

There are three questions on this exam. Do all three. For each of the first two questions, prepare a 2-page typed essay (2 pages x 2 essays = 4 pages total). For the third question use ArcGIS (and Excel/Word) to prepare the map and answers requested. *Combine solutions together in the order of the questions in a single PDF document*, and submit through the class Canvas website, by 11:59 PM on Friday, December 9.

This is a take-home exam. You are honor bound not to discuss this exam with your colleagues in the class. Your answers should be the result of your work and thought alone. Be assured that if essentially the same idea appears in answers from more than one person, it is fairly easy to recognize that when the grading is being done. If that happens, it is not clear from whom the idea originated and who is just using somebody else's knowledge. So, keep your ideas to yourself!

Questions 1 and 2 require you to read and synthesize information from term projects by other students in the class. The term papers that you choose to describe in answering Questions 1 and 2 should be mutually exclusive, that is, if you focus on particular term papers in answering one of the questions, don't focus on the same papers when answering the other question. The term projects can be found at:

Texas: <http://www.caee.utexas.edu/prof/maidment/giswr2016/TermProject/TermProjList.htm>

Utah: <http://hydrology.usu.edu/dtarb/giswr/2016/students.html>

You are encouraged to look at term projects from all locations in preparing your answers since this will give you a greater body of information to speak from.

What we are looking for in grading your answers to this question is:

- **Knowledge of the facts.** Make sure you lay out the facts of what has actually been done before you start offering opinions about what could have or should have been done. Make sure you discuss what was actually done in the term papers not just about the general subject itself.
- **Thoughtful evaluation.** How do you evaluate the advantages and limitations of the principles, methods and data that have been used? How does the knowledge you've learned in this class relate to the world around us? I am looking for a sense of reflection here, of seeing you set individual situations and facts in a larger context in an intelligent way.
- **Effective use of Maps.** Identify specific maps from these projects that you think are effective and explain why they are effective.

*In your answers, you must refer specifically to work presented in term papers prepared in this course this semester.* In other words, I am not looking here just for a general statement about your opinions in the field but rather a deduction based on the term papers presented in this class of what has been done and how you judge the effectiveness of that.

## Questions

### 1. Compare and contrast two papers dealing with the same theme

Choose two term papers that deal with the same or similar themes or topics. Neither of these papers should be your own term paper. The papers that you choose may be from any of the participating universities. Briefly summarize the contents of the papers (the problem examined, the method of analysis, the results achieved). Compare and contrast the approaches to the problem that the two papers took. Which technical approach do you think was more effective? Why? Which paper does a more effective job of communicating its results? Why? Suppose you were undertaking a study of this same subject. Having studied these two papers, what have you learned about how to go about your investigation effectively? What would you do differently from what the authors of these papers did?

### 2. Write an assessment of the utility of GIS in a particular subject area

Student term papers on a range of topics have been presented. Select four papers that fall within a similar subject area and present a critique of how effective GIS is in its application in this subject area. What is the scope of the subject area? How has GIS been used? What types of problems have been solved effectively? What limitations exist that have yet to be overcome in the application of GIS in this area? You are encouraged to look at and use papers from both Utah and Texas where they address similar subject areas.

### 3. GIS Analysis of Canyon Lake

Figure 1 on the next page shows Canyon Lake, a large reservoir located in the upper reaches of the Guadalupe Basin in Texas. A polygon of the lake boundary was created in 2000 during a hydrographic survey of the lake bathymetry made by the Texas Water Development Board<sup>1</sup>. This polygon can be found at:

<http://www.cae.utexas.edu/prof/maidment/giswr2016/exam/CanyonLake.zip>

Please do the following analysis which contains six parts. When you respond to each part, besides providing the answers to the questions posed, please briefly explain how you arrived at these answers.

(1) The (Latitude, Longitude) coordinates of the outlet of Canyon Lake at the dam in decimal degrees are (29.869001, -98.198014) in the NAD83 geographic coordinate system. Convert these coordinates to degrees, minutes and seconds. Create a point feature at the outlet of the dam and delineate its watershed using the ESRI hydro services with the Finest data resolution. What is the drainage area of this watershed (Km<sup>2</sup>)?

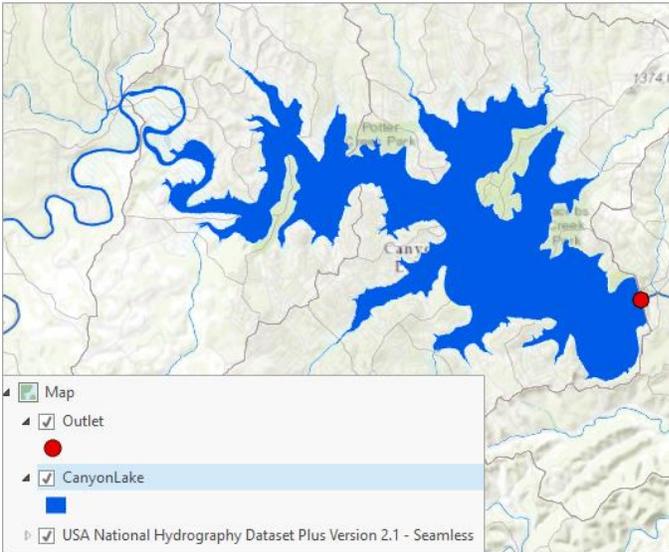
(2) The Canyon Lake shape file is in geographic coordinates using the NAD83 datum. Project this to an Albers Equal Area projection and state which projection parameters you have used.

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<sup>1</sup> Canyon Lake Survey Data can be obtained at:

<http://www.twdb.texas.gov/surfacewater/surveys/completed/list/index.asp>

Determine the area of Canyon Lake (Km<sup>2</sup>). What percentage of the watershed area is occupied by the lake?



