Ecological Risk Assessment

Syllabus of August 9, 2021

EAS 523-01 (2 credits) Section 001 "in-person" Section 002 "remote"

Tues 5:30 – 6:30

Fall 2021

Remote Office Hours flexible – schedule via email for Zoom discussion

Prof. Allen Burton

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Class Overview & Outcomes

The Teaching Goals of all my classes are:

- Develop an awareness of primary issues: interdisciplinary ecosystem elements, chemical/physical/biological stressors, sociological and economic drivers, regional political drivers;
- Understand a systems approach of issues and their qualitative interactions and relationships;
- Understand the trigger points of systems that initiate change;
- Developing solutions and rank them using Weight-of-Evidence based approaches;
- Understanding of what is involved in solution facilitation along with associated impediments; and how to rank them in a strategic manner;
- Maintaining improving action inertia with adaptation; and
- Understand how to evaluate outcomes: Is positive change occurring? Is it sustainable? How can it be improved/optimized? How can impediments be minimized/circumvented?
- *Understand and commit to always continuing to grow in knowledge and wisdom – throughout your life – to stay abreast of the interdisciplinary sciences and using that knowledge to improve life and ecosystems.*

Learning outcomes of this course include:

- Understand how ecological risk is determined
- Understand the role of multiple stressors in ecosystem impairments
- Learn how to make science-based decisions via weight-of-evidence approaches to better manage, protect and restore waters.
- Develop an appreciation for stakeholder and environmental justice issues

This course introduces ecological risk assessment (ERA), describing the basics of how ERAs are most often conducted by governments and environmental consultants. A wide range of assessment approaches exist dealing for small to mega-sites exceeding $1billion in remediation costs. Case study examples will demonstrate the state-of-the-practice and new approaches that decrease uncertainty associated with the ERA process. The important linkage of ERA issues to decision-making in the risk management process will be emphasized, with real-world, high visibility case studies discussed by guest speakers.

In addition, we will include a Michigan Sustainability Class case study. Our case example will focus on Ann Arbor's 1,4 dioxane groundwater pollution plume caused by Gelman industry. Students will "enter" the immersive Gelman case environment as an assignment (readings, watching videos, listening to interviews). The in-class case discussion offers a chance to digest and debate elements of the case. We will consider the environmental, human health, and political complexities of this site, which are common to most contaminated sites.

The course reviews the ERA and hazard assessment processes used to determine 1) whether contaminated sites should be cleaned-up, 2) safe levels for chemicals in the environment, 3) if other non-chemical stressors are a concern, and, 4) thereby, provide for sound environmental management applications. This approach is primarily used in Developed Countries, but we will discuss how perceptions and approaches vary in Developing Countries.

In addition to the Learning Outcomes above, the primary objectives of the course are to build competency in assessing stressors in ecosystems and thereby become more effective in dealing with real-world issues commonly encountered. This bridges process, science and practice throughout the ERA process and often intertwines with environmental injustices. This should result in the ability to recognize quality ERAs and identify ways to strengthen the linkage between an accurate ERA and management options. *Students in this course will learn how to both recognize an ERA that is strong and scientifically-grounded vs. one that is laden with scientific uncertainties that confound litigation settlements and decision making.* We will describe the state-of-the-practice including its limitations, realities and ways to improve ERAs along with remediation efforts in freshwaters and marine near-coastal areas.

Prerequisite requirements

Ecology and freshman chemistry courses are helpful - but not required.

Course logistics

The class will consist of two separate formats using in-person lectures (Section 1) and also remote learning (Section 2) using live recorded lectures. The recorded lectures will include the class discussion during the scheduled class time. There will be assigned readings and videos in addition to the lectures. All class materials are on Canvas for access by enrolled students. Announcements and assignments will be communicated via Canvas and lectures. I will include non-video Powerpoint files for both Sections to support in-person and recorded lectures. My Office Hours are flexible and I am available to meet with you on Zoom during most times between 8:00 and 6:00 M-F, as long as we preschedule via email

Grading

- **BONUS:** Up to 10 points from **paper summaries** (150-200 words). Each summary is worth 1 point. Papers should be journal articles or report chapters from the reading material folders on Canvas, unless pre-approved by Dr. Burton.

