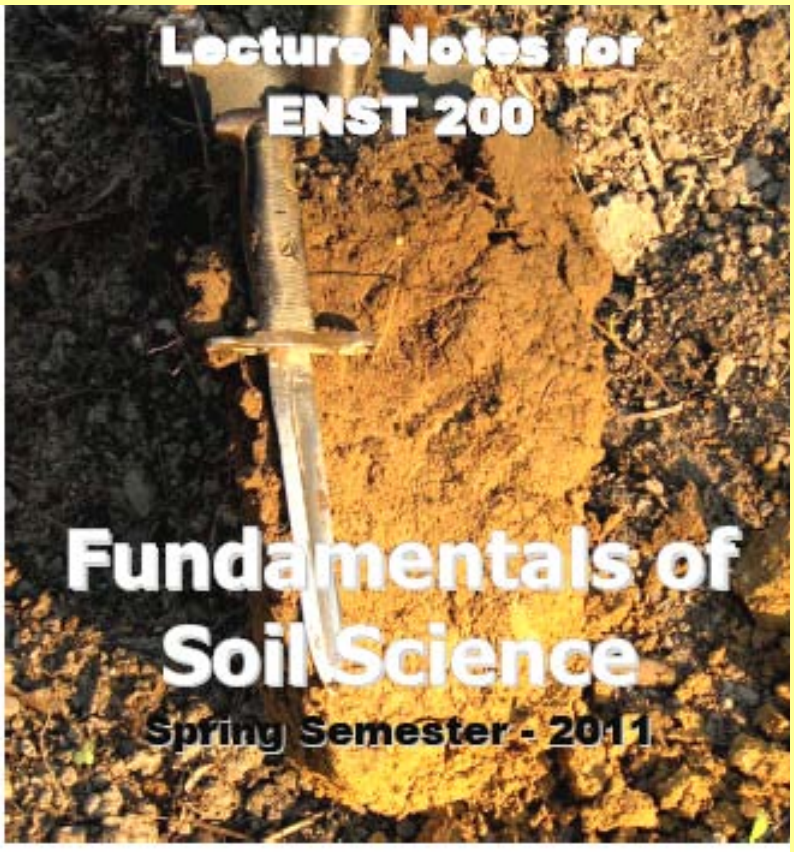
ENST 200 Syllabus: Fundamentals of Soil Science

NOTE TO ENROLLED STUDENTS:
Buy this course packet (cover shown below) before coming to lecture – available ONLY at Maryland Book Exchange!



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ENST 200: A Note to Students

Welcome to ENST 200 and the world of soils! Soils are not only beautiful to look at, fascinating to study, and challenging to understand, they are also critically important to all living things, ourselves included. Everyday our life is made possible by the functions that soils perform in our environment. This fact is just as true today, as ever, but is less clearly perceived by the majority of people who no longer work directly with the land. I hope this course will be an enjoyable and stimulating experience that opens up a part of your world to which, perhaps, you have previously given little thought.

The lecture outline packet (available at the Maryland Book Exchange) contains course information as well as black and white versions of many of the power point slides you will see in class. I put this booklet together in response to suggestions from students who told me that they had a hard time getting everything down in their lecture notes during class. Furthermore, as you have probably experienced, if all your attention is directed toward note taking, you can't pay much attention or react to what is being said. On the other hand, if the entire lecture is handed out in written form so that there is no need to write down anything, it is easy to become disengaged from the material. This booklet is therefore a compromise. Some of the lecture materials are reproduced, often in skeletal form, so that note taking will be easier and you can get an advance idea of what the lecture will cover. However, you will still need to flesh out the diagrams and fill in the gaps with notes during class.

Not all lectures are covered to an equal extent in the booklet, and a few might not be covered at all. The enclosed lecture schedule gives the topics and readings for each lecture. Of course, circumstances may subject it to change (except for the dates of exams). The material in the lecture notes booklet and that presented in class are meant to complement readings assigned from the textbook. The textbook will give you a comprehensive overview, while in class we will be limited mainly to the highlights.

The soil is a complex system; every aspect of it is connected to every other. As the semester progresses, these connections should become increasingly clear. We will focus on understanding the fundamental physical, biological and chemical principles that explain how soils work. We will avoid memorization as much as possible, but some terminology will have to be learned in order for us to communicate. We will study the soil as a natural system and consider applications of soils concepts in many locations and professions from farming to engineering.

