



## Rocky Mountain Mapping Center

### Analyzing Watersheds With GIS

**Author:** Joseph J. Kerski, USGS, [jjkerski@usgs.gov](mailto:jjkerski@usgs.gov), 303-202-4315

**Lesson:** More Tabular and Spatial Query, and Overlay. The Rosebud Tribal Land Enterprise is conducting an agricultural study based on watersheds in the region. Your task will be to define and analyze a study area containing watersheds that cover the Rosebud Sioux reservation.

**Skills Involved:**

- 1) Changing legends.
- 2) Creating a layout.
- 3) Tabular sort and query.
- 4) Spatial sort and query.
- 5) Digitizing features.
- 6) Intersecting and clipping map themes.
- 7) Solving a problem based on spatial analysis.

#### Data Management

Create a folder for this exercise and name it *southdakota*. As you know from the last lesson, it is best to name the folder without any spaces in the name.

Click [here to download the data](#) that you will need for this lab exercise.

This file is named watershedssdlesson.zip and totals approximately 5.5 MB.

After downloading, unzip the file using the Winzip program.

You now should have 42 files with the following themes:

agriculture  
demography  
landown  
prec-ann  
rivers  
sd\_city  
sd\_coal  
sd\_geol  
watershed

Start ArcView with a new project and a new view.

Add all of the themes to your view.

Go to View—> Properties and name your view "South Dakota."

Save your project and give it an appropriate name," placing it into the appropriate directory.


Under View--> Properties, set map units to meters, and set the distance units to kilometers.

Your data sets are now ready to analyze.

Open the theme table  for the Land Ownership (landown) theme.

- 1) What is the largest Indian Reservation in the state?
  
- 2) How many acres does it occupy?
  
- 3) What ranking in size does the Rosebud Sioux have in terms of all of the Indian Reservations in the state?
  
- 4) How many acres does it occupy, according to the data set?
  
- 5) Indicate what GIS functions you used to find out the information in questions 1 through 4, above.

Make the view active and look at your map.

Use the fourth button from the left,  the select features button. Select the Rosebud Sioux Reservation.

Make the watersheds theme active by single-clicking on it.

Use Theme--> Select By Theme to select watersheds that intersect the selected features of the land ownership theme. Select "New Set."

- 6) How many watersheds are selected?
  
- 7) Which watersheds are selected?


Convert the selected watersheds to a theme, using Theme--> Convert to Shapefile. Name it rose\_watersheds.shp and add it as a theme to your view.

8) How many polygons are in your new theme?

9) Why?

10) Which watershed is the largest in size?

11) Which watershed has the largest perimeter?

Clear any selected watersheds **and** anything selected in land ownership using the clear selection  button.

Next, you'll need to clip your other data to the extent of the watersheds that intersect the Rosebud Sioux reservation. Engage the Geoprocessing Extension (under File--> Extensions).

Access the View menu and select —> Geoprocessing Wizard.

*Clip* your rivers theme with your Rosebud watersheds theme. Name your new theme rosebudrivers.shp.

12) How many rivers are in your new theme?

Make a graduated symbol map symbolized on the mean flow of the rivers.

13) Make three observations about the direction of flow in this region and about the drainage pattern.

14) What river segment contains the highest Mean Flow (mnflow)?

15) Select this river with the highest mean flow in the table and then look at the map. Does the location of the river with the highest mean flow surprise you? Why or why not?

Examine the current water level for the Little White River near Rosebud, at the following address:

[http://waterdata.usgs.gov/sd/nwis/uv/?site\\_no=06449500&PARAMeter\\_cd=00060,00065](http://waterdata.usgs.gov/sd/nwis/uv/?site_no=06449500&PARAMeter_cd=00060,00065)

16) What is the river flow in cubic feet per second?

17) How old was this reading at the time that you examined it?

Clip the land ownership theme to the extent of the Rosebud Watersheds. Name your new theme "RosebudLandOwnership."

Examine the table for this new theme.

