CIV ENV 346 Ecohydrology

Prerequisites: CE260 Environmental Systems & Processes, One course in fluid mechanics (ME241 recommended).

Instructor: **Aaron Packman**
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Grader: **TBD**
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Class: Monday and Wednesday 12:30-1:50, Location: TBD
Discussion Section: Friday 12:30-1:50, Location: TBD
Office hours: After class or by appointment.

Course Description:

Interactions between water and ecosystems in freshwater, terrestrial, and urban environments. Feedbacks between ecological and hydrological processes. Engineering of ecosystems such as constructed wetlands, green roofs, and other green infrastructure for resilient and sustainable water management.

Course Objectives:

After taking this course, students will:

- Understand key interactions between water and ecosystems, including linkages and feedbacks between ecological and hydrological processes.
- Understand how coupling between physical, chemical, and biological processes controls ecosystem structure and function.
- Understand the strategies used to engineer ecosystems as green infrastructure in urban and rural environments, and the implications of conventional and green infrastructure for resilience and sustainability.
- Be able to quantitatively assess, simulate, and predict essential aspects of linkages between ecosystems and hydrology, including both natural and constructed ecosystems.
- Be able to design green infrastructure for urban water management, biodiversity, and climate adaptation.

The course contributes to the following Program Student Learning Outcomes:

1. An ability to identify, formulate, and solve complex engineering problems by applying principles of engineering, science, and mathematics
2. An ability to apply engineering design to produce solutions that meet specified needs with consideration of public health, safety, and welfare, as well as global, cultural, social, environmental, and economic factors
4. An ability to recognize ethical and professional responsibilities in engineering situations and make informed judgments, which must consider the impact of engineering solutions in global, economic, environmental, and societal contexts
5. An ability to develop and conduct appropriate experimentation, analyze and interpret data, and use engineering judgment to draw conclusions
7. An ability to acquire and apply new knowledge as needed, using appropriate learning strategies.

Outline of Topics

Overview of linkages between hydrology and ecosystems

Urban ecohydrology and green infrastructure for water storage and flood control

Terrestrial ecohydrology – interactions between plants, soil, and water

Watershed ecohydrology – large-scale interactions between water, topography, ecosystems, and land use

Aquatic ecohydrology – aquatic habitat and flow-vegetation-sediment interactions

Biogeochemical cycling in terrestrial and aquatic ecosystems

Ecosystem engineering and green infrastructure

Design of green roofs for sustainability and ecosystem services

Design of constructed and restored wetlands for nutrient management and ecosystem health

River restoration for geomorphic stability and ecosystem restoration

Advanced sensing approaches for real-time and adaptive monitoring of ecosystems

Assignments

Reading and discussing papers from the literature. All papers for discussion are posted on Canvas.

Three projects using software to analyze and design constructed and restored hydro-ecosystems:

- Green roofs – HYDRUS 1D software, data from green roof on the Conservation Science Center at Chicago Botanic Garden
- Wetland restoration – Wetlands by Design software, datasets covering entire state of Wisconsin.
- River restoration – Freshwater Network Floodplain Prioritization Tool, data covering entire Mississippi River Basin

This will require you to learn to use each set of software. Materials will be posted on Canvas, and tutorials will be scheduled during the discussion section.

Northwestern University Syllabus Standards

This course follows the Northwestern University Syllabus Standards. Students are responsible for familiarizing themselves with this information. NU's Syllabus Standards includes specific guidance and university regulations on the following topics:

- Academic Integrity
- Academic Support and Learning Advancement
- Accessibility
- Course Details Subject to Change
- Exceptions to Class Modality
- Guidance on Class Recordings
- Providing Display/Preferred Names and Pronouns
- Prohibition of Recording of Class Sessions by Students
- Religious Observance
- Support for Wellness and Health
- Undergraduate In-Person Arrival and Course Engagement
- The Writing Place
- Use of Generative AI Systems

All of the rules on those pages apply to you, so please read them. There are also useful resources on Accessibility, Student Support, Wellness and Health. I want to highlight a few specific items:

Academic Integrity:

The course involves written submissions of project reports and case studies. You may work with other students on the analysis, but the materials you submit for a grade have to be your own. Make sure to properly cite all external sources of information. Plagiarism standards will be strictly enforced.

Class Teaching Modality and Illness:

Class sessions for this course will occur in person. Individual students will not be granted permission to attend remotely except as the result of an Americans with Disabilities Act (ADA) accommodation as determined by AccessibleNU. Should public health recommendations prevent in person class from being held on a given day, the instructor or the university will notify students.

If you are sick with a respiratory virus, do not attend class to prevent spread of infection. If you are ill or have a medical emergency, contact the instructor as soon as possible to arrange to complete coursework. NU will set up live video and/or recording for anyone who is ill, but this has to be arranged in advance.