As with so much in life, you will be likely to benefit from this course in proportion to what you put into it. I do hope you will participate fully and enjoy!

- RRW

Opportunities to Gain Research Experience:

Every year, I work with one or two students who participate in my research as Maryland Student Researchers, under the program administered by the Office of the Dean for Undergraduate Studies. This program introduces undergraduates to the discipline and rewards of scholarly research. Students spend four to six hours a week working with or under the direction of a faculty mentor on that faculty member's own research and receive an Undergraduate Research Assistant notation on their transcript at the conclusion of the assistantship. **See detail at:**
http://www.ugresearch.umd.edu/programs/msr.html

The University of Maryland also has a Senior Summer Research Scholars program that pays $3,000 for doing a research project with a professor during the summer. This award requires a written proposal and is quite competitive. F**or Summer 2011 the anticipated date is mid-late March, 2011.** Students who will have senior status (86 or more credits completed) following the completion of the Spring semester and who will be enrolled at Maryland as seniors in the Fall semester are eligible to apply. Students who are awarded the Senior Summer Scholars grant earn a competitive edge when applying for graduate study, fellowships, and other awards. Many of the Scholars turn their research into an independent study or honors thesis during their senior year.

Details at: http://www.ugresearch.umd.edu/programs/sssreq.html

See me *early* if you are interested in applying for this.

My research examines how land-use management and plant growth affects various aspects of soil quality (especially organic matter, structure and microbial ecology) and water quality (especially nitrate contamination and nutrient eutrophication).

Interested in undergraduate research or Senior summer Research?

Visit or e-mail me (rweil@umd.edu) about your interest and get appropriate forms online.

Information about teachers and textbooks

For ENST 200 -- Spring 2011

Professor:

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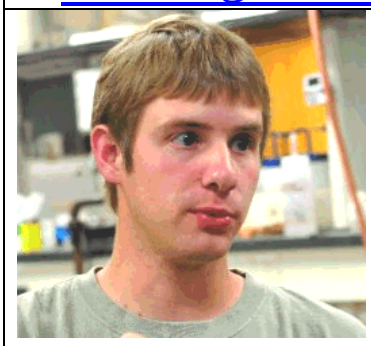
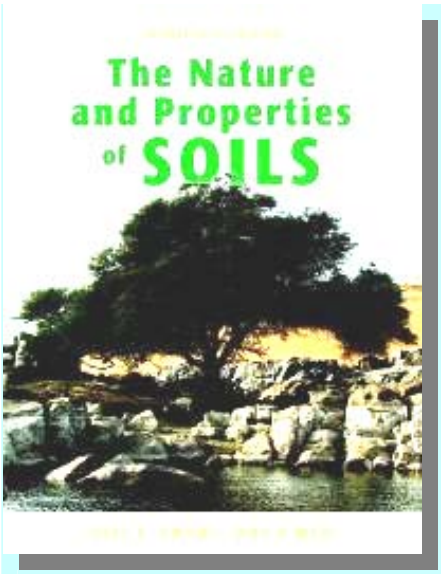
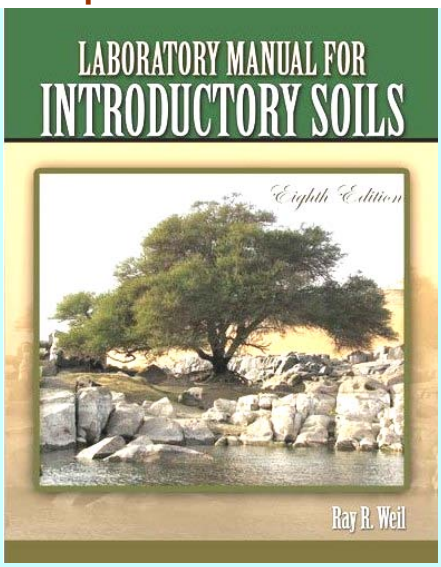
		

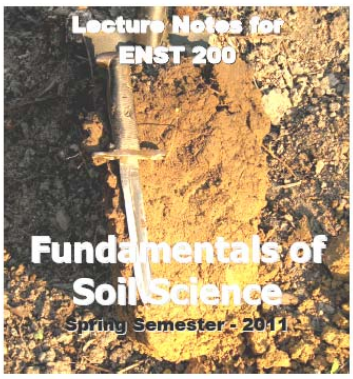
Required textbooks



BRADY/WEIL (2008). The Nature and Properties of Soils. **14**th ed. **Revised printing**. Prentice Hall. (Both bookstores)

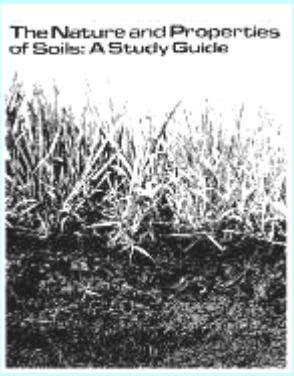


WEIL (2009). A Laboratory Manual for Introductory Soils. 8th Ed. Kendall/Hunt. (Both bookstores).