18) What do you notice about the area in acres for the two pieces of Pine Ridge lands?

You will need to recalculate these areas. Edit the table and select the acres field. Calculate acres to [shape]. returnarea as you did in a previous lab. Stop editing and save edits.

19) What happened to the values for acres?

20) Who owns the second largest piece land in the Rosebud Land Ownership theme?

You need to perform 4 more clip operations. You may have noticed that it becomes tiresome to navigate to the correct folder each time you create a new theme. Try entering the directory (folder) where you are saving your data to under "File--> Set working Directory" to avoid having to give the full path and folder name in the future.

Clip the geology to the Rosebud Watersheds in a similar way as you clipped the land ownership and the rivers. Make a unique value map on your Rosebud Geology theme based on the field "descriptio."

21) What two types of geology underlie this region?

In a similar way, clip your cities, demography, and agriculture maps to the extent of Rosebud Watersheds, naming the new files appropriately.

Turn off all layers covering all of South Dakota, and make visible only the layers clipped to the extent of Rosebud Watersheds.

22) How many cities are in your clipped dataset?

23) Make a graduated symbol map based on city size. What is the largest city in the dataset and what is its population?

24) What is the sum total of the population of these cities?

25) How did you find out the answer to the above question?

26) How many whole counties exist in your agriculture and demography maps?

27) How many partial counties exist in your agriculture and demography maps?

Your investigation requires you to determine the cities that exist in each watershed so that you can conduct water quality studies in each one.

Make only the following themes visible: Rosebud cities, watersheds, and rivers. Arrange them so you can see all three layers.

28) To be able to see them all, which layer (theme) needs to be at the top of the table of contents list?

Use Theme--> Auto Label and label the cities. Label the watersheds so that you can see the watershed name at its most detailed level.

29) What watershed attribute did you use to label the watersheds?

30) Which watershed is the town of Mission in?

31) Which watershed is the town of Rosebud in?

32) Now you need to know which watershed EACH city falls in. Examine your cities table. Does this indicate which watershed the city is in?

33) How did you determine which watershed Mission and Rosebud were in, above?


Therefore, if you don't want to count the cities manually on a map, to efficiently determine the watershed that each city in the entire study area is in, you'll need to add that information to the cities table. To do this, use the Geoprocessing Wizard one more time. This time, select "assign data by location."

34) If you want to determine which watershed each city is in, describe the steps that you will need to take in the Geoprocessing Wizard under "assign data by location:"

35) When complete with the assigning of data, examine the cities table. What did the assign data operation accomplish?

36) How many cities are in the Keya Paha watershed?

37) Use a field summarize on the "Unit" field to create a summary table indicating how many cities are in each watershed. Which watershed contains the most cities?

Use the measure tool  to answer the following:

38) How far from Mission and Antelope is the drainage divide between the watershed that Antelope are in and the one to the north?

Your program will address the needs of sunflower and barley farmers. You therefore need to find areas where these types of agriculture are most common.

Make a graduated color map on 1992 Sunflowers for Agriculture for your study area.

39) Which area in your study area contained the most Sunflowers in 1992?

40) Which file gave you the above information?

41) Make a graduated color map of 1992 barley for the study area. Which area in your study area contained the most Barley in 1992?

42) Sort on some of the values in the agriculture table. What is the "problem" with the values in the agriculture file?

43) Name one way you could fix this problem.

