



# **AVSWAT - X short Tutorial**

Prepared by Mauro Di Luzio, Georgie Mitchell and Nancy Sammons for the Workshop

# Watershed Modeling using SWAT2003 March 5, 2005

Instructors:

Dr. Jeff Arnold	USDA - ARS, Temple TX
Dr. Mauro Di Luzio	TAES - BREC, Temple TX
Dr. Cole Green	USDA - ARS, Temple TX
Dr. Ali Saleh	TIAER, Stephenville, TX



Third Conference on Watershed Management to Meet Water Quality Standards and Emerging TMDL (Total Maximum Daily Load)

> March 5 - 9, 2005 Sheraton Atlanta, Georgia





# Index

Installing AVSWATX	Page	2
CHAPTER 1: An application example	Page	6
CHAPTER 2: The SEA (SSURGO Extension for AVSWATX)	Page	45
CHAPTER 3: Land Use–Land Cover Splitting Tool	Page	57
CHAPTER 4: Sensitivity Analysis, Automatic Calibration and Uncertainty Analysis	Page	62

# Installing AVSWATX

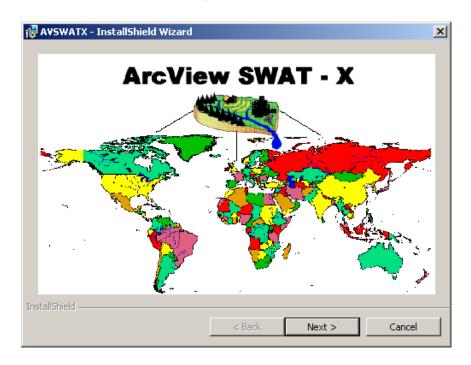
### Temple, TX, February 24, 2005

## **Required Software**

- 1. <u>ArcView 3.1 or later (only up to 3.3)</u> (3.3 recommended with Windows XP).
- 2. ArcView Spatial Analyst Extension (1.1 or 2.0).
- 3. <u>ArcView Dialog Designer Extension</u> (in general already installed with ArcView 3.1 and later).

### Installation

- 1. Use the provided CD-ROM or unzip the avswatx.zip (soon distributed in the Web) in a temporary directory.
- 2. Double click the Start.apr project file or use ArcView to open it.
- 3. The opening project starts the AVSWATX Install Wizard driving through the remainder of the installation process.

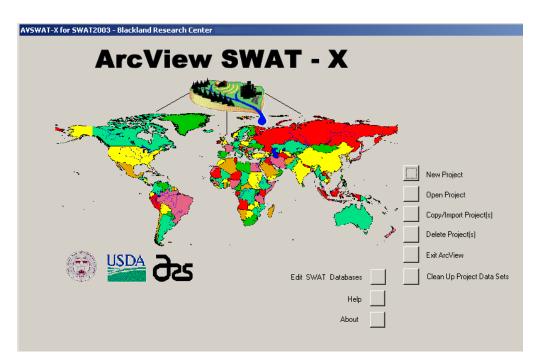


4. Once the installation is complete, open a new-empty ArcView session (do not use a working project with Tables or Views in it), select the menu *File*, menu item *Extensions*, select "*AVSWATX Extendable*", and press the *OK* button.

🍳 Extensions	×
Available Extensions:	
ADRG Image Support       ▲        AVSWAT2000       ▲         ✓       AVSWATX Extendable        CADRG Image Support       ▲        Cad Reader       ↓        CeapRuns       ▲	OK Cancel Reset
CIB Image Support	🧮 Make Default
Extendable ArcView interface for SWAT2003 mo MDL Thu Sep 30 10:58:53 2004	del

**Note:** Avoid setting the extension as default (i.e. do NOT check the Make Default Option).

5. The main interface dialog will be displayed. Continue creating a new project (*New Project*) or opening a previous one (*Open Project*) identified by the file extension *.avsx.* 



# Notes

- No need to uninstall AVSWAT2000
- Not possible to use AVSWAT2000 projects (.swat) with the new AVSWATX

### Adding STATSGO Soils Data parameters by State

The installation provides soils data only for a few states, such as Texas, Pennsylvania, and Wisconsin.

For other states, data can be installed separately following these steps:

- 1. At <u>ftp://ftp.brc.tamus.edu/pub/swat/pc/soilav/</u> download the soils data, zipped by state.
- 2. In the AWSWATX soils directory (e.g. C:\AVSWATX\AvSwatDB\AllUs\statsgo\) create a directory for each downloaded state file, using the respective two-letter abbreviation (i.e., CO for Colorado, OK for Oklahoma, etc.).
- 3. Unzip each state file within the respective directory.

Mauro Di Luzio, TAES- BREC

Data for the Sabine River Watershed Headwaters in Northeast Texas has been included in the installation package as a demonstration data set. The example data set is stored in the directory :\<*Installation dir>*\AvSwatDB\Example3 which can be found on the drive that the AVSWATX was installed (Figure 1.).

ole3 s Help			
earch 😥 Folders 🛄 🔹			
xample3			
	× Name 🔺	Size Type	D
	amask	File Folder	3
	💳 🔂 dem	File Folder	3
	info 🔁	File Folder	3
	🔄 🗀 landuse	File Folder	3
	🔳 hop0pcp	13 KB DBF File	3
	📕 Mop1pcp	13 KB DBF File	;
	📕 🔳 hop2pcp	13 KB DBF File	
	📕 📕 hop3pcp	13 KB DBF File	:
	📕 🔳 hop4pcp	13 KB DBF File	:
	🔳 lucsplit	1 KB DBF File	:
	🔳 Iunicd	1 KB DBF File	;
	📃 📃 observ	47 KB Text Document	
	📕 🔳 pcpfork	1 KB DBF File	:
	🔳 soils	3 KB DBF File	:
	🔤 soils.sbn	2 KB SBN File	
	soils.sbx	1 KB SBX File	
	🖬 soils.shp	472 KB SHP File	
	🖬 soils.shx	1 KB SHX File	:
	🔳 strflow	1 KB DBF File	:
	📕 tmp_2902	20 KB DBF File	;
	📕 tmp_4483	20 KB DBF File	3
	📕 tmp_4976	20 KB DBF File	3
	📕 tmp_8743	20 KB DBF File	3
	🛛 🔳 tmpfork	1 KB DBF File	3

#### Figure 1.

The example data set includes 3 ESRI grid themes and one shape file in the same projection coordinates (a Albers Equal Area projection), and other supporting files. The 3 grid themes are:

- Dem: a Digital Elevation Model (DEM): The map was created with the resolution in meters (100) and the elevation in meters.
- *Amask*: a zonal mask.

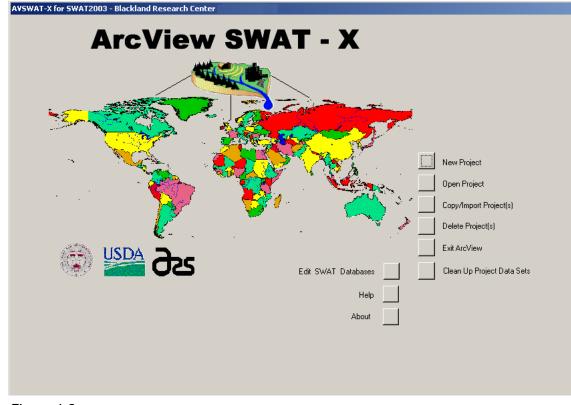
- *Landuse*: a Land Cover/Land Use extracted from the USGS NLCD (National Land Cover Data set).
- Soils: A shape file soil map compiled from the NRCS STATSGO (Natural Resource Conservation Service database.

The DBF tables are:

- Location table for USGS stream flow gages: strflow.dbf.
- Location table for rain gages: *pcpfork.dbf*
- Precipitation data tables: pcp\_8743.dbf, pcp\_2902.dbf, pcp\_9836.dbf, pcp\_4483.dbf, pcp\_4976.dbf
- Location table for temperature gages: *tmpfork.dbf*
- Temperature data tables: *tmp\_2902.dbf*, *tmp\_4483.dbf*, *tmp\_4976.dbf*, *tmp\_8743.dbf*
- Land Use look up table: *lunlcd.dbf*
- Land Use look up table: *lucsplit.dbf*
- Observation records: *observ.txt.*

# SECTION 1: CREATE SWAT RUN WITH EXAMPLE DATASET

- 1. Start ArcView by double-clicking the icon. If an icon for the program is not present, click the Start button, then highlight Programs. From the software list displayed, highlight ESRI. The program name ArcView 3.x will be displayed. Click the program name to start ArcView. A Welcome to ArcView GIS window will pop up. Click Cancel.
- 2. On the File menu, click Extensions.
- 3. Scroll the list of available extensions until you locate AVSWATX Extendable. Check the box beside AVSWATX Extendable and click OK.
- 4. The main interface will be displayed (Figure 1.2).





- 5. Click the box beside New Project.
- 6. A browser will be displayed requesting a name for the new project. Type *sabine* in the text box labeled File Name (Figure 1.3).

🝳 New AVSWATX Project		×
File Name: sabine	Directories: I:\avswatx	ОК
sociarsz     cli arsz     c2 arsz     c3 arsz     geguaros     agitzuaros     rowili arsz     rowili arsz	I:\ avswatx aio avswatdb avswatpr c1 c2 c3	Cancel
	Drives:	

Figure 1.3

7. Click OK.

Note Once OK is clicked, the interface creates a subdirectory called *sabine* within the active directory displayed in the directory tree on the dialog box. This directory is used to store maps and database tables created by the interface as well the input files for SWAT.

8. After the project name is specified, the interface brings up the Environmental Variables prompt box (Figure 1.4). This prompt box lists the directories that the interface searches for the information needed to create the SWAT input files.

👰 Directories browser	×
Selected Dir: E\avswatx\sabine	Up
Directories:	
scenarios watershed	OK Cancel

Figure 1.4

Programs used by the interface are stored in the directory listed next to SWAT Programs. This directory is defined when the interface is installed.

The directory listed next to SWAT Data Bases contains all the database (.dbf) tables used by the interface to set default input values and define the upper and lower limits for variable values. This directory also contains the soil and weather generator databases included with the interface. As with the previous directory, this directory is defined when the interface is installed.

The third directory is the SWAT User Data directory. When the interface brings up the Environmental Variables prompt box, the project directory created by the interface is listed in the text box (the interface *output* directory). This needs to be changed to the

directory where the DBF tables containing the measured precipitation and temperature data are stored.

9. The maps and database tables required for the example project are stored in :/*Installation dir*/AvSwatDB/Example1. The name in the text box may be changed by 1) typing the directory pathway in the text box, or 2) searching for the correct directory with a browser.

To activate a browser:

- a. Click the 📴 button to the right of the text box.
- b. A directory browser will appear with the directory listed in the text box visible (Figure 1.5).

🍭 Directorie	s browser		×
Selected Dir:	I:\avswatx\avswatdb		Up
D	lirectories:		
	allus example1 example2 example3 exinputs	OK Cancel	



c. Click the button labeled Up. This will make the *installation dir* directory active. You will see at least three directories listed: *avswatdb, avswatpr* and *sabine*. Select *avswatdb* by clicking on the name in the list of directories. When the *avswatdb* directory is active, several subdirectories will be listed: *allus, example1, example2, example3, etc.* Select *example3* by clicking on the name in the list of directories. The Directory browser will now look like Figure 1.6.

👰 Directories browser	×
Selected Dir: I:\avswatx\avswatdb\example3	Up
Directories:	
amask dem info landuse usgs	OK Cancel



- d. Once the proper directory is listed in the text box next to Selected Dir, click the button labeled OK.
- 10. The SWAT User Data directory in the prompt box will show the directory chosen with the browser (Figure 1.7).

🍳 SWAT - ArcView : Data	sets	×
SWAT Programs:	L:\AVSWATX\AVSWATPR	
SWAT Data Bases:	L:\AVSWATX\AVSWATDB	
SWAT User Data:	L:\AVSWATX\AVSWATDB\EXAMPLE3	)
	Help Cancel OK	

- 11. Click OK to confirm the choice.
  - Note To access the Environmental Variables prompt : box at any time, select Avswat Main Interface Dialog from the Avswatx menu to bring up the Main Interface screen and then click the button next to Environmental Variables.

