SCHOOL OF ENGINEERING
UNIVERSITY OF GUELPH

WATER MANAGEMENT
ENGG*2550

WINTER 2004
Course Outline

Calendar Description:

The influence of fundamental engineering and hydrologic principles on the choices available for management of water on a watershed basis is demonstrated for representative techniques used in management for water supply, irrigation, flood control, drainage and water pollution control. Selected problems are studied to reveal the technical, environmental, legal, jurisdiction, political, economic and social aspects of water management decisions.

Prerequisites: (CHEM*1040 or CHEM*1310), GEOG*2000

Objectives:

At the successful completion of this course, the student will have demonstrated:

1) an appreciation of watershed management principles and techniques
2) the ability to identify and discuss the multiple dimensions of global water management issues
3) the ability to perform quantitative analyses of water resources – groundwater, lakes, rivers, wetlands – and the effects of human activities on these water resources
4) knowledge of the tools and techniques used in water management and the ability to apply this knowledge to develop solutions to water management challenges
5) an understanding of Ontario's legislative framework for water management

Faculty:

Andrea Bradford, PhD., P.Eng.
Room 1342, Thornbrough Building.
Office Hours: Tuesday 2:00 – 4:00 pm.
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Teaching Assistant: Mauricio Herrera (0.5 GTA)

Class Times and Locations:

Lectures	Tuesday	10:00 – 11:20	Room 314 MACK.
	Thursday	10:00 – 11:20	Room 314 MACK.

Course notes:

Most lectures will be conducted using an overhead or computer projector. Copies of most lecture notes will be made available for $10. Students are expected to provide further annotation and may need to take full notes on some topics.

Textbook: none

Other resources:

Required readings will be assigned weekly (see the attached preliminary reading list). Students should be prepared to discuss the required readings during the lecture periods. Other recommended readings may also be suggested.

Course Organization:

Week 1: Fundamental water management concepts and themes for the course

Introduction to fundamental concepts in water management (properties of water; inter-relationship of land, air and water systems; inter-relationship of quality and quantity). Competing demands and the multiple dimensions of water management - social, economic and ecologic. Management objectives. Tools and techniques for analysis and management. Importance of analysis and management on a watershed scale. Unintended consequences.

Week 2: Introduction to Watershed Management

Definition and delineation of watersheds. The importance of the hydrological cycle within watersheds. Watershed water balances. Important principles of watershed management.

Weeks 3-4: Groundwater and Surface Water: A Single Resource

The subsurface environment. Groundwater flow. Groundwater – surface water interactions. Introduction to geochemistry. Effects of human activities. Analysis and management tools including monitoring, models, and water budgets. Source protection.

Weeks 4-5: Lakes

Physical, chemical, and biological characteristics of lakes. Buffering capacity.Thermal stratification. Nutrient cycles. Eutrophication. Sturgeon Bay Case Study: Developing a solution to excessive nutrient loading.

Week 6: Rivers

Physical, chemical, and biological characteristics of rivers. Flow measurements. Sediment transport. Temperature, dissolved oxygen and assimilative capacity of streams. Effects of urbanization on streams. Management techniques including low water response, buffers and restoration. Flood mitigation techniques.

Week 7: Wetlands

Wetland types and functions. Wetland hydrology. Wetland policy. Presentation on the eco-hydrology of Minesing Swamp.

Weeks 8 and 9: Water Supply

Groundwater and surface water sources. Water quantity and quality requirements. Demand management. Walkerton and the multiple barrier approach to protecting drinking water. Legislation and regulations in Ontario. Treatment processes. International challenges.

Weeks 10 and 11: Wastewater Management

Legislation and regulations in Ontario. Wastewater treatment processes. On-site systems. Pollution prevention. Stormwater management.

Week 12: Integrated Watershed Management

The adaptive management process – watershed characterization; setting goals and targets for the ecosystem; developing a management strategy; implementation; monitoring, evaluation, and adaptation. Key tools such as GIS. Discussion of presentation on the Oak Ridges Moraine Conservation Plan.

