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1. INTRODUCTION

The purpose of this handbook is to provide information to current and potential graduate students about the Civil and Environmental Engineering (CEE) Graduate Programs in the School of Engineering at the University of Vermont (UVM). The UVM Graduate College is responsible for all advanced degrees at the University of Vermont and sets forth the minimum requirements and standards. These requirements are available in the graduate catalogue available on their website (www.uvm.edu/~gradcoll/). The Graduate College provides excellent information on this website about all Graduate College policies, procedures, deadlines, required forms (see Services, Forms and Policies link) as well as graduate courses and should be consulted frequently by all graduate students.

This handbook provides more details that are specific to the Civil and Environmental Engineering Graduate Programs. All graduate students are expected to become familiar with this handbook and other Graduate College information within the first months of attending UVM.

2. ABOUT THE CEE PROGRAMS

The Civil and Environmental Engineering Programs are part of the School of Engineering (http://www.uvm.edu/~cems/soe/) in the College of Engineering and Mathematical Sciences (http://www.uvm.edu/~cems) at the University of Vermont (www.uvm.edu). The Programs offer B.S., M.S. and Ph.D. degrees in a small, focused setting which provides excellent opportunities for faculty mentoring of students, and high quality research of national and international prominence.

The CEE Programs comprise about 200 undergraduate students and about 25 graduate students. Approximately one-third of the graduate students are pursuing a doctoral degree. Because of the small size of our Programs, there is considerable interaction between graduate and undergraduate students through teaching, coursework, research and extracurricular activities. Faculty and students in CEE engage in multidisciplinary research with a number of other colleges across the UVM campus, notable The Rubenstein School of Natural Resources, College of Medicine, College of Agricultural and Life Science (CALS) and College of Arts and Science (CAS).

Students pursuing a M.S. degree may pursue advanced training and research in a variety of areas in civil engineering including geotechnical, structural, transportation, construction, hydraulics, materials, and environmental. Students pursuing a Ph.D. degree may conduct research related to Civil and Environmental Engineering.

There are currently 10 faculty members (Table 1) in the CEE Programs. All are involved in research, teaching and service activities. The majority of the faculty members are involved in research dealing with environmental issues, computational and information technology applications, and transportation-related problems which makes these three areas the strong research foci of the Program.

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1 Here, “Program” normally refers to the Graduate Program and “Programs” to the two undergraduate programs, Civil and Environmental, which are both represented in the single graduate Program.
Table 1. Summary of faculty and areas of expertise.

<table>
<thead>
<tr>
<th>Name (office and email)</th>
<th>Typical Courses Taught</th>
<th>Research Area</th>
</tr>
</thead>
<tbody>
<tr>
<td>Aultman-Hall, Lisa</td>
<td>Critical issues in transportation</td>
<td>Transportation planning, bicycle transport, GPS related to transport, tailpipe emissions</td>
</tr>
<tr>
<td>Farrell Hall Director, UVM Transportation Research Center <a href="mailto:laultman@uvm.edu">laultman@uvm.edu</a></td>
<td>Sustainable transportation</td>
<td></td>
</tr>
<tr>
<td>Bomblies, Arne</td>
<td>Hydrology, Geomatics</td>
<td>Public health and hydrology</td>
</tr>
<tr>
<td>221 Votey <a href="mailto:bomblies@cem.uvm.edu">bomblies@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DeWoolkar, Mandar</td>
<td>Geotechnical principles, applied soil mechanics, geotechnical design</td>
<td>Experimental and computational soil mechanics, building restoration</td>
</tr>
<tr>
<td>213A Votey, <a href="mailto:Mandar@cems.uvm.edu">Mandar@cems.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hayden, Nancy</td>
<td>Chemical/physical and biological treatment, contaminant fate, transport and remediation</td>
<td>Soil and groundwater remediation, ecological eng., phytoremediation</td>
</tr>
<tr>
<td>215 Votey, <a href="mailto:nhayden@cem.uvm.edu">nhayden@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Hill, Jane</td>
<td>Water quality engineering, biological processes, Phosphorus transformation processes</td>
<td>Phosphorylated compound cycling, pathogen migration, and rapid detection of bacterial pathogens</td>
</tr>
<tr>
<td>213B Votey, <a href="mailto:jane.hill@uvm.edu">jane.hill@uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Holmén, Britt</td>
<td>Environmental analytical practice, transportation and air quality</td>
<td>Airborne particles, environmental organic chemistry</td>
</tr>
<tr>
<td>213D Votey, <a href="mailto:baholmen@cem.uvm.edu">baholmen@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lee, Brian</td>
<td>Transportation systems, Decision Analysis, Transportation Planning</td>
<td>Transportation &amp; land use modeling, non-motorized transport, policy evaluation</td>
</tr>
<tr>
<td>359 Votey, 114 Farrell <a href="mailto:bhylee@uvm.edu">bhylee@uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laible, Jeff</td>
<td>Structural analysis, finite elements, surface water modeling</td>
<td>Computational modeling, numerical methods for structural analysis.</td>
</tr>
<tr>
<td>216 Votey, <a href="mailto:laible@cem.uvm.edu">laible@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pinder, George</td>
<td>Groundwater and groundwater modeling</td>
<td>Computational modeling, optimization in groundwater systems</td>
</tr>
<tr>
<td>379 Votey, <a href="mailto:pinder@cem.uvm.edu">pinder@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Rizzo, Donna</td>
<td>Hydraulics, engineering economics, geostatistics</td>
<td>Computation modeling, optimization, Artificial Neural Networks applied to hydrology.</td>
</tr>
<tr>
<td>217 Votey, <a href="mailto:drizzo@cem.uvm.edu">drizzo@cem.uvm.edu</a></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The staff in the School of Engineering Main Office, located in 301 Votey, is another source of information for graduate students. This office handles all paperwork related to graduate student assistantships, including hiring and stipends, keys and office information.

Karen Bernard <kbernard@cem.uvm.edu> (656-3333)
Pattie McNatt <pmcnatt@uvm.edu> (656-8157)
2.1 Program Research

Research is an integral part of the graduate student experience within our Programs and all students are expected to develop capabilities for independent research during their tenure. It is, therefore, very important that students be interested and enthusiastic about their research topic. All graduate students are expected to make a contribution to the scientific or engineering field related to their area. This is usually accomplished by coauthoring a journal or proceedings paper.

The ongoing research in the Programs can be broken down into five general areas (Figure 1). However, there is considerable overlap between these areas. Additional information regarding research topics and faculty expertise can be found on our website http://www.uvm.edu/~cems/soe/?Page=grad/cee/default.php&SM=grad/_gradmenu.html

Student involvement in specific research areas may be limited based upon the available openings identified by each of the various faculty members. Upon acceptance into the program, it is often advisable for students to contact the graduate program coordinator or specific faculty members to discuss research options available to them.

![Figure 1. Research focus areas in Civil and Environmental Engineering](image)

2.2 Facilities

Graduate students may conduct their research and some of their coursework in a number of experimental and computational facilities on campus as well as field research sites. This section describes these laboratories and field sites in detail.
The Program, faculty, and graduate student offices as well as Program laboratories are located in the Votey and Perkins buildings on the main UVM campus. Additional Program-related faculty have offices in Farrell Hall on the Trinity campus. Field research sites are generally all located within an hour’s drive from UVM.

2.2.1 CEE Laboratories
Program laboratories include the Environmental Fluids Laboratory, the Soils Laboratory, the Structures Laboratory the Concrete/Materials Laboratory, the Atmospheric Emissions and Air Pollution Laboratory, the Physical Groundwater Flow and Transport Modeling Facility and the Transportation Systems Research Laboratory. These are located on the first floor of the Votey building. Environmental Engineering Chemistry Laboratories are located on the first and second floors of Votey. Students should be aware of important safety rules associated with these laboratories and should be aware of research and classes that may be underway at certain times.