- **Lecture summary questions** Each lecture will have 4 short answer questions for submission weekly. 4 points x 10 wks) **40 points**
- **Class project** (described below) **40** points
- **Participation** (via Zoom discussion period, Online Chat or email with Burton, or submitting current relevant news links) **20** points

Reading and viewing materials

Dozens of recent (2020-2021) journal papers, chapters, reports, videos and news releases are on Canvas to support the lectures and provide options for your reading. Keystone papers and reports from prior to 2020 are also included. These will be amended *each week* from current materials I find or you provide me. The papers cover all aspects of ecological risk assessment, including physical, chemical and biological stressor that impair ecosystems, human-related stressors, impacts on organisms, adaptive management, solutions and good news.

Class Project Description:

Each student (or pair of students) will prepare Powerpoint and video presentations (which may or may not be shared with the class) addressing the class problem assignment. This will be presented as a video recording by the student and submitted as both ppt and mp4 files. The Powerpoint should be 30 slides maximum and video presentation 15 mins maximum. *Exceeding these limits will reduce the grade by one letter*.

Design an ERA proposal to study an existing or hypothetical contaminated site and present as a Powerpoint presentation with a recorded video (such as my Zoom lectures). Assume your ERA project proposal is being submitted to the State EPA for approval, so it must follow the U.S. EPA paradigm structure: *Problem Formulation, Analysis Phase (Exposure characterization + Effects characterization, and Risk Characterization*.

Do not use real site data, as you are proposing to study the site. Simply describe the site and how you envision characterizing exposure and effects, then determining the ecological risk. List the chemicals present (e.g., Auto-refinishing plant as metals, degreasers, solvents, PAHs) – as Chemicals-of-Concern (COCs) and organisms (ecological receptors) that are likely to be present (or should be present). These should be presented in your Conceptual Model. Describe how you are defining the "Reference Condition" for your determination of biological impairments. Is it two or three nearby streams that are uncontaminated? What is the whole watershed is human-dominated and impaired?

As an add-on component of this proposal (Appendix A) – describe a process for ranking the physical and chemical stressors that likely exist and are causing biological impairments, such as altered flow, degraded habitat, PFAS, metals, etc. You are ranking based on which of the stressors likely cause the greatest impairments to fish and benthic populations and communities. Explain your ranking rationale.

Project Grading: 30 points total, based on 1) Following suggested EPA framework; 2) Conceptual model detail; 3) Sampling design to characterize exposure; 4) Design of effects characterization; 5) How exposure and effects results will be used to determine risk; and 5) Role of stakeholders in the process.

- Presentation files (ppt and video) must be submitted no later than **November Monday 5:00 pm November 29th**. Submit via Canvas under "Assignments".
- A subset of projects will be randomly selected for classes. Those selected must be present to lead the discussion of their project. Those projects selected will be awarded 5 bonus points.
- All materials must be submitted no later than the official UM final exam date, as ppt and mp4 files to Canvas.

* *As graduate students, you understand the more you put into a course, the more you increase your expertise and benefit professionally. Materials submitted will be checked for plagiarism; but, other than that, the learning is up to you.*

Policy Statements Mandated by UM

For the safety of all students, faculty, and staff on campus, it is important for each of us to be mindful of safety measures that have been required for our protection. By returning to campus, you have acknowledged your responsibility for protecting the collective health of our community. Your participation in this course on an in-person basis is conditional upon your adherence to all safety measures mandated by the State of Michigan and the University, including maintaining physical distancing of six feet from others, and properly wearing a face covering in class. Other applicable safety measures may be described in the Wolverine Culture of Care, the University's Face Covering Policy for COVID-19 and SEAS Questions & Concerns document. Your ability to participate in this course in-person as well as your grade may be impacted by failure to comply with campus safety measures. Individuals seeking to request an accommodation related to the face covering requirement under the Americans with Disabilities Act should contact the Office for Institutional Equity. If you are unable or unwilling to adhere to these safety measures while in a face-to-face class setting, you will be required to participate on a remote basis (if available) or to disenroll from the class. I also encourage you to review the Statement of Students Rights and Responsibilities and check-in with the Office of Academic Affairs Director to navigate support and resources for you.

You may find the latest UM information on COVID-19 alerts and policies for UM at the Maize and Blueprint website. I will adapt the course as needed due to the COVID-19 outbreak and support each student's needs. All assignments and recordings are available to enrolled students on Canvas. Note UM's Recording and Privacy Concerns FAQ. "Students are prohibited from recording/distributing any Class Activity without written permission from the instructor, except as necessary as part of approved accommodations for students with disabilities. Any approved recordings may only be used for the student's own private use." Students will not be recorded during Zoom discussions and presentations.

