University of Pennsylvania
EESC6610 Sustainable Development of Water Resource Systems
Syllabus Spring 2025

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Guest lecturers with experience in water and sanitation in the Americas, Africa & Asia

Course Description: The evaluation of technical, social, and economic constraints on the implementation of water supply and sanitation projects. The development of sustainable technical solutions within the appropriate social context. Discussion draws insight from successful small rural community system approaches to inform practical larger regional and watershed approaches in the US and internationally. Case studies are used to demonstrate these principles across a range of examples from developed and developing countries including detailed studies from rural communities with limited financial resources.

Course Outcomes: By the end of this course, students will be able to:

1. Understand the challenges in developing practical solutions for safe drinking water, culturally appropriate sanitation systems, and comprehensive water resource management.
2. Recognize the social requirements for sustainable water, sanitation and hygiene projects for healthy communities and long-term improvements in quality of life.
3. Evaluate causes of water scarcity including climate, policy, and watershed management
4. Communicate effectively while working with a team to identify key sustainability metrics in a project case study based on the UN Sustainable Development Goals.

Assignments and Grading: Weekly homework (30%). Midterm and quizzes (15%) Canvas topic discussion and class participation (5%). Group research paper and presentation evaluating social and technical approach to a water, sanitation or hygiene project as described in a case study (25%). Final Exam (25%).

Primary Text: Mihelcic, et al, "*Field Guide to Environmental Engineering for Development Workers*", 2009, ASCE Press. While this is an environmental engineering text, much of the content and practical solutions are accessible to community based development workers who are not trained as engineers.

Secondary Text: Anisfeld, S.C. "Water Management Prioritizing Justice and Sustainability", 2024, Island Press. This text provide broad discussion of various global water management topics that will be referenced throughout the course

Schedule: Dates, text chapters and lecture topics shown below **are subject to change and speaker availability**:

1/22 1st Chp 1, 2nd Chp 1	**1. Introduction, Water, Health & Development** Introduction and overview of course objectives and topics. Why study global water & sanitation?
1/29 1st Chps 10 &17 2nd Chp 2	**2. Hydrology, Watersheds and Water Harvesting** Understanding community and environment with a watershed approach. Reviewing topographic maps. Determining water balance for the watershed. Channel flow. Evaluating the feasibility of rainwater catchment. Runoff retention and storage in semi-arid areas.
2/5 1st Chps. 3,4 & 5 2nd Chp 10	**3. Participatory Assessment, Planning and Community Mapping** Facilitating assessment and planning for community ownership of project using participatory methods. Community mapping by representative stakeholders and field survey techniques for topographic and GPS mapping.
2/12 1st Chps 11&12	**4. Implementation of Piped Gravity Water Systems**

	Determining water demand and source yield. Understanding system hydraulics, head losses and energy grade line. Selecting pipe sizes, break-pressure tanks/valves, distribution storage, water tap locations. Working with local skills and knowledge ***Introduction of case studies***
2/19 1st Chp. 2 & 9 2nd Chp. 13	**5. Water Related Health and Hygiene** (Angelita Fasnacht, MPH) Addressing pathways for fecal-oral transmission. Water borne and water washed diseases. Engineering vs. social interventions. ***Selection of case studies and initial meeting.***
2/26 1st Chps 15 & 16 2nd Chp 5	**6. Groundwater – Wells & Springs** – groundwater evaluation in Ethiopia (Vince Uhl, PG) Evaluating hydrogeology. Identifying existing and potential sources during community mapping. Evaluating local technologies for accessing groundwater. Construction of spring protections and wells ***Case Study Outlines and Roles due***
3/5 Various	**7. Watershed Management & Water Scarcity** - California and Cape Town Droughts Challenges of meeting domestic and agricultural demands while sustaining the environment and drinking water supplies. Groundwater exploitation and wastewater reuse **MIDTERM *(in class)***
3/12	**No class "Spring Break"**
3/19 1st Chp.-16.9	**8. Water Storage and Pumping Systems Overview** Review water systems appropriate technology. Types of hand pumps, treadle pumps, hydraulic ram pumps, solar powered or electric pumps. Selecting a pump: appropriate technologies, evaluating pump curves and efficiencies
3/26 1st Chp 18 2nd Chp 14	**9. Water Treatment - Monitoring & Evaluation of WASH** Treatment processes for a water system to render surface water potable. Difficulties in maintaining a chlorinated water supply. Point of use filters and treatment methods. M&E WASH ***Submit Draft Case Study Reports***
4/2 1st Chps. 19, 20,21,22,23 2nd Chp 16	**10. Wastewater treatment and Sanitation** (Water Recycling – Dr. Miriam Hacker) Basic processes for treating wastewater. Working within social norms, designing latrines. On-lot septic and latrine impact on Groundwater
4/9 Various	**11. Environmental Justice ID layers in Philadelphia** (Jazmin Ricks, MPH) Spatial mapping GIS exercise in evaluating community vulnerability and EJ Indices Interactive map link: https://tinyurl.com/2p82p6ja
4/16	**12. Student Presentations** Presentations by groups on evaluation of case studies with analysis and recommendations for scaling up and program improvements.
4/23 2nd Chp 18	**13. Surface Water, Irrigation & Innovative Water Solutions** River basin and watershed management to balance irrigation, water supply and environmental needs. Transboundary issues. Improving livelihoods through efficient use of irrigation water. Role of social entrepreneurship in advancing WASH ***Submit Final Case Study Reports***
4/30 Various	**14. Nature based Solutions** (Debbie Heuckeroth, PE)_Review examples enhancing natural solutions and of maximization of local resources, community engagement to advance equitable development. ***Review for Final Exam.***
5/7	**Take Home Final Exam**