Environmental Fluids Laboratory
This laboratory includes a state-of-the-art groundwater physical model (10’ by 14’ by 8’) that contains a dense matrix of sophisticated sensors (temperature, pressure, moisture content, conductivity and water sampling probes), a data acquisition system and pumping capability from 84 locations in the physical model. This laboratory also houses a large 40’ flume, recirculating water supply, a Pelton wheel, friction factor/pressure drop piping arrangement, a small moveable flume, and many full-sizes valves and orifices within pipe networks.

GIS Lab
The Programs maintain a GIS laboratory that has NT-based computers with ESRI-Arc/Info software and a large-format color plotter. In addition, this laboratory contains various equipment used for field work at streams and wetlands such as; flow meters, water level meters, total station, GPS unit, laser level, pressure transducers, barometric pressure loggers, tensiometers, water quality probe, and rain/snow gauge.

Surveying Laboratory
Instruments available include automatic levels, digital transits, theodolites, EDM, total station, portable GPS receivers, and one GPS base station.

Soils Laboratory
The Soils Laboratory houses several computers, the data acquisition system, and a high performance liquid chromatograph that are necessary for the groundwater physical model. The soils laboratory is equipped for many of the standard suite of tests associated with basic instruction and research in geotechnical engineering. Testing capabilities include grain size, permeability, compaction (including Harvard miniature), CBR testing, consolidation, direct shear and triaxial tests.

Structures Laboratory
The laboratory has two universal testing machines, a 300,000 pound Young static machine for compression and tension measurements, a 200,000 pound static machine with a 10’ long specimen for compression. In addition, this laboratory contains four loading frames, a 60,000 pound Tinius-Olsen machine for compression and tension testing, and a 10,000 MTS system for force or
displacement controlled testing in tension or compression, and a special testing floor. The universal machines are maintained and calibrated on a regular basis (most recently January 2000). These machines have full-scale capacities ranging from 600 pounds to 300,000 pounds. The machines in this laboratory are not new, but are quite functional and reliable. The beam/column machine has an electronic load cell adapted, rather than utilizing the older, mechanical load measuring system.

**Concrete/Materials Laboratory**

This laboratory is equipped for materials testing that involves concrete mixes, additives and curing histories. The curing environment is a mobile curing box. Equipment for measuring, mixing, and testing are in good condition, and are able to handle casting of cubes, cylinders, or beams. This laboratory contains sieves and a shaker for media analysis, large drying ovens, balances and other standard equipment.

**Transportation Modeling Resources**

The Programs maintain a state-of-the-art transportation computational laboratory that supports both educational and research activities. The “Design Laboratory” is equipped with the following types of transportation-related software:

- **traffic operations and simulation software**, including the Highway Capacity Software (HCS 2000); the traffic simulation models, CORSIM, VISSIM, and INTEGRATION; and the signal optimization model, TRANSYT-7F
- **transportation planning software**, including TP-Plus/Viper and Tmodel2
- **statistical software**, including SAS, SPSS, and Minitab
- **computational intelligence modeling tools**, including Artificial Neural Networks and Case-Based Reasoning development software

**Transportation Research Center (TRC)**

In addition to serving as the UVM nexus for transportation research and graduate education, the TRC, located in Farrell Hall on the Trinity Campus, has equipment for conducting traffic counts, and other types of traffic studies as well as a transportation library. The library holds several TRB, NCHRP, TRCP, ITE, and AASHTO publications, along with several useful textbooks.

**Environmental Engineering Laboratories**

**Hazardous Waste Research Laboratory** is located on the second floor of Votey and contains a variety of soil column systems, micromodels, and two-dimensional models for investigating contaminant transport and behavior in porous media. This laboratory also contains a Hewlett-Packard gas chromatograph with three detectors, two automated samplers and HP chemstation software for analysis. In addition, there is a goniometer to measure interfacial tension and contact angle, a fume hood, balances, centrifuge, microscopes, ovens, controlled temperature rooms, shakers, and other laboratory equipment.

**Environmental Engineering Teaching Laboratory** contains various bench-scale experimental systems for education and research experiments. In addition it contains a surface area analyzer, portable gas chromatograph, microbalance, fume hoods, refrigerators, pH meters, visible spectrophotometers, conductivity meters, centrifuge, autoclave, water purification systems,
Transportation Air Quality (TAQ) Laboratory (opened May 2009) houses vehicle emissions monitoring equipment, a mini-dilution tunnel for sampling vehicle exhaust, gas and particle sampling instrumentation, and an Armfield CM-12 engine test bed with exhaust extraction system. Numerous on-board vehicle monitoring devices (scantool, accelerometer, T, RH, GPS, tailpipe adapter) are used in interdisciplinary research on airborne particle number distributions and mobile source air toxics (MSATs) as a function of vehicle operating characteristics. Studies on biodiesel fuel properties, diesel engine performance and emissions are carried out in collaboration with mechanical engineering faculty and students.

Microbiology and Biotechnology Laboratory includes molecular and microbiological facilities, microscopes, microfluidic fabrication instruments, standard hazardous chemical handling equipment, and a state-of-the art triple quadrupole mass spectrometry instrument. Studies in this laboratory focus on understanding (i) measurement of how microorganisms cycle organophosphorus compounds in various ecosystems, (ii) measurement and prediction of how motile bacteria are transported in laminar flow, and (iii) identification and measurement of pathogen and human-pathogen volatile metabolomes.

Students or personnel working in the four chemical/biological laboratories must be familiar with important rules related to these labs. The first and foremost is laboratory safety. At a minimum, all student using these labs must pass the online chemical safety training courses available at the Environmental Safety Facility website under “training” (www.uvm.edu/~esf). The results of the online training should be submitted to the laboratory supervisor.

**Laboratory Safety**: Courses and research performed in these laboratories often involves the use of potentially toxic and hazardous chemicals, and disease-causing organisms. In the interest of protecting all students and laboratory personnel, it is important that each individual exercise common sense, good judgment and safe laboratory practices. The following is a list of information pertaining to laboratory safety and rules that must be followed when working in the laboratory.

1) Attend a class offered by the Environmental Safety Facility (ESF) personnel. This is a mandatory requirement for graduate students working in the laboratories.

2) Know the location of the following emergency items in each laboratory; Emergency shower, Fire extinguisher, First aid kit, Emergency spill kit.

3) Emergency phone number: dial 911.

4) Make sure you are well prepared for laboratory work in advance of entering the lab by understanding the nature of the chemicals and biological materials you are working with. If you are unsure of something, **ask**! You should assume a chemical is hazardous unless instructed otherwise. Pay attention in the laboratory.

5) No smoking, eating or drinking in the laboratory. Always wash hands before touching eyes, nose or mouth and prior to leaving the laboratory for the day.

6) **NEVER** add chemicals back into the stock reagent bottle after you have withdrawn the chemical. **NEVER** pipette liquids from the original storage bottle. Transfer the liquid to a beaker. Pipette the liquid from the beaker. Know the specific disposal procedures for your chemicals.

7) In the case of spills, notify the instructor or Drs. Hayden, Hill or Holmén immediately. Do not use bare hands to clean up mercury, acids, bases, solvents or other materials of unknown toxicity.

8) Broken glass should be disposed of in the box near the door.

9) Dispose of excess chemicals as advised by ESF or Drs. Hayden, Hill or Holmén. **NEVER** put
chemicals back into the original bottle.
10) **Every** container of liquid in the laboratory must be identifiable in terms of its liquid contents at all times – Use ESF labels to properly label every beaker, bottle, flask and buret with chemical name, date and your initials.

