

Environmental and Water Resources Engineering Program

Requirements for the Doctor of Philosophy Degree in Civil Engineering, Environmental and Water Resources Engineering Emphasis February 2024

This document describes procedures followed by full-time students pursuing the PhD degree. These procedures have been developed by the Environmental and Water Resources (EWR) Engineering faculty. The procedures for part-time PhD students are the same, although the timeline for completion will be established on a case-by-case basis. Students should also consult the [“Graduate Policies and Procedures Manual”](#) of the Department of Civil and Environmental Engineering as well as the [“Graduate Policies and Procedures and Course Catalog”](#) of Virginia Tech, as these two documents contain general policies and procedures that apply to all PhD degrees. **All students entering EWR’s PhD degree program must complete [the EWR Graduate Degree Requirements Contract](#) within the first two weeks of entering the program.**

The following procedures are described in this document:

1. Formal Application to the PhD Program
2. Degree Requirements
3. Selection of PhD Committee and Development of Program of Study
4. Satisfactory Academic Progress
5. Qualifying Examination
6. Preliminary Examination
7. Annual Committee Meetings
8. Final Dissertation Defense
9. Direct PhD Program

1. Formal Application to the PhD Program

This occurs prior to beginning the program. The student should formally apply to the PhD program so the proper forms and records can be generated. Following admission, Master's students may convert to a direct PhD with approval of EWR faculty or apply to the PhD program after completion of the Master's degree.

2. Degree Requirements

Candidates for the PhD degree must complete 90 semester hours of graduate credit including a minimum of 27 credits of 5000-level course work and 30 credits of Research and Dissertation (CEE 7994). Each PhD student must complete the Residency Requirements, pass Qualifying and Preliminary Exams, and complete and successfully defend a dissertation. For a complete description of degree requirements mandated specifically by the Graduate School consult the [Graduate Catalog](#).

Specific courses for a PhD student are usually selected on a case-by-case basis depending on the

student's background and research topic. All PhD students are required to complete one of these two foundational course requirements, or with permission of the committee a combination of these two requirements:

(A) Environmental Core Courses – Complete two courses from:

| | | |
|------------------------------------|--|---|
| CEE 5104 – Environmental Chemistry | CEE 5304 – Environmental Fluid Mechanics | CEE 5794 – Environmental Engineering Principles |
|------------------------------------|--|---|

(B) Foundational Water Resources Courses – Complete a minimum of 9 credits in water resources subjects

| | | |
|--|---|--|
| CEE 5130 - Turbulence | CEE 5314 - River Mechanics & Sed Trans | CEE 5384 - Adv Open Channel |
| CEE 5174 - Applied Analytics for Env. Science and CE | CEE 5334 - Hydrology/ Quantitative Hydro | CEE 5390 - Adv Urban Water Sustain |
| CEE 5244 - Adv GIS in Hydrologic Analysis | CEE 5344 - Surface Water-Groundwater Inter | CEE 5854G - Adv Coastal Engr |
| CEE 5304 - Environmental Fluid Mechanics | CEE 5374 - Dynamics Groundwater | planned - Advanced Topics in Water Resources Eng. |
| CEE 5864 - Coastal and Estuarine Morphodynamics | CEE 5814 - Structure-Sediment Interaction in the Coastal Zone | CEE 5140 - Pollutant Fate and Transport in the Environment |
| CEE 5354 Num. Mod. Groundwater | | |

With major advisor and PhD committee approval, PhD students with an MS from EWR's MS program may request up to 27 course credits be accepted to meet PhD coursework requirements. With advisor and PhD committee approval, up to 13 credits of courses taken at other universities can be accepted to meet PhD coursework requirements; credits transferred to meet the EWR's foundational course requirements additionally require the approval of the EWR faculty member in charge of the course.

All PhD students are required to complete two semesters of EWR Seminar (CEE 5944). Credits associated with CEE 5944 do not count toward the minimum degree requirements for any degree. All students must complete Appendix A – Worksheet for Verifying Core Knowledge Base, which will determine if specific undergraduate courses are required. Courses at the 3000 level or below, and some 4000 level courses, do not count towards minimum degree requirements.

The Graduate School offers several certificate options through the Transformative Graduate Education Program. Students who complete professional development certificate programs,

which typically require a minimum of 9 credit hours and are housed under the Transformative Graduate Education program at the Graduate School or the Engineering Education Graduate Certificate in the College of Engineering can request approval from their Advisory Committee to count up to 3 credit hours earned as part of the certificate program toward the 15 credit hours required for the PhD degree.

