WATER SCIENCE AND POLICY

GRADUATE PROGRAM POLICY STATEMENT
(UPDATED – JANUARY 2014)

I. PROGRAM HISTORY

A. RATIONALE

Global climate change, unsustainable population growth, and widespread pollution and degradation of our natural resources are putting immense pressure on the supply and quality of our water resources. Addressing these complex challenges and finding solutions will require a comprehensive, integrated and interdisciplinary approach. Not only must society address the physical, chemical and biological aspects of these problems; society must also ensure that the proposed solutions are socially acceptable, economically viable, and environmentally sustainable. The National Science Foundation, National Academy of Sciences, Congressional Research Service, USGS, NOAA, and USEPA have all concluded that a new interdisciplinary education and research approach is needed that integrates science and policy to address society's emerging challenges in water sustainability. The interdisciplinary graduate program in Water Science and Policy at the University of Delaware is focused on these challenges by training students and professionals who can think broadly across disciplines and simultaneously possess a depth of knowledge to address important water issues.

The graduate program in Water Science and Policy reflects the strategic priorities at the University of Delaware, including an emphasis on environmental research and sustainability, the growing number of environmentally focused faculty, and the University's *Initiative for the Planet*, all within the University's *Path to Prominence*.

The vision is a university-wide graduate program that will attract students to many departments and colleges across the campus. The students will be located within individual departments and will work with individual advisors who are affiliated with the program. The students are required to meet the specific requirements of the program to be awarded the degree in Water Science & Policy.

The graduate program in Water Science & Policy is synergistic with other programs on campus, and draws entirely upon existing courses. All students in the Water Science & Policy program take a team-taught course, entitled "Research Methods and Topics in Water Science and Policy" that involves both field and lab experiences, as well as a companion one-credit seminar series.

The availability of high quality water to sustain human activities and ecosystem health is among the most critical global challenges of the 21st century, given pressures on water resources due to climate change, contaminants, population growth, hydropolitics, conservation issues and infrastructure challenges. Solutions to complex problems of water quantity and quality will require both scientific understanding and implementation through effective policy. Scientists, engineers and policy experts need to understand and predict the interactions of Earth's water system with climate change, land use, the built environment and ecosystem function and

services. They will need to determine how the built water systems and our governance systems can be made more reliable, resilient and sustainable in the face of diverse and often conflicting needs.

Despite its name, the Earth is a water planet. However, pressure on water resources is growing, increasing the need for understanding water availability, quality and dynamics. The impacts of climate change and human activity have created an urgent need for experts who bring both depth and breadth of experience, and a systemic perspective to the science and policy of water at the local, regional, national, and international scales.

The program in Water Science and Policy at the University of Delaware is designed to meet this increasing national and international demand for interdisciplinary water experts and to provide students with an educational opportunity that crosses traditional disciplinary and organizational boundaries. Due to the interdisciplinary nature of water sciences and policy, experts in these fields within the University of Delaware are housed in many Colleges and Departments and affiliated centers and institutes on campus; thus, the faculty affiliated with the program may be in one of several science, engineering or social science disciplines.

The Water Science & Policy program aims to train the next generation of researchers and professionals who will play key roles in protecting and managing a vital resource, and who will play a key role in multi- and interdisciplinary teams, bridging physical, chemical, biological and policy sciences. The program is administered through the College of Agriculture & Natural Resources, and the scientific curriculum builds upon the research and educational strengths of departments across the Colleges of Agriculture & Natural Resources, Arts & Sciences, Earth, Ocean & Environment, and Engineering. Water Science & Policy is an essential 21st century environmental thrust in academia, industry, and government, and affects public policy decisions across the globe.

B. DEGREES OFFERED

Three degree options are offered:
1) **PhD in Water Science & Policy**, Water Science Concentration;
2) **PhD in Water Science & Policy**, Water Policy Concentration; and
3) **Master of Science in Water Science & Policy**.

Doctoral students in the Water Science Concentration complete course requirements and carry out research that emphasizes science and engineering, but that provides exposure to policy tools and processes. Doctoral students in the Water Policy Concentration complete course requirements and carry out research that emphasizes economics and public policy, but that provides exposure to relevant science and engineering areas. Students in both Concentrations will have the opportunity to pursue directed research, a special problem, independent study or internship as part of required work.

The Master of Science option in Water Science and Policy prepares students to carry out advanced research at the doctoral level, or to take professional positions requiring graduate level preparation.

II. ADMISSION

A. ADMISSION REQUIREMENTS

Admission to graduate programs is competitive. Those who meet stated requirements are not guaranteed admission, nor are those who fail to meet all of those requirements necessarily precluded from admission if they offer other appropriate strengths.

To officially apply for admission, see http://www.udel.edu/gradoffice/apply/ for detailed instructions, web-based forms, and contact information. To be admitted to the graduate program applicants should meet the following requirements:

1. A completed University of Delaware Graduate Studies application. In the application, prospective students should indicate clearly whether they are applying for the MS or the Ph.D. program (select the Water Science or the Water Policy concentration). Students may apply to the program prior to arranging for a faculty advisor; however, all students in the program will need a program faculty member to serve as advisor.