*Federal Chemical Right-to-Know Law* requires the availability of Material Safety Data Sheets (MSDS) for employees, and training of employees in chemical usage.

**Additional Laboratory Information**

1. You are responsible for cleaning all glassware and your workstation at the end of your laboratory sessions. Do not leave dirty dishes by the sink for any prolonged period of time, especially when classes are in session. Unless otherwise directed, first wash with detergent and thoroughly rinse with tap water.

2. If you break anything in the laboratory, please report it to Drs. Hayden, Hill or Holmén, so that they are aware of it and can order replacements as needed. Some items may need to be replaced by the student’s advisor from research grants.

3. Many of the supplies and some of the equipment located in Room 222 (Hazardous Waste Research Laboratory) and Room 116 B (Phytoremediation Laboratory) were purchased on research grants or are being used for research. You should consult with faculty to ensure that these items are available for general use.

4. Never take items or touch other people’s experiments without first consulting with them.

### 2.2.2 Field sites

A *constructed wetland center* is located at the campus dairy farm on Spears Street (construction began in Summer 2002). This fully functioning wetland with multiple cells and smaller research cells will be used for research, education and demonstrations. The system is instrumented with spatially distributed, nested piezometers for evaluating continuous flow through the wetland and flow and water quality monitoring devices that are used to determine the flow and contaminant fate and transport through the system.

A *natural ombrotrophic bog* (shown in Figure 2) is currently monitored to understand bog hydrology and its impact on biodiversity. The bog is instrumented with a weather station and a unique factorial design of nested piezometers allowing examination of the three-dimensional flux of water and various geochemical parameters in bog pore-water.

Numerous streams and their watersheds are used for research, as well as Lake Champlain. Various UVM engineers (CEE) and scientists from other departments are involved in a number of Lake Champlain research projects.

### 2.2.3 General Research Facilities

**Libraries (http://library.uvm.edu/)**
There are three libraries located on the UVM campus, Bailey/Howe Library, Cook Physical Sciences Library, and the Dana Medical Library. The Bailey/Howe Library is the main library on campus that includes the majority of books and periodicals. It is also home to Government Documents, Reserve Section for various classes, Media Services, Reference Section, Special Collections, Study rooms, and additional computers for student use. The Cook Library and the Dana Medical Library include collections in the physical, medical and health-related sciences.

All UVM libraries have on-line computer systems (http://library.uvm.edu), which includes UVM holdings as well as access to a variety of reference databases. Students should become familiar with the on-line system. Reference librarians can assist students in how to use the different data bases available. Interlibrary loan is used for obtaining books and articles that are not available within the library.

**Computer Support (help.cems.uvm.edu)**

The College of Engineering and Mathematical Sciences (CEMS) computing facility is located on the second floor of Votey. Tim Raymond, Victor Rossi and Jim White maintain the computer laboratories within Votey, set up computer and email accounts for students, and deal with a variety of hardware concerns for faculty and laboratory computers. They can be reached by emailing help@cems.uvm.edu.

This office generally does not provide technical support for specific software applications. This is achieved either by talking to other students and faculty or by contacting the software company sales and technical representatives. Beyond setting up student accounts, the computer facility services are available on a fee basis and therefore need a budget number before the facility can start a job.

![Figure 2. Ombrotrophic bog field site.](image)

The Programs and individual faculty members maintain computers within Program offices and laboratories. The PCs in laboratories or graduate offices are often shared. Computers within the College computer laboratories are also available for student use. Students should also have access to their own computers for home use. Laptops are useful in that they can be used at work or in the field. Laptops left in offices at night should be locked in drawers or cabinets to protect them from theft.

The Computer Depot, located on the first floor of the Davis Center, has computers from a variety of manufacturers available for sale to students. They generally sell at competitive prices and assist in the initial set up and installation of the computer.

**Metal Machine Shop**
The College also maintains a complete metal machine shop with a computerized milling machine, high speed lathes, drill presses and other standard shop equipment. This facility is available for some student use, provided the students have sufficient training, including safety training, in the shop. The shop manager, Floyd Vilmont, can provide assistance in designing and building needed items and in training. A wood shop in Williams Hall is available upon approval by the shop manager.

**Other Facilities of Interest**

The UVM Risk Management Department provides the campus community, including staff, faculty, students and visitors, with the support, advice and leadership necessary to maintain a safe, healthy campus; to minimize liabilities; and to protect the University's assets. This is done through a comprehensive risk identification process and by providing effective risk financing, sound claims management, health and safety support services, and regulatory compliance assistance.

The Environmental Safety Facility ([http://www.uvm.edu/~esf/](http://www.uvm.edu/~esf/)) provides information such as safety training, and laboratory hazardous waste management that will be useful for graduate students working in chemical laboratories in the Votey building. Some chemicals can also be purchased through the ESF. All graduate students working in one of the environmental engineering chemical laboratories must complete a safety training course at the ESF prior to working in the laboratories.

The Chemistry Department in the Cook Building operates a glass blowing facility operated by Angie Gatesy. This facility can be used for making specialty glass items or for repairing laboratory glassware.

### 3. GRADUATE PROGRAMS

The Civil and Environmental Engineering Programs offer graduate study leading to the degrees of Masters of Science and Doctor of Philosophy. A Student Summary Record Form (found in Appendix A and electronically on the Graduate Seminar Blackboard course site (Excel file)) should be used by the student and advisor to keep a record of the student’s completion of various Program requirements as they are fulfilled.

#### 3.1 Acceptance into the Program

**Timeline for Application Submission.** Students apply to the UVM Graduate College indicating their graduate program and degree objective (M.S. or Ph.D.) on their application. Applications must be received by the Graduate College by **February 1** of each year for entrance the following fall semester. The Program faculty generally begin to review applications in March when the completed application records are received from the Graduate College. Although applications can be accepted at other times, and admission in January is possible, applying by February 1 for entrance in September provides the student with the best chance for funding opportunities. It is important to note that only completed applications can be forwarded from the Graduate College to the CEE Program. It is therefore important that prospective students ensure all of the required application materials are received before February 1. The Program also accepts students for Spring admission and application materials should be completed by October 15 to ensure sufficient time for Program review prior to the start of Spring semester in mid-January.
**Application Review Methodology.** Completed applications are reviewed by the entire CEE faculty. Factors considered for admission include grade point average (GPA), graduate record examination (GRE) scores, letters of recommendation, statement of interest, relevant engineering experience, and TOEFL scores (for international students). The overall package is considered, therefore strengths in some areas can make up for deficiencies in others. The Programs seek to find high quality, hard working students whose interests and strengths best match the strengths of our CEE Programs.

The first step in the application package review process is to determine who is qualified. It is important that the application package be complete and fully reflect the applicant’s strengths and specific academic interests. *Applicants are encouraged to identify a CEE faculty member with research interests most closely aligned with their academic objectives.* Of the qualified applicants, we then determine who in the faculty would be the applicant’s major advisor. Only applicants with at least one faculty member committed to be their advisor are admitted. This ensures that all of our graduate students have the commitment of a faculty member during their tenure as a graduate student. In cases where several faculty members may be interested in advising one student, we often decide later with input from the applicant who will be the advisor.

Qualified applicants who have the commitment of at least one faculty member are admitted to the CEE Programs. Of the admitted students, awarding of *graduate teaching assistantships* (GTAs) and *graduate research assistantships* (GRAs) is then determined based on applicant qualifications and the need for the applicant’s skills within the Programs.

