolbars.
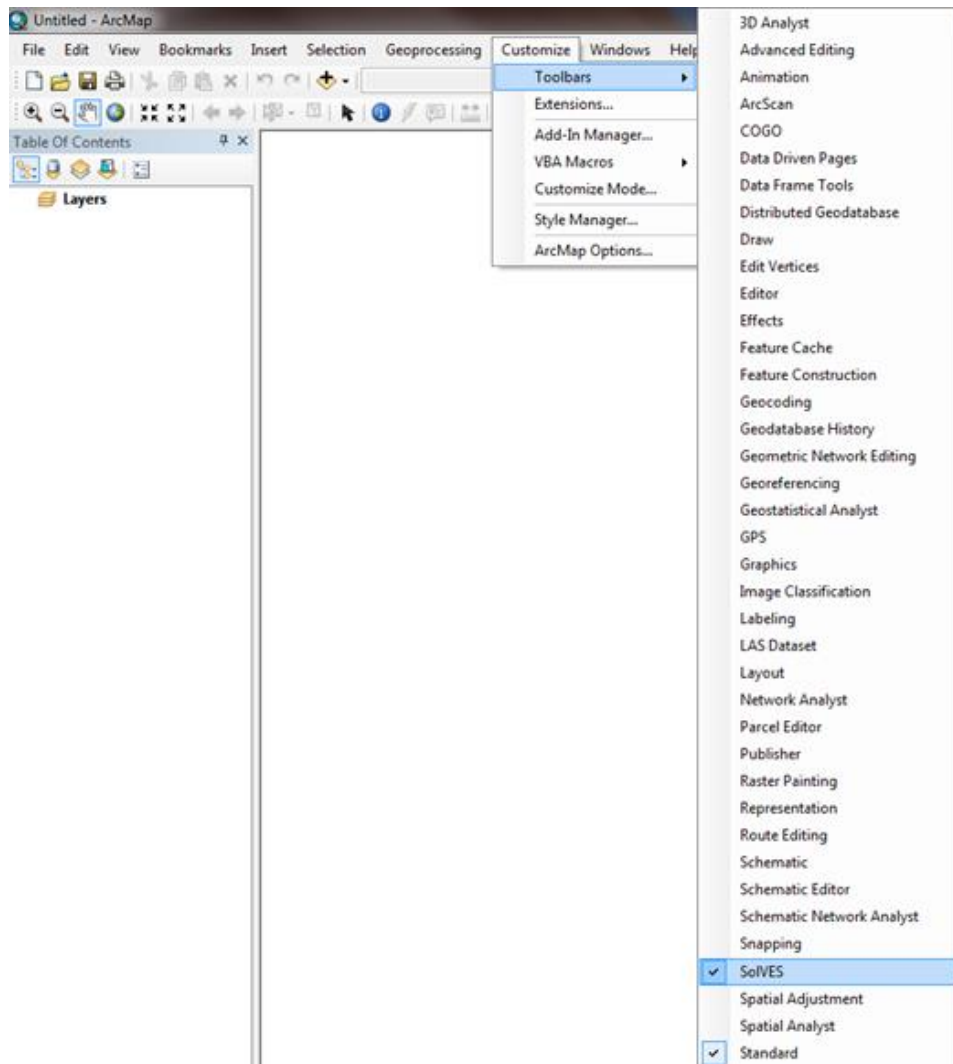
10. If not already docked to the top of the ArcMap window, click and drag the SolVES toolbar there.
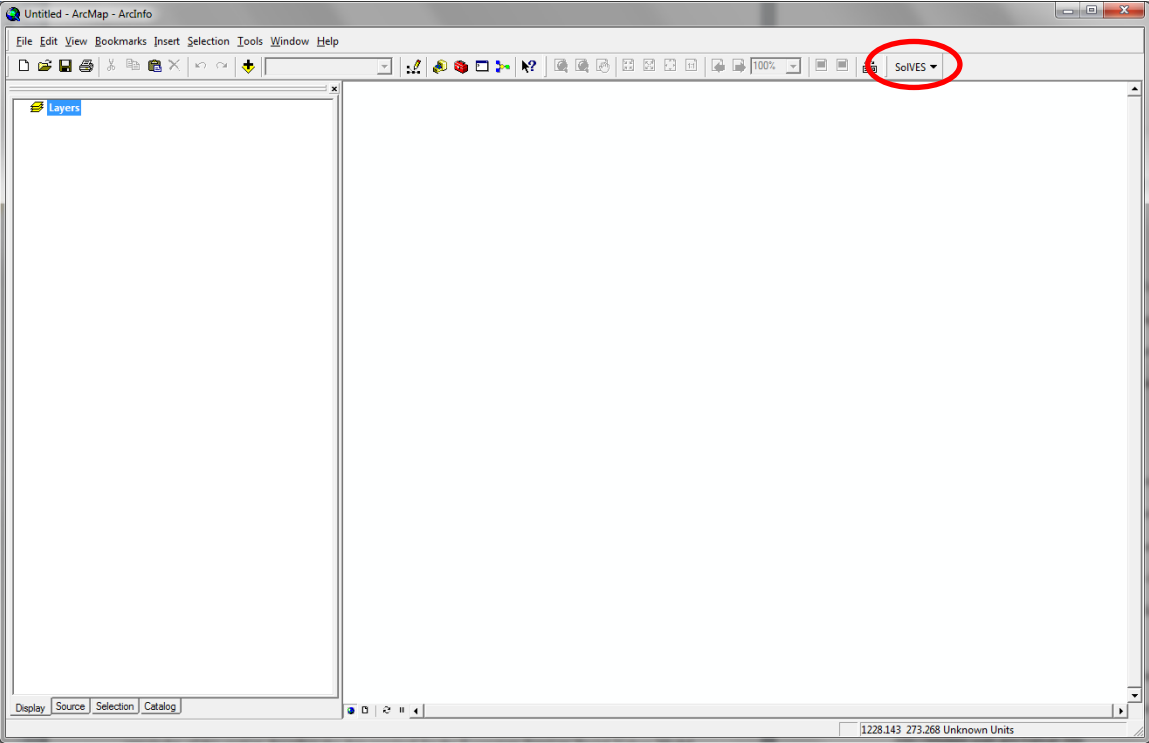
Confirming Windows Regional Settings

SolVES users outside the United States should access the Windows Control Panel Region and Language settings on their computer to confirm these settings are compatible with SolVES.