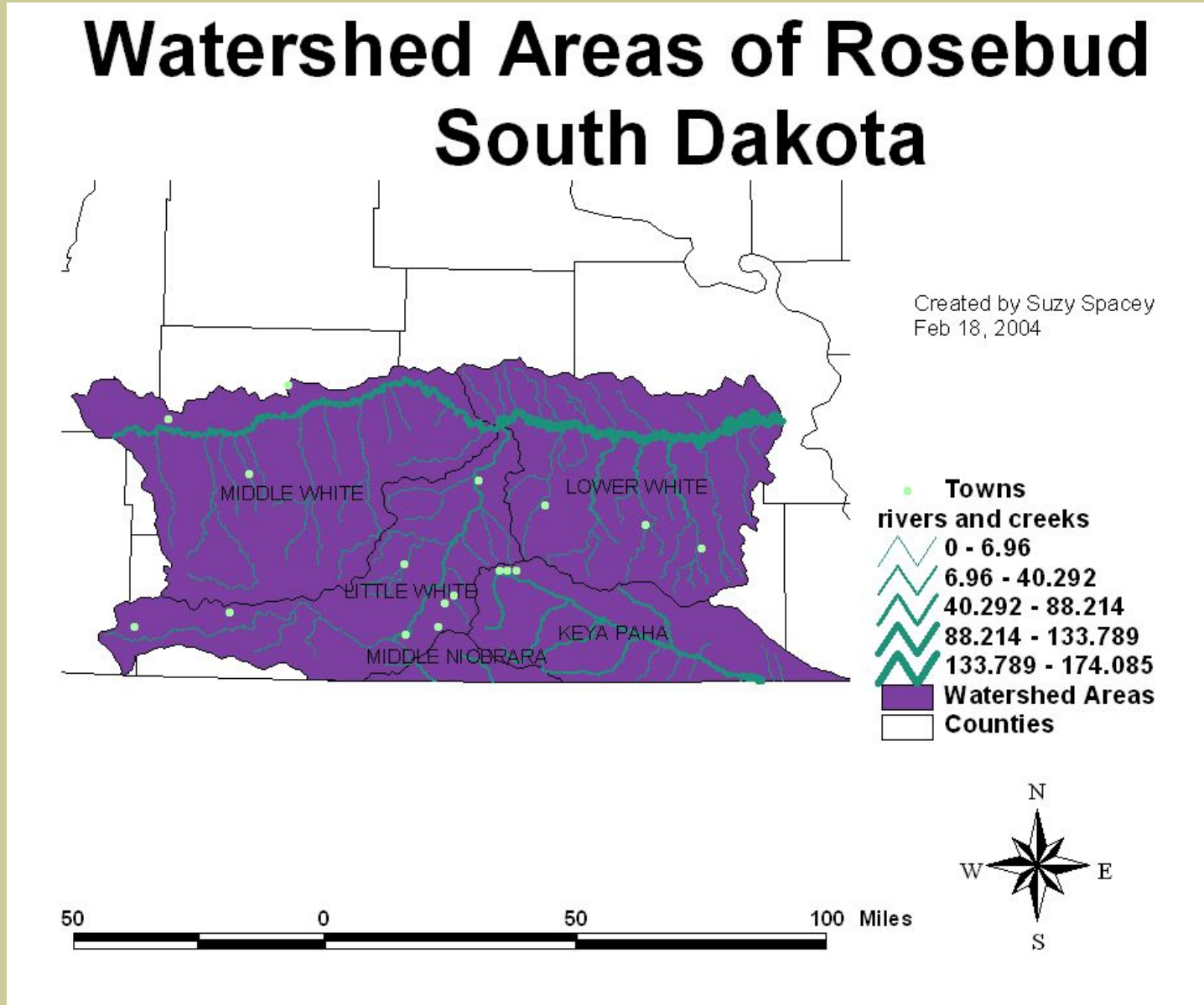
44) In what other theme's table does this problem exist? Why?

Save your project.

Create a layout for printing that contains your watersheds, cities, and rivers, and any other themes you would like to map.

View → Layout. Create your layout. With the text tool, add your name, date, and change the title of the map to something that reflects what the map is showing.

Print the layout. Example below.



Save your project. Close your project and exit ArcView.

45) Summarize in a few sentences what you have learned about watersheds analysis in this lesson.

46) Summarize in a few sentences what you have learned about GIS in this lesson.

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Maintainer: [webmaster@rockyweb.cr.usgs.gov](mailto:webmaster@rockyweb.cr.usgs.gov)

URL: <http://rockyweb.cr.usgs.gov/public/outreach/sgu/watershedssdlesson.html>

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