3. Selection of PhD Committee and Development of Program of Study

All students must develop an approved Program of Study for the PhD degree prior to completing 15 credit hours of graduate study beyond the MS degree at Virginia Tech. Each student should work with their major advisor to develop a Program of Study and choose a PhD Advisory Committee during the first academic year in the PhD program. Additional requirements for the Program of Study may be found in the CEE Graduate Policies and Procedures Manual. The PhD Committee should consist of at least four faculty members with two or more members from the EWR Engineering Program. At least one member of the committee should be from outside the CEE Department. Members of the graduate advisory committee will evaluate the student's progress at committee meetings and be available for consultation with the student. The student should initiate a search for a research dissertation topic during the first academic year in the PhD program in consultation with their advisor and graduate advisory committee.

4. Satisfactory Academic Progress

Academic performance will be monitored by the EWR Engineering faculty each year the student is enrolled. At the end of every Spring semester, each student will submit a progress report to the CEE Department and for review by their advisor and graduate advisory committee. If satisfactory progress toward the PhD degree is not demonstrated, permission to continue may be denied. This decision may be reached by the PhD Committee, the EWR Engineering faculty, or the CEE Department Head, and recommended to the Graduate School for action.

Should concerns arise regarding academic performance, the student will be notified in writing. The letter will indicate the specific concerns of the faculty, the corrective actions that must be taken, and the time frame for achieving such progress. Normally, the notification procedure will also provide for a meeting between the student and the faculty so that concerns regarding academic performance can be discussed. The faculty will reconvene at a later date to review progress and make a formal decision on whether the student will be allowed to continue in the PhD program.

5. Qualifying Examination

Scope – The Qualifying Exam consists of a written critical review of a technical paper followed by an oral presentation and exam. The goal of the qualifying exam is to ensure that the student has the ability to learn independently, write concisely, think critically, make a brief oral presentation, and answer questions logically. Qualifying Exams are administered at the program level and are not scheduled or approved through the Graduate School.

Scheduling – The Qualifying Exam is administered twice each year (January and August). PhD students who already have an MS degree typically take the exam at the end of the first year,

prior to the start of their third semester. Students are additionally advised to have completed CEE 5794 Environmental Engineering Principles or to have taken at least one of EWR's Foundational Water Resources courses before taking the qualifier. Students in the direct PhD program are advised to complete three semesters, or a minimum of 24 hours of graduate course credit, before taking the qualifier. Students should consult with the qualifier exam coordinators if there are any questions regarding their readiness for the exam.

Administration – In consultation with the EWR Engineering faculty, the faculty coordinator of the Qualifying Exam will provide students with two peer-reviewed research papers from which each student will select one to critically evaluate. The paper will be chosen from an area outside the student's core area of proficiency within environmental and water resources engineering. Approximately one week will be allowed to read the paper, to obtain and read any references necessary to understand the material, to critically evaluate the paper, and to write a review that is not to exceed four pages. After handing in the critical review, the student will be required to orally present and defend the review in front of three Environmental and Water Resources Engineering faculty members (none of whom may be the student's Advisor(s)). After reading the written paper review and discussing the student's performance in the oral exam, the faculty will assign a grade of pass or fail.

The exam may be re-taken once if the student fails, or the faculty may recommend other steps to address identified deficiencies. The decision for a second failure is made by the EWR faculty as a whole, based on input from the examining committee. In the event of two failures, the student is deemed not suitable to continue the Ph.D. program. Guidelines for the critical review will be provided to each student prior to the exam. After passing the qualifying exam, the academic progress of the student becomes the responsibility of the PhD Committee.

6. Preliminary Examination

Scope – The Preliminary Exam is the responsibility of the PhD Committee. It will typically consist of the preparation and presentation of a dissertation research proposal, but the student's advisor, in consultation with the committee, may add other components to the exam.

Scheduling – The Preliminary Exam is typically scheduled sometime following the successful completion of a minimum of 24 credit hours (two semesters) and passing the Qualifying Exam. Although rarely scheduled in a student's final academic year, the Preliminary Exam cannot be scheduled less than nine months prior to the Dissertation Defense. Students must be enrolled to take the Preliminary Exam. The Preliminary Exam must be scheduled through the Graduate School at least two full weeks prior to the proposed defense date. Each member of the Advisory Committee must approve the request.