1. Click on the Additional Settings button on the Formats tab.
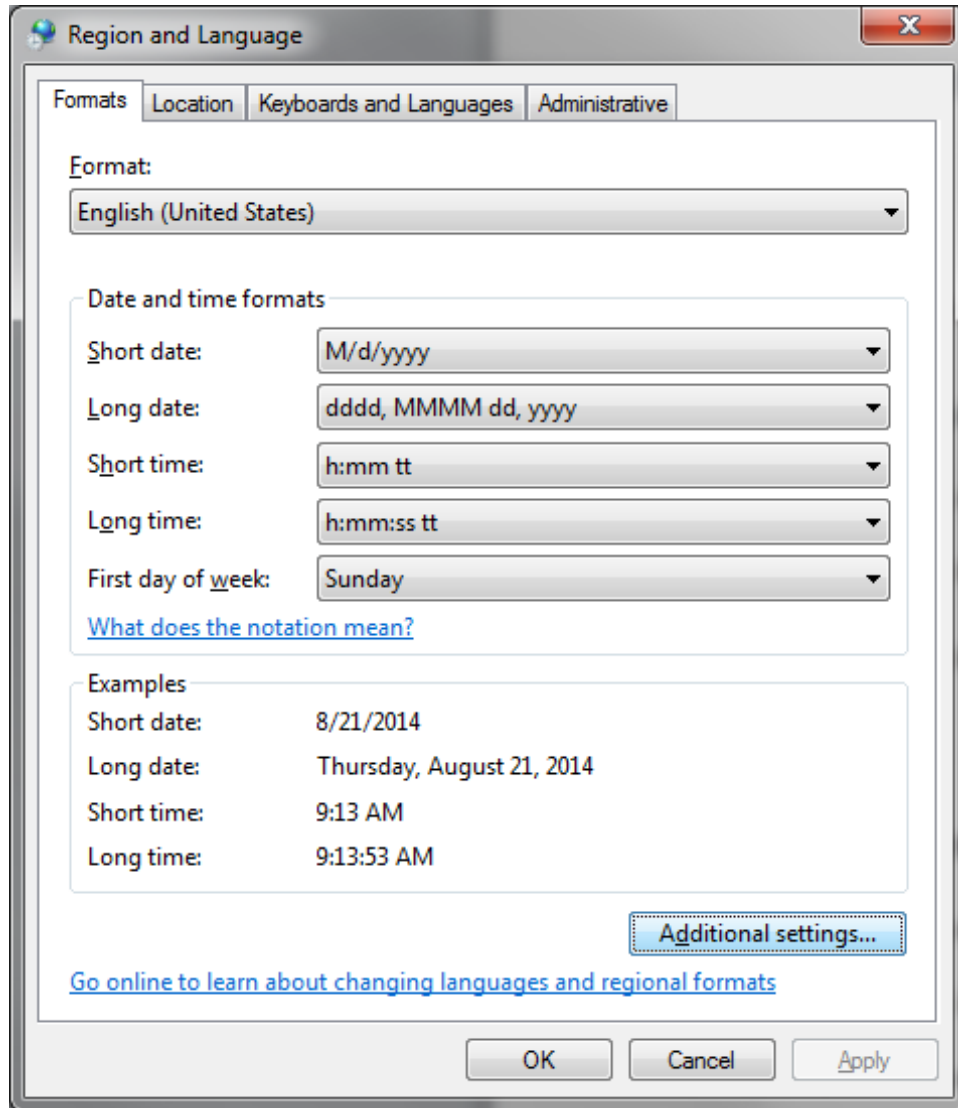
2. Compare the values entered on the Numbers tab shown below to those on the computer running SolVES and adjust them to match those shown in the figure. Users should note the original settings on the Numbers tab to ensure they are correctly restored. When finished using SolVES, the Reset button on the Numbers tab can be selected to restore the system default settings.
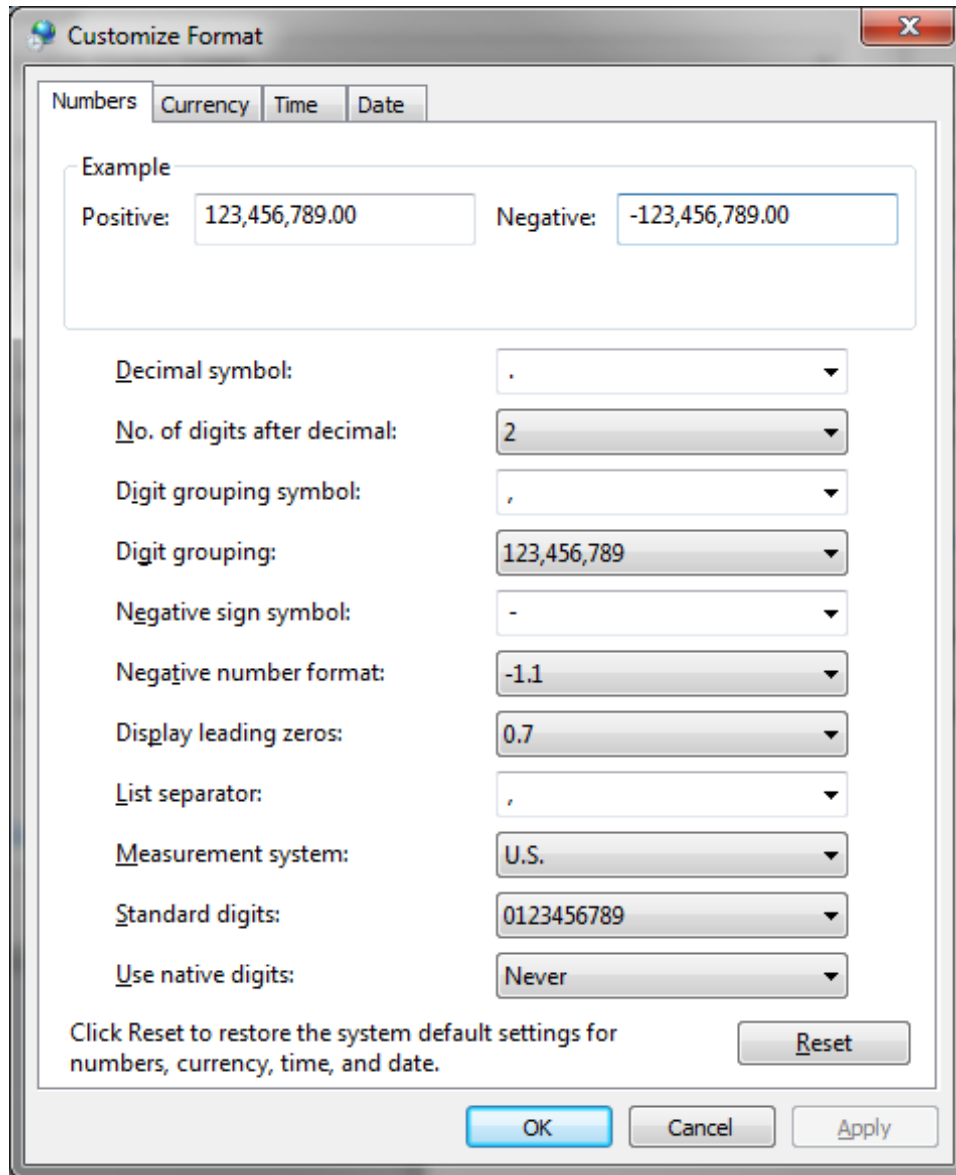
Maxent Maximum Entropy Modeling Software Installation Instructions

Maxent maximum entropy modeling software is freely available for educational and research activities; however, it is not authorized for redistribution by its users. Maxent must be downloaded directly from the Maxent website at *www.cs.princeton.edu/~schapire/maxent/.* The website also contains various links to additional information regarding Maxent. After navigating to the website, complete the following steps.

1. Follow the website instructions to download Maxent version 3.3.3k.
2. Return to the location of the unzipped SolVES 3.0 download file and copy the three downloaded Maxent files (maxent.bat, maxent.jar, and readme.txt) into the Maxent folder contained within the SolVES directory. (\\SolVES\Maxent).
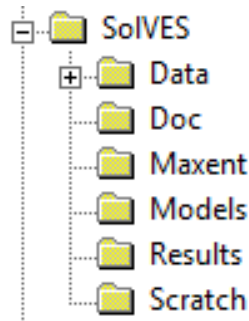

Data Installation

1. Copy the SolVES folder to a local directory that will serve as the SolVES home directory (for example, D:\\SolVES).
2. If a properly loaded file geodatabase containing study area data is available, copy it into the \\SolVES\Data folder to make it accessible to SolVES.

File geodatabases containing sample datasets for the Pike and San Isabel National Forest and Grand County, Colorado, can be downloaded from the SolVES website http://solves.cr.usgs.gov to provide hands-on experience using SolVES. These data, along with the supplied social-value models generated from these data, are meant for demonstration only.

# EXERCISE #1: USING THE ANALYZE SURVEY DATA AND VIEW RESULTS TOOLS

For this exercise, copy the SolVES.gdb file containing the Pike and San Isabel National Forest sample data to the Data folder in the SolVES directory. The Analyze Survey Data tool will use social survey data collected for the Pike and San Isabel National Forest to analyze aesthetic and recreation values for survey respondents opposed to motorized recreation in the forest. The View Results tool will then be used to generate a map layout for aesthetic value. To begin the exercise, open ArcMap if it is not already.

