

THE GRADUATE SCHOOL - UNIVERSITY OF RHODE ISLAND
NEW PROGRAM REPORT FROM THE GRADUATE COUNCIL TO THE
FACULTY SENATE
CURRICULAR REPORT 2014-15-8B; 23 February 2015

At Meeting No. 488 held on 23 February 2015, the Graduate Council approved the attached proposal that is now submitted to the Faculty Senate.

SECTION I

ABSTRACT AND BACKGROUND INFORMATION

ABSTRACT (modified from proposal)

The Graduate Council approved a proposal from the College of the Environment and Life Sciences to create a ***Graduate Certificate in Hydrology***. The URI Graduate Certificate in Hydrology provides students with advanced training in the practice and processes that affect the availability and quality of groundwater- and 2 surface water resources. These two are major sources of drinking, agricultural and industrial water. Hydrologic processes and management influence ecosystems, human health and economic vitality. On completion of the hydrology graduate certificate, students will have the knowledge and skills to (1) conduct hydrologic investigations that support state, national and international industries, agencies and institutions that address the water quantity and quality based challenges facing society (2) perform hydrologic data processing appropriate for research, scholarly, and applied problem-solving endeavors. Students completing the URI Hydrology Certificate program will have the opportunity to use their newly acquired skills in class projects and specialty courses such as modeling watersheds or devising remediation strategies for polluted water resources. The URI Hydrology Certificate program does not require any new classes or FTEs. It is based on a strong collection of existing classes offered across campus. The classes can accommodate new students pursuing the Hydrology Certificate.

BACKGROUND

The National Science Foundation recently (2013) stated that one of the most urgent challenges facing the world today is ensuring an adequate supply and quality of water in light of both burgeoning human needs and climate variability and change. Addressing this challenge requires an understanding and predicting the interactions between the water system and climate change, land use (including agriculture, managed forest and rangeland systems), the built environment, and ecosystem function and services through place-based research and integrative models. Education in water sciences, policy and engineering is now a fundamental expectation required of the new generation of a workforce in government agencies, NGOs, and private sector industries that focus on the changing environment.

SECTION II

RECOMMENDATION

The Graduate Council approved the proposal to create a ***Graduate Certificate in Hydrology*** at its Meeting No. 488 held on 23 February 2015, and forwards it to the Faculty Senate with a recommendation for approval.

THE
UNIVERSITY
OF RHODE ISLAND

Revised 10-2009 Abbreviated Proposal RIBGHE

A Proposal for a

A. PROGRAM INFORMATION

1. Name of institution

University of Rhode Island

2. Name of department, division, school or college

Department of Natural Resources Science, College of the Environment and Life Sciences

Department of Geoscience, College of the Environment and Life Sciences

3. Title of proposed program and Classification of Instructional Programs (CIP) code

Graduate Certificate in Hydrology. CIP code = 40.0605

4. Intended initiation date of program change. Include anticipated date for granting first degrees or certificates, if appropriate.

Initiation date: September 2015

First degree date: May 2016

5. Intended location of the program

URI Main Campus, College of the Environment and Life Sciences

6. Description of institutional review and approval process

Approval Date NRS and GEO Department: January 20, 2015

College CAC/Graduate Council Faculty Senate President of the University _____

7. Summary description of proposed program (not to exceed 2 pages)

The URI Graduate Certificate in Hydrology provides students with advanced training in the practice and processes that affect the availability and quality of groundwater- and

surface water resources. These two are major sources of drinking, agricultural and industrial water. Hydrologic processes and management influence ecosystems, human health and economic vitality.

On completion of the hydrology graduate certificate, students will have the knowledge and skills to (1) conduct hydrologic investigations that support state, national and international industries, agencies and institutions that address the water quantity and quality based challenges facing society (2) perform hydrologic data processing appropriate for research, scholarly, and applied problem-solving endeavors

Students completing the URI Hydrology Certificate program will have the opportunity to use their newly acquired skills in class projects and specialty courses such as modeling watersheds or devising remediation strategies for polluted water resources. The URI Hydrology Certificate program does not require any new classes or FTEs. It is based on a strong collection of existing classes offered across campus. The classes can accommodate new students pursuing the Hydrology Certificate.

