Aquifer Systems

Geology 816

Spring 2007

Meeting: TTH 9:30-10:45 Room 322 Brackett Hall
Instructor: Larry Murdoch, Room 337; 656-2597; lmurdoc@clemson.edu
Office Hours: 930-1030 T/Th or by appt

Textbook: Recommended: Hydrogeology; Back, Rosenshein, and Seaber. Groundwater Atlas of United States, USGS Hydrologic Investigations Atlas 730-#.

Objectives: The flow from a recharge zone through an aquifer system to a discharge zone is the underpinning of geological processes that range from the hydrogeology of basins to the movement of chemicals at a contaminated site. The primary objective of this course is to introduce methods for formulating conceptual and quantitative hydrogeologic models of aquifer systems. Another objective is to develop the skills of describing hydrogeologic concepts and analyses in verbal presentations and reports.

Approach: The course will consist of a lecture format with informal meetings in the computer lab as needed. The following major sections form the core of the course

I. Geologic and hydrogeologic settings of aquifers in the U.S.
II. Characterizing properties of the subsurface and water fluxes at the ground surface
III. Applied analysis of flow in watersheds

Selected aspects of these sections are highlighted on the next page.

Each student will focus on a particular study area and apply the concepts and methods from the three sections outlined above. These efforts will be summarized in papers and in-class presentations.

Prerequisites: GEOL 608, 615 and 808 or permission of instructor.

Software: Word, Excel, GW Vistas, Surfer, Scientific Notebook or equivalent

Grading

Homework and quizzes	0.30
Presentation and paper	0.40
Midterm exam	0.10
Final exam	0.20

Attendance: You are expected to attend class. Attendance at the scheduled final exam is mandatory. University policy dictates that you must wait 15 minutes after the scheduled class time if I am late.

Students with Disabilities: It is University policy to provide, on a flexible and individualized basis, reasonable accommodations to students who have disabilities. Students are encouraged to contact Student Disability Services to discuss their individual needs for accommodation.

Academic Integrity: As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

Electronic: Please give me your e-mail address if it is other than the one issued by DCIT. I will use Blackboard, as well as the 816 folder on the H: drive for the class (L:\EE&S\Depts\Everyone\GEOL 816\). I will also use this site: http://www.ces.clemson.edu/hydro/murdoch/Courses/Aquifer%20Systems/Aquifer_Systems.htm

Aquifer Systems, GEOL 816

Section 1. Hydrogeologic Settings: The **Big** Picture

An overview of the important concepts and factors affecting regional ground water flows, and a review of hydrogeologic characteristics in the U.S. Students will describe the hydrogeologic setting of a selected area and present their results.

- **Conceptual model of flow in watersheds**
- **Water balance concepts**
- **Factors affecting storage and transmission**
  - Geologic characteristics
  - Applied fluxes
- **Important hydrogeologic settings in the U.S. (and perhaps elsewhere?)**

Piedmont Region	Coastal Plain Region	Gulf Coast
Mid-Continent	Glacial sediments	Major Karst Aquifers
Central Valley, CA	Basalt Plateau	Basin and Range

Section 2. Characterizing Field Settings

A review of methods used to characterize the properties, boundary conditions and source terms required to analyze hydraulic head and flow in aquifers. Students will characterize a hydrogeologic setting by analyzing available data.

- **Aquifer properties**
  - Reconnaissance methods
  - Field methods
- **Applied fluxes**
  - Applied water balance methods
  - Analysis of stream and well hydrographs
  - Estimating evapotranspiration
  - Estimating recharge
  - Groundwater/surface water interaction

Section 3. Simulating Flow in Field Settings

Applied analysis of flow in aquifers systems using analytical and numerical methods. Students will prepare and present a calibrated model of a field setting using MODFLOW and data developed previously in the course.

- **Approach and methodology**
- **Analytical models of flow in watersheds**
- **Numerical analyses**
  - Representing hydrostratigraphy
  - Representing boundary conditions and applied fluxes
  - Calibrating models using field data
  - Troubleshooting applied analyses
  - Visualization and interpretation of results

Preliminary Schedule of Topics

	Date		*Topic*	*Project*
1	Jan 11	Th	Overview, Aquifer systems, H cycle, role of geo.	
2	16	T	**Alluvial aquifers**: AS	
3	18	Th	**High Plains aquifer**: AS	Pick a region
4	23	T	Water balances, applications: HP	
5	25	Th	Steady flow through aquifers, properties, processes: HP	Reference list
6	30	T	Head distributions in alluvial aquifers, scaling, HP	
7	Feb 1	Th	Idealized watershed, Intro to GV4	
8	6	T	Steady GW-SW interaction, HP	Outline w/ Figs
9	8	Th	Defining watershed boundaries, stream b.c. GV4	
10	13	T	Calibration of simple model, PEST, GV4	Expand outline
11	15	Th	**Piedmont, Blue Ridge,** AS	
12	20	T	Averaging layers and fractures as uniform blocks, HP	Abstract
13	22	Th	Creating and using irregular layers and b.c. in GV4	
14	27	T	Time series, Surface water flow and precip, HP	
15	1	Th	Stream hydrograph analysis, background, HP	**Draft, Part 1**
16	6	T	Hydrograph analysis, applications to calibration, HP	
17	8	Th	Transient hydrograph for Piedmont in GV4	Proposal Part 2
18	13	T	*Midterm*	
19	15	Th	**Columbia River Plateau Aquifer, AS**	
20	27	T	Representing basalt hydrostratigraphy	
21	29	Th	**MidContinent Karst** AS	Outline Part2
22	3 April	T	**Floridan Karst,** AS	
23	5	Th	Hydrochemical facies, HP	
24	10	T	Seawater intrusion, GV4	Outline + Figs
25	12	Th	Wells	
26	17*	T	Well testing	Abstract
27	19	Th	Aquifer sustainability	
28	24	T	**Student Presentations**	
29	26	Th	**Student Presentations**	Final draft

* Conflict with Hydrogeology Symposium, class to be rescheduled