Chronological Lecture Topics

Class Topic	***Other***
1. Class overview. What is risk?	
2. U.S. EPA ERA process overview.	*Risk Bite 4 videos (see below)*
3. Problem Formulation & Exposure Characterization	ECO Update: *"Selecting and using Reference information"*
4. Reference Condition	
5. Exposure Characterization	
6. Exposure and Effects Characterizations	
6. RA examples from government & industry	Dr. Steve Brown
7. Effect Characterization	*ECO Updates: Field Studies & Tox testing*
8. Ann Arbor dioxane plume: Health risk?	*MSC web site and* Risk Bite: How dangerous is 1-4 Dioxane
9. Effects and Risk Characterization	
10-13. Student presentations and discussions	

Required Reading Highlighted + Useful future reference information, Additional resources will be provided in Canvas.

Risk Bites: 4 short videos: What the heck is dose response? Part 2. Fear of the Unknown; Part 3. Dread; Hazard vs. Risk. https://www.youtube.com/user/riskbites

Dioxane Plume Pollution (Gelman Case Study in "Gala" with the Michigan Sustainability Classes.
https://www.learngala.com/magic_link?key=_30-gdkC0keOiFH4DghzUA
If you do not have a Gala account you can "Sign in with Google" and enter your UM account.

ECO Update: Selecting and using reference information in Superfund Ecological Risk Assessments
https://www.epa.gov/sites/production/files/2015-09/documents/v2no4.pdf

ECO Update: Field studies for ecological risk assessment.
https://www.epa.gov/sites/production/files/2015-09/documents/v2no3.pdf

ECO Update: Using toxicity tests in ecological risk assessment.
https://www.epa.gov/sites/production/files/2015-09/documents/v2no1.pdf

U.S. EPA ECO Update Bulletin Series: https://www.epa.gov/risk/eco-update-bulletin-series

U.S. EPA Ecological Risk Assessment Guidance. 1998
http://www.epa.gov/sites/production/files/2014-11/documents/eco_risk_assessment1998.pdf

U.S. EPA Ecological Risk Assessment Home Page
https://www.epa.gov/risk/ecological-risk-assessment

Great Lakes Areas of Concern
https://www.epa.gov/great-lakes-aocs

U.S. EPA Rapid Bioassessment Protocols for stream fish, benthic macroinvertebrates and periphyton (also includes habitat assessment and physicochemical parameters in Chp 5).
https://www3.epa.gov/region1/npdes/merrimackstation/pdfs/ar/AR-1164.pdf

Revised methods for characterizing stream habitat in the national water-quality assessment program. USGS Water-Resources Investigations Report 98-4052.
https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf

Ohio EPA Methods for assessing habitat in flowing waters: Using the Qualitative Habitat Evaluation Index (QHEI)
https://pubs.usgs.gov/wri/wri984052/pdf/wri98-4052.pdf

U.S. EPA. 2016. Stressor identification evaluation guidance.
https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=20685

U.S. EPA 2001. Methods for collection, storage and manipulation of sediments for chemical and toxicological analyses: Technical Manual. EPA-823-8-01-002

U.S. EPA, 2012. Equilibrium partitioning benchmarks (ESBs) for the protection of benthic organisms; procedures for the determination of the freely dissolved interstitial water.

U.S. EPA. 2005. Procedures for derivation of equilibrium partitioning sediment benchmarks (ESBS) for the protection of benthic organisms: Metal mixtures (Cadmium, copper, lead, nickel, silver, and zinc).
https://nepis.epa.gov/Exe/ZyPURL.cgi?Dockey=P1008GZA.TXT

Bately, G and S. Simpson. 2016. Sediment Quality Assessment: A Practical Guide
https://books.google.se/books?isbn=1486303854

U.S. EPA. Region V. Ecological Risk Assessment Sediment Quality Benchmarks.
https://archive.epa.gov/reg5sfun/ecology/web/html/screeningbench.html

NOAA. Screening Quick Reference Tables (SQuiRT). Summary of water, soil and sediment chemical guidelines. https://repository.library.noaa.gov/view/noaa/9327