2. A personal statement is required in the Graduate Studies application, and should discuss the following questions:
    a. What are your specific research and educational goals?
    b. What are your long-term professional career objectives?
    c. How do you see this program assisting you with achieving your objectives?
    d. What is the name of the faculty member (affiliated with the program) who has agreed to be advisor?
3. Graduate Record Examination Scores are required (a minimum of 1050 (on the old scale) on the VERBAL and QUANTITATIVE is desirable). Subject GRE scores are not required.

4. Official, up-to-date transcripts of all undergraduate and graduate programs. A minimum of 3.0/4.0 is required in the major.

5. Three letters of recommendation from individuals knowledgeable of the applicant's academic preparation and potential ability as a graduate student.

6. International students must take the Test of English as a Foreign Language (TOEFL) (Minimum Score: 550 paper test, 213 computer test or 79 on Internet-based tests.) TOEFL scores more than two years old cannot be considered official.

B. Prior Degree Requirements

Applicants for the Ph.D. program will typically have an M.S. degree in a related field. Direct admission to the Ph.D. program immediately after a B.S. degree will only be considered for exceptionally qualified candidates, as determined by the Program Committee. These candidates will, however, have to complete all the course requirements associated with the Water Science and Policy M.S. program prior to starting the Ph.D. curriculum. Prior graduate coursework (a maximum of 9 credit hours) will be considered toward Ph.D. course requirements, with the approval of the Program Committee.

Change of Classification and Transfer Students

Students that are currently matriculated in other degree programs should complete a "Change of Classification" Form to seek approval to be admitted into the Water Science and Policy Program. The Program Committee will evaluate the change in classification and transfer requests on a case-by case basis to determine if the applicant will need to complete a full application form submitted to the Office of Graduate and Professional Education. All transfer students will still have to meet the requirements listed above.

C. Application Deadlines

Admission decisions are made on a rolling basis as and when applications are complete. The application deadlines are:

- Fall Semester: July 1 ; February 1 for financial aid
- Spring Semester: December 1

D. Special Competencies Needed

None.

E. Admission Categories

Students are accepted in the following degree programs:
☐ M.S.– Master of Science (thesis) in Water Science and Policy
☐ Ph.D.– Doctor of Philosophy in Water Science and Policy (Water Science concentration)
☐ Ph.D.– Doctor of Philosophy in Water Science and Policy (Water Policy concentration)

Part-time students

In some circumstances it is possible to pursue a degree on a part-time basis.

Provisionally-accepted students

Full and part time students may be admitted to the program with provisional status if there are deficiencies in their academic backgrounds, as determined by the Admissions Committee. Deficiencies typically include an inadequate academic background, particularly a lack of appropriate course work in the major area and are usually remedied by satisfactory performance in a course(s) in

the deficient area. A letter of provisional admission will indicate specific area(s) of academic deficiency, and the time limits for satisfactory completion of course(s) needed to make up deficiencies. Satisfactory completion of the stipulations in the letter of provisional admission will result in a change of status from provisional to regular student status. The student's advisor and the Program Director will inform the student and the Office of Graduate and Professional Studies of the change in status. Students who do not complete the remedial training in the stipulated time may be expelled from the program.

F. OTHER DOCUMENTS REQUIRED

None.

III. ACADEMIC PROCEDURES

A. DEGREE REQUIREMENTS

1. COURSE REQUIREMENTS SUMMARY

a. PhD Program Requirements: Water Science & Policy

PhD in Water Science & Policy (36 Credits)		
Course Areas	Water Science Concentration	Water Policy Concentration
Water Science	9 Credits	3 Credits
Water Policy	3 Credits	9 Credits
Research Methods	3 Credits	3 Credits
Statistics, Analysis & Techniques	3 Credits	3 Credits
Directed Research/Special Problem/Internship/Independent Study	9 Credits	9 Credits
Dissertation	9 Credits	9 Credits

b. Master of Science Program Requirements: Water Science & Policy

MS in Water Science & Policy (30 Credits)	
Credit Hours Total	
Water Science, Policy, Research Methods, Statistics & Analysis	24 Credits
Thesis	6 Credits

2. CURRICULUM

The tables below list the course curriculum for the major components of the graduate program in Water Science & Policy. Some courses may be offered at both the 400- and 600- levels. A student who has completed a course at the 400-level may not take the same course at the 600-level for credit toward the graduate degree.

Table 1. PhD Program Requirements: Water Science & Policy

PhD in Water Science & Policy (36 Credits)		
Course Areas	Water Science Concentration	Water Policy Concentration
Water Science	9 Credits	3 Credits
Water Policy	3 Credits	9 Credits
Research Methods	3 Credits	3 Credits
Statistics, Analysis & Techniques	3 Credits	3 Credits
Directed Rsch/Special Prob./Internship/Independent Study	9 Credits	9 Credits
Dissertation	9 Credits	9 Credits