**Basic Requirements for Admission**

All applicants must have an undergraduate degree from a recognized University. A Bachelor of Science degree in engineering is preferred, but applicants with a B.S. degree in one of the sciences are often accepted. The latter, however, should have a *minimum* of the following math and science coursework *prior to* admission:

A. 3 semesters of calculus  
B. 1 semester of differential equations  
C. 1 semester of calculus-based physics  
D. 1 semester of chemistry

Some of these courses may be in progress preceding the desired Fall admission date, but this should be clearly indicated in the application package. Additional coursework at the undergraduate level may also be required for those who lack a sufficiently strong civil or environmental engineering background, and this coursework *may not count as credit for the graduate degree.* These remedial courses (2 in number) typically are (i) hydraulics or fluid mechanics and (ii) a general environmental engineering or water quality engineering course.

A grade point average (GPA) of at least a 3.0 is desired, but as previously stated, the entire application is considered, and in some cases, applicants with lower GPAs may be admitted. GRE scores are another indication of the potential of the applicant for success in the program.

Three letters of recommendation are thoroughly reviewed by the faculty for indications of the
applicant’s potential for success in our graduate programs. The applicant’s own statement of interest is very important for determining their fit into the programs. It is therefore important that the applicant understand the research and educational opportunities available within our Programs and determine where their specific interests overlap with the faculty.

International students should have Test of English as a Foreign Language (TOEFL) scores of at least 250 (computer-based) for admission, and these are the scores required for consideration for graduate teaching assistantships (GTAs).

In summary, to apply for graduate work in the CEE Program, the following materials are submitted to the UVM Graduate College:

1. Application form (on-line) that includes personal statement.
2. 3 Letters of Recommendation
3. Transcripts
4. GRE scores
5. For international students only, TOEFL scores (minimum score 250 on computer-based test).

UVM does not currently have a minimum standard for the IELTS exam.

3.2 Maintenance of Good Standing
In addition to the requirements set forth by the University and Graduate College, our students must maintain a cumulative GPA of 3.0 to remain in our graduate programs. In addition, all students must faithfully and responsibly fulfill their duties associated with their assistantships. They must also show reasonable progress toward fulfilling their graduate degree requirements and regularly attend the graduate seminars.

Students that have been accepted contingent upon completion of certain undergraduate coursework must fulfill those requirements within the first two semesters of the program (scheduling permitting).

A written proposal and oral proposal defense presented to the appropriate graduate committee members (Section 3.4) must be successfully completed by the end of the first calendar year for M.S. students and the end of the second calendar year for Ph.D. students.

3.3 Full-time Status
A minimum of six credit hours is required during the academic year to maintain full-time graduate status. No credit hours are required during the summer to maintain graduate status. Students that have completed their course requirements, but have not completed all graduation requirements, may enroll each semester for Continuous Registration (GRAD 900) and pay a $100 continuous registration fee. Most full-time graduate students take 6-10 credits per semester.

3.4 Faculty Advisor and Advising Committees
A faculty advisor is selected prior to enrollment or during the first semester in the program. Beyond
the first semester, financial and time commitments by the advisor justify that any change of advisor be approved by the Graduate Program Coordinator.

By the end of the first year for M.S. students, the advisor (with the student’s input) will recommend a Studies Committee to the Graduate Program Coordinator. This committee will consist of:
- the major advisor,
- at least one additional member of the Program graduate faculty, and
- at least one member of the graduate faculty outside of the Program.

Additional members outside the graduate faculty are also allowed. The committee’s responsibility is to provide advice regarding the student’s program of study and research activities. This committee will also participate in the review of the proposal and thesis (See Section 3.8).

By the end of the second year for Ph.D. students, the advisor (with the student’s input) will recommend two committees to the Graduate Program Coordinator; a Comprehensive Examination Committee, and a Studies Committee.

The Comprehensive Examination Committee will consist of at least five faculty members who are responsible for the student’s comprehensive examination (see Section 3.9). The Studies Committee will consist of at least four graduate faculty members, including: the student’s major advisor (who is a CEE Program faculty member), at least one other member of the CEE Program’s graduate faculty and at least one member of the graduate faculty from outside the CEE Program that will review and comment on the required coursework, research proposal and on the dissertation defense.

### 3.5 Written Research Proposal Requirements

All graduate students are required to prepare a written research proposal and to present this to their Studies Committees. The proposal will be presented by the end of the first calendar year for full-time M.S. students (See Section 3.8), and within one year of successful completion of the Comprehensive Examination for full-time Ph.D. students (See Section 3.9 for details) unless a time extension is approved by their committee and the Graduate Program Coordinator.

The written proposal must include the following; introduction to the topic, specific research goals and objectives, and/or hypotheses, pertinent background and literature review, methodology with sufficient detail, expected results, timeline and literature cited. This should be given to the committee members at least two weeks prior to the oral presentation. All Studies Committee members must attend the oral presentation of the proposal. The format for this oral presentation is left to the discretion of the advisor. If the committee does not feel that the proposal is adequate, they may allow the student an additional two-month time period to make appropriate modifications. Successful completion of this requirement should be reported to the Graduate Program Coordinator using the appropriate form in Appendix A.

### 3.6 Research Expectations

Students pursuing the M.S. thesis option and Ph.D. degrees are expected to work toward producing publishable research results. The research should be original and the students must demonstrate the
capability for independent research. In general, M.S. thesis option students generate one publishable research paper from their research, and Ph.D. students generate at least two research papers from their doctoral research.

The recommended format for the thesis and dissertation is the Journal Article Format, in which the various research chapters are written as articles publishable in a scholarly journal. Many faculty advisors only accept this format for their students. Generally, the student and advisor select an appropriate journal for expected publication and use that journal’s requirements as a guide. An Abstract, Introduction, Background and Conclusion Section are also required for the thesis or dissertation and are in addition to the journal article. Specific guidelines on the thesis and dissertation format can be obtained from the Graduate College. Guidelines for writing the articles can be obtained from the student’s advisor and committees.

3.7 Professional and Career Enhancement

Students go to graduate school for a variety of personal and professional reasons, and it is important for students to articulate their goals early in the program so that they can get the most out of their graduate school experiences. We recommend that students discuss their goals and career opportunities regularly with their advisors, committees, other faculty members and other students so that they can develop a clear vision of where they would like to be and what they would like to do when they graduate from the program.

Students should also take advantage of various opportunities for career development existing within the Programs, Graduate College, Center for Teaching and Learning, Training and Development and other groups on campus. Considerable information is available on the web or by inquiring at the Graduate College. Students should take an active role in their own professional and career development.

3.8 M.S. Degree Requirements

Students accepted into the M.S. program select either a thesis or non-thesis option within the first semester of enrollment. Generally, only thesis option students are funded by assistantships. The overall requirements for each option are presented in Table 2.

Coursework for M.S. Degree
Specific coursework for the M.S. degree is to be decided by the student and her/his Studies Committee, however, the following guidelines generally apply:

1. Six credits of statistics at the graduate level;
2. Twelve to fifteen credits of engineering coursework at the graduate level;
3. Three to six credits of coursework outside the Programs.
4. A minimum of 15 graded credits must be taken in residence at UVM.

The coursework should be laid out to enhance the student’s research experience, and to meet the interests and professional needs of the student. A maximum of one course at the 100 level is allowed subject to the approval of the Studies Committee before taking the course. The Graduate College must also be informed prior to taking the course. Under no circumstances is
coursework at less than the 100 level allowed for graduate credit. Coursework at the undergraduate level required by students to make up deficiencies at the undergraduate level may not be counted toward the graduate credit requirements.

Table 2. Requirements for thesis and non-thesis M.S. Degree options.