WEIL (2011) Lecture Notes for ENST 200. Bel Jean Packet, *only* **at Maryland Book Exchange,** Rte. 1.

Recommended **Workbook:**



WEIL/KROONTJE (1984/2002). Nature & Properties of Soils: A Study Guide. Bel Jean Packet only at Md Book Exchange. Printed on demand – special order.

Contains 1001 questions and problems with answers and calculations.

Course Policies and Learning Tools for ENST 200

Not just a class, but a community of professional colleagues developing tools and sharing their interest in the natural world.

- Open communications both ways
- Class starts & stops on time
- Class attendance - half of it is showing up.
- "Pair-Share" Book - grade insurance (see active learning tools, below)
- Exams-2 multiple choice type exams + a comprehensive final exam.
- Lab quizzes, reports and a term projects
- Late assignments-1/5 off per day
- Grades – see next page
- Cheating – don't even *think* about it.
- Plagiarism: see academic integrity code. If it's not your own original idea, give proper credit. If they're not your own words, use "quotes". If it's not your artwork, give credit and get permission.
- **DISABILITY?** If you have a documented disability and wish to discuss academic accommodations, please see Dr. Weil *in person* during the first week of class *with* your documentation.
- **ACTIVE LEARNING TOOLS**
- Lecture Notes Packet, available at Md Book Exchange
- helps you to better follow lecture, take notes and learn in the classroom.
- Textbook – the required textbook provides:
    - A comprehensive reference for the natural resource professional's bookshelf.
    - Principles, explanations, examples, references.
    - Study questions at the end of each chapter.
    - Extensive glossary of soil science terms
- Study Guide Packet - recommended for practice questions, self-study.
- "Pair-Share" exercises to challenge you and get you thinking in class. Buy an exam "blue book" and **always** bring this "pair share booklet" to class and lab. Always use next blank page, use **both** sides of the paper and **date** each page as you use it. Also used to answer brief essay questions, which are due at the beginning of each lab.
- Instructor's web site (when there see link to home page): http://www.enst.umd.edu/People/RayWeil/index.cfm
- Practice quizzes with feedback on web site: http://www.prenhall.com/brady/ -- Click on "companion website" next to our textbook cover, then select chapter of interest from bar near top of new page. Each chapter has a practice quiz and links to related soils websites. You can also see and download color versions of most of the images in the textbook.
- Course website on Blackboard (www.elms.umd.edu)
- In class discussions --please participate!
- Key words, building group answers.
- Sharing of personal experiences.
- After class-questions, discussions. The TA's and I are ready to share.
- Lab exercises/field trips. Read up on topic in the text before doing the lab.
- Get to know your TA; (s)he is part of an experienced and dedicated teaching team.

GRADING SCHEME for ENST 200.

Your semester grade in ENST 200 will have the following components:

First Hour Exam	**23%**	**46%***
Second Hour Exam	**23%**	
Third Hour Exam	**23%**	
Final Exam		**27%**
Land-Use Project		**15%**
Lab assignments		**12%**
Total		**100%**

*** We will drop the lowest hour exam.**

Letter grades will be assigned according to the tentative schedule in the table below. There will be three hour exams and we will drop the lowest of the three. T**here will, therefore, be no make up exams given. If you miss an exam that will be the lowest one that gets dropped.** Many students have told me they consider the exams in this course to be quite challenging. In the past, the class average on exams and assignments has been about 65 – 70%. Therefore, to get an A ("outstanding"), you'll have to really "stand out", that is score well above the average. There is no set proportion of the class in each grade category; therefore, it is <u>not</u> necessary that <u>anyone</u> receive an "F".