Science Courses **Water Science Concentr. Students (9)** [Select at least 3 credits from each category.] **Water Policy Concentr. Students (3)** [Select one course from physical or chemical/biological science.)	**a) Physical Sciences**
	BREG 623 Advanced Storm water Management
	CIEG 698 Groundwater Flow and Contaminant Transport
	GEOG 632 Environmental Hydrology
	GEOG 656 Hydroclimatology
	GEOG 651 Microclimatology (4)
	GEOL 628 Hydrogeology
	GEOL 611 Fluvial Geomorphology
	PLSC 603 Soil Physics
	b) Chemical/Biological Sciences
	BREG 621 Nonpoint source pollution
	BREG 667 Watershed Hydrochemistry
	CHEM/MAST 683 Environmental Chemistry
	CIEG 632 Chemical Aspects of Environmental Engineering
	CIEG 636 Biological aspects of Environmental Engineering
	CIEG 668 Principles of Water Quality Criteria
	GEOG 631 Watershed Ecology
	GEOG 667 Watershed Hydro-Ecology
	PLSC 608/CHEM 608 Environmental Soil Chemistry
	MAST 618 Marine Microbial Ecology
	c) Policy
Policy Courses **Water Science Concentr. Students (3)** [Select one course.] **Water Policy Concentr. Students (9)** [Select three courses.]	ENEP 626 Climate Change: Science, Policy and Political Economy
	ENEP 666 Topics in Sustainable Development
	ENEP 810 Political Economy of the Environment
	ENEP 868 Sustainable Water Policy Research
	ENEP 870 Sustainable Water Policy Readings
	GEOG 617 Seminar in Climate Change
	GEOG 649 Environment & Society
	MAST 672/ECON 670 Applied Policy Analysis
	MAST/ECON 867 Valuing the Environment
	MAST 670 US Ocean and Coastal Policy
	MAST 670 Legal Aspects of the Coastal Zone
	MAST/ECON 676 Environmental Economics
	MAST/UAPP 663 Decision Tools for Policy Analysis
	POSC 818 Environmental Politics and Policy
	UAPP 611 Regional Watershed Management
	UAPP/ENEP 617 Contemp. Issues in Environmental and Energy Policy (1)
	UAPP 628 Issues in Land Use and Environmental Planning
	UAPP Environmental Policy Analysis
	UAPP 667 Field Seminar in Water Policy
Research Methods Courses (3)	**d) Research Methods**
	PLSC 667 Research Methods and Topics in Water Science & Policy (2)
	PLSC 667 Interdisciplinary Seminar (1)
	CIEG 667 Research in Water Science and Policy (1)
Statistics, Analysis & Techniques (3) [Select three credits from the category Statistics, Analysis & Techniques]	**e) Statistics, Analysis & Techniques:**
	CHEG 604 Probability and Statistics for Engineering Problem Solving
	FREC/STAT 608 Statistical Research Methods
	FREC 615 Advanced Prices and Statistics
	FREC/STAT 674 Applied Database Management
	FREC 807 Mathematical Programming with Economic Applications
	GEOG 671 Advanced Geographic Information Systems
	MAST 681 Remote Sensing of Environment
	MEEG 690 Intermediate Engineering Mathematics
	STAT 657 Statistics for Earth Sciences

	STAT 675 Logistic Regression
	UAPP 816 Advanced Social Statistics
	UAPP 691 Quantitative Analysis in Public & NP Sectors
	UAPP 652 Geographic Information Systems in Public Policy (1)
Directed Research/Special Problem/Internship/Independent Study (9)	
Dissertation (9)	

Table 2. M.S. Requirements

MS in Water Science & Policy – Course Curriculum (30 credits)	
Select 24 credits, with at least 3 credits from each category.	**a) Physical Sciences**
	BREG 623 Advanced Storm water Management
	CIEG 698 Groundwater Flow and Contaminant Transport
	GEOG 632 Environmental Hydrology
	GEOG 656 Hydroclimatology
	GEOG 651 Microclimatology (4)
	GEOL 628 Hydrogeology
	GEOL 611 Fluvial Geomorphology
	PLSC 603 Soil Physics
	b) Chemical/Biological Sciences
	BREG 621 Nonpoint source pollution
	BREG 667 Watershed Hydrochemistry
	CHEM/MAST 683 Environmental Chemistry
	CIEG 632 Chemical Aspects of Environmental Engineering
	CIEG 636 Biological aspects of Environmental Engineering
	CIEG 668 Principles of Water Quality Criteria
	GEOG 631 Watershed Ecology
	GEOG 667 Watershed Hydro-Ecology
	PLSC 608/CHEM 608 Environmental Soil Chemistry
	MAST 618 Marine Microbial Ecology
	c) Policy
	ENEP 626 Climate Change: Science, Policy and Political Economy
	ENEP 666 Topics in Sustainable Development
	ENEP 810 Political Economy of the Environment
	ENEP 868 Sustainable Water Policy Research
	ENEP 870 Sustainable Water Policy Readings
	GEOG 617 Seminar in Climate Change
	GEOG 649 Environment & Society
	MAST 672/ECON 670 Applied Policy Analysis
	MAST/ECON 867 Valuing the Environment
	MAST 670 US Ocean and Coastal Policy
	MAST 670 Legal Aspects of the Coastal Zone
	MAST/ECON 676 Environmental Economics
	MAST/UAPP 663 Decision Tools for Policy Analysis
	POSC 818 Environmental Politics and Policy
	UAPP 611 Regional Watershed Management
	UAPP/ENEP 617 Contemp. Issues in Environmental and Energy Policy (1)
	UAPP 628 Issues in Land Use and Environmental Planning
	UAPP 667 Field Seminar in Water Policy
	UAPP Environmental Policy Analysis
	d) Research Methods
	PLSC 667 Research Methods and Topics in Water Science & Policy (2)
	PLSC 667 Interdisciplinary Seminar (1)
	CIEG 667 Research in Water Science and Policy (1)
	e) Statistics, Analysis & Techniques:
	CHEG 604 Probability and Statistics for Engineering Problem Solving
	FREC/STAT 608 Statistical Research Methods
	FREC 615 Advanced Prices and Statistics

	FREC/STAT 674 Applied Database Management
	FREC 807 Mathematical Programming with Economic Applications
	GEOG 670 Geographic Information Systems and Science
	GEOG 671 Advanced Geographic Information Systems
	MAST 681 Remote Sensing of Environment
	MEEG 690 Intermediate Engineering Mathematics
	STAT 657 Statistics for Earth Sciences
Directed Research Option (3) With advisor approval, MS students may opt to carry out directed research, in lieu of one course, within categories a, b, or c above.	
Thesis (6)	

3. GRADE MINIMUMS

See University policy.

