Winter 2025

Environmental Geotechnics

Department of Civil and Environmental Engineering

ENVE 4001 A1

Teaching Team

Instructor:

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EDC 4532

Office hours: Tue 11:30am – 12:30pm

TA(s): Information will be posted on Brightspace

Course Description and requirements

1) Course schedule

*Please refer to the Public Class Schedule for the most recent information

2) Course description

Landfill design; hydrogeologic principles, water budget, landfill liners, geosynthetics, landfill covers, quality control/quality assurance, clay leachate interaction, composite liner design and leak detection. Landfill operation, maintenance and monitoring. Case studies of landfill design and performance. Geotechnical design of environmental control and containment systems.

3) Precluded courses

Also offered at the graduate level, with different requirements, as ENVE 5201/EVG 7201, for which additional credit is precluded.

4) Prerequisites and recommended knowledge

Prerequisite(s): ENVE 3004, CIVE 3208.

5) Learning Outcomes

a) Overall design of landfills
b) Liner structure, composition and geochemical evaluation
c) Flow through liners

d) Computer-aided 2D flow calculations
e) Cover design
f) Waste settlement due to self-weight, creep and biochemical degradation
g) Limit equilibrium slope stability of landfills, including computer-aided calculations of FoS

6) Graduate Attributes

The Canadian Engineering Accreditation Board (CEAB) requires graduates of undergraduate engineering programs to possess 12 attributes. Courses in all four years of our programs evaluate students' progress towards acquiring these attributes. Aggregate data (typically, the data collected in all sections of a course during an academic year) is used for accreditation purposes and to guide improvements to our programs. Some of the assessments used to measure GAs may also contribute to final grades; however, the GA measurements for individual students are not used to determine the student's year-to-year progression through the program or eligibility to graduate. This following list provides the GAs that will be measured in this course, along with the Learning Outcomes that are intended to develop abilities related to these attributes.

GA - Indicator	Assessment Tool
n/a	

For information on GAs and continual curriculum improvement, visit the Accreditation section of Engineers Canada website.

7) Accreditation Units

Math	Natural Science	Complementary Studies	Engineering Science	Engineering Design
-	-	-	-	-

8) Text book(s)/Learning Materials and their costs

Mandatory materials:

1. Clayey Barrier Systems for Waste Disposal Facilities by Rowe, R. Kerry, Quigley, Robert M., Brachman, Richard W. I., and Booker, John R., 2nd ed., 2004. Spon Press, Taylor & Francis Group, London and New York City, 587 pp., 978-0367863722.

Cost: CAD 110.49 on Amazon.ca: https://www.amazon.ca/Barrier-Systems-Waste-Disposal-Facilities/dp/0367863723

2. Lecture notes (Softcopy on Brightspace; free to use).
3. Reading materials posted on Brightspace (free to use).

Optional Textbooks:

1. Solid waste landfill engineering and design by E.A. McBean, F.A. Rovers, G.J. Farquhar. Prentice Hall 1995.

2. Design, construction and monitoring of landfills by A. Bagchi. Wiley and Sons, Second Edition, 1994.

Additional References

- Solid Waste Landfill Engineering and Design, Edward A. McBean, Frank A. Rovers and Grahame J. Farquhar, Prentice-Hall, 1995.
- Design, Construction, and Monitoring of Landfills, Second Edition, A. Bagchi, John Wiley & Sons, 1994.
- Waste Containment Systems, Waste Stabilization, and Landfills - Design and Evaluation, Hari D. Sharma and Sangeeta P. Lewis, John Wiley & Sons, 1994