LetterGrade:	A	B	C	D	F
Scores (%):	≥80	65-79	50-64	36-50	≤35

NOTE: At grading time after the final exam, the TAs and the Professor will review each students grade and will give the benefit of the doubt to a student who's average is just a point or so below the next higher letter grade and who has turned in a completed "Pair Share" book and has consistently completed all assignments and participated constructively in class.

Spring 2011

---------- Lecture Schedule and Readings ----------

Date	Lecture Topics	*Optional* study **Weil&Kroontje (study guide)**	**Assigned reading** **Brady & Weil 14th Edition**
1/25	***Bring Lecture Packet to Class (available at Md Book Exchange – Route 1)*** Intro. to Course & Soil as a Natural Resource	Chp. 1, pp. 88-9	sec.1.1-1.10 20.2-20.3
2/27	Soil as a Medium for Plant Growth	Chp. 2	sec 1.10-1.20
2/01	Minerals and Weathering to Form Soils	Chp. 3	sec 2.1-2.2
2/03	Factors of Soil Formation	Chps.3/4	sec 2.3-2.10
2/08	Soil Taxonomy I: profiles and orders	Chp. 5	sec 2.9-2.10, 3.1-9
2/10	Soil Taxonomy II: orders, lower taxa	Chp. 5	sec 3.10-3.18
2/15	Soil Color, Texture and Structure	Chp. 6	sec.4.1-4.4
2/17	Other Physical Properties and Stability	Chp. 6	sec 4.4-4.10
2/22	**EXAM I**		
2/24	The Nature of Water in Soils	Chp. 7	sec 5.1-5.4
3/01	Movement of Water in Soils	Chp. 7	sec. 5.5-5.11
3/03	Soils and Plants in the Hydrologic Cycle	Chp. 7	sec. 6.1-6.5
3/08	Water Management: Irrigation and Drainage	Chp. 7	sec. 6.6-6.10
3/10	Aeration of Soils	Chp. 8	sec. 7.1-7.5
3/15	Wetlands & Soil Redox State		sec. 7.5-7.7

3/17	Temperature and Mulching	Chp. 8	sec. 7.8-7.12
21-25	********** **Spring Break** ********		
3/29	**EXAM 2**		
3/31	Soil Colloids and Charges	Chp. 10	sec. 8.1-8.6
4/05	Ion Adsorption and Exchange	Chp. 10	sec 8.7-8.15
4/07	Soil pH and Acidity	Chp. 10	sec. 9.1-9.11
4/12	Soil Alkalinity and Salinity	Chp. 10	sec. 10.1-10.12
4/14	Soil Faunal Ecology	Chp. 9	sec. 11.1-11.7
4/19	Soil Microorganisms	Chp. 9	sec. 11.8-11.15
4/21	Soil Organic Matter	Chp. 9	sec. 12.1-12.11
4/26	**EXAM 3**		
4/28	Nitrogen and other nutrient Cycles Smil: Global Pop and Nitrogen Cycle: http://hollandimac.chem.rochester.edu/n2cycle.pdf	Chp. 11	sec. 13.1-15.12
5/03	Nutrient Management and Soil Tests	Chp. 11	sec. 16.1-16.15
5/05	Soil Degradation by Wind and Water	Chp. 12	sec. 17.1-17.6, 20.1
5/10	Principles of Erosion and Sediment Control	Chp. 12	sec. 17.7-17.15
5/18	**FINAL EXAM:** Wednesday, May 18 10:30am-12:30 pm, 0226 HJP		

Spring 2011 Lab Schedule
ENST 200 –FUNDAMENTALS OF SOIL SCIENCE

Week Beginning	Lab Topics	Lab Exer.
01/24	Minerals, Rocks and Parent Materials (+Lab Safety). Factors Affecting Nutrient Release by Mineral Weathering	1 2
01/31	Soil Survey Reports in Land Use Planning; Introduction to term project. (Read Brady & Weil, ch.19). Introduce "Winogradsky" Soil Column Demo Possible field trip to campus soil pit (read page __)	5
02/07	BRING IN SOIL SAMPLE and FILL IN TABLE E1 Some Field Skills: Texture by Feel and Color Charts	4
02/14	Soil Texture: Mechanical Analysis Using Tensiometers to Monitor Soil Moisture Status (Read into only)	3 9
02/21	**+++ LAND PLANNING PROJECT OUTLINE DUE +++** **Land Use Project: Meet in GIS computer lab Plant Sci. Bldg**. HANDS-ON **QUIZ** (rocks, minerals, texture, colors): rm 0210	5
02/28	Soil Density, Porosity & Structural Stability Investigating Capillary Rise (thru step 11, only) Begin Observation of Microorganisms	6 7 14
03/07	Effect of Soil Composition on Percolation and Retention of Water	8
03/14	Cation Exchange Properties of Soil	15
03/21	++++++++++++ SPRING BREAK +++++++++++++++++	
03/28	Soil Acidity (pH) Finish observation of Microorganisms	16 14
04/04	→ **Presentation of Land Use Projects**	5
04/11	Soil Organic Matter Determination (by loss on ignition Active C Determination	11 12
04/18	Field Trip: Soils in the Field (Meet at designated site.* Dress appropriately)	20
04/25	Field Trip: Getting to Know a Catena (Meet at designated site.* Dress appropriately)	21
05/02	Turn in Winogradsky Column write-up and Appendix E Table and Report Test for Available Phosphorus in Soil	18