4. COURSES INELIGIBLE TOWARDS DEGREE

Registration as a listener (L) or enrollment in undergraduate-level courses will not apply toward the degree. Course work which is not previously approved may be judged unacceptable by the graduate advisory committee and, therefore, should be discussed with committee members when registering.

5. ENGLISH COMPETENCY

Students are expected to communicate effectively in written and oral English, including the ability to concisely present their data and compose a manuscript or research proposal. This will be assessed by the advisor and graduate committee and, more formally, during seminar presentations.

B. COMMITTEES FOR EXAMS, THESIS, OR DISSERTATIONS

1. INITIAL PROCEDURES FOR ADVISOR/STUDENT

Ideally, students may contact advisors directly to pursue study in their laboratories. Advisors can also examine the applicant pool to select students whom they are interested in advising.

2. PROCEDURE FOR SELECTING COMMITTEE MEMBERS

The major advisor and student should discuss potential committee members who might provide support for the student's research. It is the responsibility of the graduate student to ask each committee member if they are willing to serve.

Requirements for the composition of advisory committees are:
M.S. Minimum of three members, including -

- advisor
- at least one additional faculty member affiliated with the Water Science and Policy program who should be from the area of concentration other than that of the student

Ph.D. Minimum of four members, including -

- advisor
- at least two faculty members affiliated with the Water Science and Policy program
- at least one committee member must be external to the program or from outside the University

3. DEADLINES

Establishment

For a MS student, the committee should be established within the first year after being admitted to the program. For a PhD student, the committee should be established within 1.5 years of joining the program. Coincident with its establishment, it is the responsibility of the student to notify the Program Director in writing of the committee members and their affiliations.

Meetings

- Graduate committees must meet at least once each year and meetings every 6 months are recommended. It is the responsibility of the student to organize the meetings.
- Responsibilities of committee members include the following:
    - Work with student to develop a program of study
    - Review research proposal defense and provide recommendations
    - Ensure acquisition of skills (competence in certain laboratory, greenhouse, and/or field research techniques is essential for completion of an acceptable thesis or dissertation) are developed
    - Serve as advisory body during period of candidacy
    - Administer written and oral qualifying examinations to Ph.D. candidates
    - Establish the contribution of the thesis or dissertation to chosen area of expertise and determine the degree of scholarship attained by the student

4. Examination and Grading Policies

Ph.D. candidates must have at least one year between their qualifying exam and their defense. Formal grading of committee examinations will be at the discretion of the student's graduate committee.

5. Guidelines for Research Proposal involving Human and Animal Subjects

Students must attend human or animal subjects training and request approval from the human or animal subject committee at the University. Proposals that include interviews, case studies, or other interrogative methodologies must have all questions approved by the University Human Subjects Review Board.

6. Procedures for Thesis/Dissertation Approval

Admission to candidacy for the Ph.D. degree, and acceptance of the M.S. thesis or Ph.D. dissertation in partial fulfillment of the degree requirements, will be recommended if no more than a single dissenting vote is cast by the graduate committee.

7. Procedures for Changes in Committee Members

Changes are to be coordinated by advisor and student when necessary.

C. Satisfactory Progress

1. Academic Load

Full-time students are expected to complete the MS program (30 credits) within two years. The program may be completed over a longer time frame for part-time students. Students in the Ph.D. program (36 credits) will typically complete the program in four to six years.

Students enrolled in at least 9 credit hours or in sustaining credit are considered full-time students. Those enrolled for fewer than 9 credit hours are considered part-time students, although students holding assistantships are considered full-time with six credits. Generally, a maximum load is 12 graduate credit hours; however, additional credit hours may be taken with the approval of the student's adviser and the Office of Graduate and Professional Education. A maximum course load in either summer or winter session is 7 credit hours. Permission must be obtained from the Office of Graduate and Professional Education to carry an overload in any session

2. TRANSFERABILITY

Previous graduate level courses (a maximum of 9 credit hours) will be considered toward completion of Ph.D. course requirements, subject to approval by the Program Committee.

3. GRADE REQUIREMENTS

Only graduate courses completed with a grade of B- or higher count towards the requirements of the MS and PhD program in Water Sciences and Policy. Graduate students receiving financial assistance must maintain a 3.0 overall GPA. If a student's GPA should fall below this level, loss of stipend is possible. A one-semester grace period may be provided in which the student has the opportunity to improve his/her GPA. However, the grace period is not automatic and requires approval that is initiated by a written request from the faculty advisor to the Program Director and the Office of Graduate and Professional Studies. A student's stipend may be reinstated, if lost for academic or other reasons, only after approval by the Program Committee and the Director. Any graduate student, self-supporting or those receiving financial assistance, with a GPA less than 3.0, is subject to a reclassification of academic status to warning, probation, or termination depending upon the severity of the substandard academic performance. Details are provided in the University Graduate Catalog. It is the responsibility of the faculty advisor to inform the student committee and Program Director of substandard academic performance.