<table>
<thead>
<tr>
<th>Requirements</th>
<th>Thesis Option</th>
<th>Non-thesis Option</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Minimum Credits</td>
<td>30*</td>
<td>36</td>
</tr>
<tr>
<td>Research Credits</td>
<td>6-9</td>
<td>3</td>
</tr>
<tr>
<td>Comprehensive Examination</td>
<td>Oral Examination</td>
<td>Written Examination</td>
</tr>
<tr>
<td>Research Document</td>
<td>Thesis</td>
<td>Report</td>
</tr>
</tbody>
</table>

* includes research credits

Non-Thesis Option Project. A research project (taken as CE 295 special topics course) is required for the M.S. non-thesis option students. The approach and the topic will be developed by the student and advisor with input from the Studies Committee. This is usually a semester-long project resulting in a final report.

Comprehensive Examination
A comprehensive examination is required of all M.S. students and must be completed before the thesis defense. For M.S. thesis option students, this generally takes the form of an informal oral examination with the Studies Committee and often focuses around the basic principles behind the thesis research. This should generally take place in the semester preceding the thesis defense. The student should sign up for GRAD 397 during that semester.

For non-thesis option students, the required format is a written examination consisting of four to six topics related to the student’s course of study. The advisor solicits written questions from instructors from the courses the student has taken. This is usually taken in the last semester of their program. The student should sign up for GRAD 397 during that semester.

The comprehensive examination is graded satisfactory (S) or unsatisfactory (U). If unsatisfactory, the student may retake the examination with the advisor’s permission.

Time Limits and Residency
The maximum time for completion of the M.S. is 3 years for full-time students and 5 years for part-time students. Leave of absences, withdrawal from the program and continuous registration are all outlined by the Graduate College and are strictly adhered to by these Programs.

Master’s degree students must satisfactorily complete 21 credit hours in residence, 15 of which must be graded credits. This requirement is met by taking courses for graduate credit at UVM, as long as those credits are taken after a student has been admitted by the Graduate College to the
program in Civil and Environmental Engineering.

**Thesis Research**

The thesis *research* generally takes one to one and a half years to complete (generally working part time during the academic year and full time during the summer), and an additional three to six months for writing. M.S. students should determine their thesis topic by their second semester and begin a literature review during that semester. The *average* time to complete the M.S. is two years. This includes two summers actively involved in the research. Students should sign up for CE 391 *Master’s Thesis Research* for research credit.

**Thesis Format.** Students are required by the Graduate College to use a certain format for the thesis in terms of margins, fonts, and other details. The guidelines are laid out in “Guidelines for Writing a Thesis or Dissertation” and are available from the Graduate College. Students should also obtain a copy of the “Thesis/Dissertation Format-Defense Checklist” from the Graduate College probably 8-12 months prior to graduation. This document lists the steps necessary for obtaining a degree from the Graduate College and *should be read very carefully and used prior to graduating.*

The Graduate College presents a yearly calendar outlining deadlines for thesis defenses, for submission of the thesis and also provides the appropriate forms required to graduate by a certain time. This updated calendar and all forms can be found on the Graduate College Web site ([http://www.uvm.edu/~gradcoll/?Page=services.html](http://www.uvm.edu/~gradcoll/?Page=services.html)).

**Thesis Defense**

Students must enroll in GRAD 399 *Thesis Defense* prior to defending their thesis. They must also submit a public notice to the Graduate College informing them of the date and title of the thesis, one month prior to the defense date. A format check with the Graduate College staff should be scheduled three weeks prior to the defense.

The *Studies Committee* will act as the thesis defense examination committee. The chair of the committee will be the graduate faculty member who is outside the student’s Program. The members of the *Studies Committee* must receive a copy of the thesis at least two weeks prior to the defense date. The format for the defense is as follows:

1) Student gives a formal seminar on their thesis research. This should take between 40 and 45 minutes. Graduate students, other faculty, friends and interested people may attend. The talk should include an introduction, goals and objectives, methods, results and discussion, and conclusions. The general audience *is not allowed to* interrupt the speaker with questions during the defense.

2) After the presentation, the general audience may ask questions of the speaker for a maximum of approximately 15 minutes.

3) The audience leaves and the examination committee remains. Any member of the graduate faculty may remain also. The committee may then ask additional questions related to the research or related underlying principles. This usually takes about an hour, sometimes a little longer.

4) The student is then asked to leave the room and the committee discusses the thesis and its defense. The committee generally requests some changes, or additions, usually to the
discussion and analysis sections. Once the committee reaches consensus on the necessary changes, the student comes back into the room. If the changes are relatively minor, the student passes with the requirement of making the necessary changes and having those checked by the advisor. If major changes or additional work is required, then the student would be allowed additional time to complete the work and re-defend providing they are still within the required time-limits set forth by the Graduate College.

5) The necessary forms must be submitted to the Graduate College

The acceptability of the thesis is determined by the thesis defense committee. A grade of S or U is awarded. The student is allowed one re-examination if the examination performance was not satisfactory. After the defense, there may be numerous revisions required and the student should be aware of this possibility. After corrections have been made and the signature page has been signed the student must submit the original and two copies of the corrected thesis to the Graduate College within the specified time.

Students should make bound copies of the final thesis for the Program and their Advisor. Making other bound copies is at the student’s discretion. It is also advisable that students submit their journal papers before leaving UVM.

Remember it is ultimately the responsibility of the student to ensure that all requirements are met, not the advisor’s.

3.9 Ph.D. Degree Requirements

The general requirements for the degree of Doctor of Philosophy are outlined in the following sections. Some of these are similar to those outlined in the M.S. program and in those cases the reader will be directed to the previous sections. Table 3 lists some of the general requirements for the Ph.D. degree. Students should check the Graduate College website (http://www.uvm.edu/~gradcoll/) for the most recent information.

<table>
<thead>
<tr>
<th>Table 3. General requirements of Ph.D. degree.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total minimum number of credits</td>
</tr>
<tr>
<td>Minimum credits in residence</td>
</tr>
<tr>
<td>Total minimum number of research credits</td>
</tr>
<tr>
<td>Minimum number of graded course credits</td>
</tr>
<tr>
<td>Course work required outside of CEE</td>
</tr>
<tr>
<td>Significant teaching experience</td>
</tr>
<tr>
<td>Comprehensive Examination (5 topical areas)</td>
</tr>
<tr>
<td>Proposal Presentation</td>
</tr>
<tr>
<td>Successful Dissertation Defense</td>
</tr>
</tbody>
</table>

*includes research credits, see details below for CEE.

Coursework for Ph.D. Degree

The necessary coursework is determined by the student and his/her Studies Committee provided
they meet the general requirements of the Graduate College. A minimum of fifteen graded course credits is required by the Graduate College.

There are no specific course requirements for the Doctoral Degree, however, the student and her/his Studies Committee should make coursework decisions in order to address the following questions.

1) Will the course be necessary or useful for conducting the student’s dissertation research?
2) Will the course be necessary or useful for enhancing the student’s career?

There are CEE topical area requirements for the comprehensive examination that should also be considered when selecting courses. Student are recommended to have the following credit hours in these general areas:

1) Six credits of graduate level coursework in statistics;
2) Six credits of graduate level computational modeling or advanced mathematics; and
3) Eighteen credits of graduate level engineering coursework

It is possible to transfer up to 24 credits of graduate coursework from a M.S. program to the Ph.D. program upon approval by the Studies Committee and Graduate Program Coordinator.

Doctoral students may apply two 100-level, three-credit courses to their program given prior approval by their Studies Committee. The student’s advisor must petition the Graduate College for approval prior to enrollment in the course. Under no circumstances will a course numbered below 100 be applicable to a doctoral program.

**Significant Teaching Experience**

All doctoral students must have a semester-long significant teaching experience. This experience goes beyond grading, running help sessions or setting up and helping in the laboratory. A significant teaching experience is one in which the student develops course materials (including several of the following; lectures, example problems, lab exercises, homework problems, quiz questions and examination questions), presents course materials to the students, and works with the students. Examples range from developing and presenting a module within an existing course, running the laboratory section of a course, or developing and teaching a new course. The best way to gage whether something is a significant teaching experience is to determine whether it is something that a typical Master’s-level teaching assistant would do. If it is, then it is not a significant teaching experience.