* In case of **SERIOUS** rain, meet in the lab with your lab manual to do the exercises listed under the week of 05/03

Week	**Pre-questions about the lab exercises** Directions: *Every week* please read the lab manual chapter introduction and relevant pages in Brady/Weil for related information (use index). Consider the following questions. There will also be pre-quizzes on the Blackboard website to be submitted prior to attending each Lab section.	Lab Manual Exercise
01/24	Why is an understanding of the rocks, which are the parent material for a particular soil, useful to someone who is: a) using the soil for plant production, b) assessing pesticide leaching potential? Explain how differences in environmental conditions might contribute to the formation of a calcium-depleted soil in Georgia and a calcium rich soil in Oklahoma.	1 2
01/31	Describe how field borings, laboratory analysis and aerial photography are integrated to create a soil survey map.	5
02/07	Predict how the color of different soils in a landscape (e.g. hilltop vs. mid- slope vs. floodplain) is likely to differ and provide a general explanation of these color differences. Explain why the inventor of the tensiometer originally called it an "artificial root."	4 9
02/14	When a river floods and then recedes, why is the soil closest to the river coarser than soil deposited in the floodplain area farther from the river (this phenomenon results in a ridge along the river bank known as a “natural levee”).	3
02/21	What is a G.I.S. (geographic information system) – what does one consist of and how is it used?	5
02/28	Although people often refer to being on "solid ground", please provide a more accurate description of the physical nature of soil. Why does a layer of gravel under a concrete basement floor prevent capillary movement of moisture from the soil from making the basement floor damp?	6 7
03/21	Describe three common activities in which people deliberately try to change the texture of soil to manage how it retains and percolates water.	8
03/28	Predict differences in the rate of leaching of a positively charged industrial pollutant as compared to a negatively charged pollutant in a soil with high CEC.	15
04/04	Why is adding only lime to a soil that currently has a pH of 5.2 likely to increase the plant uptake of nutrients? How do fungi and actinomycetes differ in *appearance* and in the soil *conditions* under which they thrive?	16 14
04/11	Land users usually refer to “soil organic matter” while scientists usually refer to “soil organic carbon” in discussing the humus in soil. Explain the relationship between these two soil properties. A landowner begins a new program of adding manure and growing winter cover crops to increase her soil organic matter levels. Still after two years, soil tests show no clear increase in organic matter. Why might the active carbon soil test better reflect soil improvements brought about by the manure and cover crops?	11 12
05/02	Why are the "available phosphorus" results from soil testing labs in CA and VA likely to be different even if they both analyze the same MD soil?	20

My Lab section number: 010__. TA's Name:_____, office hours: _____

ENST 200 LABORATORY PROCEDURES AND POLICIES

1. The required lab text is Weil (2009): A Laboratory Manual for Introductory Soils. (8th Ed.) Kendal/Hunt Publishing.

2. Each student will bring in a sample of air-dried soil from a place of personal interest (e.g. home garden, restoration project, etc.). See Appendix G (pp 211-212) in the lab manual to learn how to sample soil. Turn in a completed information sheet with the soil sample in the **second week of lab (third week if weather is prohibitive)**. During the course of the semester, remember to fill out both tables in Appendix E so you can complete in a **report on this soil which is due on the last day of classes**.

3. It is required that you read through the lab manual exercise(s) and relevant pages in Brady/Weil (use index) before coming to lab. There will be a pre-quiz posted each week on the Blackboard website based on this reading. The quiz must be submitted prior to attending each lab section.