4. MASTER'S DEGREE REQUIREMENTS

The development of a program of study will be the joint responsibility of the student in consultation with the major advisor. The student will select a minimum of three-person thesis committee that includes the student's major advisor and at least one other member from the Water Science and Policy program. The thesis committee needs to be established within one year in the program. The names of the selected thesis committee members should be forwarded to the Program Director by the student.

M.S. Thesis students must complete 24 credit hours of course work and 6 credit hours of thesis (a total of 30 credits). Specific course requirements for the M.S. in Water Science

and Policy are described above in Section on Course Curriculum. All full-time MS students are required to complete the degree requirements in six semesters or fewer. Students are expected to write and successfully defend the thesis to receive the degree.

Advancement to degree candidacy is contingent upon successful completion and presentation of the thesis proposal. The thesis proposal should be presented to the Thesis Committee for approval within 1.5 years in the program. The completed thesis will be presented to the Thesis Committee in typewritten form at least two weeks before the scheduled oral defense. The oral defense of the student thesis will be publicly announced and all program members will be notified at least one week prior to the defense date.

The maximum time for the completion of the MS program is 5 years from the time of entry.

5. PH.D. REQUIREMENTS

The development of a program of study will be the joint responsibility of the student in consultation with the graduate advisor. The student will select a minimum of four-person Dissertation Committee that includes the student's major advisor and at least two other faculty members from the Water Science and Policy program. The Dissertation Committee needs to be established within 1.5 years of study in the program. The names of the Committee members should be submitted to the Program Committee for approval.

Ph.D. students must complete 18 credit hours of course work, plus 9 credit hours of research, and 9 credit hours of thesis (a total of 36 credits). Specific course requirements for the Water Science and the Water Policy concentrations are described above in Section on Course Curriculum. Students must maintain a minimum of 3.0 cumulative GPA in order to receive the degree. Course with a grade below a B- will not be counted towards the degree. The program of study must be submitted before the end of the first year to the graduate advisor for approval. Previous graduate-level coursework will be considered toward Ph.D. course requirements, subject to the approval of the Program Committee.

The PhD qualifying exam should be taken within 2.5 years of study in the program. The qualifying examination will include written and oral portions. The student’s graduate advisor will chair and administer the exam and the content of the exam (written and oral) will be decided jointly by the student’s Dissertation Committee. The exam will be graded by the Dissertation Committee and each member of the committee will provide a single grade (including written and oral sections) of PASS or FAIL. A student can only take the exam a maximum of two times. A failure in two attempts will result in dismissal from the PhD program.

The student must submit a research proposal prior to initiating dissertation research. A pre-proposal should be prepared within the first year and should be shared with the Dissertation Committee. A formal proposal should be presented and defended by the student no later than six months from the completion of the written qualifying exam. The proposal defense and oral qualifying examination can be combined.

Upon successful completion of the qualifying exam and the proposal defense, the student is certified as a candidate for the doctoral degree. The graduate advisor will notify the Program Committee on the result of the qualifying exam. A copy of the student's PhD proposal will also be placed in the program records.

Upon the recommendation of the Dissertation Committee the student may be admitted to candidacy for the Ph.D. degree. The stipulations for admission to doctoral candidacy are that the student has (1) had a program of study approved, (2) completed one academic year of full-time graduate study in residence at the University, (3) passed the program's qualifying examination, (4) demonstrated the ability to do research, and (5) had a research project accepted by the Dissertation Committee.

The final examination of the PhD degree will involve approval of the written dissertation and an oral defense of the candidate's dissertation. The written dissertation will be submitted to the Dissertation Committee and the Water Science & Policy Program office at least three weeks in advance of the oral defense date. The oral defense date will be publicly announced at least two weeks prior to the scheduled date. The oral presentation will be open to the public and all members of the Water Science and Policy program. The Dissertation Committee will approve the candidate's dissertation. The student and graduate advisor will be responsible for making all corrections to the dissertation document and for meeting all Graduate School deadlines for submission.

The maximum time for the completion of the PhD program is 10 years from the time of entry.

6. STANDARDS OF STUDENT CONDUCT

All graduate students are subject to University of Delaware regulations regarding academic honesty. Violations of the UD regulations regarding academic honesty or other forms of gross misconduct may result in immediate dismissal from the Program.

7. DISMISSAL

The procedures for dismissal as detailed in the University Catalog will be followed. Briefly, the Graduate Committee will report its recommendation and reason for dismissal to the Director of the Water Science and Policy program. The Director will make a recommendation to the Office of Graduate Studies, who will decide whether to dismiss the student. The student may appeal this decision to the Office of Graduate Studies, following the procedure given in the University Catalog.

8. GRADUATE STUDENT GRIEVANCE PROCEDURES

Students who feel that they have been graded inappropriately or receive what they perceive as an unfair evaluation by a faculty member may file grievances in accordance with University of Delaware policies. Students are encouraged to contact the Director of the graduate program in Water Science & Policy prior to filing a formal grievance in an effort to resolve the situation informally.

9. ATTENDANCE AT CONFERENCES AND PROFESSIONAL MEETINGS

The Water Science & Policy program encourages students to attend conferences and professional meetings. They provide opportunities to meet future employers and colleagues, and can offer specialized training beyond course work.