Canyon Lake

Figure 1. Canyon Lake

(3) In 2000, the lake survey found the volume of storage in the lake at elevation 909 ft above geodetic datum to be 378,852 acre-feet, as compared to 382,000 acre-feet at the same water surface elevation in 1972. This reduction is due to erosion in the watershed and sediment deposition in the lake. How much storage was lost during this period (acre-feet)? What depth of soil distributed over the watershed does this represent (mm)? 1 Km<sup>2</sup> = 247.105 acre. Is there significant soil erosion in this watershed?

(4) Add “Mean Annual Rainfall” from the ESRI Living Atlas to your map. The units are inches of rainfall per year. Extract the mean annual rainfall coverage for the Canyon Lake watershed, as shown in Figure 2. What is the mean annual rainfall over the watershed (inches)? If 20% of this rainfall becomes flow into Canyon Lake, and there was no evaporation from the lake, how many months would it take to fill the lake from empty to elevation 909 ft above geodetic datum, given the bathymetry of the lake as measured in 2000?

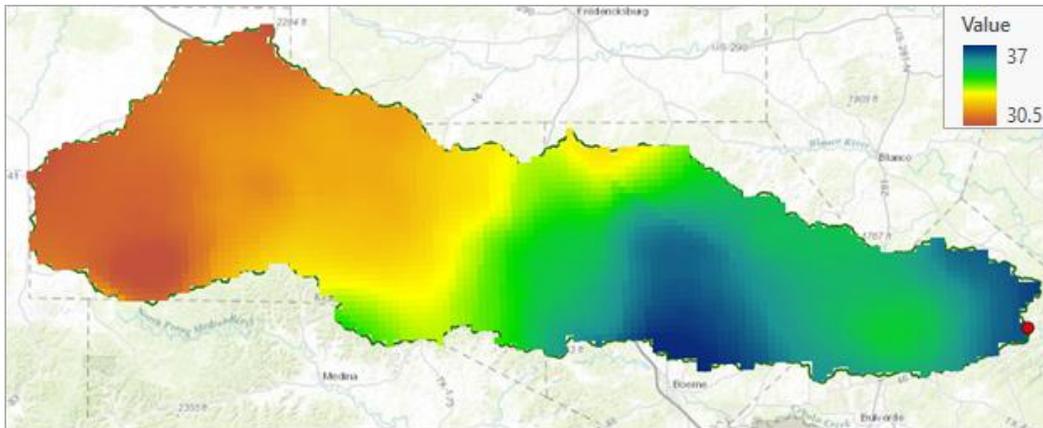


Figure 2. Canyon Lake Watershed mean annual rainfall.

(5) Load the USA NLCD 2006 land cover map from the ESRI Living Atlas. Extract the land cover of the Canyon Lake watershed. Find the percentage of the land cover in each of the major land cover classes shown in Figure 3.

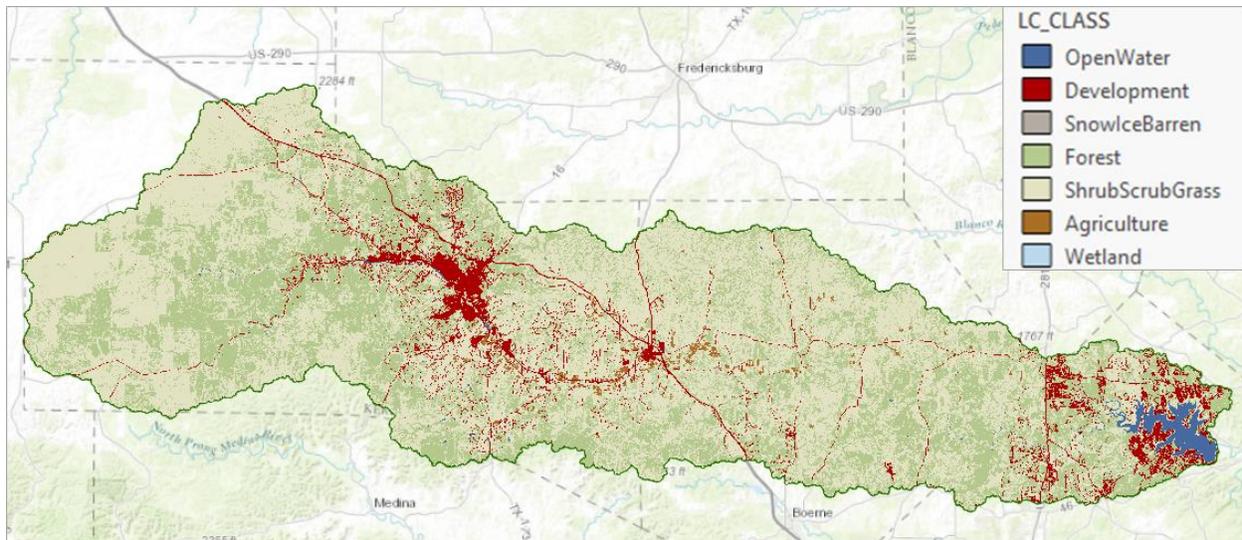


Figure 3. Canyon Lake Watershed Land Cover

(6) Load a national hydrography data source with mapped streams for this area (you may use any of the NHD or NHD Plus datasets you are familiar with from any source you know about or can find). Prepare a layout figure that shows mean annual rainfall as contours, land cover and streams for the Canyon Lake watershed. Symbolize the streams in a way that larger streams stand out more than smaller streams (e.g. based on flow or area appropriately categorized). Include a title, scale bar, north arrow and legend information on the map so that it is complete and self-explanatory. This is your chance to show off your map making skills and use of GIS to present quantitative information in a complete and clear way.