Introduction
Water in the proper quantity and quality is essential to all life. Water quality is a critical aspect of the overall management of water resources. Water quality is so central in the minds of Minnesotan’s that it played a significant role in passage of the Clean Water, Land and Legacy Amendment, a 2008 change to the State’s Constitution. Arguably, water is the most significant natural resource challenge facing Minnesotans today. Globally, more than 2.5 billion people have inadequate access to safe drinking water or sanitation. The political stability of areas such as the Middle East and parts of Africa is strongly influenced by water resource issues. As citizens of Minnesota and of the world, we are asked to vote on, comment on, and often pay for changes in water quality. Our failure to be involved often will result in increased health risk, increased economic cost and reduced quality of life. As such, we need to be aware of the costs and benefits (in the larger sense of both words) of changes in water quality.

An Overview of Global and Local Water Quality Issues
In this class, we discuss biophysical water quality in the context of society’s management concerns; we mix ecology and water resource science with policy and decision-making. I draw examples from many places in the world, many cultures and many economies because there are useful similarities and instructive differences among them. I provide an overview of water quality and its role in broader issues to help you become a better natural resource professional and a more informed citizen. Water quality is important in every natural resource field; this class provides you with depth that will be useful in your natural resources career.

Active, constructivist learning and diversity of views and interactions
I strongly believe in active and constructivist learning. That is, I believe that each of us brings a unique perspective and we each have something to offer to the discussion. As we approach an issue or a discussion, each of us learns from the interaction among us and constructs new learning from that interaction. Therefore, the class relies upon an open, highly participatory, interactive format, both in class and electronically. People from all backgrounds and orientations are explicitly welcomed. I especially seek
a wide variety of views and styles of interaction. If there are any ways I can make your participation more effective or if you have any special needs, I will try to accommodate them; please let me know.

**CLE Environmental theme**
This class has been certified as meeting the Environment theme, by the university’s Council on Liberal Education. The class focuses on the interdependency of humans and their environment, stressing the ways humans alter landscapes and the positive and negative impacts that alteration has on water quality. The class discusses in many ways the regenerative aspects of the biosphere (i.e., the ways biotic and abiotic influences can remove or mitigate negative aspects of water quality). Finally, water quality management clearly is a function of both social and ecological influences. These issues are addressed throughout the class.

**Discussion, Analysis and Synthesis**
You will be expected to participate in discussions and presentations in order to improve your grasp of the material as well as to improve your communication abilities. You will be expected to develop and demonstrate an ability to think critically and to weigh alternatives. Performance evaluations in the class depend on critical analyses of issues and interpretations of scenarios, as well as text-based facts and concepts inherent to the field.

No text is required for the class; we will read a wide range of materials and all will be posted on the class Moodle site. To excel in the class, you will need to remain sufficiently familiar with the material posted on Moodle that you can discuss it intelligently and can refer to it as necessary. You will not be asked to memorize and repeat material; rather your goal should be to become conversant with concepts and approaches and become comfortable using the concepts in the literature as a reference for practical analyses, interpretation and decision making.

**Student Learning Outcomes**
The University has adopted seven Student Learning Objectives that apply to all students. This class specifically advances objectives 1 (i.e., identify, define and solve problems), 2 (i.e., locate and critically evaluate information) and 3 (i.e., master a body of knowledge and mode of inquiry).

- **Outcome 1** is achieved through our content. Water is a critical natural resource. Water quality is a critical aspect of the overall management of water resources. Outcome 1 is assessed through our examination of conflicting issues in case studies, the analytical aspect of panel discussions, and the synthetic paper.
- **We pursue Outcome 2**, by examining the cultural and biophysical aspects of water quality. Water quality management clearly is a function of both social and ecological influences. These issues are addressed throughout the class. This outcome is assessed throughout the field of water quality and natural resources as we examine, discuss and write about case studies, read published papers and write and revise synthetic papers.
- **To achieve Outcome 3**, the class focuses on the interdependency of humans and their environment, stressing the ways humans alter landscapes and the positive and negative impacts that alteration has on water quality. This outcome is assessed through the literature review and analytical aspects of the synthetic paper, the examinations, and case study discussions.

**Class Conduct**
Water quality (by my definition) is an applied ecology approach to water resource decision making at the landscape scale. Water resources offer a range of benefits to human societies; we often express those benefits as “ecosystem services”. As we manage the landscape differently, we change the relationship between the land and water and therefore, change the ecosystem services society gains. Informed decision making means we think carefully about the balance between the benefits we derive from landscape management practices and the loss of ecosystem services we get from the water. We (should) always take an ecosystem and watershed approach to managing that relationship. Minnesota has developed a highly innovative visualization and analysis tool called the Watershed Health Assessment Framework (WHAF). We will use WHAF as a tool for understanding and writing about the future of Minnesota watersheds as climates change; that paper will represent your synthetic writing for the class.