IV. FINANCIAL AID

A. FINANCIAL AWARDS

Admission to the graduate program in Water Science & Policy does not automatically entitle an applicant to financial aid. Students may seek financial aid opportunities, such as fellowships or scholarships from sources within the University and from private and federal agencies. Interested students should check the Office of Graduate Studies website for the most current opportunities.

Financial aid is awarded on a competitive basis from the pool of admitted applicants. The University of Delaware's policies apply to all forms of financial aid. Please refer to the University Policies for Graduate Student Assistantships and Fellowships.

Students in the Water Science and Policy program may apply for Graduate Assistantships:

Research Assistantships (RAs) are generally funded by research grants and contracts provided by external funding agencies. Students may be supported as an RA through their Faculty Advisor's research funds after their first year. A research assistantship provides full tuition and a stipend. The RA's advisor is responsible for defining the student's responsibilities and for evaluating the student's performance. The amount of service or research may vary from week to week but the average is usually expected to be 20 hours per week.

Teaching Assistantships (TAs) are offered for graduate students to perform teaching and other instructional activities by individual departments. The amount of service may vary from week to week but the average is usually expected to be 20 hours per week. A teaching assistantship provides full tuition and a stipend. Award of TA will be decided by the primary advisor and their department.

Preference for graduate student stipends will be given to students in the PhD Program. Students receiving full stipends will be expected to work 20 hours per week on faculty projects and students are expected to maintain full-time status.

B. CONTINUATION OF FINANCIAL AID

Students who are awarded financial aid must maintain satisfactory academic progress with satisfactory performance of assistantship duties (when applicable). Satisfactory academic progress includes registering for a minimum of 9 graduate-level credits each Fall and Spring semester, and maintaining a minimum cumulative 3.0 GPA.

The Faculty Advisor will establish the RA’s responsibilities and performance standards. In the event of an unsatisfactory performance by an RA, the advisor will notify the student and the Program Committee at least four weeks prior to terminating the assistantship.

The Director of the course in which the student teaches will establish the TA's responsibilities and performance standards. In the event of an unsatisfactory performance by a TA, the Course Director will notify the student and the Program Committee of the academic department offering the course. The Committee may recommend termination of the assistantship to the Department Chair.

Appendix I – Course Descriptions

Physical

BREG623: Advanced Storm Water Management (3)

- Design of gutters, storm drain inlets, and storm drains. Design of distributed and low impact development storm-water management systems. Erosion and sediment control for site development, flood plain hydraulics and analysis.

CIEG698: Groundwater Flow and Contaminant Transport (3)

- Development and application of models for fluid flow and contaminant transport in porous media. Derivation of governing equations, analytical and numerical solutions, and application to the movement of groundwater and transport of contaminants at an actual field site.

GEOG632: Environmental Hydrology (3)

- Introduction to hydrologic science. Topics include precipitation, snowmelt, evapotranspiration, infiltration, groundwater, runoff, streamflow, water resources management, and hydrologic applications of remote sensing and geographic information systems. Case studies illustrate hydrological response to changes in land use and climate. Group studies include field measurements and computer simulations.

GEOG651: Microclimatology (4)

- Introduction to instrumentation and techniques involved in microclimatic monitoring and sampling. Field observation carried out in varying environmental situations.

GEOG656: Hydroclimatology (3)

- Study of the hydrologic cycle as it relates to water in the atmosphere and in and on the earth's surface. Hydrologic processes including precipitation, soil moisture, evapotranspiration, runoff and streamflow will be examined.

GEOL611: Fluvial Geomorphology (3)

- Hydrologic and sediment transport processes in rivers and watersheds. Morphology and evolution of rivers and watersheds. Depositional processes and evolution of floodplains. Structure and interpretation of fluvial deposits in the geologic record.

GEOL628: Hydrogeology (3)

- Principles of groundwater flow and water chemistry in varied geologic media. Evaluation of groundwater resources and assessment of environmental problems associated with groundwater use.

PLSC603: Soil Physics (3)

- Examines the importance of soil physics in relation to other disciplines of soil and environmental sciences. Topics include status of water in soil, fundamental principles of water flow, differences between saturated and unsaturated water flow, water balance in the field, infiltration, evapotranspiration, heat, gas and solute (contaminant) transport in soil.

Chemical/Biological

BREG421/621: Nonpoint Source Pollution (3)

- Understanding sources, transport pathways, and transformations of important pollutants and toxic chemicals generated by anthropogenic activities. Topics include transport, transformation, and fate of these pollutants in watersheds. Impacts of these pollutants on soil, forest, and aquatic ecosystems using specific case studies.

BREG 667: Watershed Hydrochemistry (3)

- The role of hydrology in the exports of solutes and chemicals from watersheds. Linkages and feedbacks between hydrologic and biogeochemical processes. Mechanistic conceptual models for solute transport will be emphasized. Innovative methods to characterize and quantify solutes in watersheds will be discussed.

CHEM/MAST683: Environmental Chemistry (3)

- Reactions in gas, liquid and solid phases of the Earth's atmosphere, hydrosphere, and geosphere, and energy fluxes and chemical exchanges across these interfaces discussed in the context of basic chemical principles. Applications to current issues such as climate change and air/water pollution discussed.