9) Topics and tentative plan

Lecture Date:	Lecture Topic:	Tutorial:	Assignments due on the day of the Lecture at 4pm:
January 14	COURSE REVIEW AND OBJECTIVES INTRODUCTION LEGISLATION		
January 21	GEOTECHNICAL PROPERTIES OF WASTE	Tutorial #1: geotechnical properties of waste	
January 28	HYDROGEOLOGIC PRINCIPLES 1/3 • 1D flow through porous media • Review of 2D flow	Tutorial #2: 1D flow through porous media	Assignment 1: geotechnical properties of waste
February 4	HYDROGEOLOGIC PRINCIPLES 2/3 • Water budget • Leachate generation	Tutorial 3: 2D seepage modelling (PLAXIS LE)	Assignment #2: 1D flow through porous media February 1: Paper abstract must be submitted in the assignment box
February 11	HYDROGEOLOGIC PRINCIPLES 3/3 • Contaminant transport 1 • Contaminant transport 2	Tutorial #4: contaminant transport	Assignment #3: 2D seepage modelling (PLAXIS LE)
February 18	WINTER BREAK		
February 25	LANDFILL DESIGN • Site selection		
March 4	LANDFILL LINERS • Compacted clay liners • Geosynthetic Liners • Geomembrane Liners		Assignment #4: contaminant transport
March 11	LANDFILL COVERS • Unsaturated flow • Cover design	Tutorial #5: unsaturated flow	
March 18	LANDFILL OPERATION, MAINTENANCE AND MONITORING • Leachate detection and monitoring • Settlement and stability		Assignment #5: unsaturated flow
March 15	LANDFILL MECHANICAL STABILITY • Settlement • Stability	Tutorial #6: 2D limit equilibrium stability of landfills (PLAXIS LE)	
April 1	Group Presentations		Assignment #6: landfill settlement and stability
April 8	Group Presentations		Group Report

Final examination will be set by Examination Services.

10) Evaluation and marking scheme

Assignments & Tutorials (6 assignments, grade equally distributed):	25%
Group Presentation and Report:	25%
Final Examination:	50%

a) Final Examination

i) **Final exams are for evaluation purpose and will not be returned to students.**

ii) Closed book; engineering calculator and student-prepared formula sheet allowed; 50% minimum grade to pass course.

iii) Final Exam Weight: 50%

ii) Deferred Final Examinations: Students who are unable to write the final examination because of extenuating circumstances, as defined in the Academic Consideration Policy, may apply for accommodation by contacting the Registrar's office. Consult the Section 4.3 of the University Calendar.

b) Exam format and e-proctoring statement

The final exam will be in-person only.

c) Additional requirements

Students who claim illness, injury, or other extraordinary circumstances beyond their control as a reason for missed term work are held responsible for immediately informing the instructor concerned and for alternate arrangements with the instructor and in all cases, this must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 4.4 of the University Calendar.

Students missing deadlines or exams due to an illness must submit a Self-declaration for Academic Considerations Form to the instructor within three (3) days. Accommodations cannot be granted more than 72 hours after the deadlines. For final exams, students must submit the self-declaration form in addition to a deferral application (carleton.ca/registrar/deferral) and submit both forms to the Registrar's Office no later than 3 days after the scheduled examination or take-home due date. If an absence from an evaluation is deemed justified:

1) Assignments: the weight of a justified missed assignment will be transferred onto the remaining assignments.

2) Final exam: the student will have to consult the academic secretariat of the faculty for the procedure to follow.

d) Term work late submission policy

Assignment and project submissions that are late by less than 48 hours will be deducted 20% of the grade. Assignments and project submissions late by more than 48 hours will receive a grade of 0%. If

assignments and/or project submissions are late due to illness, their weight can be transferred to the final examination upon receipt of appropriate documentation.

e) Deferred term work and self declaration

Students who claim extenuating circumstances defined in the Academic Consideration Policy, as a reason for missed term work are held responsible for immediately informing the instructor concerned and for making alternate arrangements with the instructor and in all cases. This must occur no later than three (3) days after the term work was due. The alternate arrangement must be made before the last day of classes in the term as published in the academic schedule. Consult Section 4.4 of the University Calendar.