Supplemental Texts and webpages:

"Environmental Health Engineering in the Tropics: An Introductory Text" by Sandy Cairncross and Richard Feachem, 2nd ed, John Wiley & Sons, Ltd, 1993

"Healthy villages: A guide for communities and community health" by Howard G., WEDC, et. al, WHO 2002. Available online: http://apps.who.int/iris/bitstream/10665/42456/1/9241545534.pdf

"Toward Better Programming, A Water Handbook", Water, Environment and Sanitation Technical Guidelines Series No. 2, by UNICEF 1999; Available online: https://waterfund.go.ke/watersource/Downloads/001.%20Water%20Handbook,%20Unicef.pdf

"*World Water Development Report*", annual reports by UNESCO: www.unwater.org/publications/un-world-water-development-report#:~:text=Launched%20on%20World%20Water%20Day,UNESCO%20World%20Water%20Assessment%20Programme.

Sustainable Services in WASH, the IRC approach: http://www.ircwash.org/news/quick-guide-ircs-approach

Plagiarism

Plagiarism is the use of another person's words, ideas, or data as one's own work. When you submit work for credit that includes the words, ideas, or data of others, the source of that information must be acknowledged through complete, accurate, and specific references, and, if verbatim statements are included, through quotation marks as well. By placing your name on work submitted for class credit, you are certifying the originality of all work not otherwise identified by appropriate references. For more information about Plagiarism see: https://guides.library.upenn.edu/citationpractices

Academic Integrity & Generative AI

Students are expected to be familiar with and comply with Penn's Code of Academic Integrity, which is available in the Pennbook. This course has a zero-tolerance policy for cheating or plagiarism, and all violations will result in substantial penalties. If you have any doubts or questions about what constitutes academic misconduct, please do not hesitate to contact me.

AI programs, such as ChatGPT, may be used for generating ideas and brainstorming, to supplement your own ideas and research. However, the final output of any work should reflect your own understanding, analysis, and synthesis of the material. **You may not submit any work generated by an AI program within an assignment.** If you use AI as part of your prep work for an assignment, you are required to disclose its use and appropriately cite all sources. Failure to do so will be a violation of the Penn's Code of Academic Integrity (see above).

AI is a tool and should be used as such; it should not replace your own creativity and independent thinking. AI will not necessarily give the best explanation or answer to your questions, and often the material(s) generated may be inaccurate, based on outdated information, or completely fabricated. Using AI should supplement your learning experience, not replace your intellectual work. Your engagement with the content in this course is essential in creating a rich learning environment and for developing critical skills in applied geosciences.

Diversity Statement

The Earth and Environmental Science Department embraces human diversity and intends equity and inclusion in our community and our classrooms. We expect instructors, staff, and students to respect our diversity. We encourage you to contact our Climate, Diversity, Equity and Inclusion (CDEI) Committee EES-CDEIC@groups.sas.upenn.edu if you need support or have suggestions for how our CDEI efforts in EES can improve.