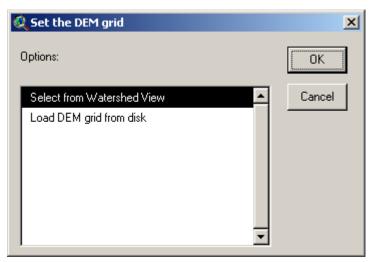
12. Once the User Data directory is defined, the interface will display the Watershed Window and automatically activate the Watershed Delineation dialog box (Figure 1.8).

🝳 Watershed Delineation	×
DEM Set Up Dem grid	
	Properties
Focusing watershed area option	
Burn_in option	
Preprocessing of the Dem to remove sinks:	Áppija
Stream definition	
Threshold Area : 0 [ha]> Number of cells	: 0
Min:	
Suggested around: Max:	Appiy
Outlet and inlet definition-M	anual
	X XA
	emove Redefine
Main watershed: outlet(s) selection and definition	emove negerine
Whole Watershed outlet(s) Calculation of subba	sin parameters:
	Áccelo
Select Undo	**\$5.879
Heservoirs	
Add 🗫 🐰 Remove	
Current number of outlets/subbasins: Help M	inimize Close

Figure 1.8

# SECTION 1.1: PROCESSING THE ELEVATION MAP GRID

- 1. To load the example DEM, click 🖻 beside the DEM grid text box.
- 2. A prompt box is opened (Figure 1.9)





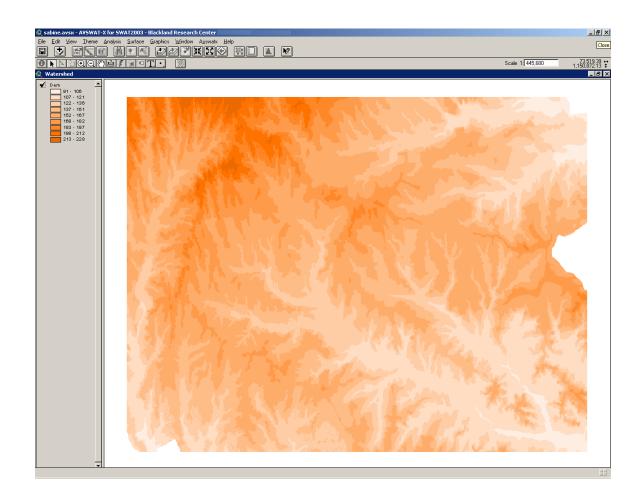
Highlight Load DEM grid from disk and click OK.

3. A grid dataset file browser will appear with the User Data directory active (Figure 1.10).

🍳 Load DEM grid from disk		×
Grid Name	Directories: I:\avswatx\avswatdb\example3 I:\ avswatx avswatdb example3 I usgs Drives:	OK Cancel



- 4. Click the name of the elevation map grid (*dem*). The name of the elevation map grid will then be displayed in the text box below Grid Name on the browser. Click OK to confirm the choice.
- 5. The name of the elevation map grid will be displayed in the DEM grid text box on the Watershed dialog box and the elevation map will be displayed (Figure 1.11).



6. A prompt box will appear reminding the user to verify DEM properties (Figure 1.12).





Click OK.Click the properties button Properties next to the DEM grid text box. The interface will activate the map Properties prompt box (Figure 1.13).

💐 Dem Properties	5	×
<mark>meters ▼</mark> Z Units		Z ↓ ↓ ↓ ↓
X -Y resolution	100	meters 💌
Cell Area	1	X-Y Units [ha]
	Project	tion
	Help	Cancel OK



7. The units for the X-Y and Z resolutions should be set to meters. To define the projection, click the projection button Projection. A prompt box will appear listing projection details for the DEM (Figure 1.14).

🍭 Current projection		×
Undefined Projection		<u> </u>
	OK	<u>_</u>

Figure 1.14

Click OK.

- 8. A prompt box will appear asking if the user wishes to modify the projection information. Click Yes.
- 9. The interface will activate the map projection prompt box (Figure 1.15).

🙋 Swat - ArcView: Data Projection Definition	
Predefined Projection	
Custom Projection	
Help Cancel	



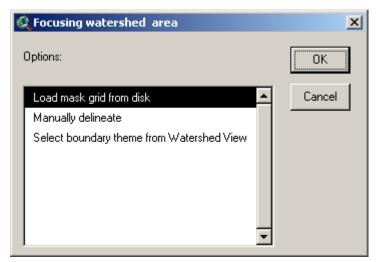
The maps in the example data set were created in the Albers Equal Area projection, which is a Predefined Projection in the interface. Click the button to the left of Predefined Projection on the map projection prompt box. A list of predefined projections will be displayed. Highlight *Albers Equal-Area (Conterminous U.S.)* by clicking on the name. Click OK to select this projection, then click OK on the DEM Properties dialog box.

The map resolution units and projection are properties of the map that are set when the map is created. While the interface can utilize maps in any projection, all maps used for a project must all be in the same projection.

10. Optional: At this point the user may load a masking map grid and/or perform a burn-in of the stream network with a shape file containing the stream delineation for the watershed. A burn-in is useful in watersheds with very little relief (e.g. delta regions) or where the elevation map is not detailed enough to accurately predict the stream network. The example data set contains a masking map grid.

To load the masking map grid:

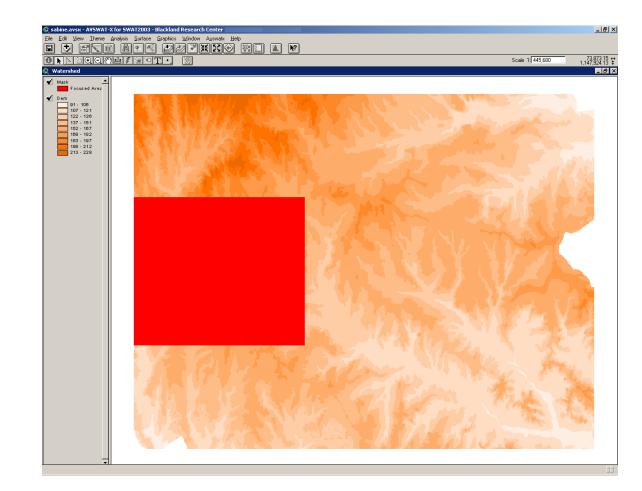
a. On the Watershed Delineation dialog box, check the box next to Focusing watershed area option. A check will appear in the box Focusing watershed area option and a prompt box will open (Figure 1.16).





Highlight Load mask grid from disk and click OK.

- b. A browser is displayed. Click the name of the masking map grid, *amask*, and then click OK.
- c. The masking map grid will be displayed on the screen (Figure 1.17).



When a masking map grid is displayed, the stream network will be delineated only for the area of the DEM covered by the masking map grid.

Once the elevation map is displayed, the map must be 11. preprocessed. The preprocessing feature "smooths" the elevation grid by filling in areas of the map that drain to a point rather than drain to a channel. Preprocessing speeds up the amount of time it takes for the interface to define the channel network. To preprocess the elevation map, click the button labeled Apply of the DEM next to Preprocessing Preprocessing of the Dem to remove sinks: Apply.

While processing the DEM, a prompt box will appear (Figure 1.18).

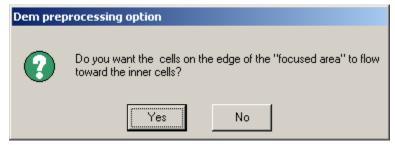


Figure 1.18

Click Yes.

- 12. A prompt box will appear after the map preprocessing is complete. Click OK.
- 13. Once the elevation map has been preprocessed, the threshold area used to define the origin of a stream needs to be specified. The smaller the number, the more detailed the stream network generated by the interface. Figure 1.19 shows the stream network generated with the threshold set to 800 ha while Figure 1.20 shows the stream network generated with the threshold set to 4000 ha.

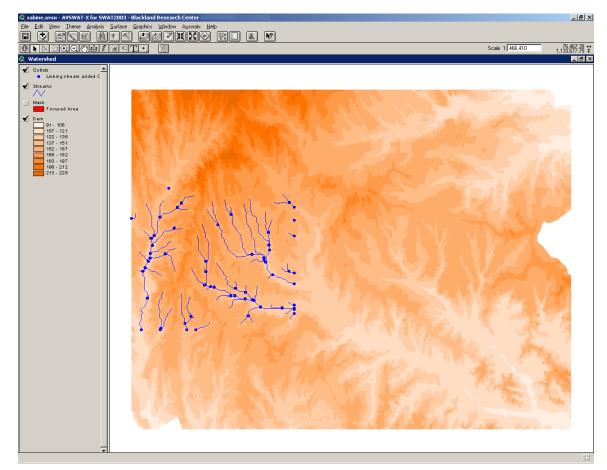
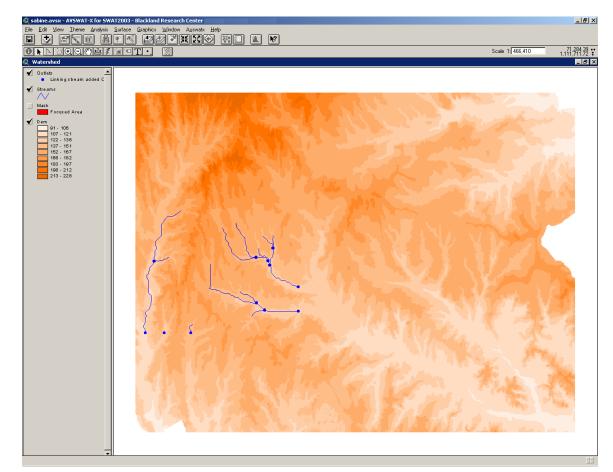


Figure 1.19



For the example project, set the threshold area to *800*. Once the proper area is displayed in the text field next to Threshold Area, click Apply.

14. The stream network will be displayed upon completion of the calculations (Figure 1.20). Subbasin outlets defined by the junction of two streams are denoted on the network by blue dots.

The user may modify the number of subbasin outlets manually or by importing an Avenue database (.dbf) table containing outlet location coordinates. Points added via the table or manually will be snapped to the closest point on the delineated stream channels.

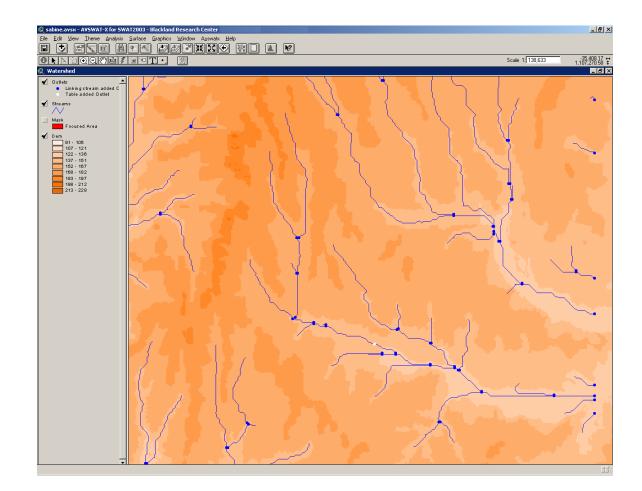
15. A table of locations where nutrient data was collected has been included in the example data set. To load the table, first verify that the Outlet radio button is selected Outlet
 Then click I next to the text field labeled Table on the Watershed Delineation dialog box.

16. A browser will be displayed (Figure 1.21).

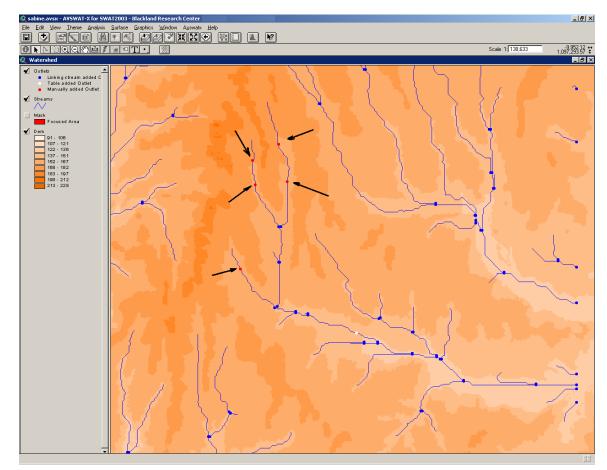
🍳 Table of locations		×
File Name: strflow.dbf	Directories: I:\avswatx\avswatdb\example3	ОК
<ul> <li>soils.dbf</li> <li>strflow.dbf</li> <li>temp.dbf</li> <li>tmp_2902.dbf</li> <li>tmp_4483.dbf</li> <li>tmp_4976.dbf</li> <li>tmp_8743.dbf</li> <li>tmp_8743.dbf</li> <li>tmpfork.dbf</li> </ul>	I\ → avswatx → avswatdb → example3 → amask → dem → info → landuse	Cancel
List Files of Type: dBASE	Drives:	

### Figure 1.21

Select *strflow.dbf* from the list of tables and click OK. The subbasin outlet location loaded from the table is displayed as white dot (Figure 1.22).