Students should discuss ideas on a significant teaching experience with the Graduate Program Coordinator and Advisor.

**Comprehensive Examination**

*Topical Areas of CEE Comprehensive Examination.* A comprehensive examination is required of all Ph.D. students and should be completed by the end of their second year in the doctoral program after they have taken at least 24 credits of graduate coursework in different topical areas. Some or all of the 24 credits required may be transferred in from their Masters degree, if desired. Passing the comprehensive examination, successful proposal presentation, and one year of residency at UVM
are needed for advancement to Ph.D. candidacy.

The comprehensive examination covers five topics or courses, from three topical areas. The three areas are described below.

**Area 1. One topic from the following three:**
1. Advanced Mathematical Methods (e.g. CE 304, 305)
2. Advanced Statistical Methods (e.g. STAT 231, STAT 225)
3. Probabilistic Methods (e.g. EE 270)

**Area 2. Two topics from the following eight:**
1. Water and Wastewater Engineering (e.g. CE 254, CE 255, CE 256)
2. Air Pollution, Hazardous Waste (e.g. CE 252, CE 253, CE 248)
3. Hydrology (e.g. CE 260, CE 360)
4. Groundwater (e.g. CE 265, CE 365)
5. Advanced Fluids (e.g. CE 261)
6. Advanced Civil Engineering Analysis (e.g. CE 226, CE 372)
7. Advanced Soils (e.g. CE 280, CE 282, CE 283)
8. Transportation Systems (CE241, CE245)

**Area 3. Two topics from the following four:**
1. Numerical Methods (e.g. CE 220)
2. Computational Modeling (e.g. CE 366)
3. Information Technology Applications (e.g. NR 285 (GIS), CS 256, CS 331)
4. Optional Area subject to approval by Studies Committee

**Comprehensive Exam Committee.** The five members of the Comprehensive Examination Committee will test the student in five appropriate topics selected from the previous list. Each faculty member will be responsible for one of the five topics. Students generally select from courses that they have had at UVM, but occasionally a student may select a faculty member that they did not have, but covers a topic that they have taken. The student and Advisor select the Comprehensive Examination Committee based on the following requirements:

1. All FIVE faculty must be approved members of the UVM Graduate Faculty.
2. ONE Major Advisor, who is member of CEE Program graduate faculty.
3. At least ONE other member of CEE Program graduate faculty.
4. At least ONE member from outside the CEE Program
5. TWO other members who are approved Graduate Faculty.

**Ph.D. Comprehensive Examination Logistics**

Students should be advised (by major advisor) to register for the appropriate Graduate College course (Grad 497 for PhD) during the semester they plan to take the Comprehensive Examination (typically at the end of Year 2 of their coursework).

The Ph.D. comprehensive examinations will be offered two times per academic year, generally
the week after Winter Break (i.e., early January) and one week after Spring semester final exams are concluded. Specific dates for the 2-day examination are determined by the student and his/her major advisor using the following procedures:

**Step 1.** At beginning of each semester the Grad Coordinator will request names of students who are expected to take Comp Exams during that semester. These students should register for GRAD 497.

**Step 2.**
1. The Ph.D. candidate's major advisor will administer both the written and oral components of the Comprehensive Exam in the following general sequence:
   a. Major advisor and student identify 5 faculty who will examine the student. Note that courses and faculty must be selected to encompass the three Topic Areas outlined in Section 3.9 of the CEE Graduate Handbook: Mathematical Methods & Statistics (1 topic), Civil & Environmental Engineering (2 topics), Modeling & Quantitative Methods (2 topics).
   b. Advisor emails faculty associated with each course/topic area to confirm participation in the Comprehensive Exam during the semester's exam period (this will routinely be the week following Final exams during both Fall and Spring semesters).
   c. Advisor notifies the Graduate Coordinator regarding the planned logistics for the written component of the Comprehensive Examination. The following information will be communicated:
      - List of FIVE faculty who comprise the Comprehensive Exam Committee
      - The course number/name (indicating Topic Area satisfied by each course).
      - Format of exam questions - closed or open book
      - Proposed date for written examination (within the week after final exams)
      - Proposed date and format for oral examination. The oral exam will take place within one week of the written examination using a format to be determined by the student's Major Advisor.
        Options for the oral exam format include: (1) One-on-one 30-minute meetings between each Exam Committee faculty member with the student followed by a full Comprehensive Examination Committee meeting without the student; (2) the full Examination Committee conducts a single two-hour oral exam of student.

**Step 3.**
The student should talk to each committee member prior to the examination to determine the format and scope of each question. The final date of the written exam will be set by the Graduate Coordinator after assembling information from all CEE faculty. The Graduate Coordinator will be responsible for reserving a room for the written exam for all students taking the exam that semester.

**Step 4.**
The Graduate Program Coordinator solicits the questions from the examiners and administers the written examination to all students on the Examination Date. The written examination is 6 hours in duration. After the exam, the Graduate Program Coordinator returns the examination to the appropriate committee members to be graded.

**Step 5.**
The Major Advisor will be responsible for coordinating the oral exam logistics with the Comprehensive Exam faculty and for reporting the outcome of the Comprehensive Exam to the
Graduate Coordinator by providing a signed photocopy of the Graduate College form, "Outcome of Comprehensive Exam".

The Comprehensive Examination must be passed at least 6 months before submitting the dissertation. Success in the Comprehensive Examination is prerequisite for an oral Dissertation Defense Examination. The student must enroll in GRAD 497 “Doctoral Comprehensive Examination” prior to taking the examination.

The comprehensive examination is graded either (i) Satisfactory, (ii) Unsatisfactory or (iii) Unsatisfactory with Committee’s recommendation to re-examine. The committee is under no obligation to allow a second (and final) sitting for the exam.

Time Limits and Residency
The maximum time for completion of the Ph.D. is 9 years for all students. Leave of absences, withdrawal from the program and continuous registration are all outlined by the Graduate College and are strictly adhered to within these Programs.

Doctoral students must satisfactorily complete 51 credit hours in residence, of which at least 15 must be graded credits. This requirement is met by taking courses for graduate credit at UVM, as long as those credits are taken after a student has been admitted by the Graduate College to the program in Civil and Environmental Engineering.

Ph.D. Studies Committee Composition
Each PhD student will form, in consultation with their Major Advisor, a Studies Committee that will serve two functions: (i) to guide and assist the student in the completion of their dissertation research; and (ii) provide breadth of expertise to the student. The Ph.D. Studies Committee must be comprised of the following FOUR faculty (at a minimum):

a. Major Advisor, who is a member of the CEE Graduate Program faculty.
b. At least ONE other member of CEE Graduate Program faculty.
c. At least ONE member from outside the CEE Program (one of whom will be designated as Chair of the Studies Committee).
d. At least ONE other member of the UVM Graduate Faculty.

Ph.D. Dissertation Proposal
Ph.D. candidates who have successfully passed the Comprehensive Examination will complete both a written and an oral defense of their dissertation research topic. The purpose of the Proposal is to inform the Studies Committee about the anticipated direction of the student’s body of research that will comprise their dissertation. This allows the student's Studies Committee to provide the student with oral feedback on the proposed research topic and methodology. The proposal must be defended within 1 year of successful completion of the Comprehensive Exam. The written proposal document shall be aligned with the student's dissertation topic.

