1. **ES/WSM/CE/GEOL 452: Geohydrology (Lecture and Laboratory)**

2. **Credits & Contact Hours:** 4 credit hours (every fall – lecture and 3 hour laboratory)

3. **Instructor's name:** Dr. Kenneth C. Carroll
   Office: Skeen Hall, Rm. 210
   Office phone number: 575-646-5929
   Email: kccarr@nmsu.edu

4. **Textbook**: Applied Hydrogeology / Edition 4 By C.W. Fetter. 2000; Prentice Hall; ISBN-13: 9780130882394 and ISBN: 0130882399

   Hydrogeology Laboratory Manual, Second Edition. 2003, Keenan Lee, C.W. Fetter, and John E. McCray, Pearson Education.

   Other supplemental materials: Aquifer testing and groundwater modeling software in the CE computer lab.

5. **Course Information**

   a. **Course Description:** Origin, occurrence, and movement of fluids in porous media and assessment of aquifer characteristics. This course will also develop a thorough understanding of groundwater hydrogeology through the lecture and laboratory, which will include experimental methods as well as analytical and numerical models. The focus will be on the application of hydrogeology for water resources. It will cover groundwater resource assessment, impact analysis, aquifer test analysis, monitoring/characterization, dewatering, aquifer storage and recovery, and resource management. Additionally, case studies will illustrate the use of groundwater flow models for various hydrogeologic applications, and the course will cover the most widely used modeling software packages. Cross-listed with ES, WSM, CE, and GEOL, which illustrates the interdisciplinary nature and applicability of the course content.

   b. **Prerequisites: -**
      No specific courses required, but must be upper level undergraduate or graduate student.

   c. **General Policies:** Attendance is mandatory. If you cannot attend a laboratory session, consult the instructor prior to the laboratory. Safety is critical during this laboratory course. There will be a pre-lab quiz at the start of each laboratory, which will cover information about the laboratory being performed on that day and lab safety. Experiments will be performed in

groups, but each individual student is responsible for turning in their own laboratory reports. Laboratory reports are due one week after the laboratory experiment is performed, and late reports will be penalized 10% for every day late. Graduate students will have an additional term project to complete, and will be evaluated separately from undergraduate students.

6. Course Goals

a. **Outcomes of instruction:** The primary objective of this course is for students to become familiar groundwater hydrology issues, problems, and analysis methods. Another objective is for students to learn critical thinking, problem solving, and reporting skills. The students will learn to apply theories through modeling assignments in the laboratory section. At the conclusion of the course the student will be able to: Use hydrologic principles to assess origins and movement of water in aquifer systems. Perform routine analyses of geohydrologic data to characterize and model movement of water in the subsurface, and assess impacts of groundwater management on aquifer status. Assess movement of water in aquifer systems, develop a water balance, measure groundwater flow and storage properties, evaluate water quality and contaminant movement, evaluate aquifer test results, and develop conceptual and quantitative models of groundwater systems.

b. Student Outcomes:

- An ability to apply knowledge of mathematics, science, and engineering
- An ability to design and conduct experiments, as well as to analyze and interpret data
- An ability to function on multidisciplinary teams
- An understanding of professional and ethical responsibility
- An ability to communicate effectively
- The broad education necessary to understand the impact of science and engineering solutions in a global, economic, environmental, and societal context
- A recognition of the need for, and an ability to engage in life-long learning
- A knowledge of contemporary water resources issues
- An ability to use the techniques, skills, and modern hydrogeologic tools necessary for science and engineering practice.