- To manually add subbasin outlets, first verify that the Outlet radio button is selected 
   Inlet Outlet
   Inlet Outlet
   Then click the button labeled Add
- 18. The dialog box will be minimized. Use the mouse to move around the map and click with the left mouse button to place a subbasin outlet where the mouse is positioned. Subbasin outlets added manually will be displayed as red dots. Add five outlets so that the map looks similar to Figure 1.23. (Arrows pinpoint location of red dots – arrows will not appear in display.)



19. Once the display of subbasin outlets is satisfactory, in the Watershed Delineation dialog box the watershed outlet must be

selected. Click the button above Select Select . The dialog box will be minimized and a prompt box will appear (Figure 1.24).

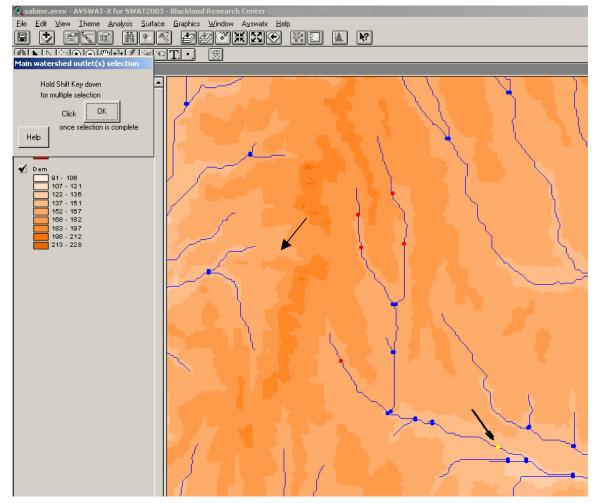
÷

Main watershed outlet(s) selection		
Hold Shift Key down for multiple selection Click OK once selection is complete		

Figure 1.24

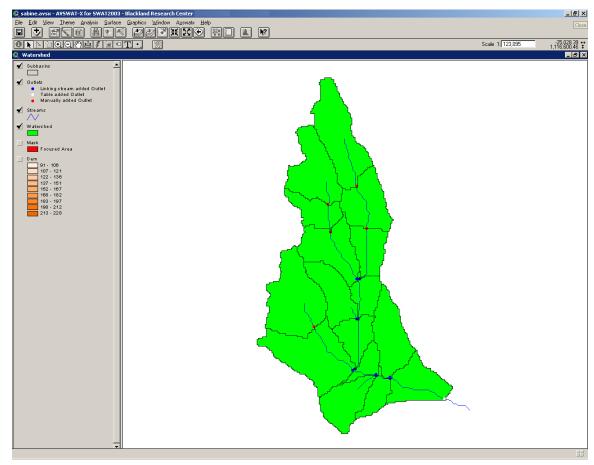
20. Select the white subbasin outlet previously imported (Figure 1.25) to be the subbasin outlet by holding down the left mouse

button and moving the mouse to form a box around the outlet dot. The outlet dot will turn yellow when it is selected.





- 21. Click OK on the prompt box once the correct outlet is selected. Another prompt box will appear to verify the outlet choice. Click Yes to continue with the processing.
- 22. The subbasin delineation for the watershed will be displayed (Figure 1.26).





23. Click the button labeled Apply next to Calculation of subbasin Calculation of subbasin parameters:

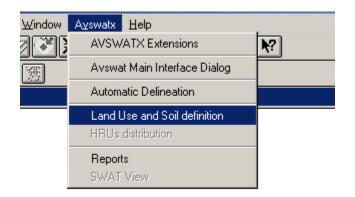
Apply

parameters

24. Once the calculation of subbasin parameters is complete, a prompt box will appear. Click OK.

### SECTION 1.2: PROCESSING THE LAND USE/SOIL MAP GRIDS

1. Select Land Use and Soil Definition in the Avswat menu (Figure 1.27).

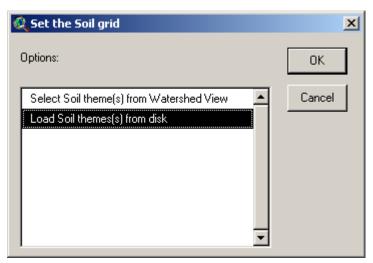


2. The Definition of Landuse and Soil themes dialog box will open (Figure 1.28)

🝳 Definition of Land Use and Soil Themes	×	
Land Use data layer Land use Grid	Soil data layer Soil Grid	
Reclassip	Fiecdarsify	
Overlap Help Close		

### Figure 1.28

- 3. To load the example land use grid, click is beside the Landuse Grid text field.
- 4. A prompt box will appear (Figure 1.29).





Highlight Load Landuse theme(s) from disk and click OK.

- 5. Another prompt box will appear for the user to define the map format. Select Grid and click OK.
- 6. A message box will appear reminding the user that the data must be projected. Click Yes.
- 7. A browser will appear with the User Data directory active. Click the name of the land use map grid (*landuse*). Click OK to confirm the choice.
- 8. The raw land use grid will be displayed and clipped to the watershed area (Figure 1.30).

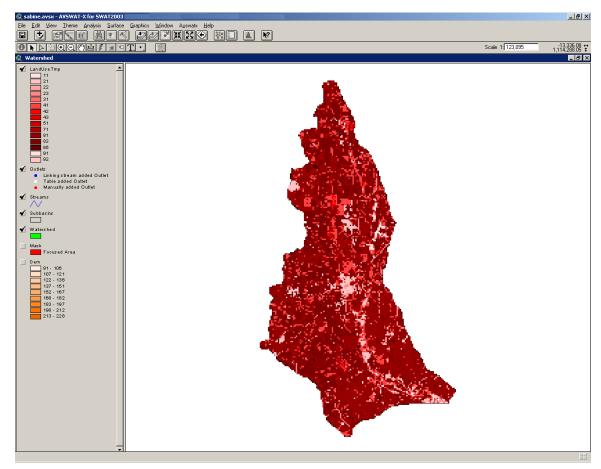


Figure 15.30

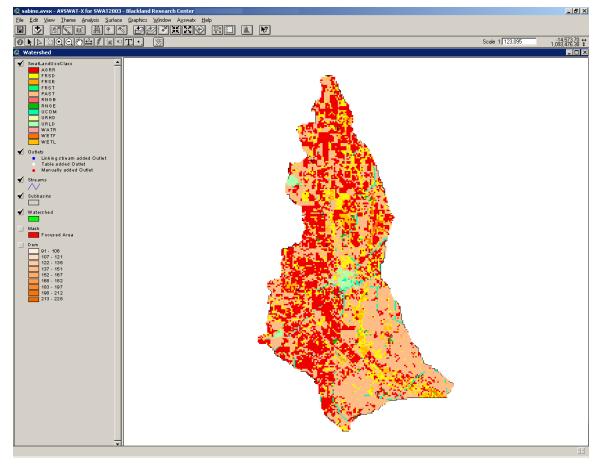
A message box will also appear reminding the user to load the look-up table for the map. Click OK.

- 9. When the land use map grid is loaded, the interface does not know which SWAT land use code to assign to the different categories.
- 10. The example data set includes a custom look up table to define the SWAT land use to be modeled for each category. Click
   is beside LookupTable Grid Values→ Land cover classes.
- 11. A prompt box will be displayed for the user to select the type of table to be loaded. Highlight User table and click OK.
- 12. Another prompt box will appear for the user to define the format of the look up table. Select .dbf file and click OK.
- 13. A browser will be displayed. Click the name of the look up table (*lunlcd.dbf*). Once the correct table is selected, click OK.

14. The SWAT land use categories will be displayed on the scrollable listing on the Land Use/Soil dialog box. Once a *LandUseSwat* code has been assigned to all map categories, the Reclassify

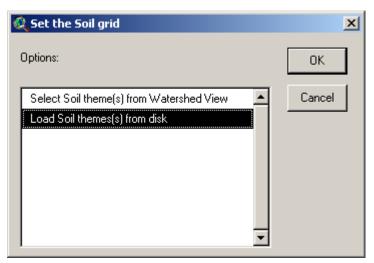
Reclassify button will be enabled. Click the Heclassify button.

15. The category display for the map will show the SWAT land use codes (Figure 1.31).





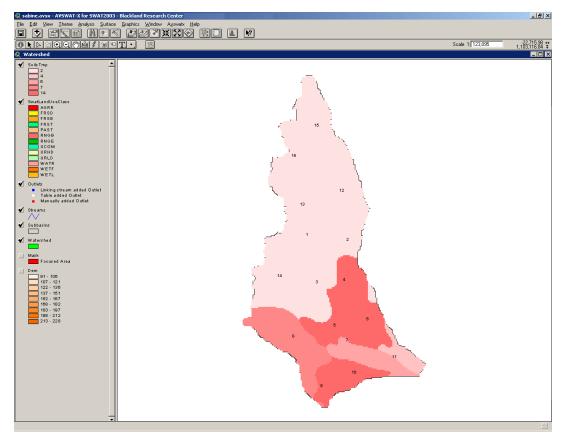
- 16. To load the example soil map, click Beside the Soil Grid text field.
- 17. A prompt box will appear (Figure 1.32).





Highlight Load Soil theme(s) from disk and click OK.

- 18. Another prompt box will appear for the user to define the map format. Select Shape and click OK.
- 19. A browser will appear with the User Data directory active. Click the name of the soil map (*soils*). Click OK to confirm the choice.
- 20. A message box will appear reminding the user that the data must be projected. Click Yes.
- 21. The raw soil map will be displayed and clipped to the watershed area (Figure 1.33).





A message box will also appear reminding the user to load the look-up table for the map. Click OK.

- 22. Five options for linking the soil map grid to the soil database are described in Section 6. The example data set is set up to link via STATSGO polygon numbers. On the Land Use/Soil dialog box, select the Stmuid option for linking the soil grid to the soil database <a href="#">O Stmuid</a>
- 23. The soil linkage information will be displayed in the scrollable listing on the Land Use/Soil dialog box). In this case a *Stmuid* code has been assigned automatically to all map categories, the

Reclassify button will be enabled. Click the Reclassify button.

24. The category display for the map will show the soil codes (Figure 1.34).

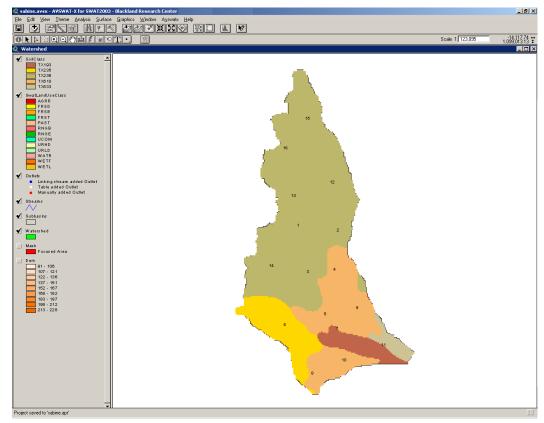


Figure 1.34

- 25. Once the land use and soil map grids have been loaded and reclassified, click the button labeled Overlay at the bottom of the Land Use/Soil dialog box.
- 26. When the overlay of the land use and soil map grids is complete, a prompt box will notify the user that the overlay process is complete. Click OK.
- 27. A report is generated during the overlay process. To access the report, select Reports under the Avswatx menu. From the list of reports, select *SWAT model: LandUse and Soil Distribution* and click OK.
- 28. Close the report after viewing.