Evaluation:

Webpage	-	15%	Thursday, Jan. 29 (Preliminary) Thursday, March 4 (Final)
Term Project	-	15%	Tuesday, March 16 and Thursday, March 18 (Presentations)
News Critique	-	10%	Thursday, March 25
Problem Sets	-	10%	
Midterm	-	20%	Thursday, Feb. 12
Final examination	-	30%	

If you obtain a failing grade on both the mid-term test and final examination, the course grade will be the mark assigned for the final exam.

Problem Sets:

During the semester there will be about four (4) problem sets. Each problem set will be handed out at least one week prior to its due date. A penalty of 10% will be deducted for each day (weekend and week days) a problem set is late.

Midterm:

Thursday February 12. During the lecture slot.

Final Exam:

April 5, 2003. 2:30 – 4:30 pm.

Please Note:

The Regulations concerning Academic Misconduct as outlined in the University of Guelph, Undergraduate Calendar for 2003-2004 will be strictly enforced.

Disclaimer:

The instructor reserves the right to change any or all of the above in the event of appropriate circumstances, subject to University of Guelph Academic Regulations.

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Required Readings (please consider this a preliminary list, changes/additions will be made over the course of the term):

Introduction and Watershed Management

Environment Canada. Properties of water. http://www.ec.gc.ca/water/en/nature/prop/e_prop.htm

Gleick, P.H., 2000. The changing water paradigm: A look at Twenty-first Century water resources development. *Water International*, 25(1): 127-138. http://www.iwra.siu.edu/win/win2000/win03-00/gleick.pdf

Postel, S., 2001. Growing more food with less water. *Scientific American*, Feb 2001: 46-51.
Also, same issue: pp: 41-45 and 52-55.

Graham, W., 1998. A hundred rivers run through it: California floats its future on a market for water. Harper's Magazine, June 1998: 51-60.

Environment Canada. Clean Water – Life Depends on it!
http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSA3.htm

Groundwater

Environment Canada. Groundwater – Nature's Hidden Treasure.
http://www.ec.gc.ca/water/en/info/pubs/FS/e_FSA5.htm

Winter, T.C., Harvey, J.W., Franke, O.L. and W.M. Alley, 1998. Groundwater and Surface Water: A Single Resource. U.S. Geological Survey Circular 1139. http://water.usgs.gov/pubs/circ/circ1139/

Lakes

Water on the Web. Understanding Lake Ecology. http://wow.nrri.umn.edu/wow/under/limnology.pdf

United Nations Environment Programme. 1999. Planning and Management of Lakes and Reservoirs. An Integrated Approach to Eutrophication.
http://www.unep.or.jp/ietc/Publications/TechPublications/TechPub-12/index.asp

Schindler, D.W., P. J. Curtis, B. R. Parker and M. P. Stainton. 1996. Consequences of climate warming and lake acidification for UV-B penetration of North American boreal lakes. Nature, Vol. 239 (February 22, 1996):705-708.

Rivers

Environment Canada. Floods. http://www.ec.gc.ca/water/en/manage/floodgen/e_floods.htm

MacBroom, J.G. 2002. River restoration planning (Connecticut). In: France, R.J. (ed.) Handbook of Water Sensitive Planning and Design. pp. 379 – 393.

Coutts, I., 2002. Lost Rivers. Canadian Geographic: May/June 2002: 64-70.

Wetlands

Ducks Unlimited, 2001. Beyond the Pipe. Submission to the Walkerton Inquiry.
http://www.ducks.ca/news/2001/010402.html

Grand River Conservation Authority Draft Wetlands Policy.
http://www.grandriver.ca/index/document.cfm?Sec=20&Sub1=0&sub2=0

Water Supply and Wastewater Treatment

The Honourable Dennis O'Connor, 2002. Part Two: Report of the Walkerton Inquiry: A Strategy for Safe Water. http://www.attorneygeneral.jus.gov.on.ca/english/about/pubs/walkerton/part2/
Especially chapters 3, 4 and 6.