7. Topics Covered

- **<u>Lecture Topics:</u>**
  - Hydrologic Cycle/Budget
  - Evaporation and Precipitation
  - Runoff and Streamflow
  - Properties of Aquifers
  - Principles of Groundwater Flow
  - Soil Moisture and Groundwater Recharge
  - Aquifer Testing Methods and Analysis
  - Regional Groundwater Flow
  - Groundwater in Various Geologic Environments
  - Water Chemistry and Solute Behavior in Groundwater
  - Groundwater Contamination and Restoration
  - Groundwater Development

- Field Methods
- Modeling Methods

- **<u>Laboratory Topics:</u>**
  - Water Budget: Precipitation and Evaporation
  - Water Budget: Runoff, Storage, and Groundwater Flow
  - Regional Aquifer: Colorado
  - Regional Aquifer: Gulf Coast
  - Water Chemistry and Water Quality
  - Porosity, Specific Yield, and Specific Retention
  - Darcy's Law and Hydraulic Conductivity
  - Modeling Groundwater with Flownets and MODFLOW
  - Aquifer Testing: Analysis Methods
  - Aquifer Testing: Nonideal Aquifers
  - Aquifer Testing: Slug-Test Data Evaluation
  - Aquifer Testing: Field Observation of an Aquifer Test
  - Contaminant Transport: Groundwater and Contaminant Velocity
  - Contaminant Transport: Tracer-Test Analysis and Contaminant-Plume Modeling
  - Contaminant Transport: Groundwater and Contaminant Particle Tracking
  - Seymour Hazardous Waste Site: Hydrogeologic Setting
  - Seymour Hazardous Waste Site: Groundwater Flow
  - Seymour Hazardous Waste Site: Contamination
  - Groundwater Basin Analysis

8. Grading

- Weekly Homework 15%
- Lab Report (19 assignments) 15%
- Quizzes (Prior to each lab) 15%
- Attendance, participation 15%
- Midterm Exam 15%
- Final Exam 25%
- *An additional project required for graduate level* *10%*

Overall Score	Grade
90-100	**A**
80-89	**B**
70-79	**C**
65-69	**C-**
<65	**F**

9. Additional Information

Academic Integrity: It is expected that students will maintain the highest degree of academic integrity and honesty. Students are expected to complete their own work to the best of their ability, and you are required to be familiar with university policies and procedures in the current NMSU Undergraduate Catalog. Policies and procedures for dealing with such cases are detailed in the Student Handbook http://www.nmsu.edu/~vpsa/SCOC/index.html. An explanation of plagiarism can be found here: http://lib.nmsu.edu/plagiarism/. Please see the Student Code of Conduct in The Student Handbook: http://deanofstudents.nmsu.edu/student-handbook/1-student-code-of-conduct/ and pay particular attention to "III.B. Academic Misconduct." Academic misconduct will not be tolerated and will result in severe penalties including an F in the class.

Student Accessibility Services
If you have, or believe you have, a disability and would benefit from accommodations, you may wish to self-identify. Section 504 of the Rehabilitation Act of 1973 and the Americans with Disabilities Act (ADA) covers issues relating to disability and accommodations. All information will be held in strict confidence. If a student has questions or needs an accommodation in the classroom (all medical information is treated confidentially), contact:
Student Accessibility Services (SAS) - Corbett Center, Rm. 244
Phone: 646.6840 E-mail: sas@nmsu.edu
Website: www.nmsu.edu/~ssd/
If you are already registered with the SSD office and need accommodations please provide your "Accommodation Memo" from the SSD within the first two weeks of class.

Non-Discrimination Policy
NMSU policy prohibits discrimination on the basis of age, ancestry, color, disability, gender identity, genetic information, national origin, race, religion, retaliation, serious medical condition, sex, sexual orientation, spousal affiliation and protected veterans status. Furthermore, Title IX prohibits sex discrimination to include sexual misconduct, sexual violence, sexual harassment and retaliation. For more information on discrimination issues, Title IX or NMSU's complaint process contact:
Office of Institutional Equity (OIE) - O'Loughlin House

Phone: 646.3635 E-mail: equity@nmsu.edu
Website: http://www.nmsu.edu/~eeo/

Disclaimer
The instructors reserve the right to modify the course schedule or other aspects of the syllabus during the semester as considered necessary to achieve course objectives. Any necessary changes to the syllabus (or to the course schedule) will be announced in class and you are responsible for being aware of them.