11) Academic dates

Students should be aware of the academic dates (e.g. last day for academic withdrawal) posted on the Registrar's office web site https://carleton.ca/registrar/registration/dates/academic-dates/

Academic Integrity and Plagiarism

a) Please consult the Faculty of Engineering and Design information page about the Academic Integrity policy and our procedures: https://carleton.ca/engineering-design/current-students/fed-academic-integrity Violations of the Academic Integrity Policy will result in the assignment of a penalty such as reduced grades, the assignment of an F in a course, a suspension or, expulsion.

b) One of the main objectives of the Academic Integrity Policy is to ensure that **the work you submit is your own.** As a result, it is important to write your own solutions when studying and preparing with other students and to avoid plagiarism in your submissions. The University Academic Integrity Policy defines plagiarism as "presenting, whether intentionally or not, the ideas, expression of ideas or work of others as one's own." This includes reproducing or paraphrasing portions of someone else's published or unpublished material, regardless of the source, and presenting these as one's own without proper citation or reference to the original source.

Examples of violations of the policy include, but are not limited to:

- any submission prepared in whole or in part, by someone else or by generative AI;
- any submission prepared in whole or in part for another course or purpose (e.g., conference or journal paper, previous thesis or project in another class)
- using another's data or research findings without appropriate acknowledgement;
- submitting a computer program developed in whole or in part by someone else, with or without modifications, as one's own; and
- failing to acknowledge sources of information through the use of proper citations when using another's work and/or failing to use quotations marks.

Copyright

The materials (including the course outline, slides, posted notes, videos, labs, projects, assignments, quizzes, exams, and solutions) created for this course are intended for personal use only. They may not be reproduced, redistributed, or transmitted in any form or by any means—electronic, mechanical, photocopying, recording, or otherwise—without written permission from the author(s), both during and after the semester.

Learning and Working Environment

The University and all members of the University community share responsibility for ensuring that the University's educational, work and living environments are free from discrimination and harassment. Should you have concerns about harassment or discrimination relating to your age, ancestry, citizenship, colour, creed (religion), disability, ethnic origin, family status, gender expression, gender identity, marital status, place of origin, race, sex (including pregnancy), or sexual orientation, please contact the Department of Equity and Inclusive Communities at equity@carleton.ca
We will strive to create an environment of mutual respect for all through equity, diversity, and inclusion within this course. The space which we work in will be safe for everyone. Please be considerate of everyone's personal beliefs, choices, and opinions.

Academic Accommodations

You may need special arrangements to meet your academic obligations during the term. For an accommodation request the processes are as follows:

Academic Accommodations for Students with Disabilities: The Paul Menton Centre for Students with Disabilities (PMC) provides services to students with Learning Disabilities (LD), psychiatric/mental health disabilities, Attention Deficit Hyperactivity Disorder (ADHD), Autism Spectrum Disorders (ASD), chronic medical conditions, and impairments in mobility, hearing, and vision. If you have a disability requiring academic accommodations in this course, please contact PMC at **613-520-6608** or pmc@carleton.ca .

You should request your academic accommodations in the Ventus Student Portal, for each course at the beginning of every term. For in-term tests or midterms, please request accommodations at least two (2) weeks before the first test or midterm. Please consult the PMC website for the deadline to request accommodations for the formally-scheduled exam (if applicable).

Accommodation for Student Activities: Carleton University recognizes the substantial benefits, both to the individual student and for the university, that result from a student participating in activities beyond the classroom experience. Reasonable accommodation must be provided to students who compete or perform at the national or international level. Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, see

the Senate Policy on Accommodation for Student Activities (PDF).

Pregnancy Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF).

Religious Obligation: Please contact your instructor with any requests for academic accommodation during the first two weeks of class, or as soon as possible after the need for accommodation is known to exist. For more details, please review the Student Guide to Academic Accommodation (PDF).

Survivors of Sexual Violence: As a community, Carleton University is committed to maintaining a positive learning, working and living environment where sexual violence will not be tolerated, and where survivors are supported through academic accommodations as per Carleton's Sexual Violence Policy. For more information about the services available at the university and to obtain information about sexual violence and/or support, visit the Sexual Violence Prevention & Survivor Support.