"Trusting the Tap". Alternatives Journal. Spring 2003. Volume 29. Issue 2.

Other Resources

Subject	Call Number Category
Water pollution	TD 419 – 428
Water and wastewater treatment	TD 430 – 760
Stormwater management	TD 653 – 665
Industrial	TD 897
Rural / agricultural	TD 920
Hydrological / hydrogeological processes	GB 656-1399
Flooding	GB 1399, TC 424-530
Irrigation and drainage	TC 805-970
River ecosystems, Lake ecosystems, Wetland ecosystems	QH 541.5 L3; QH 541.5 M3; QH541.5 S7
Economics, politics and water resources	HD1691-1694

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Assignment 1: Web Page

The assignment is to select a topic in water management and to produce a web page on this topic. The topic may be a:

a) water management issue. The paper should present the issue and its multiple dimensions which may be technical, ecological, social, political, legal, and /or economic. It should review management techniques which may be used to address the issue or water management analysis techniques which could help in the development of solutions.

b) tool used in the analysis and/or management of water resources. The paper should describe the tool and its applications in water management. It should review the benefits and drawbacks to the use of the tool and provide at least one case history of its application to analysis or management of a water management issue.

Tools and techniques may be based on the physical sciences, biological sciences, engineering, economics and/or social sciences. There are many acceptable topics. To avoid duplication of topics and to ensure that the scope of your selected topic is appropriate for the assignment, please have your topic approved by the instructor.

The content of your webpage should be based on at least four relevant references. Sources of information must be appropriately identified. Excessive quoting of material from other webpages on your own webpage is inappropriate. Links may be provided to other relevant webpages.

You must demonstrate an understanding of the selected topic. The web page should illustrate your ability to organize material and demonstrate the connection of the material to the themes of water management covered in this course.

You must select a topic and make the preliminary layout of your web page available for viewing by Thursday, January 29. The final web page will be evaluated on Thursday, March 4. Your webpage must be provided on a CDROM by that date. A penalty of 1.5 marks (out of 15) will be applied for each day (weekend and week days) the assignment is late.

The marking scheme for the web page is as follows:

Technical content / appropriate references	7.5
Web page design - layout / structure	5.0
Grammar	2.5
TOTAL	15.0

Assignment 2: Term Project

The class will develop solutions to the excessive phosphorus concentrations and associated effects in Sturgeon Bay. Background on the challenges faced in Sturgeon Bay will be provided in Week 5 of the term. The class will be divided into teams. Each team will address a different aspect of an overall solution which must include reducing the input of phosphorus into the Bay and managing the phosphorus coming from sediments at the bottom of the Bay. Each team will give a 20 minute Powerpoint presentation. Presentations will be scheduled for Tuesday, March 16 and Thursday, March 18.

The marking scheme for the project is as follows:

Technical content	4.0
Power point presentation	3.0
Oral presentation / ability to answer questions	3.0
TOTAL	10.0

Assignment 3: Critique of Media Coverage (Newspaper Article) of a Water Issue or Event

The assignment is to follow "Water in the News," select an event or issue which has been reported in the popular media, and write a critique of the media coverage. The media coverage must include at least one article in print (or available on news agency website) which must be handed in with the critique.

The critique, which should be 2-3 pages (12 point font, 1.5 line spacing, 3 cm margins), should include a brief description of the issue or event, discussion of the dimensions of the issue which were reported, and comment on potential dimensions of the issue which were not addressed by the media coverage.

The assignment is due Thursday, March 25 but may be handed in at any time on or before that date. A penalty of 1 mark (out of 10) will be applied for each day (weekend and week days) the assignment is late.

The marking scheme for the critique is as follows:

Provision of newspaper clipping	1.0
Quality / depth of discussion	6.0
Structure (logical, clear, connected)	1.5
Grammar (correct in spelling, syntax, vocabulary)	1.5
TOTAL	10.0