Proposal Format. Ph.D. students must use the NSF (National Science Foundation) Grant Proposal Guide to write their thesis proposal as if they were submitting a proposal to a federal funding agency. This provides practical grant writing experience for our students and limits the Project Description to 15 pages. The NSF Grant Proposal Guide is available for download at the NSF
Proposals

Proposal Logistics. The following guidelines shall be followed regarding the Dissertation Proposal requirement. Typically, the Ph.D. dissertation research proposal is completed in Year 3, but must be successfully defended at least six months in advance of a Ph.D. student’s defense of their dissertation.

1. The written Proposal document shall be submitted to the student’s Studies Committee at least two weeks prior to the oral proposal defense to give faculty sufficient time to review the document.

2. The Oral proposal defense shall include both a public presentation seminar (typically, but not required, at the CEE Graduate Seminar) and a closed session of the student with his/her Studies Committee.

3. The Ph.D. candidate is responsible for scheduling both sections of the oral proposal defense with their Studies Committee.

4. The candidate’s Major Advisor will communicate the outcome of proposal defense to the Graduate Coordinator within 1 week of the oral defense via email communication.

5. The Proposal must be successfully defended more than six months prior to the Dissertation Defense.

Dissertation Research

The dissertation research generally takes three to six years to complete and depends primarily on the student’s background and experience. Students with an M.S. and previous research experience generally finish within four years. Students without an M.S. degree generally take five or more years to finish. Students should sign up for CE 491 Doctoral Dissertation Research for research credit.

Dissertation Format. Students are required by the Graduate College to use a certain format for the Dissertation in terms of margins, fonts, and other details. The guidelines are laid out in “Guidelines for Writing a Thesis or Dissertation” and are available from the Graduate College. Students should also obtain a copy of the “Thesis/Dissertation Format-Defense Checklist” from the Graduate College probably 8-12 months prior to graduation. This document lists the steps necessary for obtaining a degree from the Graduate College and should be read very carefully and referred to often prior to graduating.

The Graduate College presents a yearly calendar outlining deadlines for defenses, and the
submission of the dissertation and the appropriate forms in order to graduate by a certain time. This updated calendar and all forms can be found on the Graduate College Web site (
http://www.uvm.edu/~gradcoll/?Page=services.html).

Dissertation Defense
Students must enroll in GRAD 499 Dissertation Defense prior to defending their dissertation. They must have completed their comprehensive examination and submitted their dissertation to the Graduate College for a format/record check. They must also submit a notice to the Graduate College informing them of the date and title of the dissertation, and members of their Studies Committee one month prior to the defense date. The Studies Committee will act as the dissertation defense examination committee. All members must be Graduate College faculty members. The chair of the Studies Committee will be the graduate faculty member who is outside the student’s Program. The members of the Studies Committee must receive a copy of the thesis at least two weeks prior to the defense date. The format for the defense is the same as that discussed in the Thesis Defense Section of the M.S. Requirements.

The acceptability of the dissertation is determined by the Studies Committee. A grade of S or U is awarded. The student is allowed one re-examination if the examination performance was not satisfactory. After the defense, there may be numerous revisions required and the student should be aware of this possibility. After corrections have been made and the signature page has been signed the student must submit the original and three copies of the corrected dissertation to the Graduate College within the specified time.

Students should make bound copies of the final dissertation for the Program and their Advisor. Making other bound copies is at the student’s discretion. It is also advisable that students submit their journal papers before leaving.

Remember it is ultimately the responsibility of the student to ensure that all requirements are met, not the advisor’s.

4. GRADUATE ACTIVITIES

4.1 Graduate Seminars
Faculty and graduate students within the Program organize a weekly seminar series that operates both Fall and Spring semesters. All full-time students must regularly attend. This has been ongoing in the Program since the early 1990s. The seminar series includes a mixture of invited speakers (from academia and industry), faculty speakers (from the Programs and elsewhere at UVM) and graduate student speakers. The seminar series provides an opportunity for fostering interdisciplinary research where:

1) students to annually present a talk on their research or other projects;
2) students to practice public speaking and oral presentation; and
3) students and faculty to get know each other’s work.

This is extremely beneficial for the students in that they get input from other faculty and students
during their research phase. Another benefit of the seminar series is that it exposes the students and faculty to cutting edge research and innovative engineering applications by bringing in invited speakers from around the country.

The weekly graduate seminar series provides an opportunity for faculty and graduate students to get together, thereby enhancing the sense of community within the Programs. Graduate students alternate bringing in food and drinks, creating a very friendly and collegial atmosphere preceding the formal talk.

4.2 Participation in National Scientific Meetings
All M.S. thesis and doctoral students should attend and present a paper to at least one scientific meeting during their tenure within the program. Generally, funds are available through the advisor’s research grants, Program funds, or Graduate College “mini” travel grants. Applications for the mini grant are called for each fall and spring by the Graduate College (www.uvm.edu/~gradcoll/).

4.3 Participation in Program Activities
All graduate students are expected to participate in some of the various Program and University activities that occur regularly throughout the academic year. These include outreach activities to K-12 students, organizing the seminar series, faculty search committee members, conference organizing, university-wide committees on graduate education, meeting with Program visitors, and other activities. These are important for the student’s professional development as well as enhancing the Program as a whole.

5. FELLOWSHIPS AND FINANCIAL AID
Generally, all full-time graduate students within the Programs that do not have their own funding are funded on either Graduate Teaching Assistantships (GTAs) or Graduate Research Assistantships (GRAs). These assistantships are initially awarded on a competitive basis based on the student’s application and experience, and on personal communications with the CEE faculty. Both GTA and GRA appointments are awarded with the expectation of 20 hours per week devoted to either a teaching or research assignment. Generally, upon maintenance of good standing within the program, the student will continue to receive funding throughout their UVM academic career.

5.1 Graduate Teaching Assistantship (GTA)
GTA appointments provide a stipend and 10 free credits per semester for the student and are appointed by the Dean of the Graduate College on recommendation from the CEE Program. They are 9 month appointments. A GTA is expected to assist in teaching courses for a maximum of 20 hours per week. Duties often include setting up and assisting in laboratories, grading, running help sessions, and tutoring students. Generally, students cannot receive GTA support for more than four semesters.

5.2 Graduate Research Assistantship (GRA)
GRA appointments are supported by individual faculty research grants and generally provide a larger stipend than the GTA, because the student must pay their own tuition. Tuition is at the in-state level when students receive a GRA. Appointments typically run for an academic year or summer period with a 100% GRA appointment representing 20 hours of research per week. GRA
students assist the faculty member in their research, which is usually, although not necessarily, part of the student’s thesis research.

5.3. Fellowship Grants

**National.** Students are encouraged to compete for national graduate fellowships, such as those made available by the National Science Foundation (NSF) or private foundations. Students should talk to their advisor about possible fellowship opportunities.

Some information about fellowships relevant to Civil & Environmental Engineers include:

- EPA STAR FELLOWSHIP  

- NSF GRADUATE FELLOWSHIP  

- SWITZER FOUNDATION ENVIRONMENTAL FELLOWSHIP  
  [http://www.switzernetwork.org/home.html](http://www.switzernetwork.org/home.html)

- FHWA DWIGHT DAVID EISENHOWER TRANSPORTATION FELLOWSHIP  
  [http://www.fhwa.dot.gov/opd/universitygrants.htm#FellowshipsFandI](http://www.fhwa.dot.gov/opd/universitygrants.htm#FellowshipsFandI)

Students on Research Assistantships or their own funding should look into the tuition payment plan so that they do not have to pay a large tuition bill at the beginning of each semester. In addition, direct deposit of paychecks is available for graduate students. You just need to go to the Payroll Office in Waterman and fill out a slip with a deposit and a voided check.

**Campus Fellowships.** Additional fellowships are available through various research programs at UVM. These include the Transportation Research Center ([www.uvm.edu/~transcenter](http://www.uvm.edu/~transcenter)) and the Complex Systems Center ([www.uvm.edu/cems/~cpxsys/](http://www.uvm.edu/cems/~cpxsys/)).