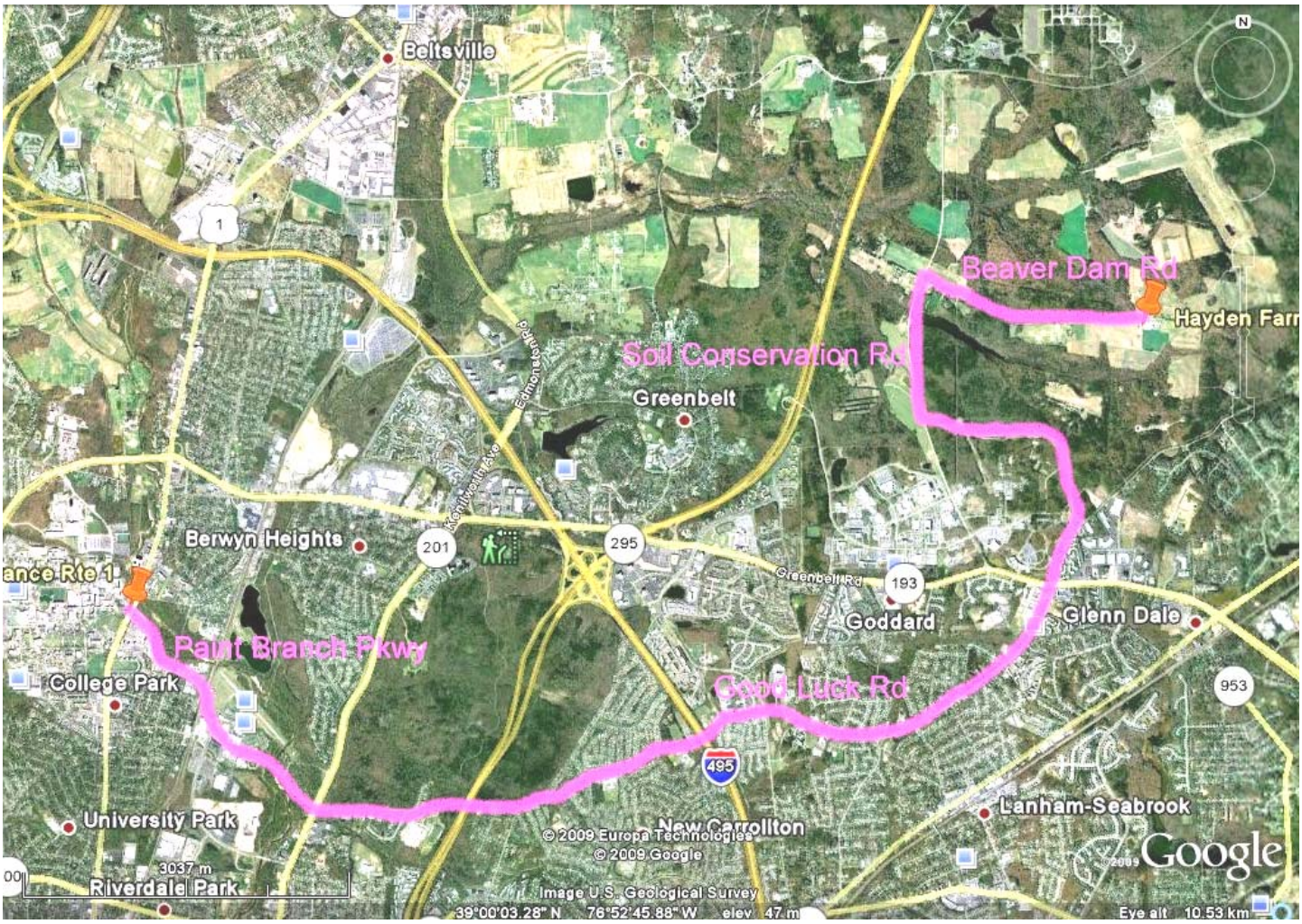
4. We will assign various types of lab reports or problem sets. Please have your assignment ready to hand in at the beginning of the period following that in which the exercise was conducted. If you have any questions about an assignment, see your TA and get them resolved **before** the assignment is due. **All grades will be lowered by 1/5 for each day late**; so do not bother with anything that is more than 5 days late. However, remember that a few zeros in lab may MURDER your grade in the course, so please keep up with the assigned work.