The flow of the days and the weeks
In this class, we use a wide variety of strategies to capture your interest and optimize your learning. You will notice that there is a wide range of exercises. Consider each as a step that helps build your critical and analytical abilities and helps develop your decision-making and management skills. Although the days and weeks will vary somewhat as I learn more about your learning style, we will use the following pedagogical approaches often:

Lecture and Discourse
I will use Power Point and other visual aids to offer information, complementing that with recent literature and other sources. I will tie together the readings from the day and real life stories from my experience. This is our principal review of content. I will present materials; your responsibility will be to develop an understanding by reading the material and by engaging with the content. This content will serve as the basis for aspects of your writing for the class.

Case Discussion
I have selected case studies from the literature that will allow us to engage in and learn about water quality. A case study is really a story about some landscape in which there are people and water resources. There are impacts from the land to the water and resulting changes in ecosystem services as the land is managed differently; trade-offs are examined and decisions are made. That is followed by another decision (i.e., accept the loss of ecosystem services or change practices). These are decision cases where you are assigned a role and asked to take that position for the purposes of the case discussion.

Panel discussion
I have selected papers from the recent literature that discuss some aspect of the issues we are discussing in class. Each of the papers addresses current issues in water quality management. We will use a panel discussion approach to those papers. Each person will serve at least once as moderator, once as proponent and once as opponent. On the days you are on a panel, you have three responsibilities:

- Read the paper(s) assigned for the day. Make notes that will allow you to serve as an active and informed participant in the discussion.
- On the day of the panel:
  - **Opening (several minutes)** I will provide an opening statement about the papers we are discussing, why I chose them, and terms that you will have found interesting, confusing or useful. This will set up the broader picture of the discussion.
  - **Moderator (2 minutes)** Provide an opening statement about the papers we are discussing. Summarize the principal So What that you see in the papers, what do you feel these papers bring to our discussion today and to our class?
Proponent(s) (10 minutes) You have 10 minutes to summarize how the research was completed and to convince the rest of the class that this work was well designed, well conducted, analyzed correctly, and interpreted correctly.

Opponent(s) (10 minutes) You have 10 minutes to offer an intelligent counterpoint. Think about and discuss other papers that might take a different approach to the questions posed here; question the research designs; question the analyses and interpretations. The role here is not to be critical of the paper per se, but rather to raise thoughtful questions.

Moderator (5 minutes) We all have read the papers, heard your introduction, and heard in-depth analyses of the papers. Open the rest of the discussion by offering two questions that will engage the class. As you listen to the proponent and opponent, come up with one more question, a third offering that occurs as a result of the early discussion. Lead the class in a discussion of those three questions.

Meeting with the Instructor
You are encouraged to initiate discussion and/or ask questions at any time. If you encounter difficulty with course material, please ask questions and see me for help. I will make time available during class and directly after class for questions on course material. I also will hold office hours at Lori’s on Mondays and Thursdays.

I react to e-mail questions very quickly and will check Moodle often to ensure you are not “held hostage” waiting for some answer. I am not available for unscheduled meetings and almost never answer the phone. I do not understand “the book of faces” or “snapping chats” or “instant grains” or “tweaker” or any form of asocial media. Do not expect me to go there.

Student Requirements

Participation Each student is required to participate in class, including Moodle postings, paper discussions, and case study discussions.

Examinations There are two examinations in the class. Each will be short essay and will require most of a full class period.

Writing This is a Writing Intensive class; it will help you learn more about writing and communicating, it will satisfy the University’s Writing Intensive requirements and it will help you learn to recognize good writing. You will have support in your writing. We will have class periods devoted to your writing (i.e., days set aside for your writing when you do not have to be in the classroom). We also will have instructor- and peer-reviews of your drafts.

An analytical paper on Synthetic Approaches to Water Quality Management Each person will participate in a group that conducts research using the WHAF, and writes two papers. One of those will characterize a watershed, using WHAF tools. The second will focus on two sub-watersheds and will offer strategies a watershed manager should implement and he/she considers climate change and attempts to prepare watershed management for 2050. Details about expectations and timing for the paper are described in detail in the paper instructions.

Case positions
We will use case studies as a way of engaging with the content this semester. Usually our cases are decision based, meaning someone has to make a decision among competing priorities. Each time we discuss a case, you will be asked to post a paragraph on Moodle describing your position and your analysis.

Grading
My core philosophy of grading is that students should be given the benefit of doubt whenever possible. I feel that students should have wide varieties of opportunities to excel, and I stress communication, expression and concepts more than details.

**There will be 265 points in the semester.** People who earn at least 92% will receive an A, 86-91% a B, 75-85% a C, 65-74% a D. I may lower the grading scale to accommodate natural breaks in the curve.

- 35 points for **In-class participation**
- 160 points for **Writing**
  - 4 for your first reactions
  - 68 for the case study analyses, usually 4 points each
  - 88 for the watershed characterization papers (in steps)
- 70 points for **Exams**
  - 25 for the first exam
  - 45 for the second