Ecological Risk Assessment Syllabus

EAS 523-01 (2 credits) Section 001 “in-person” and “remote” Section 003.
Tues 5:30 – 7:10 Fall 2022
June 21, 2022 Version
In-Office Hours T, W, Th 4:00 – 5:15; Remote Office Hours flexible – schedule via email for Zoom

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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 so as 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.

In addition, we will include a Michigan Sustainability Class case study. Our case example focuses on Ann Arbor’s ongoing 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. Topics will continually address how to conduct a high quality assessment with reduced uncertainties for decision-makers.

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. Frequently encountered Environmental Justice issues will also be discussed. 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 001) and also remote participation during class (Section 003). All lectures are recorded for later viewing. 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. In addition, there will be discussions on Canvas on topics students suggest. I will spend the beginning of each class discussing the previous week's news with 10 minutes of discussion. All class materials, including lecture videos 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 each lecture, each week. My Office Hours are T, W, Th from 4:00 – 5:15 and also flexible over Zoom between 8:00 and 6:00 M-F, as long as prescheduled via email.

Grading

Bonus: Up to 10 points from approved paper and webinar summaries (150-200 words). Each summary is worth 1 point (10 max). Papers should be journal articles or report chapters from the reading material folders on Canvas, unless pre-approved by Dr. Burton. Environmental webinars may also be appropriate to summarize.
In addition, students may volunteer to give an in-person presentation of their project during the last 2 lecture periods. Volunteers will receive 5 bonus points.

Lecture summary questions: Each lecture will have 4 short answer questions. (4 points x 10 wks). **40 points.**

Class project (described below) **50 points** (Grading rubric: Format 10, Key elements 10, Scientific certainty 10, Uncertainties 10). Due December 9, 5:00 pm. Penalty for late submission is one letter grade per day.

Participation (activity on Canvas, class discussion, Canvas Discussions, Online Chat or email with Burton, or submitting current relevant news links) **10 points**

Total points possible for semester = 100 point

Recommended readings and videos

Dozens of recent (2020-2022) journal papers, chapters, reports, videos and news releases are on Canvas to support the lectures and provide options for your reading. *Recent keystone papers and reports are also included*. These will be amended each week from current materials. 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 a Powerpoint file addressing the class problem assignment. This will be submitted as a ppt file. The Powerpoint should be 30 slides maximum. Students that wish to volunteer to present their projects in class during the last 2 class periods receive 5 bonus points. For students in pairs – each will receive the same grade. Presentations **will not be graded for style**. My in-class critique of the presentations will help others finalize their projects and the presenters may make changes to their powerpoint prior to final submission.

Design an ERA proposal to study an ***existing or hypothetical*** contaminated site. 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.

There is no need to use real site data, as **you are only proposing** to study the site. Simply describe the site and its apparent Chemicals of Concern (COCs) and how you envision characterizing exposure and effects, then determining ecological risk. List the chemicals present (e.g., Auto-refinishing plant as metals, degreasers, solvents, PAHs) as 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 your reference if the whole watershed is human-dominated and impaired?

Project Grading Rubric: 50 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; 5) Role of stakeholders and environmental justice in the process; and 6) Proposed stressor ranking approach. **Examples of student projects from 2021 will be provided to assist your proposal.**

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.

Chronological Lecture Topics

	Class topic	Other
1.	Class overview. What is risk	

2. US EPA ERA process overview Risk Bite 4 videos (see below)
3. Problem Formulation and Exposure Characterization ECOUpdate "Selecting and using reference information"
4. Reference Condition and Exposure Characterization
5. Exposure and Effects Characterization
6. RA examples from government & industry Dr. Steve Brown
7. Effect Characterization ECO Updates: Field studies and toxicity testing
8. Ann Arbor dioxane plume: Health risk? MSC web site and Risk Bite: How dangerous is 1,4 Dioxane

9 and 10. Effects and Risk Characterization

11-12. Student presentations and discussions

Useful reference information. Additional resources provided in Canvas.

1. 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
2. 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.
3. 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
4. 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
5. 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
6. U.S. EPA. 2016. Stressor identification evaluation guidance. https://cfpub.epa.gov/ncea/risk/recordisplay.cfm?deid=20685
7. U.S. EPA 2001. Methods for collection, storage and manipulation of sediments for chemical and toxicological analyses: Technical Manual. EPA-823-8-01-002
8. U.S. EPA, 2012. Equilibrium partitioning benchmarks (ESBs) for the protection of benthic organisms; procedures for the determination of the freely dissolved interstitial water.
9. 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
10. ECO Update: Using toxicity tests in ecological risk assessment https://www.epa.gov/sites/production/files/2015-09/documents/v2no1.pdf
11. U.S. EPA ECO Update Bulletin Series: https://www.epa.gov/risk/eco-update-bulletin-series
12. U.S. EPA Ecological Risk Assessment Guidance. 1998 http://www.epa.gov/sites/production/files/2014-11/documents/eco_risk_assessment1998.pdf

13. U.S. EPA Ecological Risk Assessment Home Page https://www.epa.gov/risk/ecological-risk-assessment
14. Great Lakes Areas of Concern https://www.epa.gov/great-lakes-aocs
15. Bately, G and S. Simpson. 2016. Sediment Quality Assessment: A Practical Guide https://books.google.se/books?isbn=1486303854
16. U.S. EPA. Region V. Ecological Risk Assessment Sediment Quality Benchmarks. https://archive.epa.gov/reg5sfun/ecology/web/html/screeningbench.html
17. NOAA. Screening Quick Reference Tables (SQuiRT). Summary of water, soil and sediment chemical guidelines. https://repository.library.noaa.gov/view/noaa/9327