### SECTION 1.3: LAND USE/SOIL DISTRIBUTION

1. Select HRU distribution from the Avswatx menu (Figure 1.35).

I	Ayswatx Help	
į	AVSWATX Extensions	N
i	Avswat Main Interface Dialog	
İ	Automatic Delineation	
1	Land Use and Soil definition	
	HRUs distribution	
	Reports	
	SWAT View	

2. The Land Use/Soil Distribution dialog box will be displayed

C Dominant Land Use and Soil	
	Land Use [%] over Subbasin Area 20 Image Image
	0 35.6054
Multiple Hydrologic Response Units	Soil Class [%] over Land Use Area
Help Close OK	



3. Select the Multiple Hydrologic Response Units option and set the Land Use % Threshold =10, and the Soil Class % Threshold = 10 (Figure 1.36).

**Click OK** 

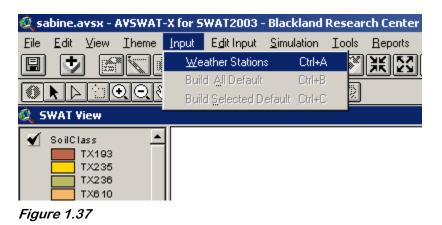
- 4. A message box will be displayed notifying the user when setup of HRUs is completed. Click OK.
- 5. A second message box is displayed notifying the user that the SWAT View is now active. Click OK. The interface will automatically switch to the SWAT View.
- 6. A report is generated during the HRU creation process. To access the report, select Show List under the Reports menu. From the list of reports, select *SWAT model: LandUse and Soil Distribution (after threshold application)* and click OK. The total number of HRUs created in the watershed is listed in the top section of the report in bold letters. The remainder of the report lists the land use and soil modeled in every subbasin and the

percent area distribution of 1) subbasins within the watershed and 2) HRUs within the subbasins.

7. Close the report after viewing.

### SECTION 1.4: WEATHER STATIONS

1. To load the example weather data, click Weather Stations under the Input menu (Figure 1.37).



2. The Weather Data dialog box will be displayed (Figure 1.38).

🍳 Weather data definition	×
Rainfall data	Solar Radiation data
<ul> <li>Simulation</li> </ul>	Simulation
C Raingages	C Solargages
Temperature data	Wind Speed data
<ul> <li>Simulation</li> </ul>	<ul> <li>Simulation</li> </ul>
C Climate stations	C Windgages
Weather simulation data	Relative Humidity data
<ul> <li>US database</li> </ul>	Simulation
C Custom database	C Rel. Humidity gages
	Help Close



The example data set contains data files with measured precipitation and temperature for weather stations around the watershed.

3. To load the table containing the locations of the rain gage stations, click the radio button next to Raingages in the section of the dialog box labeled Rainfall data.

A text box will appear at the bottom of the Rainfall data section. Click Section beside the text field.

A browser will be displayed. Click the name of the rain gage location table (*pcpfork.dbf*) then click OK.

The locations of the rain gages will be displayed as squares (Figure 1.39).

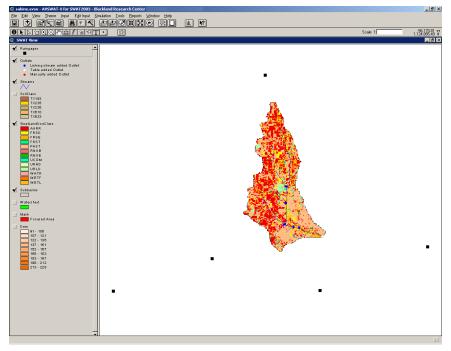


Figure 1.39

4. To load the table containing the locations of the temperature gage stations, click the radio button next to Climate stations in the section of the dialog box labeled Temperature data.

A text box will appear at the bottom of the Temperature data section. Click beside the text field.

A browser will appear. Click the name of the climate station location table (*tmpfork.dbf*) and then click OK.

The locations of the temperature gages will be displayed as triangles.

For a SWAT simulation using measured weather data, weather simulation information is needed to fill in missing data and to generate relative humidity, solar radiation and wind speed. The example data set uses weather generator data loaded into the United States database. Click Beside the text field.

The locations of the weather generator stations will be displayed as stars.

- 5. Once the weather generator data is loaded, a button labeled OK will appear at the bottom of the Weather Data dialog box. Click this button. The interface will assign the different weather station data sets to the subbasins in the watershed.
- 6. A prompt box will appear when processing of the weather data is complete. Click OK.

## SECTION 1.5: CREATE ARCVIEW DATABASES & SWAT INPUT FILES







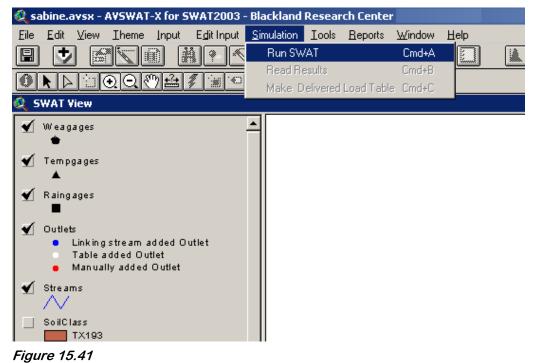
This creates the ArcView databases image of the SWAT input files containing default settings for SWAT input.

- 2. A message box will appear requesting the user to confirm the Write All command. Click Yes.
- 3. A Configuration Options box will appear click on continue.
- 4. When the interface reaches the point where general subbasin data is compiled, a prompt box will appear asking the user of the default Manning's n value of 0.014 for overland flow should be changed. Click No.
- 5. When the interface reaches the point where main channel data is compiled, a prompt box will appear asking the user of the default Manning's n value of 0.014 for channel flow should be changed. Click No.

- 6. When the interface reaches the point where management data is compiled, a prompt box will appear asking if plant heat units should be estimated or set to a default value. Click Yes to estimate.
- 7. A message box will be displayed upon completion of the SWAT input database initialization. Click OK.
- 8. Click the Continue button on the next prompt dialog.

### SECTION 1.6 RUN SWAT

1. On the Simulation menu, click Run SWAT (Figure 1.41).



2. A dialog box will be brought up (Figure 1.42).

Set Up and Run SW	/AT model sir	nulation			×
	Starting date	4077	December	Ending date	1978 💌
January 💌 Month	1 _▼ Day	1977 💌 Year	Month	Day	Year
Rainfall distribution:			Forecast Option		
Skewed norm	nal	Forecast Period:-	Starting da	ite	_
O Mixed expon	ential		December 🔽 31 🖸 Month Day	1978 Year	-
		Number oif	times that the forcast period is simulal	ted: 2	ō
Printout frequency:		Watershed parar	neters:		
C Daily			Basin Input File:	Bsn	
Monthly Yearly			General Water Quality Input File:	Wwq	
	Help	Close	Setup SWAT Run		
		J	J		

Figure 1.42

- 3. The initial and final day of simulation are set to the first and last days of measured weather data. Leave those values set to 1/1/1977 and 12/31/1978. Set the Printout Frequency to Monthly. Leave all other settings as they are.
- 4. Click the button labeled Setup SWAT Run to build the climate and watershed level input files.
- 5. A prompt box will appear asking if any input files need to be rewritten from modified .dbf files. Click No.
- 6. Click the Run SWAT button.
- 7. When the SWAT run is finished, a message box will be displayed noting that the simulation was successfully completed. Click OK.

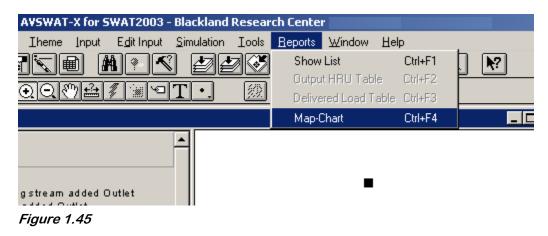
#### SECTION 1.7: VIEW RESULTS

- 1. A prompt box will be displayed informing about the location of the outputs and asking if the user wishes to "read" the ASCII outputs. Click Yes.
- 2. The SWAT output data is loaded into dBASE tables and displayed (Figure 1.43).