Dissertation Proposal – The proposal outlines the goals and details of the proposed research and should be developed with the input of the Faculty Advisor. An example structure for the document may be found in Appendix B.

The entire proposal should generally adhere to the current formatting requirements for a National Science Foundation proposal (12 point font, 15 pages single spaced including figures and tables, references on additional pages). Exceptions to these rules may be made with prior approval of

the committee. The bulk of the proposal should be the details contained in the Research Plan (roughly one-half of the proposal). The proposal should be well-written and neatly presented. References should be provided in a standard journal format.

The student is responsible for scheduling the Preliminary Exam through the Graduate School in consultation with their committee. The dissertation proposal must be presented orally to the committee at the Preliminary Exam. The proposal must be distributed to the members of the committee prior to scheduling the exam through the Graduate School. Faculty may request an opportunity to review the proposal before approving the exam date. Although not required, the dissertation proposal can be given in front of a general audience. Following the presentation, and questions from the general audience, the exam will continue in private. The student should be prepared to answer questions pertaining to the proposal and related coursework from their committee.

Administration – The presentation should focus on the major hypotheses of the research and the means by which they will be tested. The presentation should last no more than 30 minutes (not counting questions). Following the presentation, time will be allowed for questions from the general audience. Following the public portion of the presentation, the research committee will privately discuss the dissertation proposal with the student and then (after a brief, private committee session) approve or disapprove the proposal. Approval of the proposal is based on the originality and feasibility of the proposed research and the clarity of the objectives and hypothesis/experiment relationships. If the proposal is approved, the student may continue with the research.

The proposal may also be conditionally approved or disapproved. Depending on the consensus of the committee, the student may be required to (a) make selected changes to the proposal as specified by committee members, or (b) completely revise and resubmit the proposal. Revision requirements will include a time period within which the revisions must be completed.

7. Annual Committee Meetings

PhD Advisory Committee meetings must be held at least once a year. The purpose of these meetings is to keep the committee informed of academic and research progress. The Qualifying and Preliminary Examinations may count as committee meetings. At other committee meetings, the student is expected to give a formal progress report. The members of the PhD Committee will evaluate the student's progress (satisfactory or unsatisfactory) at least once a year and will produce a progress report which will be shared with the student. As per CEE Department policies and procedures, appropriate documentation of these meetings is required.

The Graduate School requires that the progress of each graduate student be evaluated by the Advisory Committee at least once a year, and that a report be placed in the student's file. In addition, **the CEE Department requires all graduate students to submit a written annual progress report.** By the end of each Spring semester, each student will submit a 1-page report to their Major Advisor that summarizes coursework, research activities, achievements, and plans for future progress over the past 12 months or from their date of admission if in their first year. In the academic year in which a student completes all degree requirements before the end of the Spring semester, no report is required.

8. Final Dissertation Defense

At the completion of the research work, the student must prepare and defend a dissertation covering all aspects of the research. Students are encouraged to use the journal format for the dissertation document and should follow the guidelines in Appendix C. A student should not schedule a Final Exam without the full consent of their advisor and committee members. The Final Exam must be scheduled through the Graduate School at least two full weeks prior to the proposed defense date. Each member of the Advisory Committee must approve the request.

A complete version of the dissertation should be distributed to the PhD committee members prior to scheduling the defense through the Graduate School. Faculty may request an opportunity to review the draft dissertation before approving the defense date. The student should “advertise” the defense at least a week in advance and schedule it in a room that allows interested people to attend.

The defense consists of a public presentation (lasting no longer than 45 minutes), public questions (no more than 15 minutes), and a private examination by the dissertation committee. The committee examination will result in either a consensus of approval or additional requirements for the successful completion of the dissertation. Final completion of the dissertation will be contingent on the approval of required changes by all members of the PhD committee. The PhD committee members will enter a grade of pass/fail via the online graduate school approval system.