5. Maintaining a clean and organized laboratory space is important for both the safety and efficiency of the lab. Students will be assigned to a specific lab bench and drawer for the duration of the semester and are required to clean and return all equipment to its appropriate location at the end of each lab session. **If the lab space is not left clean and organized, 20% of the weekly lab grade will be deducted from ALL students who use that space.**

6. Always, attend the lab section for which you are registered. If you must miss a lab, obtain the TA's permission to attend another section that same week, if possible. If not, see your TA to get data necessary to complete the lab report, as you will be responsible for all lab reports. The logistics of setting up lab materials will not permit any make-up labs.

7. There is a **term group project** in land use planning and soil survey. Each student is expected to participate fully in both the oral and written parts of this project. The grade for the project is 20% for the oral presentation and 80% for the written report turned in. The same late-policy applies

ENST 200 Field Trip Site and Directions

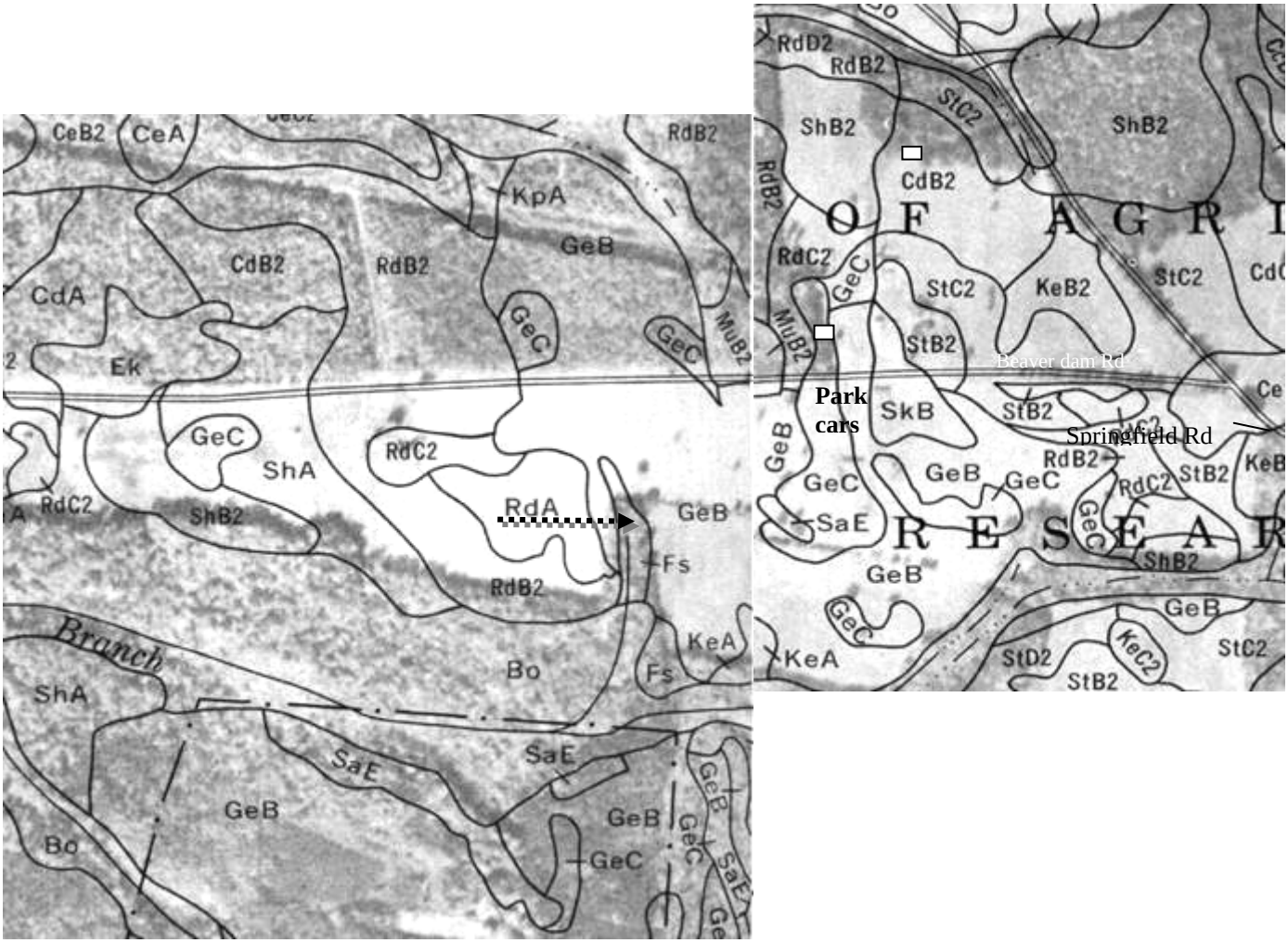


Map to ENST 200 Field Trip Site at Beltsville Field Unit of the Central Md Research and Education center, alias "Hayden Farm".
Driving from campus: Take Paint Branch drive past Metro Station and then straight across Rt. 201 to Good luck Road. Continue on Good luck to Soil Conservation Rd, go left on (new) Soil Conservation Rd 1 mile then right on Beaver Dam 1/2 mile. Turn right into parking area just west of tan/brown metal farm Buildings of UM Beltsville

Soils map for ENST 200

Field trip

Portion of Soil Map Sheet No. 9 from the old Prince Georges County Soil Survey report (Web Soil Survey has newer, but not as detailed soils information for this area).
Approximate location of class field trip soil pits shown as white rectangles. Catena transect shown as arrow. Soil mapping unit symbols: Ge = Galestown/Evesboro complex; Cd = Christiana, Rd = Rumford and Fs = Fallsington soils.



Land Planning Project - Supplementary Guide

This information is intended to clarify the purpose of the land planning project and give more specific directions for completing it. Please also refer to the lab manual pp 55-57.

Purposes of the term project:

- To explore the selection of land for a specific purpose based on how soil properties influence different land uses.
- To challenge you to demonstrate creativity in a rigorous academic planning exercise.
- To foster your ability to communicate, delegate, lead, and share responsibility in a peer group.
- To provide an opportunity for you to develop public speaking skills through presentation of your projects in front of your lab section class.

Explanation of Project Directions Given in Lab Book:

Your group is required to "purchase" a complete tract of land of the 20 tract "for sale". You do not have to use *all* of the tract for your specific land use, but you *must* include all the entire tract in your inventory of soils, describe why you are not using some land, and how the unused portion of your tract will be managed (i.e., left in forest, pasture, etc.). The purchase and specified land use you choose must be reasonable, in economic terms (i.e., if you buy a 50 acre lot for a 30 acre farm, explain what will be done with the other 20 acres and how your business will be able to afford the extra land).