		: Simulation Iools		Help	67										
					<u> </u>							Scale 1:	[	1,12	5,204 1,652
SWAT View					- IX	👰 Swat-Ou	tputSub_	_Default_Si	m1						
Raingages						Subbasin	Date	Phacip	Snomeli	Pot	Et	SHI	Parc	Sung	Gw
							011977	29.200	0.000	21.472	9.849	130.759	0.000	0.289	(
Outlets							011977	29.200	0.000	21.466	9.846	130.717	0.000	0.331	
<ul> <li>Linkingstre.</li> <li>Table added</li> </ul>	am added Outlet						011977	29.200	0.300	21.965 21.949	9.801	131.645	0.000	0.389	
<ul> <li>Manually ad</li> </ul>							011977	29.200	0.300	21.969	9.787	145.707	0.000	0.080	
Streams			4	A			011977	29.200	0.300	21.991	9.806	133.975	0.000	0.327	(
$\sim$							011977	29.200	0.300	21.973	9.898	169.298	0.000	0.000	
SoilClass							011977	29.200	0.300	22.017	9.801	145.567	0.000	0.104	
TX193				2 B			011977	29.200 29.200	0.300	21.977 21.991	9.783 9.810	152.226 155.770	0.000	0.000	
TX235				133			011977	29.200	0.300	21.980	9.893	147.546	0.000	0.000	·····
TX6 10						12	011977	29.200	0.000	21.441	9.839	130.732	0.000	0.327	(
тхөзэ							011977	29.200	0.000	21.466	9.847	130.683	0.000	0.358	(
SwatLandUseClas	s			A. T. N			011977	29.200	0.300	21.965	9.803	130.704	0.000	0.385	!
FRSD				and the second sec			011977	29.200 29.200	0.000	21.421 21.447	9.831 9.842	130.611 130.746	0.000	0.433	
FRSE FRSE			•	Work			021977	45,700	0.000	43,707	25.894	147.978	0.000	2.536	
FRST PAST				•			021977	45.700	0.000	43.695	25.874	147.667	0.000	2.828	·····
RNGB							021977	45.700	0.000	44.343	25.598	148.471	0.000	3.220	(
RNGE							021977	45.700	0.000	44.317	23.237	172.413	0.000	0.059	(
URHD				-			021977	45.700 45.700	0.000	44.332 44.362	23.795 25.308	166.631	0.000	0.939	0
													0.000	2.851	
URLD							021977								
WATR WETF						7	021977	45.700	0.000	44.331	25.351	189.638	0.000	0.000	C
WATR WETF WETL		<u> </u>				7	021977 021977	45.700	0.000				0.000	0.000	0
watr wetr wetl Swat-OutputRch			Euro	Three	- D X	7 8 1 2 8 8 8 8	021977 021977	45.700 45.700	0.000	44.331	25.351	189.638	0.000	0.000	0
WATR WETF WETL Swat-OutputRch_	Flow_In	Flow_Out	Evap	Those	Sed.	7	021977 021977	45.700 45.700	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WETF WETL Swat-OutputRch_ Subbasin Date 1 011977	Flow_In 0.00378	Flom_Oct 0.00375	0.00002	0.00000		7 8 sabine.a New	021977 021977 pr 0pe	45.700 45.700	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WETF WETL Swat-OutputRch_	Flow_In	Flow_Out			Sed.	7 8 • • • • •	021977 021977 07 07 07 07 07	45.700 45.700 m i	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WETF Swat-OutputRch 1 011977 2 011977 3 011977 4 011977	Flow_In 0.00378 0.00513 0.00137 0.00886	Flow, Out 0.00375 0.00511 0.00137 0.00885	0.00002 0.00002 0.00000 0.00000	0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sabine.a New	021977 021977 021977 Distress Distress Distress Distress Distress	45.700 45.700 m i 1 ol 41	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WETF WETL Swat-OutputRch_ Suddswir Date 1 011977 2 011977 3 011977 5 011977	Film_In 0.00378 0.00513 0.00137 0.00886 0.01042	<i>Film<u></u>Cut</i> 0.00375 0.00511 0.00137 0.00185 0.01039	0.00002 0.00002 0.00000 0.00001 0.00001 0.00002	0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobinc.a New Views	021977 021977 07 07 07 07 07	45.700 45.700 en 1 of x1 x10 x11	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WeTF WETF Skddswir 2/aste 1 011977 2 011977 3 011977 4 011977 5 011977 6 011977	Flow_In 0.00378 0.00513 0.00137 0.00886 0.01042 0.00505	Flow, Out 0.00375 0.00511 0.00137 0.00885 0.01039 0.00504	0.00002 0.00002 0.00000 0.00001 0.00002 0.00002	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sabine.a New Views	021977 021977 021977 0pr 0pr 0pr 0pr 0pr 0pr 0pr 0pr 0pr 0pr	45.700 45.700 en I of at1 at1 at1 at1 at1 at1 at1 at1 at1 at1	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WeTF WETF Stablaun 2 and 11977 2 011977 3 011977 4 011977 5 011977 6 011977 7 011977	/kwc_ln 0.00378 0.00513 0.00137 0.00886 0.01042 0.00505 0.01543	<i>Flow_Out</i> 0.00375 0.00511 0.00511 0.00885 0.01039 0.00504 0.00504	0.00002 0.00002 0.00000 0.00001 0.00002 0.00001 0.00001	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 Sabine.a New Views Views	021977 021977 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	45.700 45.700 en 1 ol et 1 et 1 et 1 et 1 et 1 et 1 et 1 et 1	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WeTF WETF Skddswir 2/aste 1 011977 2 011977 3 011977 4 011977 5 011977 6 011977	Flow_In 0.00378 0.00513 0.00137 0.00886 0.01042 0.00505	Flow, Out 0.00375 0.00511 0.00137 0.00885 0.01039 0.00504	0.00002 0.00002 0.00000 0.00001 0.00002 0.00002	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sabine.a New Views	021977 021977 021977 Distraw Dstawa Dstawa Dstawa Dstawa Dstawa Dstawa Dstawa Dstawa Dstawa	45.700 45.700 an 1 an 1 an 1 an 1 an 1 an 1 an 1 an 1	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WATR WETF WETC 2001001877 2 011977 2 011977 3 011977 5 011977 5 011977 6 011977 7 011977 8 011977 9 011977 10 011977	Flow_In           0.00378           0.00513           0.00137           0.0086           0.01042           0.00505           0.01543           0.00007           0.00007           0.00579	Plane_Dat           0.00375           0.00511           0.00137           0.0085           0.010385           0.00504           0.00504           0.01543           0.00000           0.01573	20000.0 20000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 Sabine.a New Views Views	021977 021977 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0	45.700 45.700 en i of att att att att att att att att att at	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WATR WATR WETL 201977 2 011977 2 011977 3 011977 4 011977 6 011977 7 011977 8 011977 9 011977 10 011977 10 011977	Flow_In           0.00378           0.00513           0.00137           0.0086           0.01042           0.00553           0.01543           0.00037           0.00037           0.001543           0.00037           0.00000           0.01573           0.01585	Flore_Dot           0.00375           0.0011           0.00137           0.00137           0.00138           0.00504           0.00504           0.00504           0.0036           0.0036           0.0036           0.0036           0.0036           0.0036           0.0036           0.0037	0.00002 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobine.co New Views Views Tables Charts	021977 021977 Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa Datawa	45.700 45.700 en 1 st t1 st st st t1 st st st st st st st st st st st st st	0.000	44.331	25.351	189.638	0.000	0.000	(
Swat-DutputRch Swat-OutputRch Swat-OutputRch 1 011977 2 011977 4 011977 5 011977 6 011977 7 011977 8 011977 10 011977 11 011977 12 011977	Flow_In           0.00378           0.00137           0.00137           0.00505           0.01042           0.00505           0.01543           0.00037           0.00037           0.00037           0.00037           0.00000           0.01585           0.01585           0.00423	Plane_Dot           0.00375           0.00375           0.00137           0.00137           0.00139           0.00504           0.01543           0.00036           0.00006           0.00051           0.00037           0.00039           0.01543           0.00036           0.00006           0.01573           0.01573           0.01573           0.01573           0.01573	20000.0 20000.0 10000.0 20000.0 20000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 01000.0 01000.0	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobine.o New Views Views Tables	021977 021977 021977 Distored	45.700 45.700 en 1 of at at at at at at at at at at at at at	0.000	44.331	25.351	189.638	0.000	0.000	
WATR WATR WETL Skolowir Zoder 1 011977 2 011977 3 011977 4 011977 5 011977 6 011977 7 011977 8 011977 8 011977 10 011977 11 011977 11 011977 13 011977	Films_in           0.00378           0.00513           0.00137           0.0086           0.0142           0.00505           0.01543           0.00037           0.00037           0.00037           0.001543           0.00037           0.001579           0.01558           0.01559           0.01583           0.00423           0.00245	King Dat           0.00375           0.0071           0.00811           0.0089           0.0089           0.0038           0.0038           0.0038           0.0038           0.0039           0.0038           0.0039	000000 00000 00000 00000 00000 00000 0000	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobine.co New Views Views Tables Charts	021977 021977 021977 Dstowa	45.700 45.700 en I of at at at at at at at at at at at at at	0.000	44.331	25.351	189.638	0.000	0.000	
Swat-DutputRch Swat-OutputRch Swat-OutputRch 1 011977 2 011977 4 011977 5 011977 6 011977 7 011977 8 011977 10 011977 11 011977 12 011977	Film_In           0.0078           0.00513           0.0053           0.0053           0.0053           0.0054           0.0055           0.01543           0.0050           0.0055           0.01543           0.00001           0.01579           0.00023           0.0023           0.0023	Rime_Clut           0.00375           0.00575           0.00615           0.0075           0.0085           0.0085           0.0084           0.0054           0.00000           0.0175           0.00000           0.01759           0.01759           0.01759           0.01759           0.01679           0.01621           0.00223	20000.0 20000.0 10000.0 20000.0 20000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 00000.0 01000.0 01000.0	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobine.o New Views Tobles Charts Layous	021977 021977 021977 Distored	45.700 45.700 an I an I at at at at at at at at at at at at at	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WATR WETL Soldbasin Longouthed Soldbasin Longo Soldbasin Longo Soldbasin Longo Soldbasin So	Films_in           0.00378           0.00513           0.00137           0.0086           0.0142           0.00505           0.01543           0.00037           0.00037           0.00037           0.001543           0.00037           0.001579           0.01558           0.01559           0.01583           0.00423           0.00245	King Dat           0.00375           0.0071           0.00811           0.0089           0.0089           0.0038           0.0038           0.0038           0.0038           0.0039           0.0038           0.0039	00000 20000 000000	0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000 0.00000	Sed.	7 8 sobine.co New Views Tobles Charts Layouts	021977 021977 021977 04 04 04 04 04 04 04 04 04 04 04 04 04	45.700 45.700 an 45.700 an 45.7000 an 45.700 an 45.7000 an 45.700 an 45.7000 an 45.70000 an 45.70000 an 45.70000 an 45.70000 an 45.70000 an 45.70000 an 45.700000000 an 45.7000000000000000000000000	0.000	44.331	25.351	189.638	0.000	0.000	(
WATR WETL WETL States States States States States States States States S	Film_L /r           0.00378           0.00513           0.00137           0.0087           0.0087           0.0087           0.0080           0.0142           0.0053           0.0153           0.01542           0.00632           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.01579           0.00245           0.00233           0.00233           0.00338           0.00538	Ring Cut           0.00375           0.0511           0.0611           0.0685           0.01039           0.00564           0.00564           0.00563           0.00564           0.01575           0.01672           0.01672           0.0042           0.00244           0.00252           0.0057           0.0057           0.0057           0.0057	0.00002 0.00002 0.00000 0.00001 0.00001 0.00000 0.00000 0.00000 0.00000 0.00000 0.00001 0.00001 0.00001 0.00001 0.00001 0.00000 0.00001 0.00000	0.00000 0.000000	Sed.	7 8 solutions New Tobes Charts Charts Scripts	021977 021977 021977 District Datawa	45.700 45.700 45.700 en 1 45.700 en 1 45.7000 en 1 45.70000 en 1 45.70000 en 1 45.70000 en 1 45.7000000000000000000000000000000000000	0.000	44.331	25.351	189.638	0.000	0.000	
WATR WETL WETL Swat-Outputtch. Stadbaser 2 201977 2 011977 3 011977 4 011977 6 011977 7 011977 7 011977 8 011977 10 011977 11 011977 11 011977 13 011977 13 011977 14 011977 15 011977 15 011977 16 011977 16 011977 16 011977 16 011977 12 012977	Filme_in           0.00378           0.00513           0.00533           0.00637           0.0086           0.01942           0.00637           0.00637           0.00543           0.00543           0.00543           0.00543           0.00543           0.01579           0.00645           0.00645           0.00645           0.00645           0.00645           0.00733           0.00733           0.00583           0.01543           0.01543	Ring_Oat           0.00275         0.00275           0.00371         0.00375           0.00535         0.00563           0.00564         0.00564           0.00564         0.00564           0.00564         0.00564           0.00563         0.00564           0.00564         0.00564           0.00562         0.00522           0.00522         0.00572           0.00522         0.00572           0.00552         0.04788	0 00002 0 00000 0 000000	0.00000 0.000000	Sed.	7 8 sobine.co New Views Tobles Charts Layouts	021977 021977 021977 Determ Determ Determa	45.700   45.700   45.700   64 17 17 17 17 17 17 17 17 17 17	0.000	44.331	25.351	189.638	0.000	0.000	
WATE WETE WETE WETE WETE WETE WETE WETE	Film_L /r           0.0078           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0074           0.0075           0.01543           0.0002           0.01579           0.01579           0.0023           0.0023           0.0023           0.0023           0.0023           0.0023           0.0023           0.0033           0.00538           0.0152	Rong Dia           Rong Dia           0.0075           0.0071           0.0071           0.0071           0.0071           0.0071           0.0071           0.0071           0.0071           0.0072           0.0073           0.0073           0.0075           0.0075           0.0072           0.0073           0.0075           0.00752           0.00752           0.00752           0.00752           0.00752           0.00752           0.00752	0.00002 0.00002 0.00000 0.00001 0.00002 0.000000	0.00000 0.000000	Sed.	7 8 solutions New Tobes Charts Charts Scripts	021977 021977 021977 District Datawa	45.700 45.7000 45.7000 45.7000 45.7000 45.7000 45.7000 45.7000 45.7000 45.7000 45.7000 45.70000 45.70000 45.700000 45.7000000000000000000000000000000000000	0.000	44.331	25.351	189.638	0.000	0.000	
WATE           WATE           WET           Swet-Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           WET           Swet-Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           WET           Swet-Outputted.           Outputted.	Filme_in           0.00378           0.00513           0.00533           0.00537           0.00656           0.01042           0.00505           0.011573           0.00037           0.00037           0.00037           0.00037           0.00037           0.000423           0.00233           0.00233           0.00233           0.00233           0.00158           0.00423           0.00273           0.00273           0.00273           0.00273           0.00273           0.00273           0.00273           0.00273           0.00273           0.00273           0.00275           0.01252           0.04413	Rong Dut           0.0075         0.0075           0.00511         0.00511           0.00512         0.00895           0.01543         0.00543           0.00550         0.0052           0.0052         0.00622           0.00622         0.00622           0.00623         0.00622           0.00624         0.00622           0.00625         0.00622           0.00626         0.00622           0.00627         0.00682           0.00626         0.00657           0.00627         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.05632           0.07582         0.05642	0.00002 0.00002 0.00000 0.00001 0.00001 0.000000	0.00000 0.000000	Sed.	7 8 sabine.co New Views Dats Dats Excipts	021977 021977 021977 05000000	45.700 45.700 an 45.700 an 1 at 1 at 1 at 1 at 1 at 1 at 1 at 1 at	0.000	44.331	25.351	189.638	0.000	0.000	
WATR           WATR           WETL           Stock Outputted:           Stock Outputted:           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           201977           101977	Film_L /r           0.0078           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0073           0.0074           0.0075           0.01543           0.0002           0.01579           0.01579           0.0023           0.0023           0.0023           0.0023           0.0023           0.0023           0.0023           0.0033           0.00538           0.0152	Rong Dia           0.00375         0.00375           0.00511         0.00511           0.00512         0.00513           0.00503         0.00504           0.00504         0.00504           0.00504         0.00504           0.00505         0.00504           0.00502         0.00572           0.0024         0.0022           0.0024         0.00252           0.00552         0.00452           0.00552         0.00452           0.00552         0.00541           0.01578         0.00552           0.00552         0.00541           0.01578         0.00552           0.01578         0.00541           0.01579         0.0352           0.01570         0.0352           0.01572         0.0352           0.01572         0.03511           0.01574         0.03511	0.00002 0.00002 0.00000 0.00001 0.00002 0.000000	0.00000 0.000000	Sed.	7 8 sabine.co New Views Dats Dats Excipts	D21977 D21977 D21977 D5trwa Dstowa Ds	45.700 45.700 en   1 of of of of of of of of of of	0.000	44.331	25.351	189.638	0.000	0.000	
WATE           WATE           WET           Swet-Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           WET           Swet-Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           Outputted.           WET           Swet-Outputted.           Outputted.	Pitrey_dr           0.00376           0.00376           0.00376           0.00377           0.00376           0.00377           0.00376           0.0142           0.00377           0.00377           0.00377           0.00377           0.00378           0.00425           0.00337           0.00338           0.00338           0.00352           0.03538           0.01552           0.03538           0.03534           0.03534           0.03534           0.03534	Rong Dut           0.0075         0.0075           0.00511         0.00511           0.00512         0.00895           0.01543         0.00543           0.00550         0.0052           0.0052         0.00622           0.00622         0.00622           0.00623         0.00622           0.00624         0.00622           0.00625         0.00622           0.00626         0.00622           0.00627         0.00682           0.00626         0.00657           0.00627         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.00682           0.00757         0.05632           0.07582         0.05642	0 00002 0 00002 0 00000 0 000000	2000 0 2000  0 2000 0 2000 0 2000 0 2000 0 2000 0 2000 0 2000 0 2000 0 2	Sed.	7 8 sabine.co New Views Dats Dats Excipts	021977 021977 021977 05000000	45.700 45.700 an 45.700 an 45.700 at 17.00 at 17	0.000	44.331	25.351	189.638	0.000	0.000	(

