

University of Pennsylvania
EESC6610/CBE5430 Sustainable Development of Water Resource Systems
Syllabus Spring 2024

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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 design of water supply and sanitation projects. The focus on sustainable design emphasizes how technical solutions fit within the appropriate social context. 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 resources.

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

1. Understand the design challenges to develop practical engineering 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

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

1/24 Chp 1, WWDR Case studies	1. Introduction, Water, Health & Development Introduction and overview of course objectives and topics. Why study global water & sanitation?
1/31 Chps 10 & 17	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.
2/7 Chps. 3,4 & 5 Case Studies	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.
2/14 Chps 11&12	4. Design of 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 <i>Introduction of case studies</i>
2/21 Chp. 2 & 9	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. <i>Selection of case studies and initial meeting.</i>
2/28 Chps 15 & 16	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 <i>Case Study Outlines and Roles due</i>

3/6	No class “Spring Break”
3/13 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)
3/20 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
3/27 Chp 18	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
4/3 Chps. 19, 20,21,22,23	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
4/10 Various	11a. Environmental Justice: Katrina, Flint and local concerns (LaTasha Peele, PE) Discussion of the historic context for environmental justice concerns in US and how address current concerns in impacted communities 11b. 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
4/17	12. Student Presentations Presentations by groups on evaluation of case studies with analysis and recommendations for scaling up and program improvements.
4/24 Various	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
5/1 Various	14. Sustainable Water & Wastewater in Urban India (Dr. Arun Deb)_Review examples of maximization of local resources, community engagement to advance equitable development. Review for Final Exam.
5/8	Take Home Final Exam

Supplemental Texts and webpages:

“Engineering For Sustainable Human Development - A Guide to Successful Small-Scale Community Projects”_by Bernard Amadei, ASCE Press, 2014

“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>

“Engineering for Sustainable Development: Guiding Principles”. The Royal Academy of Engineering, 2005. Available online: www.engc.org.uk/engcdocuments/internet/website/Engineering%20for%20Sustainable%20Development,%20Royal%20Academy%20of%20Engineering.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>

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.