8. Signature of the President

David M. Dooley

9. Person to contact during the proposal review

Name: Thomas Boving and Art Gold Address: Department of Geosciences, Department of Natural Resources Science Phone: 4-7053, 4-2903. Email: boving@uri.edu, agold@uri.edu

10. Signed agreements for any cooperative arrangements made with other institutions/agencies or private companies in support of the program.

N/A

B. RATIONALE: There should be a demonstrable need for the program.

1. Explain and quantify the needs addressed by this program, and present evidence that the program fulfills these needs.

The National Science Foundation recently ([2013](#)) stated that one of the most urgent challenges facing the world today is ensuring an adequate supply and quality of water in light of both burgeoning human needs and climate variability and change. Addressing this challenge requires an understanding and predicting the interactions between the water system and climate change, land use (including agriculture, managed forest and rangeland systems), the built environment, and ecosystem function and services through place-based research and integrative models. Together with the National Institute for Food and Agriculture, the NSF in 2014 awarded research grants worth \$25 million combined for water sustainability and quality studies ([executivegov.com, Sept.2014](#)). Education in water sciences, policy and engineering is now a fundamental expectation required of the new generation of a workforce in government agencies, NGOs, and private sector industries that focus on the changing environment. The multi-disciplinary Hydro-Certificate fulfills this need by offering a broad spectrum of classes and project work directly related to issues of water in a changing world.

Hydrologists are critical to developing comprehensive water management plans that address problems linked to climate change and population growth ([US Bureau of Labor Statistics](#)). Not surprisingly, in recent years we have found a large number of working professionals are seeking a Hydrology graduate certificate program to add technical skills to their portfolio of existing skills in geology, natural resources management, civil engineering, conservation biology, soils, wetlands, forestry, municipal, planning, etc. Evidence for the widespread need of Hydrologist in the work place is the simple fact that most public agencies, every large engineering and environmental consulting firm, and most NGO's have already hired 7,400 Hydrologist. A single search on the job search site "indeed.com" (1/20/2015) showed nearly 1,000 positions available on that day for the key word "hydrology". The future demand for Hydrologists is summarized in a recent US Department of Labor statistic ([www.bls.gov](#)) which predicts that employment of hydrologists is projected to grow 10 percent from 2012 to 2022 with population growth and environmental concerns are the expected demand drivers for hydrologists.

Demand for the services of hydrologists will also stem from increases in human activities such as mining, construction, and hydraulic fracturing. Environmental concerns, especially global climate change and the possibility of sea level rise in addition to local concerns such as flooding and drought, are likely to further increase demand for hydrologists. It must be noted that these US Department of Labor statistics do not even take into account the hiring potential in fields closely related to Hydrology, such as Geology or Civil and Environmental Engineering. For example the "indeed.com" search engine listed 68,000 current job offerings associated with the keyword "water" on a single day in January 2015 (1/20/2015).

To meet the demand for trained personnel in this field, academic institutions have responded by offering graduate certificate programs to provide focused training in hydrology and related water sciences. However, the number of Hydrology Certificate program in the nation is small. Among the best known ones are the programs offered at Portland State ([www.pdx.edu/esm/hydrology-certificate](#)) and the Colorado State University ([www.online.colostate.edu/certificates/water-resources](#)). In addition, the American Institute of Hydrology (AIH) offers a two-part Professional Hydrology Certificate Program

(www.aihydrology.org/hydro-certification.html). In the southern New England region, the Water: Systems, Science, and Society (WSSS) program at Tufts, while not a certificate program, is the closest competing graduate-level water program.

This new Hydrology certificate will be the first within Rhode Island and builds on URI's long-standing reputation as a national and international leader in this field. The URI Hydrology Certificate program will provide working professionals and graduate students a solid foundation in hydrology and related water sciences and prepare them to use these skills to address the complex problems facing society.

C. INSTITUTIONAL ROLE: The program should be clearly related to the published role and mission of the institution and be compatible with other programs and activities of the institution.

1. Explain how the program is consistent with the published role and mission of the institution and how it is related to the institution's academic planning.