Figure 1.43

3. To graph and map results, on the Reports menu click Map-Chart (Figure 1.44).



4. Select *default* and *sim1*, click OK. (figure 1.45)

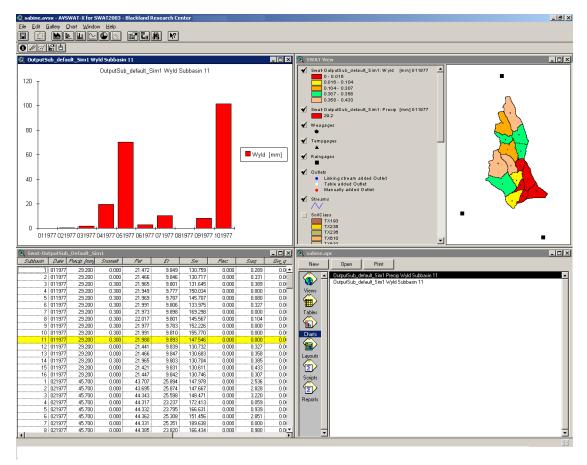
🍭 Map Chart		×
Scenarios: default	Simulations:	Simulation Info: Date: Tue Mar 01 08:44:24 2005
		Period of simulation: Start: 1977:01:01 End: 1978:12:31
	• •	Output frequency: Monthly Number of subbasins: 16
		Cancel OK



5. Select Output Sub. Then Select, for example, the subbasin at the watershed outlet (i.e. # 11), WYLD under Variables, and 011977 through 121977 (to select multiple months hold down the Shift key while clicking the desired months). Once all the settings have been made, click OK.

#### Figure 1.46

6. A map of the WYLD for all subbasins in 01/1997 will be plotted and the water yield for the specified subbasin will be graphed (Figure 1.47).





- 6. To make other plots, access the dialog box by clicking Map-Chart on the Reports menu. If the ArcView menus are not listed, click the Output map and they should appear.
- 7. If desired, input data may be edited from the Edit Inputs menu. The input data at the subbasin and HRU level can be reviewed from the Subbasins data menu item (Figure 1.48).

🔍 sabine.avsx - AVSWAT-X for S	WAT2003 - Blackland	Research Cen	ter
<u>Eile E</u> dit ⊻iew <u>I</u> heme Input	Edit Input Simulation	Iools <u>R</u> eport	s <u>W</u> indow <u>F</u>
	<u>D</u> atabases	Ctrl+0	30 🖗
	Point Source Discha	arges Ctrl+1	
	Inlet Discharges	Ctrl+2	
🍳 SWAT View	<u>R</u> eservoirs	Ctrl+3	
🖌 Swat-OutputSub_default_Sim <sup>.</sup>	<u>S</u> ubbasins data	Ctrl+4	
0-0.016			
0.104 - 0.307			
0.307 - 0.358			
Swat-OutputSub_default_Sim	l:Wyld [mm]011977		
0.016 - 0.104			
0.104 - 0.307			

Figure 1.48

A dialog tool allows targeting any subbasin, HRU, and input file type (Figure 1.49).

Q	Edit Subbasin	Inputs			×
	Select Subbasin	Select LandUse	Select Soil	Select Inpu	ıt File
	1 🔺	PAST 🔺	TX236	Gw	
	2	AGRR		.Wus	
	3			.Mgt	
	4			.Chm	
	5			.Pnd	
	6 💽			Swq.	-
				Exit	1

Figure 1.49

For example, explore the resources within the agricultural management tool editor (select the *mgt* input file) (Figure 1.50).

Q Mgt: 1_PA5T_TX236	×
Management Data:	
Generic HRU	
General Parameters: Initial Land Cover Status No land cover growing	]
BIOMIX         0.20         USLE_P         1.00           BIO_MIN         0.00         FILTERW         0.000         CN2         84.00           Urban         Irrigation         TileDrain	
  Operations:	
C Schedule by Date  © Schedule by Heat Units	
Year Operation Crop Heat Units	
1       Plant/begin. growing season       PAST       0.150       Add Year         1       Harvest and kill       1.200       Delete Year         Add Operation       Delete Operation         Edit Operation       Edit Operation	
Help Cancel OK	

Figure 1.50

Other important input can be reviewed from the *Edit Input* menu (Figure 1.48), such as: supporting databases, point sources, inlets, and reservoirs.

After editing changes have been made, repeat the steps in Section 1..6 and 1..7 to generate and view the new output.

8. Save your AVSWAT-X project (often while working) using the Save project button II. To exit the AVSWAT-X interface, click in the map display area with the right mouse button to make the pop-up menu appear. Select Avswat Main Interface dialog on the pop-up menu. Then click the button next to Exit ArcView. A prompt box will appear to confirm the exit selection. Click Yes.

# CHAPTER 2 THE SEA (SSURGO EXTENSION FOR AVSWATX)

## Introduction

The tool is developed as an addition (extension) to the SWAT model companion, the ArcView GIS interface in its latest version (AVSWAT-X), which is designed to define watershed hydrologic features; store, organize, and manipulate the related spatial and tabular data; and analyze management scenarios. Within this framework the tool expedites the otherwise complex inclusion operations of the SSURGO data, such as: (1) downloading, via the Internet (SSURGO I), up-to-date data sets (SSURGO II); (2) processing and managing variously formatted data sets in order to create the needed digital soil maps; (3) generating and/or storing the required soil physical and hydraulic model input parameters derived from pedo-transfer functions; and (4) seamlessly including them in any watershed modeling framework.

## Application

 Once delineated the watershed, or any time before importing the Land Use and Soil maps, load the SSURGO Extension for AVSWATX (SEA) using the AVSWAT-X extension manager (in the Watershed view, Avswatx menu, Avswatx Extensions menu item). (Figure 2.1)

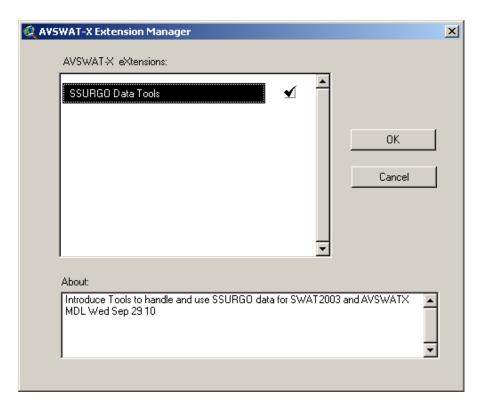


Figure 2.1

2. Double click the listed SSURGO Data Tool item and hit OK.

If the project has been already set up with a land use and/or soil map a warning message will show up (Figure 2.2). Click Yes.



Figure 2.2

The extension will be loaded in AVSWATX.

3. Select the Land Use and Soil definition item from the AVSWATX menu; in the Definition of Soil and Land Use Themes dialog, click on

the Open folder button in the Soil data layer section (top right) (Figure 2.3).

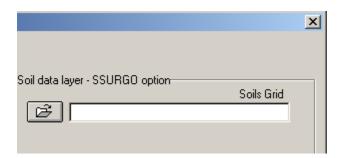


Figure 2.3

The interface will list the survey areas needed for the current study watershed. In addition will check the availability of the needed data in your disk. If the needed data are not stored in your disk, a report dialog will flag the missing Soil Survey Area(s) (Figure 2.4).

🍳 Checked current SSURGO data	×
SSURGO data sets:  TX231, Hunt County, Texas Not OK TX085, Collin County, Texas Not OK TX612, Kaufman And Rockwall Counties, Texas  Use the "AVSWAT - SSURGO Manager Tool" to set up the missing datasets (see AVSWAT Databases)	Not OK
ОК	

Figure 2.4

In this case, apply the SSURGO manager tool described in the next section (as exercise work on the survey area TX231) and copy the 2 folders (612 and 085) from \avswatx\AvswatDb\Workshop\ssurgo\tx to \avswatx\AvswatDb\AllUs\ssurgo\tx.

Once the data are already correctly stored in the disk the report dialog will allow you to continue (Figure 2.5 and Figure 2.6).

ł	🝳 Checked current SSURGO data	×
	SSURGO data sets:	
	TX231, Hunt County, Texas OK TX085, Collin County, Texas OK TX612, Kaufman And Rockwall Counties, Texas OK	
		-
	OK	

Figure 2.5

Click OK.

?	The required SSURGO dataset(s) are currently in your disk Continue?
	Yes No

Figure 2.6

Click Yes. The survey area map will be loaded, projected, merged and clipped on the watershed (Figure 2.7).

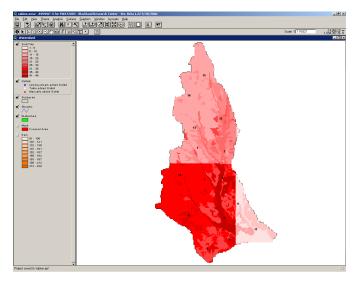


Figure 2.7

Check the Stmuid radio button (other options are available: ask me!) and click the reclassify button.

The watershed is now set up with the SSURGO data (Figure 2.8 and 2.9). You can proceed with the usual HRUs definition tool. SSURGO soil parameters will be acquired from the databases previously populated (see next section).

Q Definition of LandUse and Soil Themes	×
	Soil data layer - SSURGO option Soils Grid Cookup Table Grid Values> Soils attributes Grid Field Value Area(%) Struid 1 1.75 TX23121 2 0.60 TX23113
	Options: I Stmuid C Stmuid + S5id C Name C Stmuid + Seqn C Stmuid + Name
Peclassity	Reclassify
Ûvi	Help Close

Figure 2.8

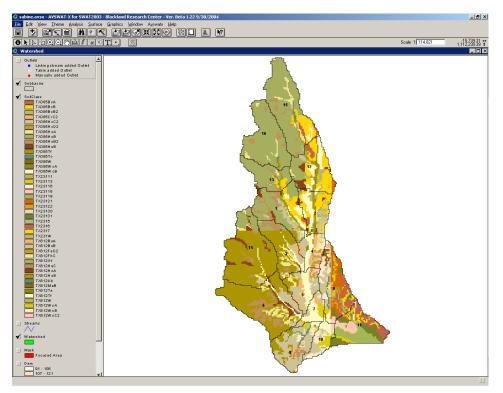


Figure 2.9

## Acquisition and preparation of the SSURGO data

You should acquire and preprocess the SSURGO data packages for the Soil Survey Areas (SSAs) overlapping your study watershed (see previous section to identify them). Load the SSURGO Data manager from the list of AVSWAT Databases, double click on the SSURGO Data Manager item (Figure 2.10).