CIEG632: Chemical Aspects of Environmental Engineering (3)

- The principles and applications of aqueous chemistry to environmental systems. Includes a review of general chemistry, with emphasis on the structure of matter and stoichiometry; chemical thermodynamics; chemical kinetics; equilibrium reactions in homogeneous and heterogeneous solutions; applied electrochemistry and Redox reaction; and interfacial phenomena.

CIEG636: Biological Aspects of Environmental Engineering (3)

- Presents fundamental molecular biological concepts that pertain to cellular function in the environment and in engineered environmental treatment systems. Briefly reviews elementary organic chemical classifications.

CIEG668: Principles of Water Quality Criteria (3)

- Toxicological and chemical background and technical basis necessary for understanding the models of water and sediment quality criteria for individual and mixtures of organic chemicals and metals that focus on bioavailability: narcosis

models of toxicity, complexation models applied to both the water column and sediments.

GEOG631: Watershed Ecology (3)

- Examines key biogeochemical processes and functional ecology of wooded ecosystems. Emphasis on examination of peer-reviewed scientific literature. Topics include inter- and intrasystem transport of nutrients and effects of abiotic stressors and animals on catchment scale nutrient budgets.

GEOG667: Watershed Hydro-Ecology (3)

- Examines linkages between hydrology and ecosystem processes in primarily human impacted watersheds. Addresses both terrestrial and aquatic ecosystems. Particular emphasis on effect of land use and climate change, and adaptive management practices.

PLSC/CHEM608: Environmental Soil Chemistry (3)

- Principles of soil chemical reactions and their application to environment including: inorganic and organic soil components, soil solution-solid phase equilibria, sorption phenomena, ion exchange reactions, kinetics of soil chemical processes, redox chemistry, soil acidity and salinity.

MAST 618: Marine Microbial Ecology (3)

Policy

ENEP626: Climate Change: Science, Policies & Political Economy (3)

- Examines existing policy responses to climate change, alongside opportunities for a redirected political economy to achieve energy and environmental conditions with meaningful CO2 reductions. Specific attention given to possibilities and limits of scientific knowledge and technology in galvanizing social change.

ENEP 666: Topics in Sustainable Development

ENEP 810: Political Economy of the Environment (3)

- Reviews major theories developed over the last half century to explain nature-society relations. Policy case studies on environmental justice, trade and environment, global climate change, and sustainable development used to evaluate current range of political-economic explanations of nature-society relations. International, national and local responses to these problems are analyzed.

ENEP 868: Sustainable Water Policy Research (1-6)

ENEP 870: Sustainable Water Policy Readings (3)

GEOG 617: Seminar in Climate Change (3)

- Examines facts and fallacies regarding global warming and climate science and assesses the current state of scientific understanding of and ability to forecast climate change.

GEOG 649: Environment & Society (3)

- Considers the relationships between environmental and social processes from theoretical, philosophical, and methodological perspectives of geography. Explores the ethical and contextual implications implied in framing environmental questions and posing solutions. Examines approaches to the geographical analysis of environmental problems.

MAST/UAPP 663: Decision Tools for Policy Analysis (3)

- Develops quantitative decision-making skills for science and technology policy decisions. Covers decision-making under uncertainty, axioms of decision analysis, decision trees, influence diagrams, sensitivity analysis, confidence intervals, value of information, probabilistic risk assessment, and multi-attribute decision theory.

MAST 672/ECON 670: Applied Policy Analysis (3)

- Empirical analysis of environmental and natural resource policy issues. Topics include valuation of natural resources, decision making under uncertainty, dynamic control and intertemporal issues in resource use and institutional aspects of policy analysis.

MAST 670: US Ocean and Coastal Policy (3)

- Provides an overview and assessment of the evolution of U.S. ocean and coastal policies, including such policy areas as coastal management, fisheries management, marine mammal protection, offshore oil development, and marine pollution control.

MAST 674 Legal Aspects of the Coastal Zone (3)

- Examines basic legal doctrines and public policy implications relevant to the development and protection of the coastal zone of the United States. Use, ownership and control of water and land beneath and bordering upon water; relationships between the states and the federal government in areas of marine affairs; environmental protection and legal controls of water pollution.

MAST/ECON 676: Environmental Economics (3)

- Study of the choice of policies to protect the environment, including land, air and water resources. Theory of market failure and externalities, use of economic incentives in policy design, valuation of environmental resources and examination of inefficiencies in existing U.S. environmental policies.

MAST/ECON 867: Valuing the Environment (3)

- The economic theory and empirical methods used for valuing environmental goods. Topics include welfare theory, contingent valuation, choice experiments and conjoint analysis, travel cost models, hedonic price analysis, defensive expenditure methods, and benefits transfer. The foundation for each method is developed along with contemporary readings on actual applications. Students must complete a 'valuation project' using empirical data.

POSC 818: Environmental Politics and Policy (3)

- U.S. and international environmental politics, policies, laws, and agreements regarding air, water, and natural resource protection. Examines environmental governance regimes, politics and science, theories of environmental policy, public and private interaction, and epistemic communities in global warming, ozone layer protection, and environmental public health.

UAPP 611: Regional Watershed Management (3)

- Reviews the practical applications of watershed planning as a tool to manage land, water and ecosystem resources. Explores public policies and practices of watershed planning by examining case studies. Uses a multidisciplinary approach involving the fields of geography, environmental science, geology, public policy, land planning, geographic information systems (GIS) and engineering.