Hydro (geo)logy has been a core component of the GEO and NRS pedagogy for decades. The Hydrology classes serve undergraduate and graduate majors from CELS, the College of Engineering, and GSO, among others. The importance of water studies has been underlined by the recent hiring of three new faculty members under the URI Water Cluster initiative. Faculty in the water field are engaged in actively researching and publishing and are funded on numerous external grants.

D. INTERINSTITUTIONAL CONSIDERATIONS: The program should be consistent with all policies of the Board of Governors pertaining to the coordination and collaboration between public institutions of higher education. (Consult the Board of Governors' *Coordination Plan for Academic Programs in Rhode Island Public Institutions of Higher Education* [www.ribghe.org/publicreg.htm] for guidelines and restrictions regarding the types and levels of programs the institutions are allowed to offer.)

Neither RIC nor CCRI have a Hydrology curriculum at the present time.

1. Estimate the projected impact of program on other public higher education institutions in Rhode Island (e.g. loss of students or revenues), provide a rationale for the assumptions made in the projections, and indicate the manner in which the other public institutions were consulted in developing the projections.

Neither RIC nor CCRI teach any classes in hydrology or hydrogeology. The proposed certificate program will complement and strengthen higher education throughout the state of Rhode Island. We expect that this certificate program will attract new students specifically for the certificate and also provide a competitive edge to URI's recruiting of new students for other graduate programs, such as MESM and the BES degrees.

2. Using the format prescribed by RIOHE, describe provisions for transfer students (into or out of the program) at other Rhode Island public institutions of higher education. Describe any transfer agreements with independent institutions. The institution must also either submit a Joint Admissions Agreement transition plan or the reason(s) the new program is not transferable. (See *Procedure for Strengthening the Articulation/Transfer Component of the Review Process for New Programs* which can be found at www.ribghe.org/publicreg.htm.)

Not applicable.

3. Describe any cooperative arrangements with institutions offering similar programs. (Signed

copies of any agreements pertaining to use of faculty, library, equipment, and facilities should be attached.)

No cooperative arrangements are required for this certificate program.

- 1 If external affiliations are required, identify providing agencies. (Indicate the status of any arrangements made and append letters of agreement, if appropriate.)

Not applicable.

- 2 Indicate whether the program will be available to students under the New England Board of Higher Education's (NEBHE) Regional Student Program (RSP).

Not applicable. We are not requesting this certificate program to be included under the NEBHE RSP. We note that Hydrology coursework is available at both UCONN and UMASS although they do not have a formal hydrology degree at the graduate level.

E. PROGRAM: The program should meet a recognized educational need and be delivered in an appropriate mode.

1. Prepare a typical curriculum display for one program cycle for each sub-major, specialty or option, including the following information:

a. Name of courses, departments, and catalog numbers and brief descriptions for new courses, preferably as these will appear in the catalog. In keeping with each institution's timetable for completion of student outcomes assessment, each institution should provide an assessment plan detailing what a student should know and be able to do at of the program and how the skills and knowledge will be assessed. For example, if a department brings forth a new program proposal but that department is not slated to have its student outcomes assessment completed until 2008, the program could be approved but with the provision that the department return no later than 2008 and present to the Academic and Student Affairs Committee its student outcomes for that particular program.

Through the stated goals and learning outcomes of this certificate program (see section L), graduates will be competent to (1) conduct hydrologic investigations that support state, national and international industries, agencies and institutions that address the water quantity and quality based challenges facing society (2) Prepare graduates with the ability to model and illustrate hydrologic data for problem-solving endeavors.

Students completing the URI Hydrology Certificate program will have the opportunity to use their newly acquired skills in class projects and specialty courses such as modeling watersheds or devising remediation strategies for polluted water resources.

Outcomes and assessment rubrics to evaluate this certificate program are provided in proposal section L.1. Assessment of this program will take place annually and in accordance with the assessment planning and reporting schedule for certificates required by the University.

The Hydrology Certificate will be based on existing classes. No new courses are required for this certificate. A typical curriculum might look like:

Example Schedule for a Hydrology Certificate Student:

Fall Semester	Spring Semester
GEO 483 Hydrogeology (Lec/Lab 4 cr.)	GEO 484/584 Environ. Hydrogeology (4 cr.)
NRS 461 Watershed Hydrology (4 cr.)	NRS 518 Ecohydrology (3 cr.)
Total: 8	Total: 7

b. Required courses in area of specialization and options, if any.