Engineering Academic Advising

The Engineering Academic Support Service assists undergraduate engineering students with course selection, registration, and learning support from first-year through to graduation.
Academic Advisors Contact can be found here: https://carleton.ca/engineering-design/current-students/undergrad-academic-support/undergraduate-advisors/.

Student Mental Health and Wellness

As a university student you may experience a range of mental health challenges that can significantly impact your academic success and overall well-being. Carleton's **Wellness Services Navigator** is designed to help students connect with mental health and wellness resources.
If you need to talk to someone from the department for more information and support with connecting to resources, you can contact the following faculty members, depending on your program. Or contact the department at orCEEUGChair@cunet.carleton.ca.

ACSE: Prof. Elie Azar
Email: Elie.Azar@carleton.ca, Office: 3432 Mackenzie

CIVE: Prof. Heng Khoo
Email: heng.khoo@carleton.ca, Office: 3364 Mackenzie

ENVE: Prof. Shoeleh Shams
Email: shoelehshams@cunet.Carleton.ca, Office: 4242 Mackenzie

Here is a list of on-campus and off-campus recourses:

1. **Carleton's Wellness Desk**: Located at 204A MacOdrum Library, is a space for students to learn about resources, connect with our Wellness Coordinator, and decompress during stressful times of the year. You can pop into the Wellness Desk any time during its hours of operation – no appointments necessary! https://wellness.carleton.ca/mental-health/wellness-desk/

2. **Carleton's Health and Counselling Services:** To book an appointment contact the main clinic by calling (613) 520-6674. If urgent, let the Patient Care Coordinator know or go in person to the main clinic (2500 Carleton Technology and Training Centre Building) and indicate that they are in crisis and need to speak to someone right away. https://carleton.ca/health/

3. **Residence Counselling and Wellness Service:** Counselling services specifically for students in residence. https://carleton.ca/health/residence-counselling/

4. **Therapy Dogs:** Carleton's therapy dogs are around campus with their owners (who are Carleton University staff and faculty) to comfort and provide support to help you thrive as a university student. https://carleton.ca/wellness/dogs/

5. Emergencies and Crisis and Emergency Numbers

6. **Good2Talk (1-866-925-5454):** Good2Talk is a free, confidential helpline providing professional counselling and information and referrals for mental health, addictions and well-being to post-secondary students in Ontario, 24/7/36 https://good2talk.ca/

7. **Empower Me:** Undergraduate students have access to free counselling services in the community through Empower Me, either in person, by telephone, video-counselling or e-counselling. **This free service is accessible 24/7, 365 days per year.** Call **1-844-741-6389 (toll free)** to make an appointment with a counsellor in the community. More information is available https://students.carleton.ca/services/empower-me-counselling-services/

8. **The Walk-In Counselling Clinic (off-campus community resource):** The walk-in Counselling Clinic have offices in various locations across Ottawa and the greater Champlain region that are open 7 days a week. Individuals will be assisted, with no appointment, on a first-come, first-serve basis during the Walk-in Counselling Clinic hours. The Walk-in Counselling Clinic **offers services in many languages** and is free and confidential. More information can be found at: https://walkincounselling.com/

9. **Distress Centre of Ottawa and Region**: Available 10am-11pm, 7 days/week, 365 days/year. **Distress Line:** 613-238-3311, **Crisis Line:** 613-722-6914 or 1-866-996-0991, **Text:** 343-306-5550. https://www.dcottawa.on.ca/

10. **Distress and Crisis Ontario**, Available for chat 2 pm – 2 am EST. https://www.dcontario.org/

11. **BounceBack Ontario (Toll-Free: 1-866-345-0224)** is a free skill-building program managed by the Canadian Mental Health Association (CMHA). It is designed to help adults and youth 15+ manage low mood, mild to moderate depression and anxiety, stress or worry. Delivered over the phone with a coach and through online videos, you will get access to tools that will support you on your path to mental wellness. https://bouncebackontario.ca/.