9. Direct PhD Program

Traditionally, students aspiring for the PhD through the EWR Engineering program have entered the doctoral program after completing an MS with thesis. Recent trends, however, suggest that many students desire to directly enter the PhD program without getting an MS degree. Making this decision has potential advantages (the student may qualify early for PhD- level funding) and disadvantages (chance of leaving without a research degree if the student drops out) that are beyond the scope of this document. Prospective students who want to directly enter the PhD program may do so either at the time of their application to the department or thereafter when enrolled as an MS student. It is expected that a MS student considering a change in degree consult with their permanent major advisor and obtain their endorsement first. Typically, this occurs after the student has completed at least one semester of study as an MS student.

Applicants for the direct PhD program who have not entered the graduate program at Virginia Tech: These applications will be reviewed by the EWR Engineering admissions committee and a decision will be made as to an applicant’s merit. Those applications that are approved by the admissions committee will be directed to faculty whose research interests overlap with those of the applicant. Individual faculty members may offer PhD level research assistantships to those students they would like to hire.

Applicants who are currently MS students: MS students may petition to convert to the direct PhD program in consultation with and approval of their primary advisor. Students must complete and have approved a Change of Degree Status form through the CEE Department and the Graduate

School.

In consultation with their advisor, candidates in the direct PhD program are strongly encouraged to complete an MS degree as they progress through the direct PhD program.

Candidates in the direct PhD program are advised to take the Qualifying Exam after they have completed three semesters in the program, or a minimum of 24 hours of graduate course credit. Students are additionally advised to have completed CEE 5794 Environmental Engineering Principles or to have taken at least one of EWR's Foundational Water Resources courses before taking the qualifier. Students should consult with the qualifier exam coordinators if there are any questions regarding their readiness for the exam.

Direct PhD candidates must complete at least 27 course credits (seminar not included) and meet all degree requirements as outlined in Section 2.

Appendix A

Worksheet for Verifying Core Knowledge Base

Students must have a well-developed “core “knowledge base for successful graduate study in EWR. Departmental policy requires that each student document having met this requirement.

Instructions

Please complete this worksheet in consultation with your advisor (or temporary advisor) who will then work with you to plan the first semester’s courses. This process may involve reviewing transcripts from your former institution(s). Your advisor (or temporary advisor) will make a preliminary assessment of your core knowledge base, initial the worksheet on the second page and make an electronic copy (pdf) as a record. Your advisory committee will also review the worksheet, typically during the second semester. The advisory committee will either approve the worksheet (usual case) or ask you to take additional courses (unusual case).

| | |
|----------------------------|--|
| Student Name (Last, first) | |
|----------------------------|--|

1. **Students with an ABET-accredited Engineering degree**

Graduates of ABET-accredited engineering programs are assumed to have the required core knowledge base*. If you are in this group, place a check in the box on the following line and write in the institution and year of your undergraduate engineering degree.

| | | | |
|---|-------------------------------------|-------------|------|
| Graduate of ABET accredited engineering program | <input checked="" type="checkbox"/> | Institution | Year |
| | | | |

2. **Students without an ABET-accredited Engineering degree enrolled in a graduate engineering degree (MS CE, MS ENE, PhD CE)**

Students must complete the courses below or demonstrate having taken an equivalent course at another institution. Students should enter the course number, name and grade earned in each course or equivalent course. Missing courses/equivalent courses can be taken either before or after entering the graduate program. Courses at the 1000/2000 level can be taken pass-fail (P/F). Courses at the 3000/4000 level must be taken for a letter grade (A/F). These undergraduate background courses do not count toward graduate degree requirements.

| Required VT Course | ✓ | Course/Equivalent Course | Grade (or P/F) |
|--|--------------------------|--------------------------|----------------|
| CHEM 1035/1045 – <i>General Chemistry</i> | <input type="checkbox"/> | | |
| MATH 1205 or MATH 1225 – <i>Calculus/Single Variable</i> | <input type="checkbox"/> | | |
| MATH 1206 or MATH 1226 – <i>Calculus/Single Variable</i> | <input type="checkbox"/> | | |
| MATH 2214 – <i>Differential Equations</i> | <input type="checkbox"/> | | |

| | | | |
|---|--|--|--|
| MATH 2224 – <i>Multivariable Calculus</i> | | | |
| PHYS 2305 – <i>Physics I</i> | | | |
| ESM 2104 – <i>Statics</i> | | | |
| CEE 3104 – <i>Intro to Environmental Eng.</i> | | | |
| CEE 3304 – <i>Fluid Mechanics</i> | | | |
| CEE 3314 – <i>Water Resources Engineering</i> or 2 nd level introductory EWR <u>engineering</u> course | | | |