1. To begin using SolVES 3.0, a new project will need to be started by selecting Project Setup and New SolVES Project from the toolbar.
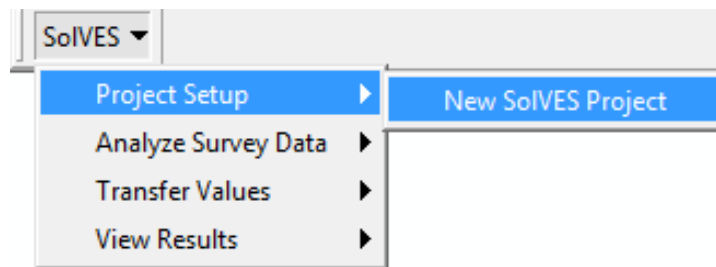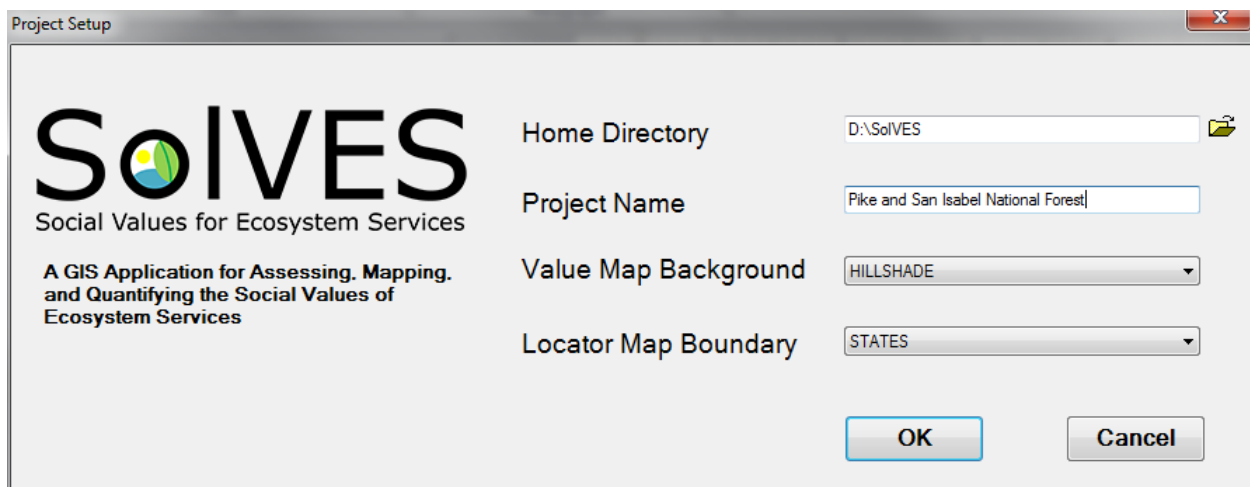