12 credits from the following core courses:

GEO 483 Hydrogeology (3 Lec., 1 Lab cr.)

GEO 586 Hydro Reading Seminar (1 cr.),

NRS 461 Watershed Hydrology and Management (4 cr.) **or** NRS 518 Ecohydrology (3 cr.)

GEO 482/582 Innovative Soil and Groundwater Remediation Technologies (4 cr.) **or** GEO 484/584 Environ. Hydrogeology (3 Lec., 1 Lab cr.)

Note: Courses can be taken for lectures only (no lab), but not the other way around.

Additional 3 Credits from the core courses or from the following strengthening courses:

GEO 590 – Environmental Hazards & Response (3 cr.); GEO 491 J-Term Indonesia (3 cr.); GEO 468/590: Aqueous Geochemistry (4); OCG 480: Introduction to Marine Pollution (3 cr.); OCG 523: Organic Geochemistry of Natural Waters (3 cr.). (Note: Given the dynamic nature of course offerings, the certificate co-directors may request revision in the list of strengthening courses to include new or revised courses at the graduate level or available for graduate credit with a substantial focus on hydrology.)

c. Course distribution requirements, if any, within program, and general education requirements.

N/A

d. Total number of free electives available after specialization and general education requirements are satisfied.

In addition to 12 credits from the core courses, 3 credits additional are to be chosen from either additional core courses or from a specific list of strengthening classes (see listings above in section E.b.). There are no free electives.

Total Credits Required to Complete Certificate = 15 cr.

e. Total number of credits required for completion of program or for graduation. Present evidence that the program is of appropriate length as illustrated by conformity with appropriate accrediting agency standards, applicable industry standards, or other credible measure, and comparability of lengths with similar programs in the state or region.

Credit/course requirements for comparable programs:

- Portland State University: 24 credits on the quarter system; equivalent to 16 semester credits
- Colorado State Online certificate program: 10 credits
- American Institute of Hydrology, professional program: Two examinations (1) Hydrology Fundamentals and (2) Specific Discipline-Practical.

f. Identify any courses that will be delivered or received by way of distance learning. (Refer to www.ribghe.org/publicreg.htm for the *Standards for Distance Learning in the Rhode Island System of Public Higher Education*.)

All classes will meet in person. None are delivered by distance learning at this time.

2. Describe certification/licensing requirements, if any, for program graduates and the degree to which completion of the required course work meets said requirements. Indicate the agencies and timetables for graduates to meet those requirements.

Not applicable.

3. Include the learning goals (what students are expected to gain, achieve, know, or demonstrate by completion of the program) and requirements for each program.

The learning goals for the Hydrology Certificate program are:

Goal I. Produce graduates with advanced-level knowledge and skills in hydrology along with analytical abilities to successfully conduct hydrologic investigations that support state, national and international industries, agencies and institutions that address the water quantity and quality based challenges facing society.

Goal II. Prepare graduates with the ability to model and illustrate hydrologic data for problem-solving endeavors.

4. Demonstrate that student learning is assessed based on clear statements of learning outcomes and expectations.

Learning outcomes for each learning goal for this certificate are:

Goal I Above Outcome – Graduates will know how to collect, process, analyze and evaluate hydrologic data from site-specific studies and from sources such as government reports, the Internet or engineering reports to achieve the results sought for the application at hand.

Goal II Above Outcome – Graduates will have acquired advanced level skills in modeling and illustrating hydrologic data.

F. FACULTY AND STAFF: The faculty and support staff for the program should be sufficient in number and demonstrate the knowledge, skills, and other attributes necessary to the success of the program.

1. Describe the faculty who will be assigned to the program. Indicate total full-time equivalent (FTE) positions required for the program, the proportion of program faculty who will be in tenure-track positions, and whether faculty positions will be new positions or reassignment of existing positions.

Core Faculty:

Thomas Boving, Professor, Geosciences, existing position; Art Gold, Professor, Natural Resources Science, existing position; Soni Pradhanang, Assist. Professor, Geosciences, existing position; Anne Veeger, Assoc. Professor, Geosciences, existing position.