UAPP/ENEP 617: Contemporary Issues in Environmental and Energy Policy (1)

- Links students with leading energy and environmental policy scholars on a bi-weekly basis to debate key issues such as global warming, ozone layer deterioration, environmental justice, sustainable development and ecological democracy. International, national and community dimensions of these and other policy issues are explored through seminar discussion.

UAPP 628: Issues in Land Use and Environmental Planning (3)

- Examines theory and contemporary practice in land use and environmental planning with emphasis on creating an integrative framework that balances development demands for urban, suburban, and agricultural land against the needs to conserve and enhance environmental and cultural resources.

UAPP 667: Field Seminar in Water Policy (3)

- Using case studies from the Delaware River and Chesapeake Bay basins, students will examine the social, economic, legal, and policy aspects of water resources planning and management. This field seminar will include visits and field reconnaissance to watershed governance organizations in the Mid- Atlantic such as the Delaware River Basin Commission, Delaware Estuary Program, and Chesapeake Bay Program. Service-based learning is envisioned, in which students will be encouraged to collaborate with career watershed managers in the field while integrating the fundamentals of water policy through instruction in the classroom.

UAPP 667: Environmental Policy Analysis (3)

Research Methods

PLSC 667: Research Methods and Topics in Water Science & Policy (2)

- Selected topics and field and laboratory methods to investigate the physical, chemical and biological aspects of water and the socioeconomic, policy, and regulatory issues associated with water.

PLSC 667: Interdisciplinary Seminar in Water Science & Policy (1)

- Interdisciplinary seminar series highlighting important scientific and policy issues related to water.

CIEG 667: Research in Water Science and Policy (1)

Statistics, Analysis & Techniques

CHEG 604: Probability and Statistics for Engineering Problem Solving (3)

- Fundamental approach to modeling, characterization and analysis of random phenomena with the objective of providing students with the basic principles, methods and tools for solving engineering problems involving randomly varying phenomena. Application areas explored include experimental design, manufacturing, system reliability, and cellular biology.

FREC/STAT 608: Statistical Research Methods (3)

- Experimental design and plot plans, collection, analysis and presentation of data in agricultural and biological research.

FREC 615: Advanced Prices and Statistics (3)

- Statistical tools used in agricultural economics research and operations research. Introduction to econometric specifications, estimation and interpretation.

FREC/STAT 674: Applied Data Base Management (3)

- Provides an in-depth understanding of using computers to manage data using programs such as SAS and Microsoft/Access.

FREC 807/ORES801

- Explores the development and application of optimization models and methods such as linear programming, integer programming, non-linear programming, and goal programming. Applications to both firm and sector-level economic issues with a particular emphasis on agricultural, environmental, resource economic applications.

GEOG 670 Geographic Information Systems and Science (3)

- Introduces the principles and concepts of geographic information science to effectively use a professional level geographic information system. Practical hands-on exposure to "real" data and GIS software and hardware is provided through exercises and a final project.

GEOG 671: Advanced Geographic Information Systems (4)

- Commerical geographical information systems (GIS) are introduced and used to analyze a wide variety of spatial databases. Georeferenced data are acquired, restructured and manipulated in a GIS environment. GIS methods are applied to local-scale geographical, environmental and land planning problems.

MAST 681: Remote Sensing of the Environment (3)

- Detection and mapping of land and ocean resources with optical, infrared and microwave sensors. Digital analysis of satellite images using multispectral and spatial analysis techniques and correlation with ground/ship data. Application to oceanography, coastal processes, geology, land use, geography, agriculture, climate and pollution studies. Includes hands-on image analysis in GIS laboratory.

MEEG 690: Intermediate Engineering Mathematics (3)

- Linear algebra: generalized vector space, eigenvalue problem, diagonalization, quadratic forms. Field theory: divergence theorem, Stokes' theorem, irrotational fields. Sturm-Liouville theory, Bessel functions, Legendre polynomials. Partial differential equations: diffusion and Laplace equations by separation of variables and Sturm-Liouville theory, wave equation. Engineering applications.

STAT 657: Statistics for Earth Sciences (3)

- Spatial distributions; directional data; statistical graphics, regression and time series analysis; model validation; sampling; principal components; cluster analysis; discriminant analysis; and statistical software routines. PREREQ: MATH201

STAT 675: Logistic Regression (3)

- Practical and computational introduction to logistic regression and related topics. Applications include financial, marketing and biomedical research. The use of SAS and other statistical packages will be emphasized.

UAPP 652: Geographic Information Systems in Public Policy (1)

- Hands-on introduction to Geographic Information Systems (GIS) and their uses in public policy areas. Content varies. Exercises focus on using geographic data in fields such as environmental analysis, land use planning, and socio-economic analysis.

UAPP 691: Quantitative Analysis in Public & NP Sectors (3)

- Study of basic research design and data analysis techniques stressing applications in the public and nonprofit sectors. Includes research design, data acquisition, measurement, descriptive statistics, data collection, probability, exploratory data analysis, hypothesis testing, simple and multiple regression, correlation, and graphical procedures.

UAPP 816: Advanced Social Statistics (3)

- Provides advanced training in applied social research. Topics include analysis of variance, regression analysis, analysis of covariance, multi-dimensional cross-classifications and future analysis. Lectures supplemented by laboratory work involving computer statistical packages and simulations.