2. Once the Project Setup form is open, navigate to the SolVES directory location to set the Home Directory.
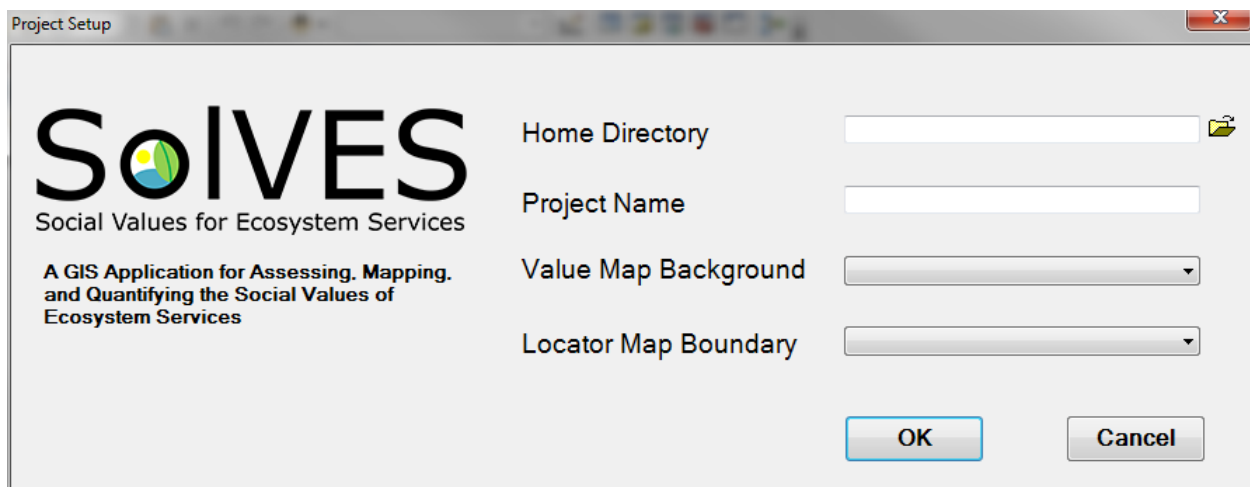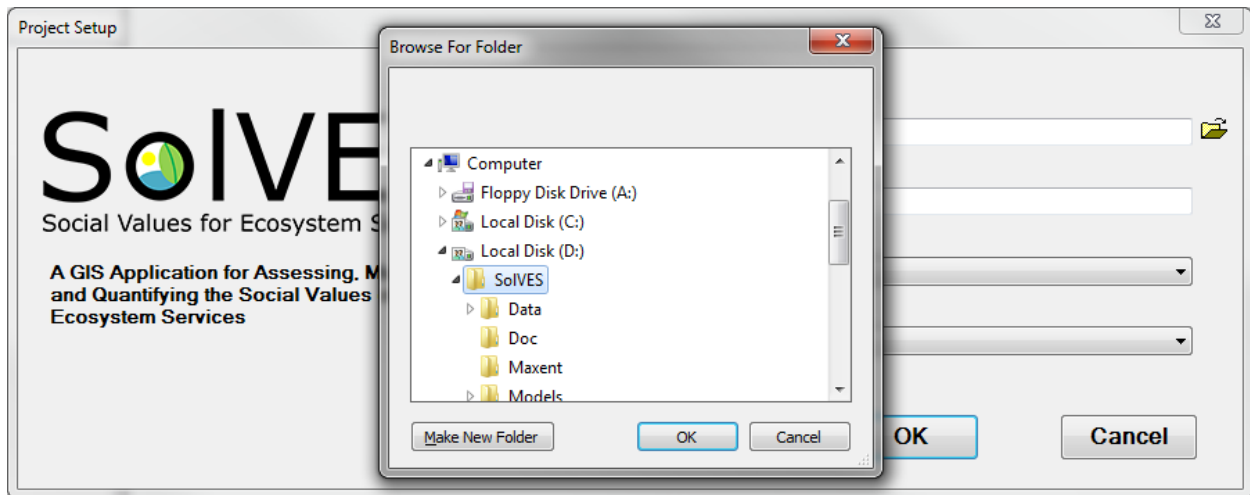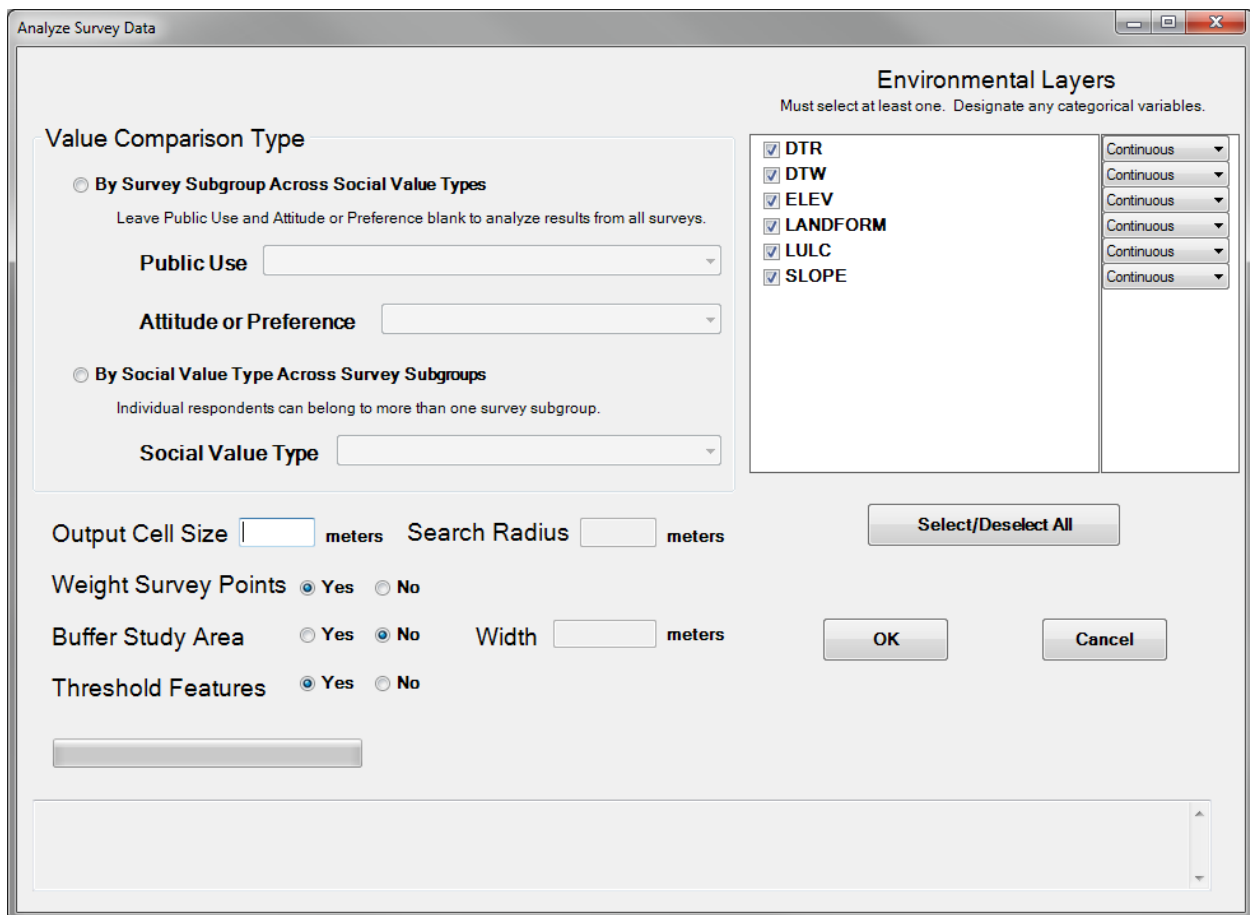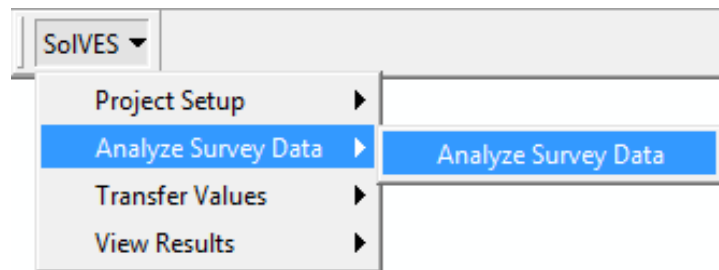
3. Enter "Pike and San Isabel National Forest" as the Project Name.
4. The Value Map Background will default to HILLSHADE. Leave the default value.
5. The Locator Map Boundary will default to STATES. Leave the default value.
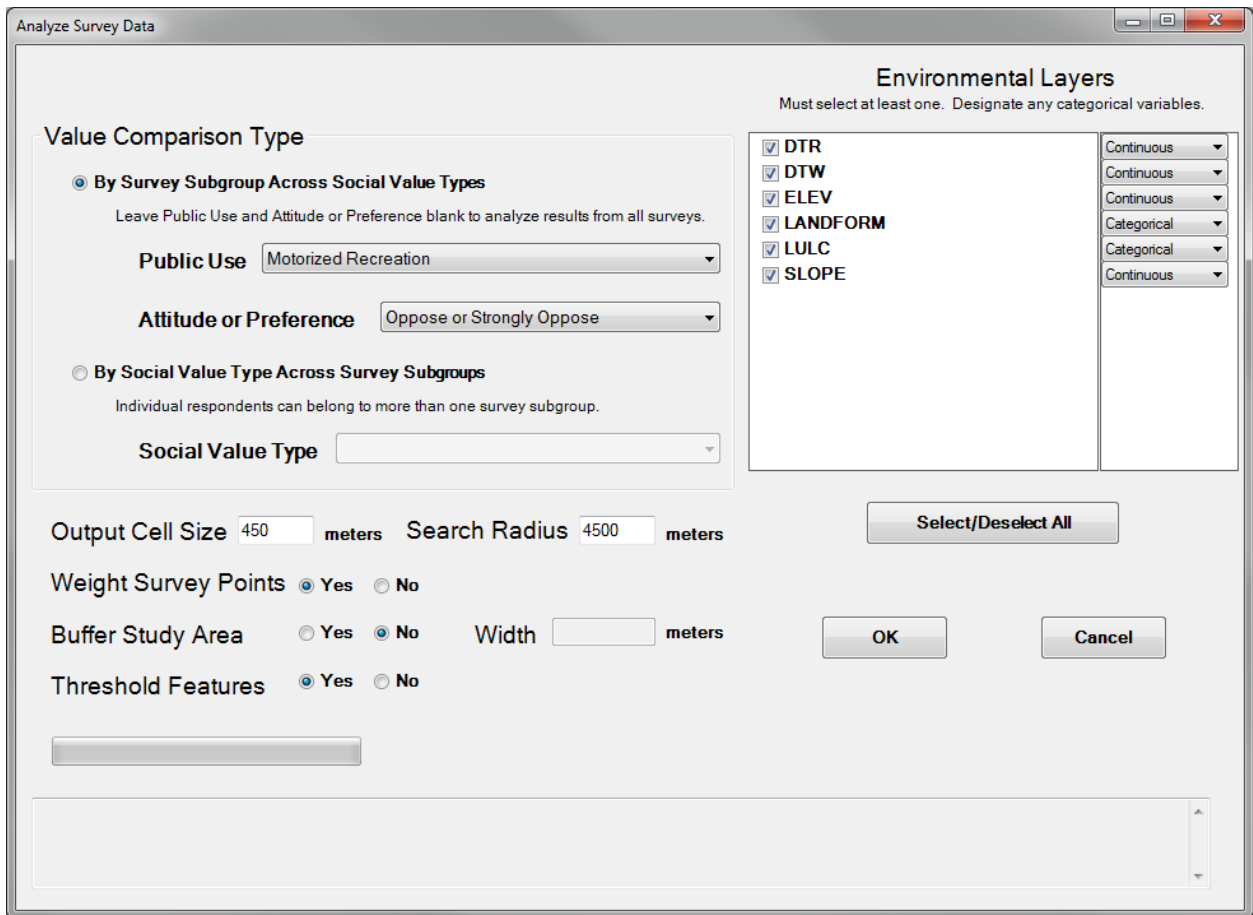6. Select OK.