Figure 2.10

The SSURGO Data Manager dialog will open. Select the State and the Stssald (two-letter state abbreviation + soil survey area Id) (i.e. Texas and TX231) (Figure 2.11).

State			Hunt County, Texas		Control Tools
Ohio Oklahoma Oregon Pennsylvania Puerto Rico Rhode Island South Carolina South Carolina South Dakota Tennessee Texas Utah Vermont		Stssald TX217 TX219 TX225 TX227 TX229 <b>TX231</b> TX233 TX235 TX235	Data Files Status:	n Cov.zip n Tab.zip	Internet Download
Virginia Washington West Virginia Wisconsin Wyoming	•				Close

Figure 2.11

Click on the Internet Download button. Select the Both files option (Figure 2.12).

🍳 Download options	×
Select option:	OK
tab.zip 🔺	Cancel
Both files	

Figure 2.12

**Note:** You need to be connected in Internet in order to proceed. For the current workshop you may skip below. Pre-downloaded datasets are provided (see below).

🍳 Select One	×
NRCS's Server Options:	OK
"Forth Worth" Ssurgo Server	Cancel
"Soil Data Mart" Server	
▼	

Figure 2.13

Select the Soil Data Mart Server option (all the new SSURGO data are supposed to be stored in the Soil Data Mart Server) (Figure 2.13). Click the button Check data sets availability for the Soil survey area (i.e. TX231) (Figure 2.14).

🍭 Using SSURGO d	ata sets from NRCS's Soil Data Mart server	×
	How to use Instructions	
	Check data sets availbility for Soil survey area TX231	
	Close	

Figure 2.14

The Internet browser will be opened at the proper query page (Figure 2.15).

🎒 Soil Data Mart - Sele	ect Soil Survey Area Microsoft Internet I	xplorer			
Eile Edit View Fav	orites Iools Help				
🕒 Back 🔹 🕥 👻	🗴 💈 🏠 🔎 Search  👷 Favorites	• 🚱 🔗 🍃 🔜 🛄 🛍	- 25		
Address 🕘 http://soilda	tamart.nrcs.usda.gov/Survey.aspx?County=TX2	31			G
	<ul> <li>Department of Agriculture</li> <li>Natural Resources</li> <li>Conservation Service</li> </ul>		Hunt County Texas	Soil Data	• •
Home Select State	State Contacts Template Databases			Logon/Reg	iste
	Please select a soil survey area:				
	Survey Area Symbol		Survey Area Name	Available Data	
	TX231	Hunt County, Texas		Tabular and Spatial	
'					
	View Metadata	Download Data	Generate Reports	Subscribe	
		Select State	Select County		
▲ Back to Top			edom of Information Act   Accessibility   Contact Us come to the USDA   USDA   NRCS		

Figure 2.15

Make sure both Tabular and Spatial data are available. Otherwise you will be unable to continue.

Click the Download Data button (Figure 2.15).

🚰 Soil Data Mart - Dow	nload Soil Survey Are	a Data Microsoft Internet Explorer					
<u>File Edit View Favo</u>	rites <u>T</u> ools <u>H</u> elp						
Ġ Back 🔹 🌍 👻 🕨	ù 💈 🏠 🔎	Search 🥂 Favorites 🙆 🔗	🖕 🖂 📒 🛍 🔏 👘				
Address 🕘 http://soildat	amart.nrcs.usda.gov/Do	wnload.aspx?Survey=TX231&UseState=TX					
<b>I</b> NRCS	Department of Ag Natural Resou Conservation State Contacts Ten	urces Service		TX231 - Hunt Hunt County Texas	County, Texas	So	il Data   Logon/Regist
Р	lease select the class	s of data you wish to download: (Sur	vey Area Version 1 , Tabular Version 1 ,	Spatial Version 1 )			
	C Tabula	r Data Only 🖲 Tai	oular and Spatial Data	C Spatial Data Only	O Templa	ite Database Only	
р	lease select a spatial	l format:	Please select a coordinate syst	em:	[	Reset Default	
	ArcView Shapefile	•	Geographic Coordinate System (NA	D83)			
Р	lease select a templa	ate database (optional):			1	Clear Selection	
l l	State	MS Access Version	Template DB Version	Template DB N	lame	Size	
	US	Access 2002	31	soildb_US_2002		1.8M	
	US	Access 2000	31	soildb_US_2000		1.8M	
	US	Access 97	31	soildb_US_97		1.8M	-
	Description:		Template Database for Microsoft Acc	ess 2002-2003. This database should	i be used only vhen		
P	lease enter your e-m	ail address:					
	Select St		Submit Request View Metadata	See Disclaimer Generate Reports	S	ubscribe	

Figure 2.16

Within the new page select:

- a. Tabular and Spatial data (class data);
- b. ArcView Shapefile (spatial format);
- c. MSAccess 2002 or 2000 (template);
- d. Geographic Coordinate System (NAD83) (coordinate system) (or your working datum; i.e. NAD27)

Click the Submit Request button (do not forget to provide your email address) (Figure 2.16).

Once received the automatically generated email message, download your customized compressed file.

**Note:** for the workshop the data file have been pre-downloaded and stored in your \avswatx\avswatdb\workshop\ssurgo\tx231notprocessed

Extract (copy for the workshop) just the following files in the folder .....\avswatdb\allus\ssurgo\<StateId>\<Soil Survey Id>\sdm (do NOT keep original folder names)

i.e .....\avswatd\allus\ssurgo\tx\231\sdm

- a. soilmu\_a\_<stateIdSurveyId>.\* files
  (i.e. soilmu\_a\_TX231.dbf, soilmu\_a\_TX231.shx, soilmu\_a\_TX231.shp, .sbn, ...sbf, ...prj)
- b. comp.txt
- c. chorizon.txt
- d. chfrags.txt

Proceed with the following steps:

a. Click the now visible Use Soil Data Mart Data Sets button;



b. Click the now Visible Table Make button



The preprocessing ends once the Ssurgo Table check box appears selected.



Review supporting information clicking on the Report button.

## **Useful References**

Di Luzio, M., J.G. Arnold, and R. Srinivasan. 2004. Integration of SSURGO maps and soil parameters within a geographic information system and nonpoint source pollution model system. Journal of Soil and Water Conservation, 59(4): 123-133.

Di Luzio, M., J.G. Arnold, and R. Srinivasan. 2005. Effect of GIS data quality on small watershed stream flow and sediment simulations. Hydrological Processes, 19: 629-650.

# CHAPTER 3: LAND USE-LAND COVER SPLITTING TOOL

## Introduction

The tool is also developed as an addition (extension) of AVSWAT-X. The tool allows creating sub-classes of the original classes in the land use-land cover map and/or retaining classes from being removed using the HRUs definition tool.

## **Application**

 Once delineated the watershed, or any time before importing the Land Use and Soil maps, load the *Land Use – Land Cover Splitting Tool* for AVSWATX using the AVSWAT-X extension manager (in the Watershed view, Avswatx menu, Avswatx Extensions menu item). (Figure 3.1).

🝳 AVSWAT-X Extension Manager	×
AVSWATX eXtensions:	
Land Use - Land Cover Splitting Tool 🖌 🔺	OK Cancel
About: Creation of Land Use-Land Cover Sub-Categories in AVSWATX Wed Mar 24 17	MDL 🔺

Figure 3.1

2. Double click the listed *Land Use – Land Cover Splitting Tool* item and hit OK. If the project has been already set up with a land use and/or soil map a warning message will show up (Figure 3.2). Click Yes.

Warning !	
?	Installing the "Land Use - Land Cover Splitting Tool" extension, the current settings will be removed starting from the landuse-soil definition Continue?
	Yes No

Figure 3.2

The extension will be loaded in AVSWATX.

3. Select the Land Use and Soil definition item from the AVSWATX menu; in the Definition of Soil and Land Use Themes dialog, click on the Open folder button in the Land Use data layer section (top left) (Figure 3.3).

🍭 Definition of LandUse and So	il Themes
Land Use data layer	
	Land use Grid
E E	
1 Cê	

Figure 3.3

- 4. Like in Section1, proceed loading the Land use map in \example3 and load the same look-up table (*lunlcd.dbf*).
- 5. Scroll down the *Land Use Swat* list and Double click on the *AGRR* item. The Land Use Reclass Options Dialog will open (Figure 3.4).

Cand Use data layer Land Use data layer Land use Grid	Soil data layer - SSURGO option Soils Grid
Grid Field Value Area(%) LandUseSwat  2 35.79 AGRR  35 0.10 URLD  31 0.76 WETF  Reclassity  0	

Figure 3.4

6. Select the Split check box.

🍳 Land Use Reclass options	x
SWAT Land Use:	
Current: AGBR	
Select New: Land Cover/Plant	
I Fallout	
🔽 Split	
Splitting Tool:	
SubClass % 🚺 Add a class	
CORN 60 A SOYB 40	
Reset K Remove Selected	
Cancel OK	

Figure 3.5

The available tools allow defining the new subclasses and their proportion (Figure 3.5).

Note 1: If the *Fallout* check box is selected, the subclasses will be sensitive to the Land Use % threshold used in the HRUs definition tools (see Section 1). Unselecting this option will determine these defining subclasses to be retained as HRUs, regardless the threshold value.

**Note 2:** The various settings (definition of the subclasses, splitting proportions, and fall out option) can be defined using a customized Lookup table (an example, the Lucsplit.dbf file is stored within the \example3 folder) (Figure 3.6).

🍭 lucsplit.dbf								
Value	Landuse	Falloff		Pett	12	Pot2	L3	Pot3
1	RNGE	False	ALFA	61		0		0
2	PAST	True		0		0		0
3	FRSD	True		0		0		0
4	WATR	False		0		0		0
5	AGRL	True	CORN	43	TOMA	20	ALFA	37
6	URBN	False	URHD	88	URLD	12		0
•								

Figure 3.6

# CHAPTER 4: SENSITIVITY ANALYSIS, AUTOMATIC CALIBRATION AND UNCERTAINTY ANALYSIS

## Introduction

The tools are grouped in an addition (extension) of AVSWAT - X. The tools allow operating a sensitivity analysis of the model input parameters, applying methods for the model automatic calibration and for the assessment of the uncertainty analysis.

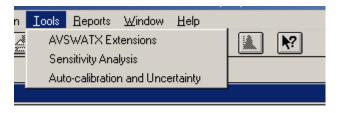
## Application

 Load this extension using the AVSWAT-X extension manager; in the Watershed view, Avswatx menu, (or in the SWAT View, Tools Menu) Avswatx Extensions menu item.

🍳 AVSWAT-X Extension Manager	×
AVSWAT-X eXtensions:	
AVSWATX Sens-Auto-Unc	
About: Sensitivity Analysis-Autocalibration-Uncertainity tools for SWAT2003 and AVSWATX A MDL Wed Mar 24 17	

Figure 4.1

2. Double click the listed AVSWATX Sens-Auto-Unc item (Figure 4.1) and hit OK.





3. Two new items are now listed (Figure 4.2): a) Sensitivity Analysis and 2) Auto-calibration and Uncertainty.

## **Sensitivity Analysis**

1. A new dialog will open selecting the *Sensitivity Analysis* item. This dialog allows you to select the scenario and the simulation target of the sensitivity analysis (Figure 4.2).

🍳 Select Sensitivity Anal	yisis Simulation		x
Scenarios:	Simulations:	Simulation Info:	
default	sim2	Date: Tue Mar 01 17:03:24 2005 Period of simulation: Start: 1977:01:01 End: 1978:12:31 Output frequency: Daily Number of subbasins: 16	
		Cancel	

Figure 4.2

2. Once pressed the OK button a new dialog will open (Figure 4.3).

🖉 Sensitivity Analysis Manager: Scenario: Default - Simulation: sim2	×
Output Settings:	Sensitivity Analysis:
<ul> <li>☞ Flow</li> <li>Flow + Sediments</li> <li>C Flow + Sediment + Water Quality</li> <li>□ Use Observed Data</li> </ul>	Start
	Close Save

Figure 4.3

- 3. The output variables are grouped in three ways, upon the simulation target (Flow, Flow+ Sediment, Flow+Sediment+Water Quality). With the (optional) usage of Observed Data will operate the sensitivity analysis on the objective function vs. using the mean average flow.
- Select the Flow option and check the Use Observed Data box. A file with observation records is provided in \example3 (observ.txt). Make sure the current simulation covers the observation period, 7/1978-12/1978 (Figure 4.4).