6. COURSE INFORMATION

Current graduate course offerings within the Programs are shown in Table 4. In addition, new topics are offered occasionally through CE 295 and CE 395, *Advanced Special Topics*. The courses shown below are generally offered each year, alternating years, or based on student interest.

**Table 4. Graduate Courses Regularly Offered in the Programs of Civil and Environmental Engineering**

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>CE 220</td>
<td>Introduction to Finite Element Analysis</td>
</tr>
<tr>
<td>CE 226</td>
<td>Civil Engineering Systems Analysis</td>
</tr>
<tr>
<td>CE 241</td>
<td>Traffic Operations and Design</td>
</tr>
<tr>
<td>CE 245</td>
<td>Intelligent Transportation Systems</td>
</tr>
<tr>
<td>CE 248</td>
<td>Hazardous Waste Management Engineering</td>
</tr>
<tr>
<td>CE 249</td>
<td>Solid Wastes</td>
</tr>
<tr>
<td>CE 251</td>
<td>Environmental Facility Design/Wastewater</td>
</tr>
<tr>
<td>CE 253</td>
<td>Air Pollution</td>
</tr>
<tr>
<td>CE 254</td>
<td>Environmental Quality Analysis</td>
</tr>
</tbody>
</table>
In addition, our graduate students typically take several mathematics and statistics courses because of their importance in engineering research and education. Courses typically taken by our graduate students from other departments are shown in Table 5.

Table 5. Example Courses Often Taken by Civil and Environmental Engineering Graduate Students Outside of CEE

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>MATH 237</td>
<td>Introduction to Numerical Analysis</td>
</tr>
<tr>
<td>MATH 238</td>
<td>Introduction to Differential Equations</td>
</tr>
<tr>
<td>MATH 240</td>
<td>Fourier Series and Integral Transforms</td>
</tr>
<tr>
<td>MATH 268</td>
<td>Mathematical Biology and Ecology</td>
</tr>
<tr>
<td>MATH 264</td>
<td>Vector Analysis</td>
</tr>
<tr>
<td>MATH 266</td>
<td>Chaos, Fractals, and Dynamic Systems</td>
</tr>
<tr>
<td>STAT 201</td>
<td>Statistical Analysis Via Computer</td>
</tr>
<tr>
<td>STAT 211</td>
<td>Statistical Methods I</td>
</tr>
<tr>
<td>STAT 221</td>
<td>Statistical Methods II</td>
</tr>
<tr>
<td>STAT 223</td>
<td>Applied Multivariate Analysis</td>
</tr>
<tr>
<td>STAT 225</td>
<td>Applied Regression Analysis</td>
</tr>
<tr>
<td>STAT 231</td>
<td>Experimental Design</td>
</tr>
<tr>
<td>STAT 237</td>
<td>Nonparametric Statistical Methods</td>
</tr>
<tr>
<td>NR 270</td>
<td>Toxic and Hazardous Substances in Surface Water</td>
</tr>
<tr>
<td>NR 278</td>
<td>Principles of Aquatic Systems</td>
</tr>
<tr>
<td>NR 285</td>
<td>Geographical Information Systems</td>
</tr>
<tr>
<td>BOT 261</td>
<td>Plant Growth and Development</td>
</tr>
<tr>
<td>GEOL 352</td>
<td>Environmental Geology Seminar</td>
</tr>
<tr>
<td>GEOL 371</td>
<td>Critical Analytical Writing</td>
</tr>
<tr>
<td>CS 251</td>
<td>Machine Intelligence</td>
</tr>
<tr>
<td>CS 256</td>
<td>Neural Computation</td>
</tr>
<tr>
<td>CS 295</td>
<td>Data Mining</td>
</tr>
</tbody>
</table>

CE 255  Physical/Chemical Processes for Water & Wastewater Treatment
CE 256  Biological Processes for Water & Wastewater Treatment
CE 259  Measurement of Airborne Contaminants
CE 260  Hydrology
CE 261  Open Channel Flow
CE 265  Groundwater Hydrology
CE 272  Structural Dynamics
CE 280  Applied Soil Mechanics
CE 281  Designing with Geosynthetics
CE 282  Engineering Properties of Soils
CE 290  Engineering Investigation
CE 295  Special Topics (Examples include Renewable Energy Systems, Wastewater Wetlands in Mexico)
CE 304  Advanced Engineering Analysis I
CE 305  Advanced Engineering Analysis II
CE 321  Engineering Computations on Advanced Architectures
CE 360  Advanced Hydrology
CE 361  Fluvial Forms and Processes
CE 365  Contaminant Hydrogeology & Remediation
CE 366  Numerical Methods for Surface Water Processes
CE 367  Physics of Flow and Transport through Porous Media
CE 368  Groundwater Modeling
CE 369  Applied Geostatistics
CE 390  Advanced Topics in Civil & Environmental Engineering
CE 391  Masters Thesis Research
CE 395  Advanced Special Topics (Examples include Fluvial Forms and Processes, Geostatistics, Multiphase Flow)
CE 491  Doctoral Dissertation Research
APPENDIX A. CEE Program Forms for Graduate Students

Student Record Forms
A.1. Student Record for the M.S. Degree (1 page)
A.2. Student Record for the Ph.D. Degree (2 pages)
A.3. Dissertation or Thesis Proposal Defense Form (1 page)
Programs of Civil and Environmental Engineering
University of Vermont

Student Record for the Master of Science Degree
(Return to Graduate Program Coordinator Annually)

Name ____________________________________________ Date __________

Date Matriculated into Program __________________________________________________

Thesis Advisor ________________________________________________________________

Studies Committee Members and Department

1)____________________________________________________

2)____________________________________________________

3)____________________________________________________

Title/Subject of Thesis (Project):

Credits for Degree (30 Thesis, 36 Non-thesis)

<table>
<thead>
<tr>
<th>Course Number and Name</th>
<th>Grade</th>
<th>Credits</th>
<th>Course Number and Name</th>
<th>Grade</th>
<th>Credits</th>
</tr>
</thead>
</table>

Research Credits Accrued (CE 391) __________________________________

Date of Thesis Proposal Presentation _________________________________

Dates of Studies Committee Meetings ________________________________

Comprehensive Exam, Date Completed (Must Sign up for GRAD397 semester preceding defense) ________________________________

Thesis Defense Date (Must Sign up for GRAD399) ___________________________
Programs of Civil and Environmental Engineering
University of Vermont

Student Record for the Doctor of Philosophy Degree
(Return to Graduate Program Coordinator Annually)

Name ___________________________ Date _____________

Date Entered Program _____________________________

Dissertation Advisor _____________________________

Studies Committee Members and Department
1) _________________________________________________
2) _________________________________________________
3) _________________________________________________
4) _________________________________________________

Comprehensive Examination Committee Members and Department
1) _________________________________________________
2) _________________________________________________
3) _________________________________________________
4) _________________________________________________
5) _________________________________________________

Title/Subject of Dissertation

Date of Dissertation Proposal Presentation ________________

Dates of Studies Committee Meetings _______________________________

Comprehensive Examination, Date Completed (Must Sign up for Grad 497) ______________

________________________________________________

Dissertation Defense Date (Must Sign up for Grad 499 Prior to Defense) ______________
### Course Credits for Degree

<table>
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<th>Grade</th>
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### Course Credits Transferred

<table>
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Research Credits Accrued (CE 491): ____________________________
Programs of Civil and Environmental Engineering
University of Vermont

Dissertation or Thesis Proposal Defense Form
(Return to Graduate Program Coordinator)

Student Name

Date of Proposal Defense

Title of Proposal

Decision (pass, fail, retake)

Studies Committee Members and Signatures
1)
2)
3)
4)