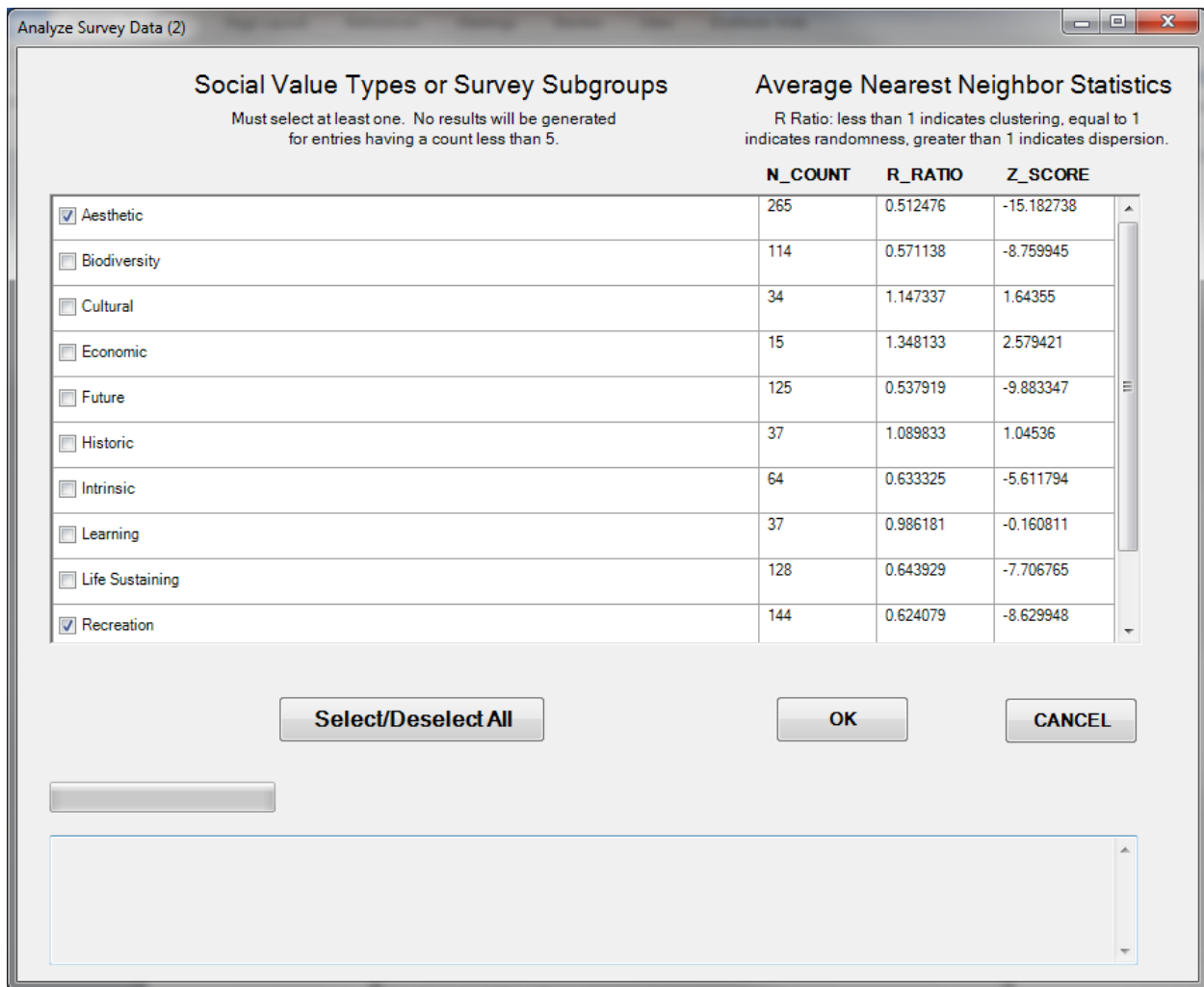7. Select the Analyze Survey Data tool from the toolbar.

8. Select By Survey Subgroup Across Social Value Types as the Value Comparison Type.
9. Select Motorized Recreation from the Public Use dropdown list.
10. Select Oppose or Strongly Oppose from the Attitude or Preference dropdown list.
11. Enter 450 as the Output Cell Size.
12. The Search Radius parameter defaults to 10 times the Output Cell Size. Leave the default value of 4500.
13. Set Weight Survey Points to Yes.
14. Set Buffer Study Area to No.
15. Set Threshold Features to Yes.

16. Leave all six Environmental Layers selected.
17. Set the LANDFORM and LULC dropdown list values to Categorical.

18. Select OK. The main ArcMap application window will not be visible during processing. After a few minutes, a second Analyze Survey Data tool screen will appear.

19. Select the Select/Deselect All button to deselect all social value types.

20. Select the checkboxes next to Aesthetic and Recreation.

Analyze Survey Data (2)

Social Value Types or Survey Subgroups
Must select at least one. No results will be generated
for entries having a count less than 5.

Average Nearest Neighbor Statistics
R Ratio: less than 1 indicates clustering, equal to 1
indicates randomness, greater than 1 indicates dispersion.

Social Value Type	N_COUNT	R_RATIO	Z_SCORE
☑ Aesthetic	265	0.512476	-15.182738
☐ Biodiversity	114	0.571138	-8.759945
☐ Cultural	34	1.147337	1.64355
☐ Economic	15	1.348133	2.579421
☐ Future	125	0.537919	-9.883347
☐ Historic	37	1.089833	1.04536
☐ Intrinsic	64	0.633325	-5.611794
☐ Learning	37	0.986181	-0.160811
☐ Life Sustaining	128	0.643929	-7.706765
☑ Recreation	144	0.624079	-8.629948

Select/Deselect All   **OK**   **CANCEL**

21. Select OK.

For a few minutes during processing, the Maxent user interface will be partially visible behind the above screen. Do not attempt to interact with the Maxent user interface because it may cause SolVES 3.0 to malfunction. After several minutes, the tool will finish processing and an empty ArcMap document will be visible. Now it is time to review some of the results produced by the Analyze Survey Data tool.

1. Select the View Results tool from the toolbar.
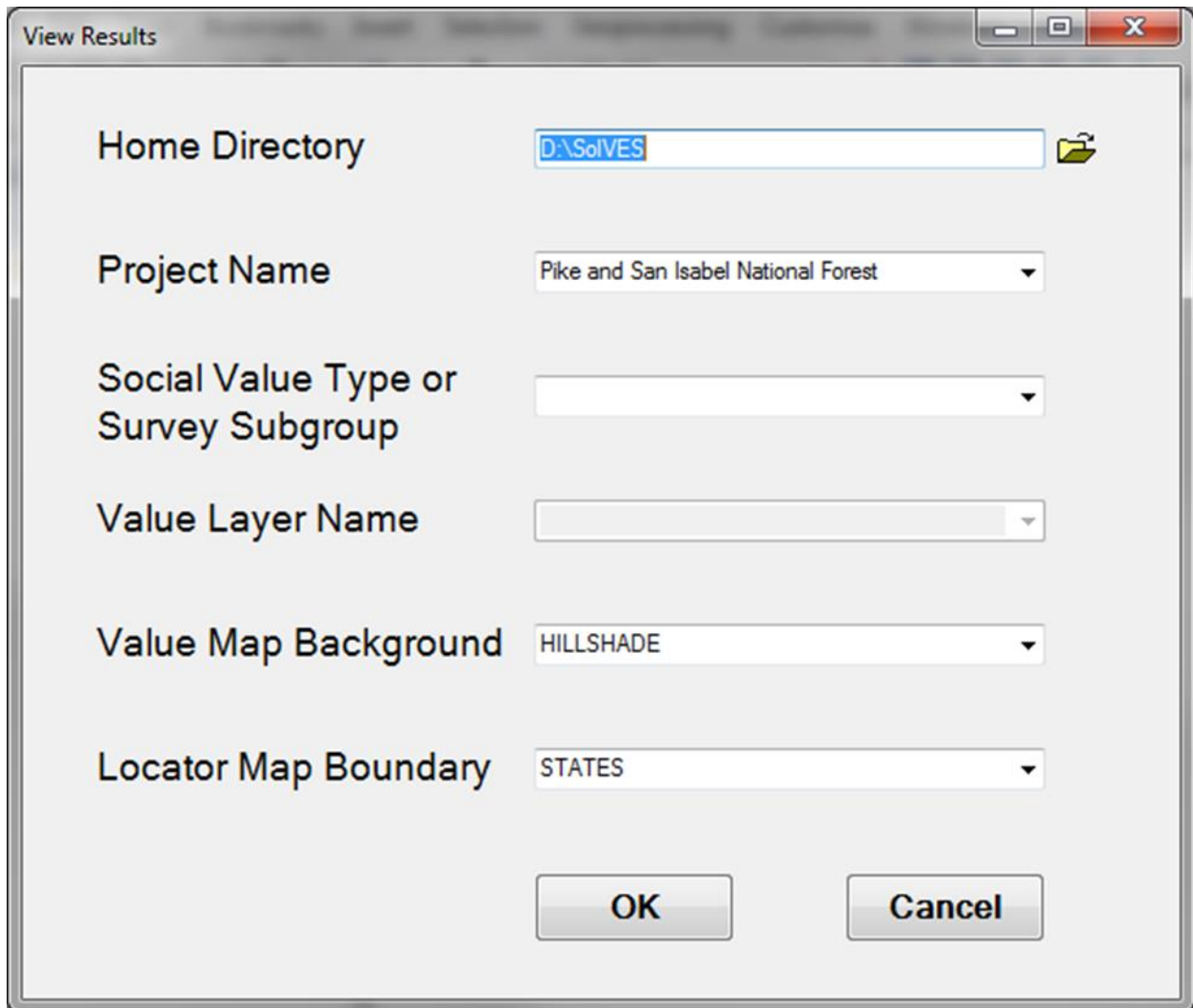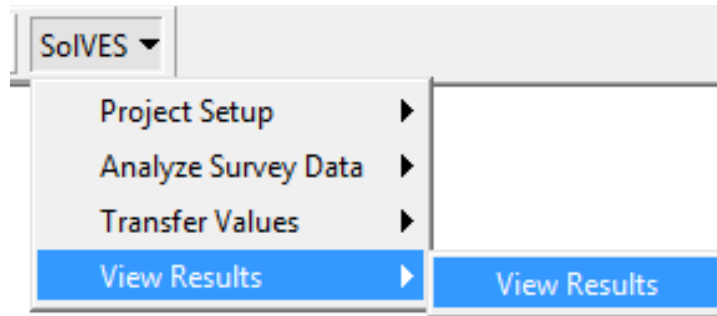
2. Leave the existing Home Directory, Project Name, Value Map Background, and Locator Map Boundary values as they are.