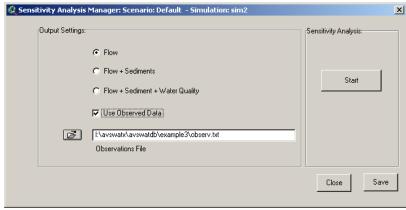


Figure 4.4

- 5. Press the Save button to store the current setting, and the Start button to begin the simulation cover the observation period, 7/1978-12/1978 (Figure 4.4).
- Select the target Outlet (stream section) for the analysis from another opening dialog (select the main outlet, i.e. # 11) (Figure 4.5).

6	Observations Outlet	×
	Select Subbasin:	ОК
	7	Cancel
	8	
	9	
	10	
	11	
	12	
	13	
	14	

Figure 4.5

7. A message dialog will warn about the risk of a number of long lasting iterative simulations. Press the Yes button to continue. The SWAT2003 runs will start in a DOS-window.

**Note:** The interface provided the analysis using predefined sets of input variables (Table 4.1).

Par	Name	Туре	Description	Location
1	ALPHA_BF	Sub	Baseflow alpha factor [days]	*.gw
2	GW_DELAY	Sub	Groundwater delay [days]	*.gw
3	GW_REVAP	Sub	Groundwater "revap" coefficient	*.gw
4	RCHRG_DP	Sub	Deep aquifer percolation fraction	*.gw
5	REVAPMN	Sub	Threshold water depth in the shallow aquifer for "revap" [mm]	*.gw
6	QWQMN	Sub	Threshold water depth in the shallow aquifer for flow [mm]	*.gw
7	CANMX	Sub	Maximum canopy storage [mm]	*.hru
8	GWNO3	Sub	Concentration of nitrate in groundwater contribution [mg N/I]	*.gw
10	CN2	Sub	Initial SCS CN II value	*.mgt
15	SOL_K	Sub	Saturated hydraulic conductivity [mm/hr]	*.sol
16	SOL_Z	Sub	Soil depth [mm]	*.sol
17	SOL_AWC	Sub	Available water capacity [mm H20/mm soil]	*.sol
18	SOL_LABP	Sub	Initial labile P concentration [mg/kg]	*.chm
19	SOL_ORGN	Sub	Initial organic N concentration [mg/kg]	*.chm
20	SOL_ORGP	Sub	Initial organic P concentration [mg/kg]	*.chm
21	SOL_NO3	Sub	Initial N03 concentration [mg/kg]	*.chm
22	SOL_ALB	Sub	Moist soil albedo	*.sol
23	SLOPE	Sub	Average slope steepness [m/m]	*.hru
24	SLSUBBSN	Sub	Average slope length [m]	*.hru
25	BIOMIX	Sub	Biological mixing efficiency	*.mgt
26	USLE_P	Sub	USLE support practice factor	*.mgt
27	ESCO	Sub	Soil evaporation compensation factor	*.hru
28	EPCO	Sub	Plant uptake compensation factor	*.hru
30	SPCON	Bas	Lin. re-entrainment parameter for channel sediment routing	*.bsn
31	SPEXP	Bas	Exp. re-entrainment parameter for channel sediment routing	*.bsn
33	SURLAG	Bas	Surface runoff lag time [days]	*.bsn
34	SMFMX	Bas	Melt factor for snow on June 21 [mm H2O/ºC-day]	*.bsn
35	SMFMN	Bas	Melt factor for snow on December 21 [mm H2O/ºC-day]	*.bsn
36	SFTMP	Bas	Snowfall temperature [ºC]	*.bsn
37	SMTMP	Bas	Snow melt base temperature [°C]	*.bsn
38	TIMP	Bas	Snow pack temperature lag factor	*.bsn
41	NPERCO	Bas	Nitrogen percolation coefficient	*.bsn
42	PPERCO	Bas	Phosphorus percolation coefficient	*.bsn
43	PHOSKD	Bas	Phosphorus soil partitioning coefficient	*.bsn
50	CH_EROD	Sub	Channel erodibility factor	*.rte
51	CH_N	Sub	Manning's nvalue for main channel	*.rte
52	TLAPS	Sub	Temperature lapse rate [°C/km]	*.sub
53	CH_COV	Sub	Channel cover factor	*.rte
54	 СН_К2	Sub	Channel effective hydraulic conductivity [mm/hr]	*.rte
60	USLE_C	Sub	Minimum USLE cover factor	crop.dat
61	BLAI	Sub	Maximum potential leaf area index	crop.dat

Table 4.1

8. You can stop the run typing CTR+C. An example of output files is stored in \AvSwatDB\Workshop\sensitivityout. Table 4.2 lists the main output files.

File name	Description
sensresult.out	List of parameter ranks
sensout.out	Detailed output with mean, variance and partial sensitivities
senspar.out	Parameter values of each run
sensobjf.out	Value of objective function for each run
sensrespons.out	Model output values for each run
lathyppar.out	Normalized Latin-Hypercube sampling points
oatpar.out	Normalized OAT sampling points
Table 12	

Table 4.2

The main output file, the sensresult.out contains the final ranking of each parameter in the analysis.

Using the interface, once the analysis is completed, this file can be reviewed pressing the Report button (Figure 4.6).

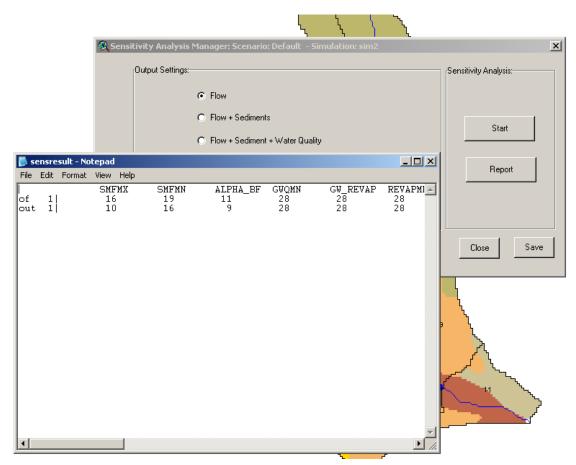


Figure 4.6

## Autocalibration and Uncertainty

1. A new dialog will open selecting the *Auto-calibration and Uncertainty* item. This dialog allows you to select the scenario and the simulation target of the application. Select *Default* and *Sim2* (Figure 4.7).

🍳 Select Autocalibration Sim	ulation		×
Scenarios:	ulation Simulations: sim1 sim2 v	Simulation Info: Date: Tue Mar 01 17:03:24 2005 Period of simulation: Start: 1977:01:01 End: 1978:12:31 Output frequency: Daily Number of subbasins: 16 Cancel DK	×

Figure 4.7

2. Once pressed the OK button a new dialog will open (Figure 4.8).

<b>Autocalibration Manager: Scena</b>	rio: Default - Simulation: sim2		×
Input Variables:	Watershed Sections:	Autocalibration:	Uncertainity Analysis:
Name     Apply       Alpha_Bf     Image: Apply       Biomix     Image: Apply       Blai     Image: Apply       Canmx     Image: Apply       Ch_Cov     Image: Apply       Ch_K2     Image: Apply       Ch_N     Image: Apply	Subbasin Apply 1	Start	
			Close Save

Figure 4.8

- 3. Once pressed the OK button a new dialog will open (Figure 4.8).
- 4. Any listed *Input Variable* can be added to the application double clicking on the check mark on the right of the name. The Curve Number (CN2) is already added by default (leave it selected). Additional options could be specified double clicking on the variable name (Figure 4.9).

Q Input Variable: Cn2 Autocalibration Settings:			×
Update method: Replacement by value		Max Value: 98.000 Min Value: 35.000	
Subbasins:	LandUses:	Soils:	
• All	© All	⊙ All	
C Selected	C Selected	C Selected	
	🗖 Split	🗖 Split	
		Cancel	OK



5. Any listed *Watershed Section/Subbasin* provided with observed records can be included. Double click on the Subbasin # 11 and browse the observation file (*observ.txt*) (Figure 4.9).

Autocalibration Manager: Sce	enario: Default - Simulation: sim2		X
Input Variables:	Watershed Sections:	Autocalibration:	Uncertainity Analysis:
Name     Apply       Ch_Erod     ✓       Ch_K2     ✓       Ch_N     ✓       Epco     ✓       Esco     ✓       Gw_Delay     ✓       Gw_Revap     ✓	Subbasin     Apply       4     ✓       5     ✓       6     ✓       7     ✓       8     ✓       9     ✓       10     ✓       11     ✓	Start	
🔍 Watershed Se	ction: 11		× Current Current
Variables: Nam Flo Se Org No Nh	w ✓ ✓ ▲ d ✓ ✓ gN ✓ ✓ gP ✓ ✓ 3 ✓ ✓ 3 ✓ ✓	serv.txt	Close Save
Figure 4.0		Cance	

Figure 4.9

- 6. Click OK and Save.Click the Start button to begin the calibration.
- 7. A message dialog will warn about the risk of a number of long lasting iterative simulations. Press the Yes button to continue. The SWAT2003 runs will start in a DOS-window.
- 8. You can stop the run typing CTR+C. An example of output files is stored in \AvSwatDB\Workshop\autocalibrationout.
- Using the interface, once the calibration is completed, a set of output files can be reviewed pressing the Reports button (Figure 4.10).

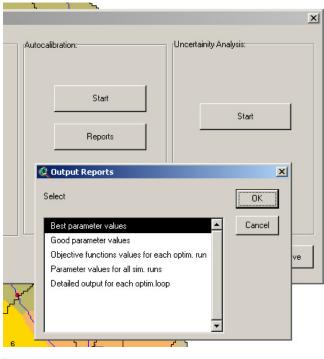


Figure 4.10

10. The Best parameter values (bestpar.out) shows the parameter set that had the lowest value for the objective function. Good parameter values files (goodpar.out) shows the The parameter sets that had acceptable values for the objective function. The Objective functions values for each optimization run (*sceobjf.out*) shows the objective function values for all parameter sets considered in the automatic calibration. The Parameter values for all simulation runs (scepar.out) provides the parameter sets considered in the automatic calibration. Finally, the option *Detailed* output for each optimization loop (parasolout.out) shows a detailed summary of the input and the results of the automatic calibration.

## Uncertainty

Once successfully completed the calibration, the input for the uncertainty analysis are ready. A Start button is now visible in the Uncertainty Analysis dialog section (Figure 4.11).

Q Autocalibration Manager: Sco	nario: Default – Simulation: sim2	Autocalibration:	Uncertainity Analysis:
Name Apply Alpha_Bf Biomix Cammx Ch_Cov Ch_Cov Ch_Erod Ch_K2 Ch_K	Subbasin Apply 1	Start Reports	Start
			Close Save

Figure 4.11

- 1. Pressing the Start button, a message dialog will warn about the risk of a number of long lasting iterative simulations. Press the Yes button to continue. The SWAT2003 runs will start in a DOS-window.
- 2. Once successfully completed the uncertainty analysis, the Reports button in the uncertainty analysis section is also activated. Select this Reports button. A new dialog box will open (Figure 4.12).

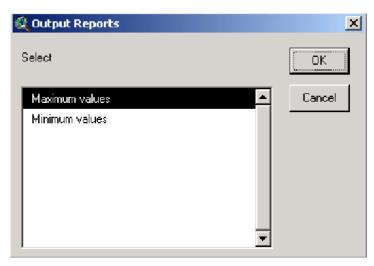


Figure 4.12

3. There are two items in dialog. *Selecting Maximum* values will open the file *maxval.out*, which contains the maximum values simulated for each day and for each output variable included in the uncertainty analysis. *Selecting Minimum* values will open the file *minval.out*, which contains the minimum values simulated for each day and for each output variable included in the uncertainty analysis.