Other:

Rainer Lohmann, Professor, Oceanography, existing position; Dawn Cardace, Assist. Professor, Geosciences, existing position;

These faculty members have been provided a copy of this Hydrology Certificate proposal for review and all of the feedback we have received has been positive and supportive.

No new FTE's are required for the certificate.

G. STUDENTS: The program should be designed to provide students with a course of study that will contribute to their intellectual, social and economic well-being. Students selected should have the necessary potential and commitment to complete the program successfully.

- 1. Describe the potential students for the program and the primary source of students. Indicate the extent to which the program will attract new students or will draw students from existing programs and provide a specific rationale for these assumptions. For graduate programs, indicate which undergraduate programs would be a potential source of students.**

We anticipate three types of students working toward this certificate. (1) Students enrolled in existing graduate programs (e.g., Biological and Environmental Science, Marine Affairs, Oceanography, Civil Engineering, MESM) will enter this certificate program to obtain this credential in addition to their graduate degree. (2) We expect to attract students who possess a Bachelor's degree and want to improve their Hydrology skills to enhance their employability. These students would complete the program in two semesters. (3) Finally, we expect to attract working professionals who require advanced training in Hydrology and will complete the requirements for the certificate in 3-4 semesters as part-time students. Inasmuch as there is no similar certificate program at URI, we will not be redirecting students from another program to ours.

The Hydrology Graduate Certificate will be granted in three different ways:

- 1) As a stand-alone certificate to students meeting the course requirements.
- 2) As a precursor to a M.S. degree. Students who come to URI for the certificate might choose to expand their studies and enter a Master's Degree program (such as MESM or BES in CELS). In cases such as this, credits taken to satisfy the certificate requirement would count toward the M.S. degree.
- 3) Concurrent with a graduate degree. A matriculating graduate student who can satisfy the Hydrology Graduate Certificate requirements in conjunction with the courses identified in their M.S. or Ph.D. Program of Study would be eligible to receive the Hydrology Certificate.

L. EVALUATION: Appropriate criteria for evaluating the success of a program should be development and used.

- 1. List the performance measures by which the institution plans to evaluate the program. Indicate the frequency of measurement and the personnel responsible for performance measurements. Describe provisions made for external evaluation, as appropriate.**

The core faculty members (Boving, Gold, Pradhanang and Veeger) will measure the success of the overall program (annually) using the following rubric. Threshold values for each cell are based on our initial expectations for the certificate program.

Metric	Successful Beyond Expectations	As Expected	Does Not Meet Expectation
Number of applicants per year. The larger this number, the more successful the program. If we get no applicants in the first three years, we will assume we misjudged the marketplace. Since all the classes used to meet the requirements for the certificate are already being taught, there will be no impact if the program is poorly subscribed.	Over 15	1-15	0
Number of matriculating students. We will monitor the number of students actively pursuing a Hydrology certificate. Because we might be hosting part-time students who need extra time to complete the requirements for the certificate, the number of matriculating students will give us a good indication of program vitality.	Over 10	1-10	0
Number of certificates granted per year. A student should be able to complete the certificate in two semesters if they take three classes per semester. Part-time students should be able to complete the program in four semesters. If students fail to complete the requirements in these time windows, we will have to determine what the obstacles are.	Over 10	1-10	0
Student diversity. We will advertise the Hydrology certificate to reach students representing a diversity of cultures, genders, ages, and stage of career.	Equitable distribution of students across all diversity categories	Some representation of diversity categories but not spread evenly	No students from underrepresented diversity categories

Boving, Gold, Pradhanang and Veeger will measure the attainment of learning outcomes for students using the following rubric:

<i>Outcome – Graduates will know how to collect and evaluate hydrologic data from sources such as government files, the internet or engineering reports and process the data in software such as EXCEL, Surfer or Sigma Plot to achieve the results sought for the application at hand.</i>			
Element/Evaluation Event	Accomplished	Proficient	Novice
Data Search and Database Creation 1. Final Project in GEO 482/582 or GEO 484/584. 2. Evaluated in NRS 518	Able to find accurate and current hydrological data at an appropriate scale and process data in appropriate software.	Able to create a database in support of a hydrogeologic application but some requisite data are missing or processed incorrectly.	Unable to locate readily available hydrogeologic data, not able to process the data.
<i>Outcome – Graduates will have acquired advanced level skills in modeling and illustrating hydrogeologic data.</i>			

Element/Evaluation Point	Accomplished	Proficient	Novice
Modeling and Analysis 1. Evaluated in Final Project in GEO 482/582 or GEO 484/584. 2. Evaluated in Final Project NRS 461	Capable of developing models that include water quality or quantity data and analyze or illustrate results in graphical format.	Able to develop models that include some water quality or quantity data and able to analyze or illustrate results in graphical format.	Unable to develop a model and/or analyze or illustrate the data.