3. Select Motorized Recreation_OPPOSE from the Social Value Type or Survey Subgroup dropdown list.

4. Select Aesthetic from the Value Layer Name dropdown list.

5. Select OK.

A map layout is generated showing aesthetic value across the Pike and San Isabel National Forest for survey respondents opposed to motorized recreation in the forest. The layout also includes graphs reporting environmental metrics across the Value Index gradient. Statements regarding the goodness of fit of the model generated for the Pike and San Isabel National Forest as well as the model's potential performance in transferring values to similar study areas are included below the environmental metric graphs.
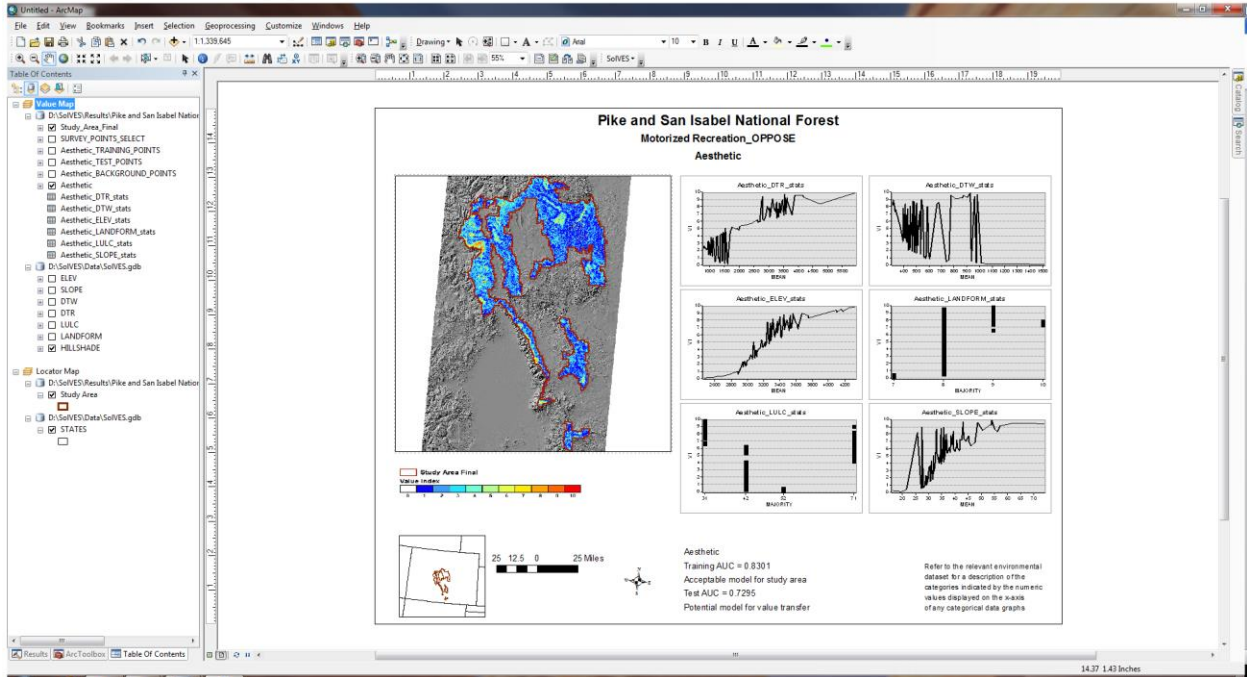
6. Exit ArcMap.

This is the end of Exercise #1.
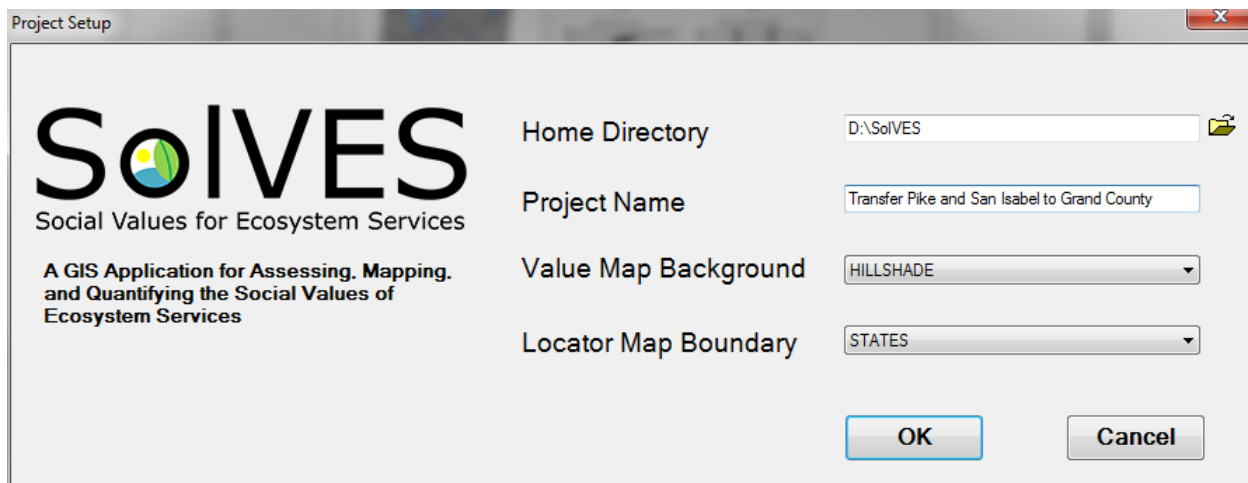
EXERCISE #2: USING THE TRANSFER VALUES AND VIEW RESULTS TOOLS

For this exercise, copy the SolVES.gdb file containing the Grand County, Colorado, sample data to the Data folder in the SolVES directory. The Transfer Values tool will be used to apply an aesthetic value model generated from the Pike and San Isabel National Forest social survey data to an area immediately north of the forest, Grand County, Colorado. To begin the exercise, open ArcMap if it is not already.