If you have a personal association with a real tract of land in the U.S. large enough to have considerable soil diversity, you may use that tract of land for the project, with TA approval, provided you can obtain the Soil Survey for that tract of land.

Your method for choosing your site should be logical and clearly articulated in your written and oral reports. The way you choose your site should demonstrates that you based your land planning decisions on *all* the information available, general and specific. (i.e., look at the capability class descriptions, soil series descriptions (including slope) as well as land use classifications).

If you choose to use the Geographic Information System mapping program, remember that we have made electronic file of some, but not all, of the information from the Harford County soil survey book. Use *both* resources to gain a working understanding of the soils; this will optimize your ability to choose a tract appropriate for your project.

An important part of the project is the construction of soil maps. One of your maps must combine at least two types of soil characteristics (e.g., suitability for habitat elements and slopes) which together present a clearer view of why certain areas may or may not be suitable for various uses that you specify.

If you choose to make overlay maps by hand, you can print soil maps of your tract using the GIS program maps or trace maps by hand onto transparencies sheet. You can print your transparencies from a file at most commercial copy centers. For printing maps in the GIS lab, PLEASE print in grayscale only (*not* color) until your **final** version. Color printing is very expensive and color drafts are against the GIS computer room rules.

Your soil inventory must first list all the soil series and then organize them into a smaller number of group that have practical significance for your planned use of the land (e.g. you could group 10 soil series by drainage class, three poorly drained, three moderately well drained and four well drained, OR you could group them into those that have severe, moderate and slight limitations for streets and roads). The soil survey may not rate soil for exactly the use you intend. For example a campground project might include a category of suitability for paths and trails, but probably not a category for suitability of land for homes with basements (except for construction of the office or shower rooms). [A few other notes to consider: *Texture* should be considered at the depths appropriate for your land use. *Filtration* is related to the purification of wastes from septic systems, not necessarily infiltration.]

In the soil survey, suitability for "topsoil" pertains to the removal of the top layer for use in landscaping elsewhere. Therefore a soil which is a good source of topsoil might have a restrictive layer beneath, making it poorly suited for farming.

See the next page for explanations of suitability classes available in our GIS data files. You are also expected to use other suitability classes, which are in the soil survey report.