3. Students in the MS ESEN program

Students must complete the courses below or demonstrate having taken an equivalent course at another institution. Students should enter the course number, name and grade earned in each course or equivalent course. Missing courses/equivalent courses can be taken either before or after entering the graduate program. Courses at the 1000/2000 level can be taken pass-fail (P/F). Courses at the 3000/4000 level must be taken for a letter grade (A/F). These undergraduate background courses do not count toward graduate degree requirements.

| Required VT Course | ✓ | Course/Equivalent Course | Grade (or P/F) |
|---|---|--------------------------|----------------|
| CHEM 1035/1045- <i>General Chemistry</i> | | | |
| MATH 1205 or MATH 1225 – <i>Calculus/Single Variable</i> | | | |
| MATH 1206 or MATH 1226 – <i>Calculus/Single Variable</i> | | | |
| MATH 2214 – <i>Differential Equations</i> | | | |
| PHYS 2305 - <i>Physics I</i> | | | |

Approvals

Temp. Advisor/Advisor Initials Date

Advisory Committee:

Chair Date

Member Date

Member Date

Member Date

Appendix B

Dissertation Proposal – The proposal outlines the goals and details of the proposed research and should be developed with the input of the Faculty Advisor. An example structure for the document is shown below. Although the specific titles of the section and ordering are flexible, the document should address each of these areas.

- Identification of Research Needs. In this section, the significance of the research topic must be demonstrated. Answer the question, “Why should anyone care about this research?” The existing literature should then be succinctly reviewed and research questions that remain should be identified.
- Preliminary Results. A brief description of preliminary results that have helped to identify future research needs may then be provided. These results should be presented in the same manner as the literature reviewed in the previous section because these preliminary results are already part of the scientific knowledge leading toward the proposed work.
- Hypotheses. The hypotheses are the concepts to be tested in the research. The hypotheses should be stated as scientific opinions on the unanswered questions raised in the previous sections. As such, the hypotheses are the basis of the remaining research and the most important component of the proposal.
- Objectives. The objectives should be concise statements of the overall goals of the research in general terms. In the broadest sense, the objective of the research is to answer the unanswered questions by testing the hypotheses stated above.
- Research Plan. The plan for future research should comprise the bulk of the proposal. The research plan should be driven by the need to test the hypotheses to arrive at answers to the unanswered questions. The plan should be organized into a set of experiments with separate descriptions of materials, methods, data analysis, and expected results. Experiments to test the hypotheses should be described and potential experimental outcomes should be anticipated.
- Schedule and Budget. Finally, a realistic schedule and budget (if appropriate) for the research plan should be included. The graduate school requires at least three semesters of residence prior to the defense of the thesis. The budget should include cost estimates for Salary, Equipment, Expendable Materials and Supplies and Travel.

Appendix C

Using the Journal Manuscript Format in Preparing Your Dissertation Environmental and Water Resources Engineering Program Department of Civil and Environmental Engineering Policy Statement Originally Adopted April 10, 1998

Objectives

1. To provide students with an opportunity to prepare written scientific work with the target audience being their professional peers.
2. To encourage students to conduct their research in a manner that will be defensible to the academic/professional community.
3. To encourage timely submission of research results for publication.

General Policy

1. Preparation of a dissertation in a journal manuscript format is optional; format choice should be decided by the student in conjunction with their advisor(s). However, if manuscript format is selected, a minimum of two manuscripts must be included in the dissertation.
2. For students who have produced work that is appropriate for publication in a peer-reviewed journal or national professional conference. At least one of the manuscripts must be prepared for submission to a peer-reviewed journal.
3. Manuscript is prepared in accordance with rules of publication source.
4. Manuscript does not have to be submitted for review prior to dissertation defense, but should be submitted shortly after the defense.
5. Identify in dissertation as a manuscript (i.e., a title page with all authors and targeted publication source for manuscript).
6. Dissertation Format:
 - a) Abstract (per graduate school requirements)
 - b) Acknowledgements
 - c) Table of Contents
 - d) List of Tables
 - e) List of Figures
 - f) Executive Summary (optional)
 - g) Literature Review
 - h) Manuscript(s) (according to rules for target publication)
 - i) Engineering Significance (optional)
 - j) Appendices
7. References can be listed at the end of each section, or as a separate section at the end (after Engineering Significance but before Appendices).