1. Select Project Setup and New SolVES Project from the toolbar.
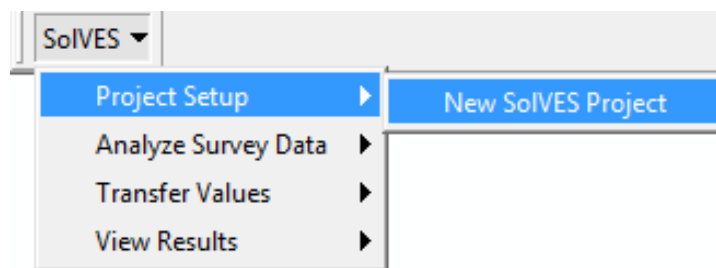
2. Once the Project Setup form is open, navigate to the SolVES directory location to set the Home Directory.
3. Enter the Project Name as "Transfer Pike and San Isabel to Grand County".
4. Leave HILLSHADE as the default Value Map Background.
5. Leave STATES as the default Locator Map Boundary.
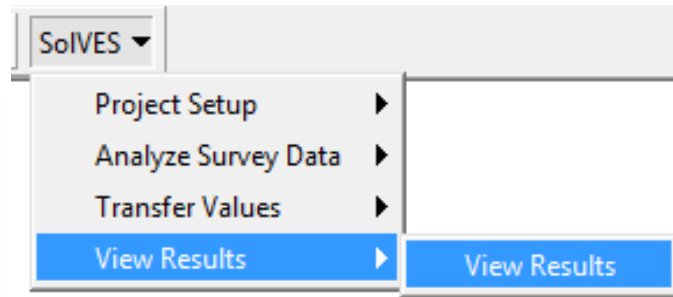

6. Select OK.

7. Select the Transfer Values tool from the toolbar.
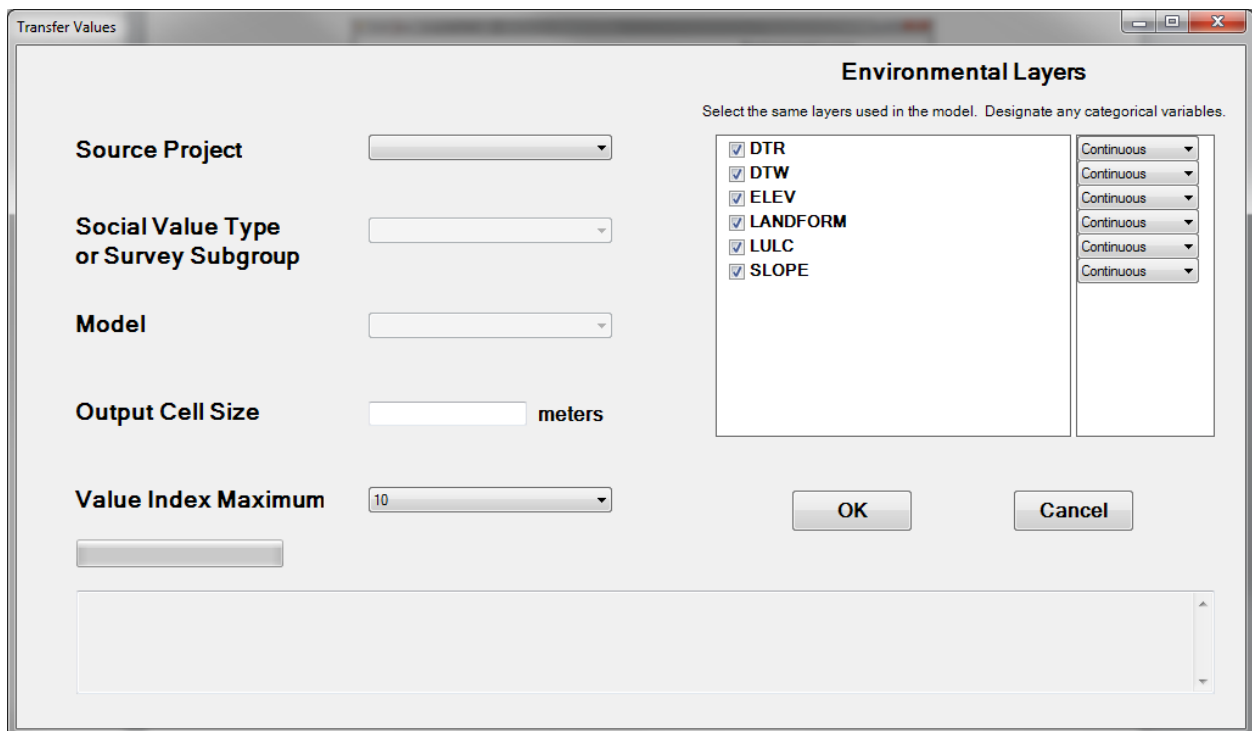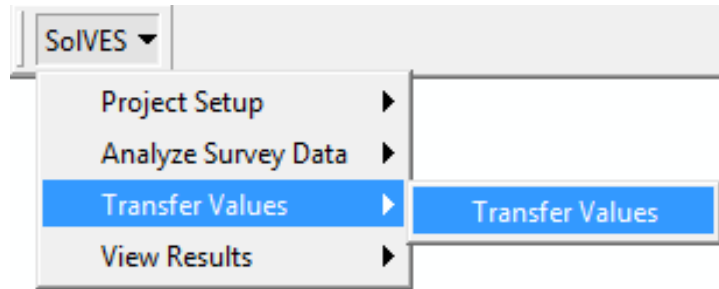
8.   Select Pike and San Isabel National Forests from the Source Project dropdown list.

9.   Select All Surveys from the Social Value Type or Survey Subgroup dropdown list.

10. Select Aesthetic from the Model dropdown list.

11. Enter 450 into the Output Cell Size field.

12. Leave the default Value Index Maximum as 10.

13. Leave all the Environmental Layers selected.

14. Set the LANDFORM and LULC dropdown list values to Categorical.

15. Select OK. The main ArcMap application window will not be visible during processing.

After a few minutes, the tool will finish processing and an empty ArcMap document will be visible. Now is the time to review the results produced by the Transfer Values tool.

1. Select the View Results tool from the toolbar.

2. Leave the existing Home Directory, Project Name, Value Map Background, and Locator Map Boundary values as they are.
3. Select All Surveys from the Social Value Type or Survey Subgroup dropdown list.
4. Select Aesthetic from the Value Layer Name dropdown list.
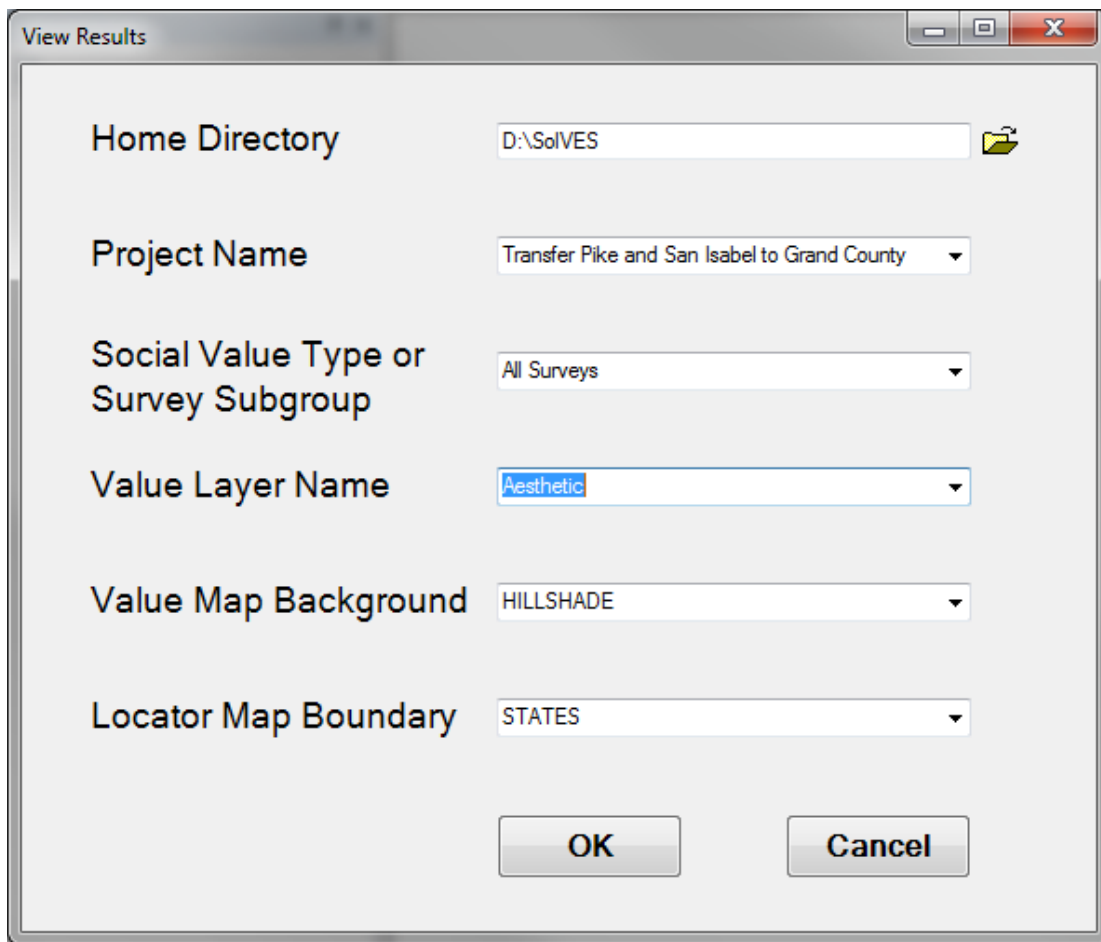
5. Select OK.