Evaluation Roadmap. Student Evaluation of learning outcomes will occur at the following required courses within in the Hydrology Certificate program.

Learning Outcome	Required Course			
	GEO 483	GEO 482/582 or GEO 484/584	NRS 461 or NRS 518	GEO 586
Outcome 1 - Graduates will know how to collect, process, analyze and evaluate hydrologic data from site-specific studies and from sources such as government reports, the Internet or engineering reports to achieve the results sought for the application at hand	✗	✗	✗	
Outcome 2 - Graduates will have acquired advanced level skills in modeling and illustrating hydrologic data.	✗	✗	✗	✗

Courses with content largely focused on hydrology, water pollution and/or wetlands

NRS 406 Wetland Wildlife Management (4)
NRS 412: Soil-Water Chemistry (3)
NRS 415: Remote Sensing Of the Environment (3)
NRS 423/425/525: Wetland Ecology (5)
NRS 424: Wetlands and Land Use (4)
NRS 450/452 Soils and Land Use/Soil, Water and Land Use Investigation (4)
NRS 461: Watershed Hydrology and Management (4)
NRS 518 Ecohydrology (3)
GEO562 Aqueous Geochemistry (Cardace, 4, Spring)
GEO 482/582: Innovative Subsurface Remediation Technologies (Boving; 4, Spring - odd years)
GEO 483: Hydrogeology (Veeger, 3+1; Fall)
GEO 484/484: Environmental Hydrogeology (Boving; 3+1; Spring - even years)
GEO 586 è offer as GEO 486 Hydro Reading Seminar? (Boving, 1, F and S)
GEO 568: Isotopes in Hydrology (Veeger) inactive
GEO 583: Groundwater Modeling (Veeger) inactive
OCG 480: Introduction to Marine Pollution (3 cr.)
OCG 523: Organic Geochemistry of Natural Waters (3 cr.)
CVE 470 Water Transport
CVE 471 Water and Water Treatment Systems
CVE 475 Water and the Environment
CVE 594 Water and Public Health
EEC 430 Water Resource Economics

Related courses:

GEG 101: World Geography (3) S
GCH 103: Grand Challenges in the Natural Sciences (Boving, 4, F) inactive
GEO 100 Environmental Geology
GEO 103 Understanding Earth (Staff; 3+1, Fall and Spring)
GEO 210 Landforms: Origin and Evolution (4)
GEO 305: Global Climate Change (4)
NRS 100 Natural Resource Conservation
NRS 212 Introduction to Soil Science
NRS 300: Introduction to Global Issues in Sustainable Development (3)
NRS 409: Concepts in GIS and Remote Sensing (4)
NRS 410: Fundamentals of GIS (3)
NRS 426 Soil Microbiology
NRS 496: International Development Seminar (3)
NRS 522: Advanced GIS Analysis of Environmental Data
NRS 526 Microbial Ecology of Soils and Sediments
BIO 458 Freshwater Ecology
BIO/NRS 563 Biology and Ecology for Fish
GEO/OCG 110: The Ocean Planet (3)
GEO 491 J-Term Indonesia (Boving, 3)
CVE 374 Environmental Engineering
CVE 370 Hydraulic Engineering
CVE 477/577 Environmental sustainability and Green Engineering

CVE 572 Biosystems in Sanitary Engineering

CHE 576 Pollution Prevention

OCG 693 Environmental Organic Chemistry

HPR 411/CVE 323 Designing Sustainable Solutions for Developing Communities (Craver/Boving; 3 cr., Fall)

NRS 496 - Seminar in International Development (Abedon, 3 cr., Spring)

OCG 200, Extreme Weather, (Heikes & Donohue; 3 cr., Spring)