A map layout is generated showing predicted aesthetic value across Grand County, Colorado, for all survey respondents. Since no survey data were available for Grand County, the map was produced by using a model generated from the survey data for the Pike and San Isabel National Forest. The layout also includes graphs reporting the environmental metrics across the Value Index gradient.
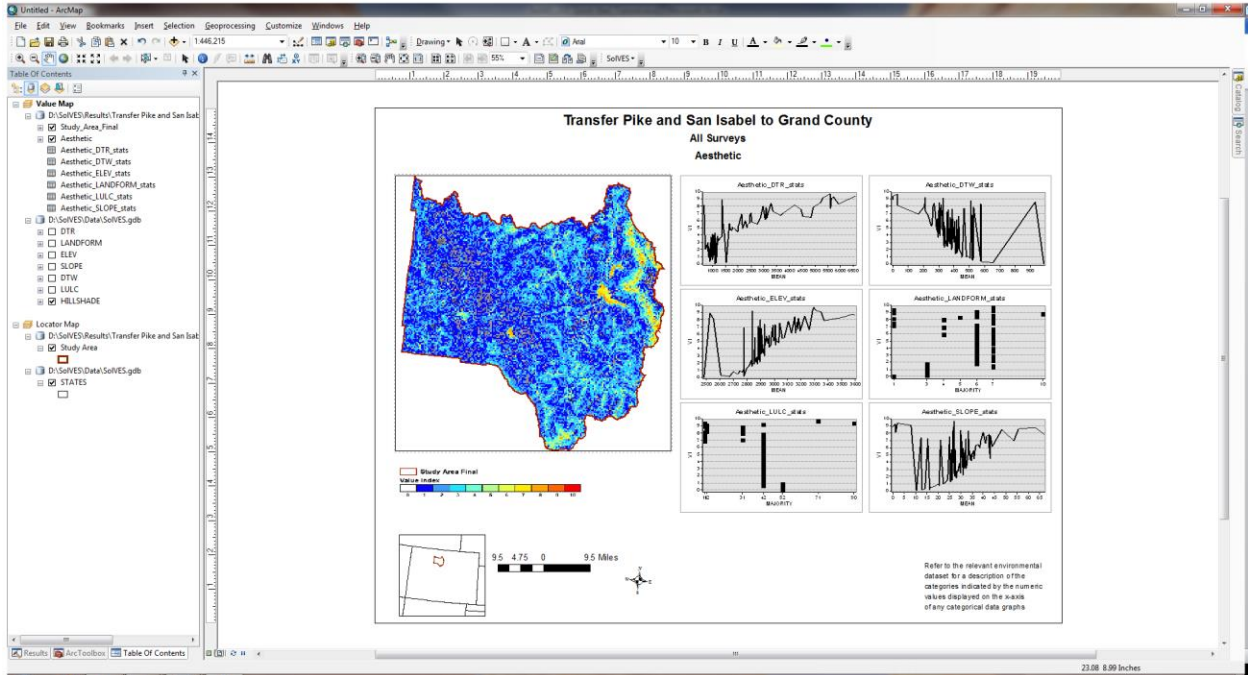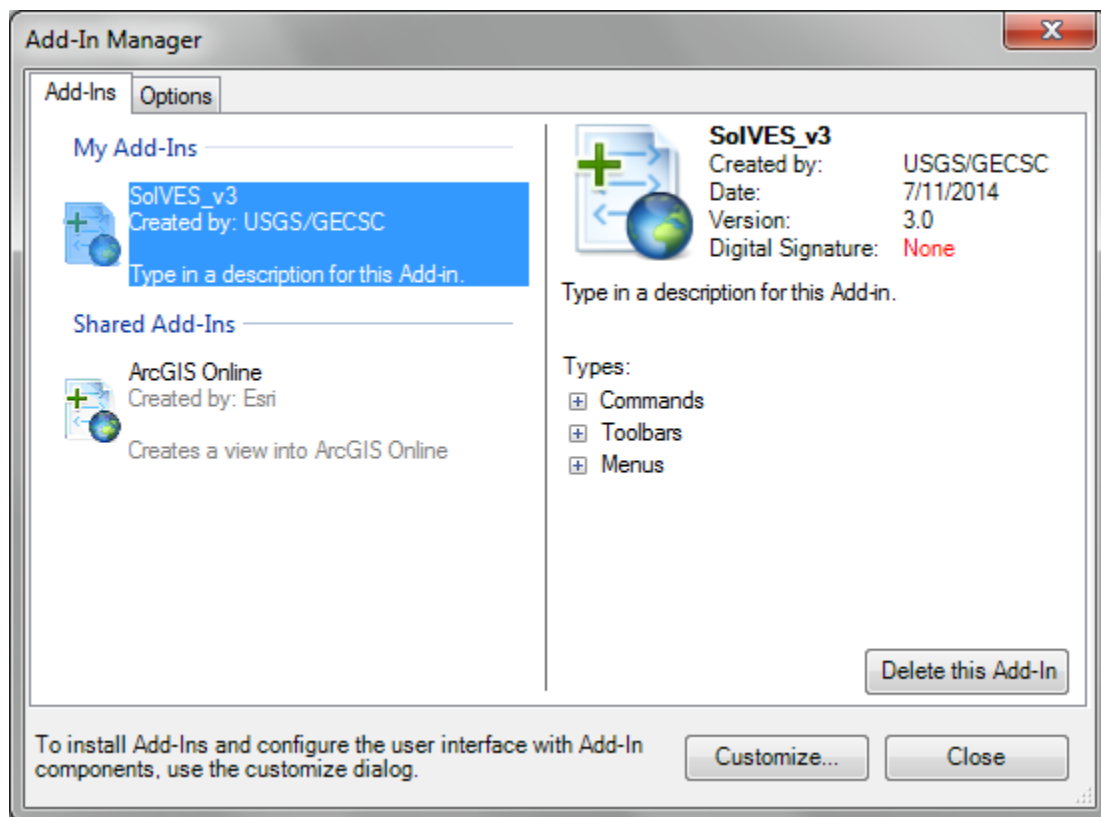

6. Exit ArcMap.

This is the end of Exercise #2.

UNINSTALL

To uninstall SolVES 3.0:

1. Open ArcMap.
2. Select Customize -> Add-In Manager from the main menu.
3. Select SolVES_v3 under My Add-Ins.
4. Select Delete this Add-In.

5. Select Yes at the "Do you really want to delete this Add-In?" prompt.
6. Select Close.
7. Exit ArcMap.

Again, for more detailed information regarding SolVES 3.0, including its design, functionality, data requirements, and troubleshooting, please refer to the SolVES, Version 3.0 User Manual available for download at *http://solves.cr.usgs.gov*.